SOLENT 3 DESCRIPTIVE & SERVICING MANUAL

SOLENT 3
FLYING BOAT

DESCRIPTIVE & SERVICING MANUAL

Shorts

AMENDMENT RECORD

Amendment Lists will be issued as necessary, and incorporation of an amendment must be recorded below.

A.L. No.	Amended by	Date	A.L. No.	Amended by	Date
1	H. G. JOHNSON	AUG. '51			
2	J. H. STEVENS	MARCH '52			

SOLENT 3

MAINTENANCE MANUAL

LIST OF SECTIONS

SOLENT 3

MAINTENANCE MANUAL

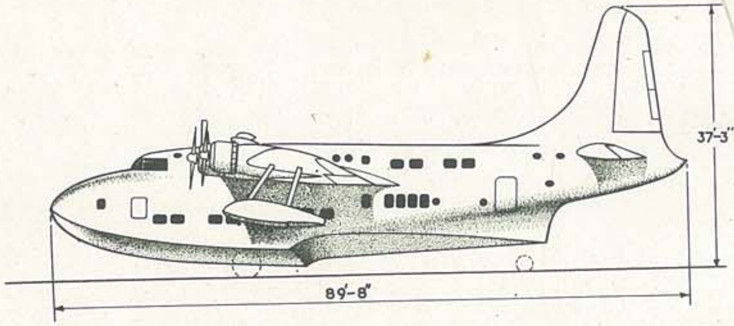
SECTION 1

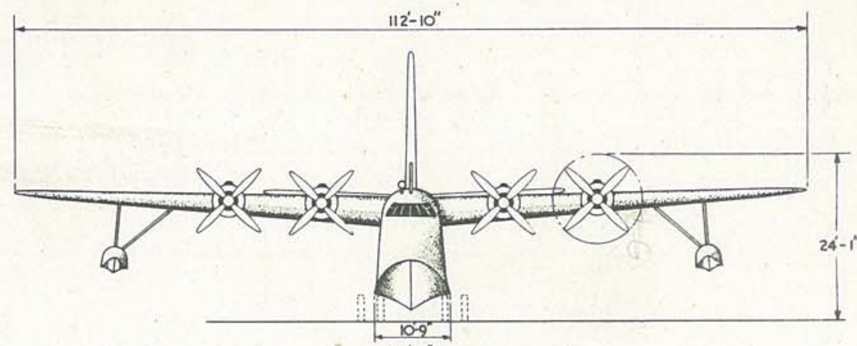
GENERAL DATA

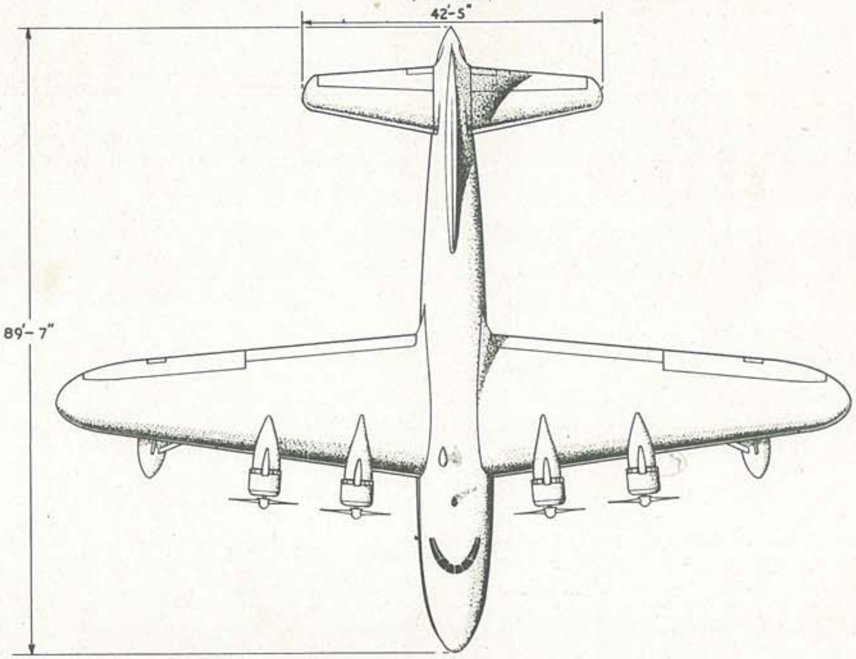
Contents

Illustrations

Prepared by Short Brothers and Harland Ltd. Jan. 1951.







MAIN PLANE

AEROFOIL SECTION	GÖTTINGEN 436 MODIFIED
INCIDENCE: AERODYNAMIC CHORD TO HULL DATUM	6°-9'
DIHEDRAL: TOP FRONT SPAR-BOOM	0°-50'
AREAS:	
MAIN PLANES TOTAL INCLUDING FLAPS AND AILERONS	1487·60 SQ.FT.
FLAPS TOTAL	286·24 SQ.FT.
AILERONS TOTAL INCLUDING TRIMMING TABS	134·40 SQ.FT.
AILERON TRIMMING TABS TOTAL	2·39 SQ.FT.

TAIL PLANE

AEROFOIL SECTION	R.A.F. 30 MODIFIED
INCIDENCE: AERODYNAMIC CHORD TO HULL DATUM	4°-0'
DIHEDRAL: TOP FRONT SPAR-BOOM	4°-15'
AREAS:	
TAIL PLANE TOTAL INCLUDING ELEVATORS	265·79 SQ.FT.
ELEVATORS TOTAL INCLUDING TRIMMING TABS	102·29 SQ.FT.
ELEVATOR TRIMMING TAB (PORT) AND ANTI-BALANCE TAB (STBD.) 2·27 SQ.FT. EACH	4·54 SQ.FT.

FIN AND RUDDER

AEROFOIL SECTION	R.A.F. 30 MODIFIED
AREAS:	
FIN INCLUDING DORSAL FIN AND RUDDER	195·00 SQ.FT.
RUDDER INCLUDING TRIMMING AND BALANCE TABS	82·18 SQ.FT.
RUDDER TRIMMING TAB	4·55 SQ.FT.
RUDDER ANTI-BALANCE TAB	3·41 SQ.FT.

GENERAL ARRANGEMENT

FIG. I

INTRODUCTION

1. The Solent Aircraft is an all-metal, high-wing cantilever monoplane flying boat with a two step planing bottom. Power is supplied by four Bristol Hercules 637 engines (Hercules 630 with a special 7-point mounting ring and torque meter) each giving 1690 B.H.P. at take-off.

De Havilland four-bladed, hydromatic, fully feathering propellers with constant speed control are fitted.

The hull, which is of monocoque construction, is divided into upper and lower decks with the control cabin and crew stations on the upper deck.

The main plane has Gouge-type extended chord flaps and Frise-type ailerons. A dorsal fin and a dihedral tail plane are fitted.

The aircraft accommodates 39 passengers and carries a crew of 7.

LEADING PARTICULARS.

2. Weights. -

	Lb.	Kg.
Tare weight approx	48,500	22,000
Maximum take-off weight permitted by C. of A....	78,000	35,380
Maximum Landing weight	78,000	35,380
Beaching weight	61,000	27,669
Hull loading maximum (i.e. weight of aircraft) less fuel and oil)	66,500	30,164

3. Dimensions. -

Span of main plane	112 ft. 10 in.
Overall length on beaching chassis	89 ft. 8 in.
Overall height (over fin) on beaching chassis .. (Normal tail trolley)....	37 ft. 3 in.
(low-level tail trolley).	32 ft. 10 in.
Maximum beam	10 ft. 9 in.
Draughts at 78,000 lb. (35,380 Kg.)	5 ft. 6 in.
Distance between wing-tip float and hull	34 ft. 6 in.
Track of beaching chassis (centre of outer wheels)	14 ft. 9 in.
Depth of water (minimum) required for beaching..	6 ft. 9 in.

4. Areas. -

Main planes total to centre line of hull........	1687.46 sq. ft.
Flaps total	286.24 sq. ft.
Ailerons total including trimming tabs..........	134.40 sq. ft.
Aileron trimming tabs total	2.39 sq. ft.
Tail plane total including elevators	265.79 sq. ft.
Elevators total including trimming tabs	102.29 sq. ft.
Elevator trimming tab (port) and anti-balance tab (starboard) 2.27 sq. ft. each	4.54 sq. ft.
Fin including dorsal fin and rudder	195.00 sq. ft.
Rudder including trimming and anti-balance tabs	82.18 sq. ft.
Rudder trimming tab	4.55 sq. ft.
Rudder anti-balance tab	3.41 sq. ft.

5. Control Surface Ranges. - .... 18° - 30' each way
Ailerons .... 18° - 0' each way
Elevators .... 14° - 0' each way
Rudder .... 25° - 0' out
Flaps ....

For control surface settings see Sect. 2, fig. 27 and 30.

6. Engines. -
Make - Bristol Hercules 637
Type - 14 cylinder air-cooled sleeve-valve radial, geared and supercharged (single speed)
Bore and stroke .... 5.75 in. x 6.5 in.
Swept Volume .... 2360 cub. in.
Reduction gear ratio .... 0.444 engine speed
Carburation .... Hobson/R.A.E. injector type B.1/B.H.6.
Starter .... Rotax electric
Magnetos .... Two Rotax type N.14A.

7. Engine Limitations. -

Conditions	R.P.M.	Manifold pressure "Hg.Abs.	Cyl. head temp. °C			Oil temp. °C			B.H.P. (Corrected)
			Min.	Desired	Max.	Min.	Normal	Max.	
At start of take-off	-	-	120	-	170	15		70	-
During take-off (5 mins. limit)	2,800	46.25	-	-	310	15	-	100	1570 to 1700 at S.L.
Max. climbing (1 hour)	2,200 *	43.75	-	-	300	-	-	90	-
Max. cruise (RICH MIXTURE)	2,400	43.75	-	200 / 240	280	-	-	80	-
Cruise (LEAN MIXTURE)	1,850 to 2,250	36.00	-	200 / 240	280	-	65 / 70	80	-
Warming engines	1,100 to 1,200	-	-	120	-	15	-	40	-
Taxying	Max. 1,200	-	-	below 170	280	15	-	80	-
Run-up	Power check	3"Hg. below atmospheric pressure	120	below 170	280	15	-	40	-
Stopping	Slow running R.P.M.	-	-	-	180	-	-	-	-
Rated power	2,400	43.75	120	240	280	-	-	80	-

* Note.... Climb above full throttle height, i.e. boost dropping 43.75" Hg. 2,400 R.P.M. may be used if required to obtain the minimum I.A.S. of 140 knots. Throttle lever fully forward.

8. Propellers -

Make ....DeHavilland Hydromatic fully feathering.
Type ........................C.D.80/446/1-/2-/3-/4 or C.D.108/446/1 (split barrel)
Number of blades ....Four
Propeller diameter ....12 ft. 3 in.
Pitch range ....26° fine, 91° feathered

9. Fuel Tankages. -

Total capacity 2640 imp. gall. individual tankages being as follows. -

Tank No. 1 Port and Starboard	529 gall. each
Tank No. 2 Port and Starboard	348 gall. each
Tank No. 3 Port and Starboard	131 gall. each
Tank No. 4 Port and Starboard	97 gall. each
Tank No. 5 Port and Starboard	74 gall. each
Tank No. 6 Port and Starboard	141 gall. each

10. Fuel Specification. - 100/130 Octane (D.E.D.2475)

11. Oil Tankages. - One tank per engine

Engine Oil	Feathering Reserve	Air Space	Total
38 gall.	2 gall.	$6\frac{3}{4}$ gall.	$46\frac{3}{4}$ gall.

NOTE...... On aircraft G-AHIN, G-AHIO, G-AKNO, G-AKNP, G-AKNR, the capacity of each oil tank is as below :-

$30\frac{1}{2}$ gall.	2 gall.	5 gall.	$37\frac{1}{2}$ gall.

12. Oil Specification

Aero-Shell 100B (for winter and summer use)
or
Intava 1 AA 745, 1 AA 810
or
D.E.D.2472 A/2 (Winter)
D.E.D.2472 B/2 (Summer)

NOTE..... Aero-Shell 100B must be used and only in extreme emergency should any of the above alternatives be used.

In such a case it is necessary to drain completely and flush the oil system before using an alternative oil.

13. Flying Limitations

Maximum permissible diving speed	250 Kts. I.A.S.
Normal operating limit speed	160 Kts. I.A.S.
Maximum speed flaps 1/3 out	160 Kts. I.A.S.
Maximum speed flaps 1/2 out	155 Kts. I.A.S.
Maximum speed flaps 2/3 out	150 Kts. I.A.S.
Maximum speed flaps fully out	141 Kts. I.A.S.
Maximum Auto-pilot-in-operation speed	200 Kts. I.A.S.
Minimum Safe operating speed at max. A.U.W......	108 Kts. I.A.S.
Take-off safety speed	108 Kts. I.A.S.

14. Performance -

Take-off time to unstick (no head wind, civil safety technique)
A.U.W. 78,000 lb....... 40 secs.

Performance (contd.)
Distance to 50 ft. .... 1660 yds.
Service Ceiling (A.U.W. 78,000 lb. at S.L.) ....15,500 ft.
Climb to 10,000 ft. ....$13\frac{1}{2}$ min.

Average Cruising Consumption

Mean weight	R.P.M.	Altitude	Speed	Consumption
65,000 lb.	2,000	10,000 ft.	158 Kts. I.A.S.	218 gall/hr.

Stalling Speeds (kts. I.A.S.)

A.U.W. lb.	Flaps up	1/3 Flap	Full Flap
78,000	93	85	78
75,000	91	83	76
67,500	87	79	72
60,000	82	75	68
52,500	77	70	64

The above figures refer to flight with oil cooler flaps limited to a maximum of 1/4 full opening.

15. ANCILLARY AND PROPRIETARY EQUIPMENT

The following table gives the ancillary proprietary equipment used on the aircraft and includes the manufacturer's name and address, and, where possible, part numbers. Ground equipment is dealt with in Section 13.

EMERGENCY EQUIPMENT.

Description	Manufacturer	Part No.
Fire extinguisher system.	Graviner Ltd. 16, Bassett Gdns., Osterley, Middlesex.	
Engine fire extinguisher bottle.	Graviner Ltd., 16, Bassett Gdns., Osterley, Middlesex.	Mk. 4 ref.27N/66

OXYGEN SYSTEM

Union (twin point)	Siebe Gorman Ltd., Davis Road, Kingston By-pass Surbiton, Surrey.	
Cylinders. - (charging equipment) Regulators Mk.10. Aircraft Systems. Valves. Masks.	Ref. A.P.1275A	

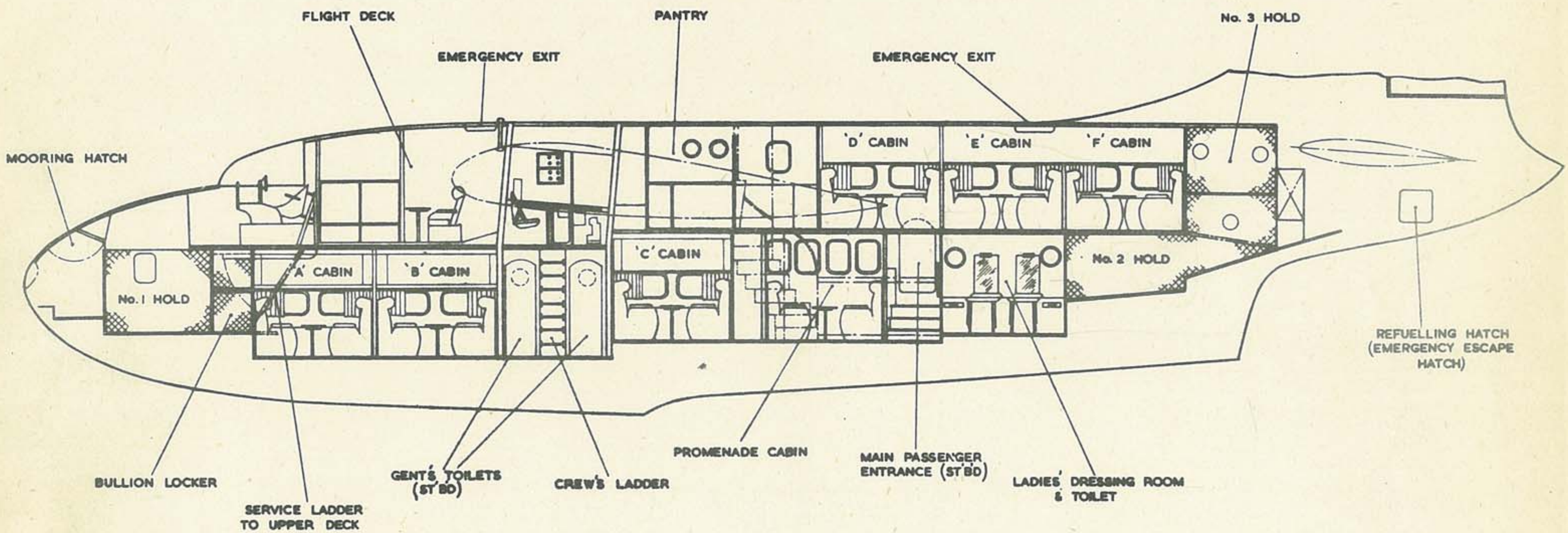
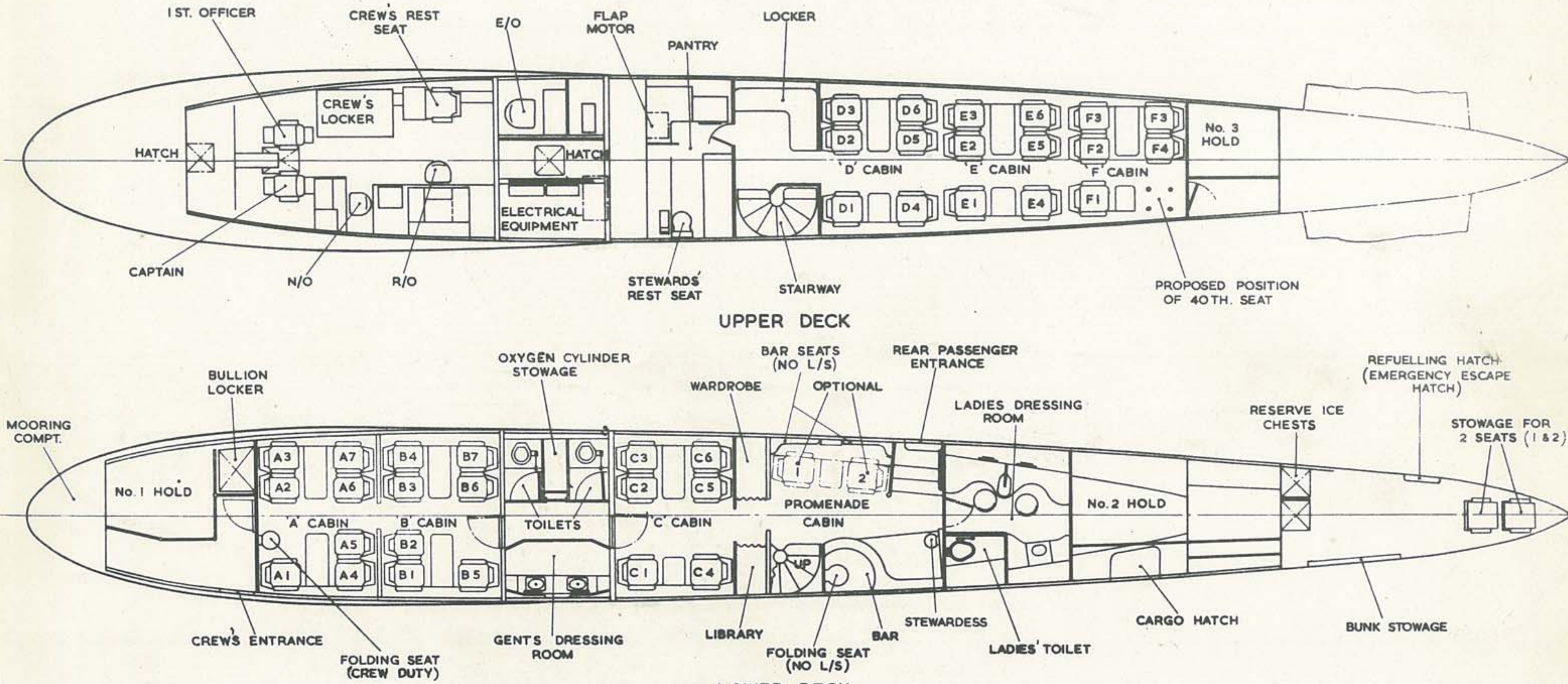


FIG. 2

ACCOMMODATION

HQ-D 8880 SHT. 1.



UNLESS OTHERWISE STATED, ALL SEATS SHOWN ARE FITTED WITH LAPSTRAPS.

ACCOMMODATION

HQ-D 8880 SHT.2

FIG. 2A

Description	Manufacturer	Part No.
FUEL SYSTEM		
Cocks - fuel	Aircraftings Ltd., Power Road, Gunnersbury, London.	1103/B A1104/B 2670/Q ($\frac{5}{8}$" BSP)
	Vickers-Armstrongs, Vickers House, Broadway, Westminster, S.W.1.	Various
Valve - fuel	Aircraftings Ltd.,	1316/M
Valve - fuel (non-return)	Aircraftings Ltd.,	3180/B & /C
Valve - fuel	Amal Ltd., Holford Works, Pennybarr, Birmingham, 20	213/106/027
Valves - (refuelling)	Flight Refuelling Co. St. Nicholas, Littlehampton, Sussex.	B.1107070 A to J.
Pump (backing pump)	Self-priming Pump & Engineering Co. Trading Estate, Slough, Bucks.	B.P.1 Mk. 4
Pump - Priming (A.G.P. tank filling)	Self-priming Pump & Engineering Co. Trading Estate, Slough, Bucks.	Type P.9A
Pump (engine priming)	Ki-gass Ltd.,	Type 40
Pump (cabin heater fuel system)	Pulsometer Eng. Co.,	FB.4 Mk.1
Indicator - Rate-of-Flow (12 - 100 G.P.H.)	George Kent Ltd., Biscot Road, Works, Luton, Beds.	
Transmitter (Rate-of-Flow)	George Kent Ltd., Biscot Road, Works, Luton, Beds.	MA.4011
Actuator (slow running cut-outs)	Rotax Ltd., Willesden Junction London, N.W.10.	A.0208-1
Transmitter (fuel pressure)	Smith's Inst., Co. Cricklewood Works, London, N.W.2.	288/P.G.

Description	Manufacturer	Part No.
OIL SYSTEM		
Cooler - oil (12" dia.)	Serck Ltd., Warwick Road, Birmingham.	WS.10886
VENTILATING SYSTEMS		
Cabin heater	D.A. Daniel & Co., Maengwyn Street, Machynlleth, Wales.	XH/1/D
ELECTRICAL INSTALLATION		
Generator D.C. 6 Kw. type P.2.	Ref. A.P.1095.C	
Motor (flap operating)	Croydon Engineering Co. Commercial Way, Purley, Croydon.	A.40/S34
Motor (aileron trimming tab)	Evershed & Vignoles Acton Lane Works, London, W.4.	RW.2154
Indicator - "Duplex" (aileron trimming tabs)	Evershed & Vignoles Acton Lane Works, London, W.4.	RX.2669
Transmitter (aileron trimming tab control)	Evershed & Vignoles Acton Lane Works, London, W.4	RX.2393
Transmitter (position)	Evershed & Vignoles Acton Lane Works, London, W.4	RY.2659
Battery - "Exide" 12V - 60A c/w lug connections.	Chloride Electrical Storage Co.Ltd. Exide Works, Clifton Junction. Nr. Manchester.	6 FZ.17-3
Lamp (steward's call-box)	Walter Co.,	8/8
Buzzer (steward's call-box)	Walter Co.,	819/A
Plunger Catch (steward's call-box)	Walter Co.,	No. 5
Heater - water (immersion) $1\frac{1}{2}$ gall. 500 watt.	G.E.C. Ltd., Magnet House, Kingsway, W.C.2.	W.45024 R.
Urn (water heater) 1 gall aircraft urn.	Jackson Stove Co., 143, Sloane Street, London, S.W.1.	

ELECTRICAL INSTALLATION (contd.)

Description	Manufacturer	Part No.
Bonding and screening	Ref. A.P.1464.D	
Cut-outs	Ref. A.P.1095.C	
Lamps)		
Magnetic Relays)		
Suppressors)	Ref. A.P.1095.A	
Switches)		
Voltage Regulators	Ref. A.P.1095.C	
Warning Lights)	Ref. A.P.1095.A	
Wiring)		

RADIO AND RADAR

Description	Manufacturer	Part No.
Marconator -	Marconi's Wireless & Telegraph Co., Africa House, Kingsway, London, WC2.	WQ.5150
R.1155 Receiver)	Ref. A.P.2548.A	
T.1154 Transmitter)		
A.1134 Intercom. Amplifier	Ref. A.P.1186 Vol. 1 Sect. 4	
Circuit Breakers.	Ref. A.P.1095 Vol. 1 Sect. 9	
T.R.1464 - VHF/RT/SET	Ref. A.P.2528.B	
A.S.V. Mk. 2 - Radar	Ref. A.P.2544 Vol. 1	
S.C.R.578 - Dinghy Radio	Ref. A.P. 2273.A	

DE-ICING EQUIPMENT

Description	Manufacturer	Part No.
Overshoes	Dunlop Ltd. Aviation Division, Foleshill, Coventry.	AH.8546-58 - 59 - 60
Pump (10 unit de-icing))	T.K.S. Ltd. Great West Road, Brentford, Middlesex.	26300
Filter (de-icing pump))		Type 1
Controller (aerofoil de-icing pump))		27700
Pump (throttle de-icing)	Self-priming Pump & Engineering Co. Trading Estate Slough, Bucks.	P.9A Mk.3B
Pump (propeller de-icing)	Rotax Ltd., Willesden Junction, London, N.W.10.	M.1101 24 volt

ELECTRICAL INSTALLATION (contd.)

Description	Manufacturer	Part No.
Rheostats (propeller de-icing) Pump - hand (windscreen de-icing)	Rotax Ltd., Willesden Junction London, N.W.10	M.1002 - British 3924 - American 1128

INSTRUMENTS AND VACUUM SYSTEM

Description	Manufacturer	Part No.
Thermometer (Mercury in steel) 40 - 240° F	Cambridge Inst. Co. Cambridge.	A.15282
Synchroscope (Kollsman type)	Kelvin Bottomley & Baird, Winchester Road Basingstoke, Hants.	635/01/7760 or KB.300/01
Gauge - Torque-meter (0-800 lb/sq.in.).	Negretti & Zambra Ltd. 122, Regent Street, London, W.1.	
Gauges (manifold pressure)	Smith's Instrument Co. Cricklewood Works, London, N.W.2.	67 BG.
Gauges (fuel pressure)		Various (see Sect. 8)
Gauges (fuel and oil contents)		Various (see Sect.8)
Gauges (oil pressure) Mk. 11 E *		A.M.Ref.6A/1178 (40'cap) A.M.Ref.6A/1179 (50'cap)
Gauge (Cylinder temperature)	Sangamo Weston Co. Great Cambridge Rd., Enfield, Middlesex.	
Indicator (flap position)	Smith's Inst. Co. Cricklewood Works, London, N.W.2.	1 FL.
Switch (carburettor thermometer)	A.F. Bulgin Ltd., Alfred's Way, Barking, Essex.	S.270
Pump (vacuum)	Plessey Co. Ltd., Ilford, Essex.	B 3x Mk. 2
Indicator (air speed)	Kelvin Bottomley & Baird, Winchester Road, Basingstoke, Hants.	KB.217/01

Description	Manufacturer	Part No.
INSTRUMENTS AND VACUUM SYSTEM (contd.)		
Altimeter		BOAC. Code EKBM/1000
Artificial Horizon Mk. 1B		AM. Ref.6A/1599
Automatic Controls Mk. 8A	Ref. A.P.1469C	
Clocks. -	Smith's Inst. Co.	
Pilot's inst. panel	or A.M. Ref. 6A/676	V.304
E/O's panel and N/O's panel.	Smith's Inst. Co.	V.308
Compasses. -		
Type 0.6		A.M. Ref. 6A/473
Type P.10		A.M. Ref. 6A/1671
Astro		A.M. Ref. 6A/11740
D.R. Compass	Ref. A.P.1275B	
Computor	Ref. A.P.1275A	
Direction Indicator		A.M. Ref. 6A/1209
Drift Recorder Mk. 2		A.M. Ref. 6B/258
Rate-of-Climb Indicator.		BOAC. Code EKBE/1001
Sextant Mk. 9B		A.M. Ref. 6B/289
or Mk. 9 BM.		A.M. Ref. 6B/313
Static Vents	Ref. A.P.1275B	
Suction Gauges	Ref. A.P.1275A	
Thermometer - Air (electrical)	Ref. A.P.1275A	
Calibrating and Test Equipment		
Calibrator - Altimeter	A.P. 1275A	
Calibrator - A.S.I.	A.P. 1275A	
Calibrator - Pressure Gauges	A.P. 1275A	
Cylinder Temperature Test Gear	A.P. 1275A	
Gyro Table Test Gear	A.P. 1275A	
Gyro Test Table Mk. 2	A.P. 1275A	
Vacuum Instrument Test Gear	A.P. 1275A	
Automatic Pilot Testing	A.P.2306F	

Description	Manufacturer	Part No.
WATER AND TOILET SYSTEMS		
Toilet (W.C.)	Blakes Ltd. 82 & 88, South St. Gosport, Hants.	Baby Lightweight Standard Model.
Heater - water (immersion) $1\frac{1}{2}$ gall. 500 watt.	G.E.C. Ltd. Magnet House, Kingsway, London, W.C.2.	W.45024 R.
Waste Plug Push Valve Mixing Valve	T.A.W. Mfg. Co. Campsbourne Works, High Street, London, N.8.	651/2 656 714
BUFFET EQUIPMENT		
Urn (water heater)	Jackson Stove Co. 143, Sloane St., London, S.W.1.	Aircraft 1 gall. urn.
ENGINE AND PROPELLER ACCESSORIES		
Filter ("Purolator")	Automotive Products Brooke House, Langham Street London, W.1.	MPA.29840
Constant Speed Unit	de Havilland A/C Co. Hatfield, Herts.	CAY.5100
Motor Type C. (Cowling gills)	Rotax Ltd., Willesden Junction, London, N.W.10.	C.1306 X
Motor (propeller feathering)	Rotax Ltd., Willesden Junction London, N.W.10.	C.2801
Pump (propeller feathering)	Integral Ltd., Cousins Street, Wolverhampton.	I.H.F. Mk. 1
Gearbox (accessory) with drive	Rotol Ltd., Cheltenham Rd., Gloucester.	ADE.45
Controls (propeller)	Teleflex Products Ltd. 9, Cavendish Square, London, W.1.	
Drive (RPM generator)	S.S. White, Brittania Works, St. Pancras Way, London, N.W.1.	A.167

Description	Manufacturer	Part No.
ENGINE AND PROPELLER ACCESSORIES (contd.)		
Coil - Booster	British Thompson Houston Ltd., Coventry.	C.2.TS
MISCELLANEOUS		
Auxiliary Generating Plant	A. Lyon & Co. Africa House, Kingsway, London, W.C.2.	"Alco Featherweight"
Fasteners (domehead)	Oddie Fasteners Ltd. Plaza Hall, Portswood Road, Southampton,	
Adhesive & Glazing compounds	Ref. A.P.1464 B	
Roller Chains	Ref. A.P.1464 D	
DZUS Fasteners	Ref. A.P.1464 B	
Flexible Pipelines	Ref. A.P.1464 D	
Metal Couplings	Ref. A.P.1464 D	
Metal Tubes for pipelines	Ref. A.P.1464 D	
Tube Bending	Ref. A.P.1464 B	
"Teleflex" remote controls	Ref. A.P.1464 D	
Working and Repair of Transparent Plastics	Ref. A.P.1464 B	

PIPELINE IDENTIFICATION COLOURS

Service	Colour Bands		
	Narrow	Broad	Narrow
Engine Fire Extinguisher	White	-	Red
Windscreen De-icing	Brown	White	Brown
Carburettor De-icing	Red	White	Red
Propeller De-icing	Yellow	White	Yellow
Aerofoil De-icing	Blue	White	Blue
Instruments - Static	Yellow	-	Yellow
- Pressure	Green	-	Yellow
Fuel	-	Red	-
Oil	-	Black	-
Oxygen	White	-	Blue
Vacuum	White	-	Black
Propeller feathering	White	-	Yellow

17. LOADING

17.1. Cabin

	Cabin	Seat Passengers	Bunks	Maximum Permissible Load		Maximum Floor Loading	
				lb.	Kg.	lb/sq.ft.	Kg./sq.ft.
Lower Deck	A	7		2,250	1,020	150	68
	B	7		2,250	1,020	150	68
	C	6		1,764	800	100	45
	Promenade	2	1	1,296	588	150	68
Upper Deck	D	6		1,058	480	75	34
	E	6		1,345	610	75	34
	F	6		1,168	530	75	34
	Steward & Galley	-	-	591	268	75	34
	Locker	-	-	231	105	75	35

17.2. Hold

	Compartment	Cubic capacity Cu.ft.	Available Area sq. ft.	Maximum Permissible Load		Maximum floor Loading	
				lb.	Kg.	lb/sq.ft.	Kg/sq.ft.
Lower Deck	No.1	160	27	3,527	1,600	160	73
	Bullion Hold	17.0	7.5	1,444	655	205	93
	Over Bullion Hold	15	7	414	188	75	34
	'C' Cabin Bilge Locker	16	7	265	120	44	20
	Wardrobe Stbd.	36	6	500	227	150	68
	No. 2	90	24	1,204	546	99	45
Upper Deck	No. 3	-	-	904	410	75	34
	Crews Locker			705	320	75	34

17.3. Restrictions

(a) Maximum weight authorised by C. of A. is 35,380 Kgs.
R.T.O.W. quoted on the Load Distribution and Trim Sheet (a copy of which faces page 14) is the 'regulated take-off weight' as defined by the local governing authority.

(b) Maximum authorised landing weight is the same as the Maximum Weight authorised i.e. 35,380 Kgs.

(c) Maximum authorised laden weight, less fuel, oil and de-icing fluid, is 30,164 Kgs.

(d) Normal passenger movement is not restricted, except for take-off, and landing when passengers must be in their allocated seats. Abnormal passenger congregations must be restricted when, in the Captain's opinion, the trim of the aircraft will be adversely affected. The captain may delegate authority to a member of the crew to prevent such congregations.

(e) The following representative passenger weights are to be used, unless, in the opinion of the captain a check weigh of any individual passenger is necessary. In this case, all the passengers' actual weights are to be used:

Adult Male ...	75 Kgs.	Child (over 2 years) ...	39 Kgs.
Adult Female ...	65 Kgs.	Child (up to 2 years) ...	8 Kgs.

If the C.G. position, as obtained by using these representative weights, is found to be at the extremes of the safe range, the actual passenger distribution must be checked to ensure that the true C.G. will not be outside the safe range.

(f) The aircraft must at all times be trimmed between -11 I.U. and + 15 I.U. The best range is between - 3 I.U. and + 3 I.U.

(g) The maximum capacity of:-

No. 1 fuel tanks is 529 imp. galls./tank
No. 2 fuel tanks is 348 imp. galls./tank
No. 3 fuel tanks is 131 imp. galls./tank
No. 4 fuel tanks is 97 imp. galls./tank
No. 5 fuel tanks is 74 imp. galls./tank
No. 6 fuel tanks is 141 imp. galls./tank
Oil tanks is 37¼ imp. galls./tank.

17.4. Instructions (For Load Distribution Sheet)

(a) Fill in items 1 and 2

(b) Total items 3 to 16 to obtain "Service Weight" and substract from "R.T.O.W." to obtain available "capacity" item 18.

(c) Fill in Traffic Load Block and total to obtain item 35, "Total Load". Check that item 35 does not exceed item 18 "Capacity".

(d) Add item 17 and items 19 to 32 to obtain "Laden Weight" and check that this does not exceed "Maximum Weight authorised by C. of A".

(e) Obtain item 36 and substract from item 33 (or 34) and check that this is less than 30,164 Kgs.

(f) To adjust fuel quantities and/or load distribution, use the "Load Adjustment Column".

17.5. Instructions (for Trim Scales)

(a) Fill in empty weight index from current A.P.S. form and indicate this position on Basic Index scale.

(b) Drop a vertical line on to the scale immediately below until the vertical line meets one of the oblique lines on that scale.

(c) Draw a horizontal line (in the direction indicated by the arrow at the end of the scale) for a distance equal to the load shown in the load column at the left hand side of the scale.

(d) Drop a vertical line on to the scale immediately below and repeat the process.

(e) Proceed down the sheet in this manner until all the scales have been completed and make sure that the vertical line that intersects the "Laden Index Less Fuel" scale and the vertical line that intersects the "Laden Index With Fuel" scale is, in both cases, within the safe range.

17.6. Instructions for "Index Change" Procedure

To determine the new "Laden Index Less Fuel" after an adjustment to the load distribution has been made, proceed as follows :-

(a) In the "Index Change" column fill in the Index Change and Index Sign opposite the scale concerned and bear in mind that, when the load adjustment is a reduction of load, the Index Change is the Index Value for the amount of the reduction with the sign of the Index reversed. When the load adjustment is an increase of load, the Index Change is the Index Unit Value for the amount of the increase with the sign of the Index unaltered.

(b) When the necessary index changes have been made, total the "Index Change" column and subtract the negative values from the positive values to obtain "Total Index Change".

(c) The vertical line which intersects the "Laden Index Less Fuel" scale can now be adjusted to show the correct position of the C.G. by moving it in the direction of the arrow which bears the same sign as "Total Change" and by an amount equal to the "Total Index Change".

(d) The new "Laden Index With Fuel" is determined by dropping a vertical line from the latest position on the "Laden Index Less Fuel" scale, on to the fuel scale. Then draw a horizontal line as laid down in the instructions (for T_{rim} scales). Note (c). Drop a vertical line on to the scale "Laden Index With Fuel".

BRITISH OVERSEAS AIRWAYS CORPORATION
SHORT S.45. – SOLENT III. LOAD DISTRIBUTION AND TRIM SHEET.

ALL WEIGHTS IN KGS.

SEATS APPROVED FOR TAKE-OFF & LANDING — CREW 9, PASSENGERS 40

DRAWING Nº	
HQ-D 9291	
ISSUE	A
DATE	15 - 6 - 50
DESIGN OFFICE APPROVAL	

ITEM Nº			
1	FLIGHT Nº	FROM	AIRCRAFT REG'N
2	DATE	TO	
3	EMPTY WEIGHT PER A.P.S. FORM Nº __________		LOAD ADJUSTMENT COLUMN
4	DEDUCTIONS OR ADDITIONS.		
5	EMPTY WEIGHT FOR THIS FLIGHT.		
6	FUEL Nºs 1, 2, 3, 4 & 5. ______ GALS.		
7	FUEL Nº 6 ______________ GALS.		
	TOTAL FUEL		
8	OIL ____________ GALS.		
9	PILOTS, N/O, R/O, E/O, REST SEAT & FL'T EQUIP.		
10	STEWARD 1		
11	STEWARD 2 & GALLEY	(MAX. LOAD 268. INTENSITY 34)	
12	STEWARDESS & BAR STOCK.	(MAX. LOAD 400. INTENSITY 68)	
13	STEWARDS' STORE LOCKER.	(MAX. LOAD 105. INTENSITY 34)	
14	COLD STORE BOXES.	(MAX. LOAD 150. INTENSITY 22)	
15	CREWS BAGS (SEE NOTE →)	(SEE NOTE →)	
16			
NOTE	ALL MAX. LOADS ARE IN KGS. ALL MAX. INTENSITIES IN KGS. / SQ.FT.	R.T.O.W *	
17	SERVICE WEIGHT		
18	CAPACITY		
	DETAILS OF LOAD AND LOAD DISTRIBUTION.		
19	CABIN 'A' MAX. LOAD 940 INTENSITY 68 / HOLD (CABIN 'A') MAX. LOAD 480 INTENSITY 68	TOTAL	
20	CABIN 'B' (MAX. LOAD 1020. INTENSITY 68)	TOTAL	
21	CABIN 'C' MAX. LOAD 800 INTENSITY 45 / HOLD (CABIN 'C') MAX. LOAD 120 INTENSITY 20	TOTAL	
22	CABIN 'D' (MAX. LOAD 480. INTENSITY 34)	TOTAL	
23	CABIN 'E' (MAX. LOAD 610. INTENSITY 34)	TOTAL	
24	CABIN 'F' (MAX. LOAD 530. INTENSITY 34)	TOTAL	
25	PROMENADE (PASSENGERS ONLY)	TOTAL	
26	HOLD 1 (MAX. LOAD 1600. INTENSITY 73)	TOTAL	
27	BULLION HOLD (MAX. LOAD 655. INTENSITY 93) OVER BULLION HOLD (MAX. LOAD 188. INTENSITY 34)	TOTAL	
28	HOLD 2 (MAX. LOAD 750. INTENSITY 45)	TOTAL	
29	HOLD 3 (MAX. LOAD 410 INTENSITY 34)	TOTAL	
30	DINGHY LOCKERS Nºs 1, 2 & 3. (MAX. LOAD 90 KGS. EACH. INTENSITY 22)	TOTAL	

PAYING PASS (_____)	31	CREWS LOCKER. (M.L. 320. INT. 34)	
FREE BAGGAGE			
EXCESS BAGGAGE	32	WARDROBE. ST'B'D MAX. LOAD 227 INTENSITY 68	
1ST. CLASS MAIL			
2ND CLASS MAIL			
PARCEL MAIL	33	LADEN WEIGHT 'A'	
DIPLOMATIC BAGS.	34	LADEN WEIGHT 'B'	
AIR CARGO		MAXIMUM WEIGHT AUTHORISED BY C.OF A.	35380
STAFF PASS. (_____)			
BAGGAGE OF ABOVE	36	TOTAL FUEL, OIL & DE-ICING FLUID CARRIED.	
STORES		MAX. LADEN WEIGHT LESS FUEL, OIL & DE-ICING FLUID — ESTIMATED	
SHIPS MAIL			
BALLAST		AUTHORISED	30164 / 30164
35 TOTAL LOAD		THIS DRAWING SUPERSEDES DRAWING Nº HQ-D 9190	

EMPTY W'T INDEX ________

NEGATIVE (−) BASIC INDEX POSITIVE (+)

28 26 24 22 20 18 16 14 12 10 8 6 4 2 0 2 4 6 8 10 12 14 16 18 20 22 24

C.G. DATUM .32·84' AFT OF NOSE REF LINE.
1·2' AFT OF MF'T'RS DATUM.

LOAD PER SEGMENT
- 500 KGS
- 100 KGS.
- 100 KGS
- 200 KGS.
- 100 KGS.
- 100 KGS.
- 50 KGS.

DO NOT ENTER CREW'S BAGS AGAIN IN HOLD DISTRIBUTION, BUT MARK OFF ON APPROPRIATE HOLD SCALE.

R.T.O.W. *

CAPACITY

INDEX CHANGE — SEE INSTRUCTIONS FOR PROCEDURE.

NOTE:-
ALL SCALES, WITH THE EXCEPTION OF FUEL SCALES, ARE DIRECTLY IN LINE WITH THE CORRESPONDING ITEMS. SPACES ARE PROVIDED AT THE END OF THE FUEL SCALES FOR NOTATION OF FUEL LOADS.

- − 1·6 I.U. – 100 KGS. — 100 KGS.
- − ·9 I.U. = 100 KGS — 100 KGS.
- + 1·0 I.U. = 200 KGS. — 200 KGS.
- + 1·7 I.U. = 100 KGS. — 100 KGS.
- + 2·4 I.U. = 100 KGS. — 100 KGS.
- + 3·1 I.U. = 100 KGS. — 100 KGS.
- + 1·6 I.U. = 100 KGS. — 100 KGS.
- − 2·5 I.U. = 100 KGS. — 100 KGS.
- − 2·1 I.U. = 100 KGS. — 100 KGS.
- + 3·3 I.U. = 100 KGS. — 100 KGS.
- + 1·8 I.U. = 50 KGS. — 50 KGS.
- + 1·7 I.U. = 500 KGS. — 500 KGS.
- − 1·3 I.U. = 100 KGS. — 100 KGS.
- + ·9 I.U. = 100 KGS. — 100 KGS.

TOTAL INDEX CHANGE

LADEN INDEX LESS FUEL

22 20 18 16 14 12 10 8 6 4 2 0 2 4 6 8 10 12 14 16 18 20 22 24

UNSAFE — SAFE – N.H. — B.R. — SAFE – T.H. — UNSAFE

← TO ADJUST C.G. POSITION MOVE IN DIRECTION OF ARROW BEARING SAME SIGN AS 'TOTAL INDEX CHANGE'. +→

FUEL Nºs 1, 2, 3, 4 & 5. 1000 KGS. ____KGS ____KGS

FUEL Nº 6 500 KGS. ____KGS ____KGS

22 20 18 16 14 12 10 8 6 4 2 0 2 4 6 8 10 12 14 16 18 20 22 24

LADEN INDEX WITH FUEL — UNSAFE — SAFE – N.H. — B.R. — SAFE – T.H. — UNSAFE

LOAD DISTRIBUTION CERTIFICATE.

I HEREBY CERTIFY THE DISTRIBUTION OF THE ABOVE LOAD TO BE IN ACCORDANCE WITH THE WRITTEN INSTRUCTIONS APPROVED BY THE MINISTRY OF CIVIL AVIATION.

SIGNATURE AND STATUS OF OFFICER RESPONSIBLE FOR TRIM __________________

TO BE USED IN CONJUNCTION WITH 'RESTRICTIONS & INSTRUCTIONS' HQ-C 9292

PILOTS CERTIFICATE OF GENERAL FITNESS OF AIRCRAFT

I HEREBY CERTIFY THAT I HAVE SATISFIED MYSELF THAT:-
(a) THE AIRCRAFT IS EQUIPPED WITH THE PRESCRIBED INSTRUMENTS AND EQUIPMENT.
(b) THE AIRCRAFT AND ITS INSTRUMENTS AND EQUIPMENT ARE FIT IN EVERY WAY FOR THE PROPOSED FLIGHT.
(c) THE AIRCRAFT IS SATISFACTORILY LOADED FOR SAFETY IN FLIGHT.
(d) THE VIEW OF THE PILOT IS NOT INTERFERED WITH BY ANY OBSTRUCTION NOT FORMING PART OF THE STRUCTURE OF THE AIRCRAFT.
(e) SUFFICIENT FUEL, OIL AND WATER ARE CARRIED FOR THE PROPOSED FLIGHT.

DATE ________ TIME ________ SIGNED ________________ CAPTAIN.

FORM Nº 4531. PRINTED IN U.K.

SOLENT 3

MAINTENANCE MANUAL

SECTION 2

AIRFRAME

Contents

Page

Illustrations

STRUCTURE - DESCRIPTION

HULL (Fig. 1)

1. General - The hull is a light alloy monocoque structure, with transverse frames interconnected by longitudinal stiffeners. The frames are secured to a centre keelson for the length of the planing bottom. For some distance above the planing bottom the hull is divided by vertical bulkheads into a number of watertight compartments.

Each of the normal communicating doors in the watertight bulkheads consists of two panels the lower panel being a watertight door which can be closed and fastened independently of the upper panel.

2. Hull Frames -

With the exception of bulkheads, which are built up with sheeting and stiffeners, the frames are constructed of channel section above the chines, with a flanged diaphragm forming, the planing bottom portion.

In the forebody certain frames are reinforced with additional channel-section members, and extra frames, which extend a short distance above the chines, strengthen the planing bottom.

Two built-up frames (spar-frames) heavily braced and incorporating booms of extruded T section, are located approximately amidships for the attachment of the main plane; similarly, two double frames incorporating attachments for the fin and tail plane are fitted in the stern.

Z-section longitudinal stiffeners are secured to the frames by tie-plates and angle pieces. The inner flanges of these stiffeners are stabilized by transverse stringers of bowler-hat section secured midway between the frames.

3. Decks -

The upper deck, from the forward end of the control cabin to the centre section, has transverse bearers of combined channel and angle section and intercostal longitudinal bearers of channel section. In the centre section are two longitudinal bearers of extruded section with intercostal bearers of channel section. The flooring consists of light alloy sheets riveted to the bearers and is reinforced by Z-section stiffeners.

Aft of the centre section, the upper deck main transverse bearers are built up of back-to-back channel sections with upper and lower rider plates riveted to the flanges. The main longitudinal bearers are built up with back-to-back channel sections and a lower rider plate; the intermediate longitudinals are of channel and angle section or Z section. Intercostal transverse bearers are of channel section. The flooring consists of a series of panels bolted to the bearers; the panels are built up of channel section framing with plywood sheeting and top-hat section stiffeners.

The transverse bearers of the lower deck forward of the rear spar-frame are formed by the upper flanges of the planing bottom portions of the hull frames, Aft of the rear spar-frame, where the floor level is raised, additional bearers of combined channel and angle section are fitted across the frames. Main longitudinal bearers are of combined channel and angle sections and subsidiary bearers are channel section.

The flooring consists of a series of panels similar to those of the rear section of the upper deck.

Access between decks is provided by a hinged ladder below the control cabin, a fixed ladder in the centre section, and a spiral stairway in the promenade cabin.

4. Hull Sheeting -

The planing bottom front-step is faired into the afterbody, and the rear step is formed into a vertical knife-edge which fairs into the rear sections of the hull.

Sheeting panels are lapped and show a thickness at the lower and rear edges, a special method of joggling being used at the overlapping corners. Braided cord is used in sheeting seams below the waterline and closing strips are fitted at the keelson and chines.

MAIN PLANE

5. General - The main plane is of all metal construction, with Gouge-type extended chord flaps and Frise-type ailerons. Two engine nacelles are built on to the leading edge of each wing. Fuel tanks are housed within the wings in the upper surface of which detachable covers are provided. A landing lamp is fitted in the undersurface of each wing. T.K.S/Dunlop fluid-type de-icing equipment is provided for the leading edges.

6. Spar -

Each wing comprises a central torsion-box spar to which are fitted the leading edge, the trailing edge sections forward of the flap and aileron, and the wing-tip.

The spar is constructed with a front and a rear truss connected at intervals by upper and lower drag members with incidence bracing. Each truss is built up of extruded T-section booms braced by tubular members, and each upper and lower drag member consists of two extruded T-section booms braced by angle section members.

Drag member incidence bracing is attained by means of streamline wires or twin flexible cables.

The spar sheeting is reinforced by continuous longitudinal stiffeners of Z section.

7. Leading edge

The leading edge is formed by a series of flanged diaphragms covered with sheeting which is reinforced by continuous V-section stiffeners. A portion of the leading edge on both sides of each engine nacelle hinges downwards and is formed into platforms by additional sheeting and stiffeners, for engine servicing purposes. Retaining cables are fitted from these platforms to the upper front spar-boom.

8. Trailing Edge

The trailing edge forward of the flap and aileron is formed by ribs with upper and lower members of extruded T section and tubular bracing members. Four of the ribs in the section forward of the flap are of heavy construction to carry the roller arms on which the flap moves and, in the section forward of the aileron, the ribs carrying the hinge arms are also of more robust construction. Certain of the trailing edge ribs are constructed to form cradles for the rear fuel tanks. The trailing edge sheeting is reinforced by Z-section stiffeners.

9. Main Plane Flap -

The flap has three main longitudinal spars constructed with upper and lower members of Z section and bracing of angle section. The ribs have upper and lower members of extruded T section connected by angle-section bracing members. Four double ribs carry extruded channel-section runners which support the flap from the roller arms on the main plane.

The metal sheeting is reinforced by longitudinal stiffeners of Z-section, transverse stringers of shallow channel section being riveted to their inner flanges midway between the ribs. At the inner end the trailing edge is reinforced for some distance by a triangular section casting and additional channel-section stiffeners.

Access panels are provided in the upper surface above the flap runner attachment bolts, and in the under surface for access to the flap screw-jack attachment and the stops in the runners.

10. Aileron (Fig. 4)

The aileron is of all metal construction with the exception of a fabric covering. Flanged nose and tail ribs are riveted to a flanged diaphragm spar.

The trailing edge is formed by a V-section member riveted to the tail ribs, and the nose ribs are covered with sheeting reinforced by longitudinal V-section stiffeners.

An electrically operated trimming tab is inset in the trailing edge, the motor being fitted in the nosing together with a mass balance weight. A metal trimming tab, which can only be adjusted on the ground, is fitted at the inboard end of the trailing edge.

Fabric covers the whole aileron, including the metal covered nosing, and is supported at the tail ribs by shallow channel-section stringers riveted to the rib flanges.

Five ball-bearing hinge arms are fitted between intermediate ribs at intervals along the spar, access being provided in the upper surface above the hinges. The operating levers are attached to the rear of the spar, adjacent to the second and fourth hinges respectively.

11. Wing-tip Float (Fig. 5)

Each float has flanged diaphragm frames and four watertight bulkheads spaced by Z-section stiffeners and a series of intercostal diaphragms which form the keelsons.

The first and third bulkheads are reinforced by channel-section stiffeners to carry the float attachment strut fittings.

The structure is covered with light alloy sheeting, and detachable panels with quick release rubber inspection covers are fitted in the top of the compartments for use when internal repairs are necessary; the panels are secured by countersunk bolts to Simmonds nuts below the sheeting. A drain plug is fitted in each watertight compartment.

The float is attached by four streamlined struts to points under the main plane spar-trusses. Incidence bracing of the two main struts is attained by flexible cables.

TAIL UNIT

12. General - The tail unit (fig. 6) is of all metal construction. The tail plane and fin are cantilever structures the general construction of which is similar to that of the main plane. The forward section of the dorsal fin is integral with the hull but the major part of the fin is detachable. T.K.S./Dunlop fluid-type de-icing equipment is provided for the leading edges of tail plane and fin.

13. Tail Plane and Fin

The spars are formed by a front and a rear truss spaced by drag members shaped to the aerofoil contour. Some of the drag members consist of back-to-back channel sections and some of sheet diaphragms reinforced by angle-section stiffeners. Each truss consists of two extruded T-section booms connected by a sheet metal diaphragm reinforced by top-hat and angle section stiffeners. The spar sheeting is reinforced by continuous longitudinal stiffeners of top-hat section.

The leading edge is attached to the front truss as a complete unit formed by a series of flanged diaphragms with a sheet metal covering reinforced by continuous longitudinal stiffeners of top-hat section (fin) and V-section (tail plane).

The tips of the tail plane and fin are also built up separately and attached to the ends of the spar-booms.

Attachment brackets for elevator and rudder hinges are fitted to the rear spar-trusses, and the tail plane and fin are attached at the ends of the spar-booms to mating fittings on the hull, using bolts with conical bushes and expanding sleeves.

14. Elevators -

The elevators are of similar construction to that of the ailerons but have no stringers supporting the fabric covering at the tail ribs, and a faired balance weight extends along the leading edge between the hinge arms,

A built-up metal trimming tab inset in the trailing edge at the inboard end of the port elevator is actuated by a push rod coupled to a worm gearbox fitted at the spar. A similar tab in the starboard elevator acts as an anti-balance tab (see para. 32). Rip-off patches in the fabric covering give access to the tab hinges and the actuating gear. Port and starboard elevators are interconnected, through universal couplings, by a torque-tube which carries operating levers in the hull.

15. Rudder -

The rudder is of similar construction to that of the elevators but has the addition of small diameter tubular stabilizers running longitudinally through the tail ribs.

The upper extremity of the rudder is of solid bakelite riveted to a sheet metal tip.

An anti-balance tab inset in the lower end of the trailing edge is automatically operated by a push-rod coupled to an arm on the lower hinge. A trimming tab similar to that on the port elevator is fitted higher up in the trailing edge.

A short torque-tube is fitted into the base of the rudder and connects to an extension tube carrying operating levers in the hull.

STRUCTURE - MAINTENANCE

16. General -

The positions of all access panels provided for maintenance and servicing purposes are illustrated in figs. 7 and 8.

Ground equipment and special tools mentioned in the following paragraphs are listed in Sect. 13.

17. Rigging -

Since the main planes, tail planes and fin are fixed cantilever structures no adjustment to them is possible, but the paragraphs concerning these components are inserted for checking purposes if malalignment is suspected.

The rigging operations described are those for checking the symmetry of the aircraft, the setting and dihedral of the main planes, the rigging of the wing-tip floats, and the incidence and dihedral of the tail planes.

18. Rigging Position (Fig. 9) -

Datum points for longitudinal and transverse levelling consist of seven brackets fitted at the hull side and located - one at each side of cabins 'A' and 'B', and three in the tail end of the hull; the brackets in the passenger cabins are detachable for stowing when not in use.

Using the jacking method described and illustrated in fig. 9, the aircraft is in the correct rigging position when straight-edges placed longitudinally and laterally are level.

In circumstances when jacking equipment is limited, the hull need not be set to bring its datum line horizontal as above. The alternative method is to first measure the attitude of the hull datum to the horizontal (by means of straight edges placed on the datum blocks) and to add or substract this angle to or from the applicable normal angles of incidence and dihedral given in fig. 11.

19. Checking Symmetry -

The symmetry of the main and tail planes about the hull can be checked by diagonal measurements from datum points marked on the airframe. The position of the datum points is shown in fig. 10 and the measurements between them should be within the limits given.

20. Checking Aerofoils -

The method of checking the setting and dihedral of the main planes and tail planes is illustrated in fig. 11.

Pin-centre dimensions of the wing-tip float bracing wires are also given in fig. 11.

21. Lubrication -

Airframe lubrication points are annotated in figs. 12 and 13. Recommended oils and greases are quoted in the illustrations.

22. Bonding -

For maintenance notes on bonding, reference should be made to Section 5.

23. Removal and assembly notes -

Figures 14 to 19 give the methods for removing and assembling the principal components. Generally only the removal is dealt with as re-assembly is usually a reversal of the removal operations. Special points are covered by notes on the illustrations.

When re-assembling, in addition to the operations covered by the illustrations, any bonding, locking, and sealing should be carefully restored to its original condition.

The numerical sequence of operations given in the illustrations is the recommended order for dismantling. The operation numbers are enclosed in circles only where the points at which the operations are to be carried out are illustrated.

When disconnecting a control cable, a weight should be attached to the cable end before releasing, to prevent it from slipping out of pulleys or unwinding from cable drums.

FLYING CONTROLS - DESCRIPTION

24. General -

Dual flying controls, operated from two rudder bars and handwheel-type control columns are connected to their respective control surfaces by tie-rods, chains and cables. Automatic controls are fitted.

The main plane flaps are operated by an electric motor, provision being made for emergency manual operation. The aileron, rudder, and elevator trimming tabs are operated from a control unit in the control cabin roof.

25. Locking of Controls -

Eye-links are interposed in the control runs (fig. 20) for locking the aileron, rudder, and elevator controls when the aircraft is moored, or when rigging and adjusting controls.

The locking gear consists of a handle fitted with six projecting pins, and is inserted in a slot in the floor aft of the captain's seat to engage the eye-links in the control runs.

The locking handle is normally stowed on the cover over the controls.

NOTE.... There are two locking positions for the elevator controls i.e., 'Neutral' - used for rigging purposes.
'Down' - used when the aircraft is moored.

26. Aileron Controls (Fig. 21) -

The control column handwheels are coupled by an endless roller chain in each column, and a circuit of chains and tie-rods between sprockets at the base of each column. The movement is transmitted to the control run through a torque-tube connected to the base of the port column.

The control run consists of three separate circuits. The first is a continuous run of tie-rods and chains from the torque-tube, through fittings forming the locks and stops, to the forward sprocket on a countershaft at the rear spar-frame.

From two further sprockets on this countershaft the other two circuits of tie-rods and chains extend, to port and starboard respectively, along the main plane rear spar-trusses to connect to the aileron levers.

A control tensioner is fitted in each wing-root (fig. 21) and consists of a system of jockey sprockets bearing on the control chains and operated by torque-tubes from a gearbox fitted on the upper deck, immediately aft of the centre section. The gearbox is operated manually from a handwheel located on the forward face of the rear spar-frame bulkhead, aft of the E/O's control stand.

27. Rudder Controls (Fig. 22) -

The rudder bars are coupled by a transverse tube attached to a lever on each rudder bar assembly. The control runs of tie-rods, chains, and cables are attached to a toggle lever on the port rudder bar, and extend aft along the flight deck to pulleys in the centre section.

From this point the runs extend upwards to the hull roof then aft along the roof to connect to levers on an automatic control-tensioning device fitted on the rudder torque-tube. This tensioner (see detail in fig. 22) is fitted to compensate for any expansion or contraction in the control runs resulting from temperature changes.

28. Elevator Controls (Fig. 22) -

The control columns are coupled for fore-and-aft movement by a transverse torque-tube fitted between their bases. The movement is transmitted from two levers, one on each side of the port column base, to two independent levers on a transverse shaft below the port seat. From the latter levers, runs of

Elevator Controls (contd.)

tie-rods, chains and cables extend aft beside the rudder controls to connect to the levers of a control tensioner (similar to that in the rudder control) on the torque-tube connecting the two elevators.

29. Rudder Trimming Tab Controls (Fig. 23) -

The rudder trimming tab is operated from a reduction gearbox fitted in the control cabin roof; a crank handle extends from the underside of the unit.

Roller chains are employed to transmit the movement from the sprocket in the unit to the main run of tie-rods and flexible cable. Control stops are formed by a special link between the drive chain and the cable; this link also carries a pointer over a graduated scale to indicate the position of the tab.

The control run extends aft along the hull roof to pulleys at the rear spar-frame. From this point the runs extend aft beside the main flying controls to pulleys in the tail end of the hull, then up into the rudder to be coupled by a length of roller chain to the sprocket on a worm gearbox mounted on the rear face of the spar.

The gearbox is coupled by a push-rod to the trimming tab.

30. Rudder Anti-balance Tab -

As the rudder control is basically light in operation, an anti-balance tab is fitted to increase the effort required to move the control. The tab is operated automatically by movement of the rudder, being coupled through a cam plate and a push-rod to the lower hinge; this causes the tab to be deflected in the same sense as the main surface.

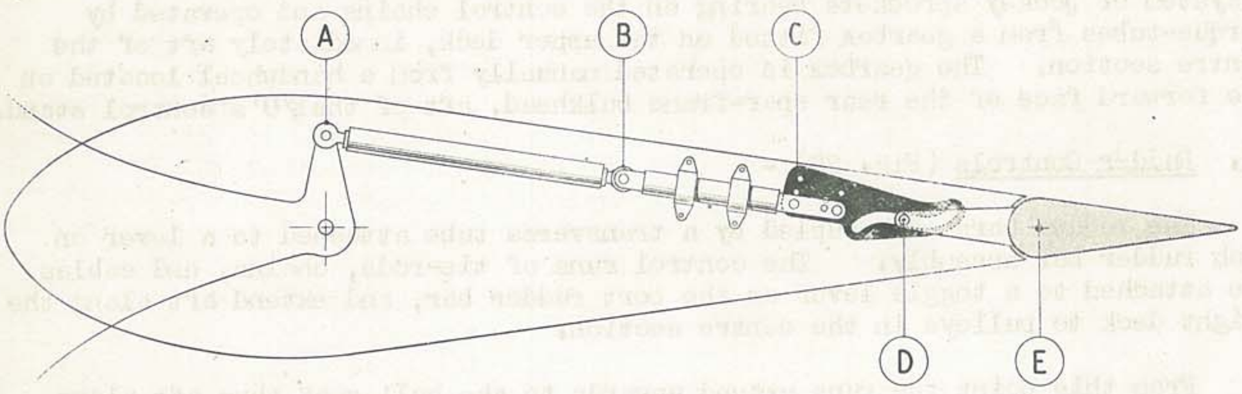


FIG. 1A.

The cam plate C (fig. 1a) which is attached to the push-rod BC is constrained by two bearings to move only in the fore-and-aft direction. It is operated by the push-rod AB attached to the point A on the rudder hinge arm. The pin D, which moves in the cam plate C, is fitted on the arm DE fixed to the tab.

Alternative bolt holes are provided in the cam plate (see fig.24) so that the cam plate can be set in any one of three positions. There is therefore, a choice of three gear ratios between rudder and tab. This makes it possible to correct for variations in rudder heaviness between one aircraft and another.

Rudder Anti-balance Tab (contd.)

The aircraft manufacturers set the cam plate in the optimum position as determined by flight tests.

Thereafter, there should be no reason for altering the cam plate unless a new rudder is fitted (see para. 47).

31. Elevator Trimming Tab Controls (Fig. 23)

The tab in the trailing edge of the port elevator is a normal trimming tab operated in a similar manner to the rudder trimming tab, the control gear being contained in the same unit in the control cabin.

The control run extends aft beside the rudder tab controls to pulleys in the tail end of the hull where a roller chain connected to the cables is carried over the forward sprocket on a countershaft. From a rear sprocket on this countershaft a circuit of cables and roller chains extends outboard to a sprocket attached to a short torque-shaft at the rear spar-truss of the port tail plane; this torque-shaft is connected by a toggle/socket type joint to a universally-jointed torque-tube driving a worm gearbox in the elevator. The gearbox is coupled to the trimming tab by push-rod.

32. Elevator Anti-balance Tab -

The elevator control, like the rudder control, is basically light in operation; therefore as a safeguard against overbalance, an anti-balance tab is fitted to the starboard elevator to increase the effort required to move the controls.

The tab is operated automatically and is deflected in the same sense as the main surface but the range of movement (±0° to 9° for full elevator travel) can be adjusted from a handwheel in the aft end of the hull.

From the handwheel (fig. 24) a torque-tube extends into the starboard tail plane to a bevel gearbox incorporating a small screw-jack. The screw-jack is connected to the lower extremity of a triangular plate which pivots on a bearing attached to the tail plane and extends aft into the elevator. A push-rod connected to the rear extremity of the triangular plate extends out through the under surface of the elevator to a lever on the tab. A worm at the rear of the control handwheel moves a pointer over a graduated scale to indicate in degrees the range of tab movement.

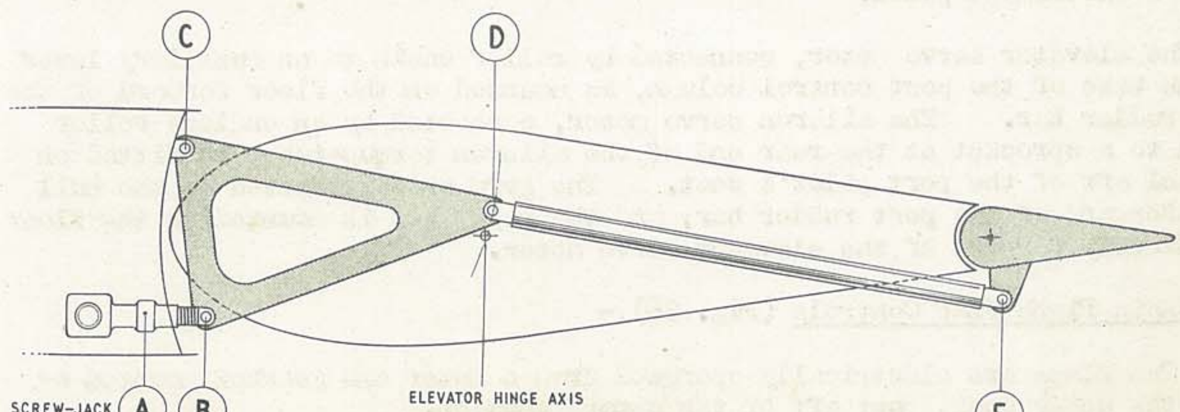


FIG. 2a.

Elevator Anti-balance Tab (contd.)

Screw-jack A (fig. 2a) is operated from the handwheel in the hull and moves the plate BCD about the pivot C.

The point D which is linked to the tab lever E can, therefore, be moved nearer to or further from the elevator hinge axis. The tab gearing is proportional to the distance between D and the hinge axis and becomes zero when these two points coincide.

The range of movement required varies with individual aircraft and is determined at flight trials. The handwheel is then locked and sealed and must on no account be disturbed. The procedure to be adopted when a new elevator has been fitted is described in para. 46.

33. Aileron Trimming Tab Controls -

The aileron trimming tabs are operated by the Evershed Powerotor system, the electric motor and tab actuating gear being fitted in the aileron nosing. The motor is controlled from a rotary switch fitted adjacent to the rudder and elevator tab control box in the control cabin roof, and a two-pointer tab position indicator is fitted at the lower port side of the pilot's instrument panel.

Further details of the electrical control are given in Sect. 5.

34. Automatic Controls (R.A.E. type Mk. 8A) (Fig. 25) -

The engine-driven compressor is fitted on the accessory gearbox of No. 2 engine, and the oil cooler is fitted in the leading edge of the port wing, between No. 2 engine and the hull side. The oil reservoir and air drier are mounted on the rear bulkhead of No. 1 hold while the water drain trap is fitted on the port side of the hull, just forward of the crew entrance door.

A panel at the port side of the control cabin carries the control cock, clutch lever, and the lever controlling the friction-type rudder control damper unit mounted forward of the port rudder bar. The COMPASS CONTROL - JINK TURN switch and a cut-out cock (under the control of the 1st officer) are fitted between the throttle and propeller levers in the engine control stand.

A combined trim and pressure gauge is fitted near the top centre of the pilot's instrument panel.

The elevator servo motor, connected by roller chain to an auxiliary lever at the base of the port control column, is mounted on the floor forward of the port rudder bar. The aileron servo motor, connected by an endless roller chain to a sprocket at the rear end of the aileron torque-tube, is fitted on a panel aft of the port pilot's seat. The gyro unit is fitted on the hull side forward of the port rudder bar, and the relay box is mounted on the floor immediately forward of the elevator servo motor.

35. Main Plane Flap Controls (Fig. 26) -

The flaps are electrically operated from a motor and gearbox mounted above the upper deck, just aft of the centre section.

Main Plane Flap Controls (contd.)

The gearbox is coupled to a series of universally-jointed torque-tubes extending outboard to a worm gearbox and screw-jack anchored to the lower rear spar-boom in each wing.

The screw-jack consists of a square-threaded spindle operating in two square-threaded nuts riveted in a tubular casing. The end of the spindle is attached to the flap and the rotation of the casing by the worm gear causes the spindle to extend or retract, depending on the direction of rotation.

The electric motor is controlled from a two-way and OFF switch on the pilot's instrument panel. Two switches, which cut out the motor at the IN and fully OUT positions of the flaps, are fitted on a unit adjacent to the motor and gearbox. The switches are actuated by a travelling arm on a screw shaft, the latter being operated through a worm gear by the control torque-tubes.

The switch unit also operates a transmitter and a ramp; the transmitter controls a flap position indicator on the pilot's instrument panel, and the ramp operates a switch for an indicator lamp which shows red when the flaps are one-third out and remains on until they are returned past this position.

In the event of electrical failure, the flaps can be operated manually after disengaging the motor drive. A square-ended shaft projecting from the top of the gearbox accommodates a handle which is normally stowed on the bulkhead below the gearbox.

FLYING CONTROLS - MAINTENANCE

36. Identification of Control Runs -

To ensure the correct rigging, guides are fitted at various positions along the runs and identification symbols are marked on all levers and adjacent to pulleys and sprockets, the following code is used. -

Aileron Controls	A.1 and S.2
Elevator Controls	E.1 and E.2
Rudder Controls	R.1 and R.2
Elevator Tab Controls	E.T.1 and E.T.2
Rudder Tab Controls	R.T.1 and R.T.2

37. Control Surface Settings -

The permissible setting limits and the range of movement of the flying control surfaces are given in fig. 27.

Notes on setting the controls and the automatic controls in conjunction with them are given in the following paragraphs.

With the control locking handle in position (see fig. 20) the control surfaces are in the neutral position.

NOTE... There are two locking positions for the elevator controls, i.e., 'neutral' for rigging and 'down' when the aircraft is moored or parked.

38. Automatic Control Couplings -

The stops on the servo motors must always come into operation before the main stops. Adjustment to the flying controls should be made aft of the main stops if possible, but if adjustment has to be forward, it should be checked that the coupling of the automatic controls to the main controls has not been disturbed (see fig. 28).

If the coupling has been altered, it should be re-set by slackening one adjuster and tensioning the other.

For maintenance information on the Mk. 8 automatic controls reference should be made to **A.P.1469.C.**

39. Setting Ailerons -

The heaviness of the ailerons can be controlled by varying the aileron reflex. The angle of reflex necessary for a particular aircraft is determined at flight trials and is normally 0° - 30' but up to a maximum setting of 1° - 30' may be used on each aileron.

It should be possible to apply manoeuvring angles of aileron at the cruise condition with one hand. An unduly light control for this condition should be avoided since this involves a possible risk of over-balance at high speeds and to ineffectiveness during take-off or approach conditions at low speeds. It should be noted that there is a normal tendency for the control to become heavier when the flaps are lowered. Good control at lower speeds should not be sacrificed to obtain manoeuvrability near maximum diving speeds.

To set the ailerons to the required angle of reflex, the following is the recommended method.

39.1. With the control locking handle in position (fig. 20) rig the aileron controls so that the ailerons are in line with the main plane profile, checking with the rigging boards (ref. S45.C. 229000) the inboard one of which is used on nodes 12 and 72, (between the covers of fuel tanks No. 4 and 5) and the outboard one on nodes 21 and 81 (approximately 5' - 6" from the wing-tip)

39.2. The angle of reflex can then be obtained by slackening the lower tie-rods and tensioning the upper tie-rods the location of which is shown in fig. 29. Two complete turns of the tie-rods (8 flats at the swaged ends) constitute 1° movement of the aileron.

40. Setting Rudder and Elevator -

With the control locking handle in position, the rudder and elevator controls are rigged so that the control surfaces are in line with the stub sections on the hull.

The method of tensioning the control runs is given in para. 49.

41. Setting Trimming Tabs - General -

The trimming tab settings are individual for each aircraft, being determined at flight trials and recorded in the aircraft log book to which reference should be made.

42. Setting Aileron Trimming Tabs -

The electrically operated tabs have a range of movement of 10° with limits of + 1° or - $1\frac{1}{2}$°. For the initial test flight the tabs are set with the neutral position in line with the aileron. After test flights the test pilot may request a basic setting of up to a maximum of 5° to correct lateral bias at the cruise condition. The adjustment should be carried out equally on both tabs (one up and one down) as follows. -

42.1. Slacken the lock nut at the forward end of the tab push-rods.

42.2. Release the aft end of the push-rods from the tabs and adjust as required; one complete turn of the push-rod is equivalent to approximately 2° on the tab. The adjustment must be within ± $\frac{1}{2}$° of the setting requested.

42.3 Re-connect the push-rod to the tab and tighten the locknut.

After the above adjustment has been made, the tab movement of 10° (+1° or - $1\frac{1}{2}$°) from the basic setting should be possible.

43. When a new aileron or a new tab motor and gearbox is fitted, the following operations should be carried out to assemble the tab actuating gear before making the test flight.

43.1 With the wormwheel segments in the tab gearboxes set midway between the full travel stops, check that the links and levers between gearbox and indicator transmitter are positioned as shown in fig. 3a.

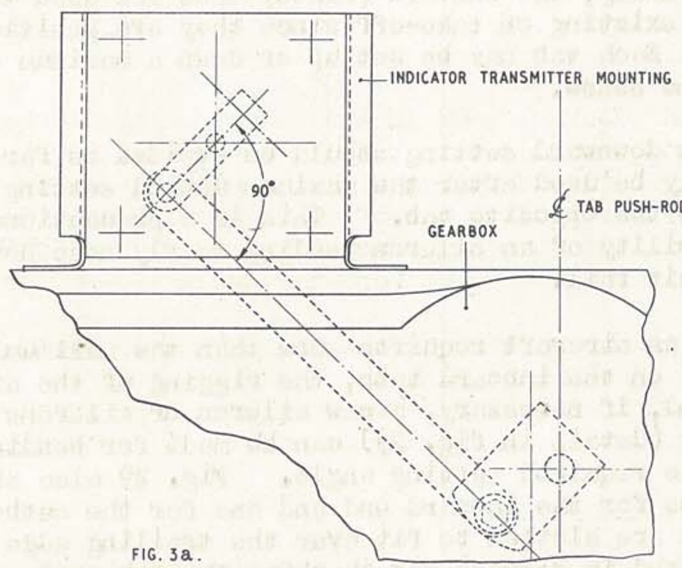


FIG. 3a.

43.2. Set the wormwheel segments in the gearboxes to the revelant stops for one tab 'up' and the other 'down'.

43.3. Set the indicators on the pilot's instrument panel to the relevant full travel positions.

43.4. Operate the control handwheel (in the control cabin roof) to the full extent of the indicator in the reverse direction.

43.5. Check that the wormwheel segments have reached the reverse stops. If the stops have not contacted or if they contact before the pilot's indicator shows full travel, the amount of discrepancy should be equispaced at each end of the full travel.

43.6. Operate the control handwheel until the indicators show "0"

43.7. Connect the tab push-rods to the levers on the gearboxes (if this has not already been done).

43.8. Set the tabs in the neutral position, adjust the push-rods to connect up with the tab levers and tighten the lock nuts.

After fitting a new aileron and assembling the tab gear as above, the bearing fitting at the tab end of the push-rod should be locked with a 1/16" dia. split pin positioned as shown in fig. 4a.

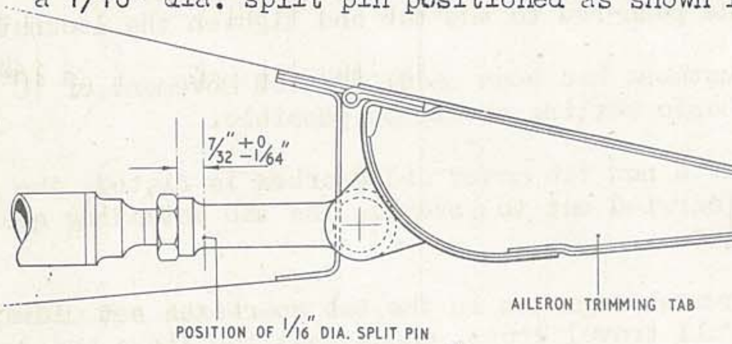


FIG. 4a.

44. Normally, the inboard (fixed) tabs are used to correct any bias primarily existing on take-off since they are positioned in the slip-stream. Each tab may be set up or down a maximum of 10° but not both in the same sense.

The downward setting should be avoided as far as possible and should only be used after the maximum upward setting of 10° has been applied to the opposite tab. This is a precautionary measure against the possibility of an aileron tending to fly nose down should the control circuit fail.

If an aircraft requires more than the maximum permissible setting of 10° on the inboard tabs, the rigging of the ailerons should be checked and, if necessary, a new aileron or ailerons fitted. A wooden jig (detail in fig. 29) can be made for bending the inboard tabs to the required setting angle. Fig. 29 also shows two checking boards, one for the inboard end and one for the outboard end of the tab, which are slotted to fit over the trailing edge of the aileron and graduated in degrees for checking the tab angle.

45. Setting Rudder and Elevator Trimming Tabs -

Provided the rudder or elevator has not been changed, either of the following methods may be used for checking the tab setting. -

45.1. Set the appropriate indicator in the control cab to zero then measure the angle of the tab.

or

45.2. Wind the control handle until the tab is in line with the control surface, then take the indicator reading.

If the setting angle thus found is different from that given in the log book (it should not be unless the adjustment of the tab push-rod has been disturbed) adjust the tab push-rod until the correct angle is obtained.

Before attempting to set the tabs when a new rudder or elevator has been fitted, it should first be checked that with the indicators in the control cabin set to zero the control runs are rigged so that the tab actuating worm gear is in the mid position. The tab should then be set to the 'old' angle given in the log book, by adjusting the push-rod, and the aircraft test flown under the operating cruise conditions.

Ensure that the engines are synchronised, trim the aircraft to straight and level flight (feet off rudder pedals) and note the readings on the tab position indicators. Each reading will be the difference between the 'old' and the required 'new' setting angle, and should be added to or substracted from the 'old' angle, dependent on the conditions found during flight.

If this 'new' setting angle is outside the limits given in fig. 30, the rigging of the rudder or elevator should be checked, and if necessary, a new rudder or elevator fitted and the test repeated. The tab should then be set to the resultant 'new' angle and the angle recorded in the log book.

46. Elevator Anti-balance Tab -

46.1. The anti-balance tab in the starboard elevator has a maximum range of movement of ± 9 degrees each way and is used to adjust the heaviness of elevator control.

The ratio of movement of this tab to elevator movement is adjustable by means of a wheel control in the rear of the hull. This control is set during test flight and is then locked and sealed.

ON NO ACCOUNT MUST THIS ADJUSTMENT BE TAMPERED WITH UNLESS THE FOLLOWING PROCEDURE IS ADOPTED

46.2. Procedure for Setting Elevator Heaviness.

It is most important that this procedure is closely followed, since maladjustment of the elevator may leave the control dangerously light with consequent danger of over-stressing the structure and of control over-balance should the aircraft fly into ice forming conditions.

A flight test for the purpose of setting the elevator heaviness is necessary in the following circumstances. -

(a) On all new aircraft when tested for issue of certificate of airworthiness.

(b) After any changes or adjustments to components have been made which are likely to affect the elevator characteristics (e.g. changes of tailplane, elevator or tab, skin repairs to tailplane or elevator etc.)

Before flight the elevator anti-balance tab adjustment is to be set to give the maximum tab deflection of ± 9 degrees with full elevator movement. The machine is to be loaded to 61,000 lb. and arrangements are to be made for varying the position of the centre of gravity in the air.

NOTE: A convenient way of doing this is to carry 9 passengers in addition to the flight crew and to vary the position of the centre of gravity by moving them between the forward cabin and the aft freight compartment.

It is essential that the test flight is made by a pilot fully familiar with the characteristics of the type and he must be furnished with a spring balance or other stick force measuring device, arranged so that it can be used to measure the control column load at a height from the floor, level with the axis of the control wheel.

Before the flight, the static friction of the elevator circuit must be checked. This is difficult to assess owing to the controls not being mass balanced. However, the difference between the force required to take up the control to approximately neutral and the force then required to hold it there to be 6 lb. and not greater than 8 lb.

With the aircraft in flight, the elevator anti-balance tab is to be adjusted if necessary to give normal hand loads and so that, in rough air conditions, there is no abnormal fore and aft movement of the control column when it is freed. This test must be made under cruise, climb and approach (flaps out) conditions. If it is not possible to find rough air conditions, the effect of bumps is to be simulated by striking the control columns and observing the subsequent motion with controls free.

The elevator heaviness is then to be measured in three configurations.

(a) Climb at 2400 R.P.M. 47" HG. at 135 Kts. I.A.S.
(b) Cruise at 2400 R.P.M. 30" HG. at 160 Kts. I.A.S.
(c) Glide power off with flaps 1/3 out at 110 Kts. I.A.S.

For each condition, the aircraft is to be carefully set at the desired speed and power at the forward C.G. position of 26% M.A.C. (6.34 inches aft of datum) and the trimmer adjusted so that the control loads are not quite trimmed out leaving a small residual push force. This force is to be measured and recorded. The centre of gravity is then to be moved aft so as to give the aft C.G. position of 32½% M.A.C. (18.59 inches aft of datum) and the stick push force measured when the machine is again steady. During this test the air speed must be constant and the settings of the power and trim controls must not be altered.

This test is then to be repeated for the other configurations prescribed. If necessary, the test may be started at the aft C.G. position, but if this is done the first measurement must be made with a small pull force so that the load on the control column does not reverse during the movement of the loading.

The difference between the readings of the stick force at the two C.G. positions must be at least 13 lb., if the force is less than this, the elevator anti-balance tab must be adjusted to bring the difference between the measured forces up to at least 13 lb.

If there is not sufficient adjustment available on the anti-balance tab, the elevator heaviness may be increased by the addition of lengths of $\frac{1}{4}$" cord, to both upper and lower surfaces of the elevator trailing edge. This should not normally be necessary.

At the conclusion of this test, the setting of the tab gear must be recorded in the aircraft log book together with the amount of cord, if any, attached to the elevator trailing edge, and the adjusted handwheel locked and sealed.

47. Rudder Anti-balance Tab -

Rudder control loads must be left to the discretion of the test pilot and are adjustable through the anti-balance tab for which three ranges of movement i.e. $\pm$ 0° 45', $\pm$ 1°50' and $\pm$ 2°55' are provided by a slotted cam plate. These movements can only be adjusted on the ground and the cam plate should be set to the 2°55' position prior to the initial test flight after a new rudder has been fitted.

There should be no undue lightness of the rudder through its initial movement whilst permitting full rudder to be obtained by footload alone up to speeds of approximately 120 Kts., (indicated) if one or more engines are throttled on either side.

There should be no tendency for the rudder to lock over when the maximum rudder is applied at this speed.

48. Checking Flap Movement. -

Fig. 27 gives details of a suitable rigging board for checking the range of movement of the main plane flaps. With the flaps fully IN, fit the checking board on the trailing edge of the flap and place an inclinometer on the fillet provided. Note the angle and mark the position of the inclinometer on the checking board.

Fully extend the flaps, place the inclinometer in the same position on the checking board fillet as before and again note the angle.

The difference between the readings should be within the limits given in fig. 27.

49. Tensioning Rudder and Elevator Controls -

While tensioning the controls they should be locked in the neutral position by the locking handle (fig. 20) and checks made to ensure that the control surface settings are not disturbed. Adjustment is provided in the fork joints at the ends of each tie-rod in the control runs, and the controls should be tensioned so that the datum hole in the compensator bar is just visible (see detail in fig. 22).

50. Tensioning Rudder and Elevator Trimming Tab Controls -

Turnbuckles are provided in each of the main runs and in the closed circuit driving the port elevator tab-actuating gearbox. With the tabs in the neutral position, the final chain drives should be equalised on either side of the sprockets.

51. Lubrication -

Lubrication points and the positions of gearboxes are given in figs. 12 and 13. The following special points should be noted. -

51.1. All sprockets are fitted with sealed bearings packed with grease during assembly and do not require further lubrication.

51.2. Control pulleys of the fabric-reinforced bakelite type, and those of the Tufnol type do not need lubrication.

51.3. For access to lubrication points reference should be made to figs. 7 and 8.

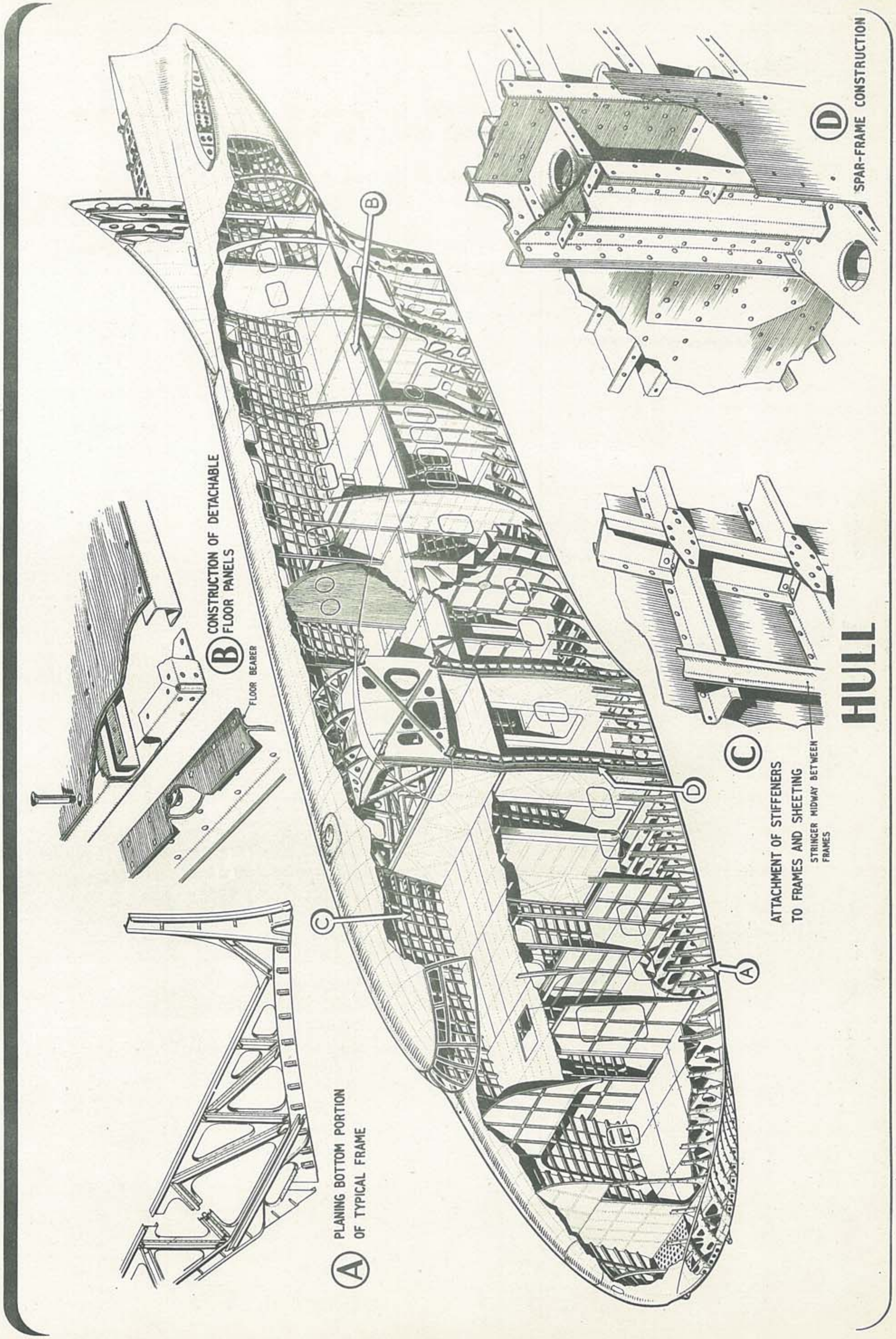
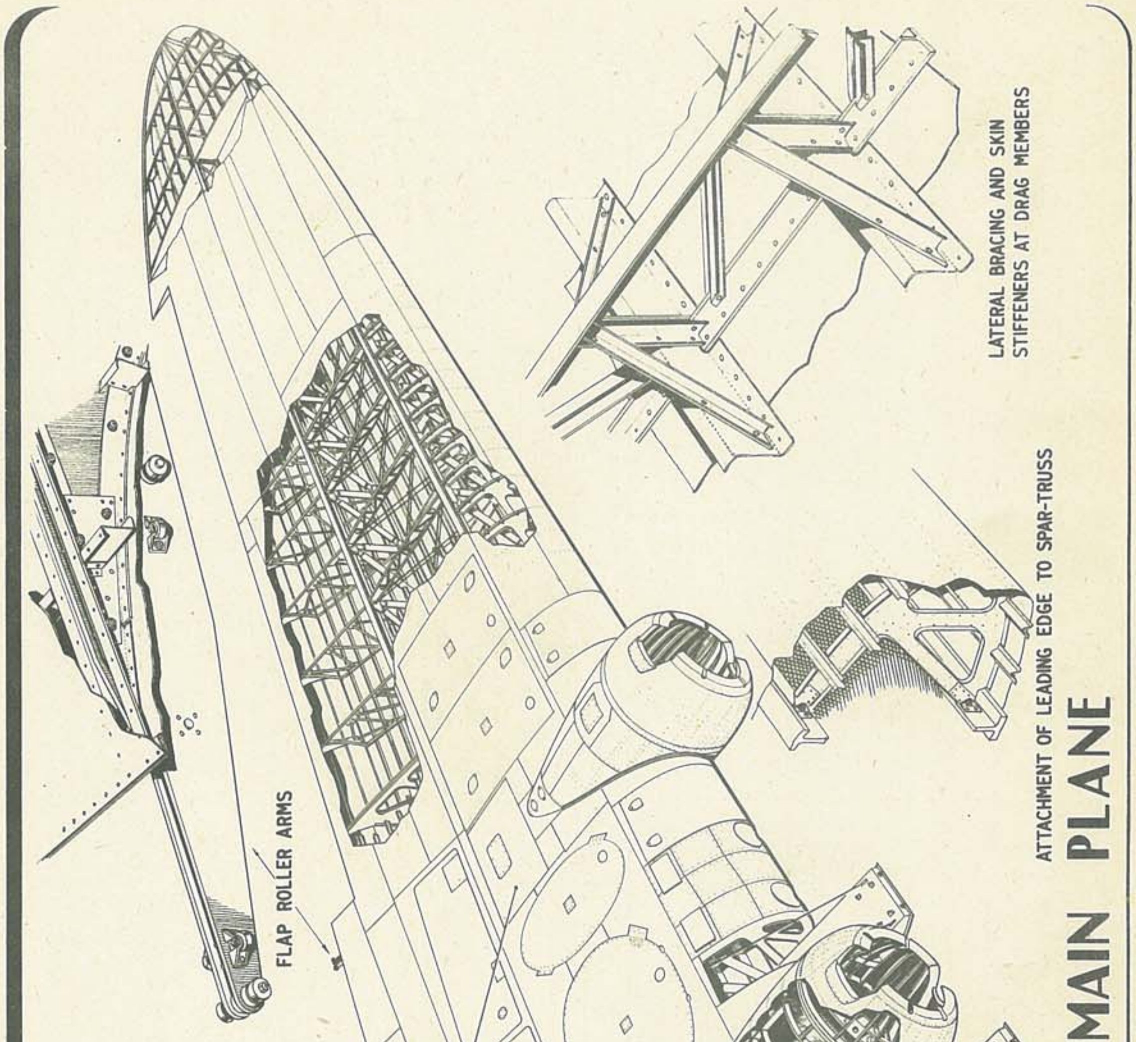

HULL
A PLANING BOTTOM PORTION OF TYPICAL FRAME
B CONSTRUCTION OF DETACHABLE FLOOR PANELS
FLOOR BEARER
C ATTACHMENT OF STIFFENERS TO FRAMES AND SHEETING
STRINGER MIDWAY BETWEEN FRAMES
D SPAR-FRAME CONSTRUCTION

FIG. I



MAIN PLANE

FIG. 2

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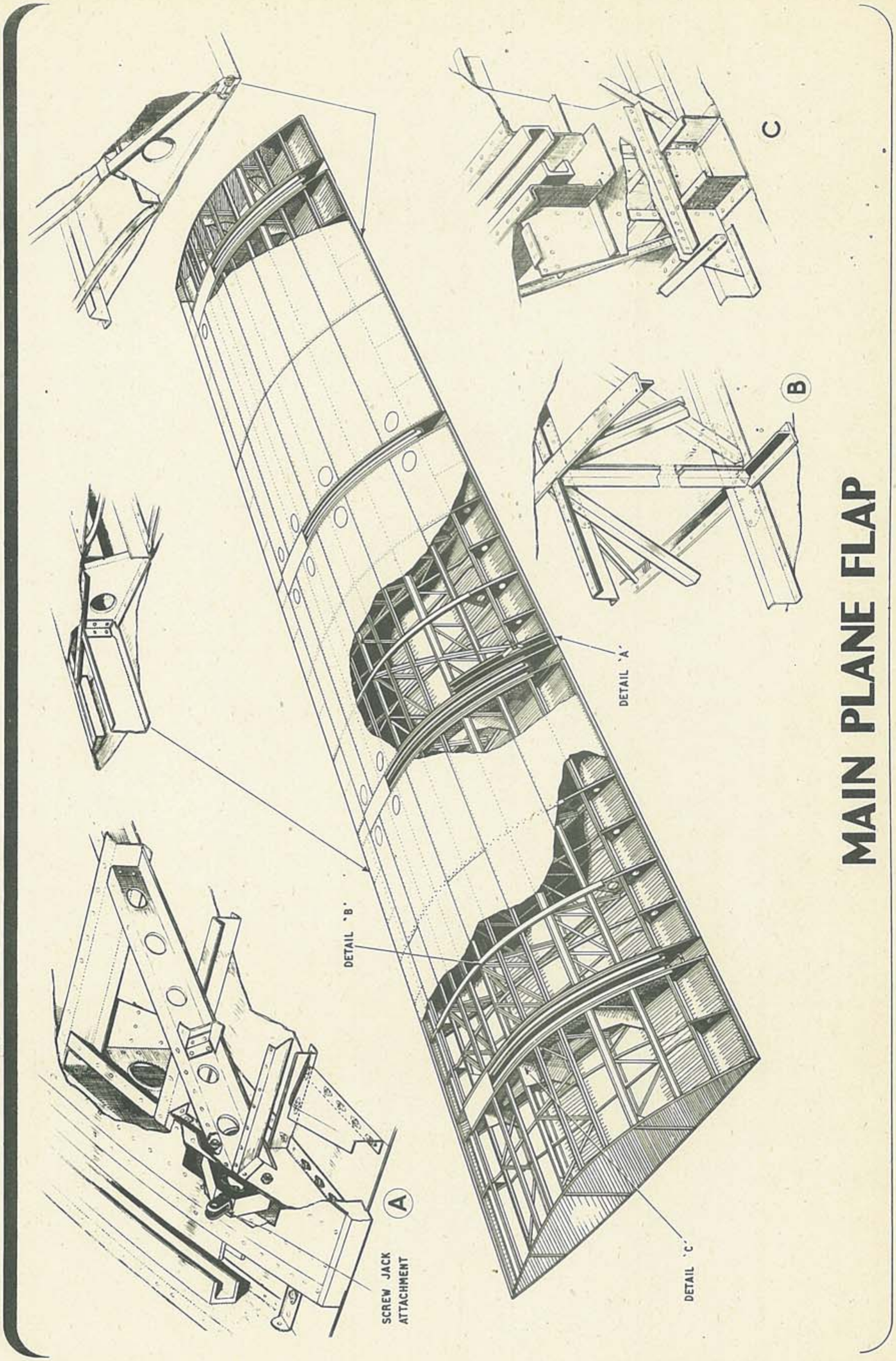

FIG.3

ISSO TP/1067
ISSUE 1 DATE 25/10/46

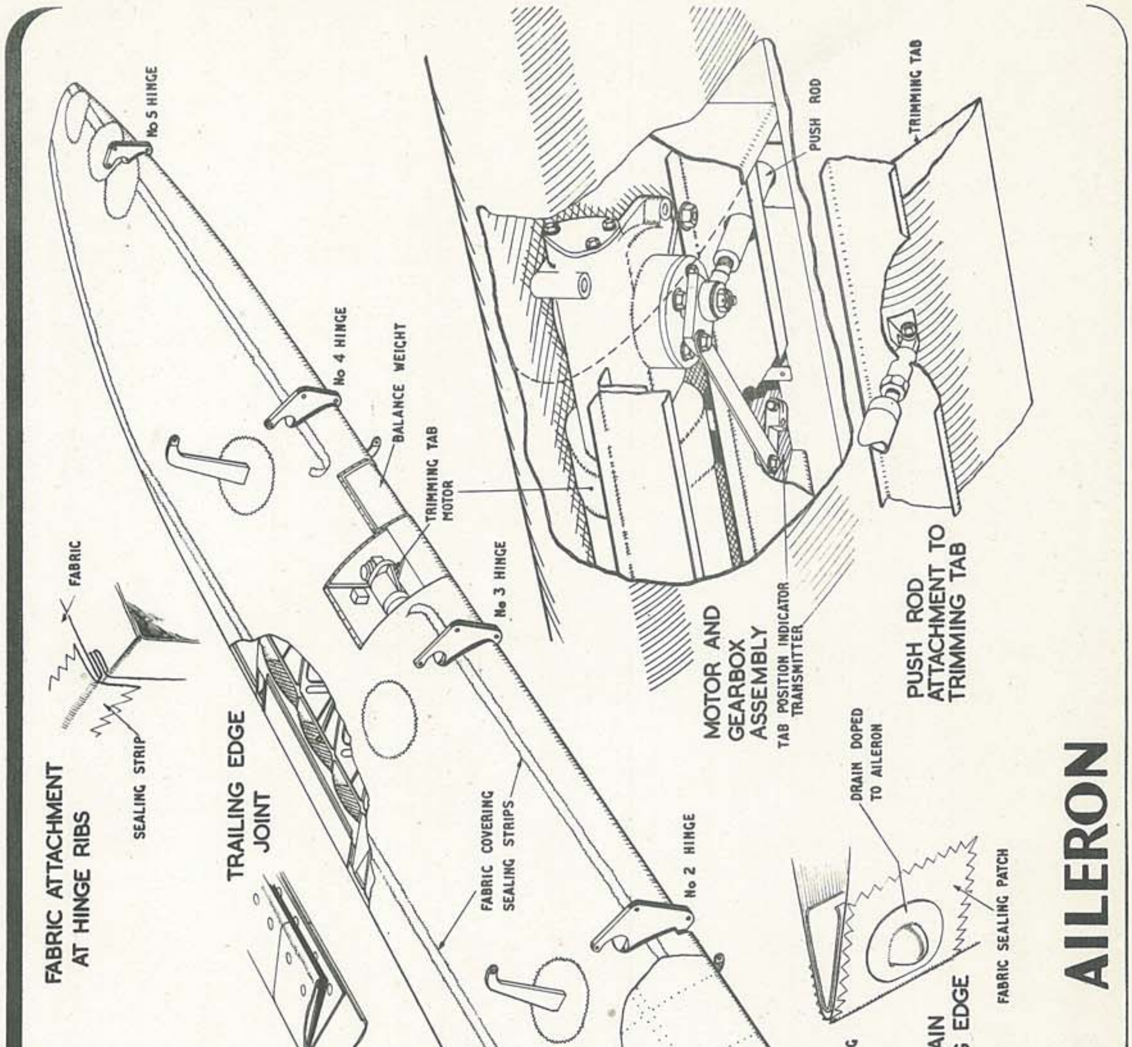

FIG. 4

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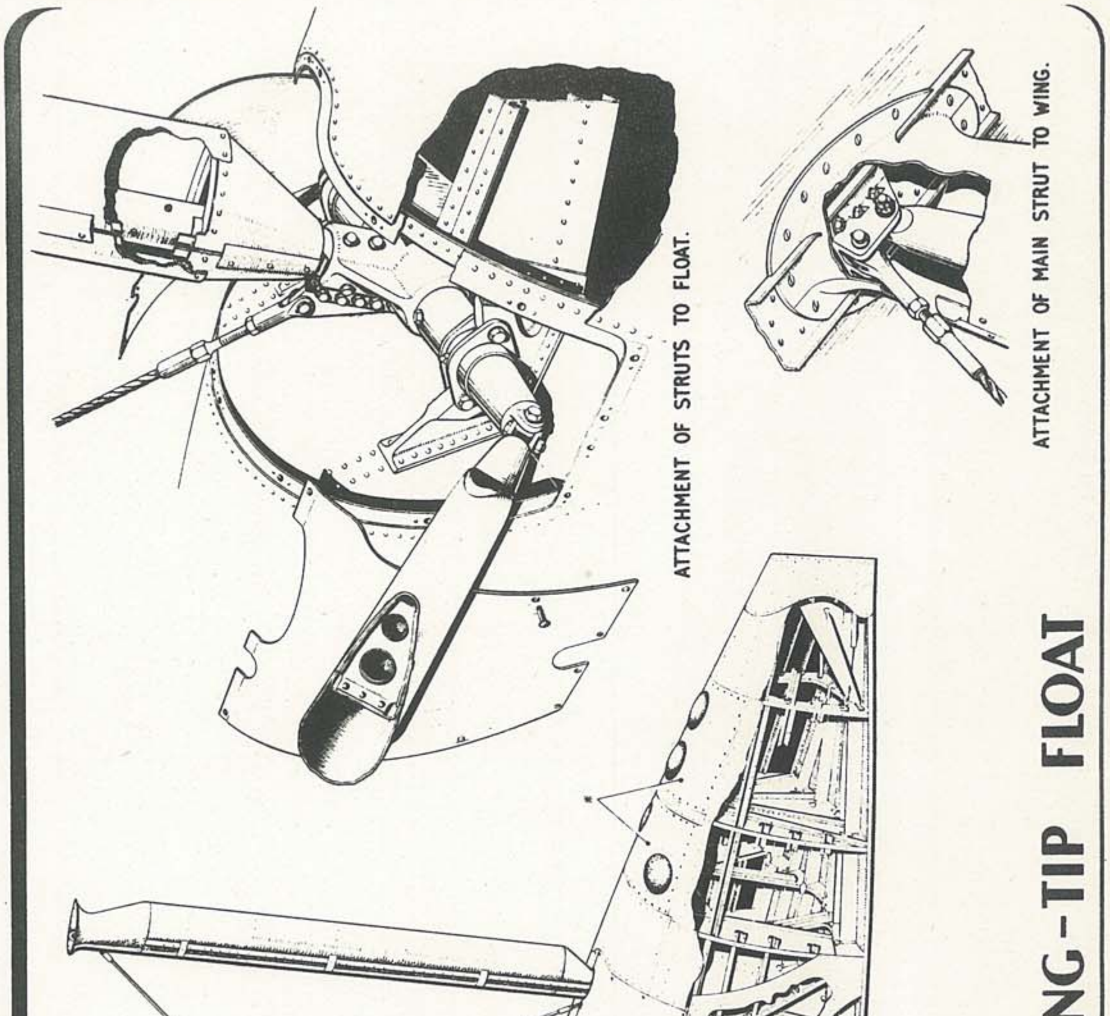
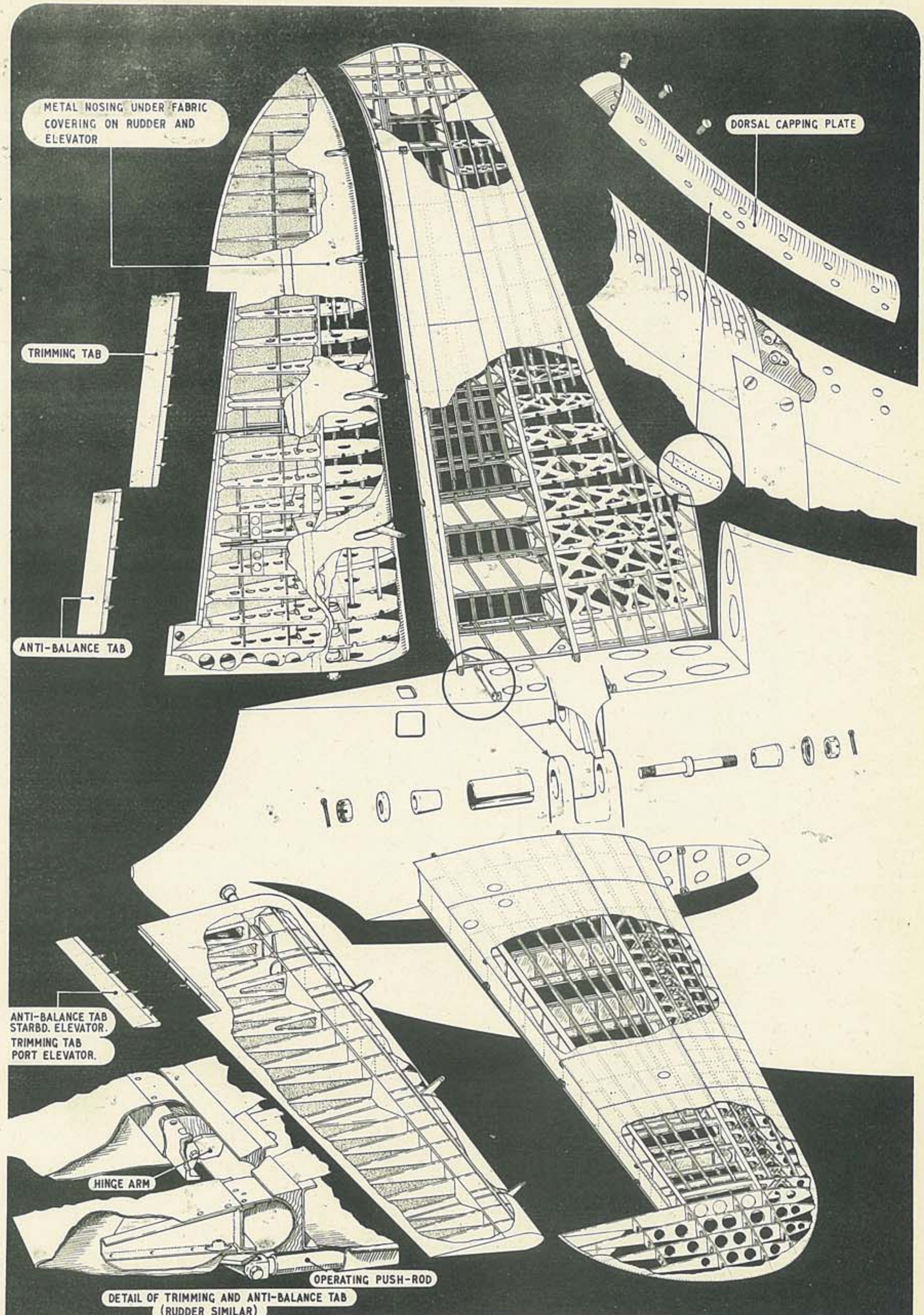

ATTACHMENT OF STRUTS TO FLOAT.
ATTACHMENT OF MAIN STRUT TO WING.
WING-TIP FLOAT
'PRESS-IN' INSPECTION COVER.
DETACHABLE PANELS.*
ATTACHMENT OF DIAGONAL STRUT TO WING.

FIG. 5.



TAIL UNIT

FIG. 6

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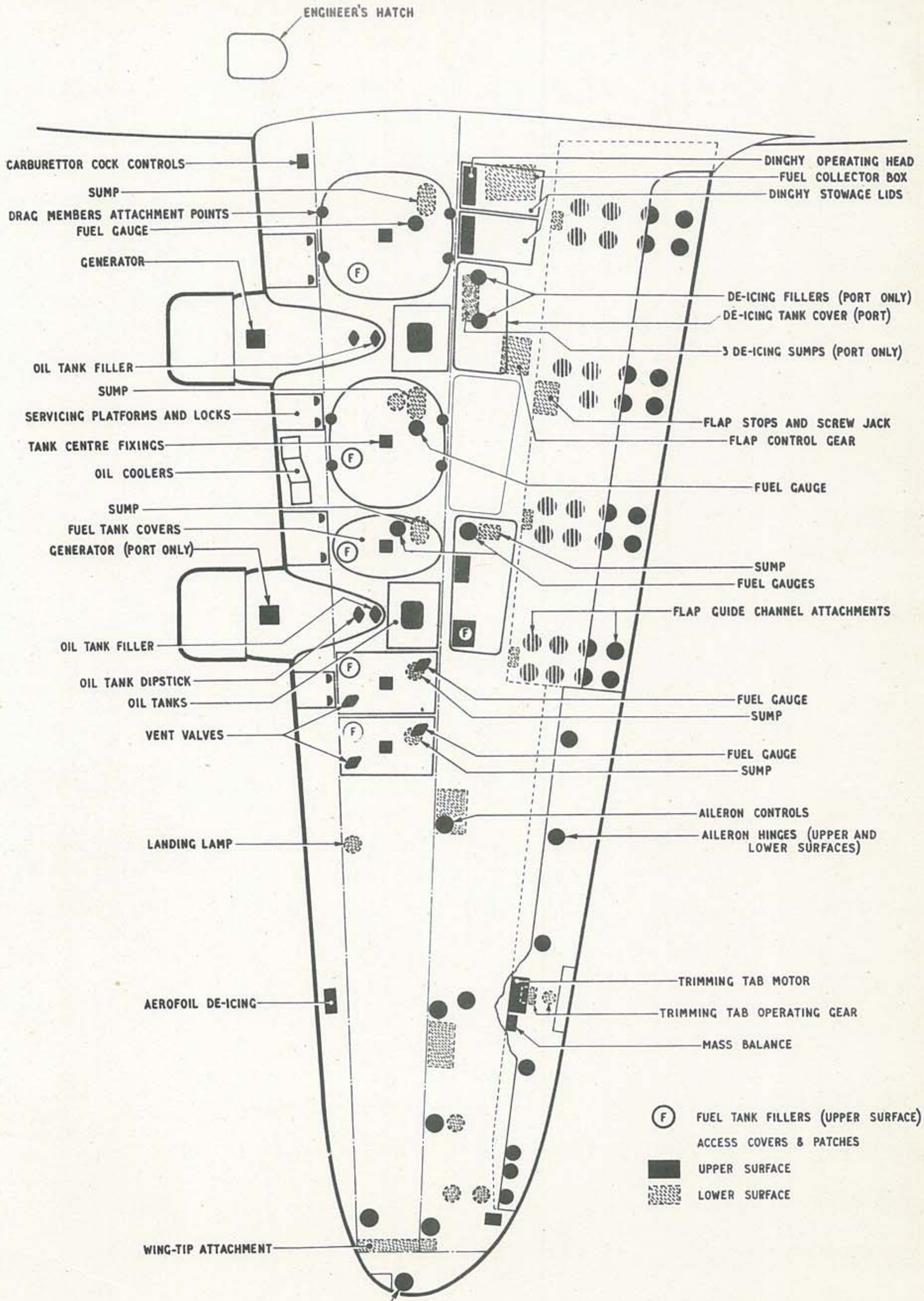
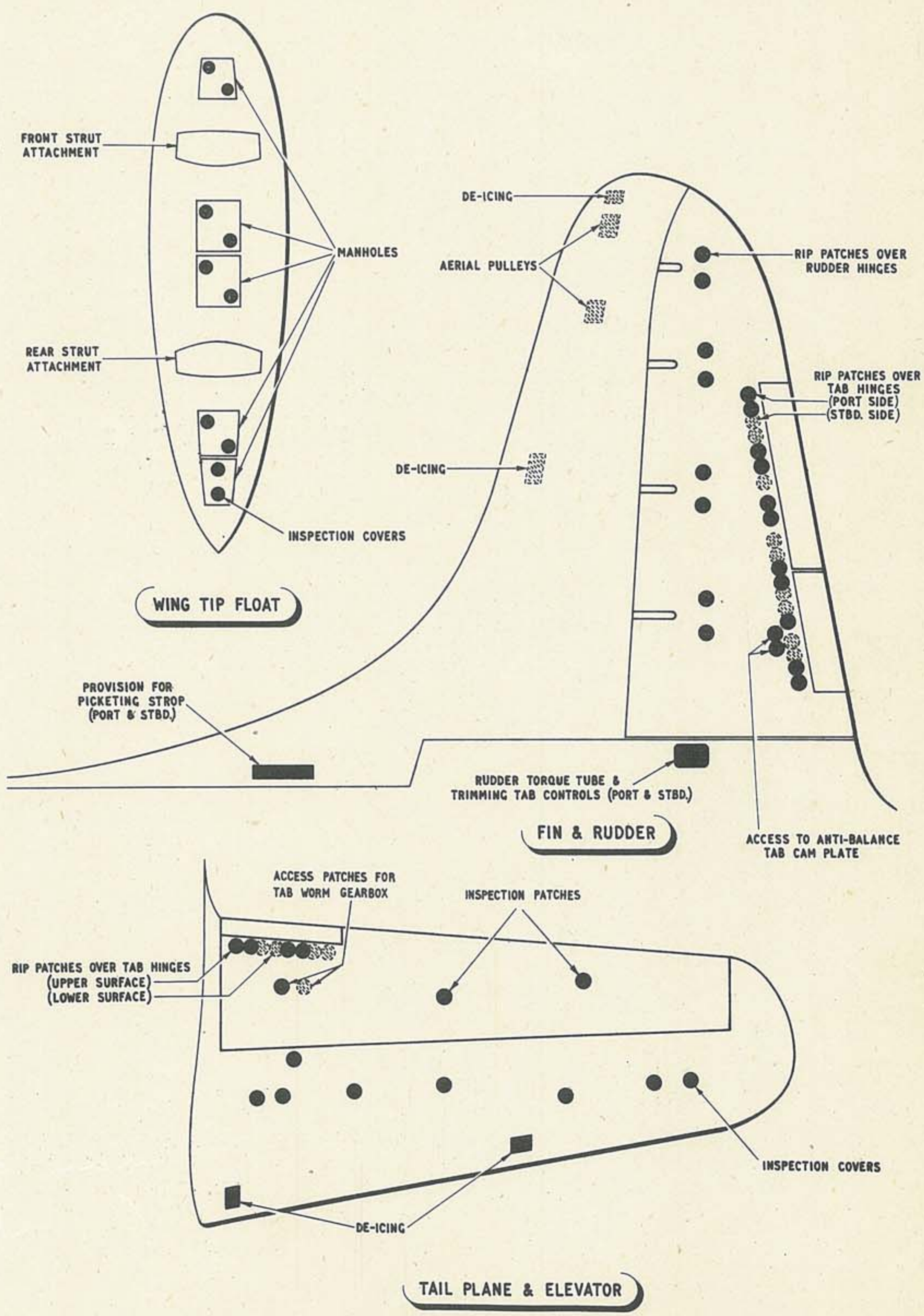


ACCESS PANELS (1)

FIG. 7



ACCESS PANELS (2)

FIG. 8

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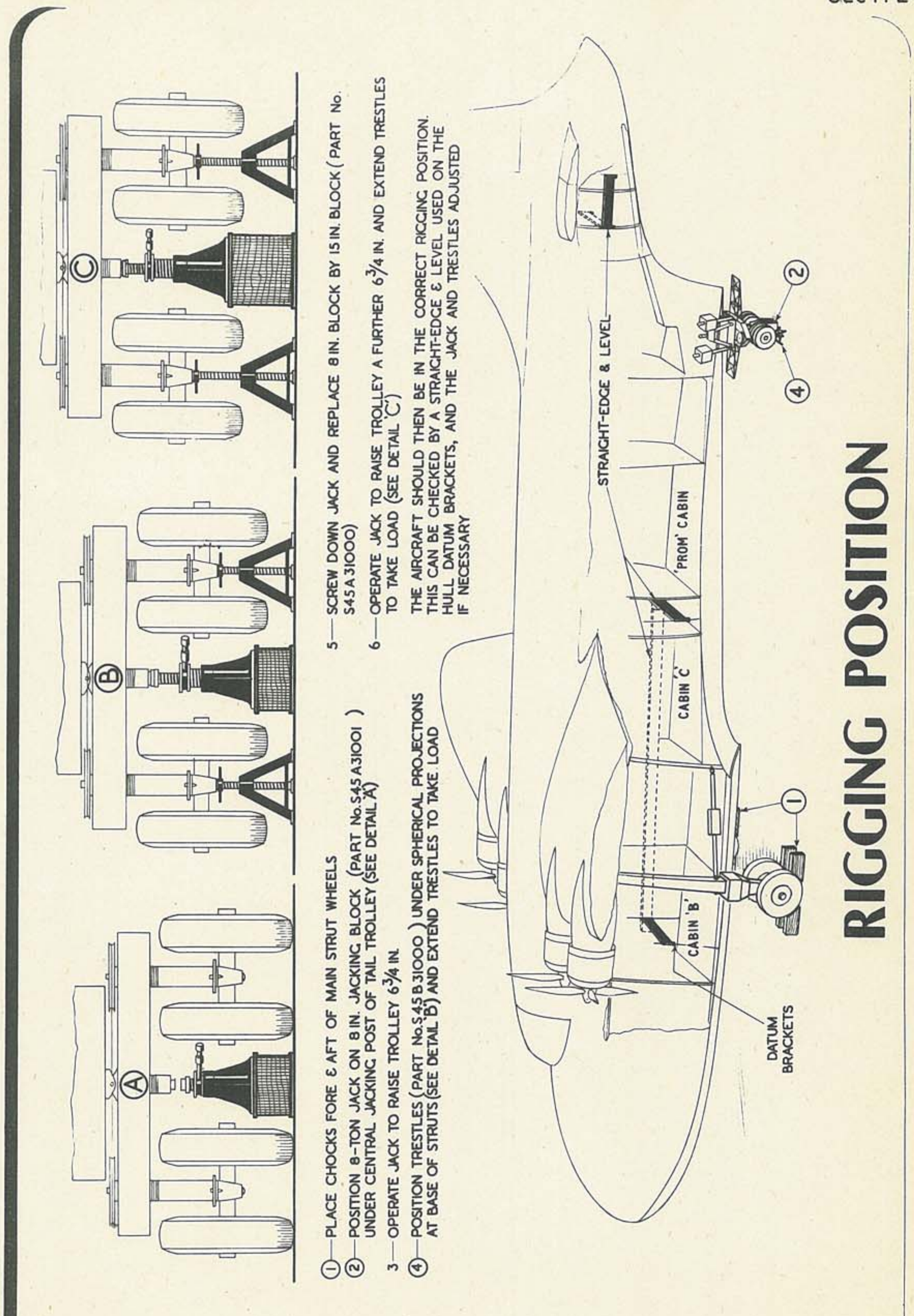
2	MAY 1948



RIGGING POSITION

FIG. 9

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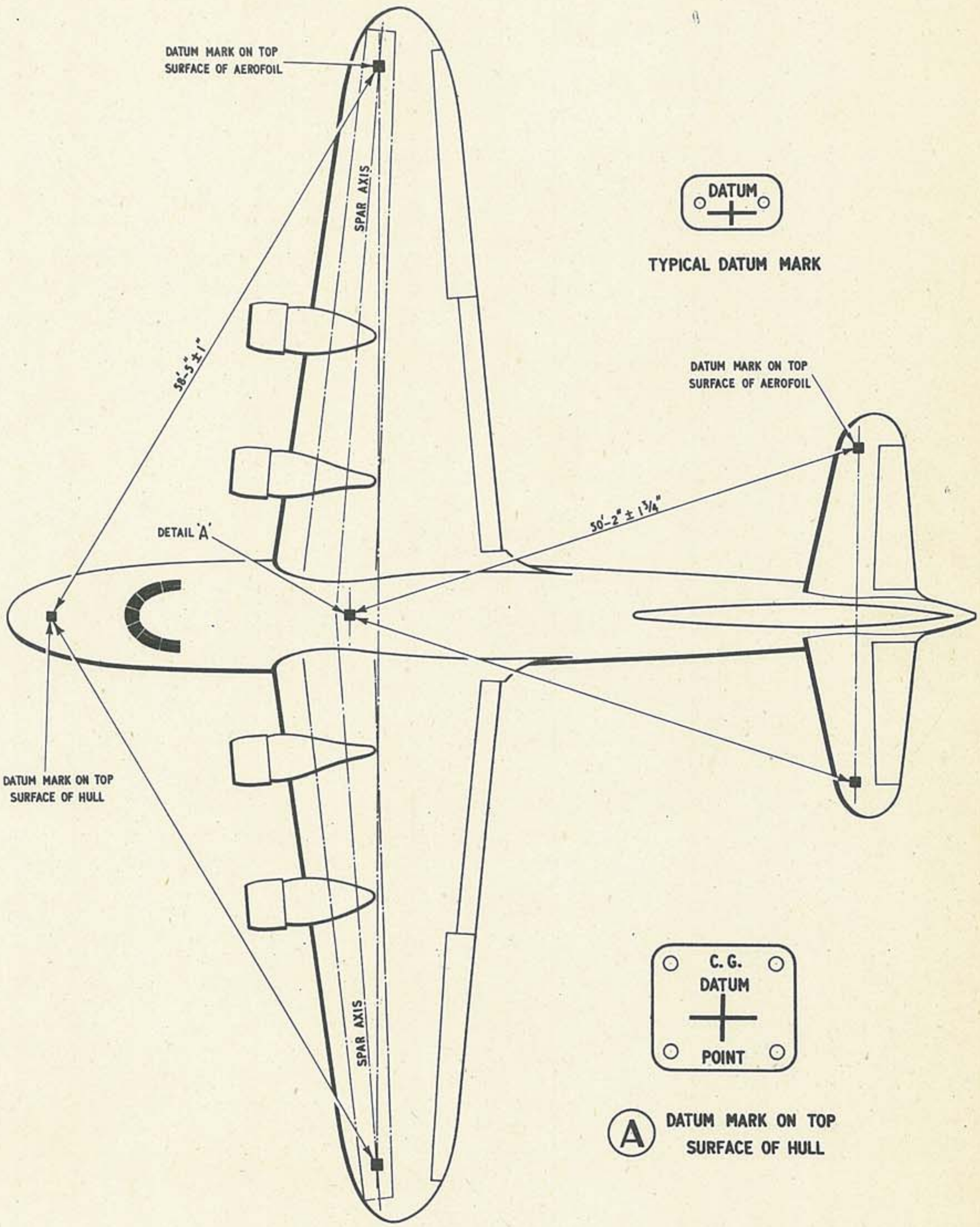
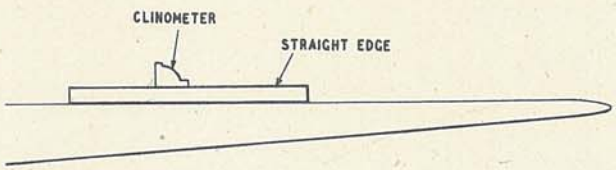
ISSUE	DATE
1	OCT. '47



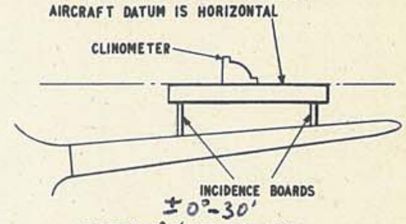
CHECKING SYMMETRY

FIG. 10

A

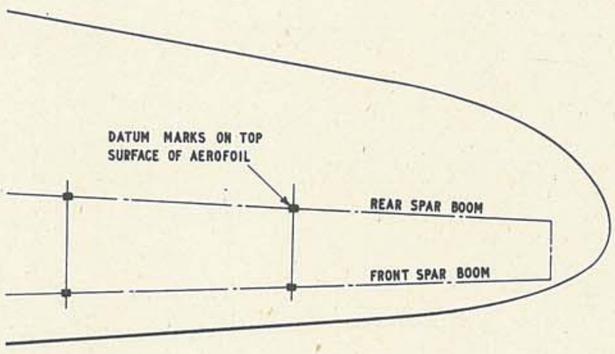


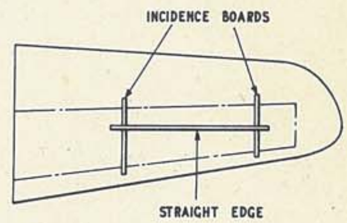
DIHEDRAL 0° 50' ± 30' MEASURED ALONG TOP FRONT SPAR (15% ORDINATE)

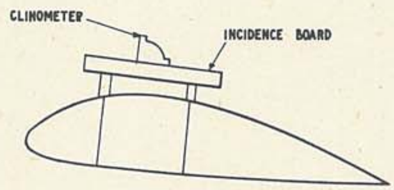


DIHEDRAL 4° 15' ± 0°-30' MEASURED ALONG FRONT SPAR-BOOM

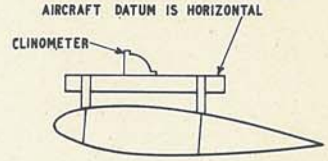
A.L.2





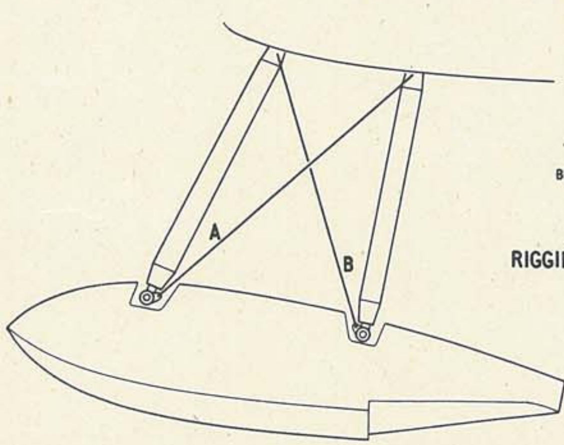


MAIN PLANE SETTING 5° ± 15'



TAIL PLANE INCIDENCE 4° ± 15'

FOR PART NUMBERS OF INCIDENCE BOARDS SEE SECT. 13



CABLE LENGTHS BETWEEN PIN CENTRES { A. 105·874" B. 86·431"

RIGGING OF WING-TIP FLOAT MAIN STRUTS.

CHECKING AEROFOILS

FIG. 11

Key to LUBRICATION POINTS - HULL

1. Rudder bars
2. Control column hand wheel bearing
3. Seat operating gear
4. Elevator control intermediate levers
5. Aileron control torque-tube
6. Engine master fuel cock levers
7. Trimming tab control box and control pulleys
8. Mooring hatch hinges and catches
9. Tail mooring release hook operating lever
10. Navigator's seat
11. Roof hatch hinges and catches
12. Control pulleys
13. Control cable drums
14. Control levers at engineer's station
15. Aileron control right-angle drive
16. Flap motor gearbox and limit switch gear
17. Porthole hinges and fasteners
18. Escape hatch locking mechanism
19. Rudder trimming tab gearbox
20. Rudder anti-balance tab operating gear
21. Rudder anti-balance tab hinges
22. Rudder trimming tab lever hinges
23. Rudder trimming tab hinges
24. Rudder hinges
25. Aerial tensioning cable pulley
26. Elevator anti-balance tab hand wheel and indicator bearings.
27. Elevator anti-balance tab lever bearings
28. Elevator anti-balance tab gearbox
29. Mooring bollard hinge and operating gear
30. Drogue eyes
31. Anchor shackles and eyes
32. Windscreen wipers
33. Forward entrance door hinges and clamps
34. Aerial winch
35. Beaching gear attachment lugs
36. Sliding door rollers and catches
37. Beaching gear outrigger strut attachment lug
38. Aft entrance door hinges and clamps
39. Loading hatch hinges and clamps
40. Aerial tensioning winch
41. Tail mooring release hook gear
42. Elevator trimming tab driving sprocket
43. Elevator trimming tab gearbox
44. Elevator hinges
45. Elevator trimming tab push-rod bearings
46. Elevator trimming tab hinges
47. Aerofoil de-icing pump gearbox

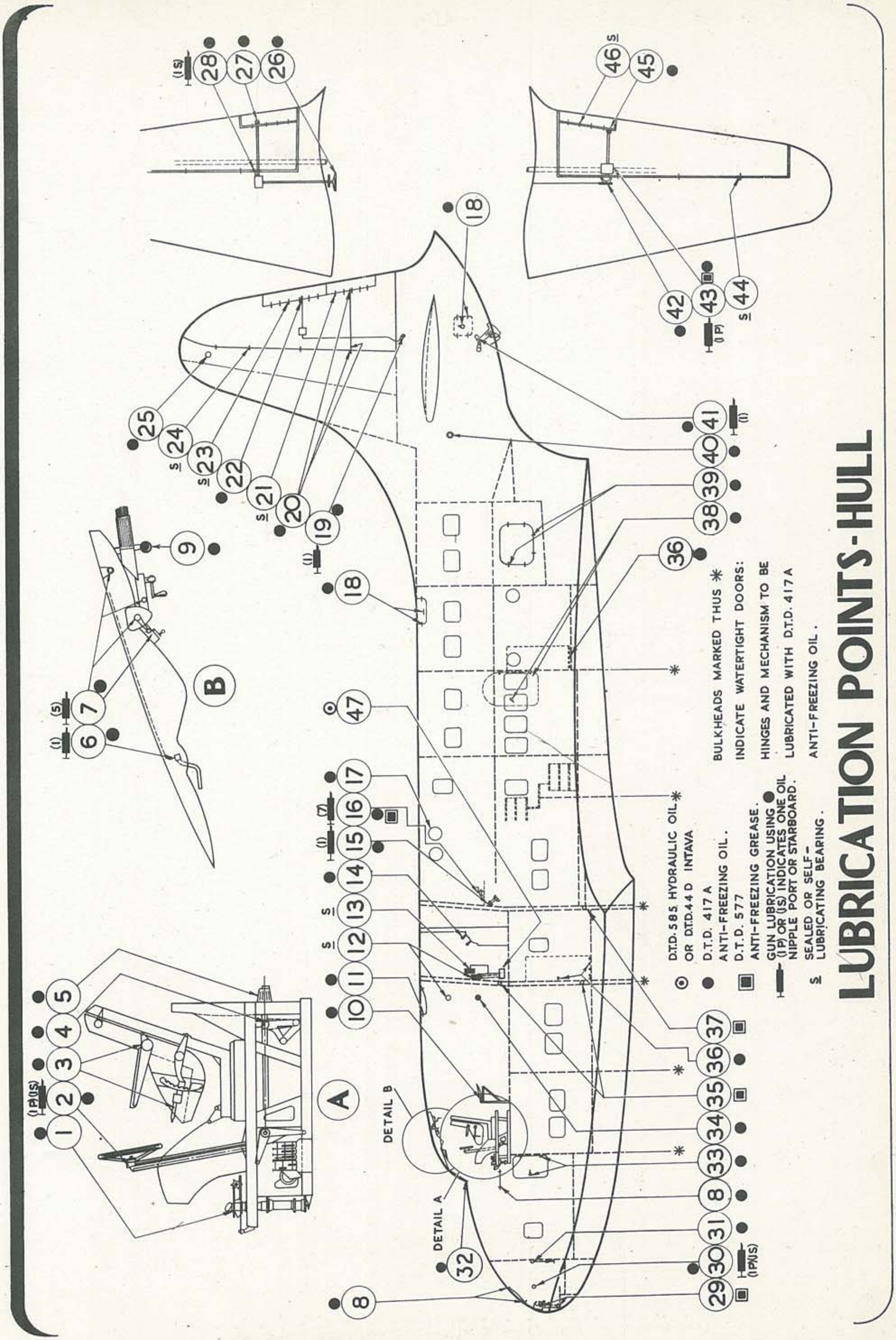

LUBRICATION POINTS-HULL
DETAIL A
DETAIL B
A
B
D.T.D. 585 HYDRAULIC OIL OR D.T.D. 44 D INTAVA
D.T.D. 417 A ANTI-FREEZING OIL.
D.T.D. 577 ANTI-FREEZING GREASE.
GUN LUBRICATION USING (1P) OR (1S) INDICATES ONE OIL NIPPLE PORT OR STARBOARD.
S SEALED OR SELF-LUBRICATING BEARING.
BULKHEADS MARKED THUS * INDICATE WATERTIGHT DOORS: HINGES AND MECHANISM TO BE LUBRICATED WITH D.T.D. 417 A ANTI-FREEZING OIL.

FIG. 12

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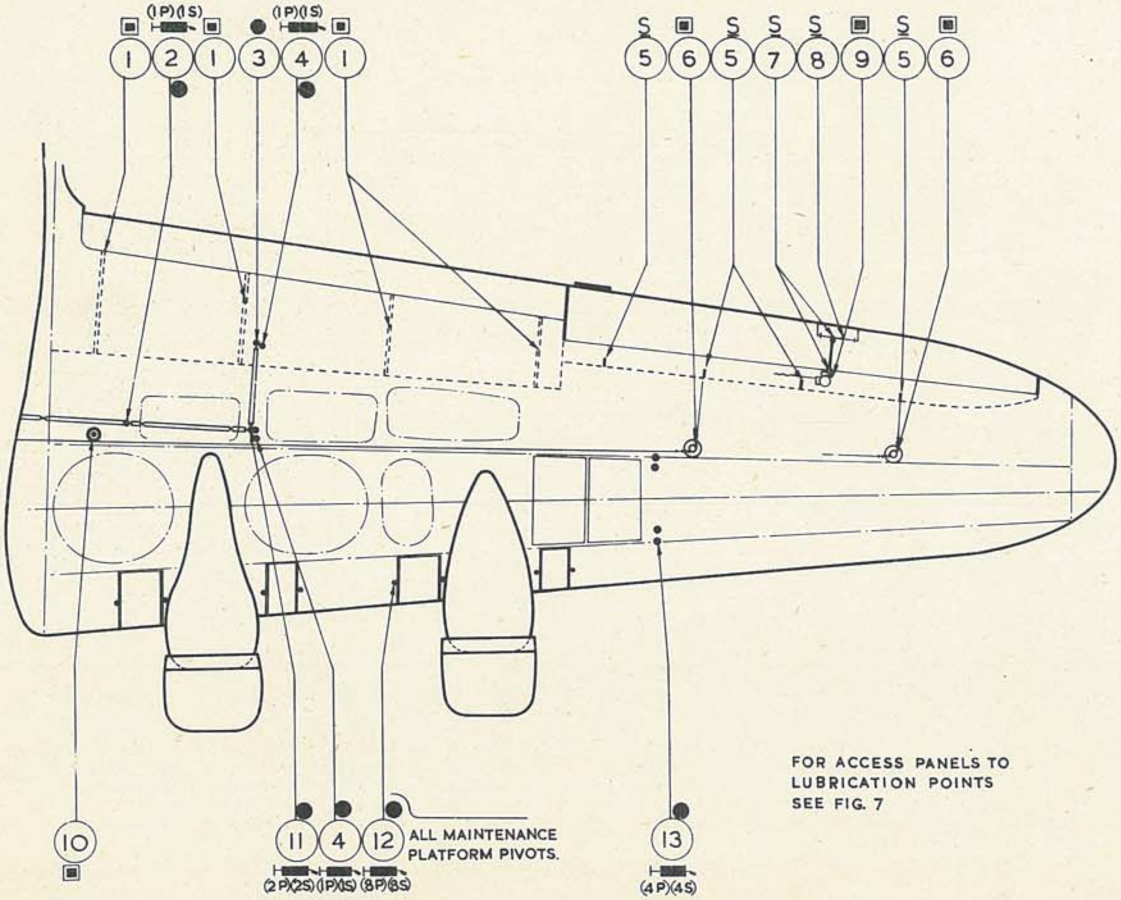


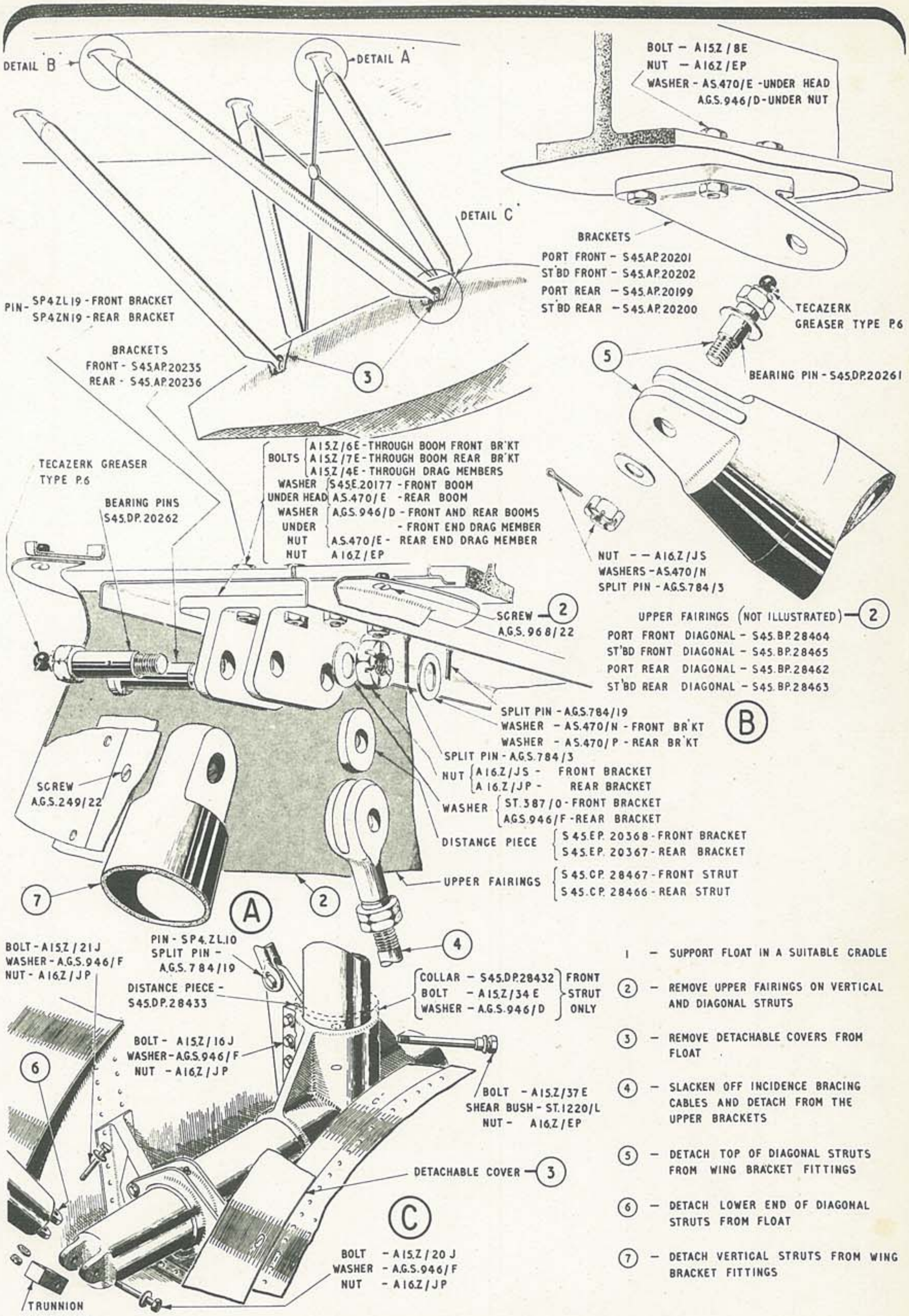
● ANTI-FREEZING OIL. D.T.D. 417A.
■ ANTI-FREEZING GREASE. D.T.D. 577.
S SEALED OR SELF-LUBRICATING BEARING.
GUN LUBRICATION USING ● (1P) OR (1S) INDICATES ONE OIL NIPPLE PORT OR STARBOARD.

KEY TO LUBRICATION POINTS.

1 FLAP ROLLERS AND GUIDES.
2 FLAP CONTROLS.
3 ANCHORAGE EYE-BOLT (UNDER HEAD).
4 FLAP OPERATING SCREW ATTACHMENTS.
5 AILERON HINGES.
6 AILERON CONTROL CHAINS.
7 TRIMMING TAB PUSH-ROD BEARINGS.
8 TRIMMING TAB BEARINGS.
9 TRIMMING TAB OPERATING LINK BEARING.
10 AILERON CONTROL TENSIONER.
11 GEAR BOX AND JACK SCREWS.
12 MAINTENANCE PLATFORM PIVOTS.
13 WING TIP STRUT AND INCIDENCE BRACING WIRE ATTACHMENTS.

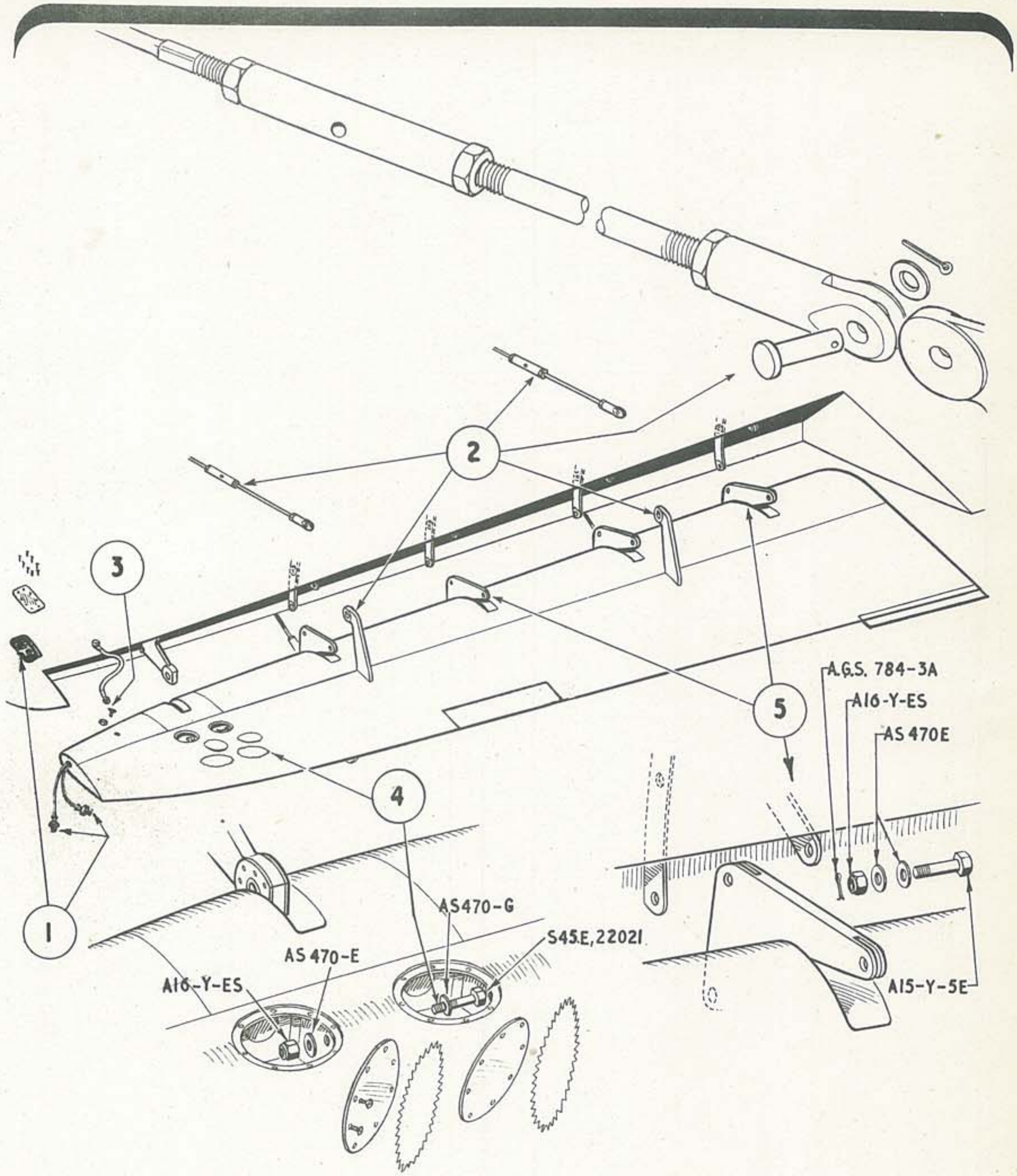
LUBRICATION POINTS - MAIN PLANE

FIG. 13



WING-TIP FLOAT REMOVAL

FIG. 14



(1) REMOVE ACCESS COVER AND UNSCREW BULKHEAD PLUGS.

(2) LOOSEN LOCKNUT, SLACKEN OFF ADJUSTER BARRELS AND DISCONNECT CONTROLS FROM LEVERS

(3) DISCONNECT BONDING WIRE

(4) REMOVE FABRIC PATCHES AND ACCESS COVERS, AND TAKE OUT HINGE BOLT

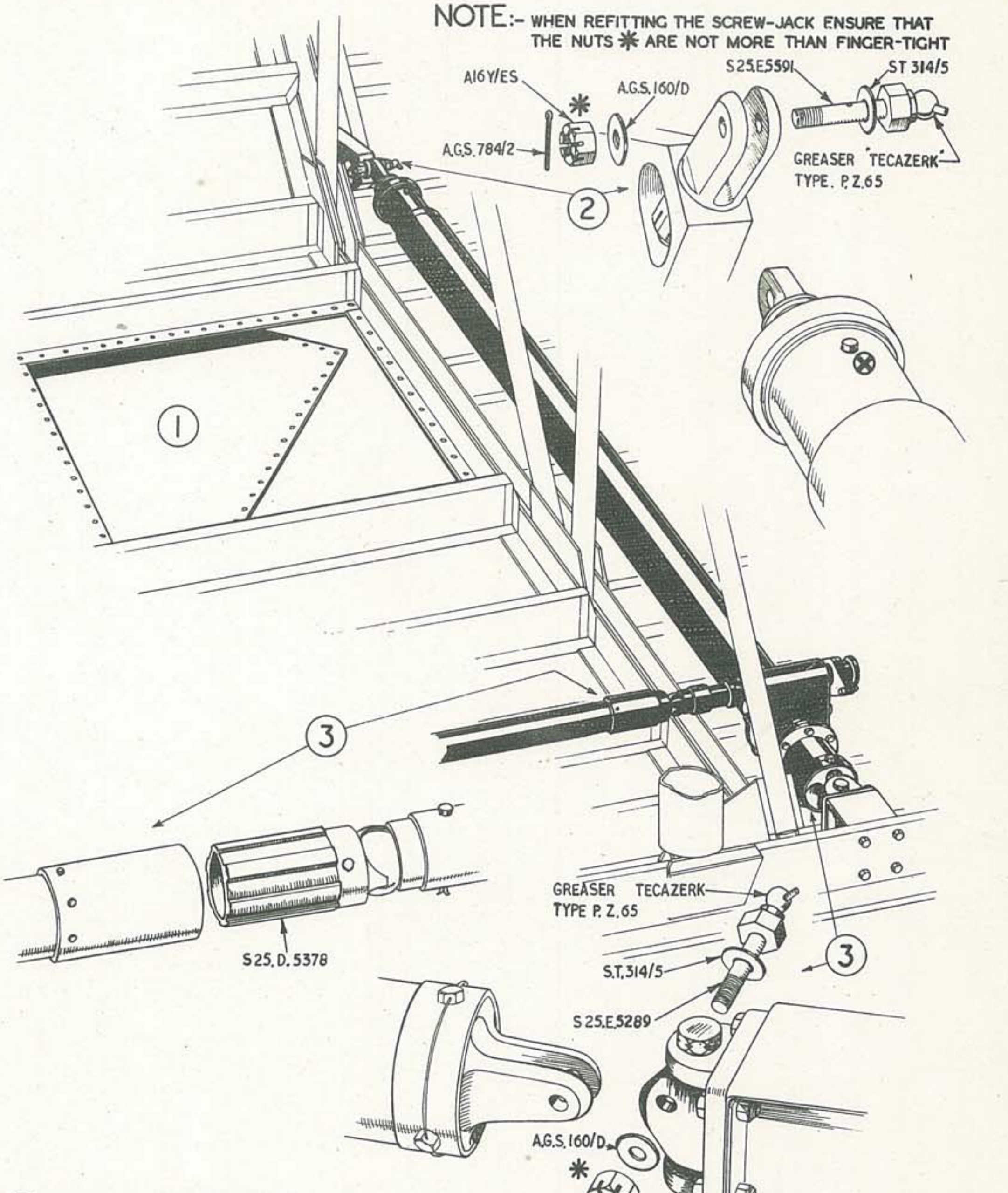
(5) REMOVE BOLTS FROM REMAINING HINGE ARMS

6 REMOVE AILERON; DRAWING BULKHEAD PLUGS ONE AT A TIME THROUGH CABLE GROMMET HOLE.

AILERON REMOVAL

FIG. 15

NOTE:- WHEN REFITTING THE SCREW-JACK ENSURE THAT THE NUTS ✱ ARE NOT MORE THAN FINGER-TIGHT



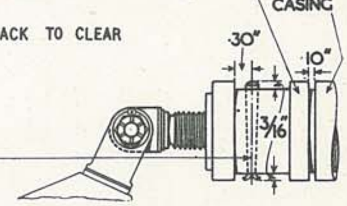
① — REMOVE ACCESS PANEL FROM MAIN PLANE UNDERSURFACE.

② — REMOVE BOLT FROM JACK ATTACHMENT FITTING ON FLAP.

③ — REMOVE BOLT FROM JACK ANCHORAGE FITTING ON REAR SPAR, LIFT SCREW-JACK TO CLEAR ATTACHMENTS AND EASE OUTBOARD TO DISENGAGE FROM TORQUE-TUBE.

4 — REMOVE THROUGH ACCESS PANEL.

NOTE:- WHEN A NEW SCREW-JACK IS FITTED, THE TAPER PIN ⊗ MUST BE POSITIONED THUS



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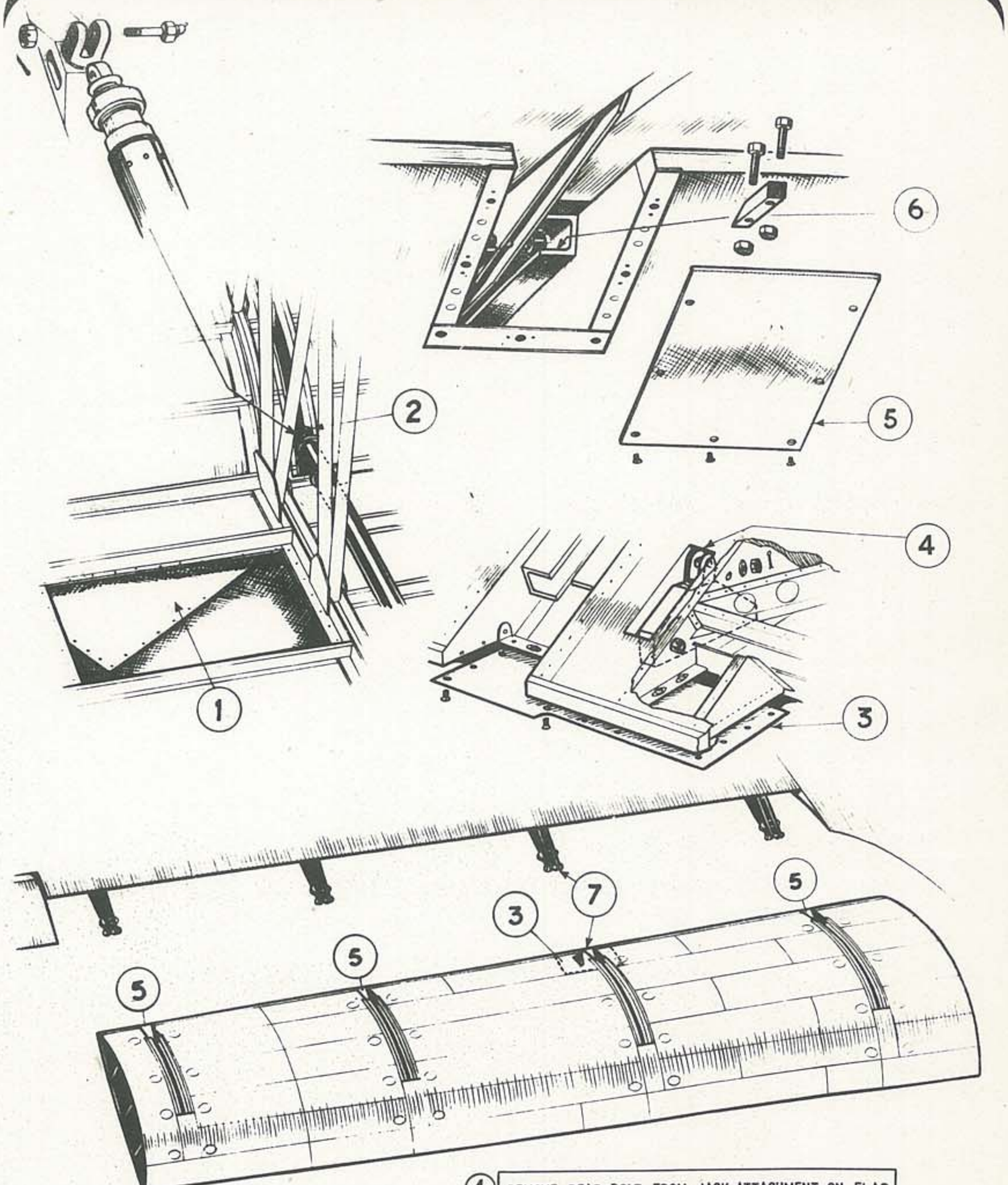
FLAP SCREW-JACK REMOVAL

FIG. 16



④ REMOVE REAR BOLT FROM JACK ATTACHMENT ON FLAP, SLACKEN OFF FRONT BOLT, THEN PUSH FITTING DOWN INTO FLAP TO CLEAR MAIN PLANE SHEETING

THIS IS IMPORTANT

① REMOVE DETACHABLE PANEL IN MAIN PLANE UNDERSURFACE

② DISCONNECT OPERATING SCREW-JACK FROM FLAP

③ REMOVE ACCESS COVER FROM FLAP LEADING EDGE

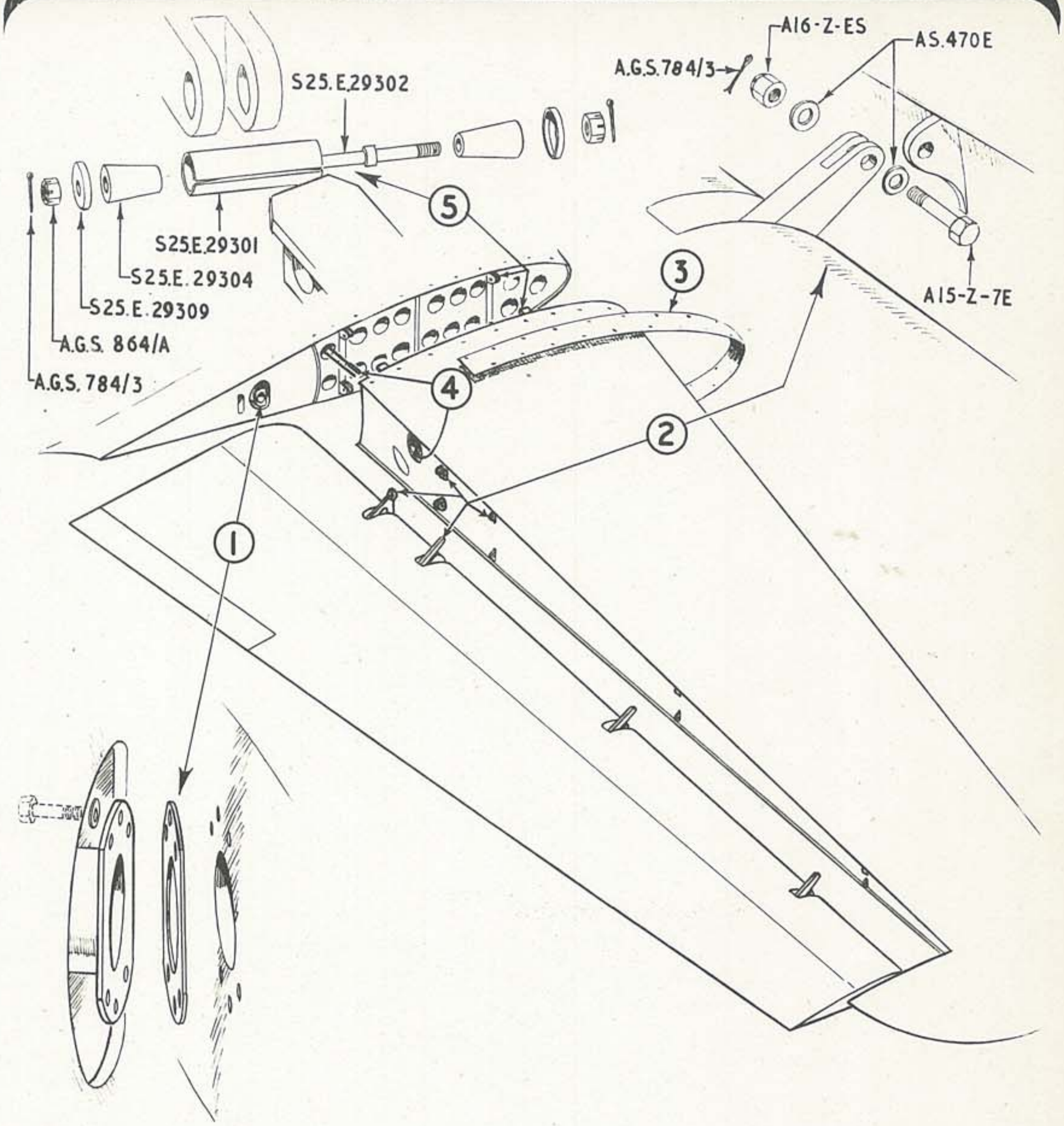
⑤ REMOVE ACCESS COVERS AT FLAP LEADING EDGE

⑥ REMOVE STOPS FROM ROLLER CHANNELS

⑦ ROLL FLAP OFF SUPPORT ARMS

FLAP REMOVAL

FIG. 17



ELEVATOR

(1)—REMOVE THE BOLTS, WASHERS AND PACKING FROM THE TORQUE-TUBE COUPLING

(2)—REMOVE THE NUTS, WASHERS AND BOLTS FROM THE HINGES AND ANTI-BALANCE TAB LEVER (STBD. ELEVATOR), AND EASE THE ELEVATOR CLEAR.

TAIL PLANE

(3)— REMOVE SECURING SCREWS OF METAL STRIP AT THE BASE

(4)— REMOVE THE FABRIC RING IN THE CLOSING PLATE, UNSCREW TO DISCONNECT THE TURNBUCKLE, AND DISCONNECT THE OTHER END OF THE TRIMMING TAB CONTROL CHAIN; TIE THE ENDS TO THE ADJACENT STRUCTURE (PORT) TAIL PLANE.

(5)— AT THE ATTACHMENT POINTS REMOVE THE NUTS AND RETAINING WASHERS; TAP THE SPINDLE TO FREE THE CONICAL BUSHES, AND REMOVE THE CONICAL BUSHES, SPINDLE, AND SPLIT BUSH

ELEVATOR & TAIL PLANE REMOVAL

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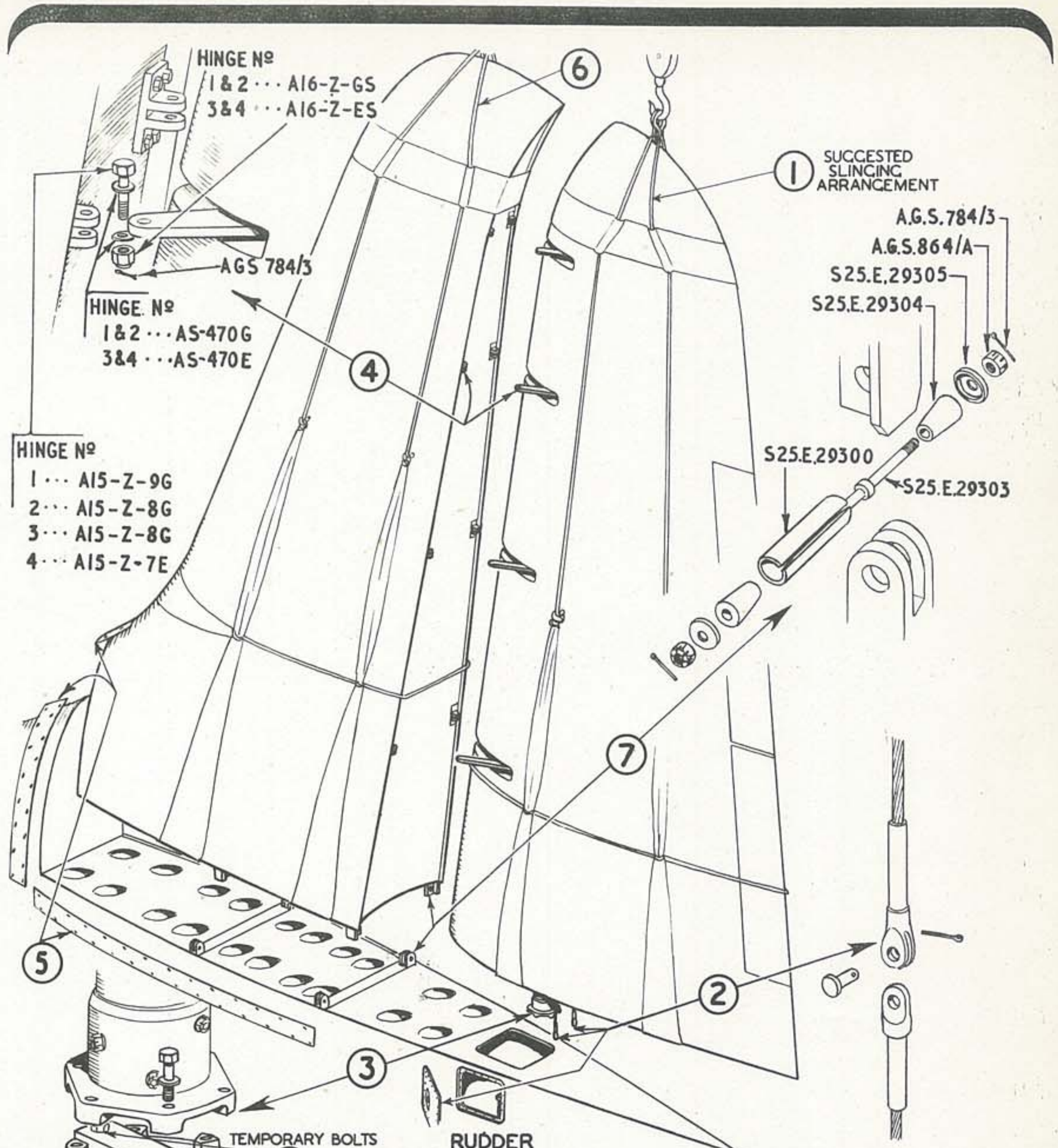

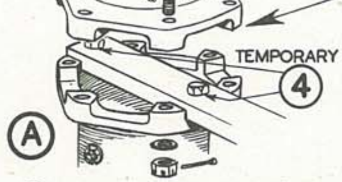

RUDDER

1 — FIT THE SLING

2 — TAKE OUT THE SCREWS AND REMOVE THE SERVICING PANEL, THEN DISCONNECT THE TRIMMING TAB CABLES AND TIE THE ENDS TO THE RUDDER TORQUE-TUBE

3 — REMOVE THE NUTS, WASHERS & BOLTS FROM THE TORQUE-TUBE COUPLING

4 — REMOVE THE NUTS, WASHERS & BOLTS FROM THE HINGES, AND EASE THE RUDDER CLEAR; INSERT TEMPORARY BOLTS THROUGH THE HINGE ARM AND THE COUPLING ON THE TORQUE-TUBE EXTENSION (SEE DETAIL 'A')

FIN

5 — REMOVE SECURING SCREWS OF THE BUTT-PLATE, AND METAL STRIPS AT DORSAL RIB AND BASE

6 — FIT THE SLING - SIMILAR TO THE RUDDER SLING

7 — AT THE ATTACHMENT POINTS, REMOVE THE NUTS & RETAINING WASHERS; TAP THE SPINDLE TO FREE THE CONICAL BUSHES, AND REMOVE THE CONICAL BUSHES, SPINDLE AND SPLIT BUSH

NOTE:- REPLACEMENT OF RUDDER

(i) REMOVE FLANGED COUPLING FROM TORQUE-TUBE OF OLD RUDDER

(ii) SLIDE COUPLING OVER TORQUE-TUBE ON NEW RUDDER, LIFT RUDDER INTO POSITION AND TEMPORARILY INSERT BOLTS IN HINGES AND COUPLING

(iii) FIT LOCKING HANDLE IN CONTROL RUNS (SECT. 2, FIG. 20), SUITABLY CLAMP RUDDER TRAILING EDGE TO FIN STUB, AND MARK POSITION OF TAPER PINS ON TORQUE TUBE

(iv) REMOVE RUDDER, DRILL TORQUE-TUBE, FIT COUPLING AND REPLACE RUDDER

RUDDER AND FIN REMOVAL

FIG. 19

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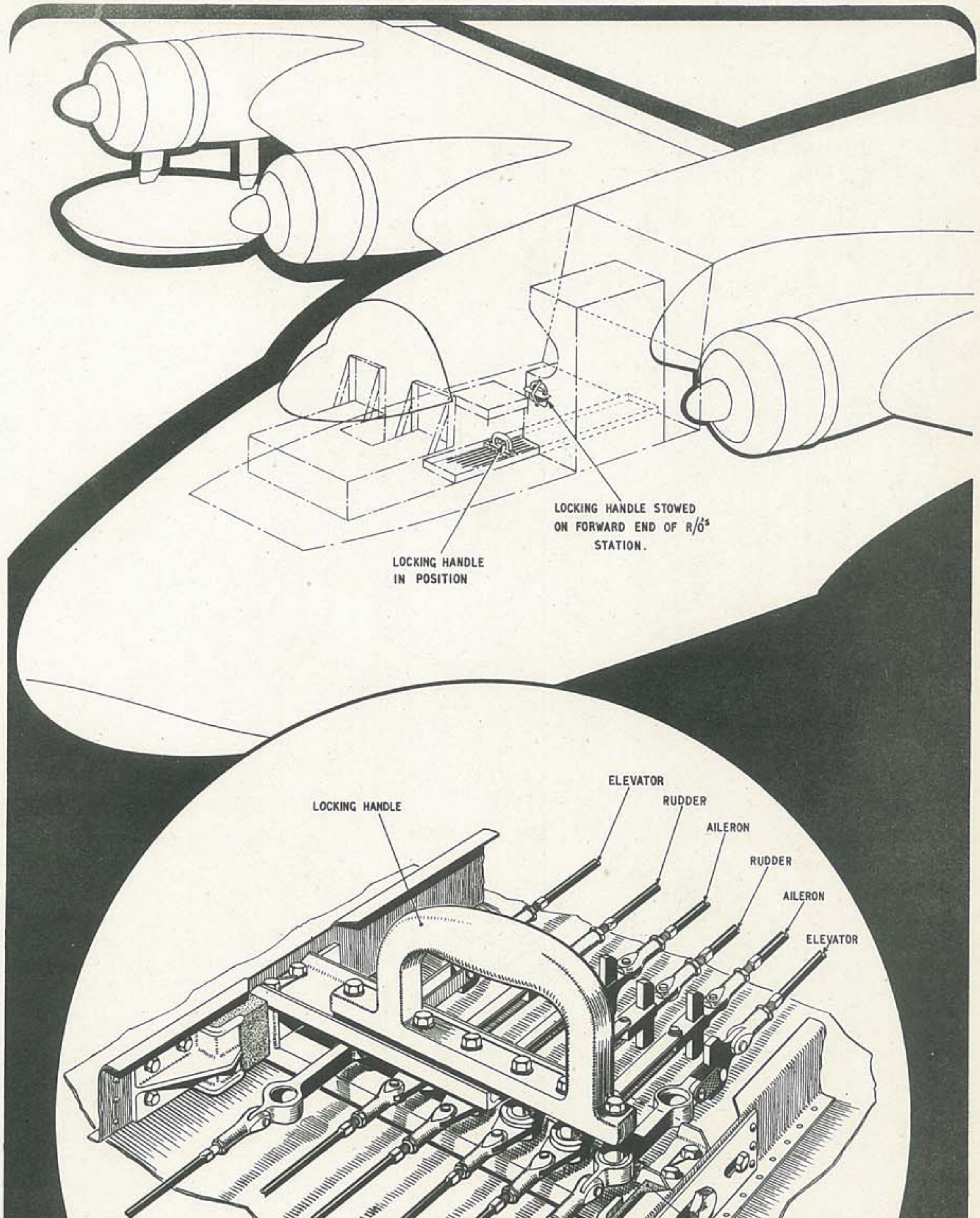

FLYING CONTROL LOCKS

FIG. 20.

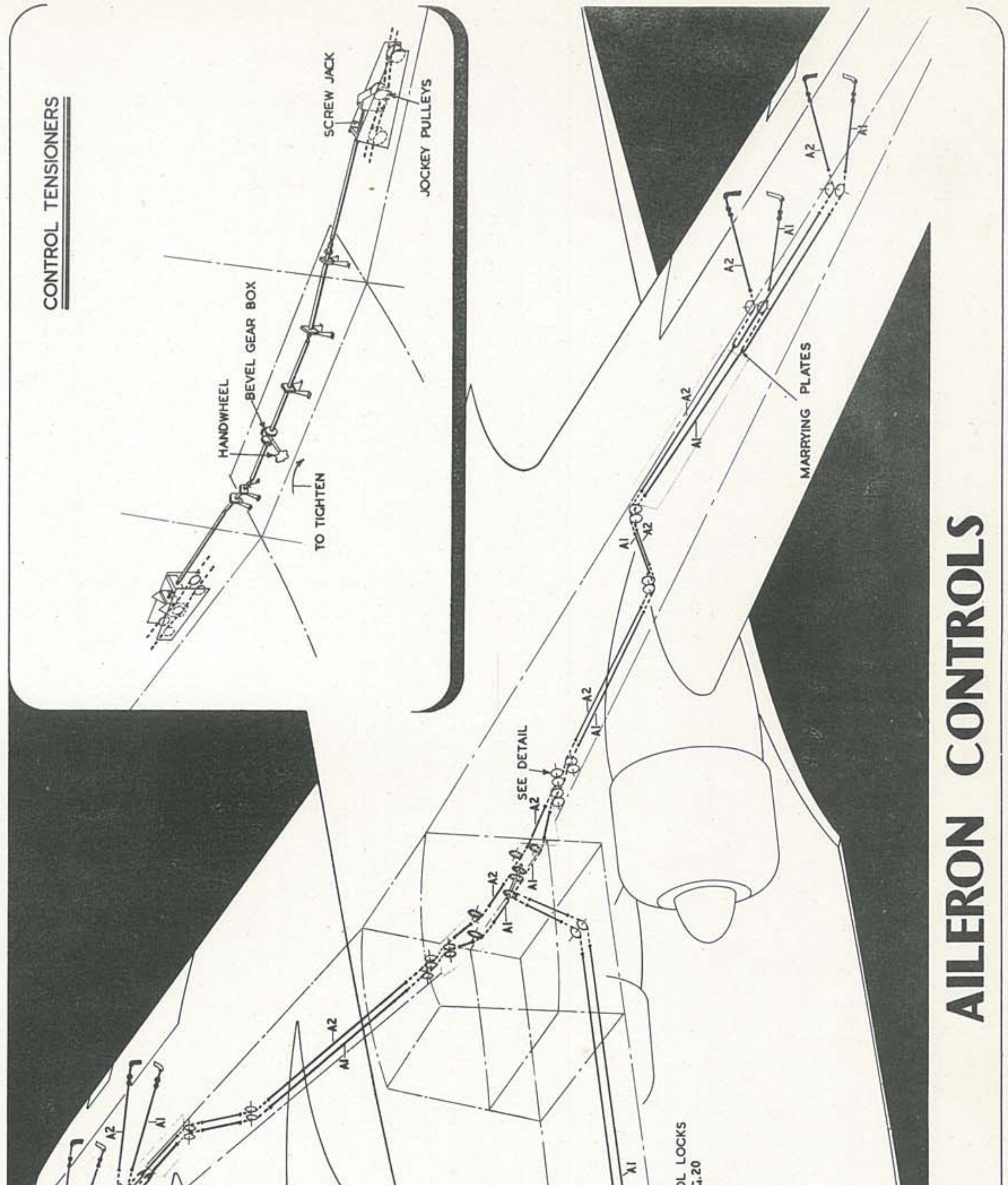

FIG.21

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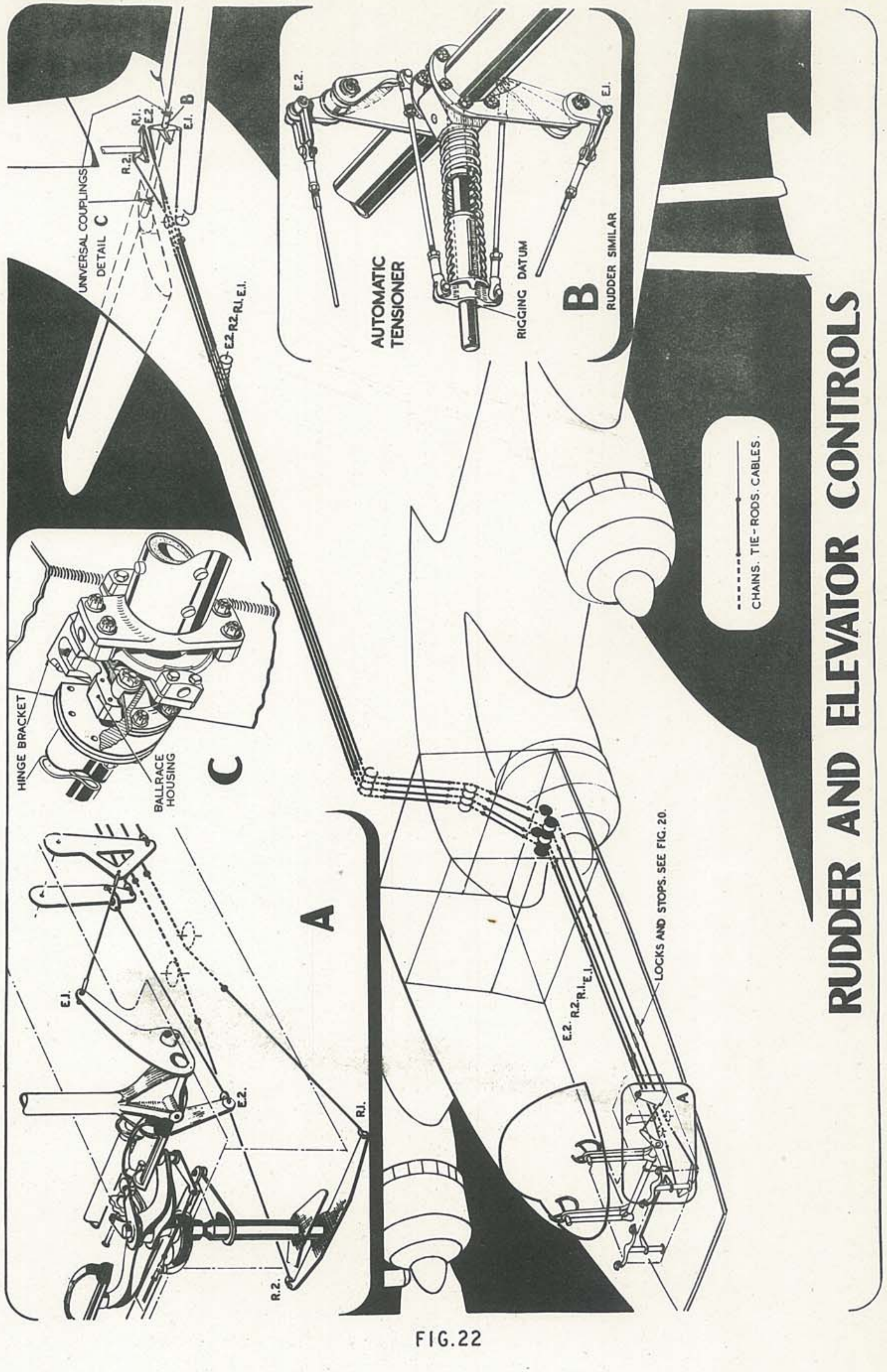

FIG.22

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2	20-1-47

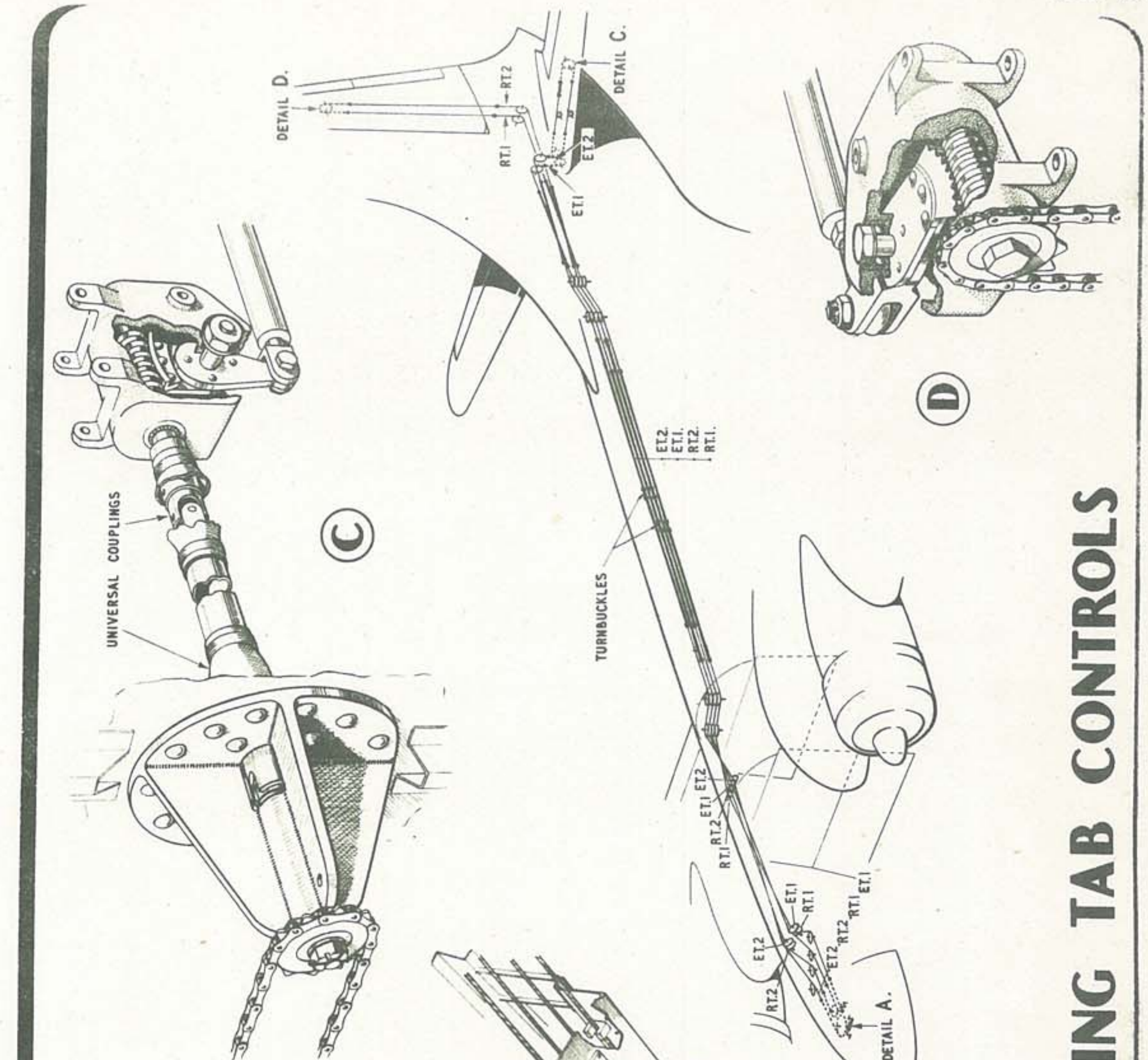
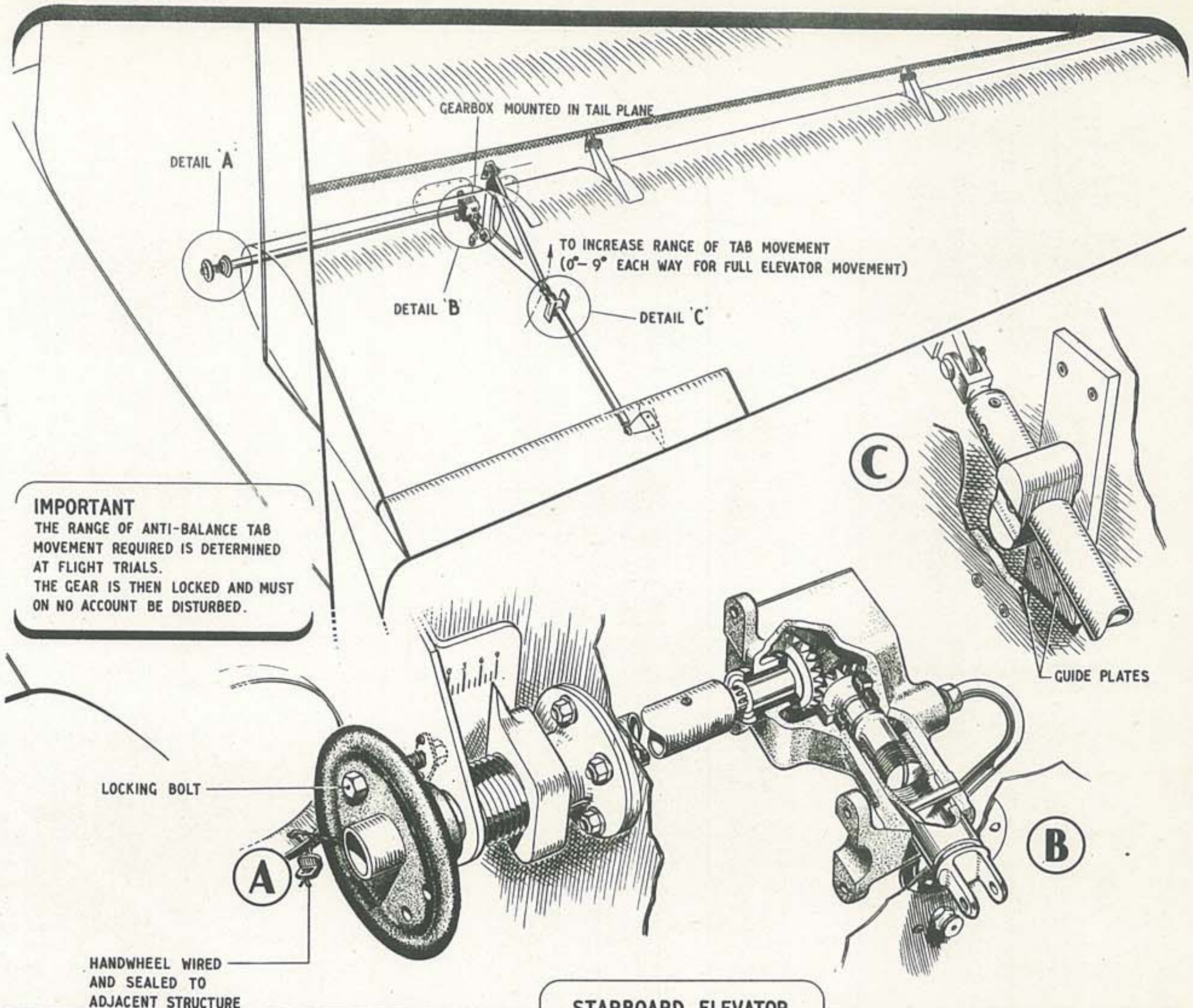
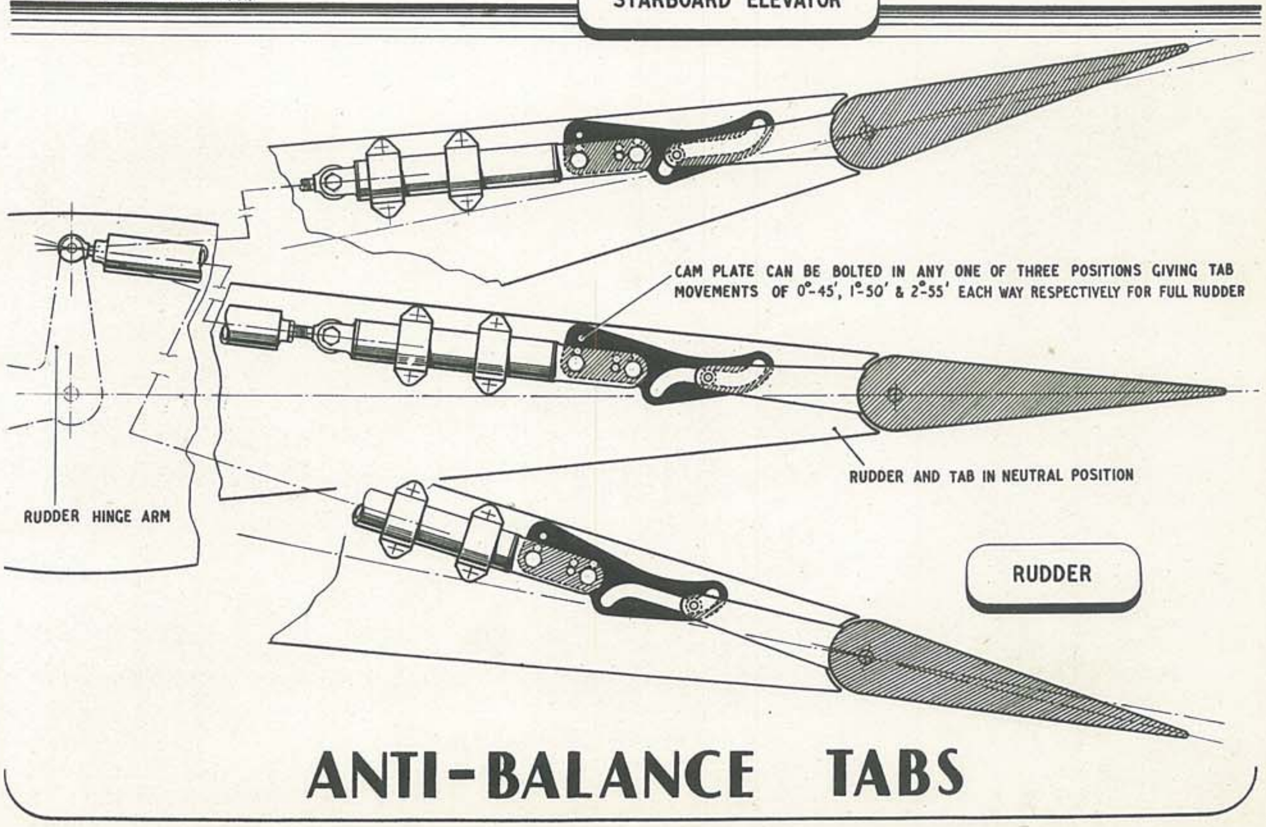

TRIMMING TAB CONTROLS
NOTE: FOR AILERON TRIMMING TABS SEE FIG.4.
KEY.
TIE ROD.
CABLE.
CHAIN.
A
B
C
D
DETAIL A.
DETAIL B.
DETAIL C.
DETAIL D.
UNIVERSAL COUPLINGS
TURNBUCKLES
ET.1
ET.2
RT.1
RT.2
TO CORRECT FOR NOSE HEAVY
FOR TAIL HEAVY

FIG. 23.

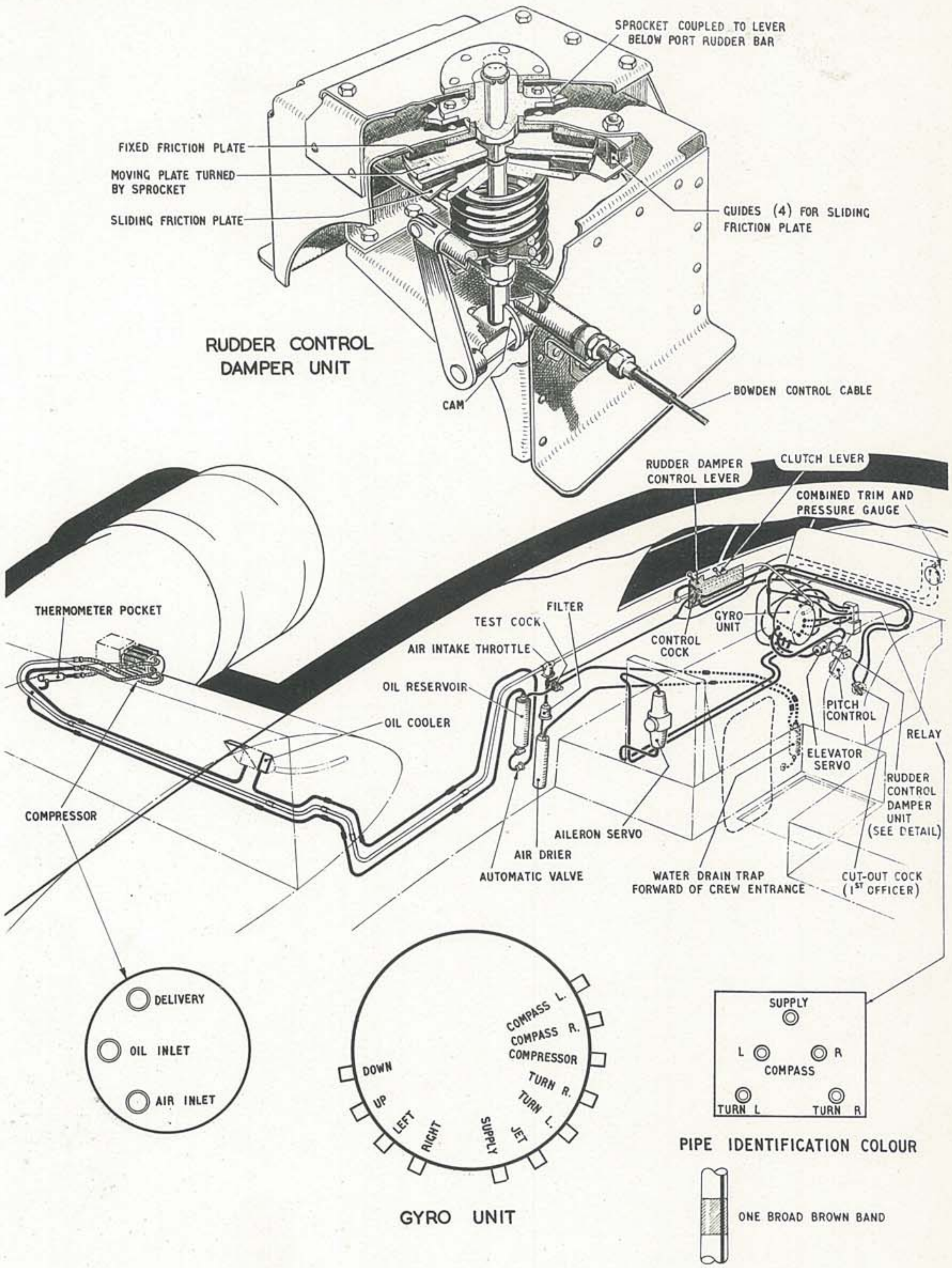




RE-ISSUED WITH A.L.3

ANTI-BALANCE TABS

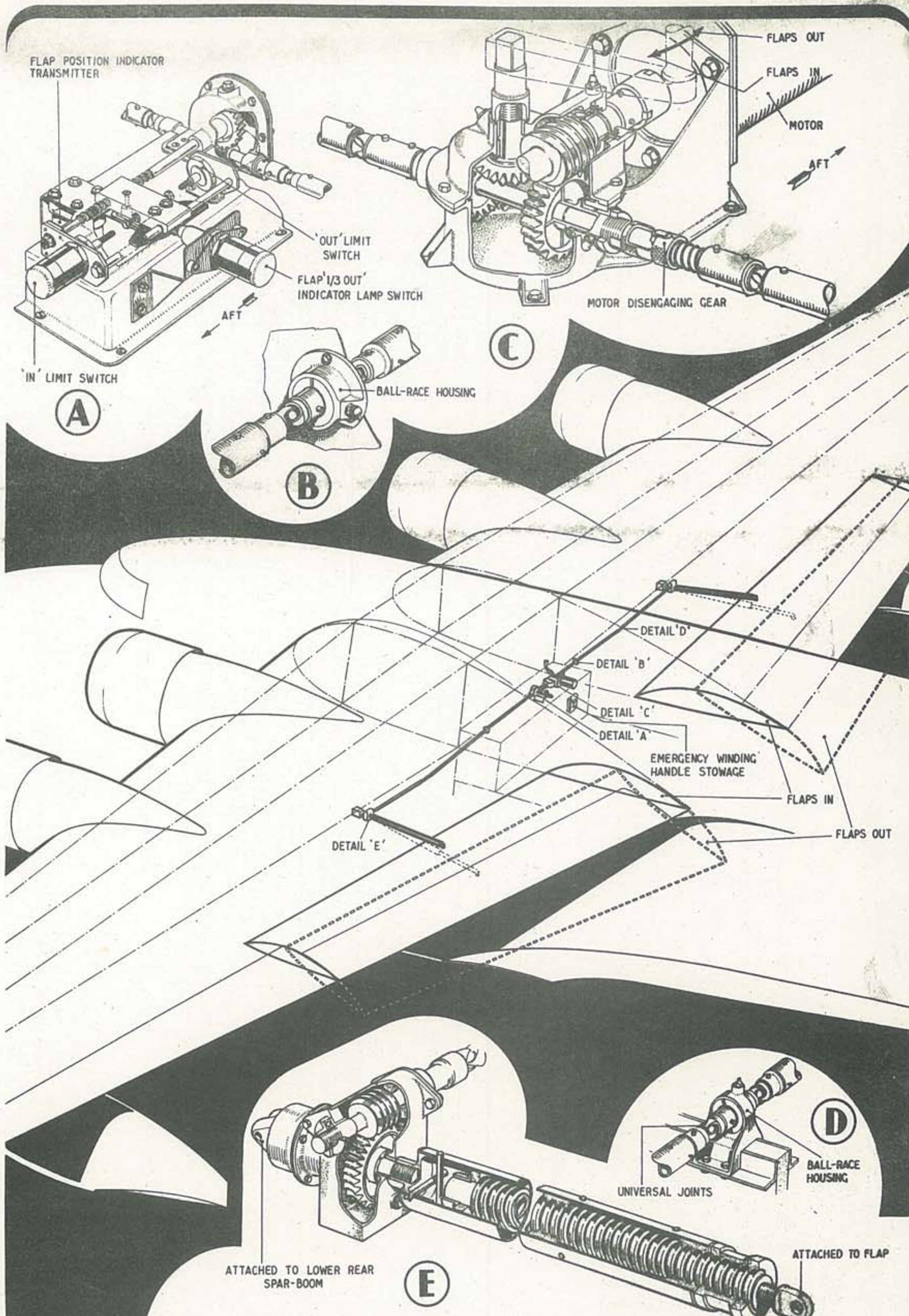
FIG. 24



AUTOMATIC CONTROLS

FIG. 25

ISSO/TP/1067
ISSUE | DATE
2 | MAY 47



FLAP CONTROLS

FIG. 26

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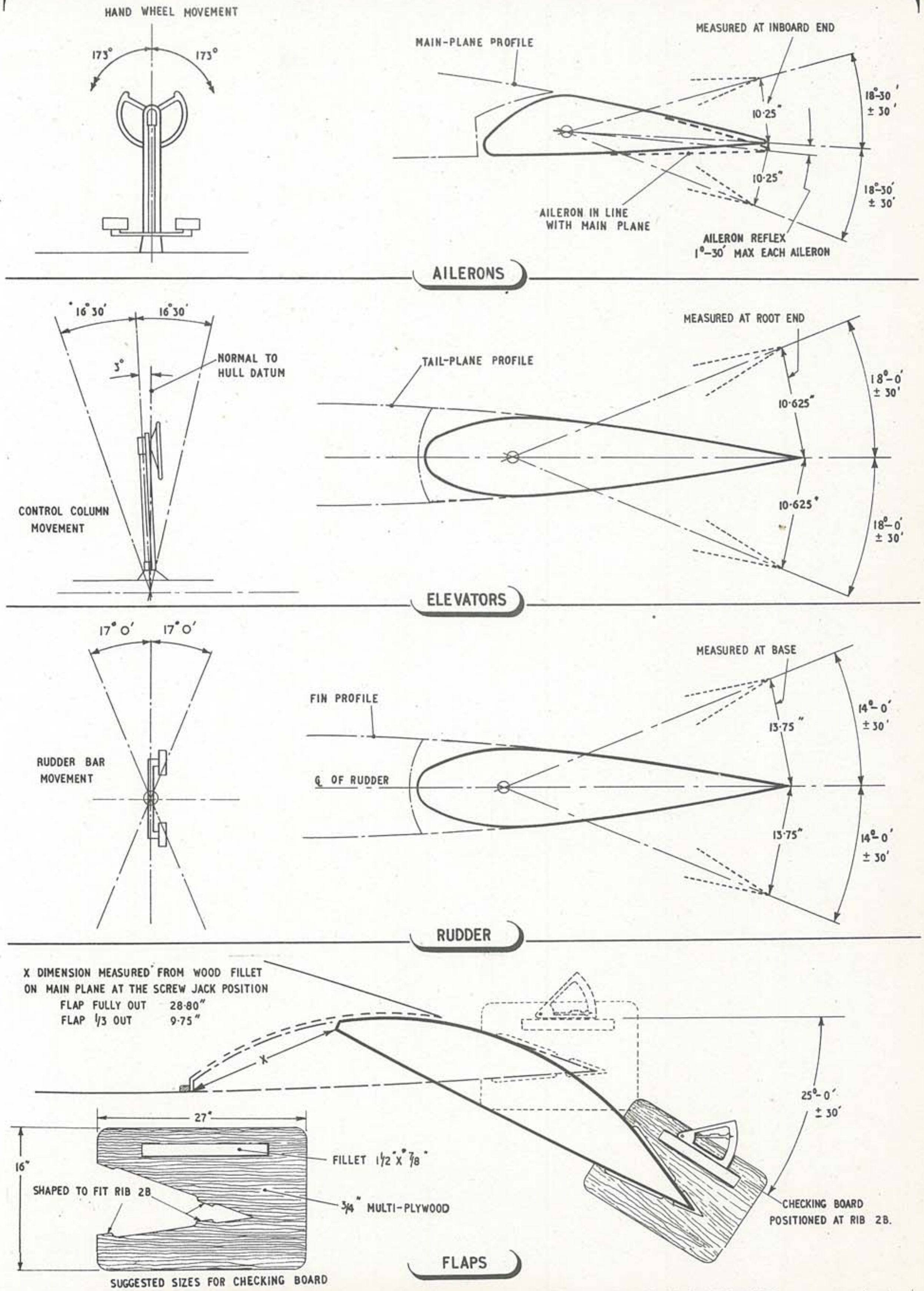
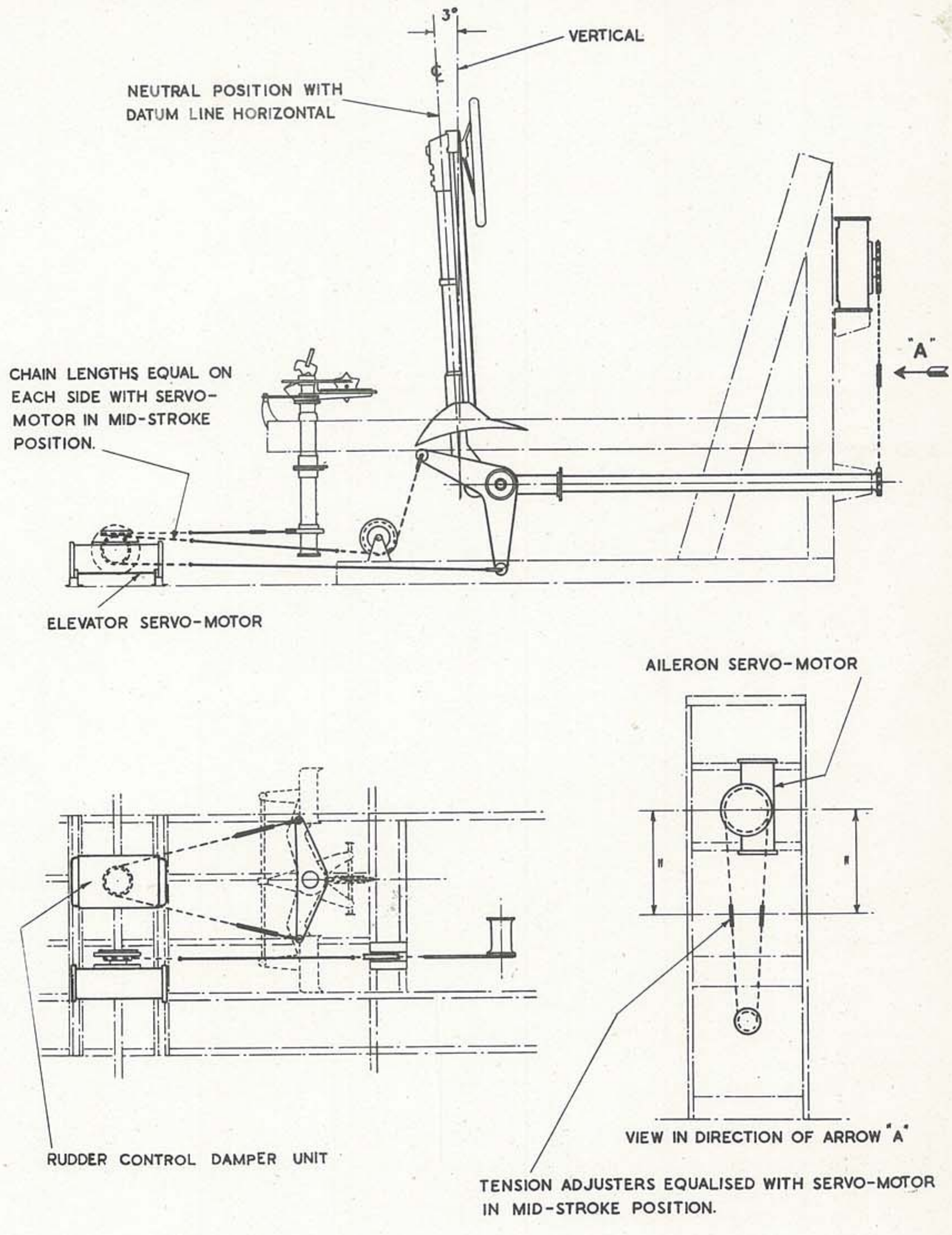
1	18-OCT-46
2	OCT '47



CONTROL SURFACE RANGES

FIG. 27



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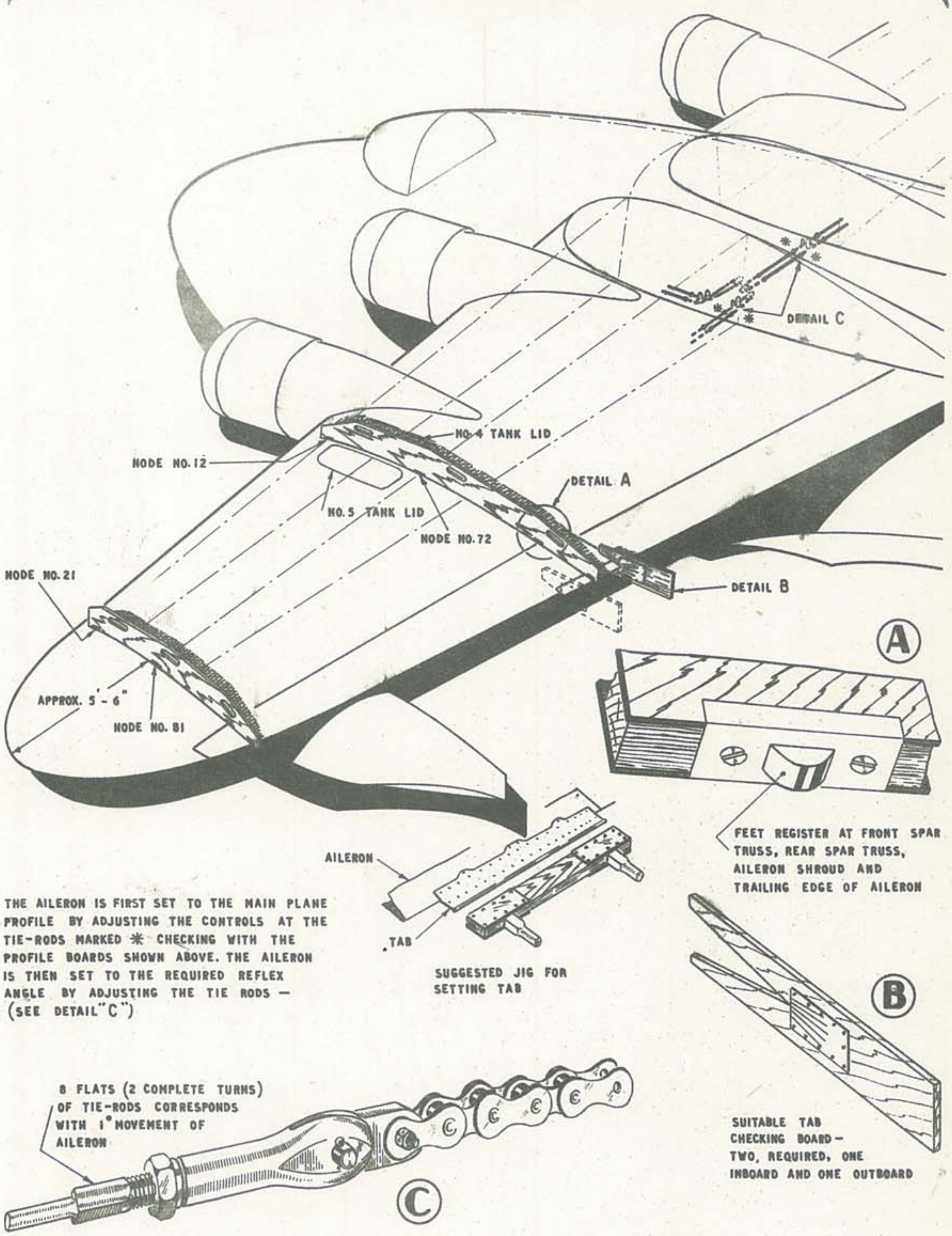
AUTO-CONTROL COUPLINGS

FIG. 28

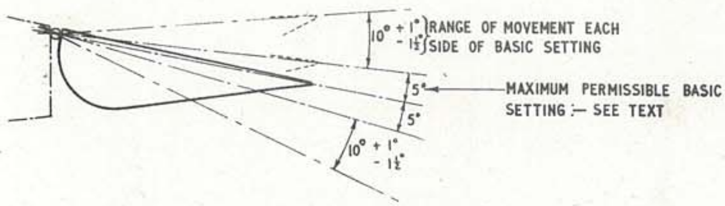


THE AILERON IS FIRST SET TO THE MAIN PLANE PROFILE BY ADJUSTING THE CONTROLS AT THE TIE-RODS MARKED * CHECKING WITH THE PROFILE BOARDS SHOWN ABOVE. THE AILERON IS THEN SET TO THE REQUIRED REFLEX ANGLE BY ADJUSTING THE TIE RODS — (SEE DETAIL "C")

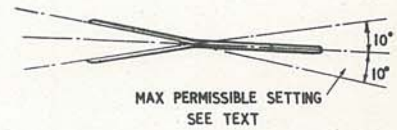
* INDICATES TIE-RODS AT WHICH ADJUSTMENTS CAN BE MADE

SETTING AILERON AND TRIM TAB

FIG. 29

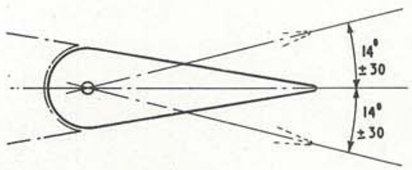


ELECTRICALLY-OPERATED TAB

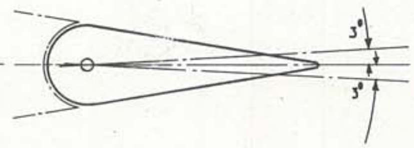


FIXED TAB

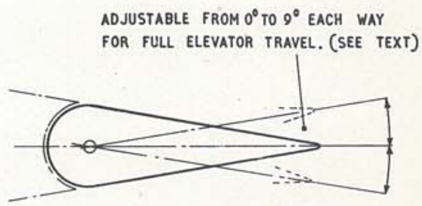
AILERON



TRIMMING TAB MOVEMENT

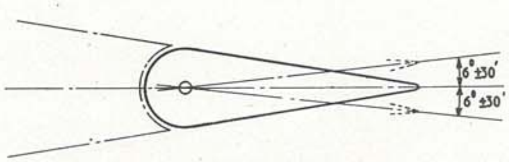


ACCEPTABLE SETTING LIMITS

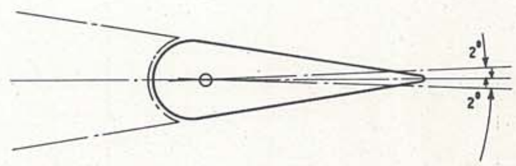


ANTI-BALANCE TAB MOVEMENT

ELEVATOR

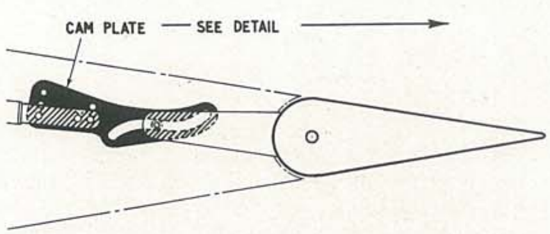


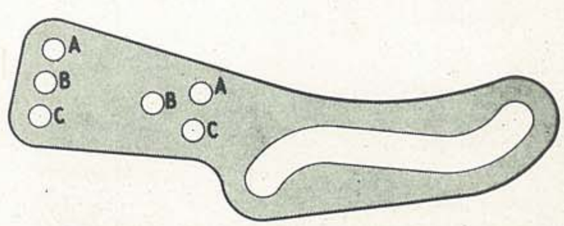
MOVEMENT



ACCEPTABLE SETTING LIMITS

RUDDER TRIM TAB





HOLES AA GIVE 2° 55' FOR FULL RUDDER
" BB " 1° 50' " " "
" CC " 0° 45' " " "

RUDDER ANTI-BALANCE TAB

TAB RANGES & SETTINGS

FIG.30

ELECTRICAL INSTALLATION - GENERAL DESCRIPTION

Contents

Illustrations

Introduction

1. In this chapter the various circuits are briefly described under their service headings, the notes being supplemented by theoretical diagrams where the circuit arrangement is less obvious. Chapter 2 gives servicing instructions for those items of equipment which may be tested or adjusted in the aircraft. The wiring and distribution is fully covered in Chapter 3 and the routing chart type wiring diagrams, preceded by an alphabetical index are given in Chapter. 4.

2. LEADING PARTICULARS

System ... ... 24 volt D.C. single-pole

Wiring ... ... S.B.A.C. with Crabtree type fuse blocks.

Generators

Type ... ... 24 volt 6 K.W. type P. No.2

Number ... ... Three in parallel.

Auxiliary generating plant

Type ... ... Lyon "Alco Featherweight" type F.

Engine ... ... Single cylinder 4-stroke air-cooled $1\frac{1}{2}$ h.p.

Generator ... ... 500 watt type HZ.

Accumulators

Type ... ... Exide type 6 FZ, 17-3,60 AH

Number ... ... Four in series-parallel

Voltage regulators ... ... Three type 23 and one master regulator type 32.

3 POWER SUPPLY

3.1. Under normal flying conditions three generators, driven by engines 1, 2 and 3, provide the power for the electrical and radio installations. In addition to supplying the normal load, the generators charge four series-parallel connected 12 volt 60 ampere hour accumulators. An auxiliary generating plant, incorporating a 24 volt 500 watt generator is provided to charge the accumulators when the main engines are not running, or in the event of the failure of the generators.

3.2. The generator output voltages are controlled by carbon-pile voltage regulators type 23 which are themselves controlled by a master regulator type 32. On referring to fig. 1 it will be seen that the master regulator operates by varying the resistence between the voltage coils of the generator voltage regulators and earth. It will also be seen that, in the event of the master regulator carbon-pile becoming "open-circuit" the resistance to earth will be immediately increased to that of the diverter resistance, thereby causing an undesirable rise in output voltage. When this happens the safety resistance may be substituted for the carbon-pile by turning the switch, marked NORMAL and EMERGENCY, to the latter position, thereby reducing the voltage to approximately normal.

3.3. The generators are protected against "short circuit" conditions by 200 amp. circuit breakers, Type D, whose main contacts are fitted with thermal trip mechanisms. These circuit breakers are connected in the main generator feeds to the accumulator bus-bar and are brought into operation by the central unit on the battery master switch, which completes the earth return for their operating coils. The positive feeds to these operating coils are controlled by the contacts of B.T.H. differential cut-outs, type A, which operate on the voltage difference between the generator and the accumulators. Further reference to fig. 1 will show that each circuit breaker is provided with a re-set switch which, in one position, connects the supply from the cut-out contacts to the coil of the breaker and completes the controlling circuit between the generator voltage regulator and the master voltage regulator. In its other position the switch breaks the controlling circuit and "earths" the main coil of the generator voltage regulator and at the same time breaks the circuit breaker coil circuit to allow its armature to be released to pick up the main contact arm when it has been tripped on overload. The generator field circuits are protected by 15 amp. circuit breakers, type A.

3.4. The metering equipment consists of 50-0-200 ammeters, connected in the main positive lines on the generator sides of the voltage regulators, and an 0-40 voltmeter, connected between the accumulator bus-bar and earth.

3.5. The auxiliary generating plant is of the "Alco" Featherweight type, fitted with a 24 volt 500-watt generator type HZ. The control gear for the generator is housed in a box at the engineer officer's position and consists of an ammeter, a cut-out, a main fuse and a manually operated field rheostat.

3.6. The main bus-bar may be disconnected from the accumulators and connected to the external supply socket by means of the battery master switch. It will also be appreciated that, providing no external source of supply is plugged into the socket, the disconnection of the accumulators from the bus-bar will render the installation "dead". As already stated in 3.2. a further function of the battery master switch is to break the earth return circuit for the operating coils of the circuit breakers.

4. DISTRIBUTION SYSTEM

General.

4.1. The panels and boxes (shown in fig. 2) comprising the distribution equipment are, for identification purposes, grouped according to their functions, each group being referenced as follows :-

C - Charging or control boxes

D - Distribution boxes

J - Junction boxes

P - Panels (Instrument)

In each group the reference letter is prefixed by a number to indicate the individual box or panel in that group.

Charging and control boxes

4.2. The generators are provided with their own charging and control boxes to house their voltage regulators, cut-outs, and circuit breakers. These boxes are connected to the generators in the following order.

1C - generator on engine No. 2

2C - generator on engine No. 3

3C - generator on engine No. 1

The main bus-bar, to which the controlled outputs from 2C and 3C are also connected, is mounted in 1C. In addition, 1C contains the master voltage regulator and its safety resistance switch, field circuit breakers, and main circuit breaker re-set switches for the generators on engines 1 and 2. From the foregoing it will be seen that 1C may be regarded as the master control box and for this reason it is mounted on the starboard side of the centre section, as shown in fig. 3, so that it faces, and is easily accessible from, the engineer officer's position. Box 2C, which is mounted just aft of 1C, carries, in addition to its charging equipment, the ammeter and field circuit breaker for the generator on engine No. 3, the main circuit breaker emergency switch, and the manually operated circuit breakers for the engine instrument services.

4.3. The third control box 3C contains, in addition to the charging equipment for the generator on engine No. 1, the auxiliary radio and domestic supply circuit breakers, also the feathering and domestic interlocking relay (see para. 11.8). As the equipment in this box is all remotely controlled and requires no attention during flight, it is mounted below 1C and 2C.

4.4. With the exception of those for emergency services, radio power supplies, and engine instruments, all fuses are contained in three distribution boxes. These boxes (referenced 1D, 2D, and 3D), are mounted:- 1D and 2D on the port and starboard sides respectively of the door in the rear spar frame bulkhead, and 3D on the partition at the aft end of the radio officer's station (see fig. 3). The feeds from the charging and control boxes to the distribution boxes are as follows :-

1D - One feed directly from the bus-bar in 2C.

2D - Two feeds from 2C, one directly from the bus-bar and the other via the cabin lighting master switch. A third feed to this box is taken from 3C and controlled by the domestic circuit breaker therein, 3D - A double feed directly from the bus-bar in 2C

4.5. The Crabtree type fuse blocks in the boxes are referenced alphabetically and the fuses numerically from 1 to 6. Tables I to VIII in Chapter 2 gives the rating, type, block reference letter, and number of each fuse. This information is also provided on the aircraft, in both alphabetical and box order, on charts attached to the underside of the desk flap at the engineer officier's station. Those fuses not contained in the distribution boxes are located as follows :-

Emergency services ...	....	1C
Radio power supplies...	...	3C
Engine instruments ...	...	4P

4.6. Junction boxes are included in the wiring system to provide breakdown points at structural attachment positions (viz. wing roots, firewalls, etc. and, where necessary, to allow the cables to radiate to the various items of equipment. The boxes, the locations of which are given in fig. 2, contain S.B.A.C. type terminal blocks referenced in the same way as the fuses (see chap. 3).

4.7. The majority of those electrical controls not fitted on the pilot's instrument panel are grouped on smaller panels, located at the various crew positions as shown in fig. 2.

1P - Captain's electrical panel

2P - First officer's electrical panel

3P - Control cabin roof panel

4P - Engineer officier's main panel

5P - Master switch panel

6P - Engineer officer's side panel

These panels are fitted with terminal blocks to provide breakdown points in the wiring to the components mounted on them. In addition to the terminal blocks, a complete distribution box is built into 4P to carry the fuses for the engine service circuits.

FLIGHT SERVICES

5.

Propeller Feathering

5.1. The feathering pump motors are switched by relays located:- these for the port motors in 1C and those for the starboard in 2C. These relays are controlled by solenoid type push switches, mounted on the pilot's instrument panel, which are themselves automatically controlled, when the feathering operation is complete, by pressure-operated cut-out switches fitted on the propeller constant-speed-units.

5.2. Electrically as is shown in fig. 4, the feathering operation for an engine is as follows :-

The feathering push switch is pressed, and held in that position by its retaining coil. This coil receives its fused positive supply through its own subsidiary contact on the switch and its earth return through the pressure operated cut-out switch. The closing of the feathering switch applies the positive supply to the operating coil of the pump motor relay, the other end of which is permanently earthed, thereby causing the relay contacts to close and the motor to run until the propeller is fully feathered. At this stage the pressure in the hydraulic system will have built up sufficiently to open the cut-out contacts to release the feathering push switch and stop the motor by allowing its relay to open. To unfeather a propeller, the feathering switch is pressed and held manually to over-ride the pressure switch until the required engine speed is reached.

5.3. The common feed to the propeller feathering and engine starting relays is controlled by a master switch on panel 5P. A B.O.A.C. type current flow relay, whose contacts complete the feed to a warning lamp on panel 4P when current flows in the motor circuit, is fitted in the feed between the master switch and the accumulator. Thus if after a feathering or starting operation is completed the lamp (by remaining illuminated) indicates that a relay is sticking, the master switch may be opened to isolate all the relays until the one at fault is located and its contacts opened.

Flap motor and indicator

5.4. The flaps are operated by screw-jacks driven by a torque shaft which is, in turn, driven through a gearbox by a split-field series-wound motor. The windings of this motor are switched, as shown in fig. 5, by a pair of relays mounted in 2C. Selection of either the IN or OUT field winding of the motor is by means of a two-way-and-off switch, on the control cabin roof panel 3P. This switch completes the positive feed to the operating coil of the relay, through the contacts of the appropriate limit switch. The other end of the relay operating coil being earthed, the relay contacts close to complete the main supply from the manually-operated circuit breaker (on 2C) to the motor winding, causing the motor to run until the mechansim opens the contacts of the limit switch. (For details of the operating mechanisms of the flaps, limit switches, and motor, reference should be made to Sect. 3).

5.5. The flap position indicator system is of the Smith's three-wire type, fully described in A.P.1275A. The segment of the meter scale traversed by the pointer, from the fully-in to the one-third-out position is painted red. This system is supplemented by a lamp which is illuminated when the flaps are one-third or more out. The one-third-out indicator lamp is controlled by a trip switch operated by a ramp driven by the screw in the switch gearbox. This screw, which is driven from the torque shaft, also operates the limit switches and the transmitter for the indicator system.

Aileron trimming tab control

5.6. The aileron trimming tabs are operated by the Evershed Powerotor system which consists of a controlling transmitter, mounted in the control cabin roof, and a motor and gearbox for each tab. The motors, which are of the step-by-step type, rotate in synchronism with one another. The underlying principle of the system is that if an electric motor has its stator windings energised singly, or in groups, in sequence, the rotor will take up a definite position with each arrangement, according to the energisation of the coils. On this aircraft the coils of two such meters are suitably arranged and are supplied with current, in proper sequence, from a rotary switch type transmitter as shown in fig. 6. From the foregoing it will be seen that the speed of the angular movement of the tabs will be in direct proportion to the speed of the transmitter handle. The transmitter is the only control for the system as its handle, which is of the "dead man" type, completes the circuit by closing the built-in on-off switch as soon as it is turned. Continuous indication of the position of each tab is provided by an indicator, mounted on the pilot's instrument panel, in which a pair of pointers move over an edgewise duplex scale. The indicator system is of the three-wire type, similar to that used for the flaps, in which the pointers follow the movement of transmitters driven by the tab actuating mechanism. This circuit is not provided with an on-off switch; it is only switched off when the battery master switch is set to GROUND.

Automatic controls and D.R. Compass

5.7. This installation consists of the Mk. VIII automatic control system operating in conjunction with the normal D.R. compass circuit. The electrical equipment for the two systems is located as follows :-

Automatic controls -

Main controls switch - engine control stand.

Relay box - just forward of the port rudder bar.

D.R. Compass -

Master compass - on the starboard side of the rear freight compartment.

Pilot's repeater - Pilot's instrument panel.

Navigator's repeater) - On a small panel above the
Control panel) navigating officer's table.

Pressure head heating -

5.8. The supplies to the heaters in the two pressure heads, fitted at the top of the radio aerial mast, are controlled by a pair of switches on the captain's electrical panel 1P. A lamp, incorporated in its switch, is connected in parallel with each heater.

Aerofoil de-icing

5.9. For aerofoil de-icing, the T.K.S. system (without an ice detector unit) is installed). The de-icing fluid is supplied to the distributors by a ten-unit pump whose driving motor is controlled by a T.K.S. type 3 controller, mounted on the E.O's side panel 6P. On referring to fig. 7 it will be seen that there are three switches on the controller, the switch marked AUTOMATIC being unused. The MANUAL switch is used to bring the system under pilot's control for intermittent operation. The closing of the EMERGENCY switch causes the system to provide a very high continuous rate of flow to combat abnormal icing conditions. The electrical operation of the system, under the control of these switches is as follows :-

(i) MANUAL - On referring to the diagram, it will be seen that when this switch is closed it completes the positive supply to the filament of the vacuum hot wire relay switch; the other end of this filament being connected to earth through the contacts (normally closed) of the regulator thermal switch. After approximately five seconds the contacts of the hot wire relay close to put the pump motor and the green lamp in circuit. Further reference to the diagram will show that the closing of the MANUAL switch also completes, through the barretter, the positive supply to the bi-metal strip heater of the delay thermal switch.

(ii) After about one minute, the delay thermal switch heats sufficiently to close its contacts and place the regulator thermal relay in circuit. This latter will, after an interval, heat up sufficiently to open its contacts and break the earth return for the filament of the vacuum hot wire relay switch, thereby breaking the feed to the motor and the green lamp.

(iii) Following a further predetermined interval the bi-metal strip of the regulator thermal switch will cool, thereby allowing its contacts to close and re-make the circuit for the filament of the vacuum hot wire relay. The contacts of this relay will then close to re-start the motor and illuminate the green lamp. The above sequence of operations will be repeated at regular intervals, under the control of the regulator thermal switch, until the MANUAL switch is opened.

(iv) EMERGENCY - A brief glance at the diagram will show that the closing of this switch connects the supply directly to the motor and to both the red and green lamps. The motor will therefore run continuously and provide a very high rate of flow.

Outside air temperature gauge

5.10. This installation consists of a Wheatstone bridge type circuit in which the variable resistance is contained in a bulb mounted on the hull side just below the starboard wing. The case which contains the galvonometor, calibrated in degrees centigrade, and the remaining arms of the bridge is mounted on the E.O's main panel, 4P.

6. ENGINE SERVICES

Starter Motors

6.1. The main feeds to the starter motors, are switched by relays housed:- those for the port engines in 1C and those for the starboard in 2C. The feeds from the push switches, on the engine control stand, to the coils of the relays are interrupted by safety switches operated by the maintenance doors in the leading edge of the main plane. These switches are arranged as shown in fig. 4 so that the starter relay control circuit for any engine is only complete when both its maintenance doors are properly closed, thus preventing the inadvertent starting of the engine during servicing operations. It should be noted that these motors have the same main supply feed as the feathering pump motors and are, consequently, under the control of the same master switch on panel 5P as described in para. 5.2.

Booster coils

6.2. The booster coils, which are of the H.T. type, take their supplies directly from the engine starter push switches to ensure that they operate simultaneously with the starter motors. The feeds are not controlled by the safety switches but they are, however, provided with isolating switches, on the E.O's main panel, 4P, to allow a coil to be taken out circuit when it is required to turn, but not start, an engine. When an engine is started by hand its booster coil may be used by first opening the engine starting and propeller feathering master switch, on the master switch panel 5P, and then pressing the engine starting push switch until the engine is started.

Ignition

6.3. The earthing switches for the magnetos are mounted in two groups at the top of the control cabin roof panel 3P. Each group consists of two pairs of switches, one pair for the magnetos on each engine, the leads from the magnetos to the switches are broken at the wing roots and engine firewalls by A.M. type ignition connector boxes.

R.P.M. indicators

6.4. This installation consists of a Kollsman type three-phase r.p.m. generator and two indicators for each engine, and a synshroscope with its selector switch. The duplicate indicators are mounted on the E.O's main panel 4P, and the main indicators, synchroscope and switch are mounted on the pilot's instrument panel. The synschroscope is permanently connected into the circuit for engine No. 1 which, for this installation, is regarded as the master. When this engine has been set at the required speed the others may be switched, in turn, so that their speeds may be compared with, and adjusted to, that of the master.

Cylinder temperature gauges

6.5. The thermo-couples for this installation are, on each engine, fitted to cylinder number 14. The gauges, to which the thermo-couples are connected by copper-constantan leads, are mounted on the E.O's main panel 4P.

Cowl gill motors and indicators

6.6. The motors which operate the cowl gills are of the series-wound split-field type, the drive to the gill mechanism being through a gear box containing a four stage epicyclic reduction system. Limit switches are contained in the gear box to change the motor field at the end of the travel of the final shaft. Creepage of the final shaft, due to air pressure on the gill surfaces, is prevented by a solenoid operated brake on the motor shaft, spring-loaded in the "on" position and released when the motor is running. The motors are controlled (as shown in fig. 8) by switches, mounted on the E.O's side panel 6P, each of which incorporates an on-off switch and a two-way-and-off switch. To operate one of these switches, the knob is pushed to close the on-off contacts, and turned to select either of the two-way-and-off contacts. The on-off portion of the switch completes the positive feed to the indicator circuit and to the two-way-and-off switch which, in turn, completes the supply to the required motor field.

6.7. A lamp, mounted with the switch assembly, is connected in parallel with each motor brake solenoid to show when that motor is running. The position indicators, mounted adjacent to the control switches, are of the Desynn double miniature type whose transmitters are driven by the operating mechanism.

This system is quite standard and is fully described in AP.1275.

Air intake temperature gauges

6.8. These gauges are of similar type to that used for outside air temperature measurements (see para. 5.9). The resistance bulbs are fitted in the carburettor air intakes and the gauges are mounted on the E.O's main panel 4P. An additional gauge for engine No. 3 is mounted on the pilot's instrument panel to provide a general indication, at that position, of the temperature at the carburettor air intakes. The resistance bulbs on engine No. 3 may be connected to either of its gauges by means of a changeover switch mounted just below the gauge in the pilot's instrument panel.

7. FUEL AND OIL SYSTEMS

Fuel contents gauges

7.1. The gauges, which are of the Desynn type, are mounted on the E.O's main panel 4P and their transmitters are fitted in the fuel tanks. The four positive supplies for the circuit are taken directly from fuses on 4P. As no on-off switch is provided for this installation the gauges remain operative until, either the circuit breakers in 2C are opened, or the battery master switch is set to GROUND.

Fuel flowmeters

7.2. The "gallons gone" indicators, which are of the veeder or counter type driven by impulses from transmitters in the engine fuel lines, are mounted on the E.O's main panel 4P. Mounted on either side of each indicator case are the on-off switch and warning lamp for each of the two counters contained therein. A solenoid, which, when energised, closes a by-pass valve, is connected in parallel with the impulse switch in the transmitter so that when the latter is switched off the fuel will by-pass the working chamber.

Fuel pumps and fuel pressure warning lamps.

7.3. In each wing the fuel supply from the tanks is boosted by a pair of pumps, working individually or in tandem, in the fuel collector box supplying both engines. On the pressure side of each pair of pumps is fitted a diaphragm-operated switch, whose contacts close to complete the circuit for a warning lamp when the pressure falls below the safe working level. The warning lamps and their switches are mounted with the motor switches on the E.O's main panel 4P. The two on-off switches for each warning lamp are connected in parallel, and each is mechanically ganged to one of the motor switches for the same wing, thereby ensuring that a motor cannot be in circuit without its appropriate warning lamp. An ammeter is mounted on 4P and is wired so that it may be connected in series with any motor by pressing the appropriate push switch

Fuel pressure gauges

7.4. The fuel pressure gauges, which are of the Desynn type, are mounted on the E.O's main panel 4P and their transmitters are fitted to the pressure manifolds on the engines. As in the case of that for fuel contents gauges, this circuit is not provided with an on-off switch; it is only controlled by the battery master switch and the circuit breakers in 2C.

Fuel cut-off controls

7.5. The cut-off valves in the engine fuel lines are opened and closed by Rotax type actuators. Each actuator is a complete self-contained assembly consisting of a split-field reversible motor driving, through a gear box, a screw-jack. Switches, to select either the "run" or "stop" field winding of the motors, are mounted on the control cabin roof panel 3P. The limit switches for changing the motor fields at the end of the travel of their screw jacks are also contained in the actuators (see fig. 10).

Oil contents gauges

7.6. The oil contents gauges are mounted on the E.O's main panel 4P and their transmitters are fitted in the oil tanks. These gauges are of similar type (Desynn) to those used for fuel contents and, like them, are not provided with an on-off switch.

Oil pressure gauges

7.7. The gauges for this installation are mounted on the engineer's main panel 4P, the transmitters being mounted on the port sides of the nacelles and connected to the engine oil pumps. In all other respects this installation is similar to that for fuel pressure.

Oil temperature gauges

7.8. This installation is similar to that described in para. 6.8. for air intake temperature, the gauges being fitted on the E.O's main panel 4P and the resistance bulbs in the oil tank sump. The gauges are, however, of the Mk.II type which operate on the ratiometer principle. In this type of gauge two coils are wound on the moving coil former and connected so that the torques produced in them are in opposition. The moving coil former, to which the pointer is attached, is arranged so that is rotates in a non-uniform magnetic field. The positive supply is connected to the two coils through a limiting resistance, one coil being earthed through a fixed resistance and the other through the resistance bulb. From the foregoing it will be seen that any change in the resistance of the bulb, due to temperature, will affect the balance of the circuit, causing the pointer to move over the calibrated scale. No on-off switch is provided for this installation, its control being as described in the foregoing paragraphs.

8. EMERGENCY SERVICES

Fire warning lamps

8.1. These lamps are fitted in the knobs of the feathering switches and, as will be seen from fig. 11 they are permanently connected on one side to earth. The positive supply to each lamp is completed to any one of the parallel-connected flame switches and a pair of contacts on a relay, whose operating coil also receives its positive supply from the flame switches. The relays, which are housed in control box 6C, also complete (by a second pair of contacts) a circuit to allow the fire extinguishers to be discharged by the feathering switches. The nine flame switches are disposed throughout each engine nacelle as follows :- four on the forward side of the firewall and five in the nacelle nose.

Fire extinguishers

8.2. Three fire extinguishers bottles are fitted in each engine nacelle two for the spray rings and one for the air intake. These extinguishers may be discharged as follows :-

(a) By pressing the push buttons on the control cabin roof panel 3P. (Each switch will discharge the three relevant bottles immediately and simultaneously).

(b) By closing the feathering switches, when the fire warning lamps are illuminated. This discharges the air intake extinguishers immediately, the spray ring extinguishers being discharged on completion of the feathering operation by pressing the appropriate push buttons.

(c) Automatically, by the closing of the inertia switches. (This discharges all extinguishers immediately).

8.3. Electrically, as will be seen from fig. 11 the above operations are as follows :-

(a) The push switches, (which are of the double-pole type), when pressed, complete the circuit to the two parallel-connected spray ring extinguishers with one pair of contacts, and to the air intake extinguisher with the other.

(b) When a flame switch has closed the warning lamp relay for an engine, the contacts of that relay are set so that the closing of the feathering switch will complete the circuit for the air intake extinguisher and to the operating coil of the relay Type P2 causing its contacts to open and disconnect the control supply for the domestic equipment circuit breaker. On completion of the feathering operation the remaining two extinguishers are discharged as described in (a)

(c) The two inertia switches, which discharge the extinguishers in the event of an impact, are located on the aft side of the bulkhead forward of the pilot's instrument panel. When they operate, switch No. 2 completes the supply to the busbar in switch No. 1 whose contacts, in turn, complete two supplies to each engine. One of these supplies is for the spray ring extinguishers and the other for the air intake extinguishers.

Dinghy inflation

8.4. The four emergency dinghies are stowed in each wing root. The supplies to the cartridges in the dinghy operating heads are controlled by switches, mounted on the captain's electrical panel 1P.

Current flow indicator lamp

8.5. Although this installation may be regarded as an emergency service, it is described with engine starting and propeller feathering as it is so closely interconnected with these services.

9. EXTERIOR LIGHTING

Landing lamps

9.1. The two K type 350 watt landing lamps, fitted one in each wing are controlled by switches on the captain's roof panel. Each of these lamps is extended and retracted by a reversible series-wound motor, fitted with a solenoid-operated brake and built into the lamp assembly. The feed to each lamp filament is separate from those for motor control and is completed by a carbon brush, on an arm attached to the lamp, which makes contact with a copper strip as the lamp begins to extend (as shown in fig. 12). The motor control switches normally provide for two lamp positions, EXTEND and RETRACT governed by limit switches, in the motor circuit, which are operated by the arm on the lamp. The lamps may be set at intermediate positions by turning the switches to STOP when they have travelled to the required positions. The solenoid brake is held in the "off" position by the motor current which, as soon as it is switched off, allows the brake to operate and prevent motor over-run.

Navigation and steaming lamps

9.2. The steaming lamp is mounted behind a window near the head of the radio aerial mast and is controlled by a switch on the captain's electrical panel 1P. The navigation (tail and wing tip) lamps are controlled by a two-way-and-off switch adjacent to the steaming lamp switch. Both switches are connected to the same fused positive supply, the navigation lamp switch connecting the supply direct or through a dimmer resistance.

Mooring lamp and signalling lamp sockets

9.3. The mooring lamp is mounted in the top of the main aerial mast and is controlled, from either inside or outside the aircraft by a watertight switch, mounted on the side of the hull near the forward entrance door. The three signalling lamp sockets are mounted one on the captain's panel 1P one on the first officer's electrical panel and the other on 1C. Both inspection lamp sockets and the mooring lamps share the same fuse, which is housed in 1C and is connected directly to accumulator positive. It will thus be seen that these circuits are not controlled by the battery master switch and are, therefore, always operative.

10. INTERIOR LIGHTING

10.1. General. - The lamps and lighting fittings are located throughout the aircraft as follows. -

(a) Flight deck lighting - general. - Roof light above rest seat switch adjacent to seat - roof light at control cabinets and roof light above batteries switch at panel 6P. One light at Rear Spar bulkhead - directly controlled with built-in switch at lamp.

(b) Cockpit lighting. - Roof Lights - one at port side of roof controlled by switch at Captain's side panel 1P; one at starboard side of roof controlled by switch at First Officer's side panel 2P.

(c) Instrument panel. - Consists of ultra-violet lighting and a system of red lighting. Ultra-violet - six lamps, four mounted on the lighting screen situated and hinged, top of main panel and one each at the port and starboard sides of the hull directed on to the panel. These lights are controlled as follows.

Port lamp on lighting screen and port lamp at hull side- Rheostat switch on Captain's panel 1P.

Two centre lamps on lighting screen - Rheostat (marked centre U/V lights) at First Officer's panel 2P.

Starboard lamp on lighting screen and starboard lamp at hull side - Rheostat switch at First Officer's panel 2P.

(d) Red lighting. - Consists of 4 lamps - two on lighting screen and one at each side of panel. The port light on the screen and the port light on the instrument panel are controlled by one Rheostat switch on Captain's panel 1P. The starboard light on screen and the starboard light on the instrument panel are controlled by one Rheostat switch on First Officer's panel 2P.

(e) Compass lighting. - One light mounted above each P10 compass controlled by an ON-OFF switch at Captain's panel 1P.

(f) Captain's panel 1P. - One light for panel controlled by ON-OFF switch mounted on panel.

(g) Navigator's station. - Strip lighting and a small panel light - controlled by switches on panel 7P.

(h) Radio station. - One G.E.C. berth type lamp and two radio instrument lamps controlled by switches at Radio Officer's side panel.

(i) Engineer's station. - Two G.E.C. berth type lamps - switches on Engineer Officer's side panel. Angle-poise - switch at forward face of Engineer Officer's side panel.

(j) Cabin lights. - The main lights are controlled by switches located in each cabin, these switches are three-way - DIM - OFF - BRIGHT

(k) Reading lights. - Small hidden lamps located in roof above each passenger seat. Switches for these lamps are located adjacent to each seat.

(l) Sockets for inspection lamps and drift sight. - The inspection lamp sockets are located at those positions where, for servicing operations, a lamp may be required. The sockets are all supplied from the same fuse and are located as follows; in the mooring compartment, and one in each engine nacelle. As a precautionary measure the latter sockets are isolated, when not in use, by a switch on the Engineer Officer's side panel, 6P.

(m) Intercommunication call lamps. - Each member of the crew is provided with an intercommunication call lamp box located as follows:

(i)	Mooring compartment	On the port side of the hull just forward of the bulkhead.
(ii)	Captain	On panel 1P.
(iii)	First Officer	On panel 2P.
(iv)	Navigating Officer	On panel 7P.
(v)	Engineer Officer	On panel 4P.
(vi)	Radio Officer	On bulkhead aft of desk
(vii)	Tail Unit	On port side of hull tail unit.

Each of these boxes contains a push switch in series with a lamp. The lamps are all connected together in parallel on one side to earth, and the other through any of the switches to fused positive. Thus when any switch is pressed all the lamps will be illuminated.

(n) Steward's call lamp. - This installation consists of a lamp indicator and a buzzer in the galley, operated by push switches located; on panel 3P in cabins A, B, C, D, E and Promenade, and in the Ladies' and Gentlemen's dressing rooms. The circuit is arranged so that when a switch is pressed, its lamp on the indicator is illuminated and the buzzer sounds. This is achieved by operating the lamps and the buzzer by double-pole relays so that the pressing of a switch completes the positive supply to the operating coil of the relay concerned, causing its contacts to close and complete the positive supplies to its lamp and the buzzer.

(o) Passenger warning indicators. - Indicators to warn passengers to "fit oxygen masks","no smoking" and "fasten lap-straps" are fitted in Cabins A., B, C, D, E, the Promenade and the Galley. These three notices are illuminated by separate sets of lamps controlled by three switches.

The control switches are located as follows: Oxygen switch at Captain's panel 1P - No Smoking and Fasten Lap-Straps on roof panel 3P.

Lighting available when the Ground/Flight Master Switch is in the ground position. (See opposite page).

(p) Crew boarding lights. - 3 Lights - two in No. 1 Hold and one in roof of flight deck. These are dual-controlled by one switch at the bulkhead near front entrance and one switch at Captain's panel 1P.

(q) Passenger entrance light. - One light mounted in roof at rear entrance - switch at bulkhead rear entrance.

(r) Dim lights in cabins. - Dim lights in all cabins controlled by a switch in each cabin.

(s) Passage way and step lights. - Controlled by switch at port side of passage way adjacent to Gent's rear lavatory.

(u) Stairway light. -Switch mounted on wall at foot of stairway.

(v) Nos. 2 and 3 Hold lights. - Dual-controlled by one switch mounted at roof just aft of rear door in "E" Cabin and one switch mounted at port side hull aft of freight door.

(w) Mooring light. - Switch mounted forward of front entrance at port side, can be operated from outside or inside aircraft.

(x) Signalling sockets (Aldis lamp). - Sockets are positioned at the Captain's panel 1P, the First Officer's panel 2P, and at the charging and control box 1C 0 No switch fitted, circuit directly connected to battery positive.

(y) Engineer's emergency lighting. - Switch at Engineer Officer's side panel controls one light in each cabin.

(z) Charging control panel and battery roof light. - Switch mounted at forward face of Engineer Officer's side panel.

11. HEATING SERVICES

11.1. **Cabin heating** - For cabin heating a pair of spray type 62,500 B.T.U/HR Daniel "Dragonfly" heaters are installed one on each side of the hull just forward of, and below, the pilot's instrument panel. A special arrangement of boosted output is provided whereby if conditions cause the duct temperature to drop below 135°F then the fuel pressure applied to the jet is increased from 10 P.S.I. to 18 P.S.I. which increases the output to 84,000 B.T.U/HR per heater. The ventilating air supply enters the aircraft via scoops which are located one on each side of the hull and combustion air enters via composite scoops and exhaust outlets. The ventilating air is ducted to the burner end of the heater, and thence to the hot air distribution system. Air enters the combustion chamber via combustion air regulators (these reguatlors being designed to provide a constant mass flow irrespective of speed and altitude) and the exhausts are connected to the outlet connections on the composite scoops. This arrangement is made so that the exhaust heat prevents the small combustion air intakes from being iced up. Fuel is fed to the unit by an electrically driven pump, situated in the starboard wing via a heater fuel control unit, the purpose of which is to govern the operation of the heater by controlling the fuel pressure applied to the jet. The electrical control of the system is as follows:- Closure of the Master Switch puts electrical supply to the air and fuel pressure switches. The air pressure switch closes at an air speed of 80 knots, and the fuel pressure switch is closed when the desired pressure from the pump has been reached. The electrical circuit to the heater switches is completed and if they have been switched on, electrical power is available to operate the two heaters. An indicating light in series with the fuel pressure switch is provided to give indication of adequate fuel pressure. Start switch should not be operated if fuel pressure light is not illuminated.

11.2. Operation of the start push button closes the spark plug circuit, main fuel valve circuit, the supply (boost) valve circuit, the supply (low heat) valve circuit and, if its switch is closed, the restriction (high heat) valve circuit.

11.3. When combustion has commenced and the air temperature reaches 120°F. contacts in the Thermo Switch Control Unit open and break and spark plug circuit. An additional pair of contacts in the boost thermostat will open and break the boost supply circuit at a predetermined temp. (approx. 160°F) and the system then operates under normal electrical control for "HIGH" and "LOW". A further pair of contacts in the overheat thermostat switch will open and shut down the whole system should a temperature of 350°F. be reached.

11.4. The air pressure switches automatically close the whole system down if the Master Switch is inadvertently left on while alighting. (See note after next para.)

11.5. Urn supply.- The hot-water supply for domestic purposes is provided by an electrically heater urn mounted on the port side of the galley. The supply to the urn is controlled by a circuit breaker housed in 2C and controlled in turn by a pair of push switches on the panel in the galley. When the ON switch is pressed it energizes the operating coil of the circuit breaker, causing its contacts to close. The main contacts then complete the supply to the urn and the auxiliary contacts complete a separate positive supply, through a resistance, to the operating coil. This latter supply is via the contacts (normally closed) of the OFF switch. It will thus be seen that the circuit breaker will remain closed until the OFF switch is pressed. An indicator lamp, connected in parallel with the urn, is mounted on the panel with the switches.

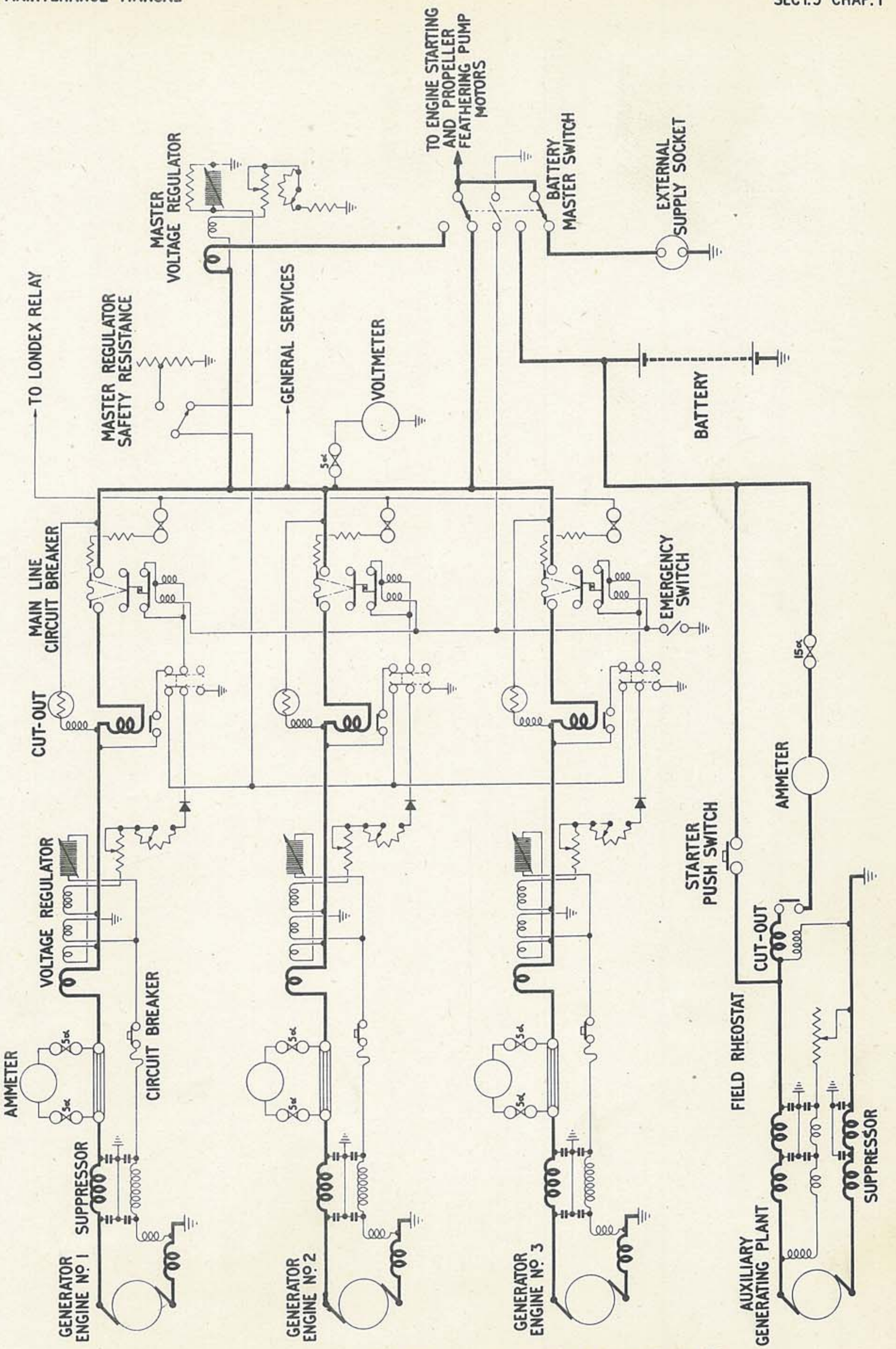
NOTE... This circuit is subject to those conditions given in the following paragraph.

11.6. Cooker. - The supply for the cooker is controlled by a switch mounted on the panel in the galley. When this switch is closed it energizes the operating coil of the domestic circuit breaker in 2C, causing its contacts to close and complete the supply to the cooker.

NOTE... This circuit is subject to those conditions given in the **para.** on "Domestic Supply and Propeller Feathering Interlock".

11.7. Immersion heaters. - Three G.E.C. type water heaters are installed - one in the Ladies' and one in each of the Gentlemen's Dressing Rooms. The supplies for the elements of these heaters are controlled by switches on the panel in the galley, which each complete the supply to the operating coil and contacts of a relay for one of the heaters. The earth returns for these relay coils are controlled by thermostats in the heaters themselves.

11.8. Domestic supply and propeller feathering interlock. - To ensure that the domestic load is not on the system during a feathering operation, the interlocking circuit in fig. 15 is installed. Reference to this diagram shows that the "holding-in" circuit of the circuit breaker in 3C (which supplies the control fuses for cabin heating, cooker and urn supply) is controlled by an interlock relay. The contacts of this relay are normally closed and are only opened when a positive supply from any of the feathering push switches energizes its operating coil. From the diagram it will be seen that the opening of the relay will have the same effect on the circuit as the pressing of the STOP push switch. It is therefore necessary to press the START AND RESET push switch to re-close the circuit breaker after a feathering operation. An indicator lamp mounted with the push switched on the master switch panel, 5P, is connected between the switched side of the main circuit breaker contact and earth.



GENERATOR CONTROLS

FIG. I

ISSUE	DATE
1	20-3-47
2	18-10-48
3	28-2-51

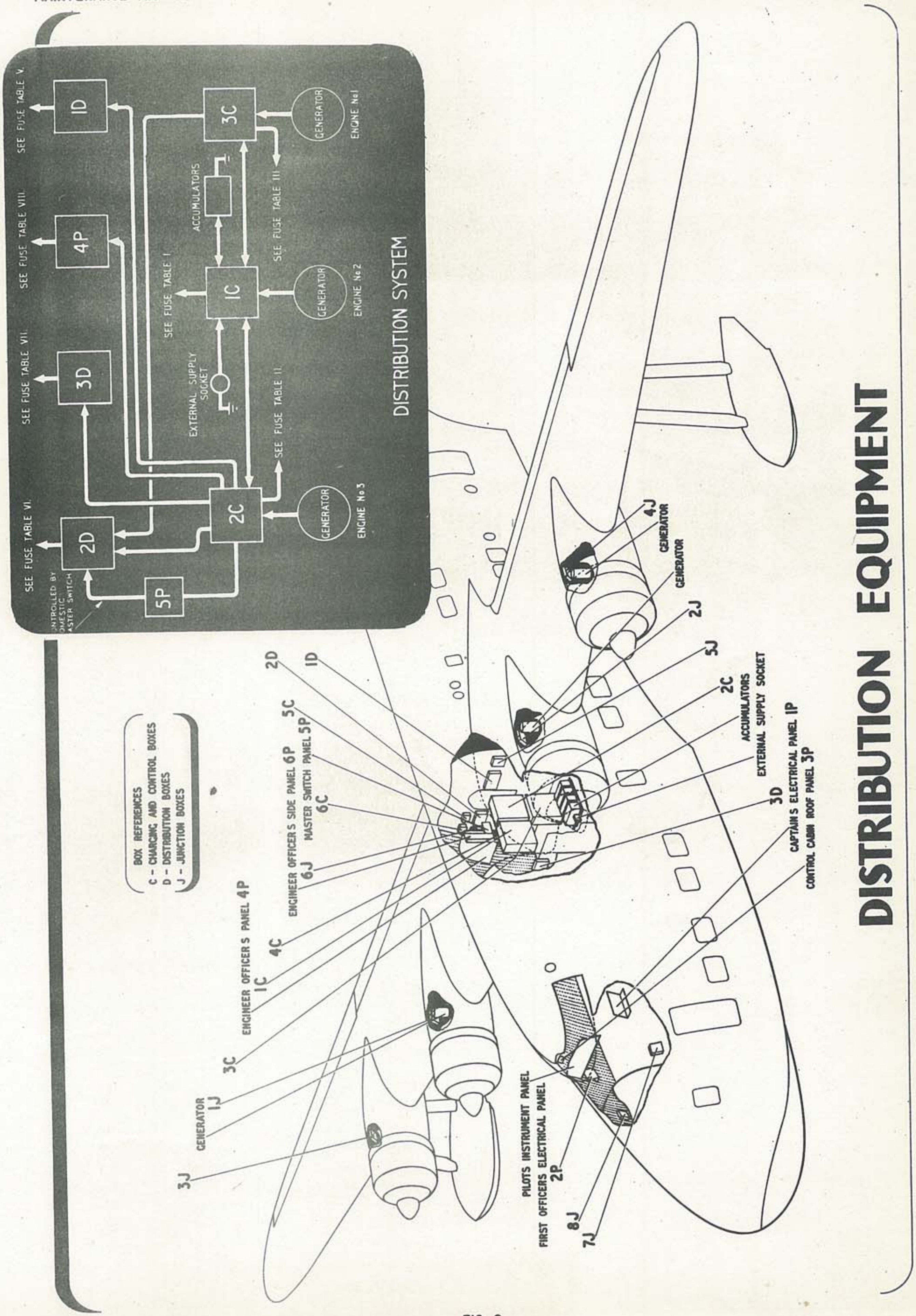

DISTRIBUTION EQUIPMENT
DISTRIBUTION SYSTEM
SEE FUSE TABLE V.
SEE FUSE TABLE VIII.
SEE FUSE TABLE VII.
SEE FUSE TABLE VI.
SEE FUSE TABLE I
SEE FUSE TABLE II
SEE FUSE TABLE III
1D
4P
3D
2D
5P
2C
1C
3C
ACCUMULATORS
EXTERNAL SUPPLY SOCKET
GENERATOR
ENGINE No 1
ENGINE No 2
ENGINE No 3
BOX REFERENCES
C - CHARGING AND CONTROL BOXES
D - DISTRIBUTION BOXES
J - JUNCTION BOXES
ENGINEER OFFICERS PANEL 4P
ENGINEER OFFICERS SIDE PANEL 6P
MASTER SWITCH PANEL 5P
4C
5C
6C
6J
GENERATOR
1J
3J
4J
2J
5J
ACCUMULATORS
EXTERNAL SUPPLY SOCKET
CAPTAINS ELECTRICAL PANEL 1P
CONTROL CABIN ROOF PANEL 3P
PILOTS INSTRUMENT PANEL
FIRST OFFICERS ELECTRICAL PANEL 2P
8J
7J

FIG. 2

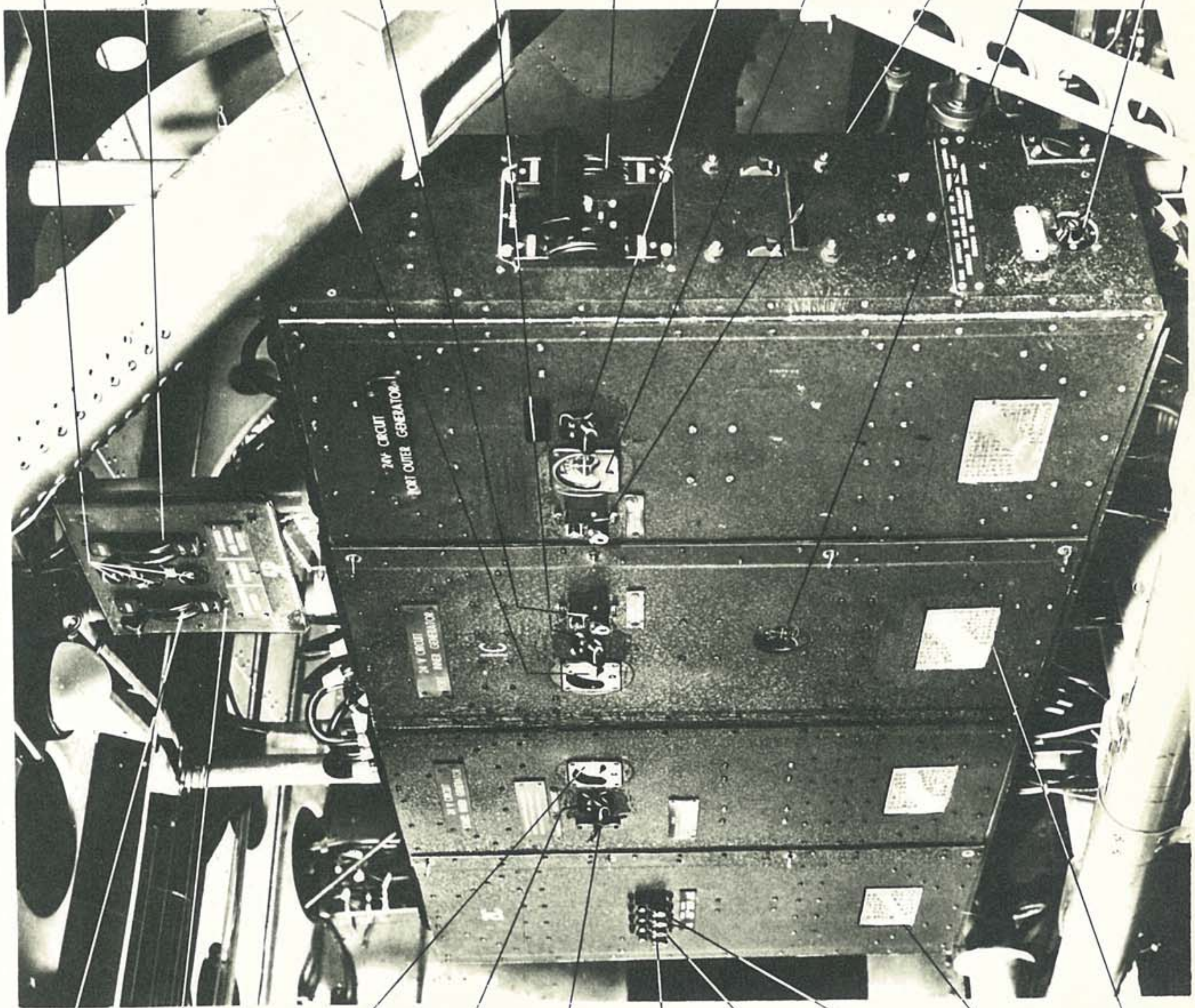
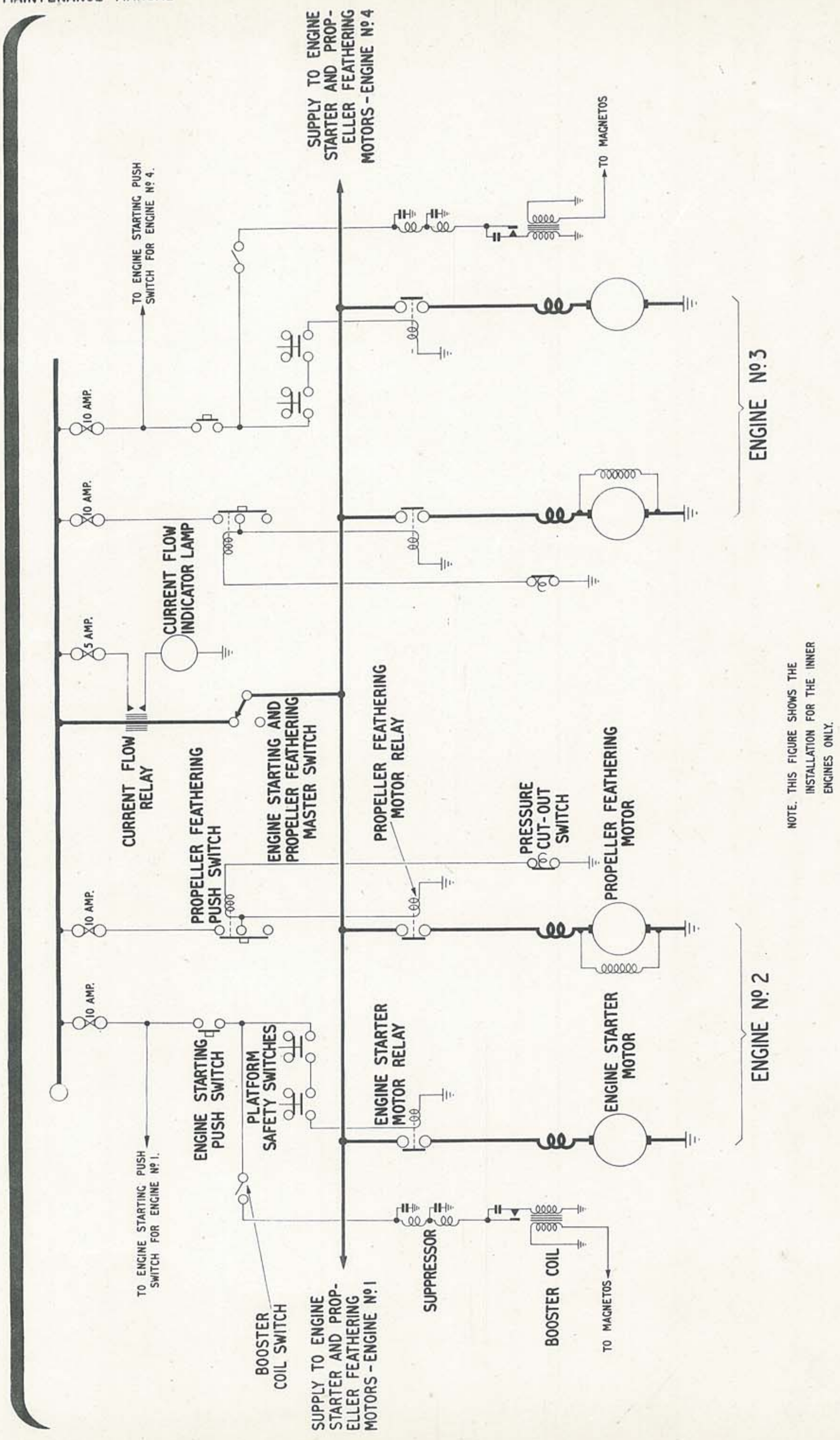


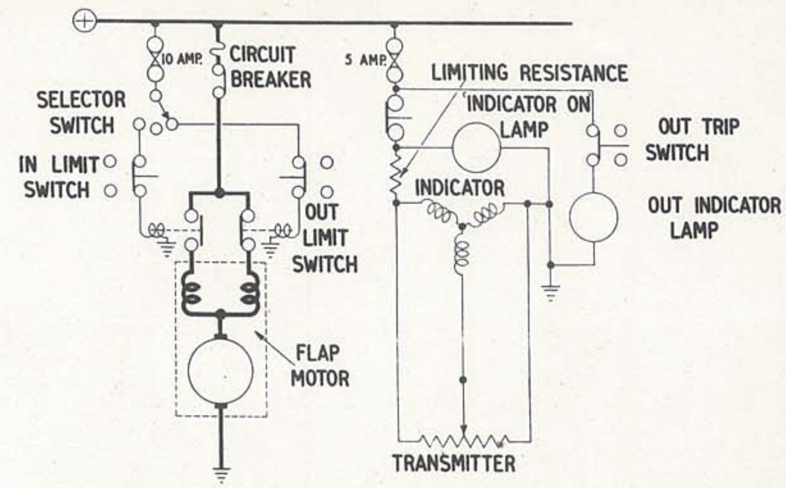
FIG. 3 MAIN ELECTRICAL CONTROL EQUIPMENT



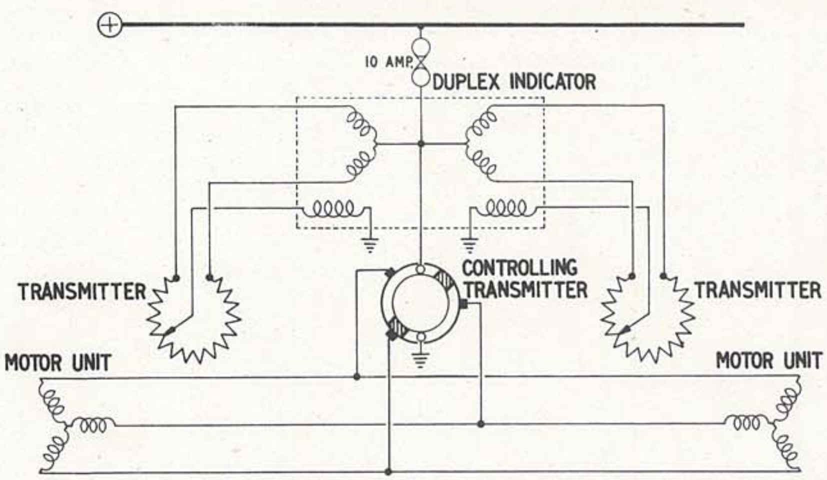
ENGINE STARTING AND PROPELLER FEATHERING

FIG. 4

FIG. 5



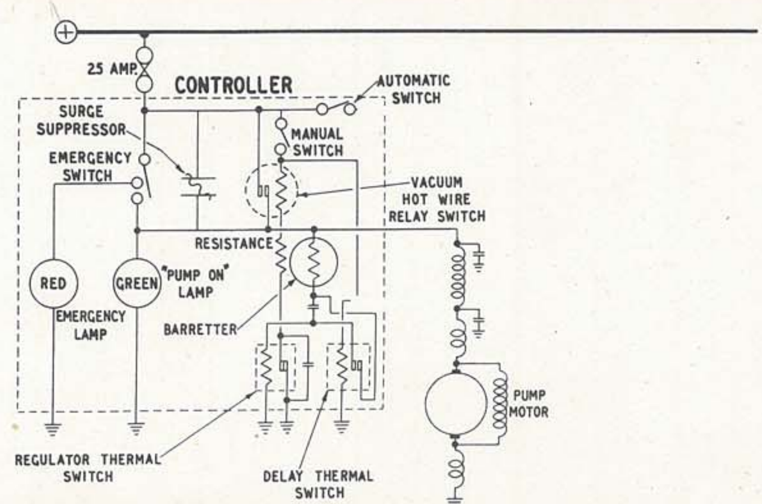
FLAP MOTOR AND INDICATORS.



AILERON TRIM TAB CONTROLS

FIG. 6

FIG. 7



AEROFOIL DE-ICING SYSTEM

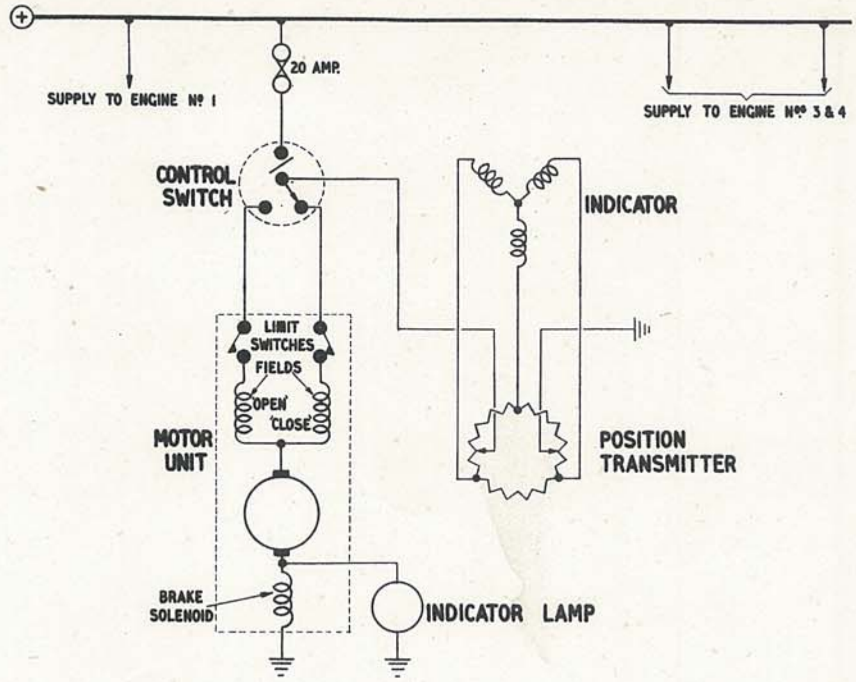


FIG. 8

COWL GILL MOTORS AND INDICATORS

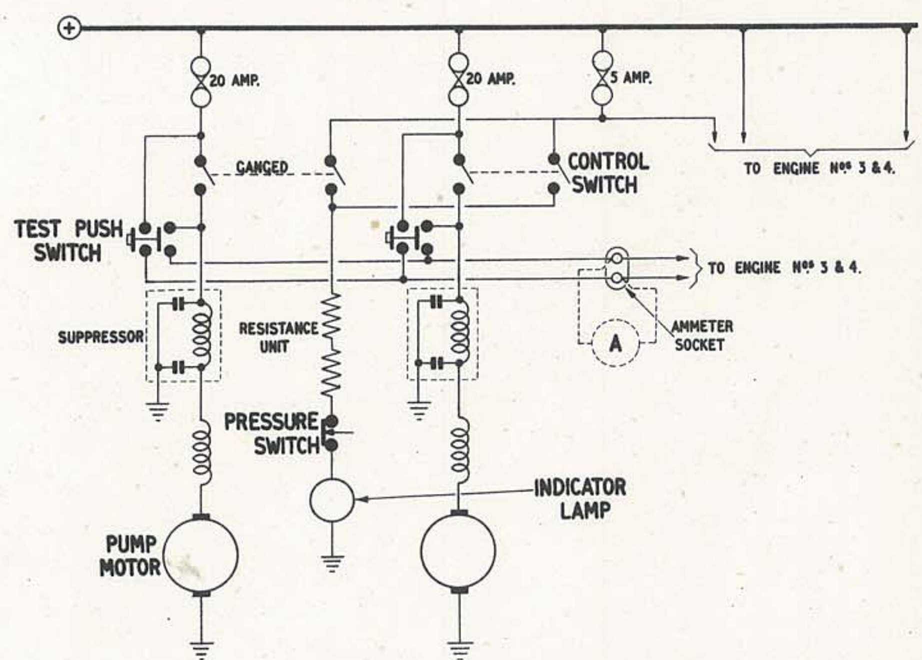
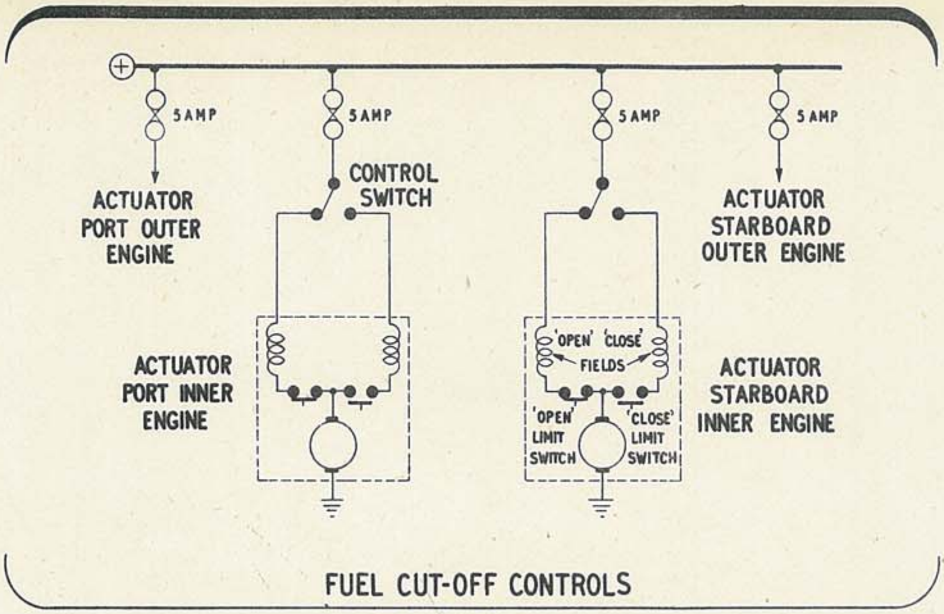


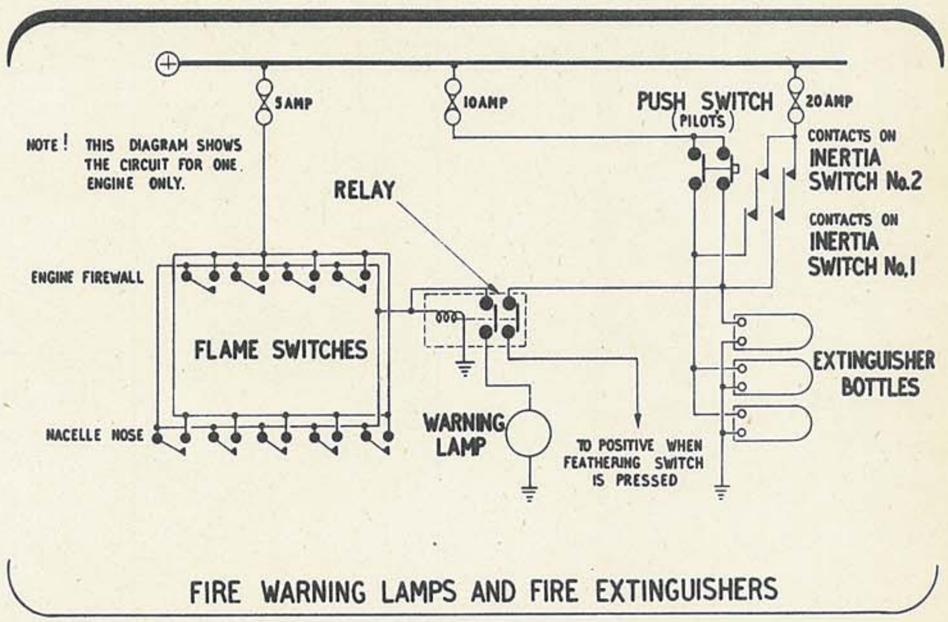
FIG. 9

FUEL PUMP MOTORS AND FUEL PRESSURE WARNING LAMPS



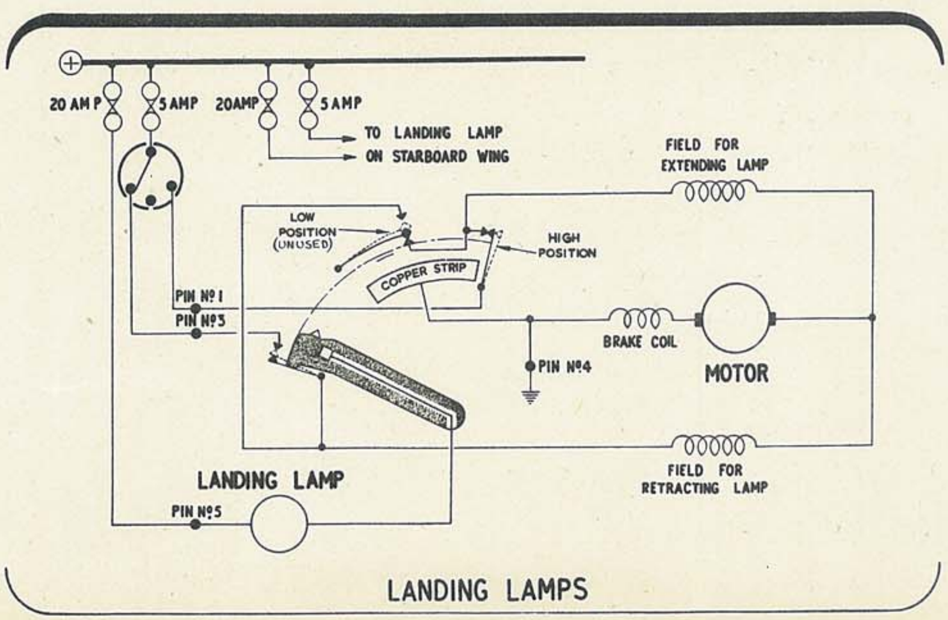
FUEL CUT-OFF CONTROLS

FIG.10



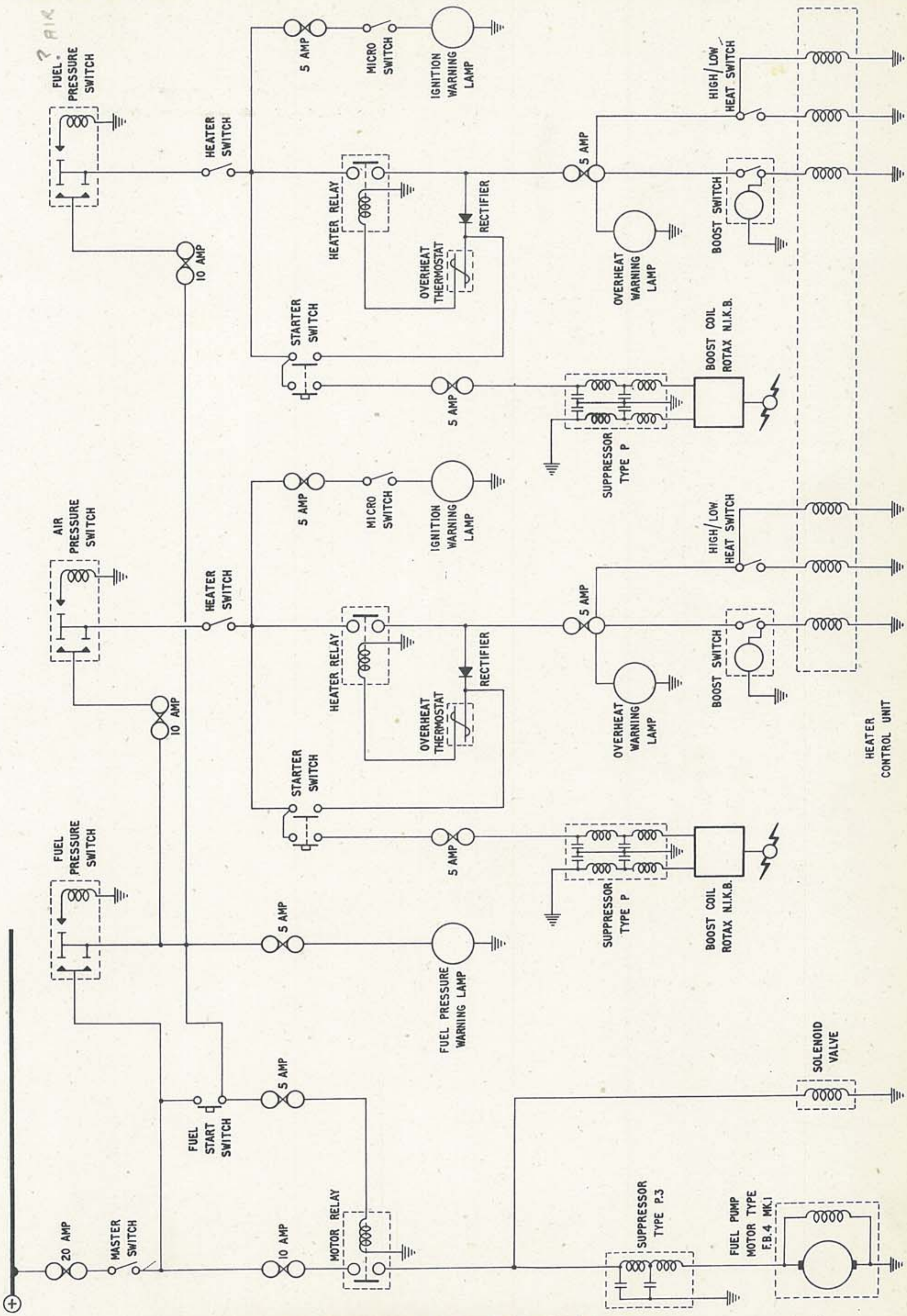
FIRE WARNING LAMPS AND FIRE EXTINGUISHERS

FIG.11



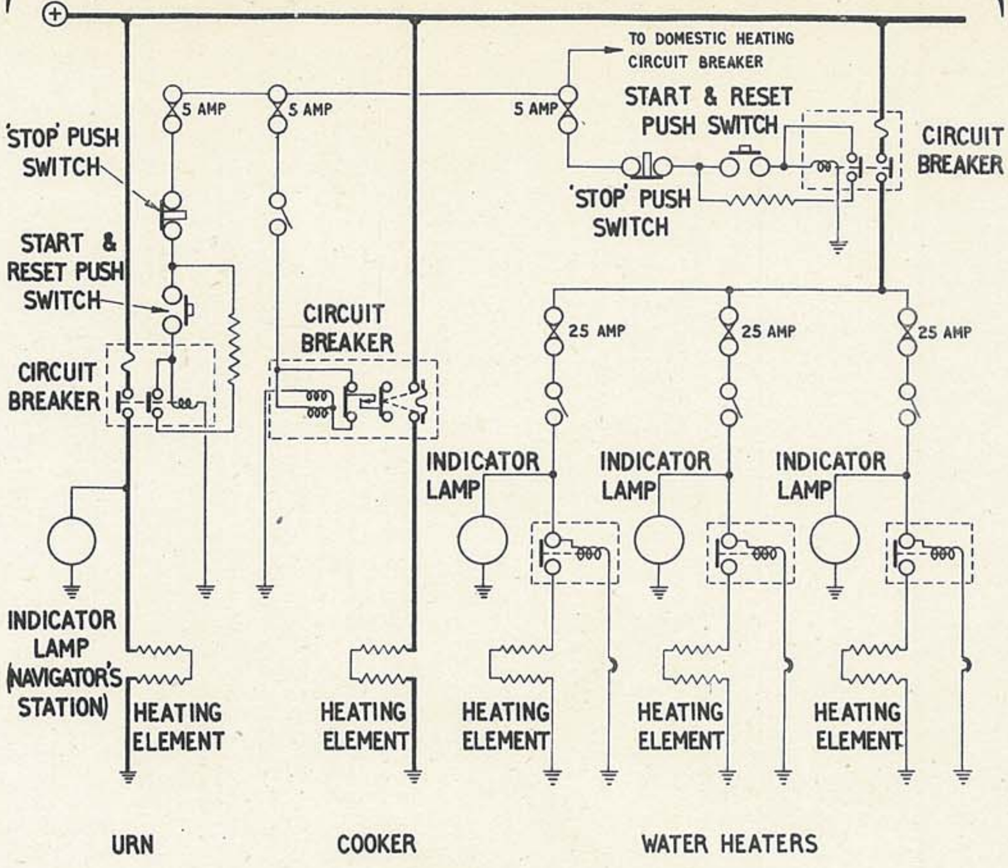
LANDING LAMPS

FIG.12



CABIN HEATING

FIG. 13



WATER HEATERS COOKER AND URN

FIG. 14

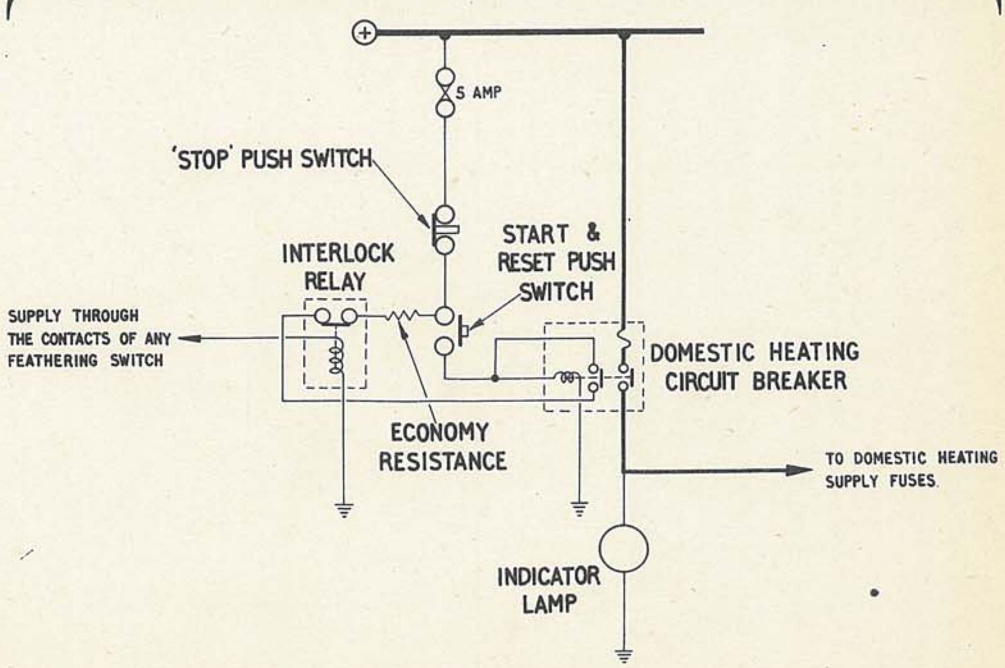


FIG. 15

DOMESTIC HEATING AND PROPELLER FEATHERING INTERLOCK

SOLENT 3

MAINTENANCE MANUAL

SECTION 5 CHAPTER 2

ELECTRICAL INSTALLATION - SERVICING

Contents

Illustrations

Introduction

1. The purpose of this chapter is to provide instructions for the servicing and adjustment of the various components of the electrical installation. Its scope is mainly confined to the equipment as installed in the aircraft, and consequently does not include instructions for lengthy bench tests on individual items. For this latter information reference should be made to the relevant manufacturers, or A.M. publications.

2. CONTROL BOXES

2.1. The generator controls and main contactors are housed in the three main control boxes (1C, 2C and 3C) mounted on the port side of the centre section, as illustrated in fig. 3, in the previous chapter. The boxes themselves are shown in detail in figs. 16, 17 and 18, their wiring diagrams being given at the end of the next chapter. The electrical components on the control boxes are as listed in the following paragraphs, the figures in parenthesis after certain items giving the number off.

2.2. Charging and control box 1C - This box, which serves the generator on engine No. 2 and carries the controls for engine No. 1, contains the following major items of equipment, located as shown in fig. 16. -

Items on Fig. 16	
9	Voltage regulator Type 23
4	Voltage regulator Type 32 (Master)
10	Cut-out Type A.
6 & 21	Circuit breaker type B, No. 1 (2)
2	Circuit breaker type D No. 1
18	Circuit breaker B.T.H. Type XL.70
12,13,14,15	Relay switch type J (4)
17	Master switch type D.
3	Voltmeter type A (0-40 volts)
8 & 20	Ammeter 50-0-200 amps (2)
11	Shunt 200 amps. (50 millivolts)
24	Rotary switch (fitted with stop)
23	Fixed resistance "Berco" type R.A.H/K.7
5 & 22	Fuse block 3-way "Crabtree" type A.W.S.1241 (3)
19	Circuit breaker re-set switches.

2.3. Charging and control box 2C - This box, illustrated in fig. 17, serves engine No. 3 only and houses the following major items of equipment. -

Items on Fig. 17	
8	Voltage regualtor Type 23
9	Cut-out type A.
7	Circuit breaker Type A, No. 3.
4,5 & 6	Circuit breaker Type A, No. 6 (3)
3	Circuit breaker Type B, No. 1
1, 23	Circuit breaker Type D, No. 1
11,12,13) 14,15,16)	Relay switch Type J (6)
22, 24	Relay switch Type P No. 1, 24 volt (4)
21	Resistance unit type A, No. 3
19	Circuit breaker re-set switches

Items on Fig. 17 (Contd.)

18	Ammeter 50-0-200 amps.
10	Shunt 200 amps. (50 millivolts)
20	Emergency control switch type B.
2	Fuse block 3-way "Crabtree" type A.W.S.1241.

2.4. Charging and control box 3C - The manually operated controls and ammeter for engine No. 1, which this box serves, are mounted on 1C. The following equipment, housed in the box, is located as shown in fig. 18. -

Items on Fig. 18

5	Voltage regualtor type 23.
4	Cut-out Type A.
3, 7	Circuit breaker Type B, No. 1 (2)
1	Circuit breaker Type D, No. 1
6	Relay switch Type P, No. 2
9	Resistance unit Type A, No. 3
8	Fuse box Type B
2	Shunt 200 amps. (50 millivolts)

3. CHARGING & DISTRIBUTION EQUIPMENT

3.1. Generators - At the periods laid down in the maintenance schedule the commutator covers should be removed and the brushgear, commutator, and internal wiring examined for condition and security. At the same time the end covers should be removed and the external connections examined for condition and security. Check all nuts unions and fixing screws for security and tighten where necessary. If it is required to remove a generator for lubrication or more detailed servicing, as given in AP.1095C Vol. 1 Sect. 5 reference should be made to Sect. 9. The leading particulars of this type of generator are given below. -

		Stores Ref.
Generator type P.2	Clockwise rotation	5U/4531
Output	200 amps at 30 volts	
Speed range	(3,250 - 4,800 r.p.m. (continuous (6,000 r.p.m. max. speed (for 5 minutes	
Brushes	Type EG12/2 H.A.M.	5U/4196
Brush spring pressure	17-19 oz.	
Lubricant	Oil, lubricating	34A/60
Weight	57 lb.	

Resistance of field windings at 20 deg.C. 1.5 ohms ± 10 per cent.

3.2. Lubrication of the bearings does not necessarily involve complete dismantling of the generator. It is sufficient to remove the driving end and commutator end outer bearing caps. This will give access to the felt reservoir pads. If the bearings require cleaning, however, or it is necessary to examine the inner felt pads the generator will have to be dismantled.

3.3. To dismantle a generator for lubrication the following procedure should be observed. -

(a) Unlock and remove the screw securing the driving end cover band and also the two screws securing the commutator cover band.

(b) Remove the four bolts and locking washers holding the screwed cable union and the seven bolts and washers holding the two sections of the end cover.

(c) Unlock and unscrew the four nuts ecuring the outer bearing cap at the commutator end and remove the cap and reservoir felt, gasket, plain felt washer and outer felt retaining disc.

(d) Unlock the tab-washers and remove the bolts securing the end frame to the yoke.

(e) Lift the brushes from the brush boxes

(f) Tap the armature shaft with a hide-faced hammer to free the driving end frame from the yoke, and remove the armature and end frame together.

The bearings may now be removed from the armature shaft using bearing extractors.

3.4. The felt pads should be saturated with oil (Stores Ref. 34A/60) and the surplus lightly removed before assembly. In addition care must be taken to ensure that the felt pads at the driving end are slightly above the top of the well surplus oil being removed before assembly in the end frame.

3.5. Brushes should be removed and renewed if worn below 85 per cent of their original length. This can best be checked by comparing the brushes with a new one. It is important that the brushes are an easy sliding fit in their holders adn that the correct brush spring pressure (see para.3.1)is maintained. All carbon dust should be removed using, if available, an air blower.

3.6. After the various parts have been examined and cleaned, and before assembly, the following tests of insulation resistance should be made with a 250 volt megger.

(a) Field winding to frame.
(b) Brush gear and terminals to frame.
(c) Armature winding to shaft.

The resistance in each case should not be less than 0.3 megohms. The insulation resistance of the armature may sometimes be found to be lower than the value given above although the armature may otherwise be in good order. This is almost invariably due to the presence of moisture, and the trouble can usually be overcome by keeping the armature in a dry atmosphere at a temperature not exceeding 100°C. If, after this treatment, the insulation resistance fails to recover to the required value the armature should be replaced.

3.7. <u>Voltage Regulators</u>. The following tests should be carried out either when new regulators are installed or when faulty operation of existing regulators is suspected. It is important that a test meter of known accuracy, and not the aircraft voltmeter, is used for these tests.

VOLTAGE REGULATOR TYPE 23

Each regulator should be tested separately after placing a shorting link across terminals 3 and 4 on the master regulator type 32.

(a) Place the battery master switch at GROUND
(b) Place the circuit breaker emergency switch at ON.
(c) Connect the test meter across terminal 2 of the cut-out, type A, and earth.
(d) Check the regulators in turn by running each engine separately at 2000 r.p.m. and check that each maintains the line voltage at 22 volts and NOT 28 volts.
(e) Adjust the voltage to 22 volts by means of the trimmer or vernier resistance in the base of the regulator.
(f) Increase the engine speed from 2000 to 3000 r.p.m. and check that the line voltage is maintained within 0.5 volts.
(g) Remove the shorting link from terminals 3 and 4 on the master regulator

VOLTAGE REGULATOR TYPE 32

(a) Remove the shorting strip from terminals 3 and 4 if this was not done after the previous test which should always be carried out first.
(b) Check the mechanical setting of the regulator by pressing the re-set button and noting that the arrow on the magnet clapper comes into line with the mark on the scale.
(c) Check that the battery master switch is at GROUND
(d) Run two engines at 2000 r.p.m. and note that the line voltage is maintained at 28 volts; measured by connecting the test meter across terminals 1 or 2 and earth. If the line voltage is not 28 volts, adjust it to that value by means of the trimmer incorporated in the regulator.

COMPLETE SYSTEM

(a) To check the complete system for balance, one engine should be selected as master and the others run up separately with it for the following test.
(b) Assuming that No. 1 has been chosen as the Master engine, connect a centre zero 20-0-20 ammeter across terminals 1 and 2 of the main circuit breaker for engine No. 2. With both engines running at the same speed (2000 r,p.m.) and the circuit breaker re-set button pressed, the readings of the ammeter should be between 0 and ± 10 amps. If the reading is outside these limits, adjust the trimmer of one regulator, type 23, until the circulating current is reduced to within the limits.
(c) Repeat the above test for engine No. 3, adjusting its trimmer if required. On no account should the trimmer on No. 1 regulator be touched at this stage.

NOTE... It is important to realise that the regulator raises the voltage when it is hot. Consequently final adjustments should be made after the regulator has been working for sufficient time to achieve its maximum temperature.

Provided that the above conditions are met, then the system should operate satisfactorily.

3.8. Cut-out Type A. - These cut-outs should require very little servicing, and provided they are functioning satisfactorily, they should be interfered with as little as possible. At periodic inspections the recommended procedure is as follows. -

(a) Set GROUND/FLIGHT **switch at** GROUND

(b) Armature. - Check that the armature suspension is satisfactory by moving the armature from the contacts-open to the contacts-closed position, and vice versa. In each case the armature should snap over positively from about the mid-position of its travel, and remain in either the closed or open position under the influence of the permanent magnets.

(c) Contacts. - Examine the palladium contacts to ensure that they are not unduly pitted. If the pitting is sufficiently bad to require re-facing of the contacts, the cut-out should be removed from the aircraft for the purpose. During this operation, the cut-out must be held in such a position that swarf does not fall into the relay, as absolute cleanliness is essentual for efficient functioning.

(d) If the pitting of the contacts is such that after re-facing there does not appear to be adequate contact material left for a further servicing period, the cut-out should be renewed, and the old unit be returned for repair. If, however, the contacts are in good condition and adequate thickness of contact material is left after re-facing, the cut-out should be submitted to the tests outlined in para.(j) to (s).

(e) Ballast lamp. - Examine the filament of the ballast resistance lamp. There should be no evidence of the filament sagging in its supports, or discoloration of the inside of the bulb. The current should be between the following limits. -

at 30 volts, 0.452-0.499 amp.
at 20 volts, 0.37-0.408 amp.

If faulty, the lamp should be renewed.

(f) Check that all internal and external connections are secure.

(g) Re-fit the cover

Note... The cover should not remain off longer than necessary.

(h) Functioning. - Start the engine, and slowly increase the speed until the differential cut-out contacts close. This should take place when the generator voltage is 0.35 to 0.75 volts above that of the accumulator or bus-bar, as measured between terminal 1 of the cut-out and terminal 2 of the circuit breaker.

Note... A sufficiently sensitive voltmeter should be used for this purpose.

Should the differential voltage be slightly above the top limit of 0.75 volts, it is not recommended that any attempt be made to re-set the value within the above mentioned limits as no harm will result.

(i) Slowly decrease the engine speed until sufficient current flows from the the accumulator to the generator to open the differential cut-out contacts. This should occur at a reverse current of between 15 to 25 amp., but no action need be taken if the upper limit is slightly exceeded.

TESTING

Differential pick-up voltage

(j) Connect the cut-out to a 2-volt accumulator through a potentionmeter.

(k) With the armature in the contacts-open position, increase the voltage across terminals 1 and 3 until the armature snaps over to the contacts-closed position; the voltage value at which this occurs should be between 0.35 and 0.75 volts. If the figure obtained is outside this range, the adjusting screw in the relay side plate to which access is gained through the hole in the side of the case, should be moved until the armature snaps over at the required value.

NOTE..... The Mk. 2 cut-out has no screwed plug; adjustment is made after removal of the top cover

(l) When the correct setting is obtained, the test sequence should be repeated a few times to ensure that the setting is stable.

(m) Reverse drop-out current - Connect the cut-out to a 2-volt accumlator through a rheostat,

(n) With the armature in the contacts-closed position, set the current through the series coil to approximately 20 amp., and gradually advance the adjustable contact screw until the armature snaps over to the contacts-open position.

(o) Decrease the current through the series coil and re-close the contacts by hand.

(p) Increase the current, and check that the armature snaps over from the contacts-closed to the contacts-open position when the current is between 15 and 25 amp.

NOTE..... The checking process given in para. (o) and (p) should be repeated several times.

(q) After testing, the two adjusting screws should be sealed with cellulose paint and the covers re-fitted.

NOTE.... The covers should not remain off longer than necessary.

(r) If for any reason the correct differential voltage and reverse drop-out current settings cannot be obtained, a new unit should be fitted and the old one returned for repair.

(s) Final check after re-fitting in aircraft - Re-fit the cut-out in the aircraft, and check the differential pick-up voltage and the reverse drop-out current, as described in para. (h) and (i). Re-adjust in situ if necessary, afterwards sealing the screws with cellulose paint and re-fitting the covers.

3.9. Circuit breakers, type D. - Little or no servicing can be done whilst the unit is installed in the aircraft and only the items outlined in this paragraph should be attempted. For all other adjustments the circuit breaker must be taken from the aircraft and removed to the workshops.

(a) Examine the contacts for signs of burning. The outer (arcing) contactor will invariably show some sign of blackening. It should be appreciated that the breakers are examined to obtain an indication of condition and reliability only, any remedial action can only be taken when the breaker has been removed for attention in the workshops.

(b) Check all cable connections ensuring that they are clean and that the terminal screws are firmly secured.

3.10. For more detailed servicing in the workshops, the front cover should be removed and the following procedure carried out. -

(a) Examine the surface of the arcing contacts to ensure that there are no beads of fused metal present.

(b) If the contacts are in good condition, check the gap between the outer stationary (arcing) contacts and their respective moving contacts, which should be not less than 0.095 in.

(c) Check the gap between the four inner stationary contacts and their respective moving contacts. To enable the arcing contacts to break the circuit and carry the arc, this gap setting should be greater than that of the arcing contacts.

(d) Check the auxiliary contact operating buttons for security in their brackets.

(e) Re-install the circuit breaker in the aircraft.

Do not attempt to close the circuit breaker manually except by pressing on the armature. The auxiliary contact buttons and brackets must be handled with great care, and only when absolutely necessary. Do not tamper with sealed screws and nuts, and if the unit proves faulty, remove, replace with new, and return the faulty breaker to the manufacturers.

3.11. Circuit breakers, type A - The interior of this type of circuit breaker is inaccessible as the pins and shafts passing through the case are riveted over, therefore inspection can only be operational. At the periods laid down in the maintenance schedule, the following tests should be carried out. -

(a) Check the closing and tripping operations a number of times making sure tha, after tripping, the breaker is resetting correctly. If the internal levers do not re-set, the 'close' push button will not operate the contacts.

(b) Pass twice the normal rated current (marked on the circuit breaker housing) through the breaker and check that it trips in the time stated below for the ambient temperature prevailing.

TEMPERATURE	TIME
10°C	14-40 secs.
20°C	12-32 secs.
30°C	11-23 secs.
40°C	10-24 secs.

(c) With the breaker in the open position, test between the terminals with a 250volt insulation resistance tester. With the breaker closed, test between the terminals and the case or the mounting studs. The minimum insulation resistance in each case should be 20 megohms.

The thermal trip adjusting screw is set and sealed by the manufacturers and therefore MUST NOT be altered. Should the breaker fail to satisfy the requirements laid down in the preceding paragraphs, it should be replaced and the faulty unit should be returned to the manufacturers.

3.12. Circuit breaker type B. - At the appropriate inspection periods the circuit breaker should be removed from the aircraft and submitted to the following tests.

(a) Remove the front cover which exposes the breaker and its mechanism. Examine the contacts and if any fused beads of metal appear on the contacts remove them with a thin dead-smooth file. Care should be taken to remove the minimum material and to blow away any particles of metal which may otherwise collect on the insulators.

(b) Close the breaker electrically and measure the gap between the contact setting-screw, in the backing spring near the moving contact, and the duralumin bridge. The manufacturers' setting for the gap is 0.015 - 0.018 in., but the breaker may be considered serviceable if the gap is not less than 0.01 in. If the gap is less than 0.01 in. the contacts should be adjusted by means of the contact setting screw.

(c) Open the breaker and check that the gap between the main contacts is 0.1 ± 0.01 ins.

(d) Check the contact pressure by closing the breaker electrically and pulling off each main contact in turn, using a spring balance and a loop of string round the Berrylium spring adjacent to the moving contact. Connect a battery with a lamp or bell across the main terminals to give an indication when the contacts have separated. The pressure given by the spring balance should read between $3\frac{1}{2}$ and $4\frac{1}{2}$ pounds when the contacts separate. If the contact pressure is below $3\frac{1}{2}$ pounds excessive heating may occur; if above $4\frac{1}{2}$ pounds the breaker will not close at 66 per cent normal voltage. No attempt should be made to bend the contact fingers to correct such errors.

(e) Check that the auxiliary switch contacts are closed at least 0.015 in. before the end of the closing stroke of the breaker. To measure this, first connect a battery and a lamp or bell in series with the auxiliary switch contacts and then close the breaker electrically. Release the breaker slowly, rstraining it by hand. Measure the movement between the tip of the bridge to the stop in two positions.

i.e. when the breaker is closed and when the lamp is extinguished or the bell ceases to ring. The difference between the two measurements should not be less than 0.015 in. for reliable operation.

To obtain greater access to the contacts and mechanism, remove the stop plate that bears against the extension of the contact bridge when the breaker is open. To do this, remove the two screws that hold the stop plate to the terminal block. When the stop plate is removed the contact bridge and armature assembly can be swung open revealing the mechanism. Care should be taken not to lose the two springs from the magnet poles. In their present position the contacts are more accessible for trimming. Ensure that the latch is free and the leaf spring keeps the latch in the "engaged" position. Care should be taken not to damage the Berrylium sheet on the face of the armature. When the internal inspection is complete, replace the armature; throw off the springs and see that they are correctly located on the armature. Replace the stop plate by placing it over the bridge extension and closing the breaker by hand. Put the stop plate in position and insert the fixing screws through the terminal block and screw down tightly.

N.B. The Twi-clips on the ends of the small shaft through the armature are not safe for use after they have been taken off. They should not, therefore, be removed unless new ones are available.

3.13. The following electrical tests should also be carried out before a breaker is re-installed in the aircraft. -

(a) With a 250 volt insulation resistance tester, check that the insulation resistance between the main or auxiliary, terminals and the case exceeds 20 megohms.

(b) Check the operation of the breaker on the minimum closing voltage of 16 volts. This operating voltage refers to breakers with their coils cold, i.e. at 20°C.

(c) Check that the voltage drop across the terminals does not exceed 180 milli-volts at the normal rated current.(100 amps).

(d) Ensure that, when carrying 200 per cent normal rated current, the breaker trips within the times quoted below at the ambient temperature prevailing.

Temperature	Time
10°C	60-200 sec.
20°C	50-150 sec.
30°C	40-120 sec.
40°C	35-100 sec.

If a breaker fails to satisfy the requirements laid down in the preceding paragraphs, it should be replaced with a new or reconditioned unit; the faulty breaker being returned to the manufacturers.

3.14. Generator (A.G.P.) - At the appropriate inspection periods, the commutator covers should be removed and the brushgear, commutator and internal and external wiring examined for condition and security, and all nuts and fixing screws examined and tightened where necessary. The leading particulars of this type of generator are as follows:-

			A.M. Stores Ref.
Generator Type HZ	...	Anti-clockwise rotation	5U/517
Output	...	20 amps at 29 volts	
Speed range	...	4000-5000 r.p.m.	
Brushes	...	Type E.G.O.	5U/741
Brush Spring pressure		10-12 ozs.	
Lubricant	...	Grease ...	34A/89
Weight	...	$23\frac{1}{2}$ lbs.	

Resistance of Field Winding at 20°C ... 13 ohms ± 10 per cent.

3.15. To dismantle the generator for lubrication the following procedure should be adopted:-

(a) Remove the end cover and commutator cover band and lift the brushes.
(b) Remove the fan, taking care not to lose the key.
(c) Take off the commutator end bearing cap after removing its three fixing screws.
(d) Remove the three countersunk screws securing the inner bearing plate at the commutator end. These screws are exposed when the bearing cap is removed.
(e) Remove the screws securing the driving end frame to the yoke. The armature and driving end frame may now be removed complete by tapping gently on the commutator end of the armature shaft.
(f) To dismantle the driving end bearing, unscrew the oil thrower disc nut and remove the three countersunk screws in the driving end frame, holding the inner bearing retaining plate. Tap the armature gently out of the end frame.

3.16. After dismantling, the bearings may be drawn off the armature shaft using a bearing extractor. The bearings should be thoroughly washed out in clean non-leaded petrol and blown dry by compressed air, if available. Before replacing the bearings, one quarter of the available space in the bearing should be tightly packed with grease, any surplus grease being removed. The inner and outer races should then be rotated in opposite directions to distribute the grease evenly over the surfaces of the ball races. Any grease which has exuded during this operation should be replaced evenly between the races. Special care should be taken to keep bearings free from dirt or swarf when they are being lubricated or refitted.

3.17. Brushes should be removed and replaced if worn to less than half their original length. (This can best be checked by comparison with new brushes of the correct grade). It is important that the brushes are an easy sliding fit in their holders and that the correct brush spring pressure is maintained. All carbon dust should be removed, using, if available, an air blower.

3.18. Before installation, the generator should be submitted to the test laid down in para. 3.6. If, after testing, the generator does not function satisfactorily and the fault cannot be located, the machine should be returned to the manufacturers.

4. FLIGHT SERVICES

Propeller Feathering

4.1. Pump motors. - The motors should be carefully examined at the appropriate inspection periods and all traces of carbon dust, due to brush wear, removed from the brush gear and commutator, by applying a dry air blast. Any grease, oil or dirt on the commutator should be removed by using a clean cloth moistened with lead-free petrol. Care should be taken to ensure that no petrol is allowed to come into contact with the armature winding. In the case of a rough commutator the surface may be smoothed with grade 00 sandpaper. On no account must emery cloth or any other kind of material be used for this purpose, or any grease or lubricant applied to the commutator or brush gear. After cleaning make sure that all sand or dust particles are blown out of the machine. The leading particulars of this type of motor are given below:-

		A.M. Stores Ref.
Motor, Rotax, Type C.2801	Clockwise rotation ...	5U/452
Input ...	24 volt, 90 amp.	
Speed ...	10,500 r.p.m.	
Horse Power ...	2.0	
Torque ...	1.0 lb/ft.	
Brushes ...	Grade E.G.O. ...	5U/2847
Brush Spring Pressure	14-16 ozs.	
Weight ...	$9\frac{3}{4}$ lb.	
Resistances at 20°C		
Armature	0.0049 ohms $\pm$ 10 per cent.	
Field (Series	0.0045 ohms $\pm$ 10 per cent.	
(Shunt	8.1 ohms $\pm$ 10 per cent.	

4.2. Lubrication of the bearings involves partial dismantling of the motor, the following procedure being observed. -

(a) Remove the band cover and take out the four brushes
(b) Remove the motor housing fixing screws
(c) Take off the driving end section of the motor housing by tapping the flange lightly with a rubber mallet, taking care not to distort the flanges. The armature should come away with this section of the motor housing.
(d) Detach the armature from the driving end frame by tapping the end of the armature shaft lightly with a rubber mallet. The driving end ball race will remain in position and may be exposed by removing three countersunk screws holding the inner bearing cap to the end frame and taking off the bearing cap.

The above sequence of operations should be reversed to re-assemble the machine, New split pins should be fitted to lock the motor housing fixing bolts, and all other screws and nuts re-locked by the method used during manufacture, 4.3. After dismantling the motor, the bearings should be washed in clean petrol and then packed with greased (Ephco No. 2 Aero Grease) to a quarter of their capacity, before re-assembling the machine, taking care to distribute the grease evenly round the bearing by rotating slowly.

4.4. Make sure that all brushes are bearing on the commutator and are not sticking in their holders. Brushes that are worn so that their connecting flexes or springs are within 1/16 in. of fouling the brush-holder must be discarded and replaced by new ones. New brushes should be checked to see that they are free to move in their brush-holders and are correctly bedded-in so that they make contact with the commutator surface over the whole of their width and at least 80 per cent of the contact area. New brushes should be bedded down on the commutator by wrapping a piece of sandpaper (Grade 000) round the circumference of the commutator in a direction opposite to the normal direction of rotation, so that the friction of the brushes, when the armature is turning, will cause the paper to tighten up on the commutator. The sanded side of the paper should face the brushes. If possible, the sandpaper should be moved along the brush surface in the direction of normal rotation only, rather than to and fro. When new brushes are fitted, they should be examined again after a few hours running in order to ensure that they are still free to move in their holders, and are bedding down over the correct area of contact surface of the brush.

4.5. After re-assembling and before installation in the aircraft, a motor should be submitted to the following tests:-

(a) Run the motor light for a period of five minutes with a supply of 26 volts. At the end of the run the speed should lie between 13,500 and 16,000 r.p.m. and the current should not exceed 25 amps.

(b) Check the armature and field resistances. After correction for temperature the readings obtained should be within the limits given in para. 4.1.

(c) The insulation resistance between the live parts and the frame must not be less than 2 megohms when checked with a 250 volt insulation resistance tester.

4.6. Relays, type J. - The relays normally require very little attention. The switch contacts and contact plate should be kept clean, and the operation of the unit should be checked after any modification or in the event of faults developing.

Operational Tests.

(a) The coil voltage should be gradually increased until the relay closes and the closing voltage noted. Relays must close with a snap and under no circumstances should the armature move slowly or the closing voltage exceed 14 volts.

(b) The coil voltage should be gradually decreased until the relay opens, when the voltage must not exceed 5 volts.

(c) With the coil excited from a supply of 16 volts and with a current of 100 amps. flowing in the main circuit, the voltage drop across the main terminals must not exceed 50 milli-volts.

(d) The insulation resistance is to be measured between all live parts and the frame with 500 volt insulation resistance tester and should not be less than 20 megohms.

(e) Before assembly of the coil and magnet pot in the relay the magnetic air gap should be checked with a feeler gauge, the settings being 0.162 in. with the switch contacts open and 0.023 and 0.01 in. with the switch contacts closed.

4.7. Feathering push switch, type XJD. - The filament lamp should be examined at regular intervals. To remove the lamp from the knob, the blanking screen should be put so that the open section is over the amber screen. Press in the amber screen with the end of a pencil, or some other suitable instrument. This releases the spring pressure on the blanking screen, which will then slide out of its grooves in the plunger knob. Take care that the amber screen and lamp do not spring out as the blanking screen is removed. To replace, put the lamp into the spring holder, hold it in position with the amber screen, the rubber washer side next to the bulb, then slide the blanking screen into the grooves of the knob and over the top of the amber screen.

4.8. To dismantle the switch for internal inspection unscrew the terminal cover nut and washer and remove the terminal cover. Unscrew the four small screws holding the terminal block into the switch body. Holding the cover locating stud in one hand, press the plunger knob with the other, and the terminal block, with the solenoid coil attached, will come away. Care should be taken not to drop the plunger return spring which is housed loosely inside the solenoid coil.

4.9. Inspect the leaf spring contacts for signs of corrosion, and the contact sleeve on the plunger for pitting or burning. Clean, if necessary, and smear very lightly with P.I.C. No..1. Check the spring contacts for the warning lamp circuit. Test the plunger movement to ensure that it runs freely and easily in its guide and if necessary, lubricate very lightly with anti-freezing grease (Stores Ref. 34A/49. The lubricant should be applied to the plunger shaft outside the switch body and worked in. If more drastic treatment is required, hold the plunger shaft firmly and unscrew the knob; the shaft can then be drawn out from the back of the switch body. Before the knob is screwed off the lamp and screen should have been removed.

4.10. Examine the cable connections for rubbing or other trouble in the glands. If there are any signs of corrosion, smear the cable terminals with P.I.C. No. 1 and pack the glands well with P.I.C. No. 2. If local climatic conditions make it desirable, the whole of the terminal block and cable channels may be packed with P.I.C. No. 2, enough of the material being used to squeeze out into a thin film or washer between the terminal cover and switch body when the cover is replaced and screwed well down.

N.B. P.I.C. No. 1 (Stores Ref. 33C/810) is rather like dark yellow lanoline in appearance and it should be used for smearing switches and other items of equipment where easy movement or disconnection of the parts is essential. Lanoline (Stores Ref. 33C/511) may be used as an alternative but it should be remembered that it is unsuitable when subjected to extremes of temperatures.

P.I.C. No. 2 (Stores Ref. 33C/887) is a plasticine-like substance, and is used for sealing terminals in electrical equipment which is not normally required to be opened in use.

Flap Motor and Position Indicator

4.11. Flap circuit general check. - The operation of the electrical equipment for this circuit may be checked as follows. -

(a) Wind the flaps manually, observing the switch gearbox (illustrated in fig. 19) until the three switches are free.

(b) Open the flap circuit breaker on 2C.

(c) Turn the control switch to OUT and note the click as the 'out' relay in 2C closes.

(d) Press the 'out' limit switch, noting the click as the 'out' relay opens.

(e) Repeat (c) and (d) for the IN position

(f) Press the one-third-out trip switch and note that the indicator lamp is illuminated.

The motor circuit may be included in the above test by simply disengaging the drive and closing the circuit breaker. When this is done, care should be taken to avoid reversing the motor when it is running.

4.12. Motor. - This motor, Croyden Type A.40/34, should be examined at inspection periods and carbon dust and brush wear dealt with as described in the paragraph dealing with the propeller feathering pump motors. The brushes used on this motor are Stores Ref. 5U/301. For more detailed servicing instructions reference should be made to the manufacturer's handbook.

4.13. Flap limit switches-adjustment - The switches are not themselves adjustable, alterations in their settings are effected by adjusting their striker bolts as follows: -

(a) Loosen the locking nuts on the striker bolts and screw the latter several turns inwards.

(b) Wind the flaps seven turns of the manual operating handle from the 'fully in' position.

(c) With the motor drive still disengaged, turn the control switch to IN, noting the click as the 'in' relay contacts close.

(d) With the flaps in this position, unscrew the 'in' limit switch striker bolt against the switch plunger until the click is heard as the relay contacts open.

(e) Tighten the locking nut on the striker bolt.

(f) Repeat the above procedure for the 'out' limit switch.

It should be noted that, on some aircraft, the above adjustment may not allow the flaps to run fully home. When this occurs, a further slight adjustment should be made to the striker bolts until the correct operation is obtained.

4.14. Flap one-third-out trip switch. - The switch should be tripped when the flaps are exactly one-third-out; this position of the flaps is determined as follows. -

(a) Run the flaps fully in

(b) Mark on one flap a point where it runs under the trailing edge of the wing.

(c) Run the flaps out

(d) Measure the distance from the trailing edge of the wing to the point marked on the flap.

(e) At two thirds of the distance measured in (d) from the trailing edge of the wing make another mark on the flap.

(f) Run in the flaps manually until the mark made in (e) is directly under the trailing edge of the wing.

The trip switch is then adjusted by tapping its operating ramp backwards or forwards (after first loosening slightly its fixing bolts) until the red one-third-out indicator lamp is just extinguished. The ramp fixing bolts should then be tightened with the ramp in the new position. The switch plunger and ramp should be occasionally smeared with anti-freezing grease.

4.15. Mechanically operated switches. - These switches must be dismantled, as shown in fig. 21, for servicing. This operation should be carried out in the following order. -

(a) Unscrew the captive slotted nut which holds the terminal cover in position.

(b) Remove the terminal tags to expose the seals over the two fixing screws.

(c) Break the seals and remove the fixing screws

(d) Withdraw the contact assembly.

The contacts should be carefully examined and any burrs or burns removed with a piece of fine carborundum cloth. When the spring contacts require re-setting, they should be bent from their bases to preserve their correct bearing on the "shorting" assembly. Before re-assembling the switch, all its working parts should be lightly smeared with anti-freezing grease. After the switch has been replaced in its housing, the fixing screws, when they have been tightened, should be sealed with Chattertons or a similar bitumen compound

4.16. Flap position indicator - Little or no servicing is required for this installation. The transmitter contact arm should be examined periodically to ensure that it is bearing correctly on the resistance. The calibration of the system should also be checked periodically. With the flap in the one-third-out position, the indicator meter reading should be checked to ensure that the pointer is at the one-third-out position. If an error is found, the reading may be corrected by adjusting the transmitter arm, which is slotted for this purpose.

4.17. After installating new or re-conditioned instruments, the system may fail to operate correctly in the aircraft. This can usually be traced to a defect in the wiring, some of the most obvious faults and the symptoms they show being given in the following table. -

SYMPTONS	FAULT
(i) The pointer does not respond to any movements of the transmitter.	(i) Break in the battery circuit to either +ve or -ve terminal on transmitter.
(ii) The pointer takes up a position opposite to the correct one, but rotates in the right directions.	(ii) Wrong polarity of battery supply.
(iii) The pointer gives a wong reading and rotates the wrong way.	(iii) A cross-over between leads 1, 2 or 3.
(iv) The pointer moves suddenly between two almost opposite readings	(iv) Either a break in lead 1.2 or 3, or a short circuit between two of them.
(v) The pointer moves suddenly between two readings about 90° apart	(v) A short circuit between a battery lead and any one of leads 1, 2 or 3.

If a 'Desynn' Portable Test Set (Code No.581/1.F.G.) is available more comprehensive servicing may be carried out as detailed in Section D.M. 10 of the maintenance manual by Smiths Aircraft Instruments Ltd.

Aileron Trimming Tab Controls

4.18. The pilot's transmitter should be examined at approximately every 120 hour inspection period and the brushes examined for wear and to ensure that they are moving freely in their spring loaded holders. As the motors have no commutator or electrical contact they require no servicing, apart from the lubrication of their gearboxes. This operation, which necessitates the removal of the unit from the aircraft, should be carried out at 120 hour inspection periods, a suitable lubricant being Silvertown Mineral Oil EV.381. The indicator system should require no servicing, apart from tightness of connections and condition of cables.

Aerofoil De-icing

4.19. The servicing instructions for this installation are fully covered in the manual supplied by T.K.S. (Aircraft De-icing) Ltd. Below are given two extracts from this publication.

Pre-Flight Check

The following check should be carried out within one hour of each flight, especially if icing conditions are likely to be encountered. This will ensure that the system is fully primed and ready for immediate use.

(i) Place controller "Emergency" switch on, and run the pump until fluid is seen to exude from all distributors. The time taken for the fluid to appear will depend upon the length of time that has elapsed since it was last in use. Switch off when all distributors are fully primed.

(ii) Place "Manual" switch on, and check that green indicator lamp lights up within five to six seconds. The lamp should remain alight for not less than 90 seconds at 29 volts and not more than $4\frac{1}{2}$ minutes at 24 volts. When the indicator lamp is extinguished, the "manual" switch should be turned off.

The carrying out of this check before each flight will ensure that the system is ready for use when required. If the flight is of long duration and icing conditions are expected, the controller "Emergency" switch should be placed on for 30 seconds every hour and a half to maintain the system fully primed.

FAULT FINDING TABLE

	FAULT		RECTIFICATION
1.	Controller fails to operate	1.	Check battery
		2.	Check internal wiring for broken connections.
		3.	Check the resistance and replace if necessary.
2.	Cycle time out of adjustment.	1.	Adjust TYD thermal switch as described in the Manual.
3.	Pump motor runs continuously with "Manual" switch on.	1.	Barrettor faulty. Replace.
		2.	Either thermal switch open circuit. Replace.
		3.	Thermal switch points dirty. Clean.
		4.	Condenser may be shorting.
		5.	Vacuum switch points sticking. Replace.
4.	Motor runs continuously with all switches off.	1.	Surge suppressor shorting. Check that mounting nut is not overtight. If this fails to cure, replace surge suppressor.

Propeller de-icing:-

4.20. The gear-type pump units are susceptible to damage by the presence of any foreign matter in the pumped fluid and quite small particles are sufficient to cause seizure. If seizure occurs or is suspected, the motor should be switched off immediately, otherwise the armature and field winding may be burnt out. In the event of a seizure, the pump should be dismantled and cleaned as described in paras.4.22 and 4.23 and at the same time the system should be thoroughly cleaned and the tank flushed to ensure that the seizure will not be repeated.

4.21. If the failure of the motor is not due to pump seizure, the leads from an external supply should be connected directly across the motor terminals. If the motor now starts, the external wiring circuit is at fault and should be checked and the fault corrected. If, however, the motor does not start, the brushes should be examined, cleaned, and replaced by new ones if necessary. It should be verified that the brushes are bedding down correctly and are free in their holders and that the springs are in a serviceable condition. The commutator should be cleaned with a clean cloth moistened with lead-free petrol. The field coils should be tested for open circuits and insulation resistance. If all appears to be satisfactory, the supply should again be applied to the motor. If it still fails to start the armature is at fault and should be replaced with a new one.

4.22. The following sequence of operations should be adopted when dismantling a pump unit.

(a) Before separating the pump plates, stencil or similar marks should be made across one side of the plates and body to ensure that the plates can subsequently be re-assembled in the same relative positions.

(b) The six bolts securing the top plate to the pump body should be removed, and the top plate detached by sliding it laterally over the under-lying centre plate.

(c) The outer gear wheels should be suitable marked to indicate their position in the assembly, after which they should be removed together with the centre plate. During manufacture the gear wheels and centre plate are matched by selective assembly; care should therefore be taken not to confuse the wheels and plates of different assemblies.

(d) The pump body should now be unscrewed from the worm-gear housing, which should then be detached from the motor which is held by three screws.

(e) The carbon brushes should be removed from the motor by unscrewing the two caps at the side of the motor and withdrawing the brushes.

(f) The motor can now be further dismantled by removing the two long screws passing through the stator from the worm-gear end, after which the stator should be detached from the worm-gear housing.

(g) To dismantle the worm-gear, the end cap should be removed by releasing its spring retaining ring.

(h) The wormwheel should be removed from its shaft by removing the hexagonal socket grub screw in its boss, using a hexagonal key which can be introduced through a hole in the housing normally plugged by a screw. The grub screw is of hardened steel and grips on a flat on the shaft, therefore the screw should be completely removed before attempting to move the wormwheel boss. The parts are a tight fit and the application of heat to the bronze boss of the wormwheel by means of a soldering iron, will probably be found necessary both in the removal of the grub screw and the shaft.

4.23. After the pump has been dismantled, the components should be cleaned; the gears and bearings being cleaned in paraffin. After cleaning and viewing, defective parts should be rejected and replaced by new ones. All ball-bearing should be lubricated on re-assembling with anti-freezing grease (Stores Ref. 34A/49), thinned slightly with anti-freezing oil (Stores Ref. 34A/43). Gears and plain bearings should be lubricated with anti-freezing oil only. Re-assembly of the pump unit should be carried out in the reverse order to the dismantling, the following details being observed:-

The markings made prior to and during dismantling operations should be checked to ensure that the parts occupy their original relative positions, it being remembered that the recessed face of the centre plate is the one in contact with the top plate. In tightening down the six bolts which secure the top plate to the body, the centre pair should be tightened before the outer pairs. Great care should be taken to ensure even tightening, otherwise distortion will result, with the risk of seizure. Tightening should be effected whilst the pump is running, if possible, when uneven tightening will be indicated by a slowing down of the pump motor. The worm-gear housing should be filled with anti-freezing grease.

4.24. The rheostats should be examined periodically to ensure that the sliding contacts are bearing correctly on the circular resistance.

Pressure head heating

4.25. The pressure heads are **fitted to the aerial mast.** Before flight, the switches controlling the pressure head heating circuit should be switched on for a period not exceeding five minutes. A check should be made by feeling the heads in order to ascertain whether the heating elements are functioning correctly. The mouth of the pitot tube and the static slots should be kept clean and free from dirt; a small brush will be found most suitable for this purpose. Care should be taken when measuring the insulation resistance of the head, since with voltages over 500 it is posssible to break down and destroy the insulation covering the heating elements. The insulation resistance should be not less than $\frac{1}{2}$ megohm hot and 3 megohms cold. In the case of a faulty or damaged pressure head, no attempt should be made to dismantle it, but it should be returned to the manufacturers for repair.

Outside air temperature gauge

4.26. The indicator and resistance bulb. should be removed for bench testing at all major overhaul periods. Using a 500 volt insulation resistance tester the following insulation test should be carried out. -

(a) Test between either of the two terminals and the metal sheath of the resistance bulb.

(b) Test between any terminal and the outer magnetic shield of the indicator.

In each case the insulation resistance should be not less than 20 megohms at room temperature.

4.27. The indicators may be checked separately as follows by using a stud resistance box, preferably calibrated in terms of temperature, permitting a series of check readings to be obtained from temperatures well below 0°C up to the maximum reading on the indicator scale. If an accurate stud resistance box is not available a series of fixed calibrating resistances equivalent to a representative variety of temperatures may be made up and used in turn. A list of the temperature/resistance equivalents is given in the following table. The indicator, tested at room temperature, should indicate accurately to within ± 2°C of the temperature equivalent of the resistance applied.

Temperature Deg. C	Resistance Ohms	Temperature Deg. C	Resistance Ohms
-60	65.8	0	90.1
-50	69.4	10	94.6
-40	73.3	20	99.2
-30	77.4	30	103.8
-20	81.5	40	108.6
-10	85.8	50	113.5

NOTE:- 0.2 ohms is to be added to each of the above as the equivalent resistance value of the aircraft leads.

4.28. The resistance bulbs may be tested by comparison with a certified sub-standard bulb and the use of a Wheatstone Bridge circuit. It is unlikely, however, that the temperature/resistance characteristics will have varied from the original calibration unless damage or deterioration has occured. The resistance in the bulbs should be in accordance with the table within ± 0.5 ohms, the checks being carried out at a point between 15 - 3° deg. C and between 90 - 100 deg. C when passing a current of 5 Ma.

4.29. A further combined test may also be made using both the indicator and resistance bulb. Connect up the bulb and indicator to an appropriate supply and immerse the bulb in a heated water or oil bath with an accurate mercury-in-glass thermometer. Heat the water or oil bath to a steady temperature and compare the indicator reading with that of the mercury thermometer. It is only necessary to take readings at two widely spaced points on the indicator scale and the readings should agree with those of the mercury thermometer within the limits given in para.4.28. The temperature must be maintained at a constant figure for at least two minutes before a satisfactory reading can be taken.

5. ENGINE SERVICES

Engine starting

5.1. Motor - At the inspection periods laid down in the maintenance schedule the following checks should be made. -

(a) Remove the window strap and check the brush spring tension. This should be 18 to 24 ozs. measured at the end of the trigger arm at brush level.

(b) Brushes should be renewed when the top of the brush is level with the top of the brush holder. It is advisable to replace the brushes with new ones (grade CM.5H) before this limit is reached to ensure proper functioning until the next inspection.

(c) Check the security of brush pigtails in brushes and to brush holders.

(d) Check the freedom of brush movement in the box. If the brush is binding it is suggested that the brush and brush box be cleaned thoroughly with a clean cloth moistened with lead-free petrol.

(e) Check the security of the field connections to the brush boxes.

(f) Examine the commutator for signs of blackening. A surface film may be removed with sandpaper, grade 00, but if the commutator is badly scored or burnt, the starter should be removed for a complete overhaul.

(g) Any indication of oil in the starter should be investigated and the point of ingress found. Oil inside the starter will impair its performance besides carrying carbon dust into the windings and lowering the insulation resistance. If the oil seal around the starter jaw is suspected of being worn the starter must be removed and the oil seal checked.

(h) Remove all carbon dust, if possible with a dry air blast or bellows.

(i) Check the insulation resistance of windings to earth. Under dry storage conditions the motor must have a minimum insulation resistance of 1 megohm.

(j) Examine the terminal nuts and connections and all external nuts, bolts, and locking devices for condition and security.

(k) Examine all housings carefully for mechanical damage.

(l) Replace the window strap and lock in a similar manner to that previously employed.

For major overhauls and lubrication, which involve dismantling the machine, reference should be made to that section of the Rotax Service and Overhaul Manual which deals with this type of motor.

5.2. Platform safety switches. - These switches, shown in fig. 20 are adjusted by means of their fixing nuts as follows. -

(a) Loosen the nut nearest the plunger and tighten the other until they are as far apart as possible.

(b) Close the maintenance door

(c) Tighten the nut nearest the plunger until the switch contacts just close.

(d) Tighten the same nut until the switch has moved approximately 0.2 in. nearer to its striker plate on the door.

(e) Screw down and lock the other nut.

Booster coils

5.3. The booster coils should require very little attention in service, the only parts which may need attention being the contacts. If these are slightly pitted and the booster coil operates satisfactorily they should not be touched. If, however, the contacts are badly pitted they can be smoothed down with a fine contact stone ensuring that at least 0.015 in. of contact material remains after this operation and that the contacts mate squarely. The springs must not be bent or otherwise altered from their original setting during this operation. Disconnect the condenser connections and check the insulation ressistance between terminal and body with a 500 volt Megger, which should give a reading of at least 2 megohms. Inspect all springs and mouldings for cracks or signs of excessive fretting due to vibration and fit new parts where necessary. See that the coil bobbin is not slack in the moulding due to vibration. If it is slack, insert silk packing washers between the end of the coil cheek and the moulding until no play can be felt. Further details for servicing and testing the booster coils are given in the Rotax Service leaflet No. S.L.1.

Engine cylinder temperature gauges

5.4. These instruments, which are of the milli-voltmeter type, require no routine maintenance beyond periodical checking of the pointer adjustment. If an indicator is suspected of being faulty, it should be replaced by another instrument of known accuracy. If incorrect readings are still obtained the external wiring is at fault and the fault should be located and rectified, If, however, the system is now found to operate satisfactorily the indicator is at fault, and should be replaced by a new or reconditioned one and the faulty unit returned to the manufacturer for repair.

Engine ignition

5.5. There is very little servicing possible on the ignition system apart from a periodical inspection of the wiring and the switchboxes to ensure that when the switches are closed the system is connected to earth. Reference should be made to the engine handbook for servicing information on the magnetos.

Engine speed indicators

5.6. Due to the simplicity of construction of the generators, indicators and synchroscope, any fault which may arise in this installation will most probably be due to wiring. If as a result of such tests an instrument is found to be at fault reference should be made to the maintenance manuals issued by. -

(a) Smith's Aircraft Instrument Ltd. - generator and indicator.

(b) Kelvin, Bottomley and Baird Ltd. - synchroscope.

(c) ~~Sangamo — Weston Ltd.~~ - selector switch

Cowl gill motors and indicators

5.7. The position indicators are of the same type as that used for the flaps, reference should therefore be made to para. 4.16. for servicing notes. The servicing of the motor is dealt with in the following paragraphs.

5.8. The brush springs of the motor should exert a pressure of 12-20 ozs. and the brushes should never be allowed to wear more than 3 mm. as, if the brushes are worn excessively, the pigtails will rest on the side of the brush box and cause bad contact between the brush and commutator. Renewal of the brushes is effected by detaching the lead, lifting the spring finger and withdrawing the brush from the box. When fitting the new brush, care should be taken to ensure that the spring washer and plain washers are assembled between the screw head and the brush tag, the spring washer being placed next to the screw head, Brush springs may be renewed by removing the split pin, withdrawing the coil spring and fitting the new spring in place of it. Access to the brush gear is obtained by slackening off the band cover clamping screw and sliding the band cover over the brake housing.

5.9. The automatic switch mechanism should not need attention except at major overhaul periods, but the contacts should be inspected for wear, and burrs and burns should be removed with a fine carborundum stone. The contact holding members should be examined to ensure that their tension is retained and if any doubt exists as to the contacts or holding members, the defective parts should be renewed. Incorrect contact adjustment, faulty contacts or contact plungers, may result in an increase in the contact gap and therefore failure of the switch. The gap with the contacts fully open should be adjusted not to exceed 0.05 in. or to that gap which gives the correct travel (new plungers being fitted if required) as follows. -

(a) Slacken the locknut

(b) Hold the contact and turn the inner nut in a clockwise direction to increase the gap and vice versa.

(c) Retighten the locknut.

5.10. If the plungers show a tendency to stick, they should be cleaned, but if the sticking is caused by burrs the plungers should be renewed. When it is required to renew the plungers or either of the inner or outer contacts, the outer contact ring must first be removed. To dismantle the switch assembly the following sequence of operations should be observed. -

(a) Remove the nut securing the outer contact ring

(b) Withdraw the contact ring

(c) In order to remove the outer contacts, detach the locknut and spring washer, contact strip and inner nut from the contact ring. The contacts may then be removed and the coil spring detached.
Repeat for the second contact assembly.

(d) Remove the two sets of nuts and washers and remove the inner contacts.

(e) Withdraw the plungers with a pair of pliers.

The reverse procedure should be adopted for assembly, but observe that in assembling the inner contacts, the nuts and washers should be fitted to the screws in this order - plain washer, spring washer, nut. When assembling the outer contacts to the ring, note that a nut is fitted first, then the strip connection, followed by a spring washer and nut. The contact ring must be assembled so that it is correctly keyed to the shaft, and the securing nut must be fitted with the hexagonal head away from the ring.

5.11. If the motor runs but fails to operate the shaft under load conditions, the clutch should be tested, and, if it is found to be slipping, adjustment may rectify the condition. The brake solenoid assembly should be removed first by undoing the four fixing screws which secure the cover to the motor housing and withdrawing it as a unit. The clutch adjustment may then be effected by removing the split pin and turning the nut in a clockwise direction to take up slip. If clutch adjustment fails to cure the slip, it will be necessary to dismantle the motor in order that the clutch may be inspected for grease on the plates. If the motor fails to start or runs slowly taking excessive current, the trouble may be due to the solenoid brake failing to release when voltage is applied; this may be caused by the plunger sticking or by an electrical fault, such as a short or open-circuit in the coil or an earth leakage. Poor perforance may also result from a dirty or badly scored commutator, worn brushes or weak spring tension, while complete failure of the motor is most probably due to faulty auto-switch contacts.

5.12. For lubrication and major overhauls, which both involve complete dismantling of the motor, and for testing, reference should be made to the appropriate section of the Rotax Service and Overhaul Manual.

5.13. Very little servicing is necessary on the switch units apart from periodically checking to ensure that the switch operates satisfactorily and that the contacts are free from burrs. At the same time the indicator lamp should be examined and replaced with a new 2 watt lamp (Stores Ref. 5L/1089) if necessary.

Air intake temperature gauges

5.14. This installation is wired as shown in fig. 11 and is similar to that for the outside air temperature gauges and should be serviced as described in para.4.26. The list of temperature/resistance equivalents for this type of instrument is given in the following table. -

TEMPERATURE IN °C	RESISTANCE IN OHMS.	TEMPERATURE IN °C.	RESISTANCE IN OHMS.
-60	65.8	10	94.6
-50	69.4	20	99.2
-40	73.3	30	103.8
-30	77.4	40	108.6
-20	81.5	50	113.5
-10	85.8	60	118.5
-0	90.1	70	123.6

NOTE... 0.2 ohms. is to be added to each of the above values as the equivalent resistance value of the aircraft leads.

6. FUEL AND OIL SYSTEMS

Fuel contents gauges

6,1. At general inspection periods, and when refuelling, each indicator should be observed to check at least the full and empty positions, and if possible the indicator movement should be watched during refuelling. Any irregularity observed should be investigated immediately. The tank unit should be inspected for leakage at the joint with the fuel tank. From time to time the travel of the float arm should be checked to ensure that it is moving freely over its entire range and that there is clearance between the float and the top and bottom of the tank. If the float clearances with the tank are out of adjustment, the transmitter should be replaced. If the pointer of the indicator reads above the zero mark on the scale when the tank is empty, it is probable that the float arm is not coming up against the stops on the tanks attachment. This may be due to the float arm having become bent and fouling on the bottom of the tank or touching a baffle or stringer.

6.2. The terminals on the transmitter should be tightened when necessary and, if there is any reason to suspect faulty contact, the sliding arms or brushes on the circular resistance should be inspected. They should bear firmly upon the resistance to ensure that good electrical contact is made. If the indicator pointer shows a tendency to oscillate between any dial reading and the off position it is an indication that the transmitter resistance has become dirty or that the brushes are not pressing sufficiently hard upon it. The resistance can be easily removed and cleaned, but in no circumstances should the float arm be moved whilst the resistance element is removed. Unless this precaution is taken there will be difficulty in meshing the operating arm with the brush gear. An insulation resistance test of the transmitter, disconnected from the external wiring, should show an insulation resistance of not less than 20 megohms, measured at 500 volts at room temperature.

6.3. If any alterations or renewals are made to the electrical connections, the performance of the system should be checked to ensure that correct reconnection has been made. The following table is provided to give approximate indications together with corresponding faults in the electrical wiring.

SYMPTOM		
As the float is moved from the bottom to the top of the tank indicator pointer moves from. -	Direction of rotation	Probable fault
7.00 to 5.30 o'clock	Clockwise	Circuit normal
5.00 to 6.30 o'clock	Anti-clockwise	Terminals 1 & 2 reversed
8.30 to 10.30 o'clock	Anti-clockwise	Terminals 1 & 3 reversed
1.30 to 3.00 o'clock	Anti-clockwise	Terminals 2 & 3 reversed
1.30 to 11.00 o'clock	Clockwise	Battery reversed
10.30 to 1.30 o'clock	Anti-clockwise	Terminal 1 & 2 reversed
3.00 to 5.30 o'clock	Anti-clockwise	Terminal 1 & 3 reversed
6.30 to 8.30 o'clock	Anti-clockwise	Terminal 2 & 3 reversed
No deflection	-	Break in 4, 5, 6 or 7.
8.00 to 8.30 to 2.30 - 4.30 o'clock	Clockwise then anti clockwise then clockwise	Break in 3.
5.30 to 11.00 to 5.30 o'clock	Clockwise then anti-clockwise	Break in 2.
7.00 to 1.30 to 6.30 o'clock	Anti-clockwise then clockwise	Break in 1.

Fuel flowmeters

6.4. The instructions for cleaning and servicing the equipment for this installation are given in the manufacturer's (GEORGE KENT LTD) publication No.1/5010 and its supplement, which latter deals with the solenoid-operated by-pass valve.

Fuel pump motors and fuel pressure warning lamps

6.5. The following test should be carried out, as often as is laid down in the maintenance schedule, to ensure that the pumps are working correctly. Before commencing the test, it is important to ensure that there is an adequate amount of fuel in the system as the pump must on no account be run unless it is immersed. When testing, the following points should be observed.

(a) Close all fuel cocks between the immersed pumps and the engine, so that no flow takes place.

(b) Leaving the ganged on-off switches open, press the test push button for each motor in turn, observing the current consumption of each, over a period of half a minute. The ammeter readings may be interpreted as follows:-

(i) A steady reading of not more than 4 amps. indicates that the pump is working satisfactorily.

(ii) A current consumption in excess of this figure indicates that the pump is unserviceable; the failure is probably due to the pump seizing owing to bearing trouble.

(iii) Fluctuating current consumption (ammeter needle oscillates) indicates that the pump is filled with fuel and that it is unserviceable.

(iv) A zero reading of the ammeter indicates either a fault in the electrical feed to the motor or the complete failure of the pump itself.

In the event of results given in (ii), (iii) or (iv) the pump must be removed and replaced by a new or reconditioned one.

6.6. When examining the pump at the inspection periods laid down in the maintenance schedule the following points should be noted :-

(a) Check the outlet pipe coupling and the Breeze plug connection for tightness.

(b) Test the pump as laid down in the previous paragraph and if faulty return to the manufacturers and fit a replacement.

(c) To ensure that the by-pass valve acts freely, turn on the tank selector cock and the appropriate engine master cock, switch on the pump and check that the fuel pressure warning lamp is extinguished. Failure to extinguish the warning lamp indicates that the valve is stuck open. Check the setting of the pressure switch (2 lbs/sq.in) before rejecting the pump as defective.

NOTE... It is essential that the idle cut-off control should be in the "cut-off" position throughout this test.

6.7. The pressure switch does not require more than periodical checks for accuracy in order to ensure its efficient operation at all times. The pressure chamber is sealed and should not be opened unless obsolutely necessary. The cover of the switch chamber can be opened by removing the snap ring that holds it in place, or by unscrewing the cover according to the type of construction employed. It should only be opened to inspect and, if necessary, to tighten the terminals and in instances where it is necessary to make a switch contact adjustment. It must be replaced securely after inspection.

6.8. If for any reason it is necessary to make an adjustment to the switch, that is, to alter or re-adjust the pressure point of operation of the pressure unit, this can only be performed on a test bench. A source of pressure is required to which the switch unit should be connected. Apply the maximum working pressure to the switch, repeating three times. After the third application, decrease the pressure slowly until the operating pressure (2 lbs/sq.in) is reached when the warning lamp should be illuminated. Turn the adjusting screw until the light comes on. When a locking nut is provided, it should be a detent which prevents it moving under vibration.

6.9. A check should be made on the setting by raising the applied pressure and allowing it to fall slowly as before, meanwhile watching the lamp to see that it lights when the pressure falls to the given value. On completion of the adjustment, it is important that the switch adjusting screw and its locknut, where provided, should be locked by the application of shellac or Bakelite varnish to the adjusting screw. The application of varnish is not required on types not fitted with a locknut.

6.10. The warning lamp must light and remain alight when the pressure is below the prescribed limit and there should be no tendency to flicker. Should such a tendency exist, the lamp fitting in its holder should be examined and tightened where necessary. If a lamp burns out it must be replaced with a new one (6 volt) 0.04 amp. Stores Ref. 5L/1428). The examination or replacement can be effected by unscrewing the bezel which allows the red window to be removed. The window and bezel must be replaced after inspection. If faulty operation is traced to the switch pressure chamber, the unit should be changed for a serviceable model and the faulty one returned for repair.

Fuel pressure gauges

6.11. Basically this installation operates on the same principle as the flap position indicators and the servicing notes given in para. 4.16. can be applied to this installation. The test equipment required for more detailed servicing is the "Desynn" Master Potentio-meter 1TE the Master indicator 3 TE and a dead weight test rig. Full information on the testing and calibrating of the indicators and transmitters is given in Section DM.15 in the maintenance manual supplied by Smiths Aircraft Instruments Ltd.

Fuel cut-off controls

6.12. For the servicing of the Rotax type actuators reference should be made to the manufacturer's manual.

Oil temperature gauges

6.13. The equipment used for this installation is similar to that dealt with in para. 4.26 under the heading "Outside air temperature gauge". The temperature/resistance equivalents for these instruments are given in the following table:-

Temperature in Deg. C.	Resistance in OHMS.	Temperature in Deg. C.	Resistance in OHMS
0	90.1	80	128.8
10	94.6	90	134.2
20	99.2	100	139.7
30	103.8	120	151.1
40	108.6	140	163.0
50	113.5	160	175.7
60	118.5	180	188.8
70	123.6	200	202.7

NOTE... 0.2 ohms is to be added to each of the above values as the equivalent resistance value of the aircraft leads.

Oil contents gauges

6.14. This installation is similar to that for fuel contents and the servicing is as described in paras. 6.1. to 6.3.

7. EMERGENCY SERVICES

Fire warning lamps and extinguishers

7.1. Circuit check. - The supplies to the extinguisher bottles may be checked by first disconnecting the bottles, replacing them by lamps, and pressing the extinguisher push buttons in turn. If, when this is done, all the lamps are illuminated, the operation of the inertia switches may be checked. This is achieved by rotating their indicator knobs until the arrows in each case point to TRIP, and pressing them firmly. The contacts of each switch should then close with a movement that is both definite and audible, all the lamps being again illuminated simultaneously.

7.2. After operation, the inertia switches must be re-set as follows:-

(a) Press down the re-setting lever, on the side of the switch case, to its lowest position and hold down.

(b) Rotate the SET-TRIP knob on top of the switch case, until the indicating arrow points to the SET position.

(c) Press this knob firmly and hold down, allowing the re-setting lever to rise slowly as far as it will go.

(d) Release the SET-TRIP knob.

The re-setting lever should now line up exactly with the indicator rib on the switch case, if it does not line up exactly, the switch is incorrectly set and the re-setting procedure must be repeated. When the inertia switches are correctly set, all the test mps should be extinguished.

7.3. The flame switches, when closed, should each cause the contacts of the magnetic relay for that engine to close and, in so doing, should illuminate the fire warning lamp in the knob of the feathering switch for the same engine. With the flame switch still closed, the pressing of the feathering switch should cause the lamp, substituted for the intake extinguisher bottle, to be illuminated and the contacts of the Type P2 relay in 3C should open and break the control circuit for the domestic supply circuit breaker. To close the contacts of a flame switch for this test, unscrew the socket below the knurled cap on the switch (using a spanner on the flats provided) and permit the contacts to close. After two turns the lamps should be illuminated. Replace the socket making certain that the contacts have sufficient clearance by ensuring that the socket has two full turns to complete before it is tight after the lamp is extinguished. When this test has been completed, lock the socket with suitable locking wire through the holes provided.

7.4. When the bottles are disconnected for the above tests, they should be weighed. The weight of a bottle when empty is engraved on its handle and a full charge of fluid should weigh $6\frac{1}{2}$ lbs (6 lbs for bottles marked 'A'). If any loss of weight is noted, the bottle should be replaced by another which is known to be full. This check, which also applies to the hand type Graviner extinguishers in the cabins, is very important because the fluid will evaporate free to the atmosphere.

Dinghy inflation

7.5. Circuit check. - The circuit for each dinghy may be checked by first removing the access panel in the stowage compartment hatch and then disconnecting the operating head. With the hatch cover in position the on-off switch should be closed to allow the electro-magnetic units to operate. The operation of the micro-switches may be checked by connecting a lamp or voltmeter in place of the operating head, re-cocking the E.M. units and closing the on-off switch. The cartridge in the operating head should then be checked for continuity (noting the maximum test current that may safely be passed through the cartridge without discharging it is 0.125 amps.)

8. EXTERIOR LIGHTING

Mooring lamp and signalling lamp sockets

8.1. Using an inspection or some other portable lamp the signalling lamp sockets should be checked periodically. At the same time the mooring lamp should be checked by closing the on-off switch at the crew's entrance door and ensuring that the lamp is illuminated. If the lamp has "blown a new one (16 watt, Stores Ref. 5L/271) should be fitted.

Landing lamps

8,2. The wattages of the lamps are very high for their size and the heat may occasionally cause cracking of the glass seals after the lamps have been in service for some time. This does not cause immediate failure, but when the lamps is switched off, a small quantity of air is drawn into the bulb as it cools, and when the lamp is next switched on, this air oxidises the filament and a streak of white tungsten oxide is deposited on the bulb above the filament. The bulbs should therefore be scrutinized at frequent intervals and the lamps replaced as soon as traces of white oxide become visible. The bulbs blacken progressively throughout their life and the filaments may sag slightly but they should last for at least 1000 landings. The lamps have prefocus caps and no adjustment to the focus is necessary after changing a lamp.

If the reflectors become dusty or dirty, they may be wiped with an ordinary cloth or washed with water and soap containing no free alkaline.

8.3. The motors are the most likely cause of failure in these lamps. In the event of this occuring, the whole lamp should be detached for examination by removing the fixing screws, dropping the lamp down and disconnecting the plug. If the fault cannot be repaired the lamp should be returned to the Manufacturers. The clutch and brake mechanisms must not be interfered with but the contacts may be adjusted as follows :-

(a) Remove the lamp from the aircraft by taking out the twelve fixing screws and disconnecting the plug.

(b) Remove the moulded cover over the switchbox.

(c) Slacken off the two adjusting screws, and move the insulated base to the required position.

(d) Tighten all screws securely.

The range of movement permits the angle of the lamp to be adjusted to any value between 73 and 85 deg.

8.4. The angular adjustment between the "low" and "high" positions is set at 7 deg. but it may be adjusted between 5 and 9 deg. by screwing the striker pin out or in respectively. After making any adjustment the striker pin must be locked by tightening the locking nut. The angle of offset is adjusted by slackening the innermost ring of fixing screws and twisting the lamp bodily with respect to the mounting plate. The contacts in the lamps should be inspected and cleaned periodically. It is important to ensure that all the adjusting nuts are tight and that the plug and socket soldered connections are secure. For circuit tests reference should be made to fig.

Navigation and steaming lamps.

8.5. This installation should be checked periodically as follows:-

(a) Close the steaming lamp switch and check that the steaming lamp is illuminated.

(b) Set the navigation lamp selector switch to DIM and ensure that all three navigation lamps are illuminated.

(c) Set the selector switch to BRIGHT and note that there is an appreciable increase in the brilliancy of all three lamps.

For changing the wing navigation lamps, a hand access hole is provided in the upper surface of the wing, through which the lamp mounting may be withdrawn after releasing the spring clip. The tail navigation lamp may be reached from inside the aircraft and the steaming lamp is mounted in the leading edge of the pressure head mast. Replacement lamps for this installation should be as follows :- wing navigation lamps - 24 volt, 20 watt, Stores Ref. 5L/1813 and tail navigation and steaming lamps - 24 volt, 10 watt, Stores Ref. 5L/1696.

9. INTERIOR LIGHTING

9.1. General - The lamps throughout the aircraft should be examined periodically and if any are found with their glass blackened or loosened they should be changed. Access to the lamps is, in most cases, gained by removing the bezel from the fitting or the front glass. The ultra violet lamps must be removed after first removing the reflector by taking out the two screws which secure it to the lamp holder. The glass front must not be removed by bending back the clips which hold it in position.

10. DOMESTIC SERVICES

Cabin heating

10.1. Servicing instructions for the two 62,500 B.T.U/HR Daniel "Dragonfly" type heaters and their associated equipment are given in the manufacturer's manual.

Urns

10.2. This installation should be tested at regular intervals. For servicing the urns reference should be made to the manual supplied by the manufacturers (The General Electric Co. Ltd.)

Cooker

10.3. For servicing instructions on the cooker reference should be made to the manufacturer's handbook, the circuit breaker Type D being dealt with earlier in this chapter.

Immersion heaters

10.4. The heaters which provide the hot water supplies in the toilets, are of the G.E.C. half gallon storage type. Each is fitted with a 500 watt, sheathed wire pattern, immersion heater and an eight inch rod type thermostat. This latter is set at a temperature of 150 deg. F., this figure being chosen to keep scale formation at a minimum. When servicing a heater, first ensure that the control switch is open and the water supply is turned off. The heater should then be drained off into a suitable receptacle and the inlet and outlet pipes disconnected from their joints. The service wires should then be removed from the terminal block and the heater unscrewed from its fixings. To release the heating element a 1½" Whitworth box spanner is required. The thermostat may be withdrawn without interfering with any of its fixings. A new washer should be used when fitting or replacing an element. For more detailed servicing reference should be made to the manual supplied by the manufacturers.

DISTRIBUTION BOX 1D

No.	Ampere Rating	Type	Circuit
A3	25	G	Aerofoil de-icing
A5			
B2			
B4	25	G	Landing light - port
B6	25	G	Landing light - starboard
C1	5	S	Auto pilot
C3	10	S	Eng. start and booster - port
C5			
D2	10	S	D.R. compass
D4	10	S	Pressure head lower
D6	10	S	Pressure head upper
E1	10	S	Aileron trim tabs
E3	5	S	U.V. lighting P.I. and S.O.
E5	5	S	Current flow relay
F2	10	S	Fire extinguishers port inner
F4	10	S	Fire extinguishers port outer
F6	5	S	Domestic relay control
G3	5	S	Landing light control starboard
G5	5	S	Landing light control port
H2			
H4	5	S	Aft E/O's panel lighting
H6	10	S	Flight deck lighting
J1	20	S	Dinghy P.O.
J3	20	S	Dinghy P.I.
J5	20	S	Dinghy S.I.
K2	5	S	T.1154 R.1155 No.1 control
K4	5	S	A.1134A H.T. P.U.
K6	10	S	Prop. feathering P.I.
L1	20	S	Dinghy S.O.
L3	5	S	U.V. lighting P.O. and S.I.
L5	5	S	Nav. and steaming lights
M2	10	S	Prop. feathering P.O.
M4	5	S	Flap position indicator
M6	10	S	Flap motor controls
N2			
N4	5	S	Fuel cut-off control P.I.
N6	5	S	Fuel cut-off control P.O.
P2	5	S	Fire warning lights P.I.
P4	5	S	Fire warning lights P.O.
P6	5	S	Instrument lighting
R2	5	S	A.S.V. control
R4	5	S	Aux. radio control
R6	5	S	T.1154 R.1155 No.2 control

DISTRIBUTION BOX 2D

No.	Ampere Rating	Type	Cricuit
A3	5	S	Fire warning lights S.O.
A5	5	S	Fire warning lights S.I.
B2	10	S	Fire extinguishers starboard inner
B4	10	S	Fire extinguishers starboard outer
B6			
C1	5	S	Fuel cut-off control S.O.
C3	5	S	Fuel cut-off control S.I.
C5	10	S	Eng. start and booster S.
D2	20	S	Fire extinguishers 'Inertia' switch
D4	10	S	Propeller feathering S.I.
D6	10	S	Propeller feathering S.O.
E1	5	S	Inspection light and drift sight sockets
E3	5	S	Propeller anti-icing outers
E5	5	S	Propeller anti-icing inners
F2	10	S	Safety belt warning light
F4	5	S	Stewards call signals
F6	5	S	Intercom. call signals
G3	5	S	Cabin lighting main lights cabin 'A'
G5	5	S	Cabin lighting reading lights Cabin 'A'
H2			
H4	5	S	Cabin lighting mirros and toilet Ladies dressing room
H6	5	S	Cabin lighting main lights ladies dressing room
J1	5	S	Cabin lighting main cabin 'B'
J3	5	S	Cabin lighting reading lights cabin 'B'
J5	5	S	Cabin lighting main cabin 'C'
K2	5	S	Cabin lighting reading and bunk Prom.
K4	5	S	Cabin lighting main and stowage Prom.
K6	5	S	Cabin lighting galley buffet and stairs
L1	5	S	Cabin lighting reading lights cabin 'C'
L3	5	S	Cabin lighting main cabin 'D'
L5	5	S	Cabin lighting reading lights cabin 'D'
M2	5	S	Cabin lighting gents toilet and dressing rooms
M4	5	S	Cabin lighting reading lights cabin 'E'
M6	5	S	Cabin lighting main lights cabin 'E'
N2	20	S	Cabin heating
N4			
N6			
P2			
P4	5	S	Cooker control
P6	5	S	Urn control
R2	5	S	F. cabin ceiling lights
R4	5	S	F. cabin reading lights
R6			

DISTRIBUTION BOX 3D

No.	Ampere Rating	Type	Circuit
A3	25	G	Immersion heater FR.16-17 gent's dressing room
A5	25	G	Immersion heater FR.18-19 gent's dressing room
B2	25	G	Immersion heater FR.34-35 ladies dressing room
B4			
B6			
C1	20	S	Fuel pump motor port outer
C3	20	S	Fuel pump motor port inner
C5	20	S	Fuel pump motor starboard inner
D2			
D4			
D6			
E1	20	S	Fuel pump motor starboard outer
E3			
E5			
F2			
F4			
F6			

ENGINEER'S PANEL 4P

No.	Ampere Rating	Type	Circuit
A3	5	S	Oil contents gauge S.I.
A5	5	S	Fuel contents gauge S.I.
B2	5	S	Outside air temperature thermometer
B4	5	S	Oil contents gauges S.O.
B6	5	S	Fuel contents gauge S.O.
C1	5	S	Fuel flowmeter S.I.
C3	5	S	Oil temperature thermometer S.I.
C5	5	S	Carburettor air temperature thermometer S.I.
D2	5	S	Fuel flowmeter S.O.
D4	5	S	Oil temperature thermometer S.O.
D6	5	S	Carburettor air temperature thermometer S.O.
E1	20	S	Cowl gill motor and indicator S.I.
E3	5	S	Oil pressure gauge S.I.
E5	5	S	Fuel pressure gauge S.I.
F2	20	S	Cowl gill motor and indicator S.O.
F4	25	S	Oil pressure gauge S.O.
F6	5	S	Fuel pressure gauge S.O.
G3	5	S	Oil contents gauge P.O.
G5	5	S	Fuel contents gauge P.O.
H2	5	S	Fuel pressure warning lamps
H4	5	S	Oil contents gauge P.I.
H6	5	S	Fuel contents gauge P.I.
J1	5	S	Fuel flowmeter P.O.
J3	5	S	Oil temperature thermometer P.O.
J5	5	S	Carburettor air temperature thermometer P.O.
K2	5	S	Fuel flowmeter P.I.
K4	5	S	Oil temperature thermometer P.I.
K6	5	S	Carburettor air temperature thermometer P.I.

ENGINEER'S PANEL 4P (Contd.)

No.	Ampere Rating	Type	Circuit
L1	20	S	Cowl gill motor and indicator P.O.
L3	5	S	Oil pressure gauge P.O.
L5	5	S	Fuel pressure gauge P.O.
M2	20	S	Cowl gill motor and indicator P.I.
M4	5	S	Oil pressure gauge P.I.
M6	5	S	Fuel pressure gauge P.I.

CHARGING & CONTROL BOX 1C

No.	Ampere Rating	Type	Circuit
AW1-2	5	S	Mooring - Aldis lamp
AW1-4	5	S	Dim step, stairway, aft entrance lights
AW1-6	5	S	Pilot and battery lights
AW2-2	5	S	Aft freight and freight inspection
AW2-4	5	S	Boarding, forward freight, mooring compartment lights
W3	5	S	Voltmeter
W5	5	S	Londex relay port inner generator

CHARGING & CONTROL BOX 2C

No.	Ampere Rating	Type	Circuit
U2	5	S	Londex relay starboard generator
U4	5	S	Urn warning lights
U6	5	S	Cooker warning lights
BB5	10	S	Heater fuel motor
BB1	5	S	Heater motor relay
BC1-3	5	S	Fuel pressure light
BC1-2	5	S	High and low, solenoids port
BF3-4	5	S	Ignition port
BB3-4	5	S	High and low, solenoids starboard
BF1-2	5	S	Ignition starboard
BF.5	10	S	Port heater system
BC.5	10	S	Starboard heater system

CHARGING & CONTROL BOX 3C

No.	Ampere Rating	Type	Circuit
A2	60	M	A.S.V.
B2			
B4			
B6	5	S	Londex relay port outer generator
C2			
C4			
C6			
D2			
D4			
D6	20	S	T.R. 1464

CHARGING & CONTROL BOX 4C

No.	Ampere Rating	Type	Circuit
	60		Dynamotor main supply

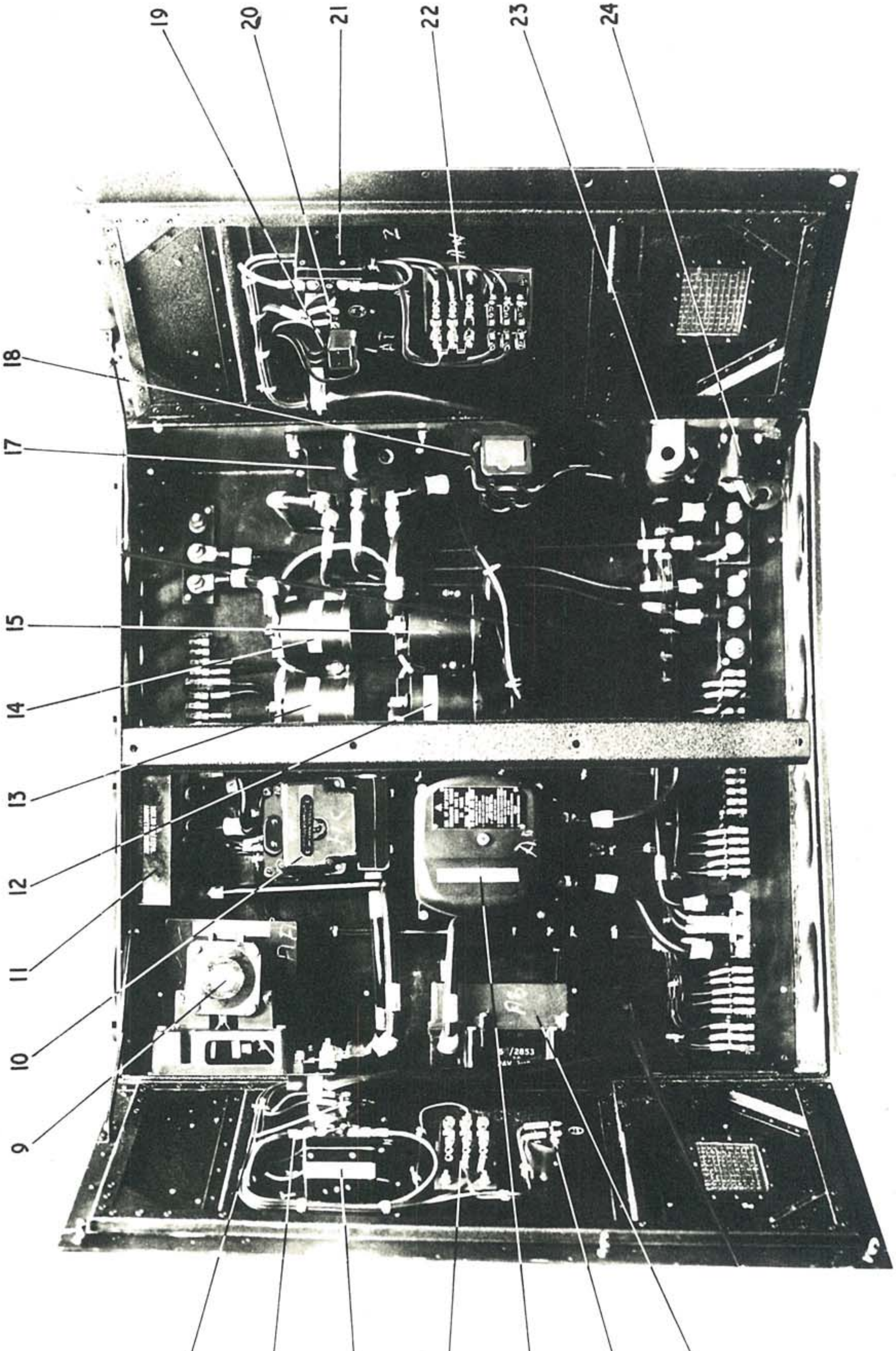


FIG. 16 CHARGING AND CONTROL BOX IC

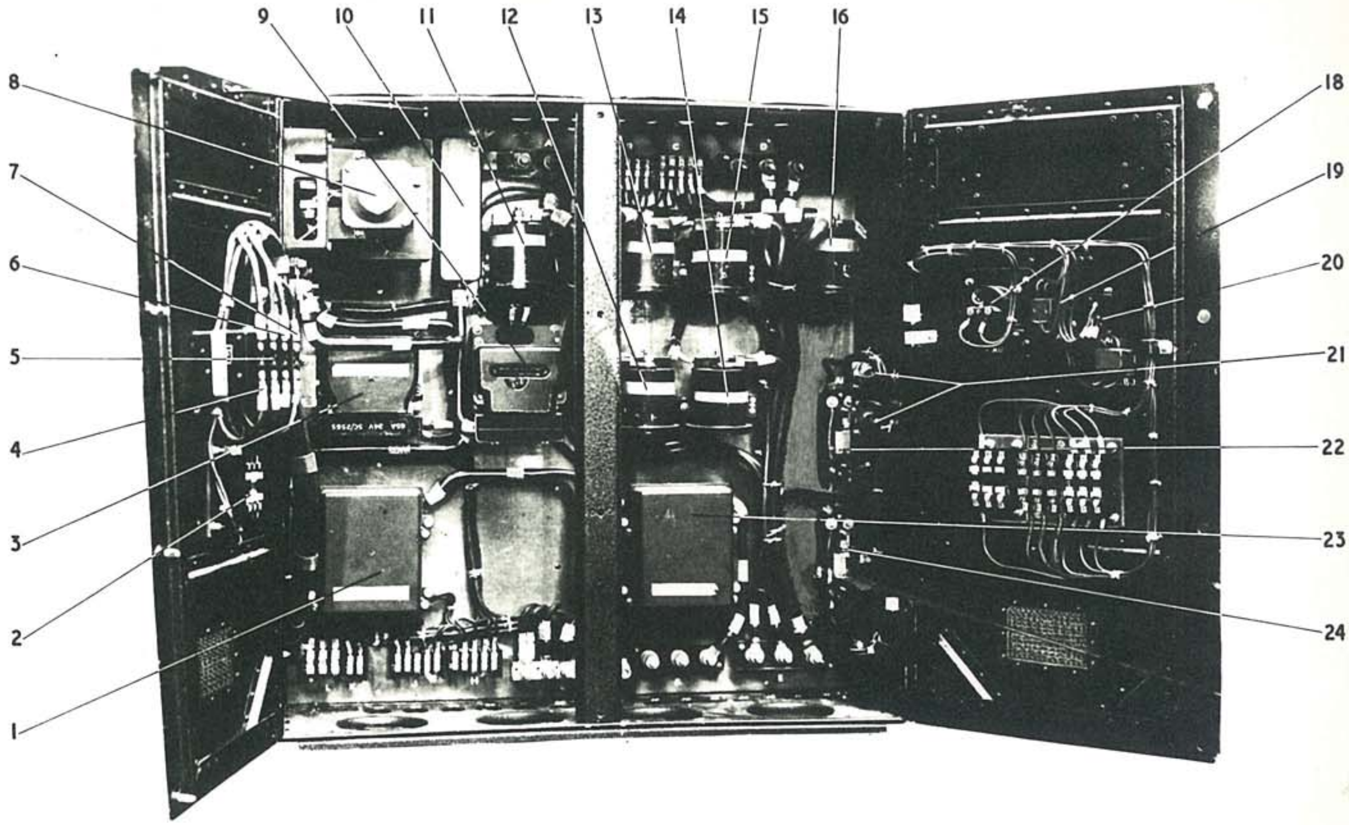


FIG. 17 CHARGING AND CONTROL BOX 2C

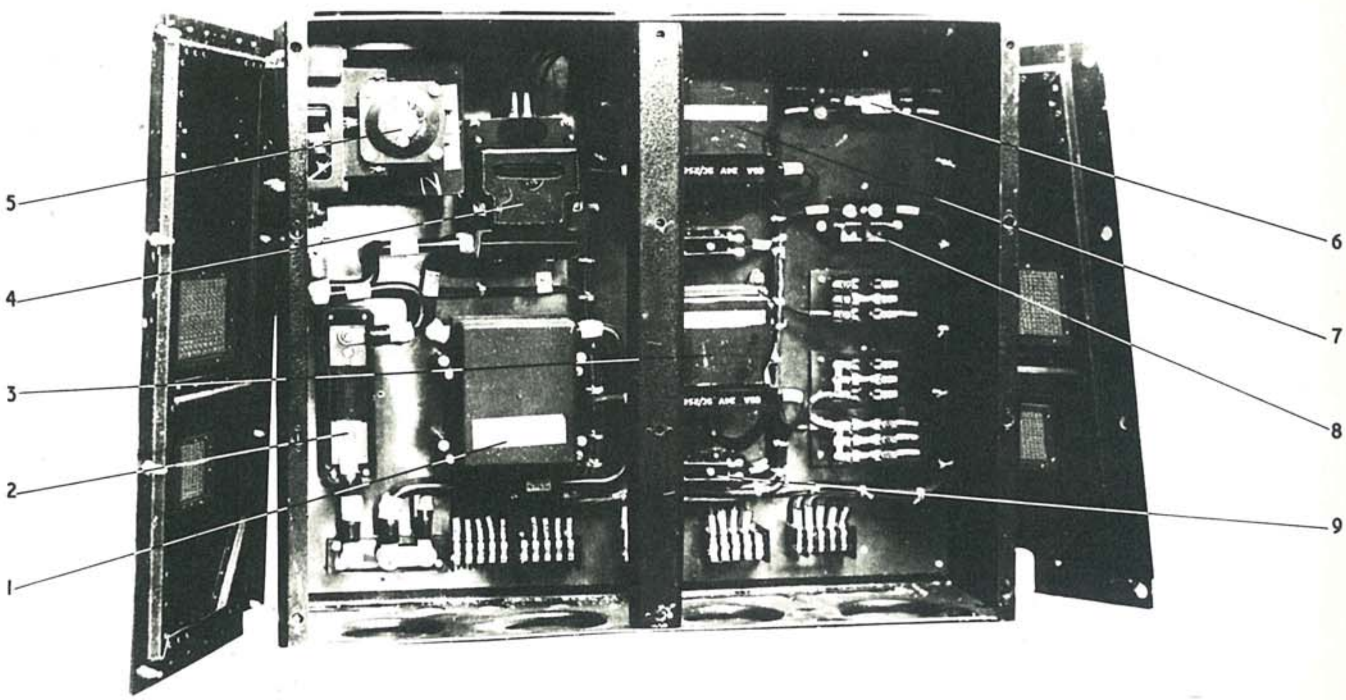


FIG. 18 CHARGING AND CONTROL BOX 3C

RSSO/TP/106

ISSUE	DATE
1	16-2-49
2	1-2-51

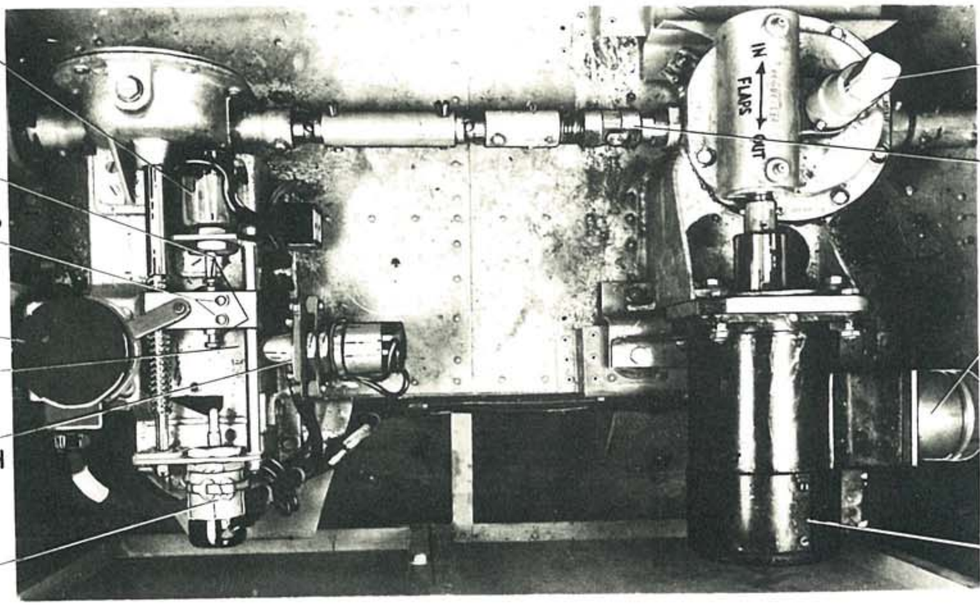


FIG. 19 FLAP MOTOR AND SWITCH GEARBOX

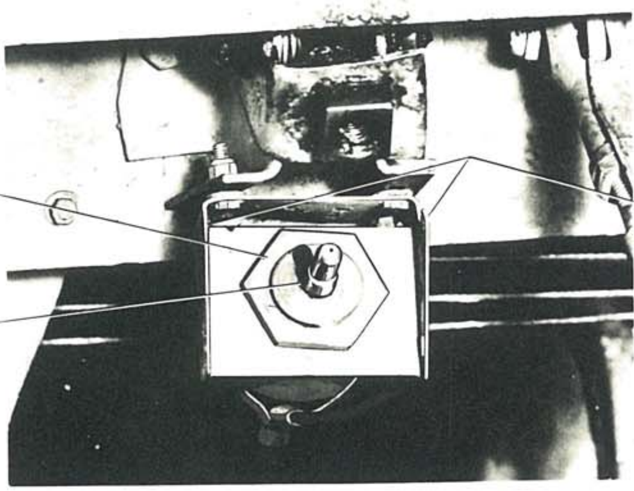
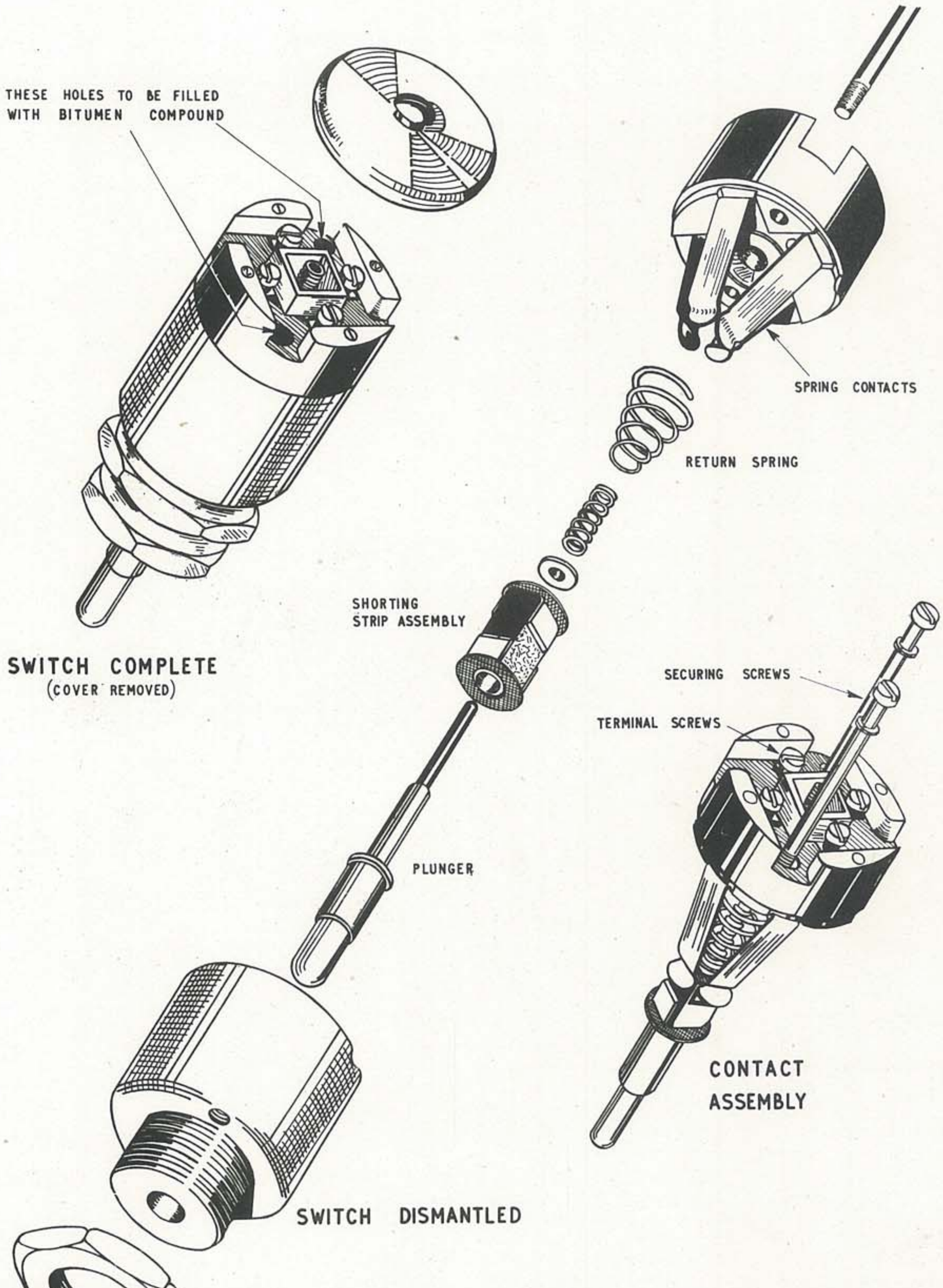


FIG. 20 PLATFORM SAFETY SWITCH (HINGED COVER REMOVED)



MECHANICALLY OPERATED SWITCH

FIG. 21

ELECTRICAL INSTALLATION - WIRING SYSTEM

Contents

Illustrations

1. The first part of this chapter gives a description of the S.B.A.C. wiring system as applied to this aircraft, followed by an explanation of the method of marking the cables and components for identification purposes. The latter part of the chapter is devoted to servicing and, consequently, gives instructions for the fitting of ferrules of various types together with a list of wiring spares. The wiring diagrams are provided as a guide for re-wiring the main control boxes.

WIRING EQUIPMENT

2. Blocks. - In the 19 amp. range, connector blocks are in 2, 3, 5 and 15-way sizes, the last mentioned not being used on this aircraft. The connector blocks for the 37 amp. range are on a larger scale than the 19 amp. and are made in the 2 and 3-way sizes. Each block is of moulded plastic material and is supplied bare, the Stores Ref. number being stamped on the underside of the base. Referring to fig. 22, it will be seen that the dividing walls between the socket channels are high enough to allow for either single or double-tier sockets. See note after next para.

2.1. Sockets. - The make-up of the sockets can be seen in fig. 22. There is only one size socket in the 19 amp. series and one size in the 37 amp. series. Each complete socket assembly, single or double-tier, as required, is built up of two or four socket halves held together on captive screws, spring-locked by a securing washer above the thread. The requisite number of complete sockets for any block assembly must be drawn from store as separate items under their own Stores Ref. numbers.

NOTE.. On this aircraft an identification label is fitted under the head of the captive screw for each socket as shown in fig. 22. As these labels are not part of the S.B.A.C. wiring system they are classified under their manufacturer's (Messrs. S.J. Crabtree Ltd.), part numbers, as shown in the Spares List at the end of this chapter. Also in this list are given the S.T. (Short Bros. & Harland) part numbers for connector blocks complete with sockets and labels.

2.2. Ferrules - In the 19 amp. range there are three sizes of ferrules, to take 4, 7 and 19 amp. cables. On referring to fig. 23 it will be seen that the difference in size affects the internal bore only, the external diameter being standard size to give constant contact in the standard 19 amp. socket. There is only one size of ferrule in the 37 amp. range although, to facilitate modification work, there is a range of ferrule adaptors which are crimped to the cable ends in place of the normal ferrules. These ferrule adaptors enable a 4, 7 or 19 amp. cable to be connected to a 37 amp. block.

2.3. Plug and socket type ferrules. - The Breeze type plugs and sockets used on this aircraft are of the solderless type in which both the plug and the socket pins are provided with hollow shanks to allow the cables to be crimped in the same way as the ferrules. The pins are made in two sizes only, 7 and 19 amp., sleeves being provided to allow cables of smaller size to be fitted. As the sockets are rolled from the flat, in order to give them the necessary springiness, a tubular thimble is slipped over the end of each, before crimping, to give sufficient strength to the joint. Some of these pins are illustrated with their accessories in fig. 24 and the complete range is given in the spares list.

2.4. Connecting links - There are two types of connecting link, one for linking adjacent terminals in one block, as shown in fig. 22 and the other for connecting the end terminals of two adjacent blocks. These links which are designated, type A and type B respectively are made in two sizes, 19 and 37 amp.

2.5. Covers for blocks. - Covers made of moulded material, as shown in fig.22 are provided to fit all blocks, on this aircraft though, they are not used on those blocks which are protected by box or panel lids. The fitting of the covers is by means of the spring-ball method, each ball registering with a hole in the end wall of the block. A locating register at one end only of each cover fits into a recess in one of the end-walls thus ensuring the correct replacement of the cover.

2.6. Heavy duty range. - The equipment in this range is designed for use with 64, 83 and 138 amp. capacity cables and is based on the stud and screw down typeof lug, illustrated in figs.22 and 23.The lugs are either soldered or connected to the cables by the same crimping process as is used for the smaller cable ferrules. The studs, complete with self-locking nuts, are moulded into the bases of the blocks as shown by the example in fig. 22 the various lugs making up the connections to a terminal being slipped over the stud and held down by the stiff nut. As certain circuit requirements may necessitate the connection of smaller cables to studs of the above type, three lug adaptors are included in this range. These adaptors are fitted with sockets to take 2-19 amp. ferrules, 4-19 amp. ferrules or 2-37 amp. ferrules.

2.7. Heavy duty cables are connected together either by commoning a pair of terminal studs with a heavy duty link, or by means of a bus-bar assembly. The bus-bar itself is a copper extrusion of channel section, grooved on the inside of each flange. Holes are spaced at intervals of $\frac{3}{4}$" along the web to allow the required length of bus-bar to be bolted to its mounting brackets of insulating material. The studs taking the cable lugs are made with square heads which are a sliding fit inthe grooves in the flanges. When a stud is placed in position a washer is placed over it so that, when the cable lugs are tightened down by the locknut, it is forced on the knurled portion of the shank, near the head of the stud thus permanently locating it. The full range of components for this assembly is given in the spares list.

2.8. Fuse blocks. - Due to the non-availability of S.B.A.C. type fuse blocks when the installation was engineered this aircraft is fitted with 'Crabtree' type fuse blocks as shown in fig. 25. These blocks which are in many respects similar to the S.B.A.C. type, are of the three-way type and may be used either singly or in tandem. To make this possible, there are two moulded fuse holder assemblies to each block, one carrying sockets (as described in para. 1.2.) connected to fuse clips and the other a double row of fuse clips commoned together. When it is required to use the fuses in tandem the latter type of moulding is mounted centrally with one of the former type on each side, the main supply then being connected to the centre block and the circuits to the sockets. When the fuses receive their supplies from different sources a pair of socket type assemblies are used thus allowing the supply to be connected to either end. These fuse blocks are supplied mounted on panels under the part numbers given in the spares list.

2.9. Distribution boxes. - The fuse units, assembled on panels of insulating material, are fitted in distribution boxes as shown in fig.25. The boxes are made of light alloy sheet and are provided with hinged lids, secured by 'Oddie' midget type fasteners. Cable entries are spaced around the top, bottom and sides of each box. To protect cables entering and leaving a box the entries are fitted with Helsyn type grommets, held in position by split fairleads of plastic material, bolted to the sides of the boxes. As the holes in the fairleads are of smaller diameter than those in the boxes it is only necessary to remove one portion of the fairlead in order to change a grommet. To facilitate modification work each box is provided with as many cable entries as it will accommodate, those which are unused being fitted with dummy grommets. The complete range of grommets of the type used on these and the junction boxes is given in the spares list at the end of the chapter.

2.10. Junction boxes. - Referring to fig.26 it will be seen that these boxes are of similar construction to the distribution boxes and that inside them are mounted the connector blocks for breaking down the wiring of the circuits they serve. It will also be seen that the connector blocks are not fitted with covers, as ample protection is provided for the terminal blocks and wiring by the box lids.

2.11. Installation of wiring. - Where a number of cables share a common route they are carried in open light-alloy ducts in which they are held by spring steel clips. These latter are slightly bent at each end to fit under the rolled edges of the duct and each is covered with a short length of p.v.c. tubing to prevent damage to the cables. For clipping single or small groups of cables two methods of clipping are used, these are:- the "D" shaped clip, fixed at each end; and the "P" shaped clip, using a single fixing. To allow for easy replacement, cables which run behind trimming material are carried in light alloy tubing.

IDENTIFICATION SYSTEM

3. The wiring identification system may be regarded as being in three groups; the first covering panels, boxes, etc., the second covering equipment (switches connector blocks, instruments, etc.) in the components in the first group; and the third covering terminals on the equipment in the second group.

3.1. The boxes panels etc. in the first group are each given a letter, to indicate the category, prefixed by a number in order to differentiate between those in the same category. On this aircraft the categories are lettered as follows:-

Control (or contactor) boxes C
Distribution boxes .... D
Junction boxes .... J
Panels .... P

3.2. All the items of equipment on boxes or panels are identified alphabetically. These identification letters are sign-written on the box or panel and not on the items themselves. This is done to avoid interfering with the standardization of the equipment and to obviate the necessity for relettering when an item is changed. To avoid confusion, letters which are likely to give rise to ambiguity are omitted, the following being the list of letters used:-

A B C D E F G H J K L M N P R S T U W X Y Z

On large boxes or panels where this list is sufficient each additional item is given a double letter reference, only the letters from the list being used. To avoid any confusion that might arise between AB and BA or CB and BC etc. each double letter sequence commences with two similar letters as follows:-

AA, AB, AC, AD, etc.
BB, BC, BD, BE, etc.
CC, CD, CE, CF, etc.

3.3. The sockets on the connector blocks are numbered by means of the identification labels, those on the two-circuit blocks being numbered from 0 to 3, those on the three-circuit blocks, from 0 to 5; and those on the five-circuit blocks, from 0 to 8 (a five-pointed star being used in place of 9 to avoid confusing it with an inverted 6). Fuse blocks are numbered similarly, each fuse on the six-way blocks having a number and each fuse on the three-way block having a number at each end. Unmarked terminals on other items of equipment are arbitrarily numbered to facilitate wiring and testing. These numbers are marked on the panels or boxes, to which the items of equipment are fitted, as close as possible to the terminals they concern.

3.4. Individual connector and A.M. type terminal blocks mounted on the aircraft structure are each suffixed TB (RTB for those used solely for radio). These numbers are sign-written on the adjacent structure.

3.5. To indicate its routing, each cable carries a pair of identification sleeves the first of which gives the box or panel reference and the entry number, and the second the reference letter and the terminal number of the item of equipment to which it is connected. The former sleeve being outside the box and the latter at the ferrule. Thus a cable entering distribution box 2D at entry number 15 and connected to terminal 5 on connector block B would be marked 2D.15 on the outer sleeve and B.5 on the inner.

SERVICING

4. There are various approved types of tool for crimping ferrules to the cable ends. For instructions on the methods of using the tools, changing dies, etc. reference should be made to the appropriate manufacturer's instructions. Wear on a tool may be detected by checking the breaking weight (see table below) of a ferrule attached by it.

MECHANICAL TESTS ON CRIMPED JOINTS

(As laid down in Specification R.D. Inst. (EL) 147, Issue 1)

DESCRIPTION OF JOINT	CABLE USED	AS No.	A.M. REF. No.	BREAKING LOAD IN LB.
Ferrule	4 amp.	2672	5H/24	28
Ferrule	7 amp.	2673	5H/25	45
Ferrule	19 amp.	2674	5H/26	100
Ferrule	37 amp.	2675	5H/27	150
4 amp. cable sleeve 7 amp. plug pin	4 amp.		5X/3148 5X/3238	28
4 amp. cable sleeve 7 amp. thimble 7 amp. socket insert	4 amp.		5X/3148 5X/3149 5X/3237	28
4 amp. cable sleeve 7 amp. special plug pin	4 amp.		5X/3148 5X/3240	28
4 amp. cable sleeve 7 amp. thimble 7 amp. special socket insert	4 amp.		5X/3148 5X/3149 5X/3239	28

DESCRIPTION OF JOINT	CABLE USED	AS No.	A.M. REF. No.	BREAKING LOAD IN LB.
7 amp. plug pin	7 amp.		5X/3238	45
7 amp. special plug pin	7 amp.		5X/3240	45
7 amp. thimble)	7 amp.		5X/3149	45
7 amp. socket insert)			5X/3237	
7 amp. thimble)	7 amp.		5X/3149	45
7 amp. special socket) insert)			5X/3239	
7 amp. cable sleeve)	7 amp.		5X/3146	45
19 amp. plug pin)			5X/3242	
7 amp. cable sleeve)	7 amp.		5X/3146	45
19 amp. thimble)			5X/3150	
19 amp. socket insert)			5X/3241	
12 amp. cable sleeve)	12 amp.		5X/3147	75
19 amp. plug pin)			5X/3242	
12 amp. cable sleeve)	12 amp.		5X/3147	75
19 amp. thimble)			5X/3150	
19 amp. socket insert)			5X/3241	
19 amp. plug pin	19 amp.		5X/3242	100
19 amp. thimble)	19 amp.		5X/3150	100
19 amp. socket insert)			5X/3241	

4.1. Standard ferrules should be fitted as shown in fig. 23 taking care not to damage the copper strands of the core when stripping. The length of core which should be exposed should be not less than 0.31" on the 4.7 and 19 amp. cables, and 0.4" on 37 amp. cables. The outer covering should be stripped back to a distance of 0.7" (from the end of the core) on 4,7, and 19 amp. cables and 0.9 on 37 amp. cables. It should be noted that the strands of the core should on no account be tightly twisted before they are inserted in a ferrule.

4.2. Adaptor ferrules, which allow 4, 7 and 19 amp. cables to be fitted to 37 amp. connector blocks, are fitted in the same way as the standard types, the cable ends being prepared to the same measurements.

4.3. The plug pins and socket inserts for Breeze type plug and socket assemblies are dealt with in the same way as the standard ferrules. The cables connected to the pins should be stripped so that the outer covering is removed as far as the first shoulder and the core bared as far as the second. In the case of socket inserts the core should be bared for a distance of 5/16" and pushed into the socket insert until the insulation touches the thimble, which should have been first fitted over the end. As the plug pins and socket inserts are only in 7 and 19 amp. sizes, a range of sleeves is provided, as shown in the spares list, to permit cables of other sizes to be fitted.

4.4. The cable marker sleeves used on this aircraft, at the junction between each ferrule and the cable insulation and on the cables exterior to the box, are of the Hellerman type. They are in a light colour, and, to avoid the necessity for carrying large stocks, the characters are marked with Indian ink and, with the exception of those in the plug and socket assemblies, are given a coating of shellac varnish. It is important to note that before removing a cable its marker should be examined and if the characters have been obliterated they should be renewed at the earliest possible opportunity to avoid confusion when the cable is replaced.

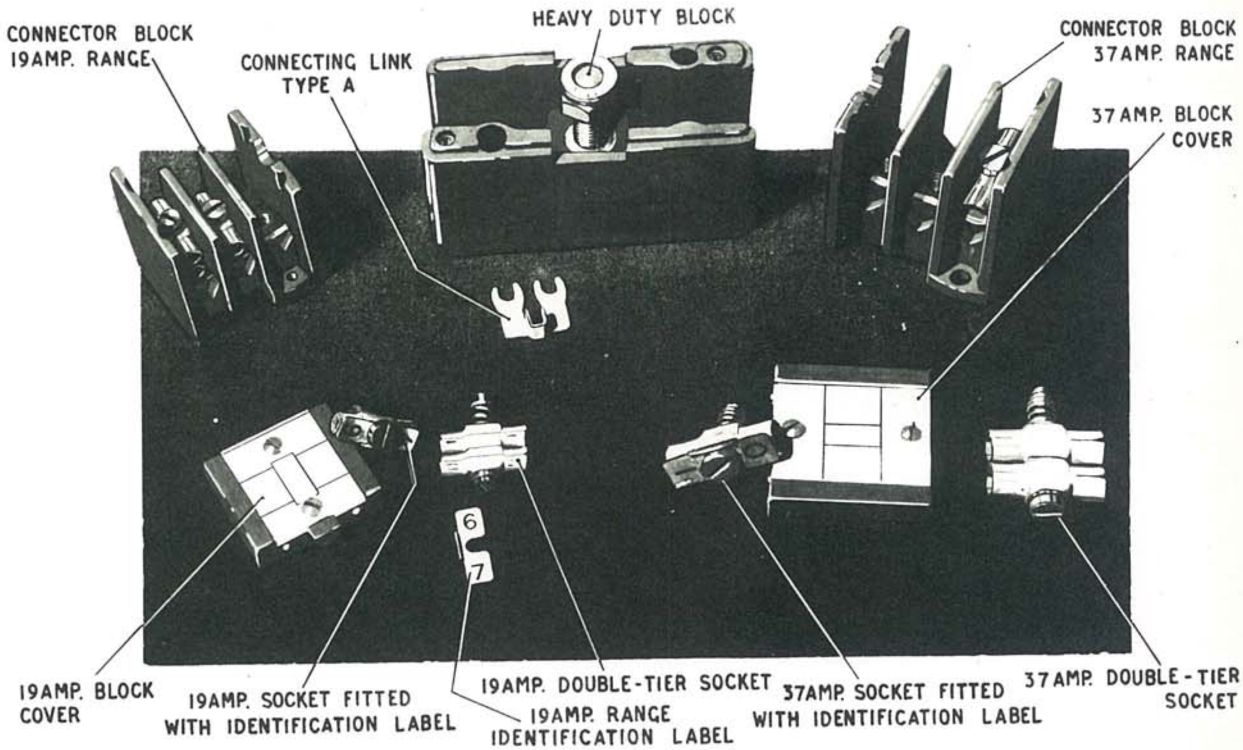
DESCRIPTION	A.S. NUMBER	A.M. STORES REF.
BLOCK CONNECTOR BARE -		
19 amp, 2 - way	AS.2633	5H/1
3 - way	AS.2634	5H/2
5 - way	AS.2635	5H/3
37 amp. 2 - way	AS.2651	5H/5
3 - way	AS.2652	5H/6
COVER BLOCK CONNECTION -		
19 amp. 2 - way	AS.2601	5H/7
3 - way	AS.2602	5H/8
5 - way	AS.2603	5H/9
37 amp. 2 - way	AS.2638	5H/11
3 - way	AS.2639	5H/12
SOCKET TERMINAL (Through type, complete with screw spring and locking washer)		
19 amp. single-tier	AS.2605	5H/124
double-tier	AS.2606	5H/125
37 amp. single-tier	AS.2640	5H/17
double-tier	AS.2641	5H/18
LINKS COMMONING		
19 amp. type 'A'	AS.2666	5H/19
type 'B'	AS.2667	5H/20
37 amp. type 'A'	AS.2668	5H/21
type 'B'	AS.2669	5H/22
150 amp.	AS.2670	5H/23
FERRULE CABLE END		
4 amp	AS.2672	5H/24
7 amp.	AS.2673	5H/25
19 amp.	AS.2674	5H/26
37 amp.	AS.2675	5H/27

DESCRIPTION	A.S. NUMBER	A.M. STORES REF.
LUG CABLE HEAVY DUTY		
64 amp.	AS.2693	5H/37
83 amp.	AS.2694	5H/38
138 amp.	AS.2695	5H/39
FERRULE ADAPTOR		
4 to 37 amp.	AS.2677	5H/29
7 to 37 amp.	AS.2678	5H/30
19 to 37 amp.	AS.2679	5H/31
BLOCK ASSEMBLY HEAVY DUTY SERIES	AS.2659	5H/13
COVER ASSEMBLY HEAVY DUTY SERIES	AS.2655	5H/14
BLOCK CONNECTOR (complete with sockets and identification labels)	SHORT BROS. & HARLAND NUMBER	
19 amp. 2 - way single-tier	ST.1373	
2 - way double-tier	ST.1374	
3 - way single-tier	ST.1370	
3 - way double-tier	ST.1371	
3 -way (2 single-tier (1 double-tier	ST.1372	
5 - way single-tier	ST.1375	
5 - way double-tier	ST.1376	
5 -way (3 single-tier (2 double-tier	ST.1377	
37 amp. 2 - way single-tier	ST.1368	
2 - way double-tier	ST.1369	
3 - way single-tier	ST.1366	
3 - way double-tier	ST.1367	
IDENTIFICATION PLATE	J.A. CRABTREE No.	
19 amp. numbered 0 and 1	51062	
numbered 2 and 3	51063	
numbered 4 and 5	51064	
numbered 6 and 7	51065	
numbered 8 and * (star)	51066	
37 amp. numbered 0 and 1	51067	
numbered 2 and 3	51068	
numbered 4 and 5	51069	
FUSE PANELS -		
3 - way (taking fuse type S)	AWS.1241	
17-way (taking fuses type S)	AWS.1214	
17-way (taking fuses types A and S)	AWS.1213	

DESCRIPTION	J.A. CRABTREE No.	A.M. STORES REF.
BREEZE TYPE PLUG AND SOCKET ACCESSORIES. -		
7 amp. plug pin		5X/3238
7 amp., socket insert		5X/3237
7 amp. special plug pin		5X/3240
19 amp. plug pin		5X/3242
19 amp. socket insert		5X/3241
Cable sleeves for use with:-		
4 amp. cable in 7 amp. socket		5X/3148
7 amp. cable in 19 amp. socket		5X/3146

HELSYN PLAIN SLEEVES

SIZE	I/D	LENGTH	MAX O/D OF CABLE
AP	1/16"	3/4"	1/8"
BP	1/8"	1"	1/4"
CP	3/16"	1"	3/8"
DP	9/32"	1"	1/2"
EP	3/8"	1"	7/8"
GP	9/16"	1"	1"
HP	11/16"	1"	1.1/8"



CONNECTOR BLOCK COMPONENTS
FIG. 22

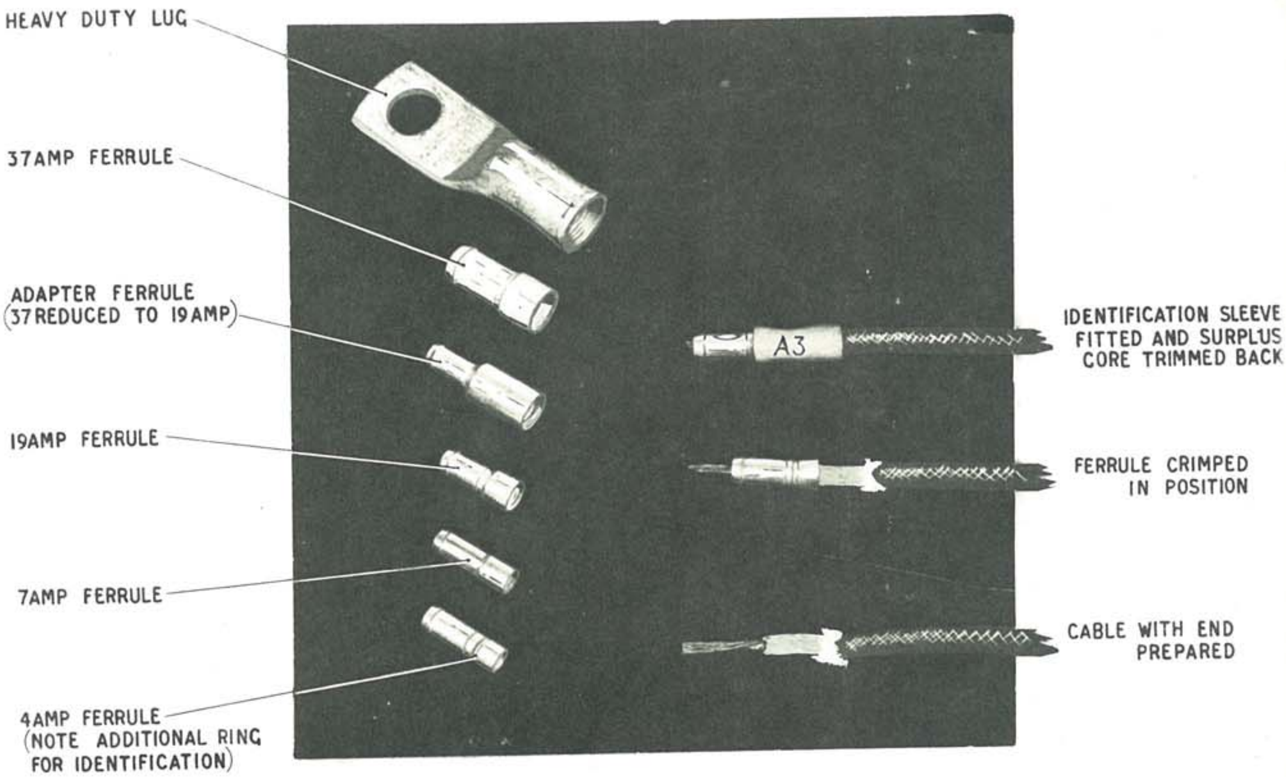


FIG. 23 FERRULES, LUGS, AND METHOD OF ATTACHMENT

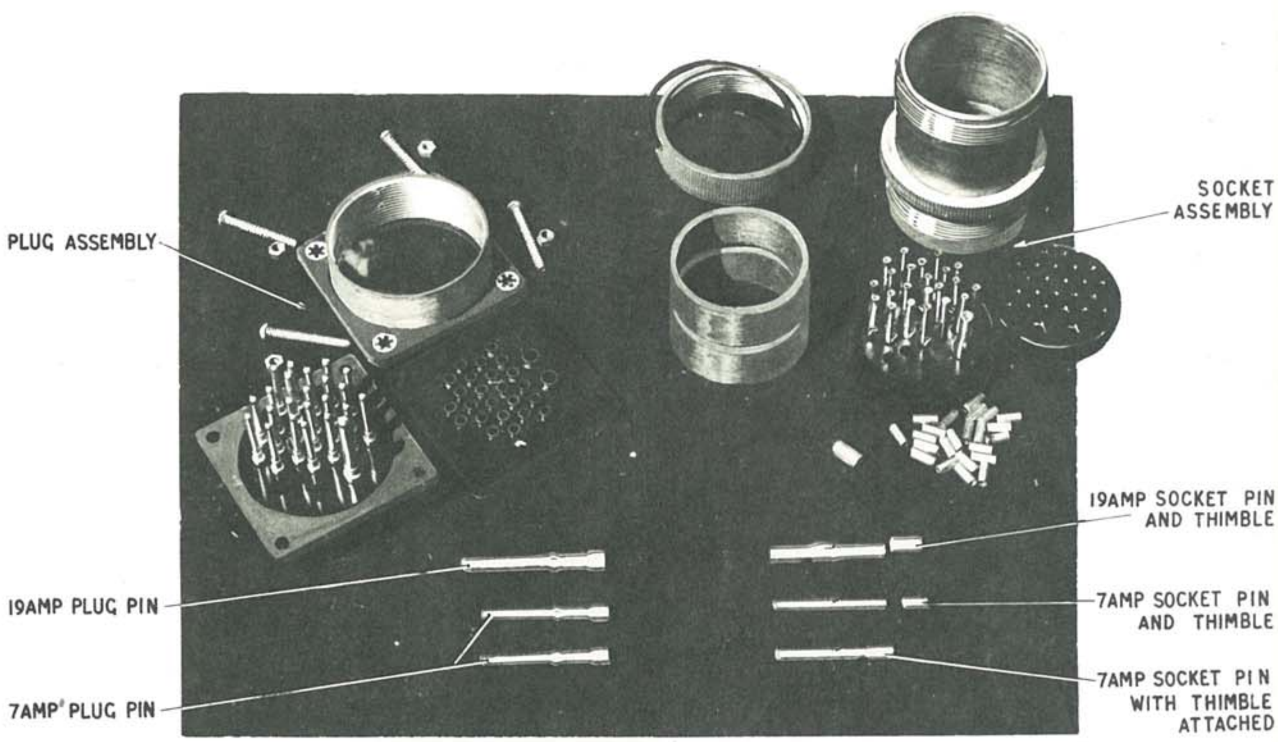


FIG. 24 PLUG AND SOCKET TYPE FERRULES

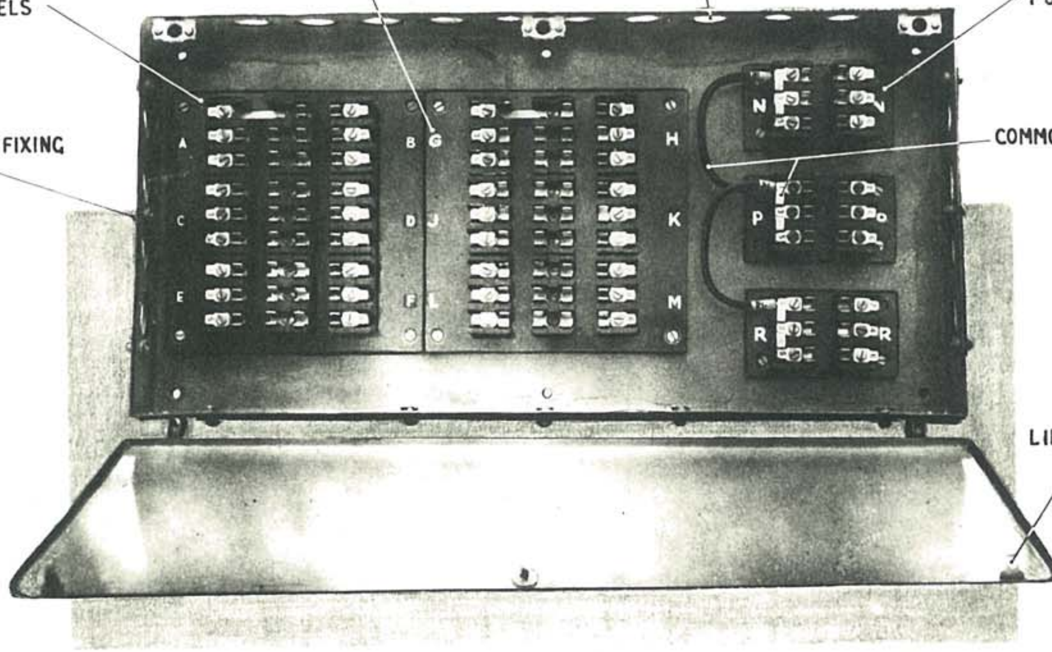


FIG.25. DISTRIBUTION BOX

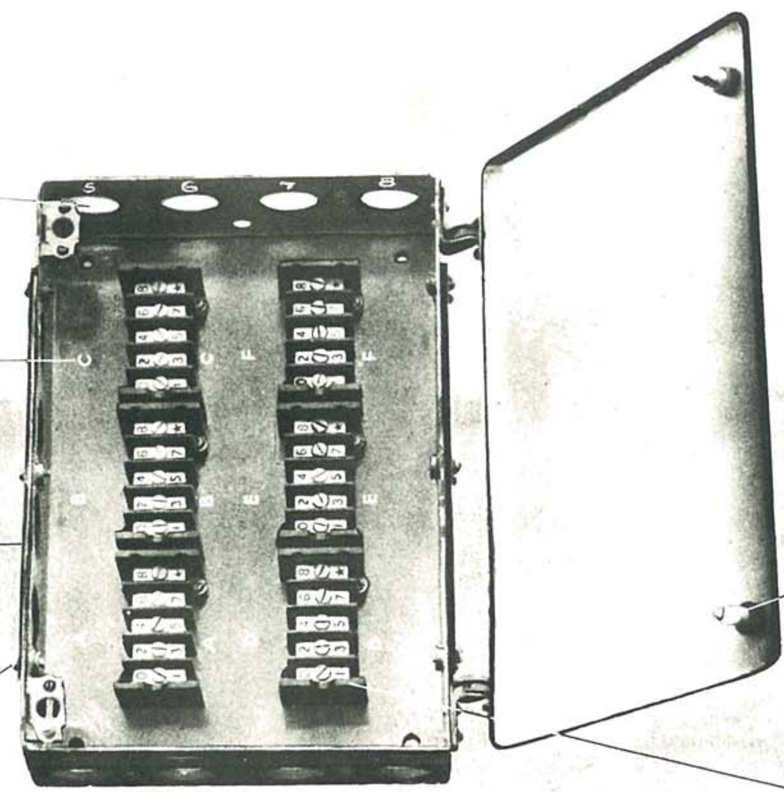
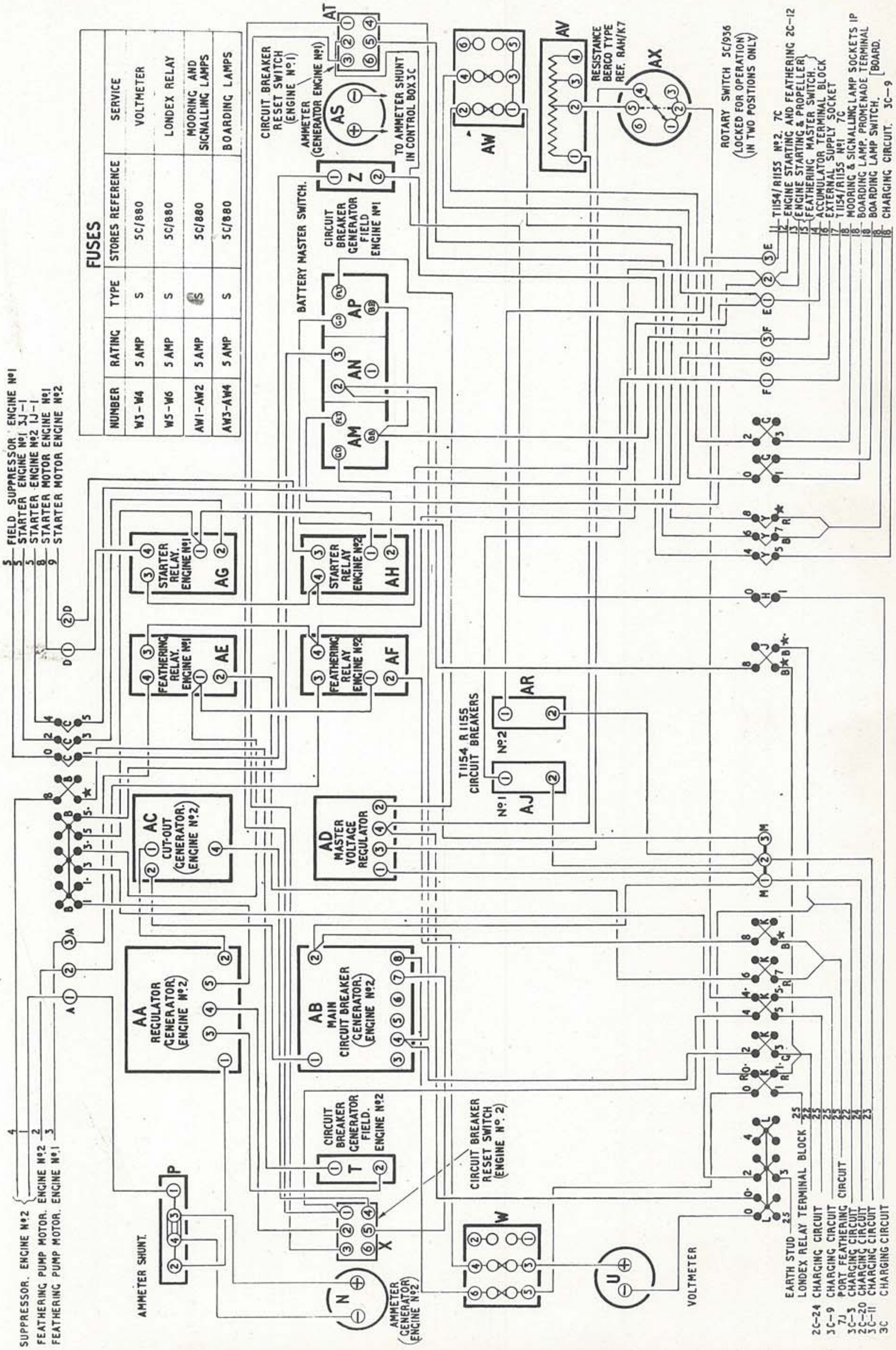


FIG. 26 JUNCTION BOX

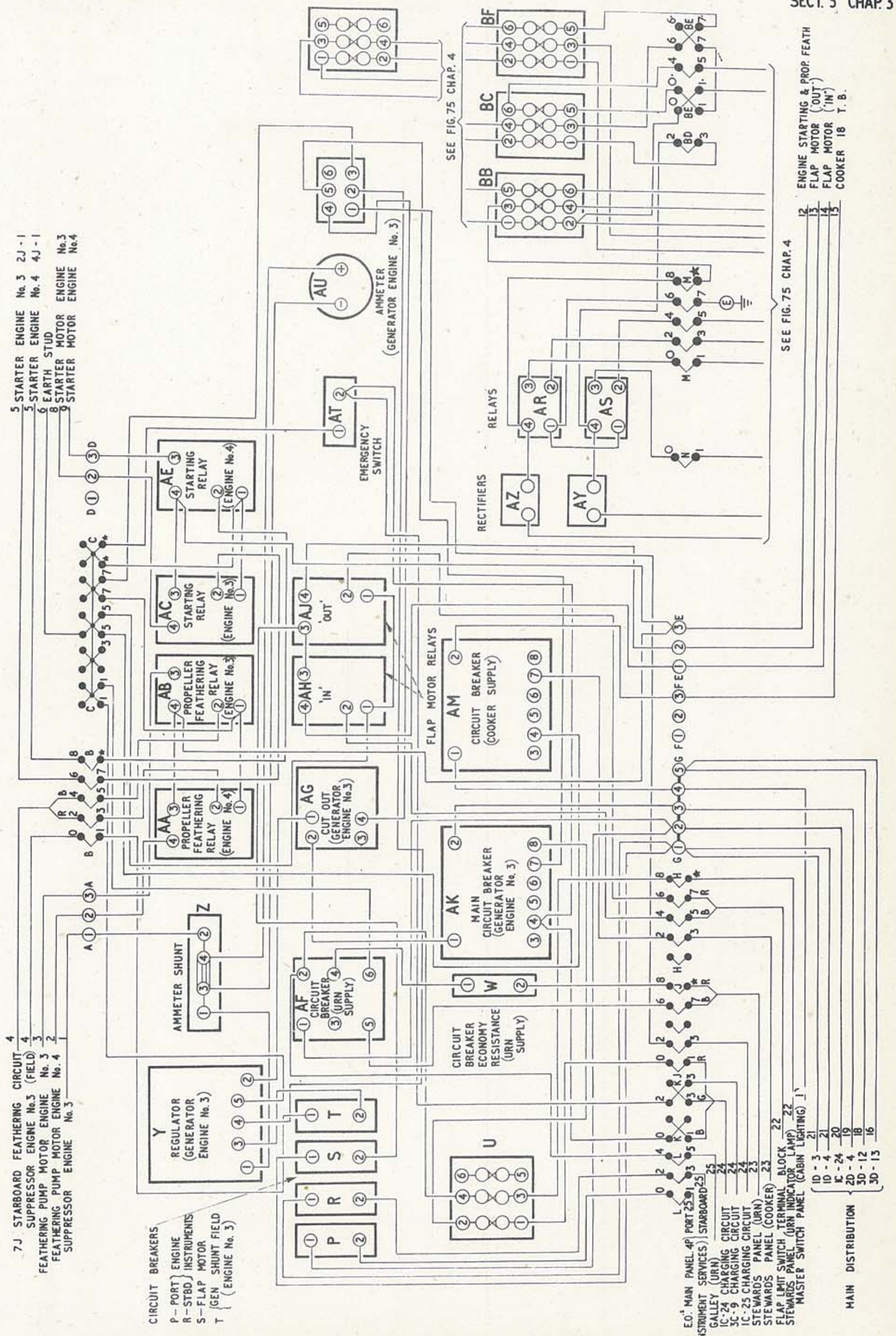


FUSES

NUMBER	RATING	TYPE	STORES REFERENCE	SERVICE
W3-W4	5 AMP	S	5C/880	VOLTMETER
W5-W6	5 AMP	S	5C/880	LONDEX RELAY
AW1-AW2	5 AMP	S	5C/880	MOORING AND SIGNALLING LAMPS
AW3-AW4	5 AMP	S	5C/880	BOARDING LAMPS

CHARGING AND CONTROL BOX IC

FIG. 27

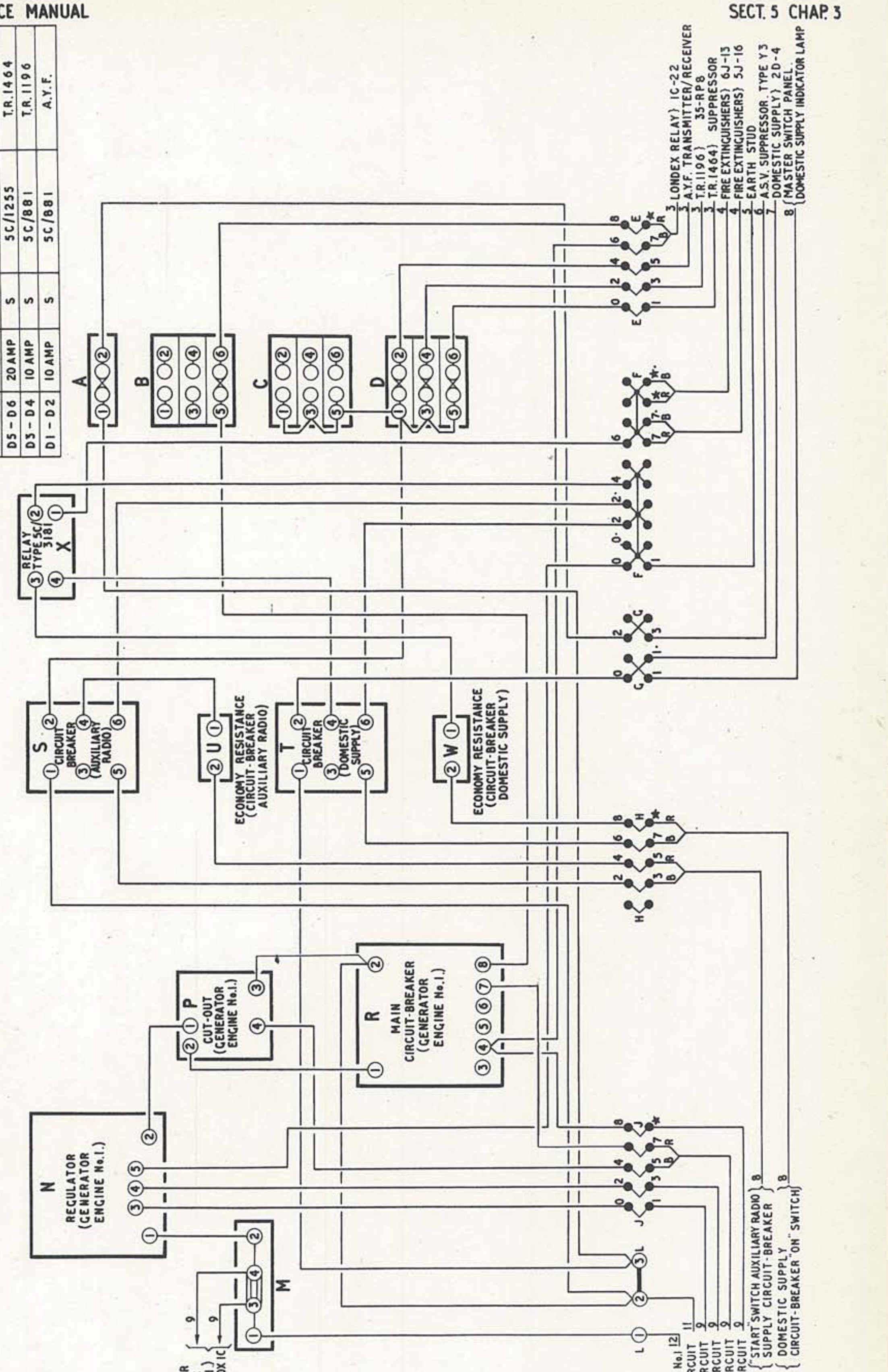


CHARGING AND CONTROL BOX 2C

FIG. 28

FUSES

NUMBER	RATING	TYPE	STORES REFERENCE	SERVICE
A1 - A2	60AMP	M	5C/1667	A.S.V.
B5 - B6	5 AMP	S	5C/880	LONDEX RELAY
D5 - D6	20 AMP	S	5C/1255	T.R.1464
D3 - D4	10 AMP	S	5C/881	T.R.1196
D1 - D2	10 AMP	S	5C/881	A.Y.F.



CHARGING AND CONTROL BOX 3C

FIG. 29

ELECTRICAL INSTALLATION - CIRCUIT DIAGRAMS

Contents

Illustrations

Illustrations (contd.)

1. General. - This chapter is mainly comprised of wiring diagrams in routing chart form. The notes below give briefly the principle of the routing chart followed by an explanation of the method of reading one.

2. Routing charts. - A routing chart, which shows the wiring of a circuit, in its simplest terms, consists basically of columns headed to represent panels, major items of equipment, or portions of the aircraft.

2.1. The columns for any circuit give those panels or major items of equipment, firewalls etc., which are necessitated by the inclusion of their components or terminals in the circuit. Those components mounted individually on the aircraft structure are shown in columns headed "Equipment".

2.2. The symbols for the S.B.A.C. type connector blocks on the routing charts are V-shaped for single, and X-shaped for double, tier types. The arms of both types terminate in small filled-in circles which represent the sockets, the dots at the points of intersection of the arms representating the fixing screws. The identification letter for the terminal block is shown centrally on the symbol, the individual socket number being shown on the line representing the cable, adjacent to the filled-in circle.

2.3. The symbols for the remaining components are shown with heavy outlines to avoid confusion with the lines representing the cables and, where possible, they show the internal wiring in order to give an approximate indication of the results that may be expected when making point-to-point continuity tests.

2.4. The method of indicating cables on routing charts is as follows:-

(i) Single core cables - Marked above the line indicating the cable.

(ii) Multi-core cables - The cable type is shown between brackets which break the lines representing its cores. The cores are indicated by the initial letters of their colours.

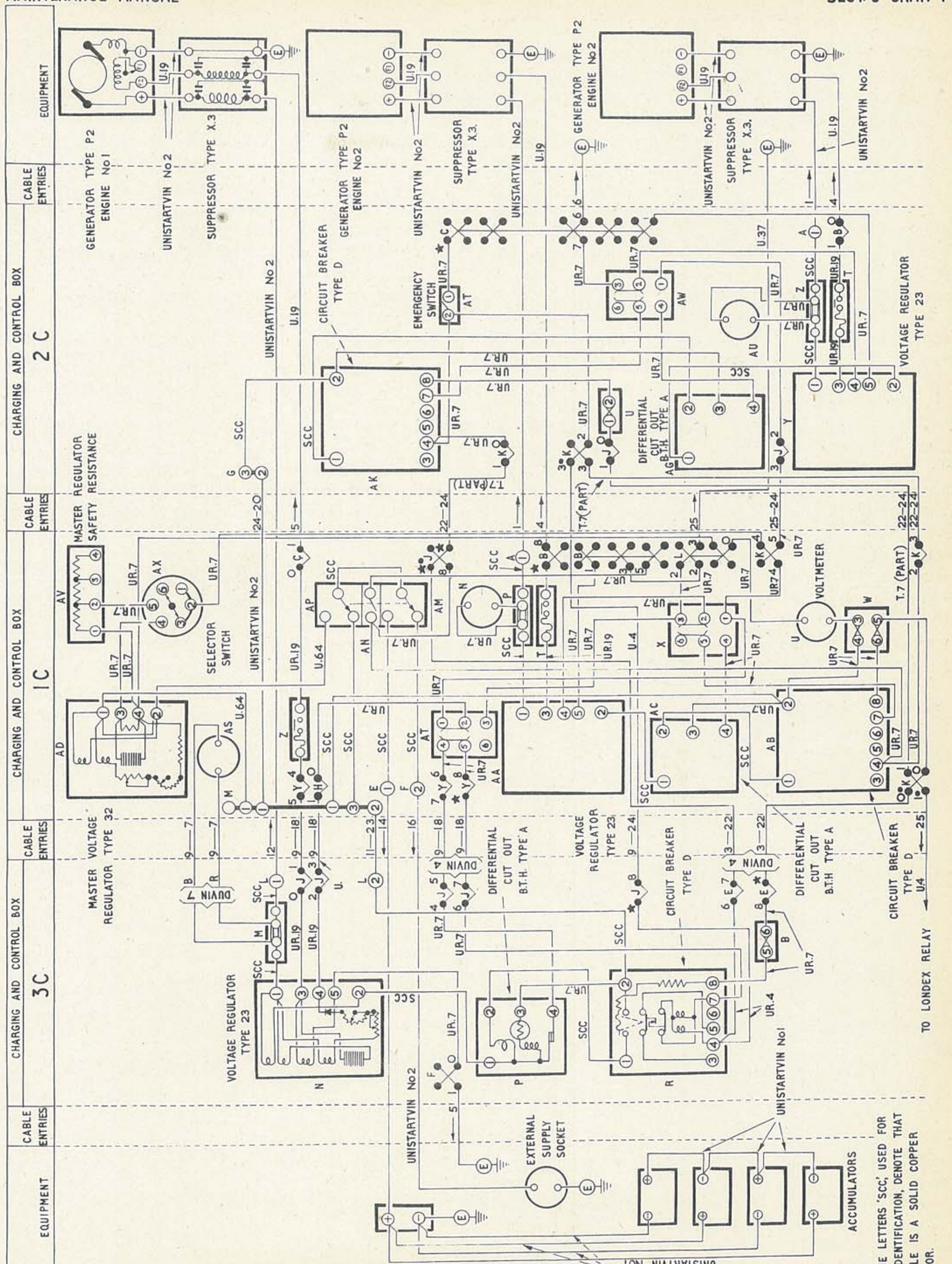
As "cel" or "vin" type cables are used for the greater portion of the installation, they are usually indicated on the diagrams by the first letter of the prefix only, thus U.4. denotes a single-core cable of 4 amperes rating and D.7 a double core "cel" or "vin" cable of 7 amperes rating. Cables with other types of dielectric are shown in full with the exception of unirubber (used for panel interconnections) which is indicated by UR.

3. Method ofreading a routing chart. - It will be noted that on the routing charts the fused circuits are fed from the heavy vertical lines in the distribution box columns. These lines represent the linking between the fuses, the figure number at the top of each giving the diagram showing their connections to the main bus-bar.

3.1. The method of reading a routing chart will be explained using the pressure head heating circuit as an example; reference should therefore be made to fig.   Taking the upper pressure head, it will be seen that the circuit is fed from fuse number 6 on block D in distribution box 1D. Tracing the line from the fuse to the left the B will indicate that it is the blue core of a multi-core cable. The number in the column headed "cable entries" indicates that the cable, of which the blue core is a part, leaves the distribution box via entry number 26 and the arrow pointing towards the panel 1P. shows that no cable entry is used (a number adjacent to that panel would denote another entry). The next annotation on the line identifies it as the blue core of a duvin 7 cable, this alternative form of marking a multi-core cable being used here because a pair of brackets between this and the red core, at the botton of the diagram, would pass through another cable. Further reference to the diagram will show that the cable is connected to terminal 8 of the single-tier block H on 1P. It leaves this block from the terminal marked with a star and is connected to terminal 2 on the switch on the Kollsman type switch unit whose internal wiring is not part of the aircraft system. The earth connection, it will be seen, is taken via terminal 1 on the switch by a U.4 cable to the terminal marked with a star on the double tier block A, which is fitted with a commoning link to complete the circuit to the earthed terminal 6.

3.2. Reverting to terminal 3 on the switch, it will be seen that the blue core of the D.7 is connected to terminal 3 on the single-tier block G which the circuit leaves on terminal 2 as the blue core of a multi-core cable. Following the line towards the right hand side it will be noted that the cable is duvin 7 and that it passes straight through the column for distribution box 1D, thus indicating that it is not connected in any way with that box. The next break-down point for the cable is on terminal 1 of the double tier block in the column headed 13 T.B. The fact that this block has been given a separate column indicates that it is mounted on the aircraft structure directly, and is not part of a box or panel. From therminal 0 on 13 T.B. the circuit is through the heater and back to the same block, via the red and blue cores respectively of the cable supplies with the heater. The return from the heater is connected to terminal 8 and that portion of 13 T.B. is connected by means of a link to 12 T.B. which is earthed. Further reference to the diagram will show that the circuit for the lower pressure head is identical.

4. Diagrams. - The diagrams in this chapter are listed in alphabetical order at the beginning of the chapter.



NOTE. THE LETTERS 'SCC' USED FOR CABLE IDENTIFICATION, DENOTE THAT THE CABLE IS A SOLID COPPER CONNECTOR.

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1	23.10.47
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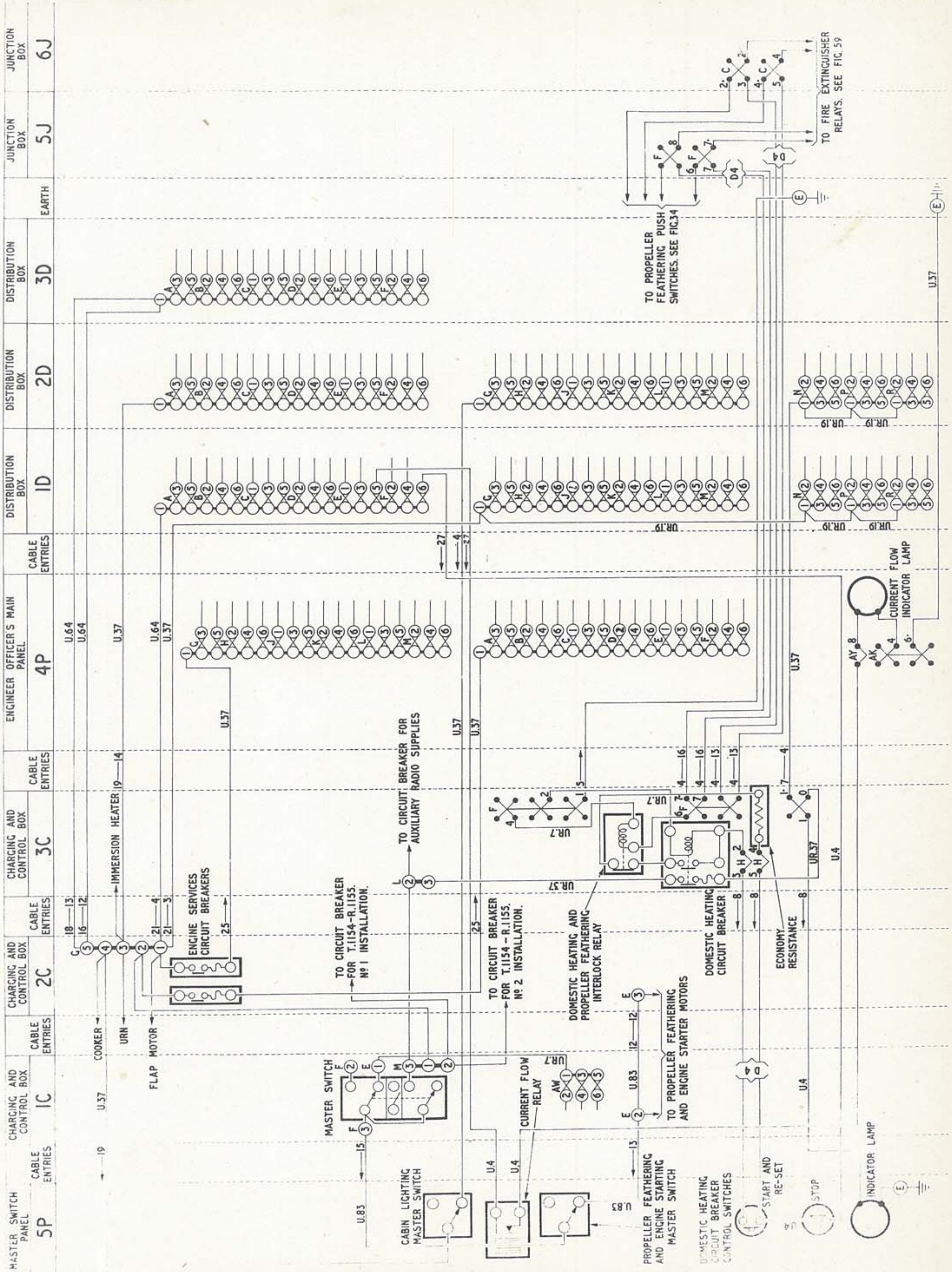
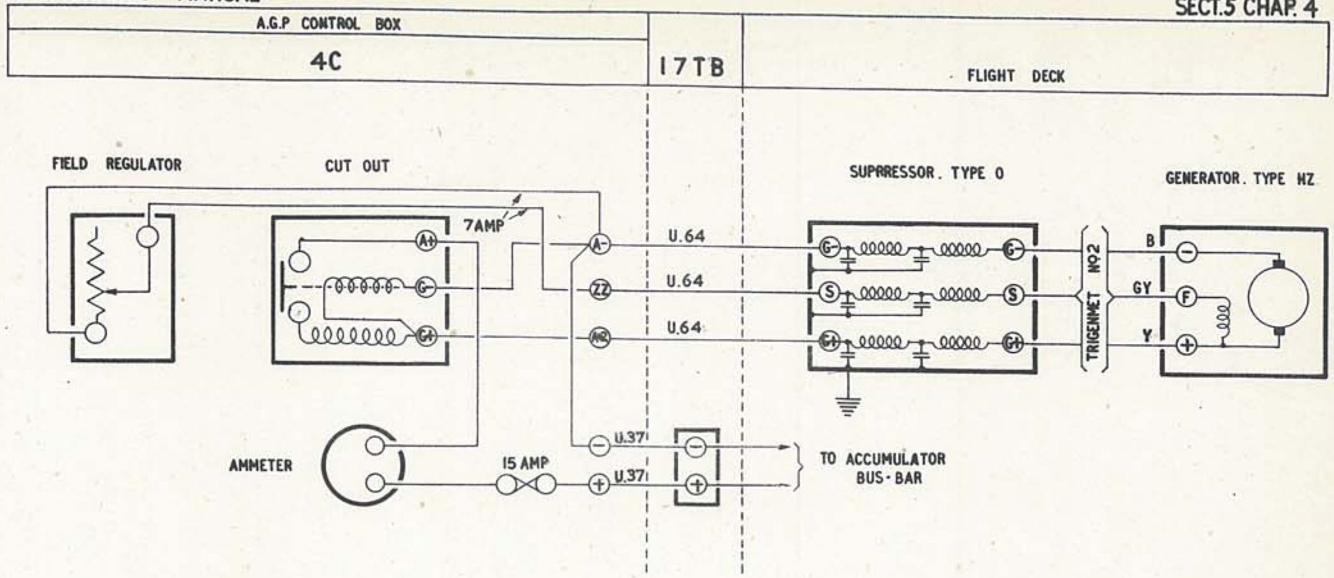
MAIN POWER SUPPLY

FIG. 31



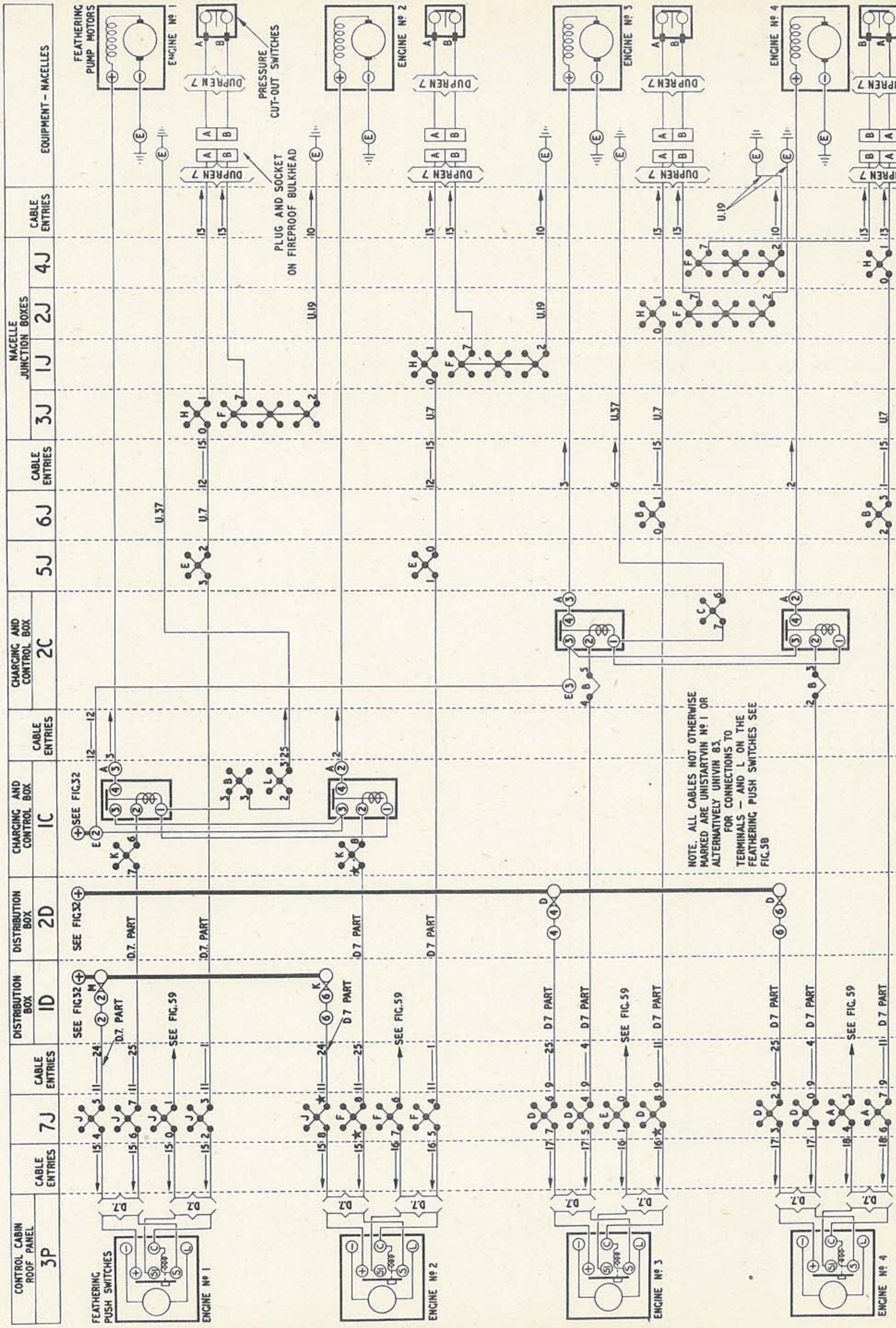
MAIN DISTRIBUTION

FIG. 32



AUXILIARY GENERATING PLANT

FIG. 33



PROPELLER FEATHERING

FIG.34

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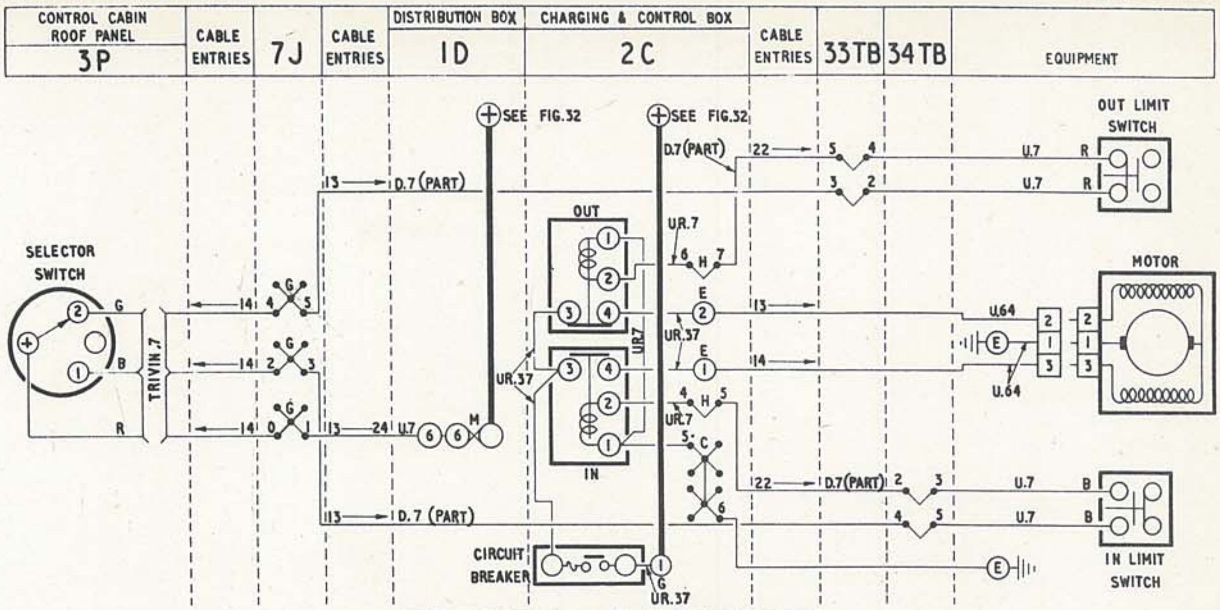
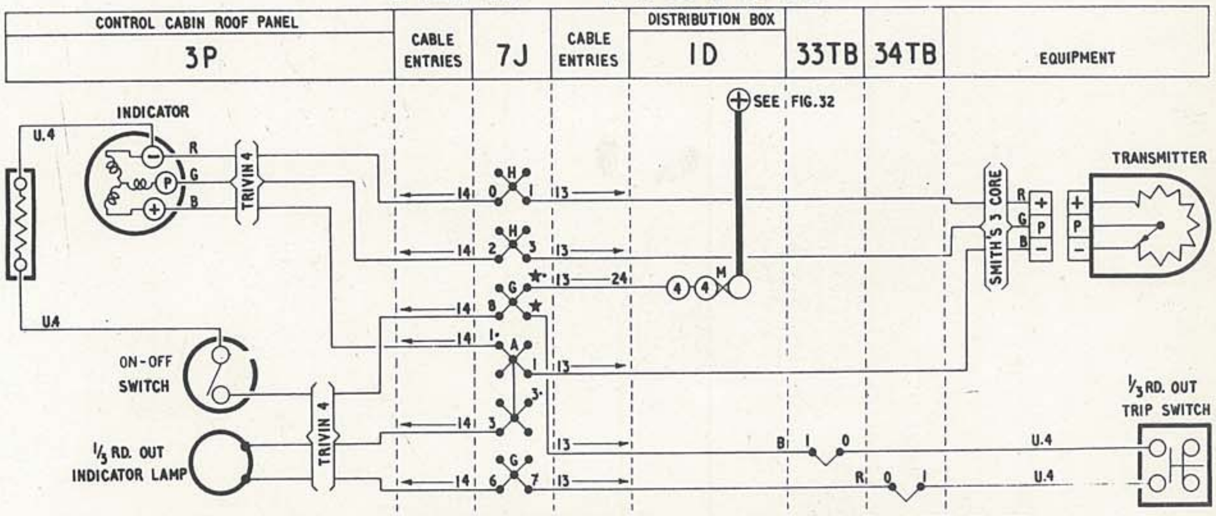
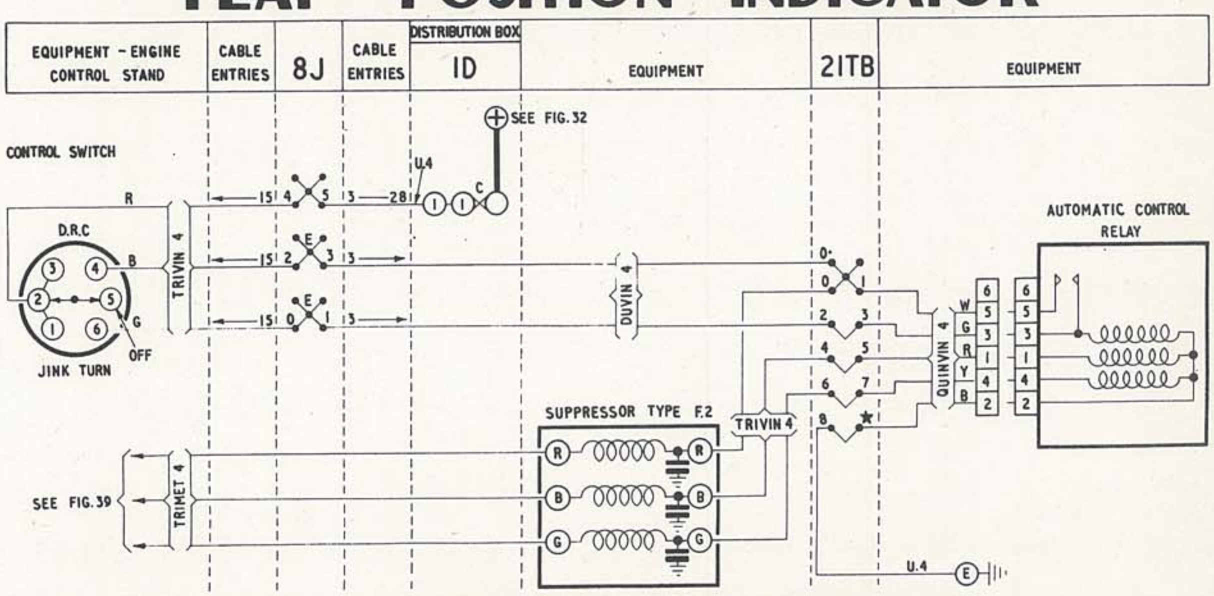
ISSUE	DATE
1	28-2-48
2	2-2-51



FLAP MOTOR

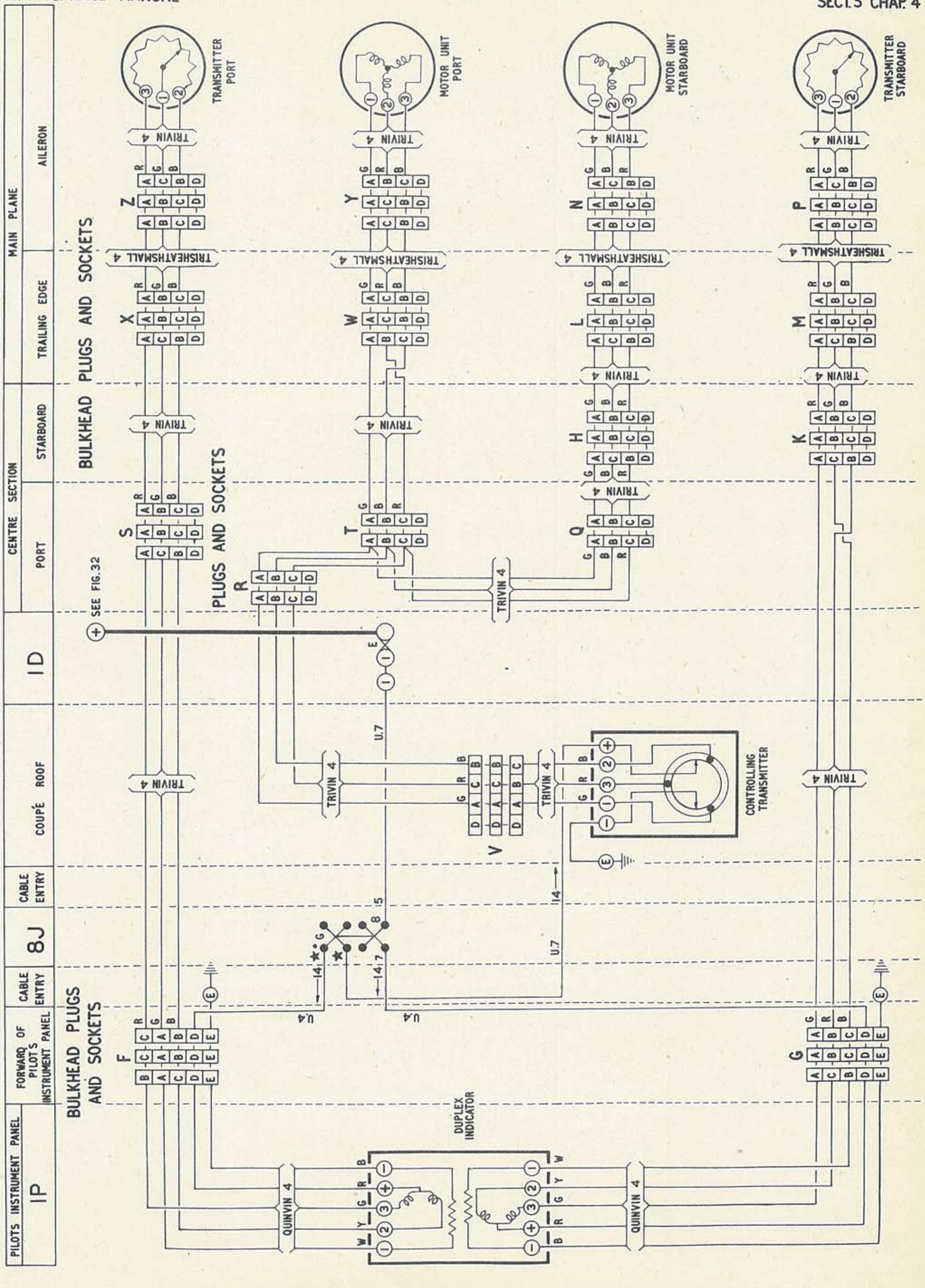


FLAP POSITION INDICATOR



AUTOMATIC CONTROLS

FIG. 35



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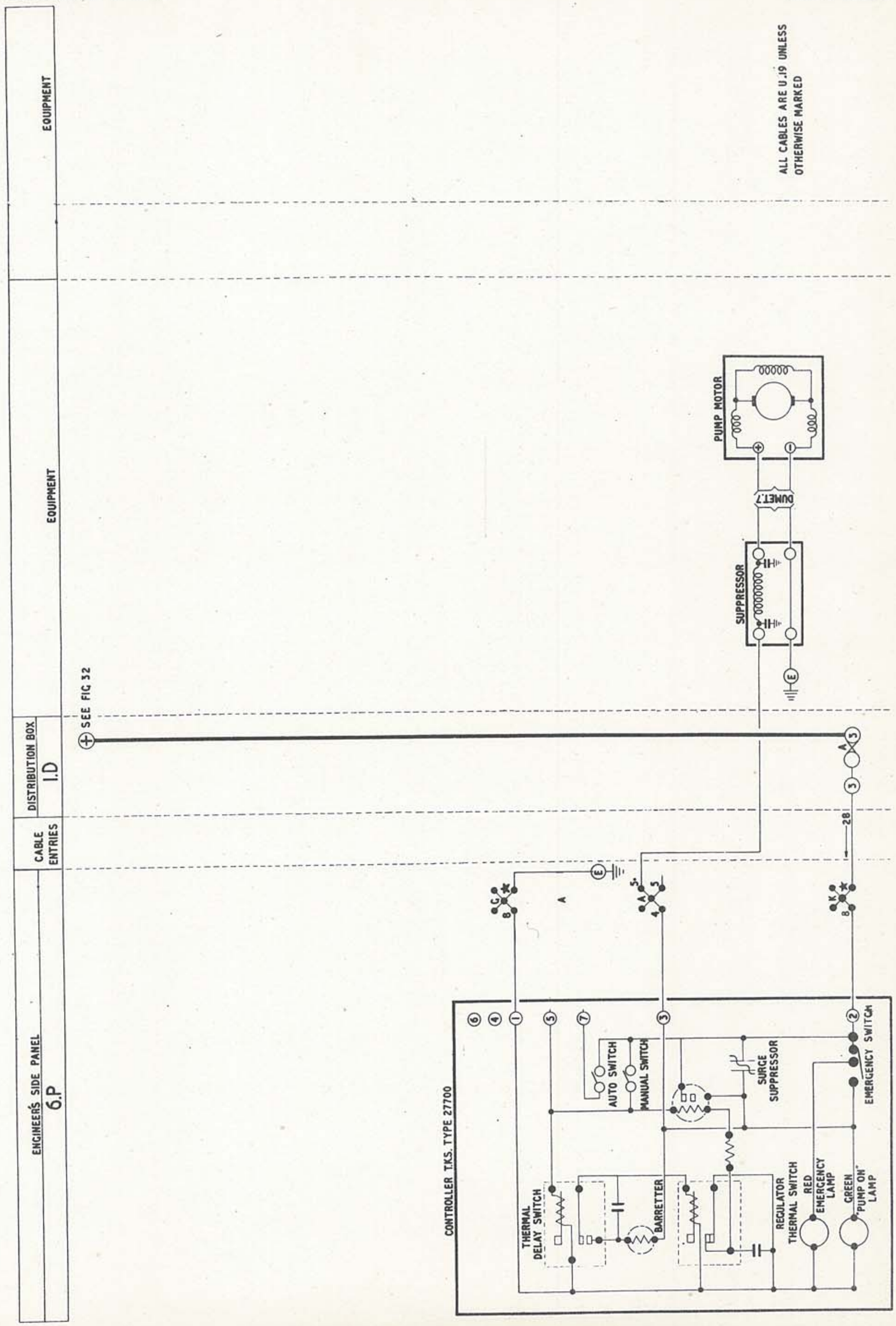
1	10-3-48
2	25-1-50

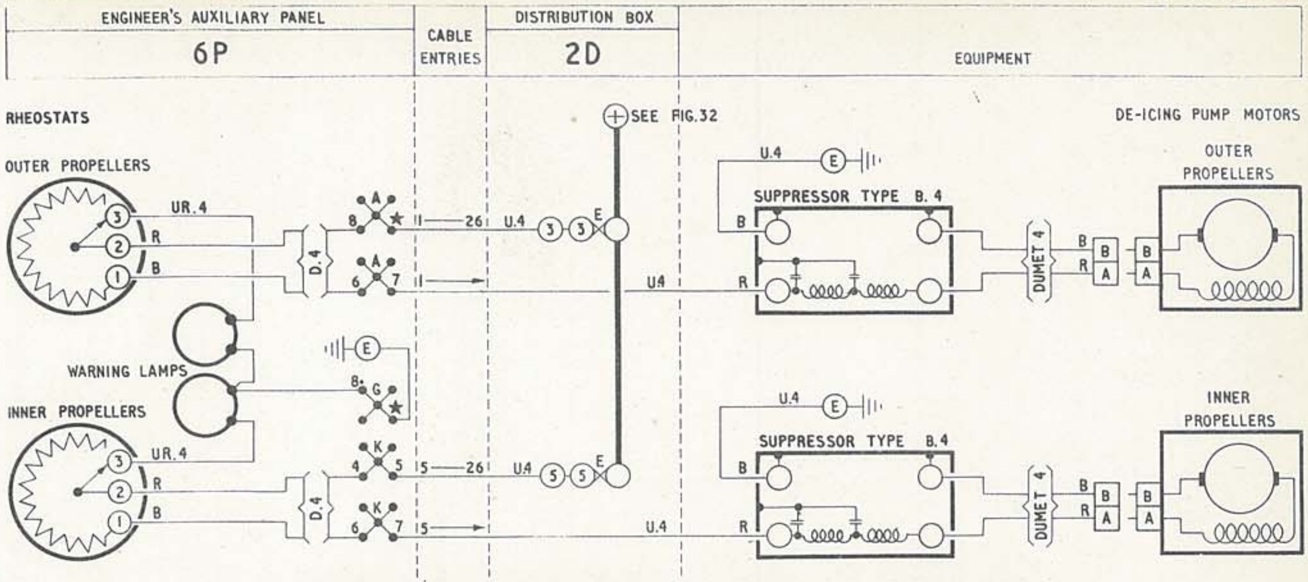
AILERON TRIMMING TAB CONTROL

FIG. 36

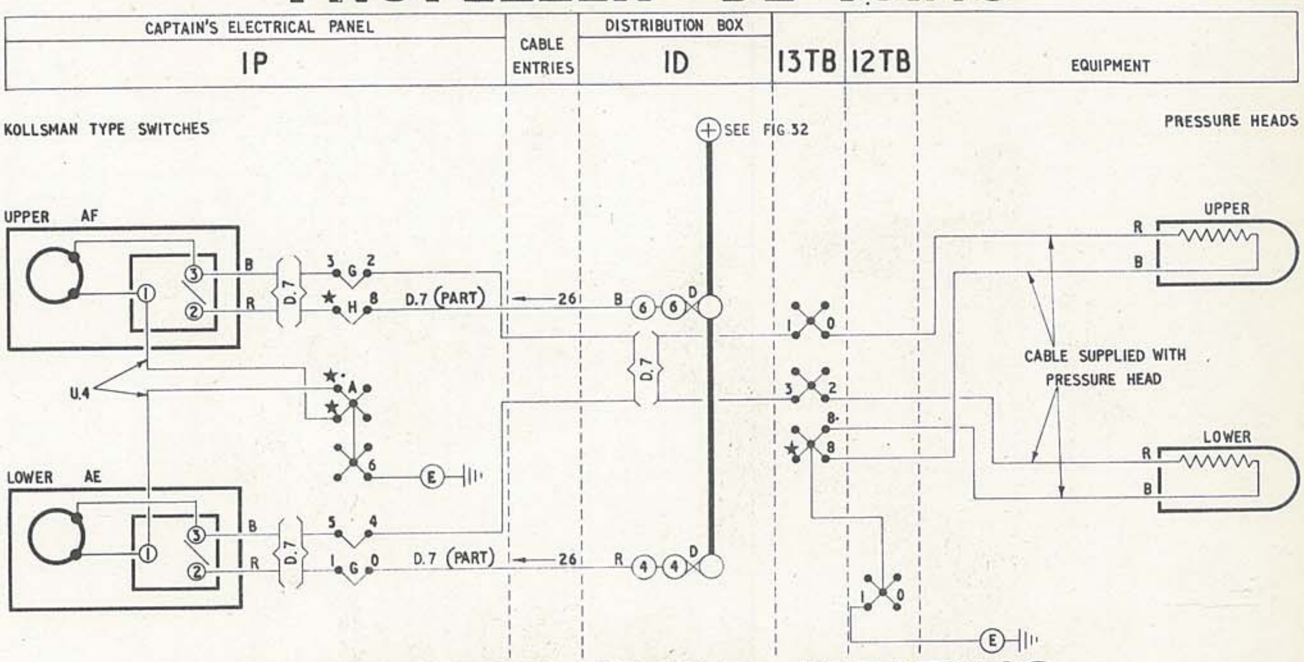


AIRFRAME DE-ICING

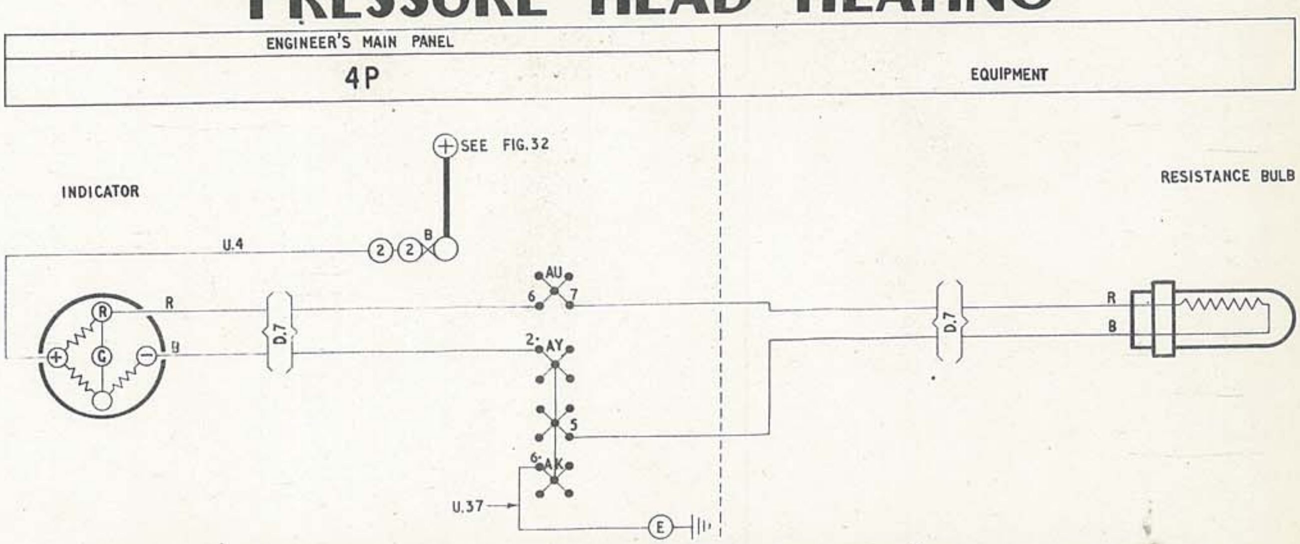
FIG 37



PROPELLER DE-ICING

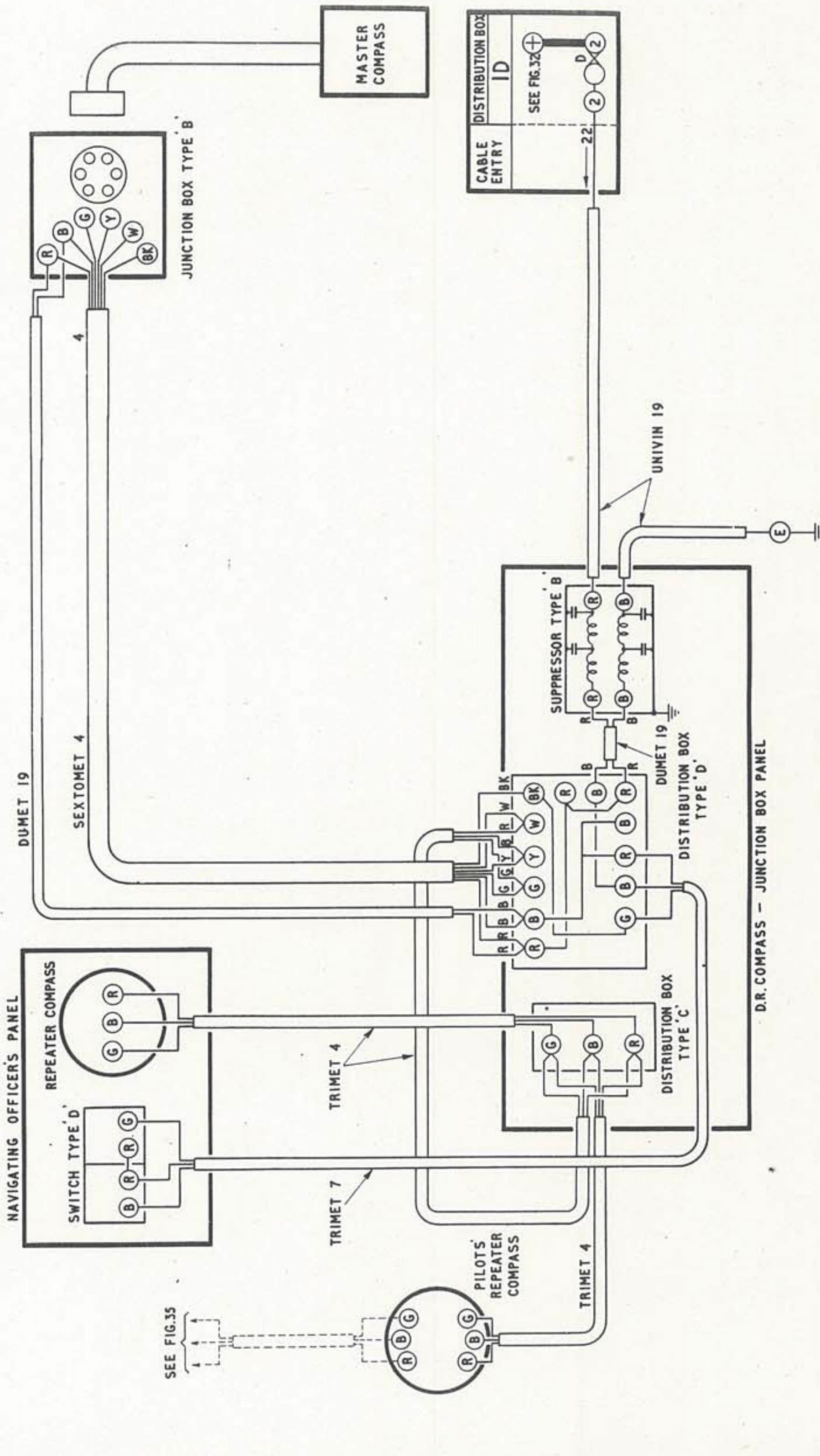


PRESSURE HEAD HEATING



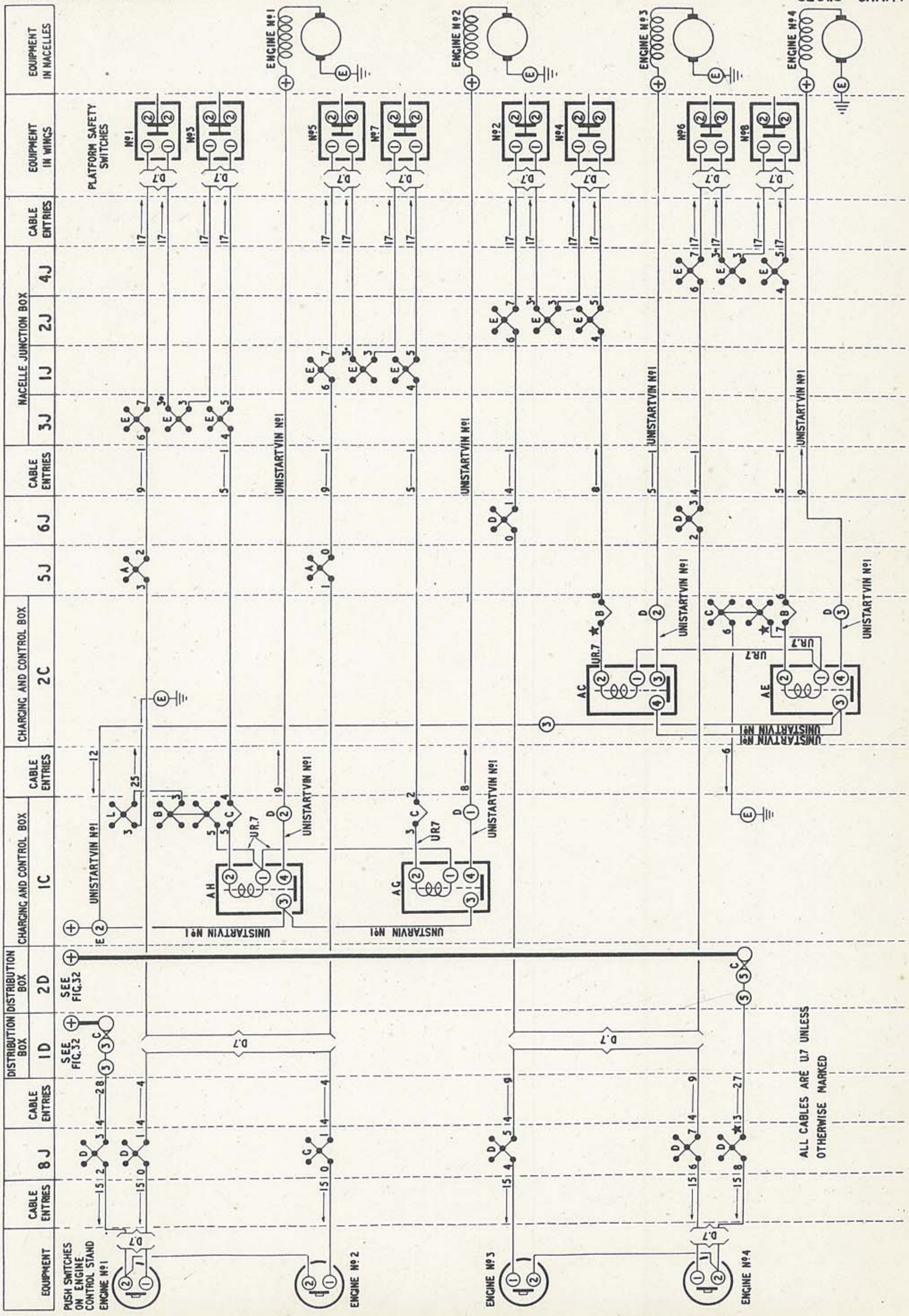
OUTSIDE AIR TEMPERATURE GAUGE

FIG. 38



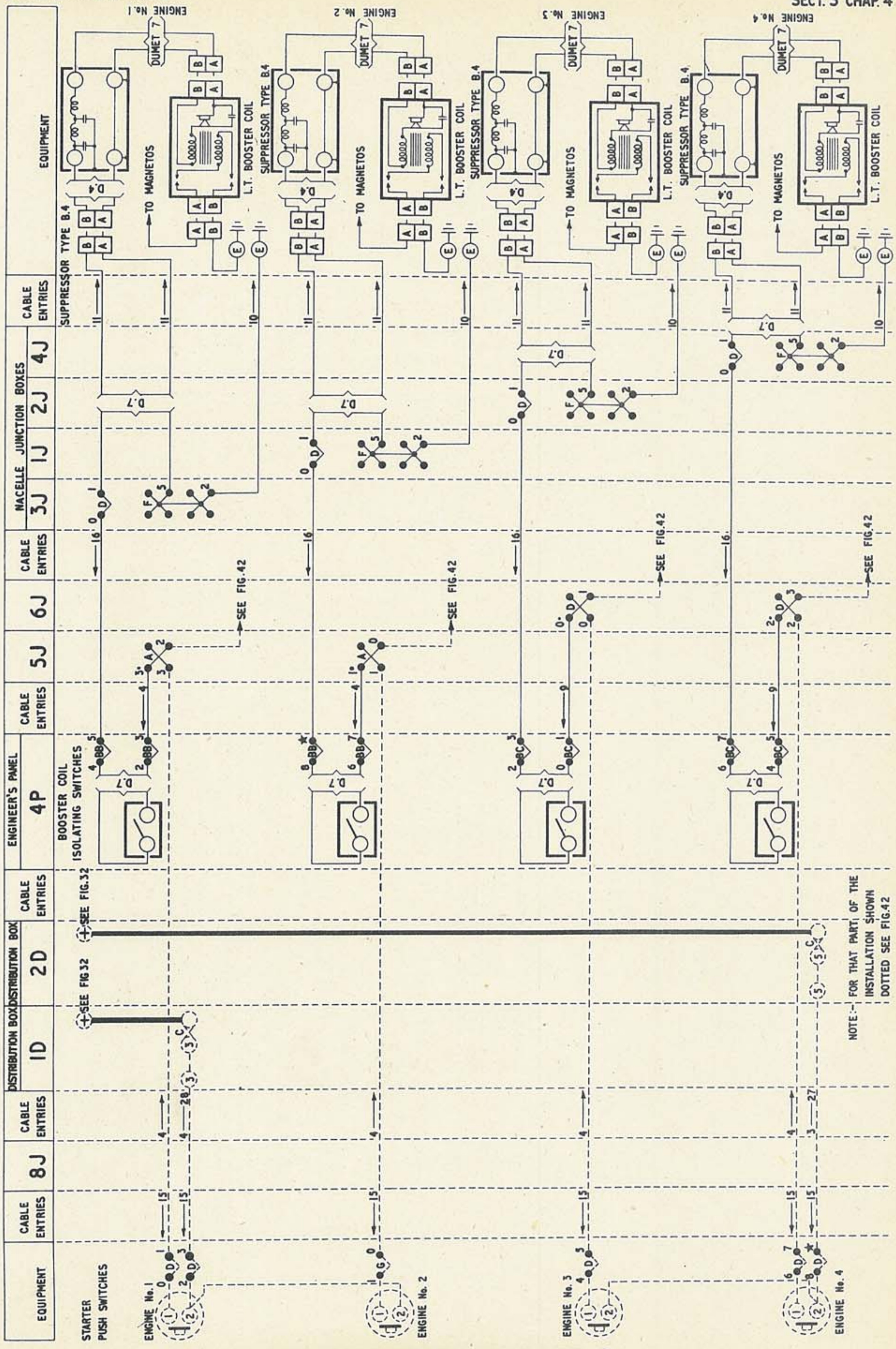
D.R. COMPASS.

FIG. 39



ENGINE STARTER MOTORS

FIG. 43



BOOSTER COILS

FIG. 43

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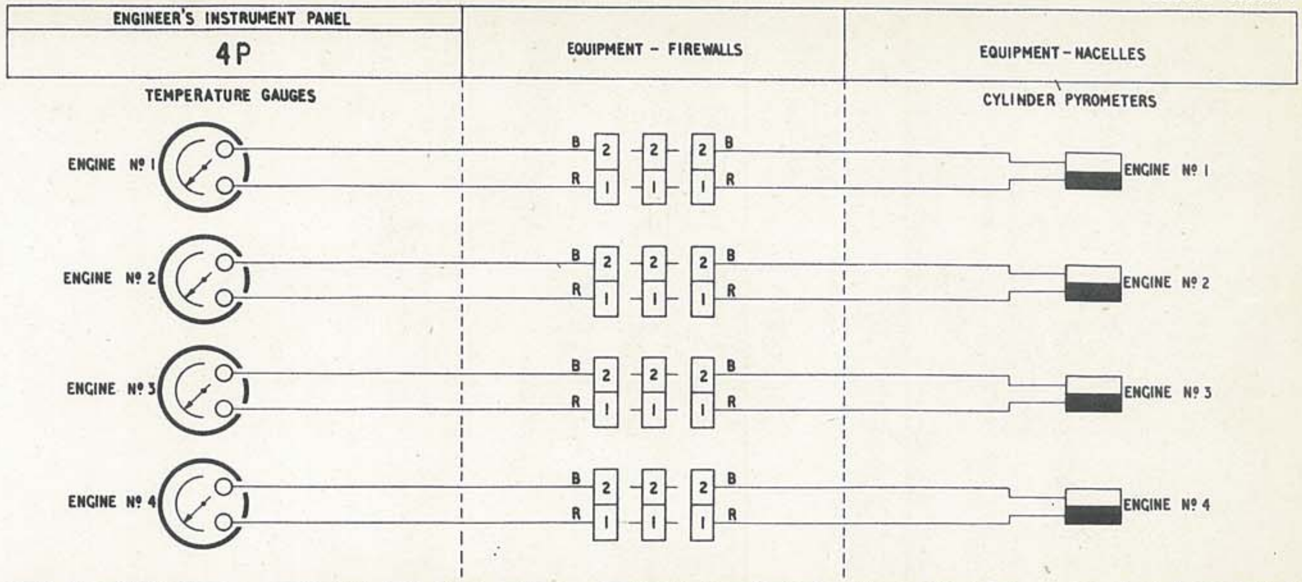
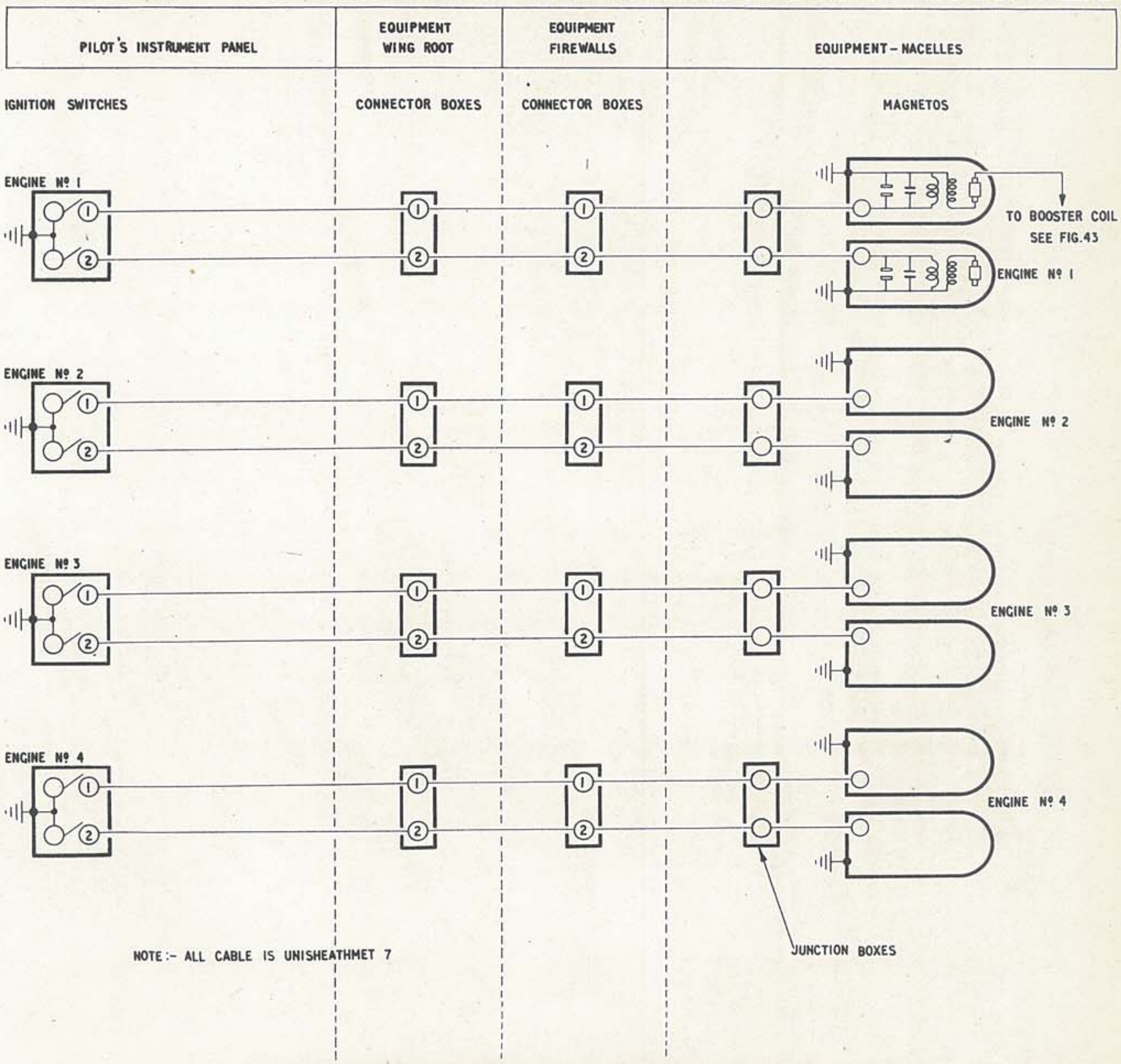
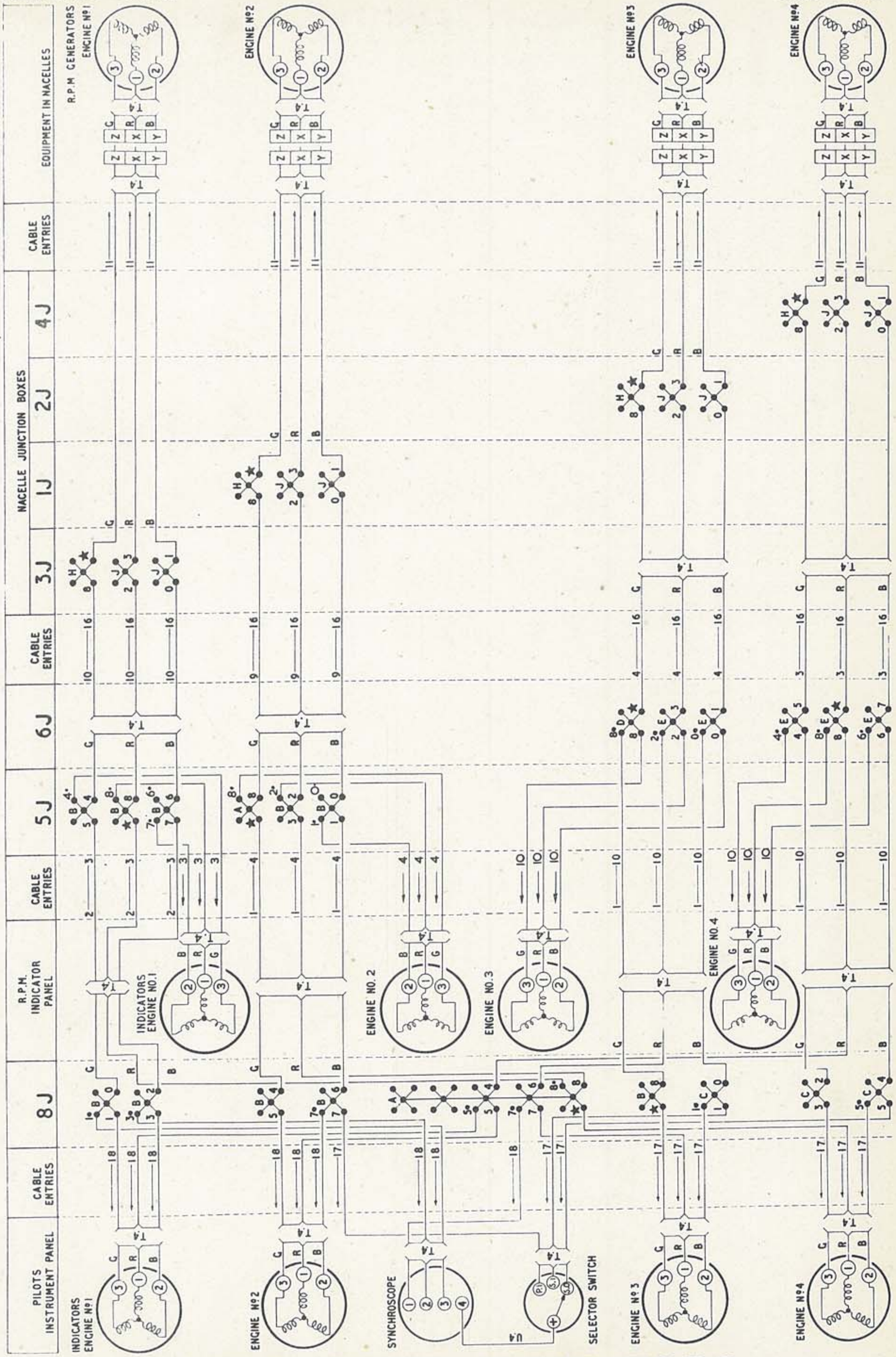


ENGINE CYLINDER TEMPERATURE GAUGES



ENGINE IGNITION

FIG. 44



ENGINE SPEED INDICATORS

FIG. 45

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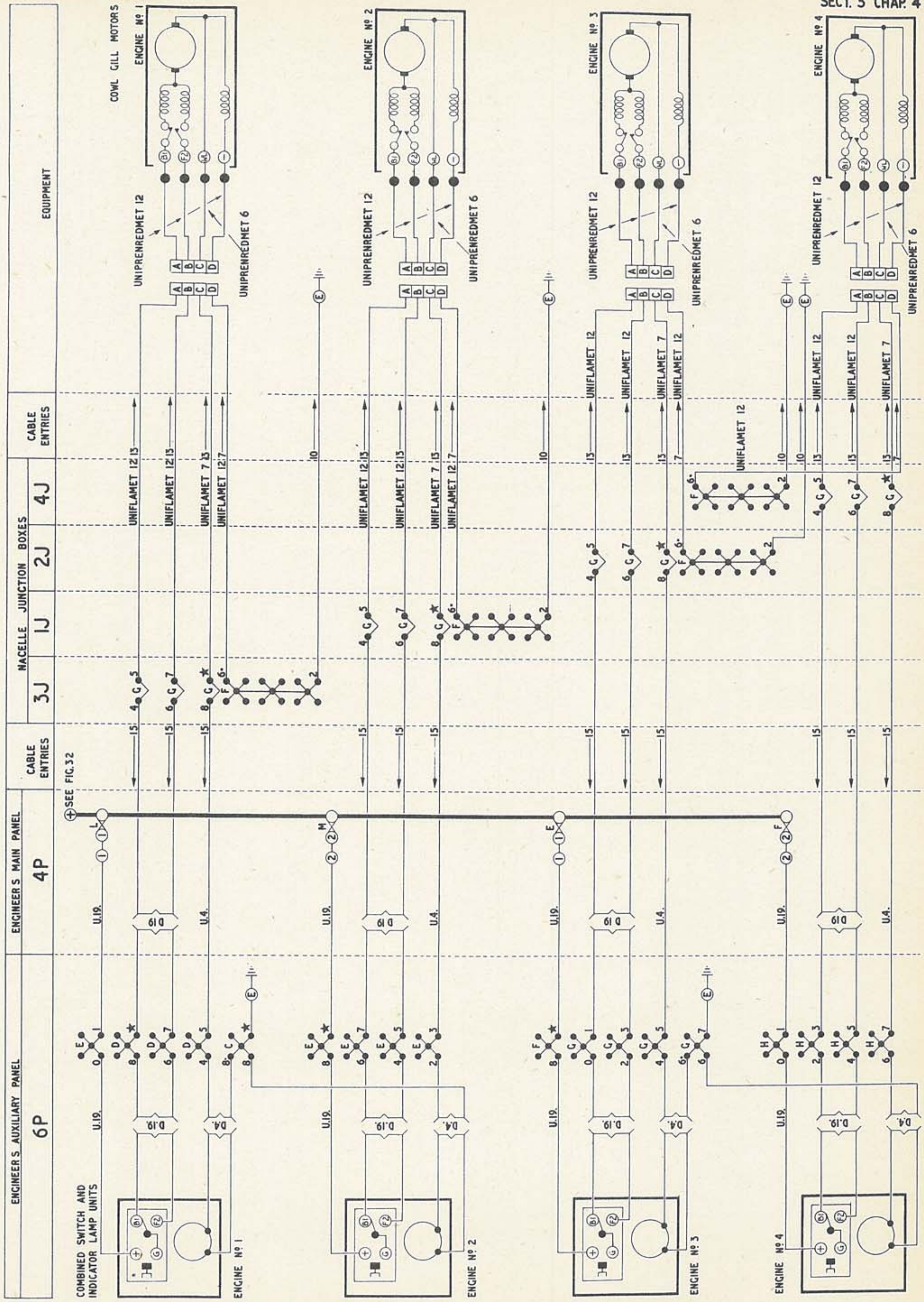
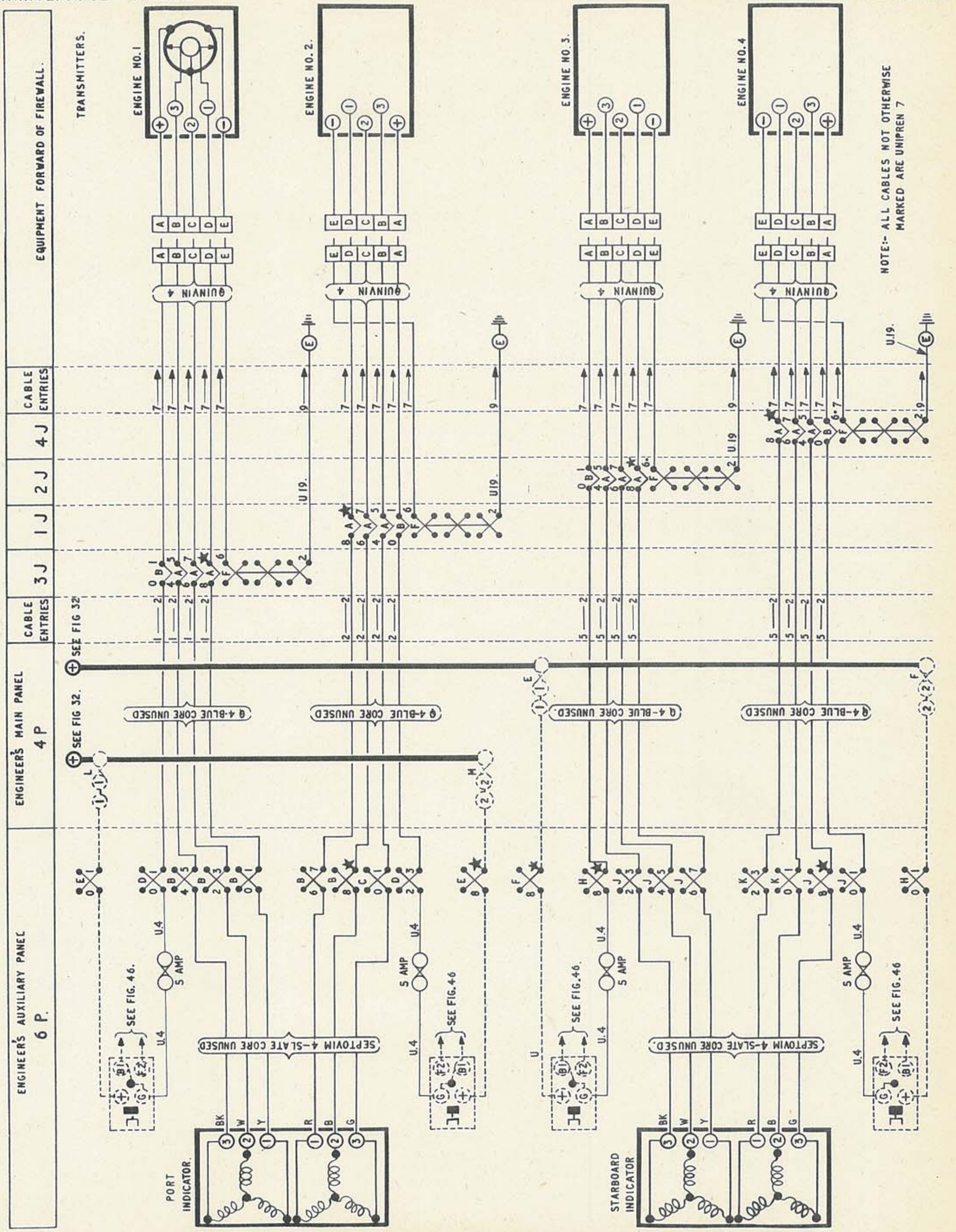
1 10.3.48
2 12.3.51



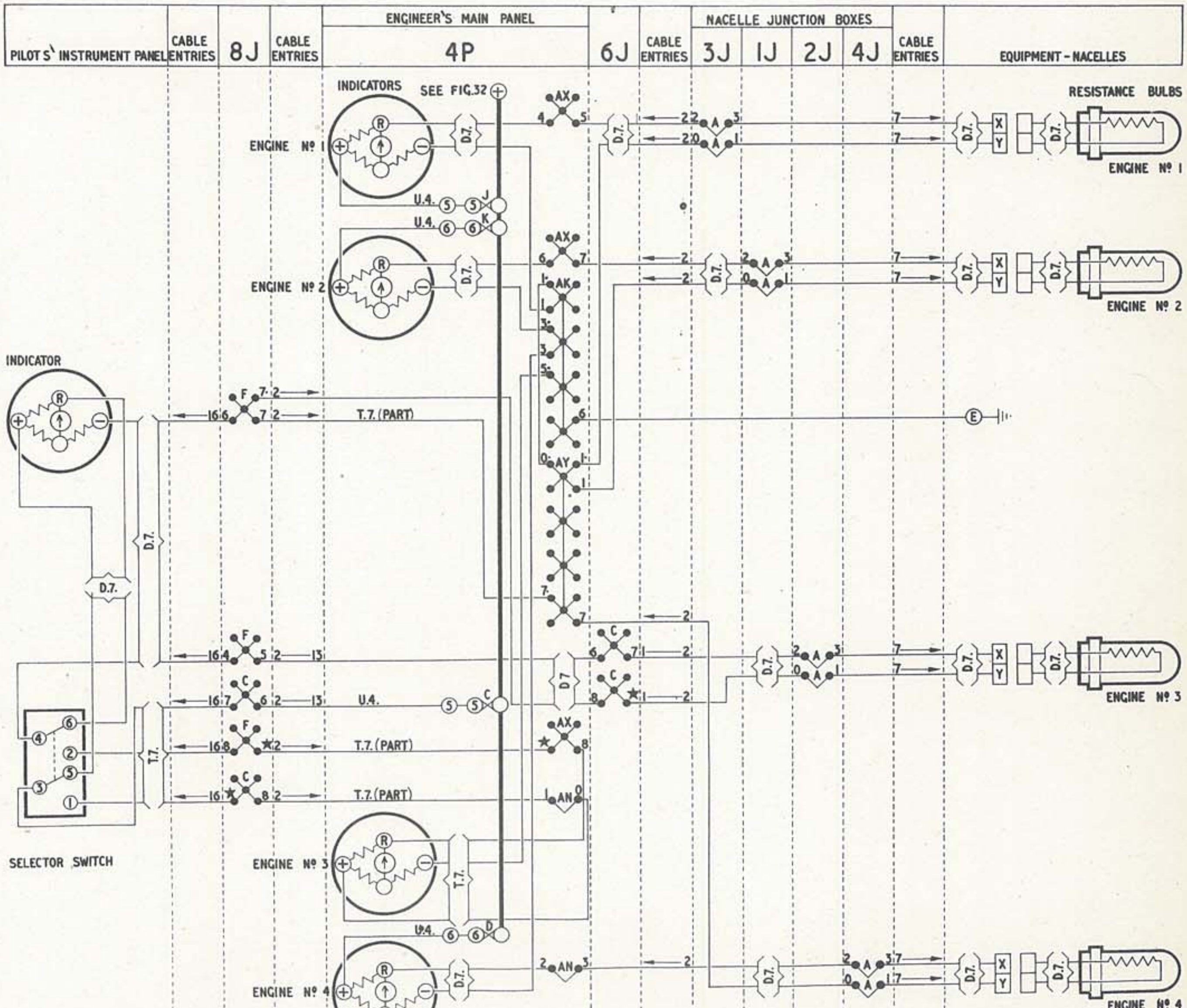
COWL GILL MOTORS

FIG. 46



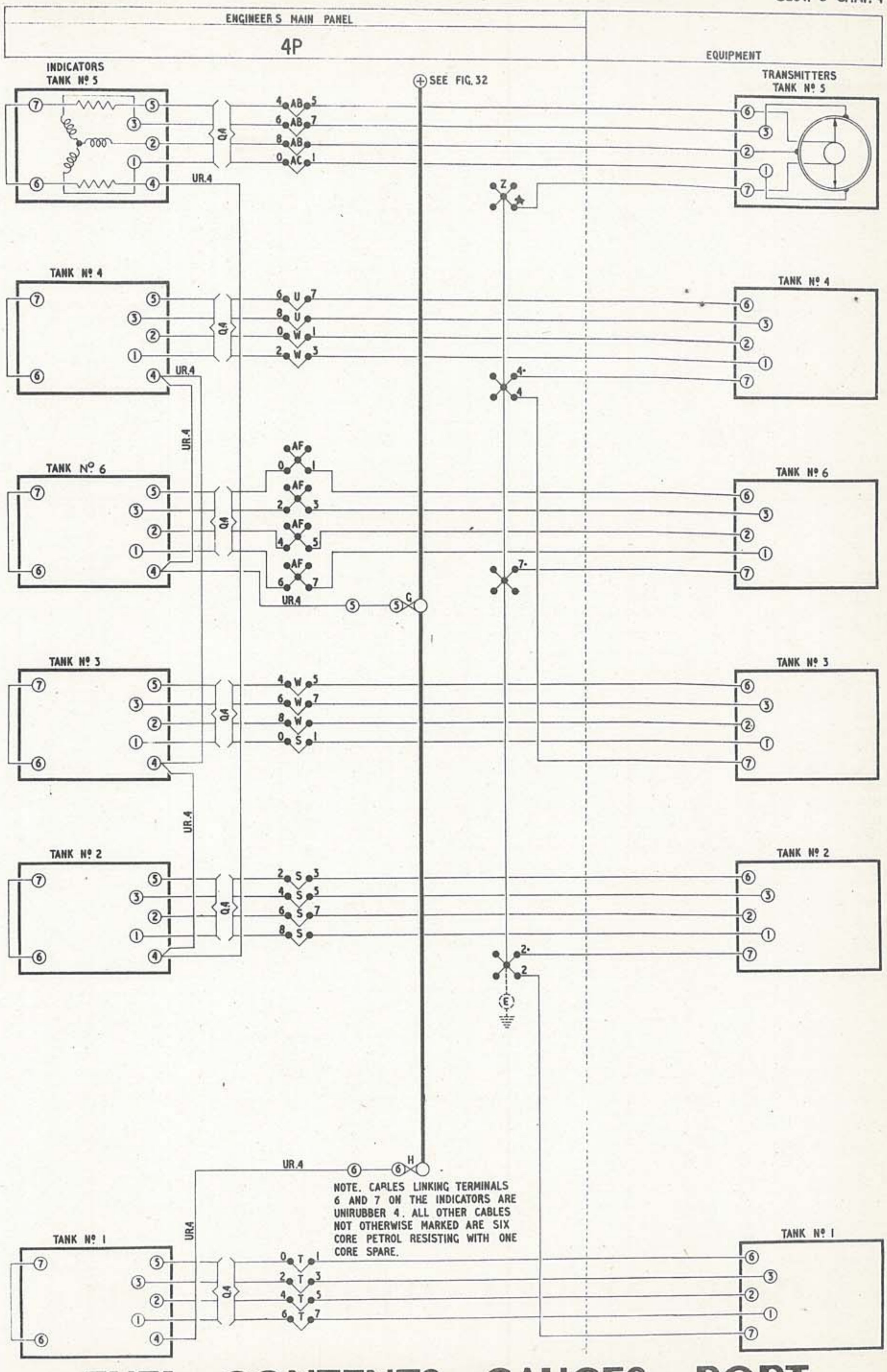
COWL GILL POSITION INDICATORS

FIG. 47



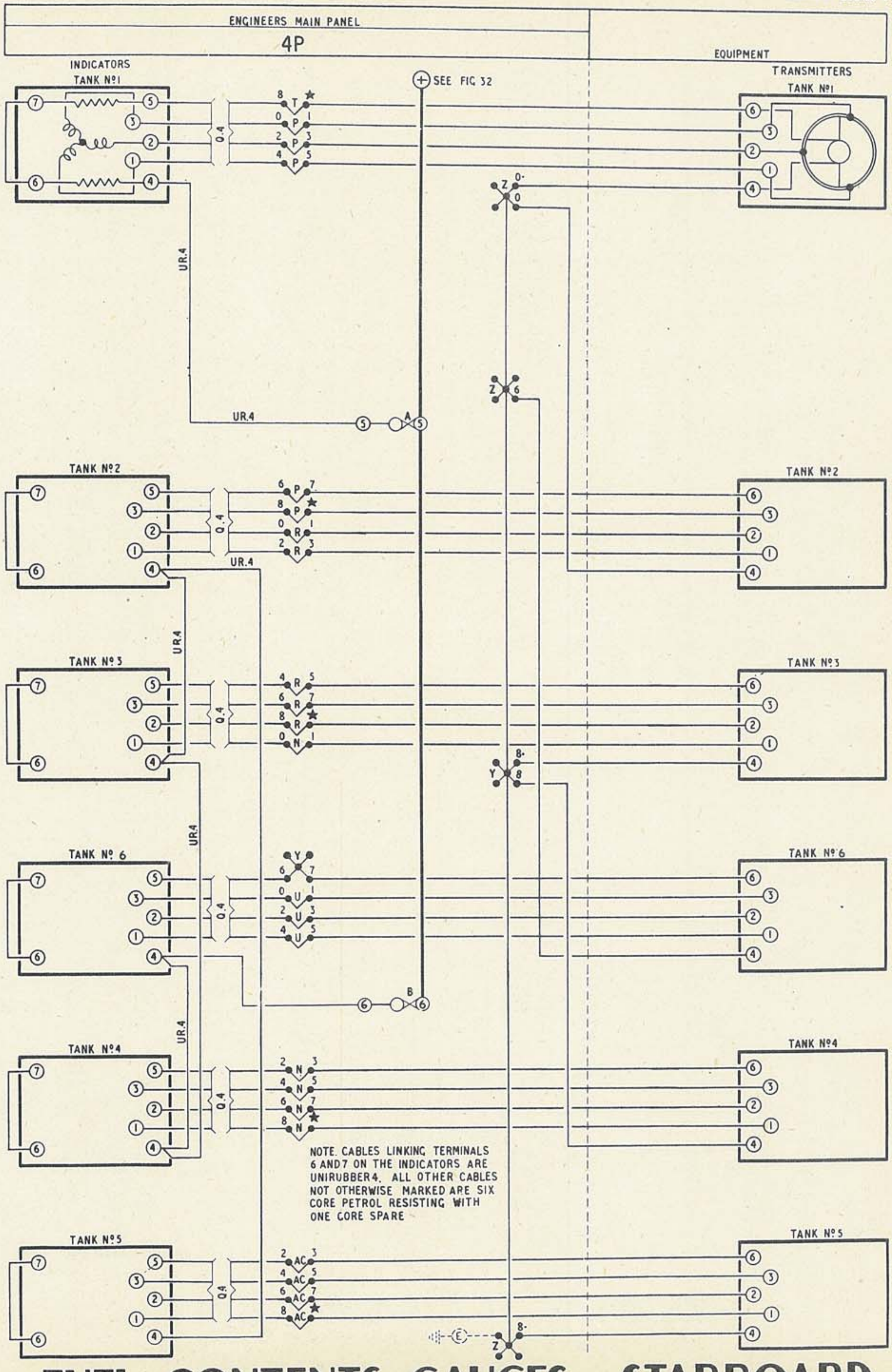
AIR INTAKE TEMPERATURE GAUGES

FIG. 48



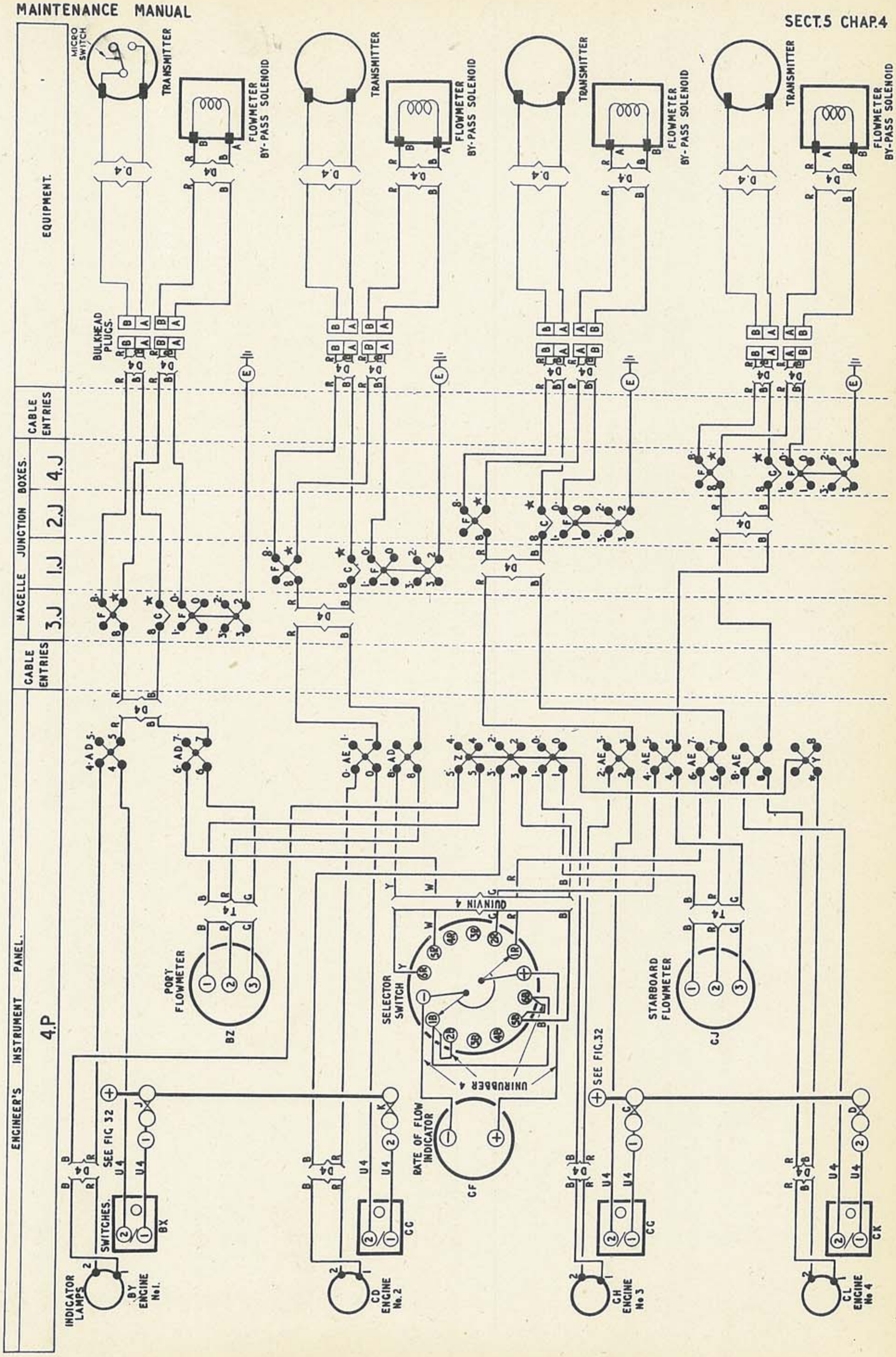
FUEL CONTENTS GAUGES - PORT

FIG. 50



FUEL CONTENTS GAUGES – STARBOARD

FIG. 51



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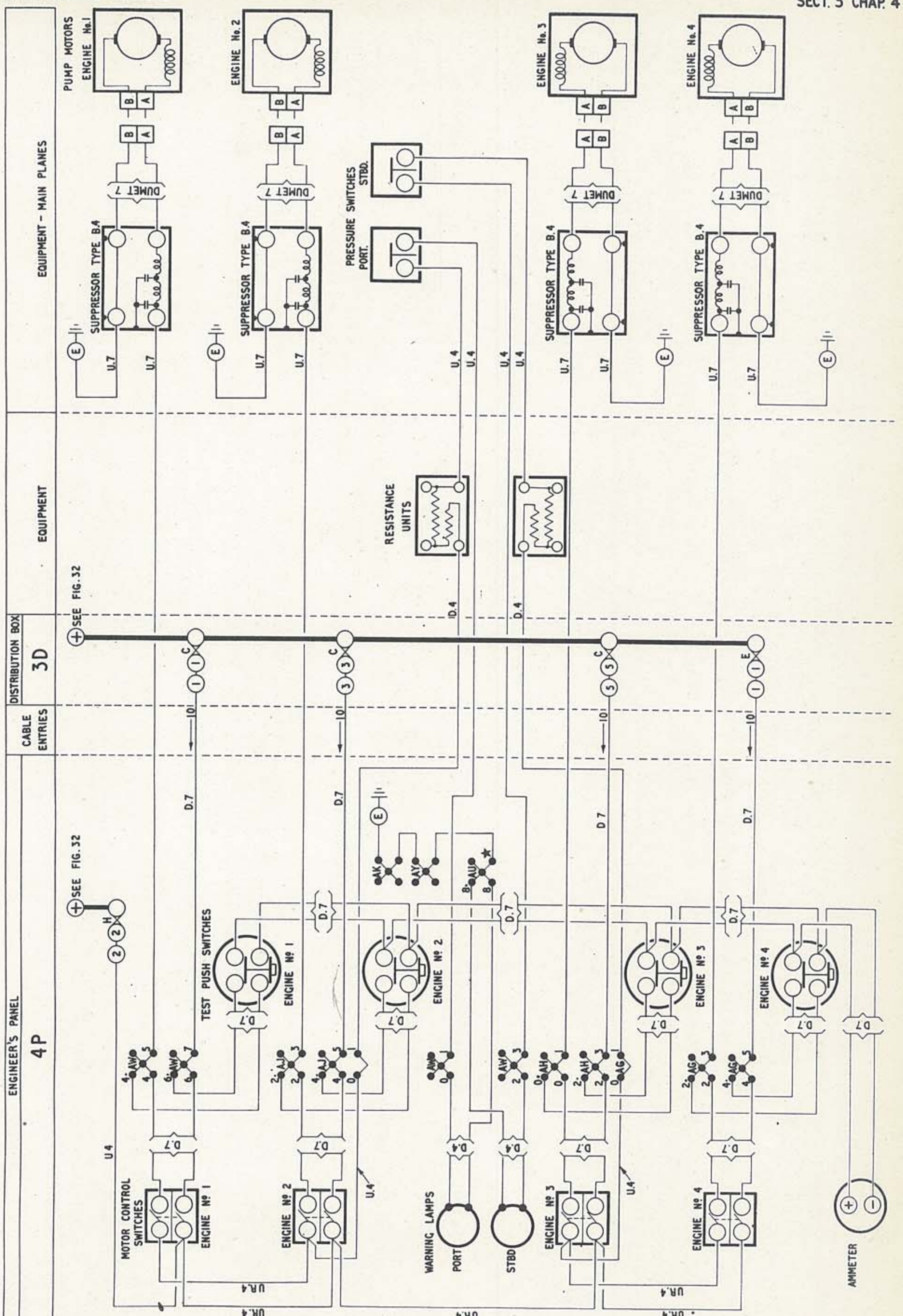
FUEL FLOWMETERS

FIG.52



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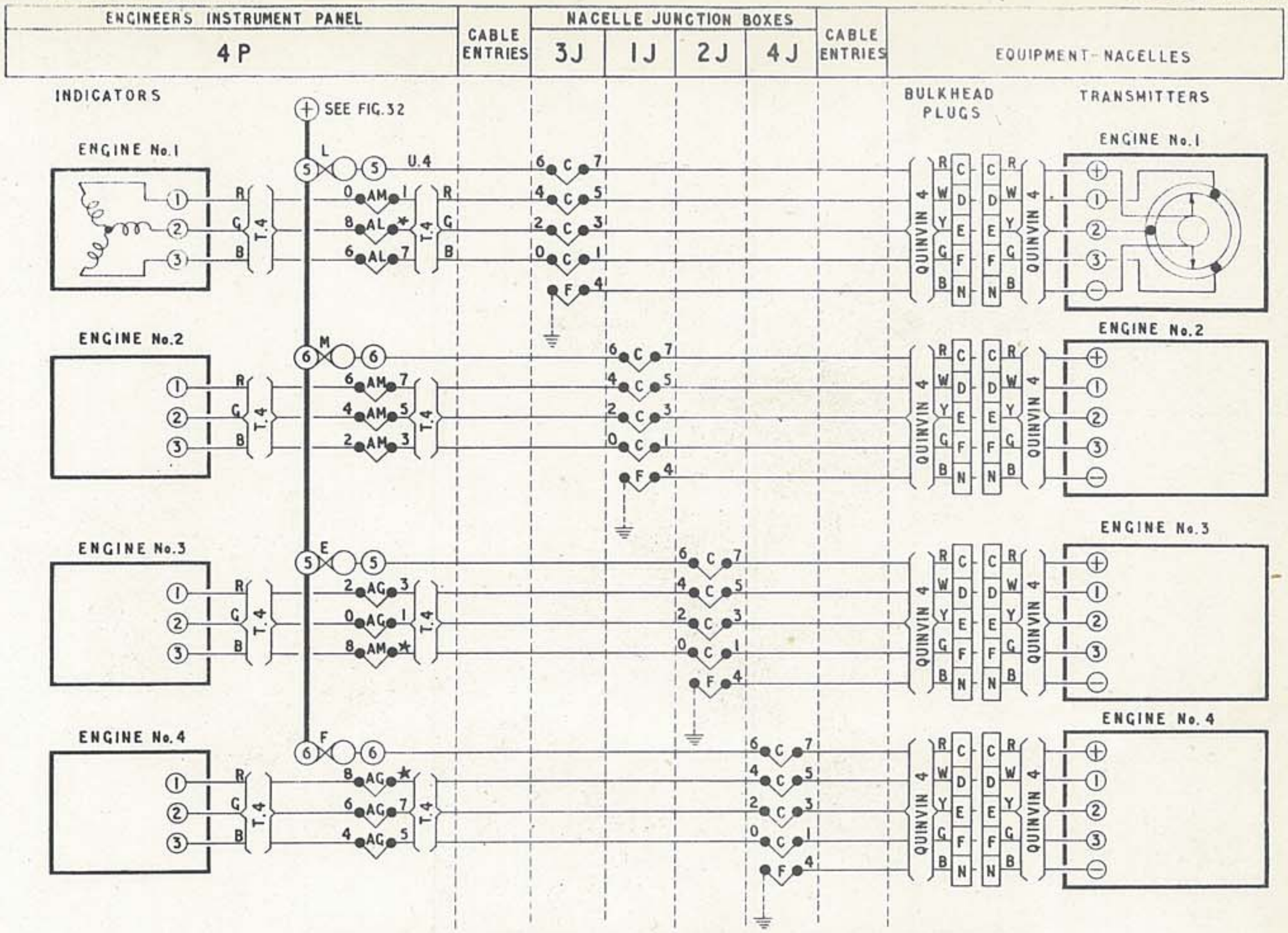
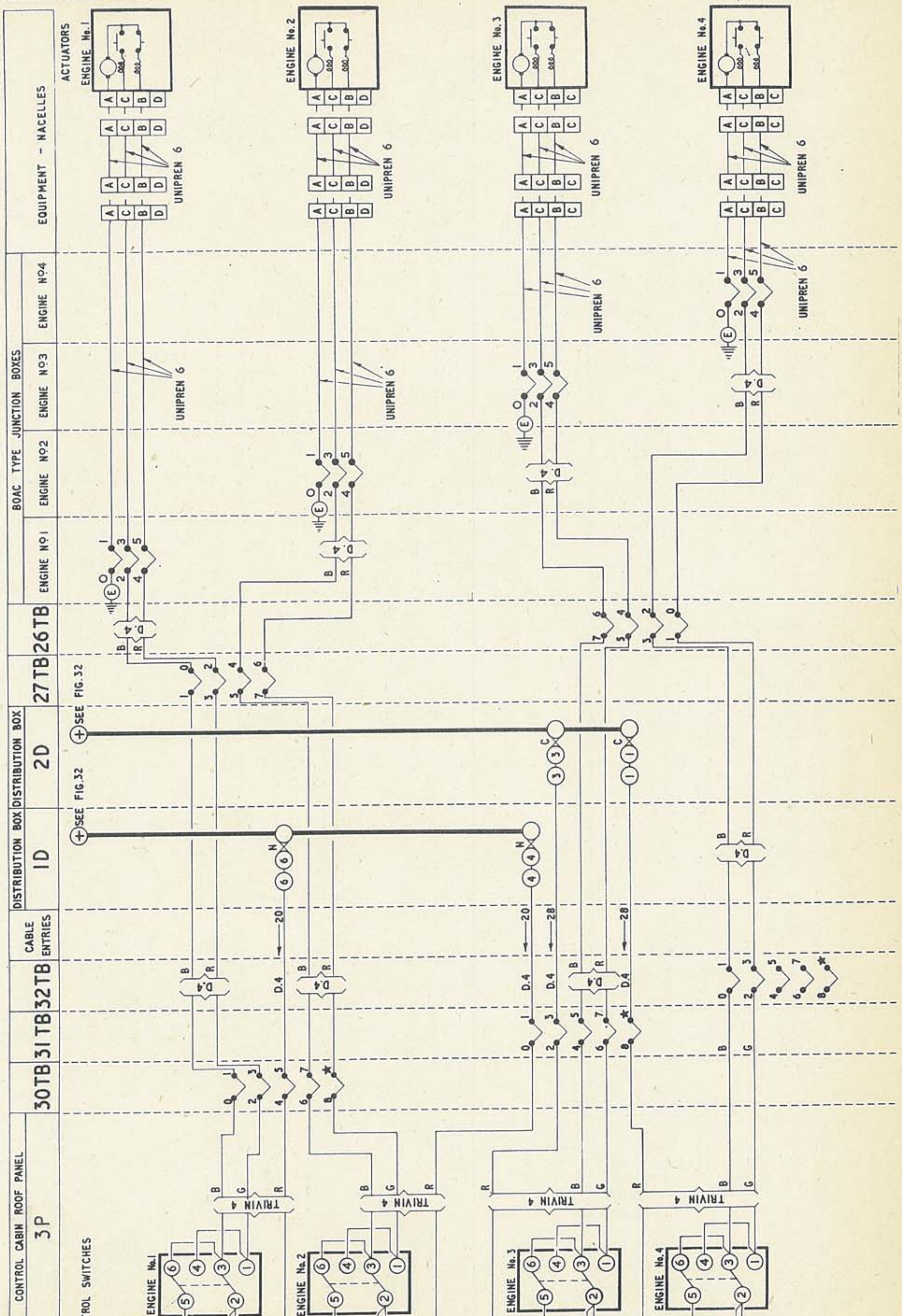
1 24-2-48
2 17-1-51

FUEL PUMP MOTORS AND PRESSURE WARNING LAMPS

FIG. 53

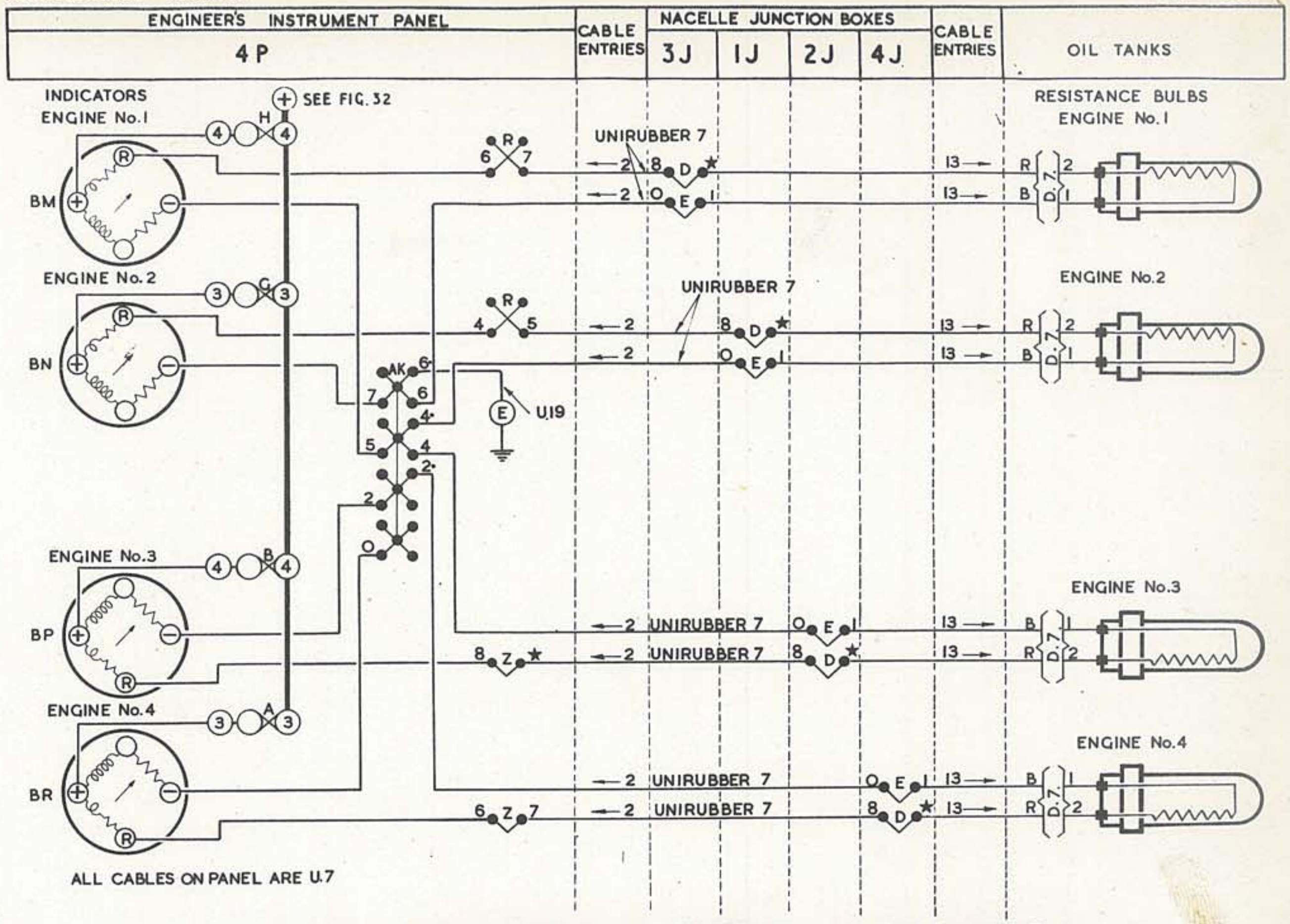


FUEL PRESSURE GAUGES

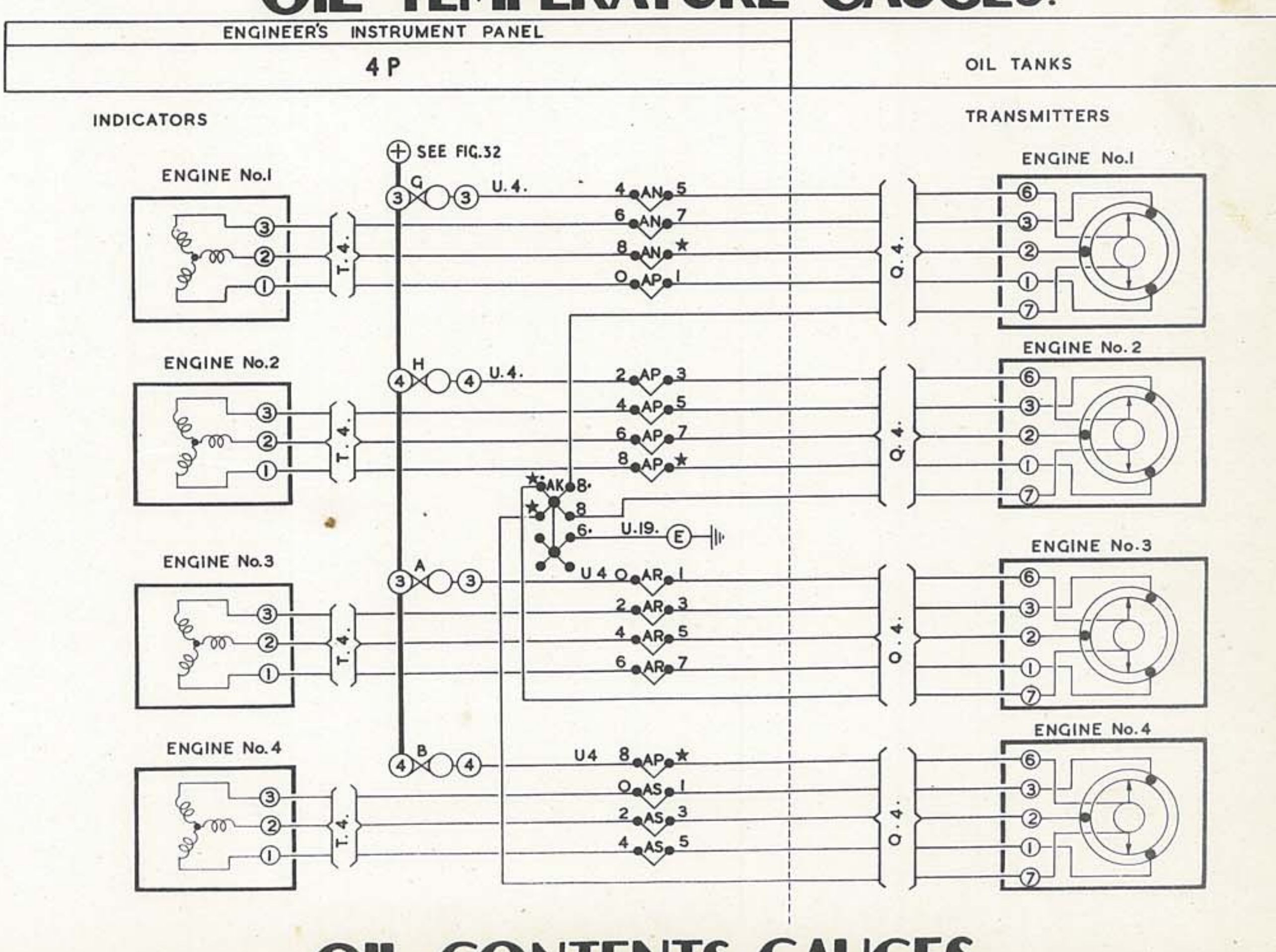


FUEL CUT-OFF CONTROLS

FIG. 55

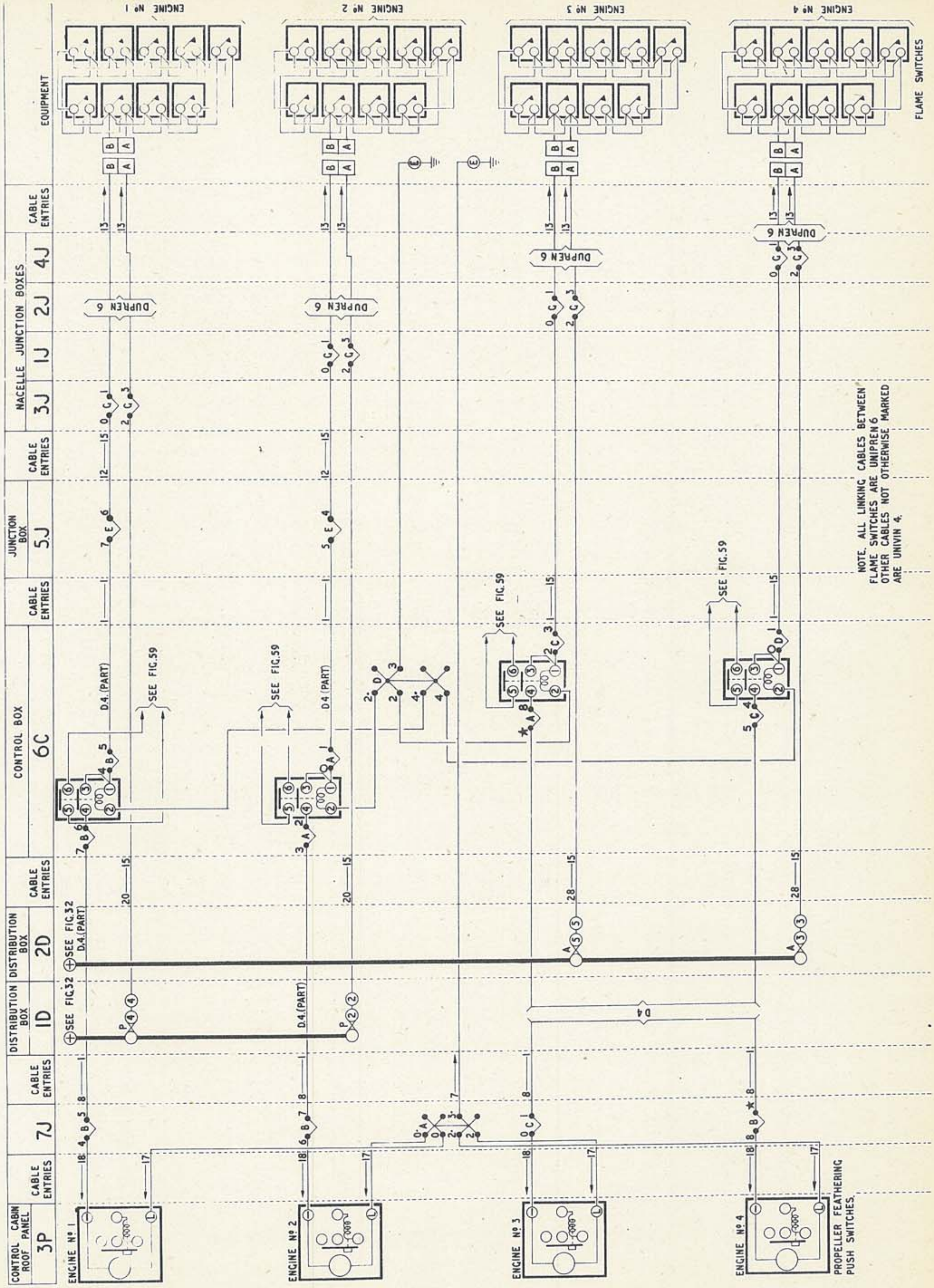


OIL TEMPERATURE GAUGES.



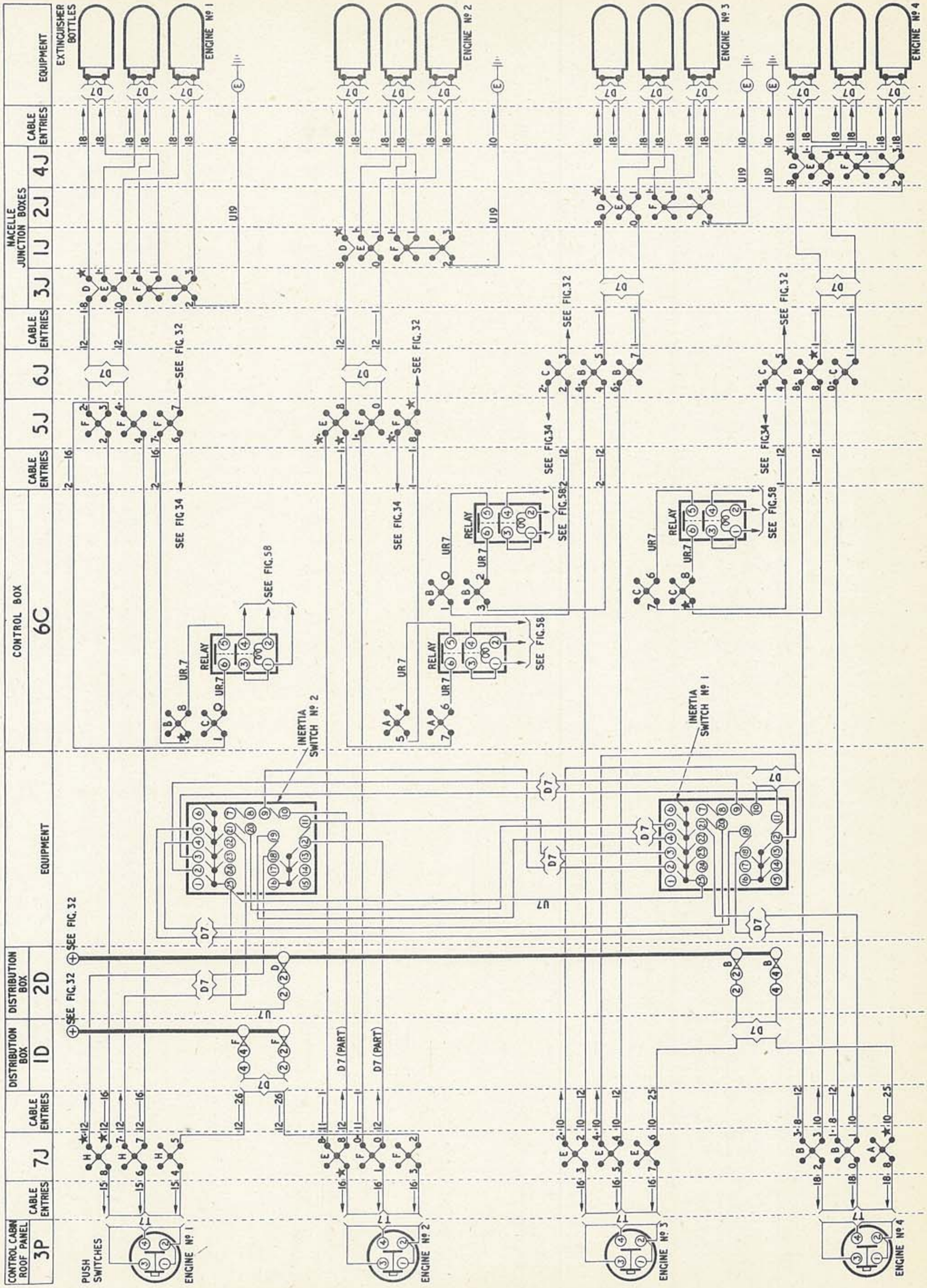
OIL CONTENTS GAUGES.

FIG. 56



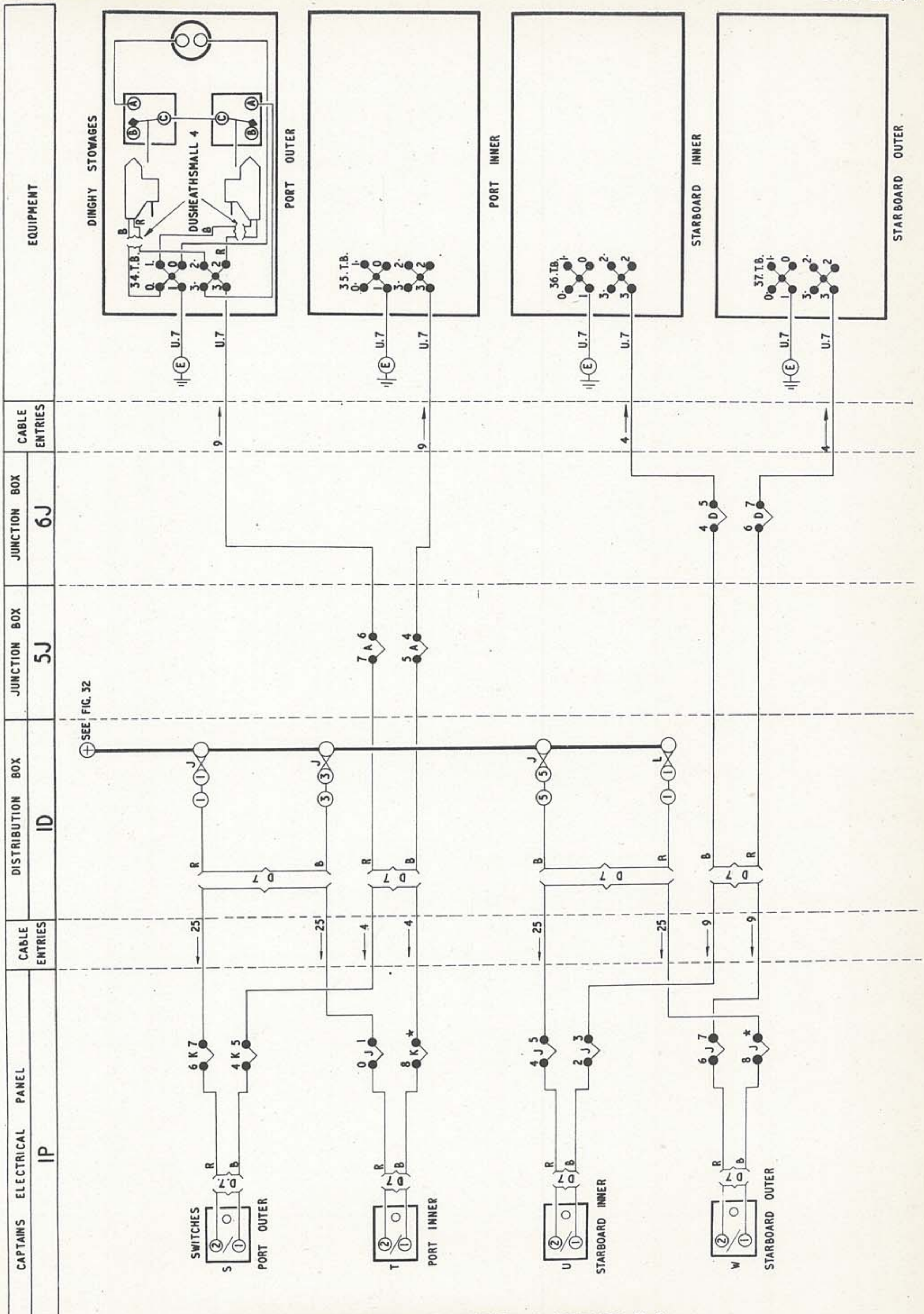
FIRE WARNING LAMPS

FIG. 58



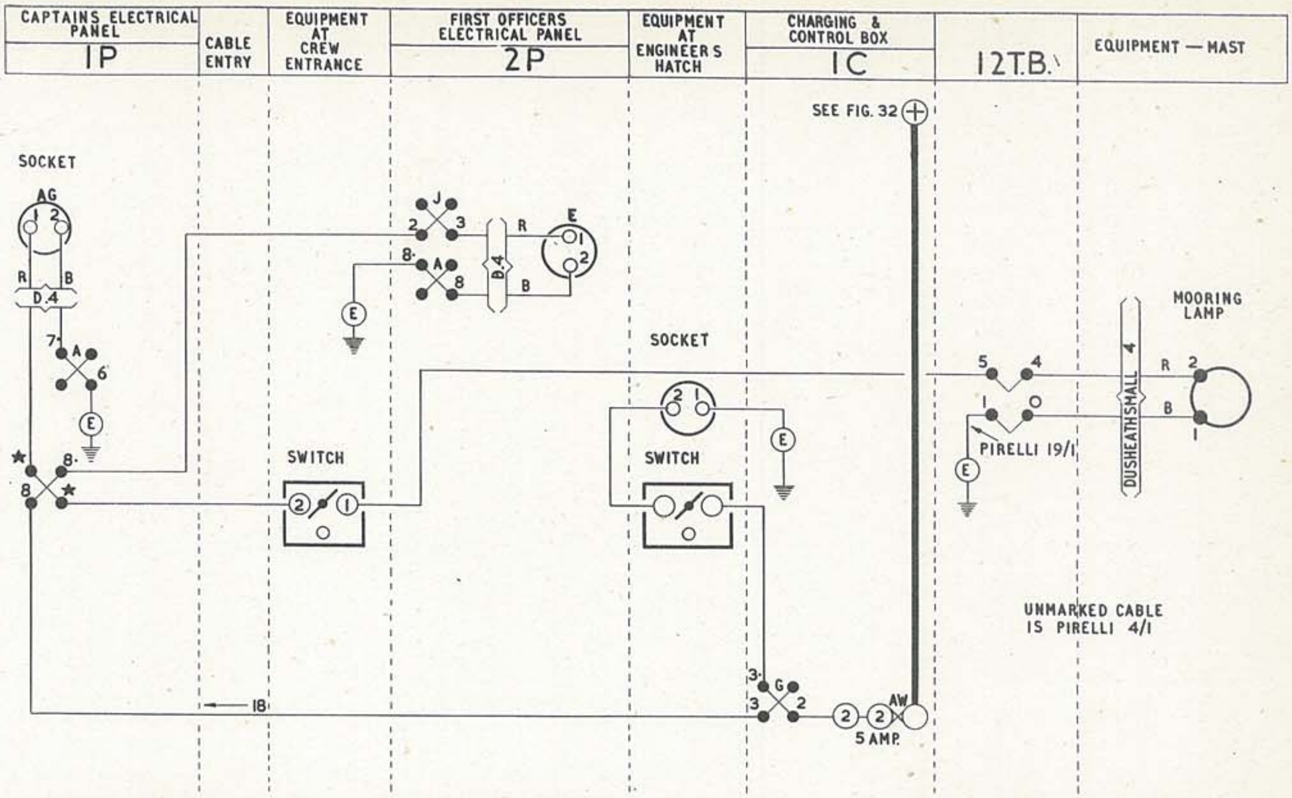
FIRE EXTINGUISHERS

FIG. 59

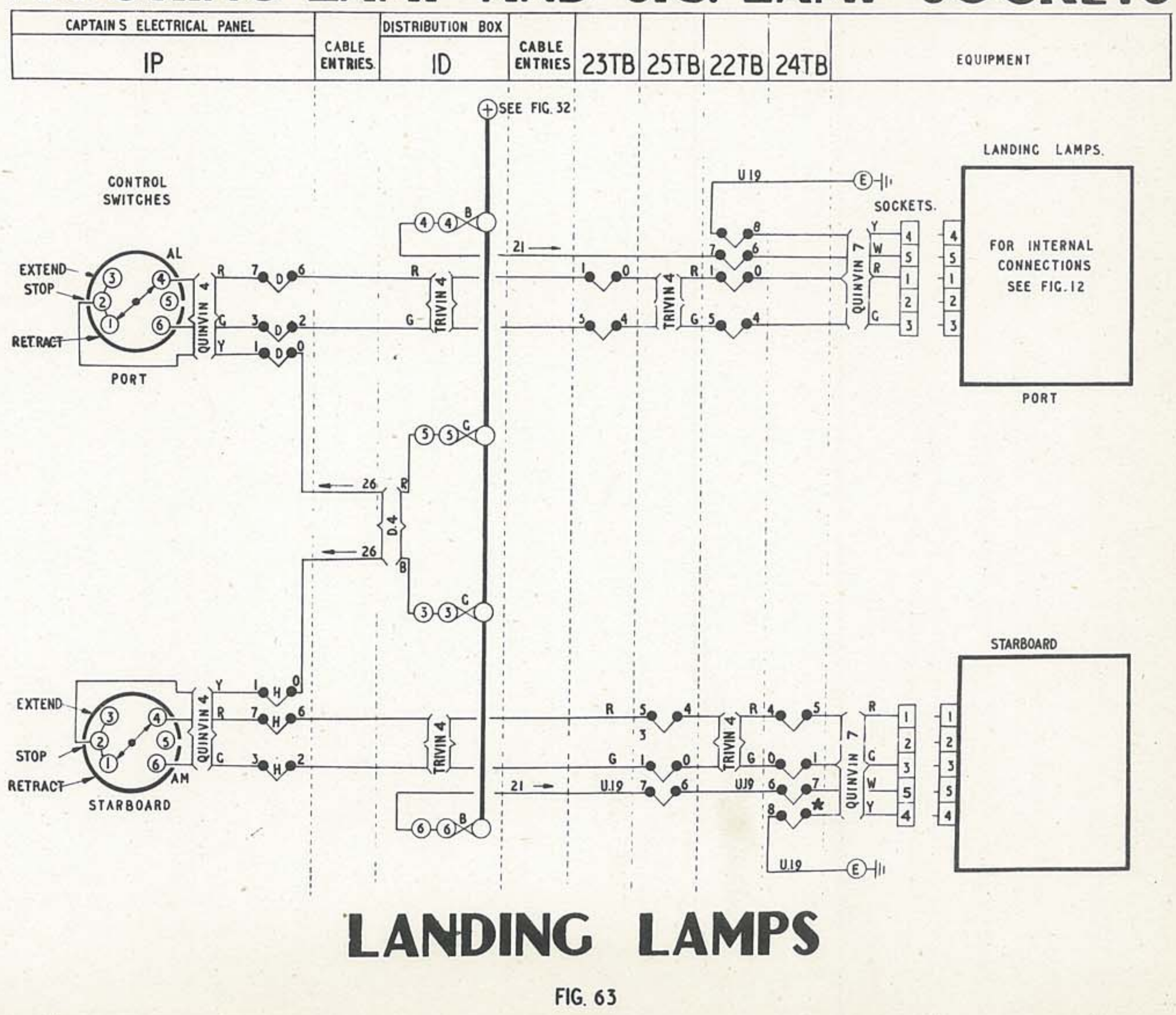


DINGHY INFLATION

FIG. 61

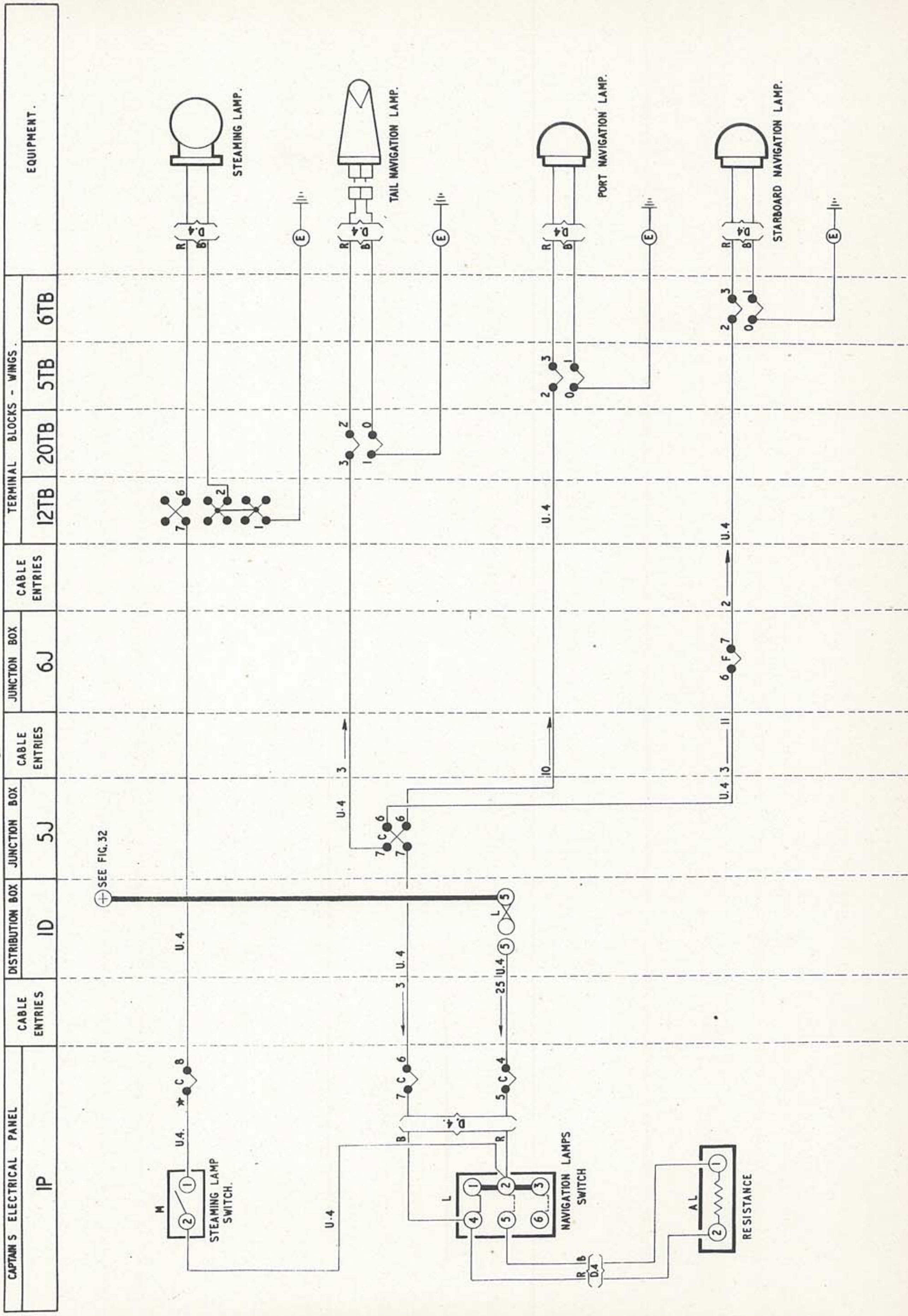


MOORING LAMP AND SIG. LAMP SOCKETS



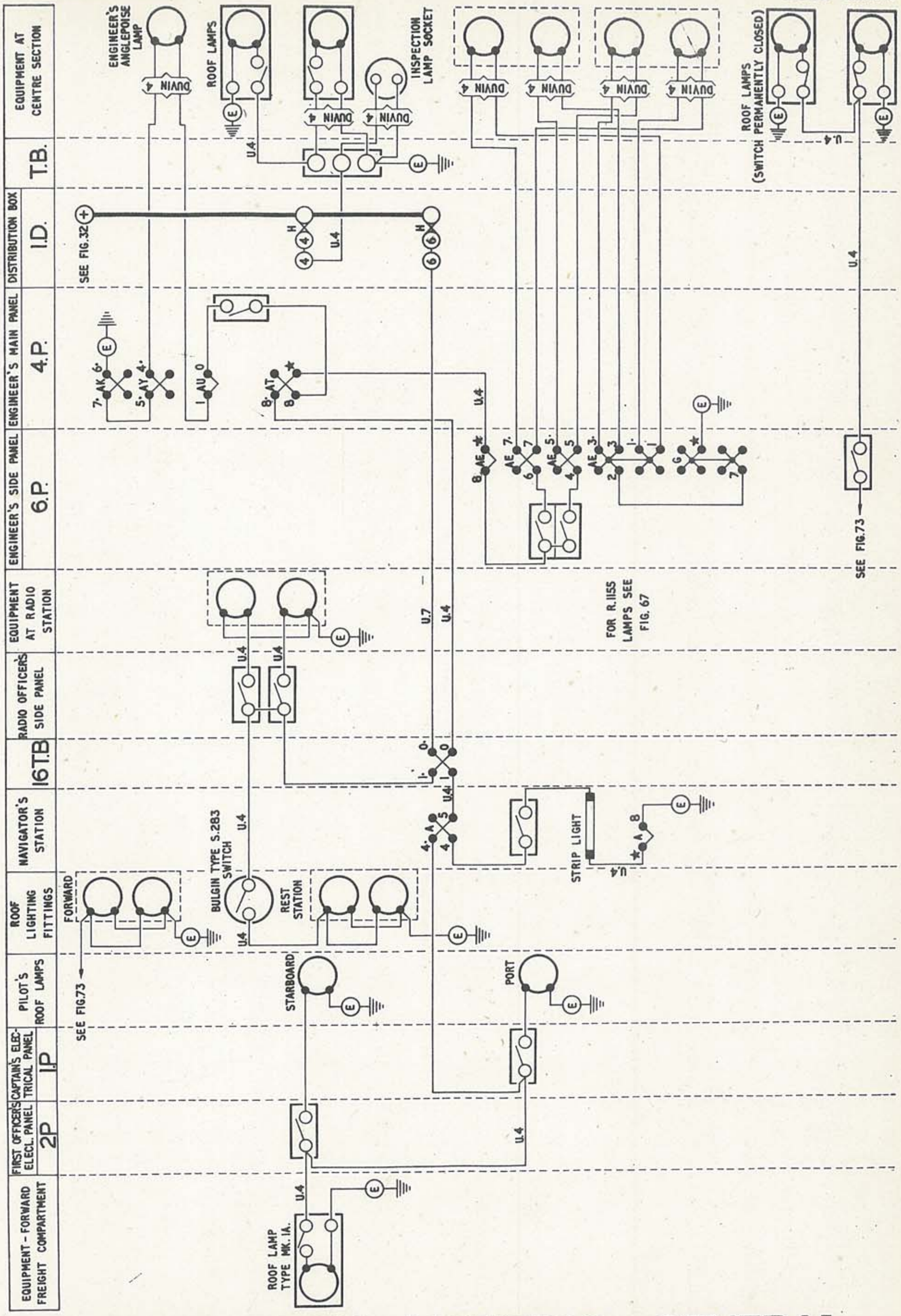
LANDING LAMPS

FIG. 63



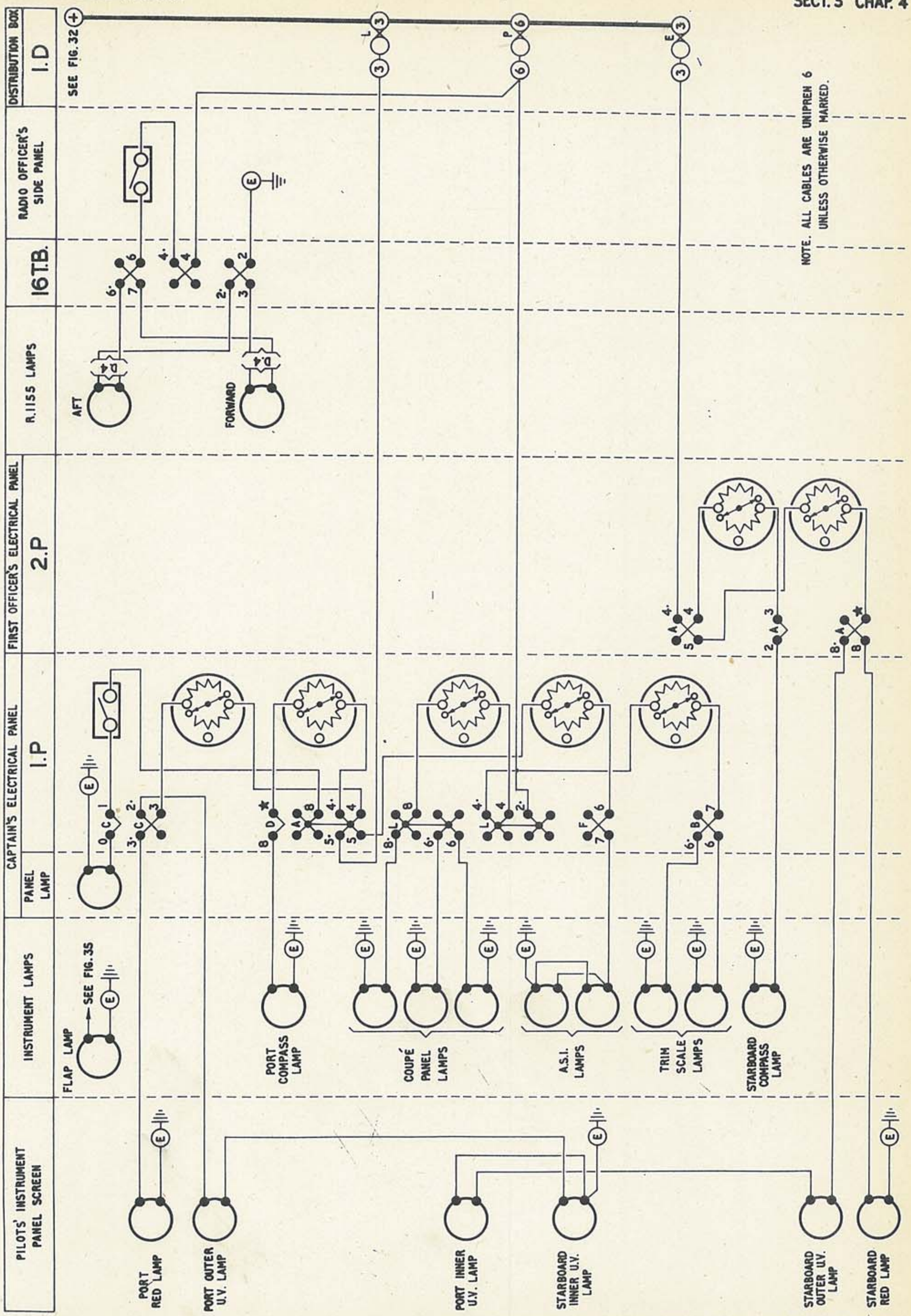
NAVIGATION AND STEAMING LAMPS.

FIG. 64



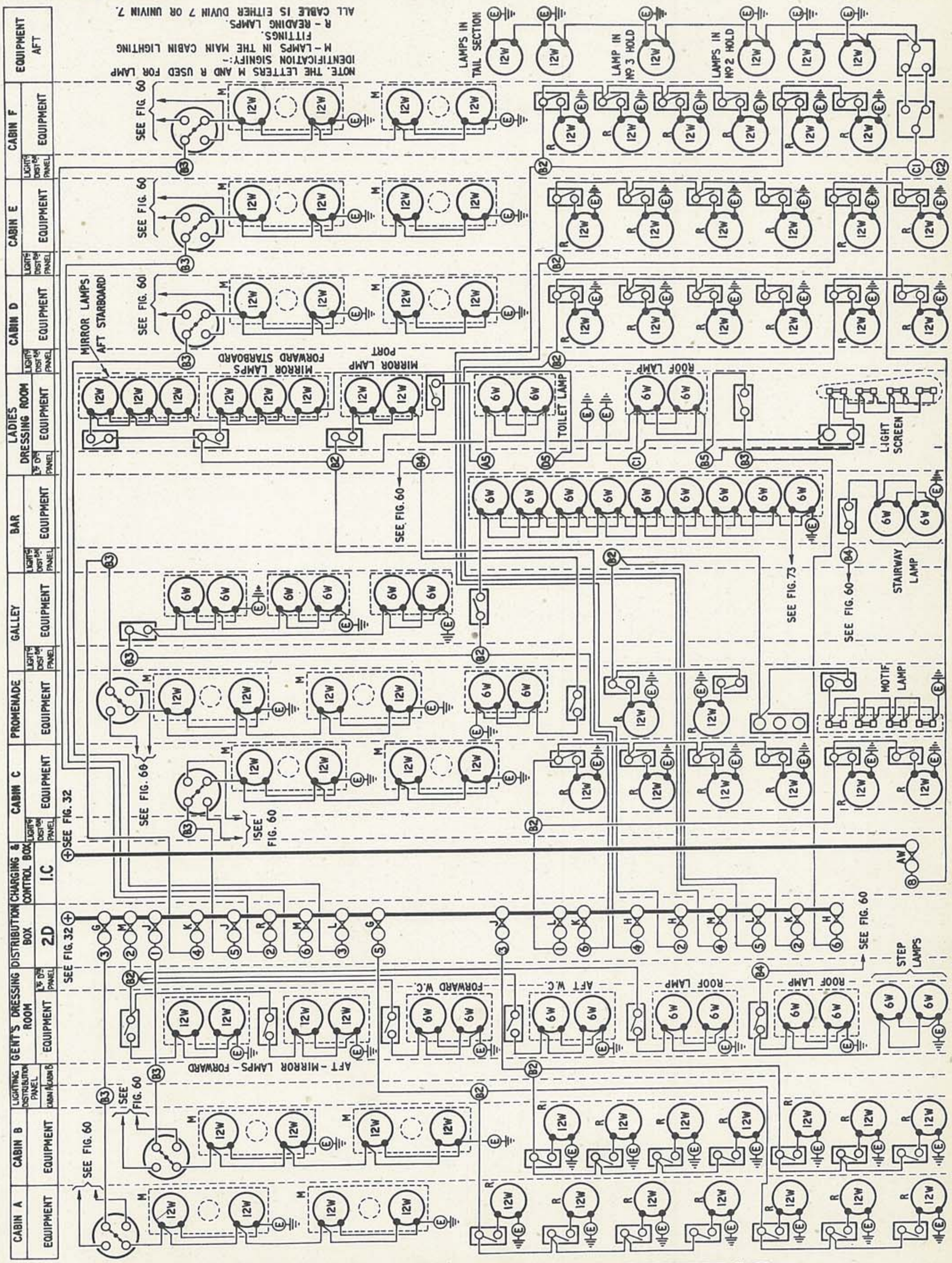
FLIGHT DECK LIGHTING - GENERAL

FIG. 66



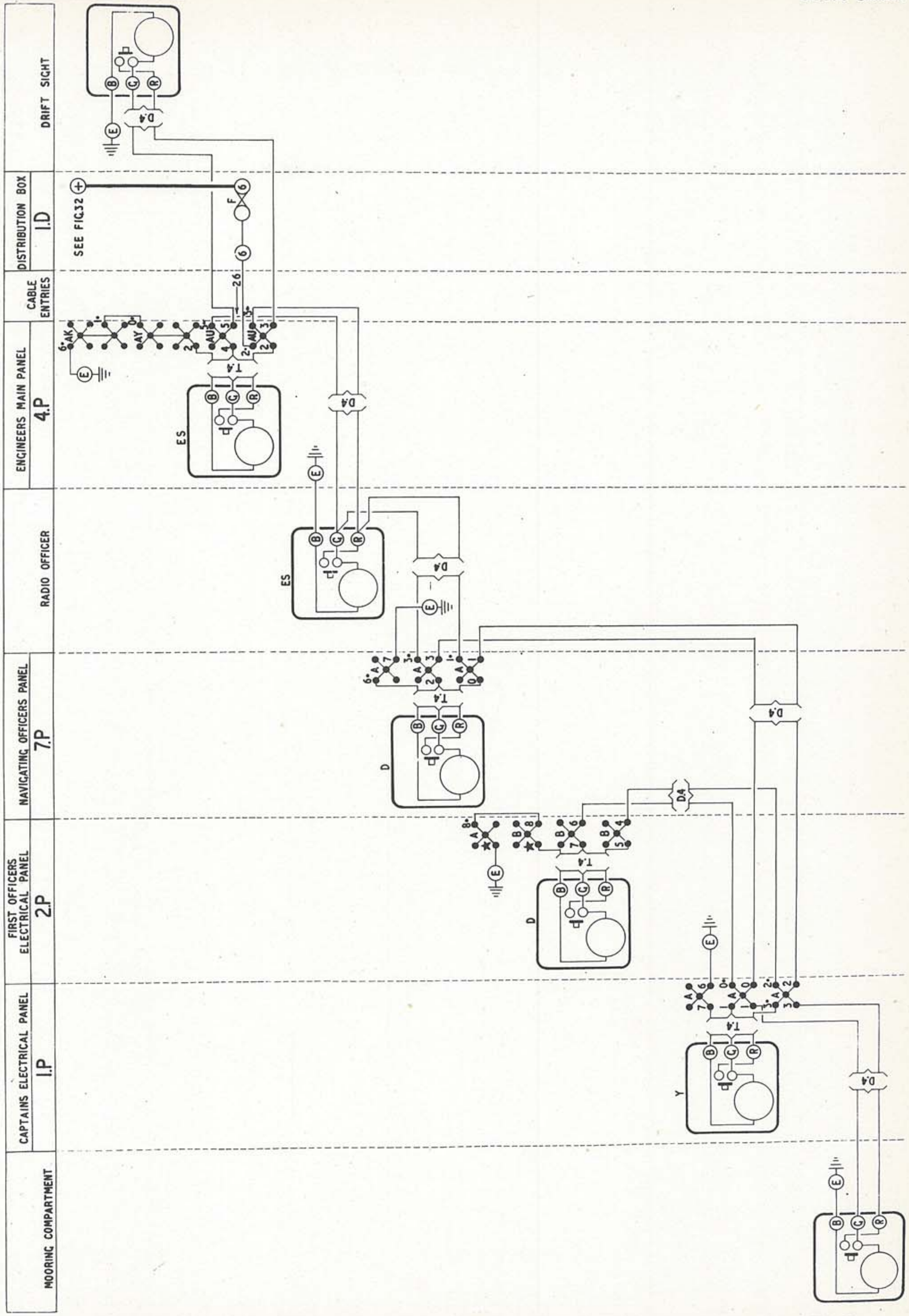
ULTRA VIOLET AND INSTRUMENT LIGHTING

FIG. 67



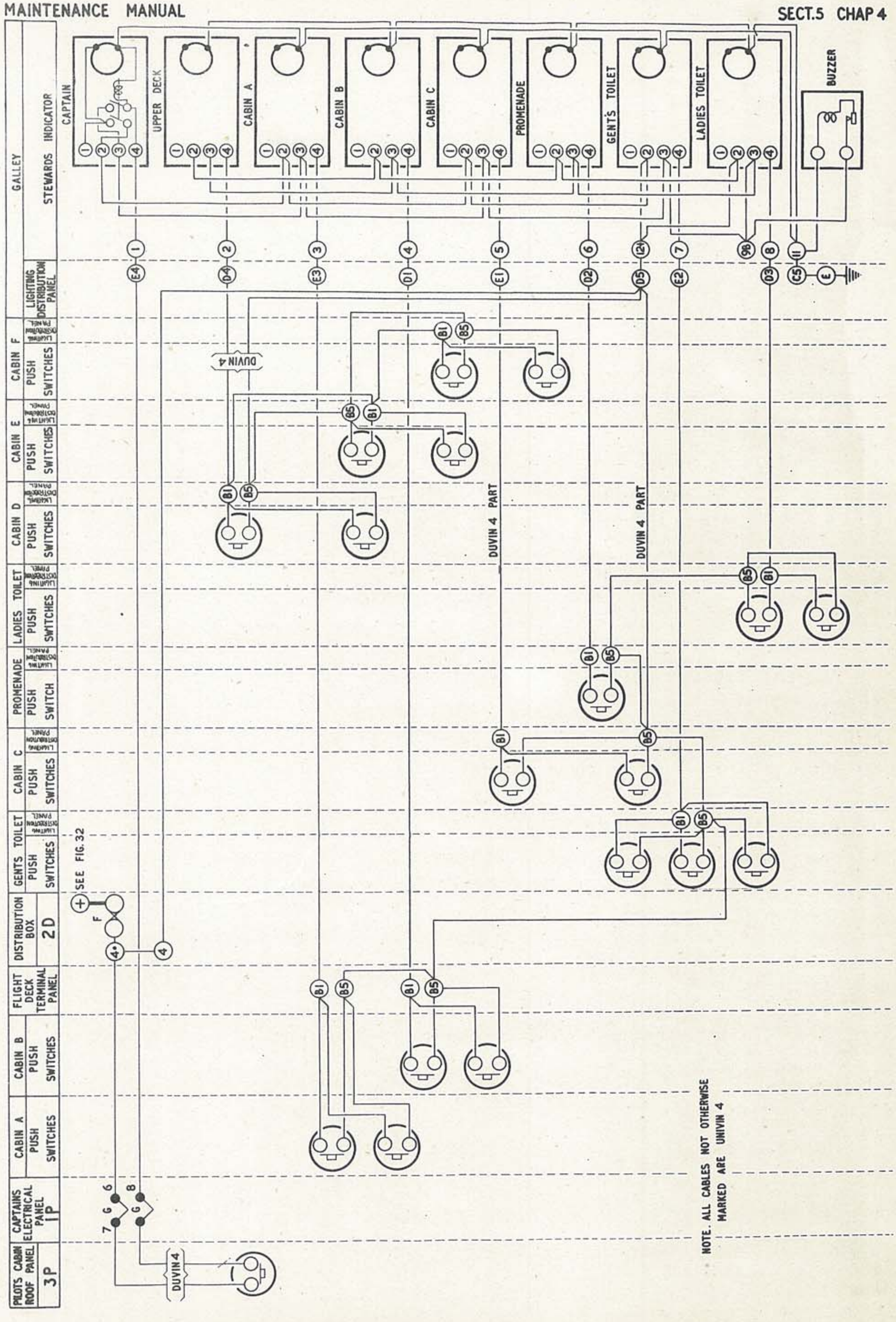
GENERAL CABIN LIGHTING

FIG. 68



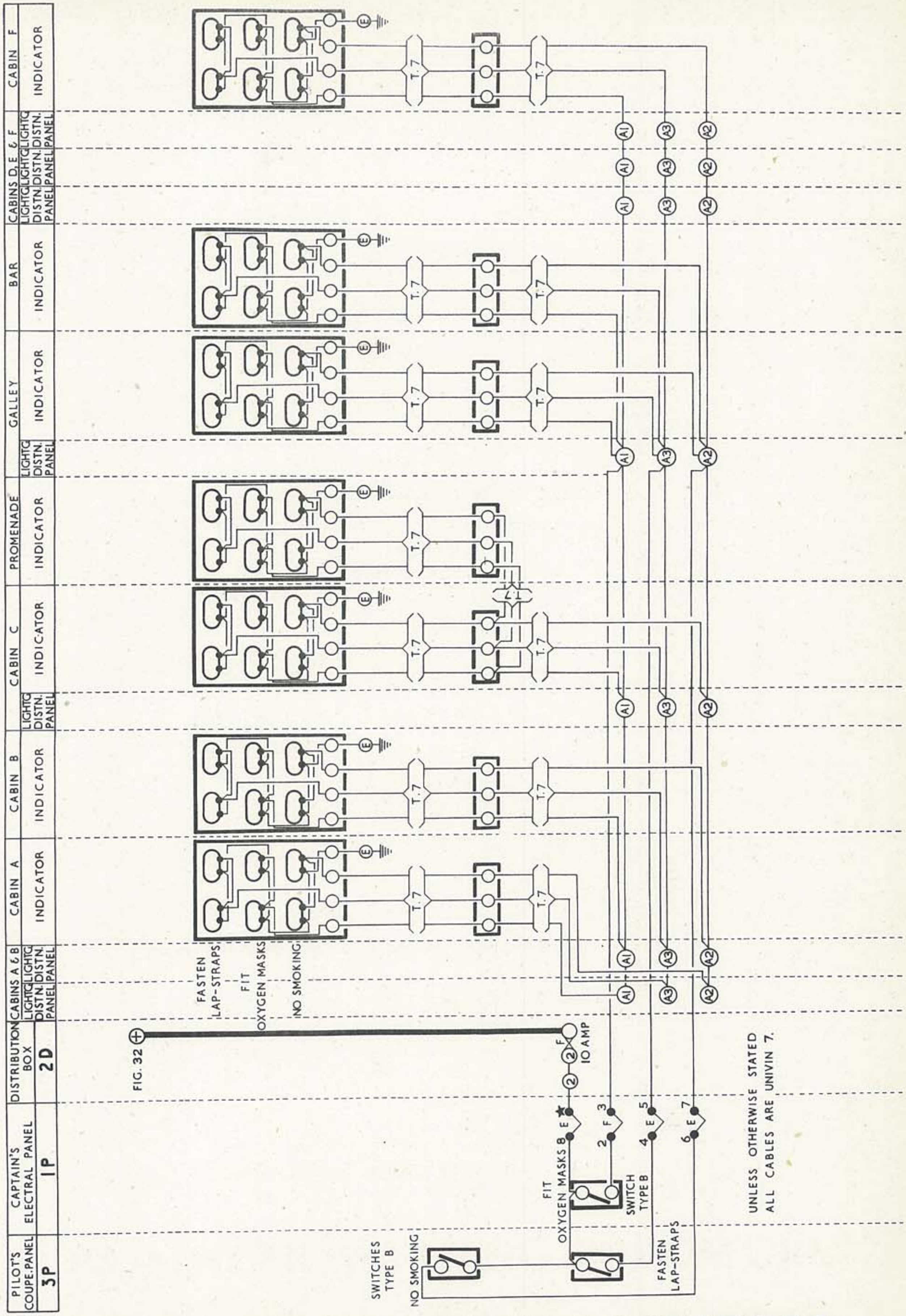
INTERCOMMUNICATION CALL LAMPS

FIG.69



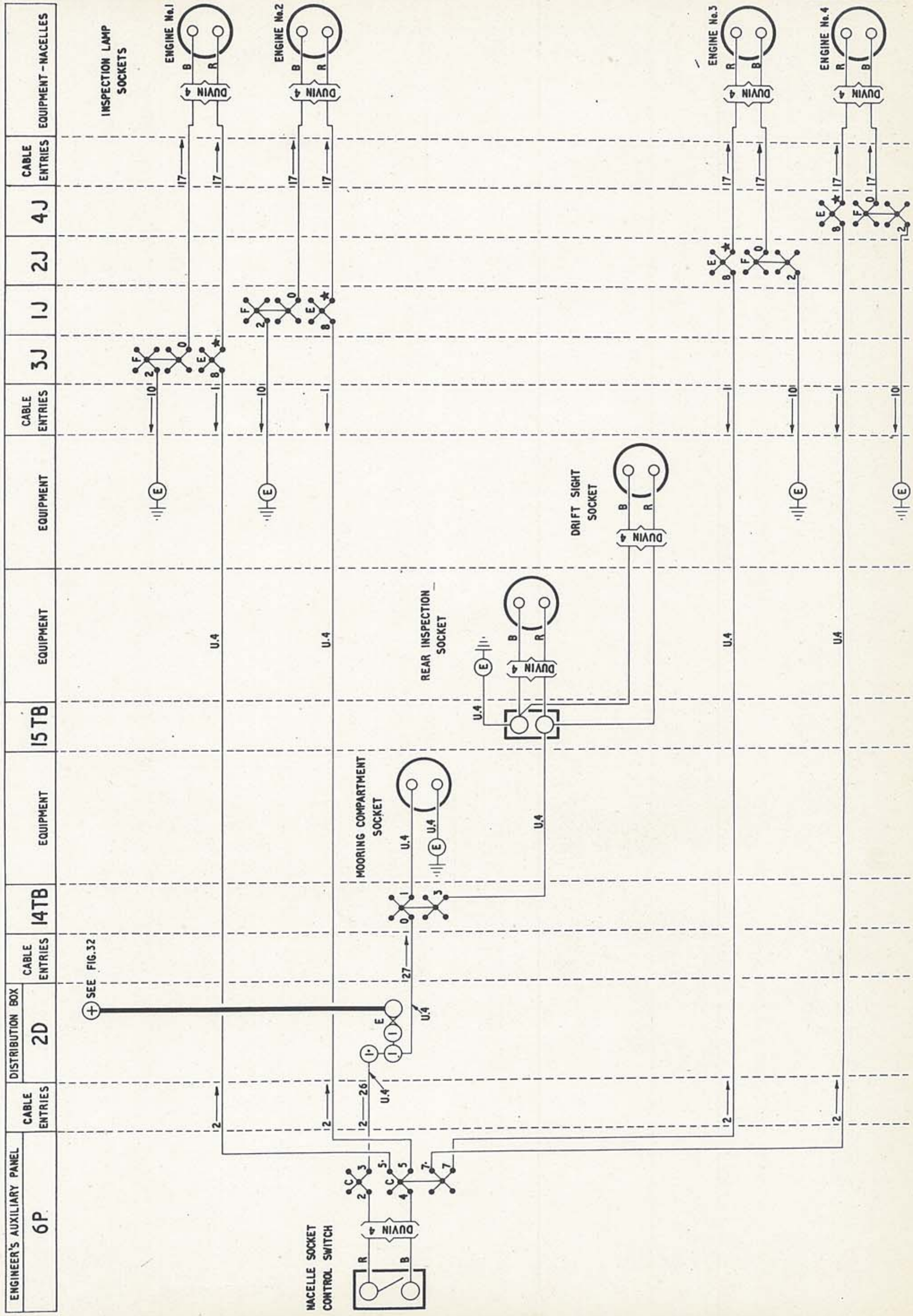
STEWARDS CALL LAMPS

FIG. 70



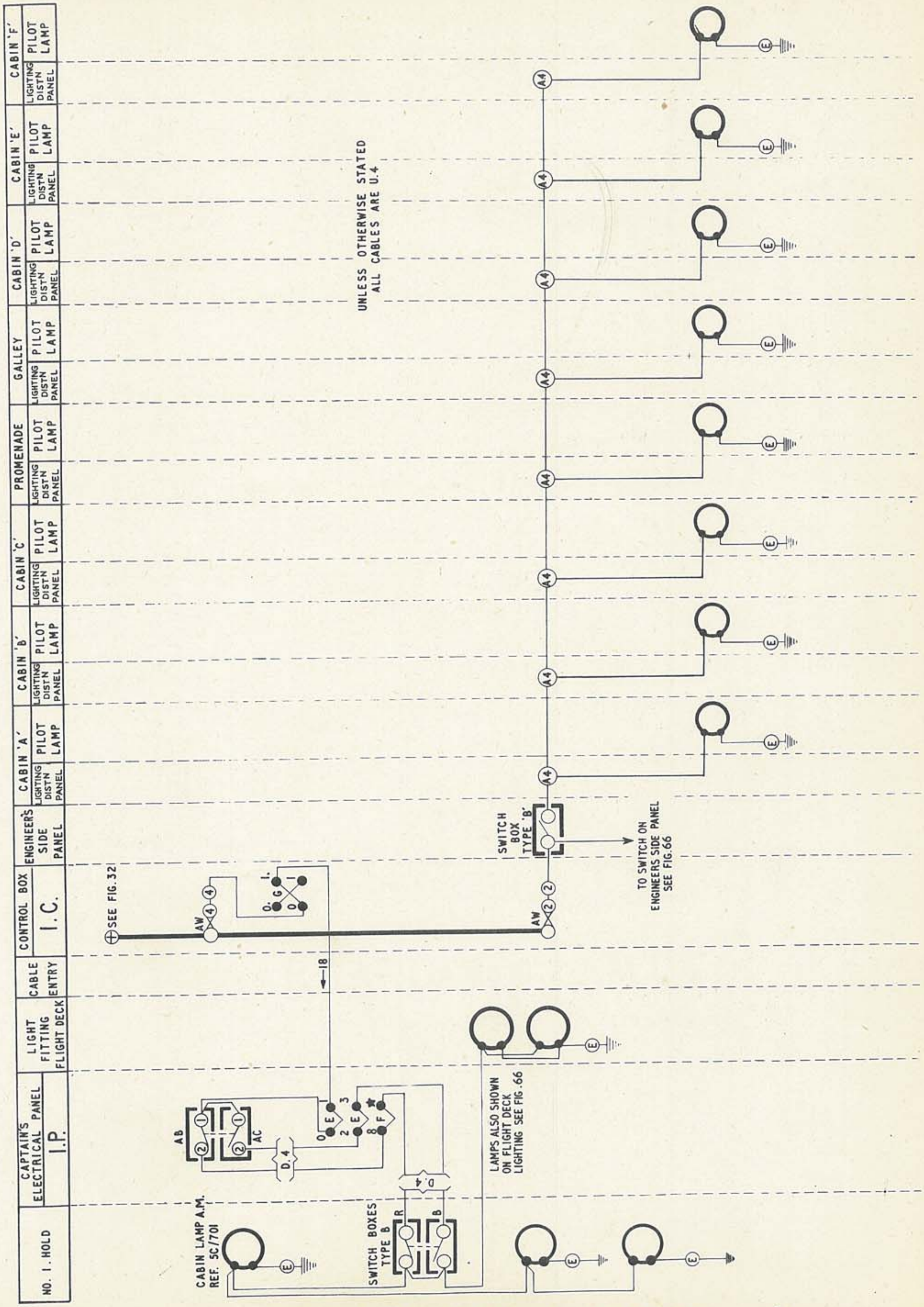
PASSENGER WARNING INDICATORS

FIG 71



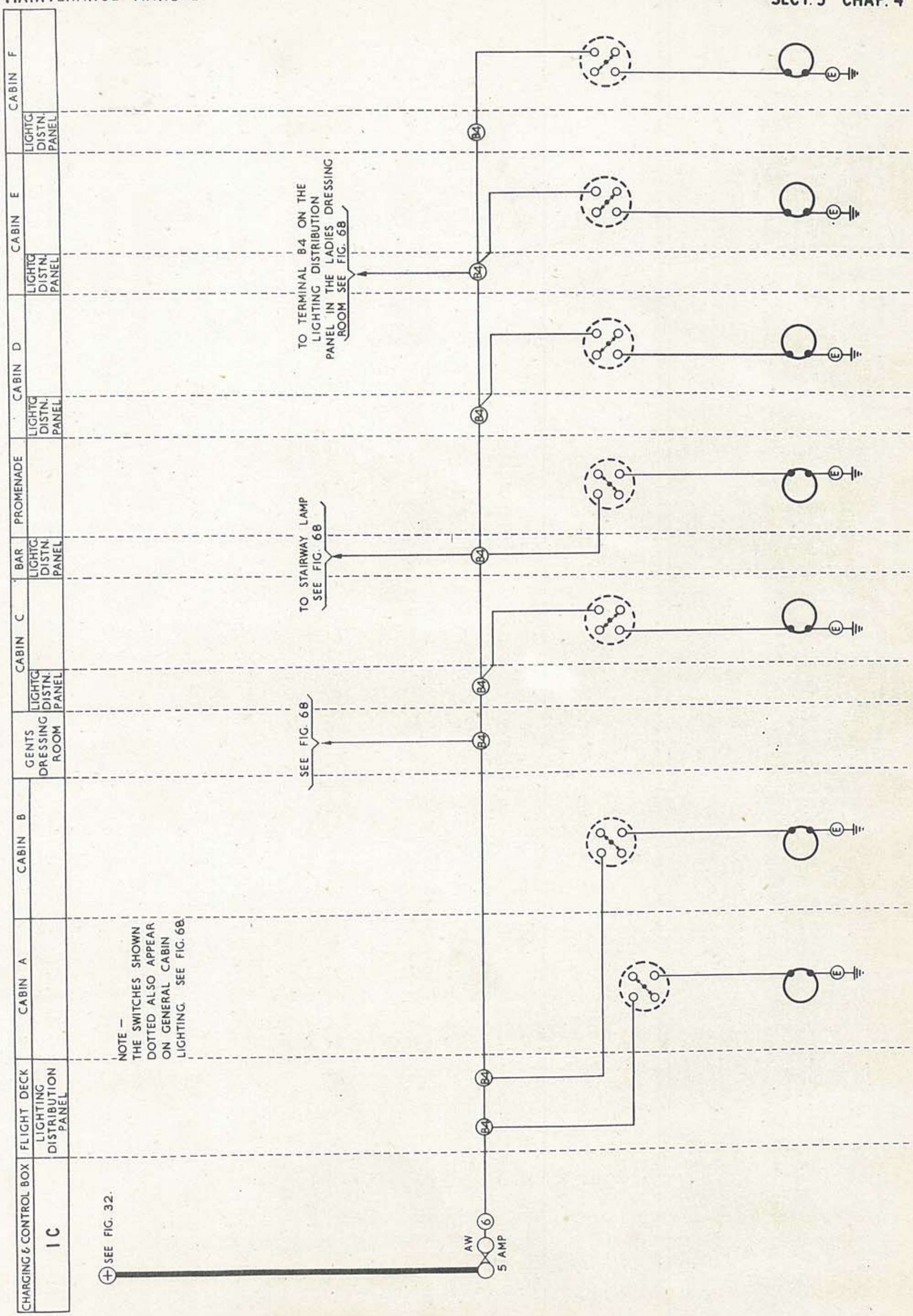
INSPECTION LAMP SOCKETS

FIG. 72



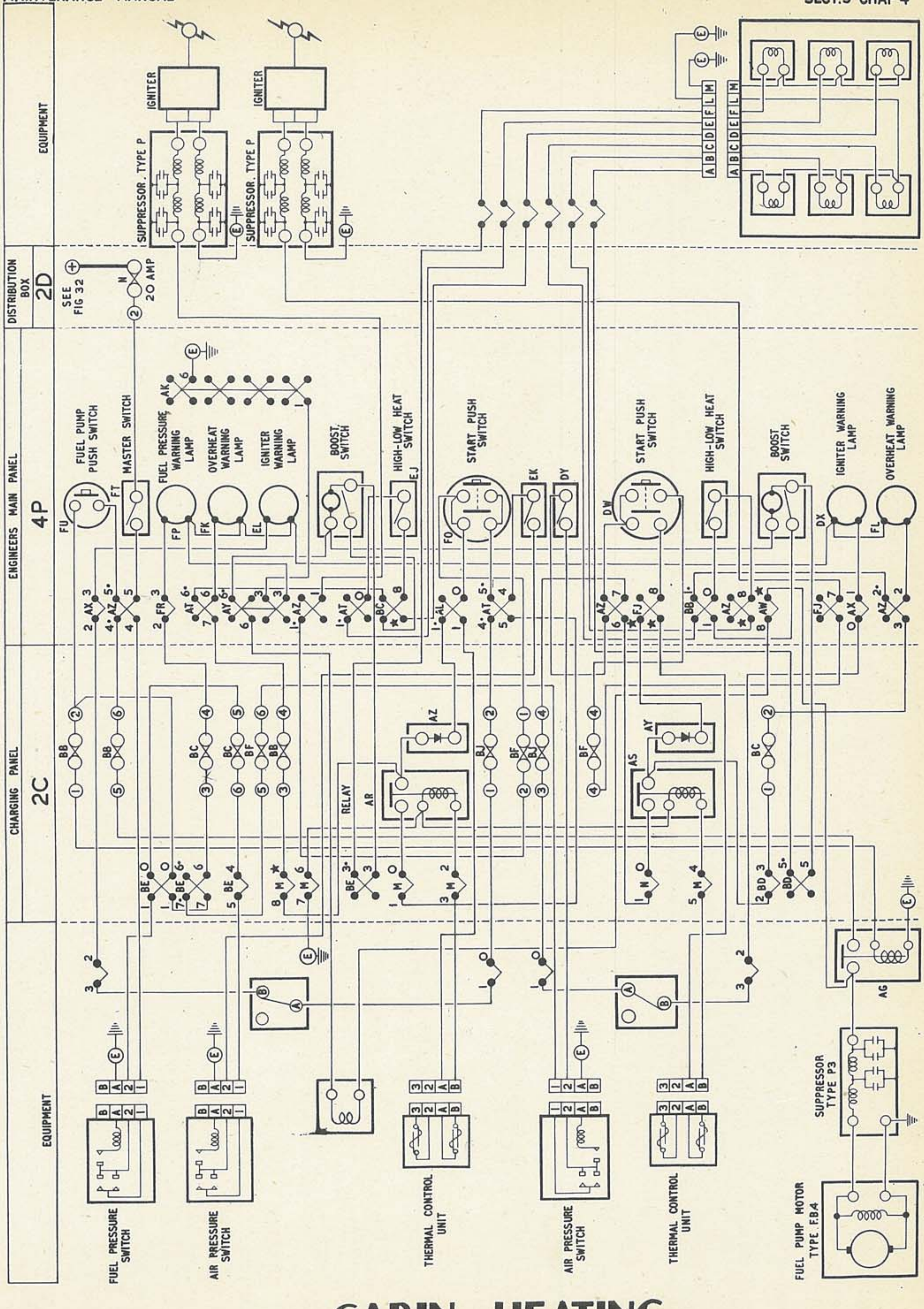
BOARDING LAMPS

FIG. 73



CABIN DIM LIGHTING

FIG 74



CABIN HEATING

FIG. 75

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1	28-4-48
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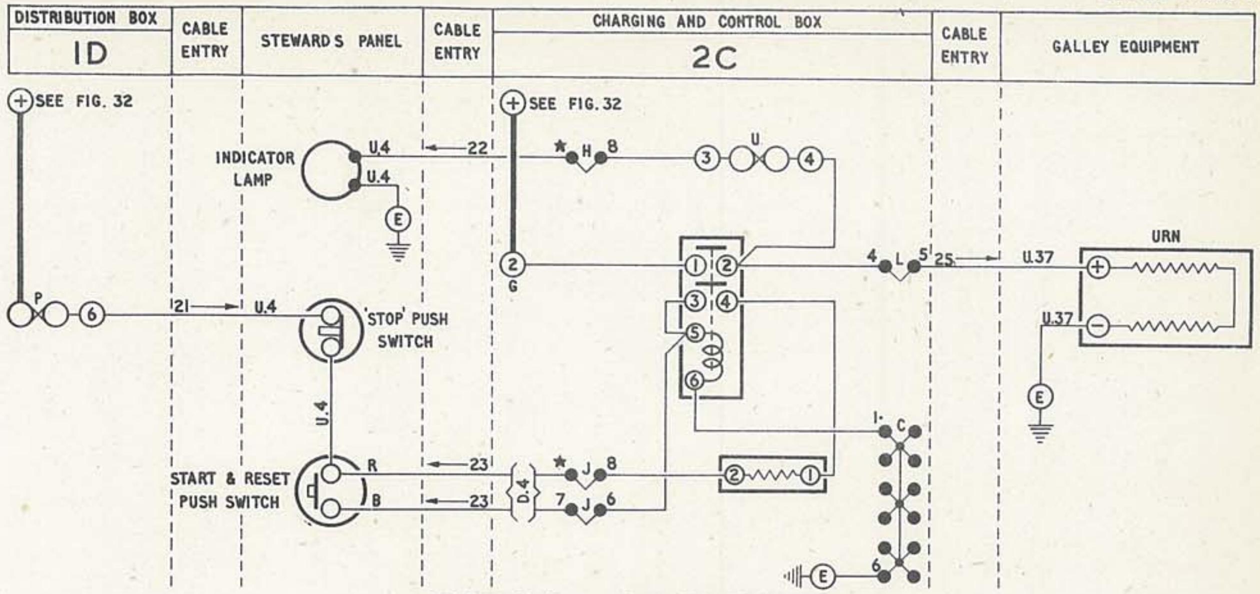
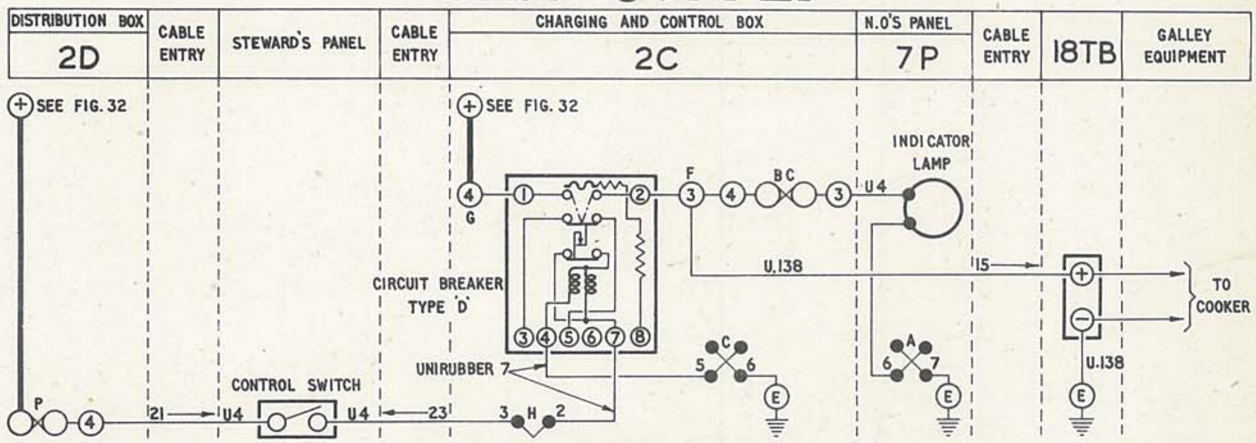
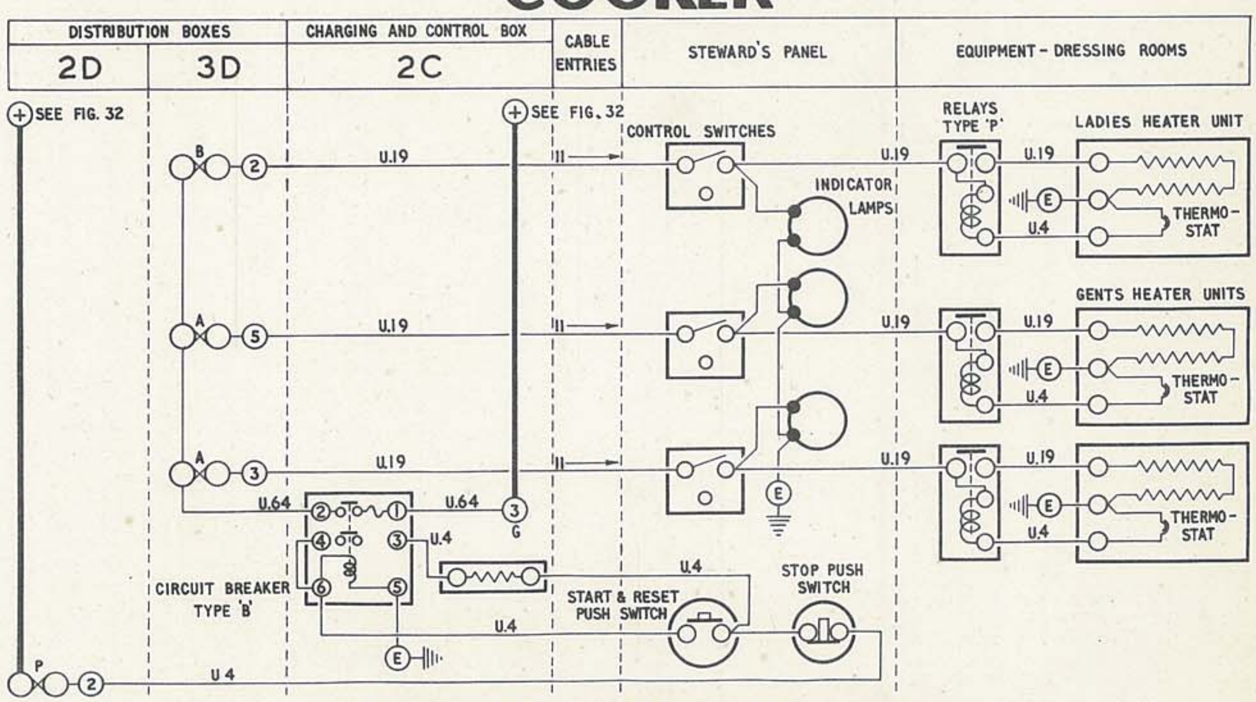


URN SUPPLY



COOKER



IMMERSION HEATERS

FIG. 76

SOLENT 3

MAINTENANCE MANUAL

SECTION 6

RADIO INSTALLATION

Contents

Illustrations

Illustrations (contd.)

INTRODUCTION AND OPERATIONAL FACILITIES

1. General

The following is a brief description of the various radio installations together with their L.T. supplies and aerial systems. The chart (fig. 1) gives the operational facilities afforded by each separate installation to the various members of the crew

1.1. Main L.T. supplies

(a) The radio L.T. feeds are taken from the main bus-bars of the aircraft 24-volt earth-return system as shown in fig. 2. The supply to these bus-bars from the battery is controlled by the battery master switch, mounted on charging and control box 1C.

(b) The supplies for A.S.V. and the interphone amplifier are taken from the bus-bars direct, those for the remaining installations being controlled by circuit breakers located as follows. -

Circuit breaker for. -

T.1154 and R.1155 No. 1 installation) T.1154 and R.1155 No. 2 installation)	Charging and control box 1C
TR.1464	Charging and control box 3C

(c) The feeds from above circuit breakers, whose contacts are provided with thermal trip mechanisms for overload or short-circuit conditions, are also controlled from the radio station by isolating switches mounted on the bulkhead at the aft end of the desk.

1.2. Aerial system

(a) The port, or upper, fixed aerial is normally connected to the main communication equipment, viz. No. 1 T.1154/R.1155 installation. A trailing aerial, with its winch mounted under the radio officer's desk, is provided for emergency use in the event of the port fixed aerial becoming defective (See also fig. 3)

(b) The rotatable D.F. loop is controlled from the radio station and is mounted over the flight deck just forward of the centre section.

(c) The whip type aerial for the V.H.F. transmitter/receiver T.R. 1464 is mounted so that it projects through the hull roof just above cabin D.

(d) The V.H.F. Radar (A.S.V. Mk.2) transmitting aerial is mounted on the mast just forward of the D.F. loop, and the receiving aerials are positioned one on each side of the hull just forward of, and below the cockpit window.

1.3. Main communications equipment

The two separate T.1154 and R.1155 installations are mounted with the transmitters above the receivers, No. 1 at the aft end and No. 2 at the forward end of the radio station. The No. 1 installation constitutes the normal main communication equipment, the transmitter for No. 2 installation being used as a standby. For further details of this installation, see para. 2.

1.4. Marconator and D.F. loop

For taking D.F. bearings the receiver (R.1155N) of No. 2 installation is used in conjunction with a Marconator and the D.F. loop aerial. With this equipment bearings may be taken relative to either the aircraft's head or the D.R. compass. For further details see para. 3.

1.5. Airport R.T. control equipment

The transmitter/receiver type TR.1464 is installed for airport control. This installation provides two-way (V.H.F.) R.T. communication on four push-button selected channels in the 100-124 mc band. For further details see para. 4.

1.6. V.H.F. radar (A.S.V. Mk.2) equipment

(a) For this installation a transmitter type T.219 and a receiver type R.219 are used in conjunction with an indicator type 96. The transmitter operates on a frequency of 219 mc/s into the Yagi aerial mounted on the mast just forward of the D.F. loop. The receiver, operating from the port and starboard stub aerials, is tunable from approximately 215 mc/s. to 221 mc/s.

(b) The cathode ray tube indicator is so constructed as to give visual indication of land masses and their distance up to 50 miles, also homing and distance indications on suitable radar beacons up to 120 miles. Results depend largely on the height of the aircraft. For further details see para. 5.

1.7. Interphone equipment

(a) The interphone system consists of parallel-connected sockets located throughout the aircraft as follows. -

Captain's station	Mooring compartment
First Officer's station	Each engine nacelle
Radio Officer's station (2)	D.R. compass position
Navigating Officer's station	
Engineer Officer's station	Captain's auxiliary
Galley	TR.1464 Test Point

(b) The sockets are used in conjunction with an amplifier type A.1134A, which receives its L.T. supply from a 2-volt accumulator and its H.T. from a vibrator unit connected to the 24-volt supply. With the exception of those at the Radio Officer's Station and T.R.1464 Test Point, all the sockets are permanently connected into the amplifier circuit. For further details see para. 6.

1.8. Equipment spares

A box which carries spare valves etc., is placed in the Radio Spares locker situated behind 2nd pilot's seat.

RADIO FUSES

Box	Fuse No.	Ampere Rating	Type	Circuit
1C	W5	5	S	Londex relay - generator engine No. 2
2C	U2	5	S	Londex relay - generator engine No. 3
3C	A2	60	M	A.S.V. - power
	B6	5	S	Londex relay - generator engine No. 1
	D6	20	S	T.R.1464
1D	K2	5	S	T.1154 and R.1155 No. 1 - control
	K4	5	S	A.1134 H.T. power unit
	R2	5	S	A.S.V. - control
	R4	5	S	Auxiliary radio control
	R6	5	S	T.1154 and R.1155 No. 2 control

MAIN COMMUNICATIONS REQUIREMENT

2. Equipment

The installation consists of the following units. -

Two transmitters, type T.1154H, or M (Modified)
Receiver, type R.1155B or N. (two off)
Two H.F. ammeters, type C
Aerial change-over switch, type 484 (Marconi) (two off)
Aerial change-over switch, type C.30177
Trailing aerial winch, Marconi type AD/W7
Trailing aerial fairlead
Two H.T. power units, type 33A or 33B
Two L.T. power units, type 35A
Transmitting key, Marconi type 486
Two relays, type L.
Two Londex relays, type 220
Two resistance units, type 52A
Two B.T.H. type X.L.70 circuit breakers
Two isolating switches type B (AM. Stores Ref. 5C/1877)

2.1. Station - Description

(a) The main communication equipment is mounted above the radio desk, the transmitters on a panel attached to the hull frames and the receivers on a framework sloping from the outboard edge of the desk to the hull side. The two T.1154/R.1155 installations are located. - No. 1 at the aft and No. 2 at the forward end of the station.

The former installation constitutes the main communication equipment, with the transmitter of the latter installation as a stand-by. The receiver of No. 2 installation is used for D.F. as described in para.3.

(b) The H.T. and L.T. power units are mounted behind detachable covers in compartments below each end of the desk. The aerial ammeters and change-over switches are mounted on a panel above the transmitters, the trailing aerial winch and fairlead being positioned in the knee-hole beneath the desk

(c) On the forward side of the bulkhead at the aft end of the station are mounted the following controls. -

Isolating switches for. -
Both T.1154/R.1155 installations
Push switches for auxiliary radio supplies (T.R.1464)
Switches for lamps illuminating the radio equipment
Switch for interphone amplifier and telephone switches
Intercommunication call light unit
T.1154 No. 1 and No. 2 Modulation Switch

Fitted on the aft side of the same bulkhead, is the radio services panel 7C, which carries the Londex relays, their resistance units, and the keying selector switches.

(d) The "tel-mic" sockets for the station are mounted, one on each side of the radio officer, on the inboard edge of the desk.

2.2. Aerial system

(a) Under normal conditions the communications installation is used in conjunction with either the port fixed main aerial, the port and starboard fixed aerials in parallel, or the trailing aerial.

(b) There are three aerial change-over switches, two of Type 484 and one Rotary Type C.30177.
No. 1 type 484, positioned above No. 1 transmitter, selects either the main fixed aerial or the trailing aerial (at the same time earthing the unused one).
No. 2 type 484, positioned above the No. 2 transmitter, switches the aerial out-put lead from the Rotary switch, C.30177, to either H.F. or M.F. on No. 2 Transmitter.
The left hand control on the Rotary switch, C.30177, switches the output from No. 2 type 484 switch to the following positions. -

H.F. Terminal)
M.F. Terminal) on Transmitter No. 1

The aerial lead on transmitter No. 2 via No. 2 type 484 switch earth.

The right hand control on the rotary switch performs a similar function in switching on starboard fixed aerial to these same positions.

2.3. Transmitters

(a) The two T.1154H or M (modified) type transmitters, connected to the aerials as stated in the previous paragraph, provide C.W., M.C.W. and R.T. (in conjunction with the A.1134A amplifier) facilities on the following frequency bands. -

Range 1 .... 16.7 mc/s to 8.7 mc/s - Blue
Range 2 .... 8.7 mc/s to 4.5 mc/s - Blue
Range 3 .... 4.5 mc/s to 2.35 mc/s - Red
Range 4 .... 500 kc/s to 200 kc/s - Yellow

The keying circuit is modified, in the transmitters, this modification consists of removing the 6.3 volt lead from terminal + 2 on the keying relay and linking that terminal with the one marked + 1. This permits the relay to operate when the master switch is at STAND BY.

(b) A panel, attached to the hull side above the desk, carries the blocks, which are slotted to take the bars on the transmitter shock absorber mountings. The transmitters are fitted to the panel by first inserting the lower ends of the bars into the bottom blocks and then the upper (hooked) ends into the top blocks. When the bars are fully home their locking screws are tightened into the top blocks.

(c) The external arrangement of the keying circuit,(see Maintenace Manual) is such that the key is automatically connected to whichever transmitter is in operation. This is achieved by connecting the key to the transmitter by means of a pair of relays (mounted on distribution panel 7C) whose coils are energized in parallel with those on the starter relays in the L.T. power units. Thus, when a transmitter and its power units are switched on the contacts of its keying selector relay close to connect the key to it. Two 5 amp. fuses for both key relays have been added. The fuse boxes are in both HT/LT.PU installation 1 and 2 housing.

(d) Particulars of the valves used in the transmitter are tabulated below. -

No. used	Type	Stores Ref.	Description	Function
2	VT.105 CV.1105	10E/216 10CV/1105	Indirectly heated triode	Master oscillator and modulator.
2	VT.104 CV.1104	10E/215 10CV/1104	Directly heated pentode	Power amplifier

2.4. Receiver

(a) The R.1155N receiver provides C.W., M.C.W. and R.T. communication facilities over the following frequency bands. -

Range 1	18.5 mc/s to 7.5 mc/s
Range 2	7.5 mc/s to 3.0 mc/s
Range 2A	3.3 mc/s to 1.5 mc/s
Range 3	1,500 kc/s to 600 kc/s
Range 4	500 kc/s to 200 kc/s

(b) The receiver of No. 2 installation provides D.F. facilities on ranges 2, 3 and 4, as described in para.3. As these receivers are indentical, either may be replaced by the other in emergency. It should be noted that in the event of failure of the D.F. receiver it must be removed and replaced by the other, as the cables are not of sufficient length to permit interchanging them.

(c) The method of mounting the receivers is similar to that for the transmitters, the blocks being fitted on the framework between the desk and the hull side.

(d) Particulars of the valves used in the receivers are tabulated below. -

No. used	Type		Description	
2	VR.99A CV.1581	10E/757 10CV/1581	Triode-hexode	Visual D.F. switching
3	VR.100 CV.1100	10E/278 10CV/1100	Variable-mu pentode	R.F. amplifier and I.F. amplifiers
1	VR.99 CV.1099	10E/277 10CV/1099	Triode-hexode	Frequency changer
2	VR.101 CV.1101	10E/280 10CV/1101	Double diode triode	A.V.C. and B.F.O. speed diode, visual meter limiter and output.
1	VI.102 CV.1102	10E/279 10CV/1102	Double triode	Visual meter switching
1	VI.103 CV.1103	10E/305 10CV/1103	-	Tuning indicator

2.5. Main L.T. supply

(a) The separate L.T. feeds for the two installations are controlled by manually operated circuit breakers which are located in charging-and control box 1C. The feeds from these breakers are also controlled by isolating switches mounted on the bulkhead at the aft end of the desk.(See fig. 4).

(b) The two power units, types 33A and 35A, are stowed in cupboards at each end of the desk, below their transmitters and receivers. Their mountings in each case consist of a pair of blocks slotted to take the flanges on the underside of the power unit, the forward, or inboard, one having a pair of tapped holes to take the captive locking screws on the unit. For further details of this equipment, see A.P.2548A, Vol. I.

2.6. Wiring

The installation is wired as shown in figs. 5 and 6.

DIRECTION FINDING EQUIPMENT

3. Equipment

(a) The equipment, wired as shown in fig. 7 for this installation, is as follows. -

D.F. all-wave receiver, type R.1155N
Rotating loop aerial, type 3
Marconator radio compass
Manual controller for Rotating loop aerial type 3.
L.T. power unit, type 35A.
Resistance unit, type 52A
Londex relay, type 220.

(b) The receiver, type R.1155N, being part of No. 2 installation, is installed immediately below No. 2 transmitter. Details of this receiver will be found in para. 2.4. D.F. facilities are provided on ranges 3 and 4, and communication facilities on the frequency bands previously stated in para. 2.4.
Note. If not "L" or "N" Ranges 3, 4 and 5 give D/F facilities

(c) The Marconator, which operates in synchronism with the manual loop orientation, is mounted beside the D.F. receiver. This instrument is equipped with a loop azimuth indicator operated by the loop flexible drive cable and controller, which is mounted at the inboard edge of the desk to the right of the radio officer.
Indication is provided against a fixed scale 0.360° and a D.R. compass repeater scale. Inside the fixed scale is a further scale which can be used to determine drift.

On the instrument face, inside the above scales, is a left/right indicator needle which operates in such a manner as to make "sense" indication of the received signals non-ambiguous. Also on the instrument face is a signal strength indicator disc which indicates visually the reception of a transmission.

A quadrantal error adjustable compensator cam is contained in the mechanism of the instrument. This cam is adjusted to the aircraft's quadrantal error; the apparent bearing of the received signal is automatically compensated to give the correct reading of the bearing of the received transmission relative to the aircraft's head.

The instrument is provided with variable illumination from 6.3-volt lamps which take their supplies from the type 35A power unit.

For further details of the Marconator radio compass, see Marconi publication ref. No. T.1929.

(d) The output from the receiver is also arranged to provide audible homing signals on the telephone at the R/O position.

(e) The D.F. installation, including the manual control of the loop and Marconator, is entirely controlled from the radio station.

3.1. Operation

(a) To bring the D.F. equipment into operation for "bearings".

Close circuit-breaker No. 2 installation by closing the isolating switch.
Set transmitter master switch No. 2 installation to "Std-Bi".
Ensure that the fixed aerial is correctly switched to No. 2 installation and that the H.F. is selected by means of type 484 switch on transmitter 2.
Turn receiver range switch to required range.
Turn receiver master switch to "Omni" and tune receiver; identify station required by using the tuning indicator for final adjustment.
Select "Balance" on master switch and adjust meter balance control until Marconator visual indicator needle is central. Adjust meter amplitude control on receiver until the Marconator signal strength indicator lies centrally in its aperture.
Switch to "Filter in" on receiver
Re-adjust balance if necessary.
Turn master switch to "Visual" position. The needle of the Marconator visual indicator will not move unless the cursor of the main is indicating the true or reciprocal bearing of the required station. In this case it is necessary to "Off Set" the needles to ascertain the true bearing.
If the Marconator needle moves to the right or left, rotate the needle of the controller so that the cursor is MOVED TOWARDS THE NEEDLE.
When the cursor and the needle are in line, read off the true and relative bearings from the outer and inner scales respectively.
The bearings will have been automatically corrected for quadrantal error by previous cam adjustment.

(b) Homing

Repeat the first ten operations as given in previous paragraph.
Rotate the loop aerial until its indicator registers 0^{o} on the Marconator fixed scale.
Homing may now be carried out by observation of the Marconator and passing verbal course adjustment instructions to the pilot.

AIRPORT R.T. CONTROL EQUIPMENT

4. Installation description

(a) The equipment located and wired as shown in figs. 9 and 11 respectively, operates in the V.H.F. bands and comprises the following main units :-

Transmitter-receiver T.R.1464
Controller, type 12.
Whip aerial, type 147
Suppressor, type H.2

(b) The transmitter-receiver T.R.1464 is mounted in the centre section over the charging and control box 1C just aft of the front spar frame. It is held in a rubber-mounted tray, from which it may be removed by loosening the two knurled fixing nuts, whose flanges engage with the feet on the front of the set.

(c) The remote controller, type 12, is fitted on the starboard side of the engine control stand.

(d) The aerial system comprises a whip aerial, type 147, mounted on the centre line of the aircraft, above cabin D. A co-axial cable (connector type 684) connects the aerial to the transmitter-receiver. A removable moulded cover is fitted to base of aerial for inspection purposes.

4.1. Main units-description

(a) The transmitter, receiver and power unit are mounted on a main chassis framework, inter-circuit connections being by soldered joints. Dust covers of extremely light gauge mild steel are provided for the above chassis and for the front panel. The equipment operates on any one of four pre-determined fixed channels within the 100 to 124 mc/s band.

(b) Transmitter - Operationally this unit is remotely controlled and is pre-set by means of special test equipment prior to flight. The tuning is accomplished by means of a motor which operates cams to operate the pre-setting mechanism. This latter rotates the tuning condensers to whichever channel is selected.

(c) Stabilization of frequency is by crystal control; the frequency to which transmitter crystals should be cut is obtained by dividing the radiated frequency by 18.

The crystals are plugged into sockets on the front panel, each bearing the reference letter, i.e. A, B, C, D of the channel it serves. Access to the sockets is gained by removing the front dust cover.

(d) Particulars of the valves used in the transmitter are tabulated below :-

No. Used	Type	Stores Ref.	Description	Function
1	CV.1091	10CV/1091	R.F. pentode	Crystal oscillator and trebler.
5	CV.1501 or VT.501A	10CV/1501 or 10E/784	R.F. beam tetrode	Frequency doubler, push-pull trebler and push-pull PA output
1	CV.1067	10CV/1067	Triode	Second A.F.
2	VT.52	10E/11398	Pentode	Modulator

(e) Receiver - The receiver unit is a superheterodyne with an intermediate frequency of 9.72 mc/s, the local oscillator voltage being derived from a two-stage crystal oscillator. The four crystals are plugged into sockets on the front panel adjacent to those for the transmitter, each being cut to a frequency of 540 kc/s less than the corresponding transmitter crystal frequency. The receiver is remotely controlled with the transmitter and has the same frequency coverage.

(f) Particulars of the valves used in the receiver are tabulated below. -

No. used	Type	Stores Ref.	Description	Function
5	CV.1091	10CV/1091	R.F. pentode	Receiver R.F. mixer crystal oscillator and trebler sextupler and third I.F.
2	VR.53	10E/11399	Variable-mu pentode	Controlled I.F. stages.
1	VR.54 CV.1054	10E/11400 10CV/1054	Double diode	Detector and A.V.C.
1	VR.56 CV.1056	10E/11402 10CV/1056	Pentode	First A.F.

(g) Power unit - The power supply for this equipment is taken from the aircraft 24-volt D.C. system. The heater circuits are fed via a voltage-regulator type 6, and the high-tension and grid-bias voltages are provided by a rotary transformer, type 79. These items with associated filters are mounted on the chassis at the rear of the unit with the BA marker amplifier, the latter being unused on this aircraft. A 500 M/A fuse is located in the MT circuit within the power unit.

Current consumption . 6 amps on "Receive", plus 2 amps for motor surge when changing channels; $8\frac{1}{2}$ amps when transmitting.

(h) Controller Electric, Type 12 - This controller, which remotely actuates the transmitter-receiver, carries the following controls.

Four push buttons marked
'A', 'B', 'C', 'D' .... For frequency selection

One push button .... For 'OFF' position

One three-way switch .... 1.Marked 'T' for Transmit (Left)
2.'VOL' for receiver. (Right)
3.Centre position marked 'R' for full volume

One volume control .... Marked 'VOL'. As above.

One dimmer control .... A knurled screw which, when turned, regulates the illumination of the buttons.

(i) The five push buttons are of translucent material and, when pressed, those marked 'A', 'B', 'C' and 'D' glow. This is achieved by a pair of pilot lamps provided with dimming cups which may be screwed down over them by means of the dimmer screw. The illumination of a depressed button is received indirectly from these pilot lamps, shields being arranged to prevent illumination of the buttons not depressed.

4.2. Operation

(a) The transmitter-receiver is pre-set on the ground for frequency adjustment, and only the operation of the button switches on the controller is necessary in flight.

(b) The electric controller is normally switched to the 'Receive' position. Transmission takes place with the T.R. switch held over in the 'Transmit' position. For details of tuning procedure to be carried out on the ground prior to flight, see A.P. 2528B.

V.H.F. RADAR (A.S.V. Mk. 2) EQUIPMENT

5. Installation description

(a) The installation wired as in fig. 13 consists of the following major items of equipment. -

Transmitter, type T.219
Receiver R.219
Indicator, type 96
Control panel, type 9
Rotary converter, type 2
Suppressor, type Y.3
Two 'ON-OFF' switches (Ref.5C/3497)
Transmitting aerial - 'Yagi' type S45.CP.33173
Two receiving aerials, type 301.

(b) As this installation is solely a navigational aid it is located at the navigation station, where it is under the control of the navigating officer.

(c) The transmitter is carried in a tray on a shock absorber mounting attached to the floor under the table. The complete unit may be removed from the tray after first loosening the two knurled nuts whose flanges engage with the feet on the front panel. Also on the front panel is the H.T. switch which is locked in 'OFF' position. Control of H.T. is obtained by means of a remote switch marked 'Transmitter' on Instrument Panel 7P.

(d) The receiver, mounted behind the facia on the table, is fitted to a shock absorber mounting.

The following controls are fitted to the panel front. -

Tuning control.........	Main control for receiver
Motor 'ON-OFF' switch...	Normally in 'ON' position
Remote/control	Should always be to 'Local' on this installation.

(e) The indicator is positioned on a shock absorber mounting which is fitted to slide on rails attached to a structure projecting over the forward end of the table. This arrangement allows the visor to be moved into the most comfortable position when in use.

The following controls are fitted to the indicator. -

Range switch - Four range scales are available, namely 3, 12, 30, and 120 nautical miles, and by rotation of this switch the desired selection is made.
By extending the range switch knob outwards a series of range calibration marks can be applied to the time base. Their appearance is arranged at the following positions; at 1/4 mile intervals on the 3-mile range, with the first mark at 1/2 mile; 1 mile intervals on the 12-mile range 5-mile intervals on the 30 mile range; and 10-mile intervals on the 120-mile range.

Range scale illumination - The perspex protection plate in front of the cathode ray tube is provided with edge lighting. The intensity of illumination is controlled by a variable resistance, the knob of which is to the left of the cathode ray tube.

Range 3 and 30 miles LEFT HAND illumination bulb lights only
Range12 and120 miles RIGHT HAND illumination bulb lights only

Gain control - For use in obtaining the desired signal amplitude.
Brilliance control - For adjusting the light level of the cathode ray tube picture.
Focus control - Used in conjunction with the brilliance control to secure a clear picture.

(f) The control panel is fitted at the aft end of the station on a shock-absorber mounting. This panel houses the relay for the rotary converter and the voltage regulators for its A.C. output. The fuses for the transmitter and receiver A.C. supplies and D.C. supply to transmitter cooling fan are accessible by first releasing the clips which hold the cover in place on the front of the panel and then removing the lid on the A.M. type fuse box. The relay is controlled by a switch on the instrument panel 7P, above the table. The switch on the front of the control panel also completes the relay coil circuit, but as it is normally unused it is kept as "OPEN".

(g) The rotary converter is bolted to the floor under the outboard end of the table. The D.C. consumption of the converter is 40 amps and 24 volts, and the A.C. output is 6.25 amps at 80 volts, with a frequency of 1,200 c.p.s.

(h) The aerial system consists of a pair of receiving aerials mounted one on each side of the nose, and a 'Yagi' type transmitting aerial on the mast just aft of the coupe roof.

(i) Particulars of the valves used in the various units are tabulated as follows. -

5.1. Transmitter

No. used	Type	Stores Ref.	Description	Function
2	VT.90 CV.1090	10E/97 10CV/1090	Directly - heated triode	Transmitter
2	VU.111 CV.1111	10E/146 10CV/1111	Half-wave rectifier	Voltage doubler

5.2. Receiver

No. used	Type	Stores Ref.	Description	Function
2	VR.136 CV.1136	10E/386 10CV/1136	R.F. pentode	R.F. amplifier
7	VR.91 CV.1091	10E/92 10CV/1091	R.F. pentode	Mixer, video amplifier I.F. amplifiers.
1	VR.137 CV.1137	10E/394 10CV/1137	R.F. triode	Local oscillator
1	VR.92 CV.1092	10E/105 10CV/1092	Diode	Diode
1	VU.39A CV.1569	10E/574 10CV/1569	Full-wave rectifier	
1	VU.134 CV.1134	10E/100 10CV/1134	Half-wave rectifier	

5.3. Indicator

No. used	Type	Stores Ref.
6	VR.65 CV.1065	10E/11446 10CV/1065
1	VR.92 CV.1092	10E/105 10CV/1092
3	VR.54 CV.1054	10E/11400 10CV/1054
1	Tube VCR.97 Tube CV.1097	10E/222 10CV/1097

5.4. Operation

To operate the equipment the following precedure should be carried out.-

(a) Close the power switch on the instrument panel and make the following checks. -

That transmitter cooling fan is running by placing hand over air intake on right-hand side of transmitter.

That transmitter filaments are glowing (these may be observed through tho louvres).

Ensure that LOCAL-REMOTE switch on receiver is at "LOCAL".

Allow 30 seconds for warming-up of receiver and indicator unit. After this period a vertical "trace" should be visible on the latter unit.

(b) Close H.T. switch on instrument panel marked "transmitter" and observe milliammeter reading; this should be approximately 4.5. If in excess of 8 ma. switch off and do not attempt to use the equipment until it has been serviced.

If the equipment is working correctly operation (b) should produce pictures on the indicator C.R.T. screen, whose size, brilliance and focus may be adjusted by the appropirate controls on the indicator.

(c) A.S.V. reception can be classified under two headings, namely, (a) Echo Reception without Aid from a Ground Beacon, and (b) Responder Signal Reception.

5.5. Echo Reception without aid from a ground beacon

When flying over sea plane echoes are obtainable from ships, islands and coastlines, and take the form of elongated horizontal peaks on either side of the vertical trace. These equally disposed about the base of the trace decreasing in length horizontally are returns from sea or land immediately below and ahead of the aircraft. Similar lines of rapidly changing amplitude will also be observed super-imposed on this trace; this is caused through receiver noise and is known as "grass".

Adjust the receiver tuning slowly to the same frequency as the transmitted pulse, using limited "gain" to obviate bad definition. Maximum strength of transmitted pulse and ground returns should be obtained at the bottom of the trace.

Range measurements are made from the bottom of the trace to the lower edge of the echo. Returns from an object dead ahead of the aircraft will produce a pattern equally disposed about the trace at a distance up the screen proportionally to the range of that object. This range may be determined by operation of range switch and reading the appropriate scale. Should such an object be to the port or starboard of "Dead ahead", the pattern on the vertical trace will be to the left or right respectively. In such cases a rough estimate can be made of the direction of the object by comparing the amplitude of returns on either side of the vertical trace.

This information is only reliable when the aircraft is flying level. There is a possibility of sense reversal when aircraft is banking steeply and receiver aerial considerably screened.

5.6. Responder Signal Reception

With the assistance of a ground or responder beacon, signals, a far greater range can be obtained with the aircraft equipment.

The procedure for reception is the same for that given in the above paragraphs. One point to note is that in the case of responder beacons it is sometimes necessary to retune slightly the receiver in order to obtain the best reception from re-radiated pulses that may be of a slightly higher frequency. Sunh adjustments have the advantage of producing a signal devoid of noises and primary returns.

INTERPHONE EQUIPMENT

6. Installation description

(a) This installation consists of the following major items of equipment.

Amplifier A.1134A
H.T. power unit, type 173
Two-volt accumulator
Tel-mic sockets (13)
Tel-mic head-set

(b) The amplifier is fitted between the transmitters on the panel at the radio station, its H.T. unit behind the aft main L.T. power unit, and its 2-volt accumulator in a stowage box on the aft side of the radio bulkhead. The supply to the H.T. power unit and the 2-volt feed to the amplifier are controlled by a double-pole switch on the forward side of the radio bulkhead on the left-hand side of the radio officer.

(c) Particulars of the valves used in the amplifier are as follows. -

No. used	Type	Stores Ref	Description	Function
1	VR.21 CV.1021	10E/7738 10CV/1021	Triode	Class A voltage amplifier
1	VR.35 CV.1035	10E/9779 10CV/1035	Twin Pentode	Class B, Q.P.P. power amplifier

(d) The interphone sockets are connected in parallel (see Maintenance Manual). Three switches marked R.1, R.2 and R.T. respectively are provided at the radio station. The former switch (R.1) breaks the No. 1 receiver output to the Radio Officer's sockets, while switch R.2 breaks the D.F. receiver output to the Radio Officer's position.

The third switch marked R.T. switches the input modulation to either transmitter.

Microphones used are of the electro-magnetic type.

6.1. Operation

(a) To bring the amplifier into operation. -

Close switch marked "I/C Power" on the radio bulkhead.
Close "ON-OFF" switch on amplifier.

(Note. A slight "Chirp" will be heard when the latter switch is opened or closed; this is a transient effect due to the warming up of the valve filaments and is quite normal).

(b) For normal interphone operation. -

Set key switch on interphone amplifier to "B" and lock by means of locking strip

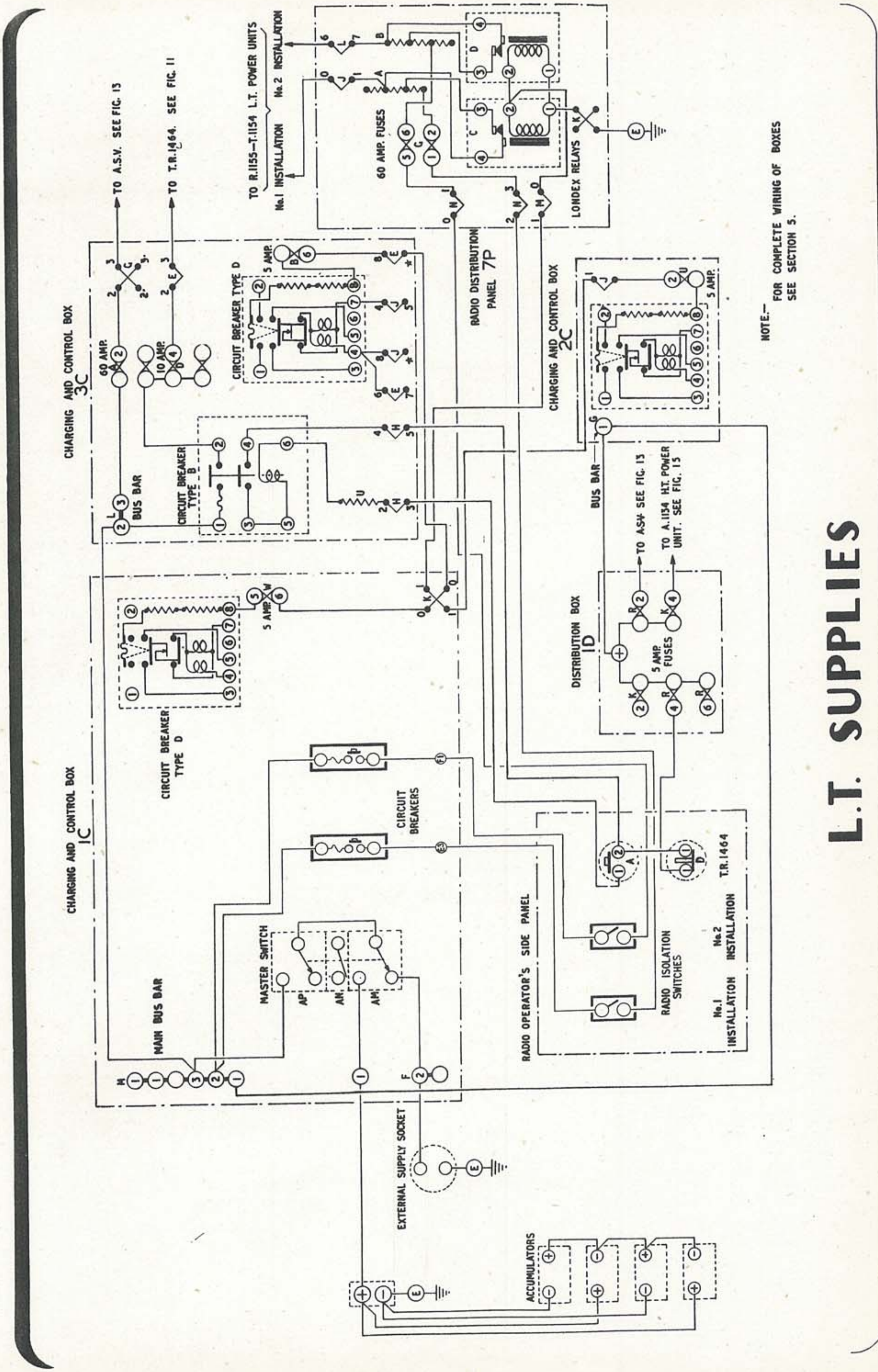
The above provides interphone facilities for all stations and C.W. and M.C.W. operation (on the T.1154/R.1155) for radio officer only. When the key-switch is set to "C" the amplifier is used to modulate the main transmitter for R.T. The "A" position of the key-switch is normally unused.

IMPORTANT - Both "ON-OFF" switches should be opened before leaving the aircraft, as the battery master switch does not control the 2-volt supply.

(c) Telephone Switch R.1 on left of Radio Officer's seat connects the headphones to No. 1 Receiver.

EQUIPMENT.	FACILITY.		RADIO OFFICER.			CAPTAIN.			FIRST OFFICER.			NAVIGATING OFFICER.			ENGINEER OFFICER.			STEWARD.		
			CONTROL	TRANSMIT	RECEIVE	CONTROL	TRANSMIT	RECEIVE	CONTROL	TRANSMIT	RECEIVE	CONTROL	TRANSMIT	RECEIVE	CONTROL	TRANSMIT	RECEIVE	CONTROL	TRANSMIT	RECEIVE
MAIN COMMUNICATIONS	H.F. & M.F.	TRANSMIT (C.W., M.C.W., & R.T.)	▨	▨			▨			▨			▨			▨			▨	
		RECEIVE (C.W., M.C.W., & R.T.)	▨		▨			▨			▨			▨			▨			▨
AIRPORT R.T. CONTROL.	H.F. (NOT FITTED)	TRANSMIT (R.T.)				▨	▨		▨	▨										
		RECEIVE (R.T., M.C.W.)			▨	▨		▨	▨		▨									
	V.H.F.	TRANSMIT (R.T.)				▨	▨		▨	▨										
		RECEIVE (R.T. & M.C.W.)			▨	▨		▨	▨		▨									
DF LOOP.	M.F. & H.F.	RECEIVE (C.W., M.C.W., & R.T.)	▨		▨			▨			▨			▨						
ALTIMETER																				
A.S.V.	HOMING AND DISTANCE IND.											▨	▨	▨						
INTERPHONE.			▨	▨	▨		▨	▨		▨	▨		▨	▨		▨	▨		▨	▨

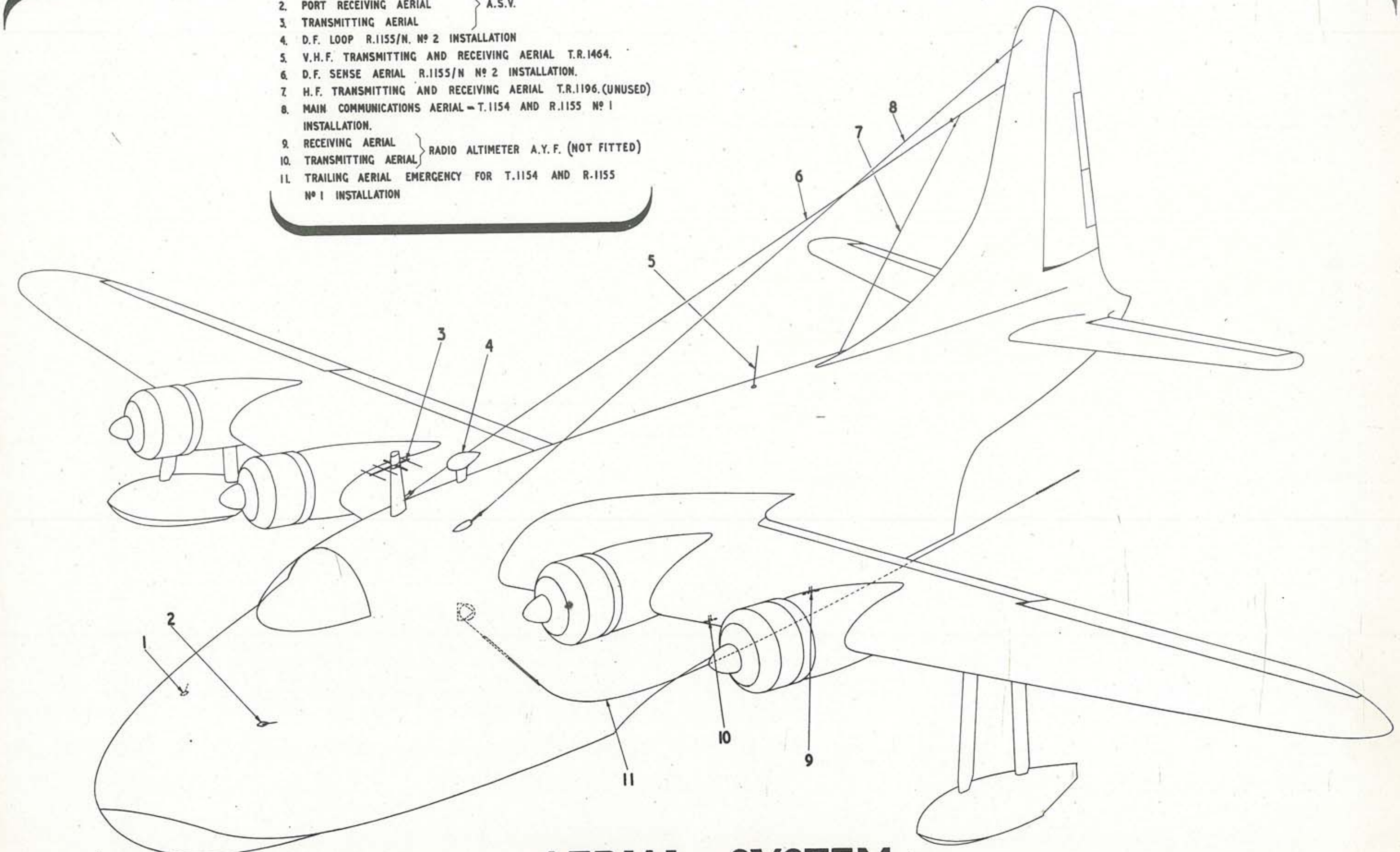
OPERATIONAL FACILITIES



L.T. SUPPLIES
CHARGING AND CONTROL BOX 3C
60 AMP.
10 AMP.
TO A.S.V. SEE FIG. 13
TO T.R.1464. SEE FIG. 11
BUS BAR
CIRCUIT BREAKER TYPE B
CIRCUIT BREAKER TYPE D
5 AMP.
TO R.1155–T.1154 L.T. POWER UNITS
No.1 INSTALLATION
No.2 INSTALLATION
60 AMP. FUSES
LONDEX RELAYS
RADIO DISTRIBUTION PANEL 7P
CHARGING AND CONTROL BOX 2C
NOTE.– FOR COMPLETE WIRING OF BOXES SEE SECTION 5.
CHARGING AND CONTROL BOX 1C
CIRCUIT BREAKER TYPE D
5 AMP
DISTRIBUTION BOX 1D
5 AMP. FUSES
TO A.S.V. SEE FIG. 13
TO A.1154 H.T. POWER UNIT. SEE FIG. 15
CIRCUIT BREAKERS
MAIN BUS BAR
MASTER SWITCH
RADIO OPERATOR'S SIDE PANEL
T.R.1464
RADIO ISOLATION SWITCHES
No.1 INSTALLATION
No.2 INSTALLATION
EXTERNAL SUPPLY SOCKET
ACCUMULATORS

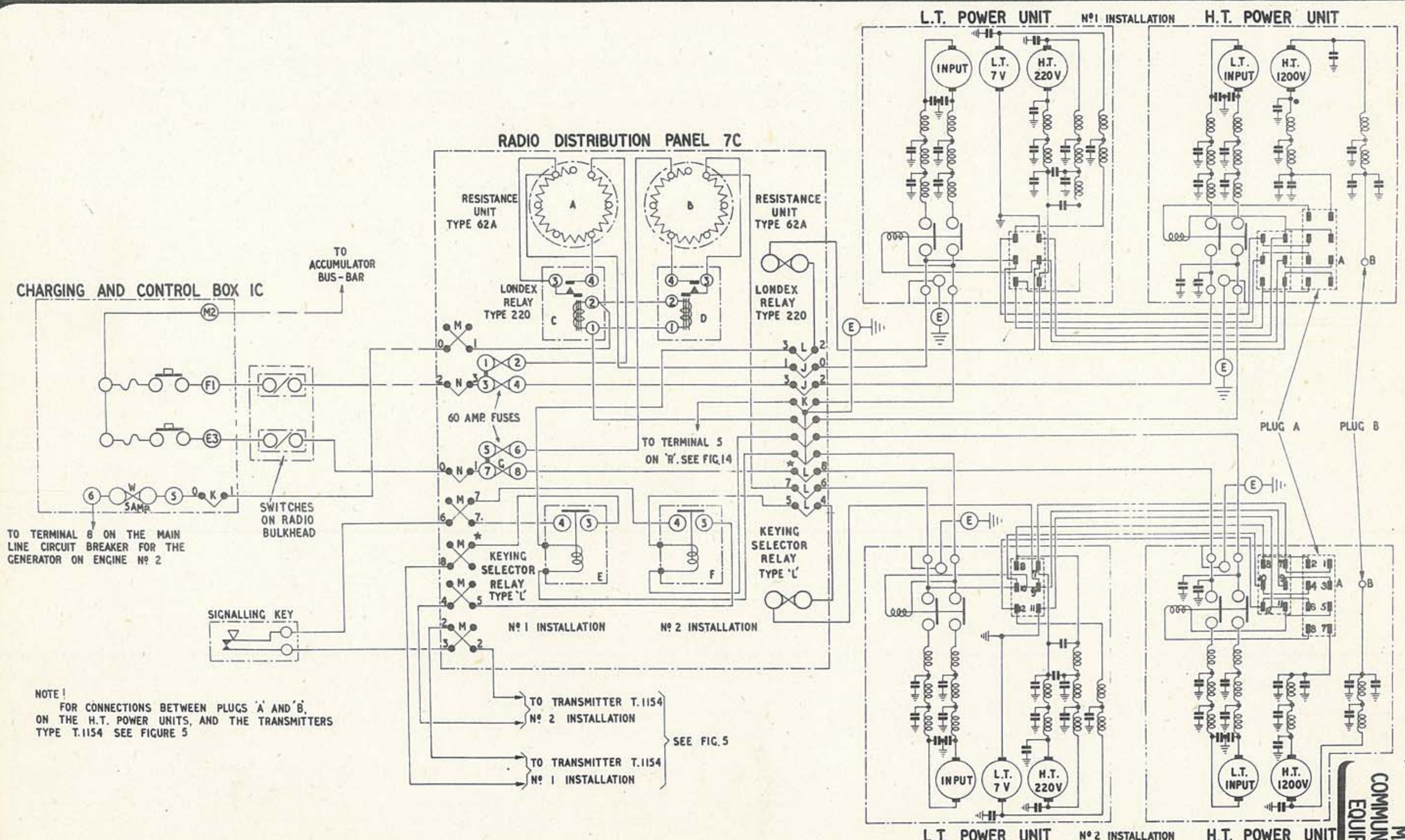
FIG. 2

1. STARBOARD RECEIVING AERIAL } A.S.V.
2. PORT RECEIVING AERIAL } A.S.V.
3. TRANSMITTING AERIAL } A.S.V.
4. D.F. LOOP R.1155/N. Nº 2 INSTALLATION
5. V.H.F. TRANSMITTING AND RECEIVING AERIAL T.R.1464.
6. D.F. SENSE AERIAL R.1155/N Nº 2 INSTALLATION.
7. H.F. TRANSMITTING AND RECEIVING AERIAL T.R.1196. (UNUSED)
8. MAIN COMMUNICATIONS AERIAL – T.1154 AND R.1155 Nº 1 INSTALLATION.
9. RECEIVING AERIAL } RADIO ALTIMETER A.Y.F. (NOT FITTED)
10. TRANSMITTING AERIAL } RADIO ALTIMETER A.Y.F. (NOT FITTED)
11. TRAILING AERIAL EMERGENCY FOR T.1154 AND R.1155 Nº 1 INSTALLATION



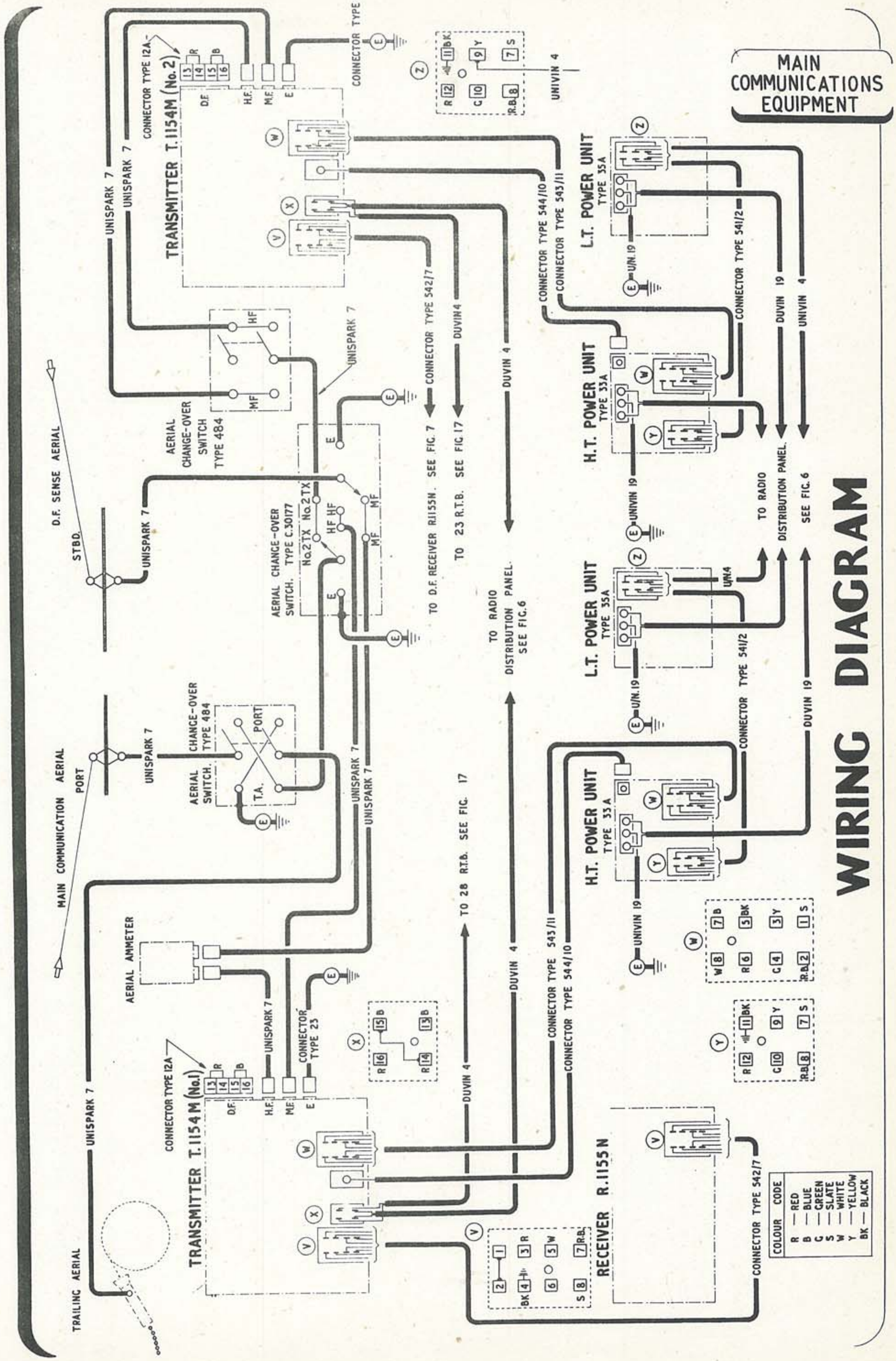
AERIAL SYSTEM

FIG. 3



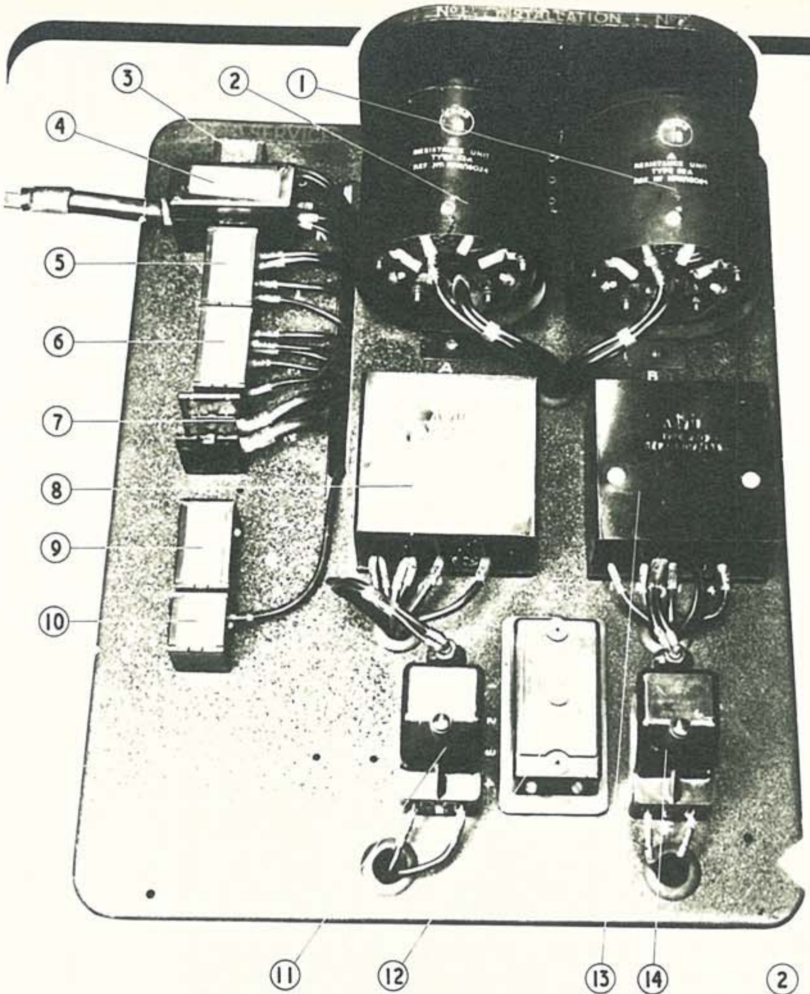
SWITCHING, KEYING, AND POWER SUPPLY

FIG. 4



RS50/TP/107	
ISSUE	DATE
1	24.11.47
2	22.3.51

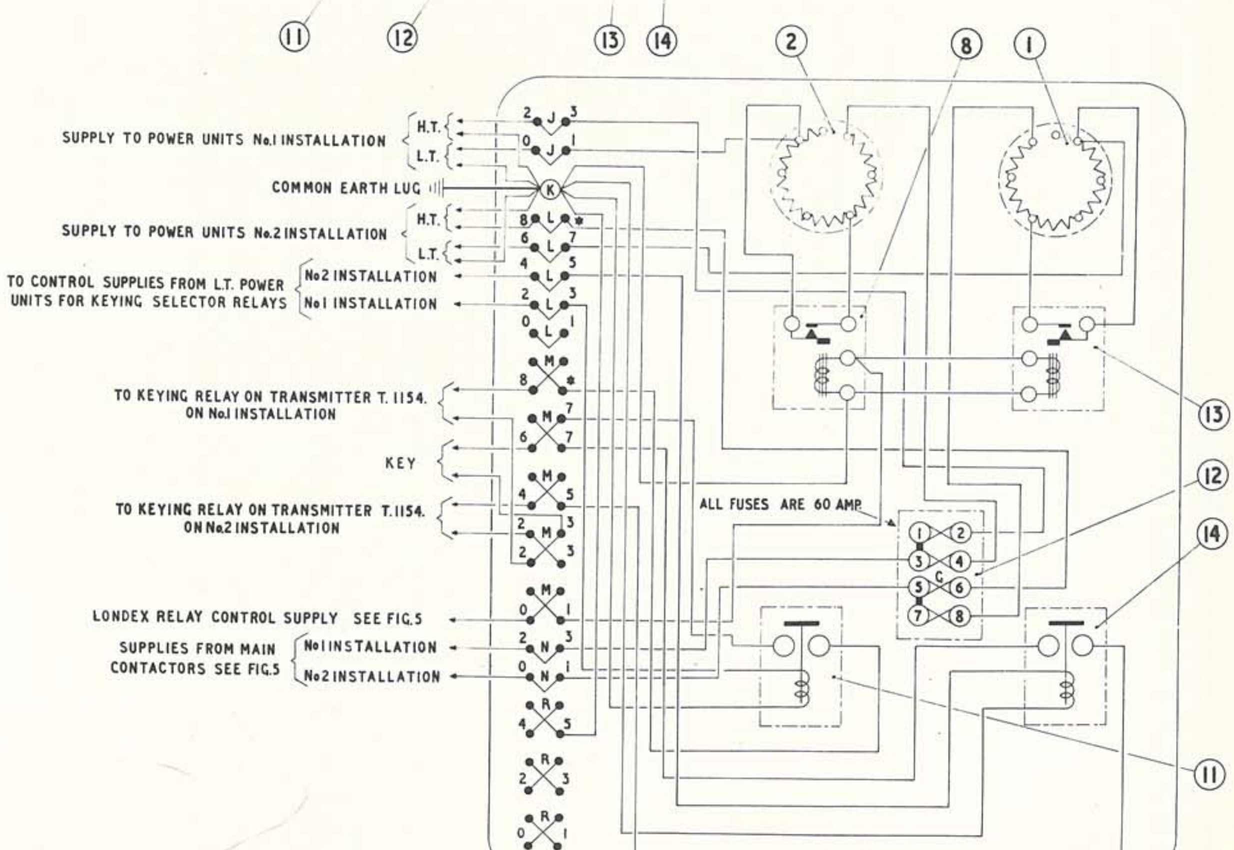
FIG. 5



1. – RESISTANCE UNIT.
2. – RESISTANCE UNIT.
3. – TERMINAL BLOCK J
4. – TERMINAL BLOCK K (COMMON EARTH)
5. – TERMINAL BLOCK L
6. – TERMINAL BLOCK M
7. – TERMINAL BLOCK N
8. – LONDEX RELAY (No.1 INSTALLATION)
9. – TERMINAL BLOCK Q
10. – TERMINAL BLOCK R
11. – KEY SELECTOR RELAY (No.1 INSTALLATION)
12. – FUSE BOX
13. – LONDEX RELAY (No.2 INSTALLATION)
14. – KEY SELECTOR RELAY (No.2 INSTALLATION)

NOTE.–

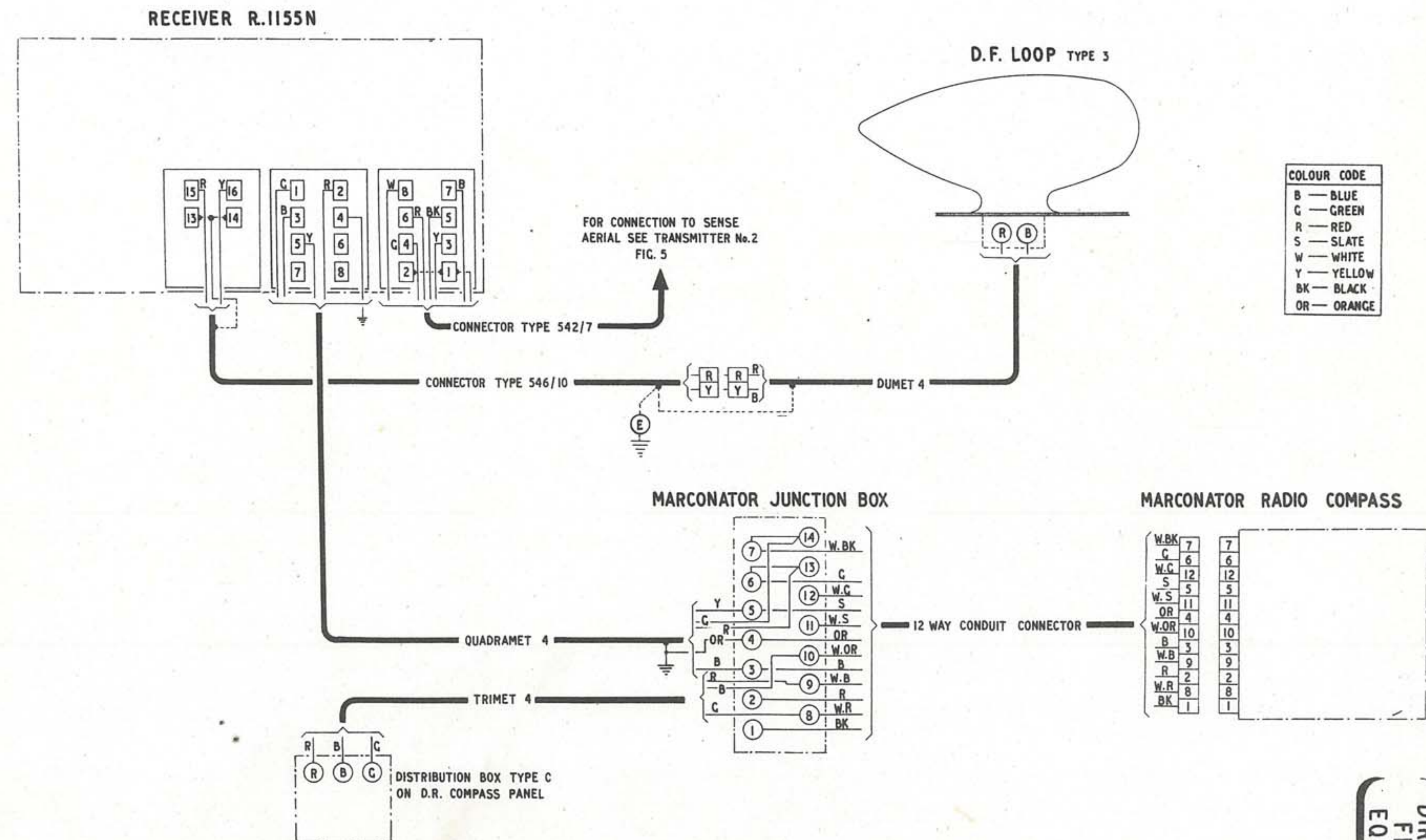
FOR WIRING OF TERMINAL BLOCKS 'Q' & 'R' SEE FIG. 17



DISTRIBUTION PANEL 7C

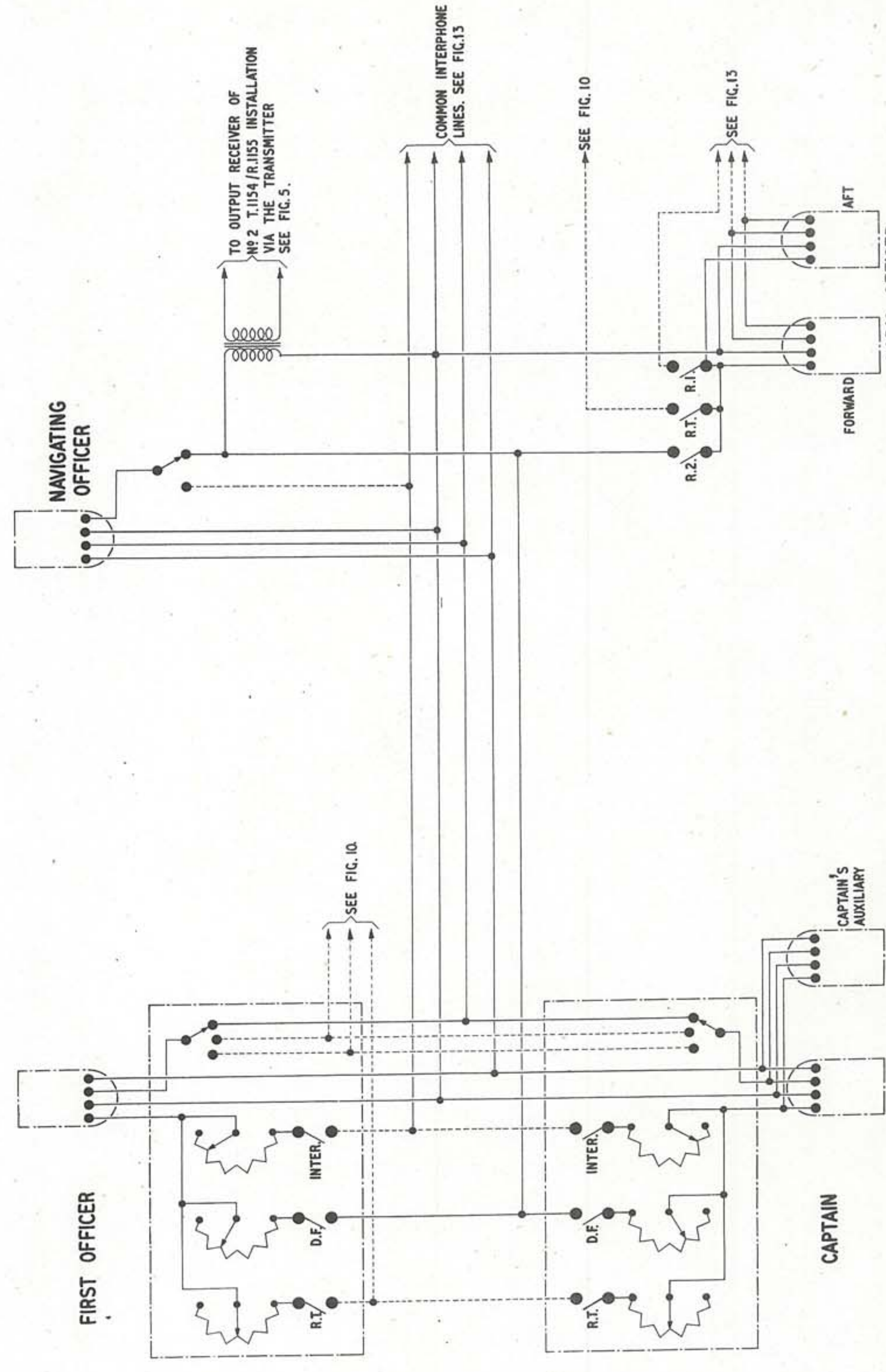
RSSO/TP/107	
ISSUE	DATE
1	27.11.47

FIG. 6



WIRING DIAGRAM

DIRECTION FINDING EQUIPMENT

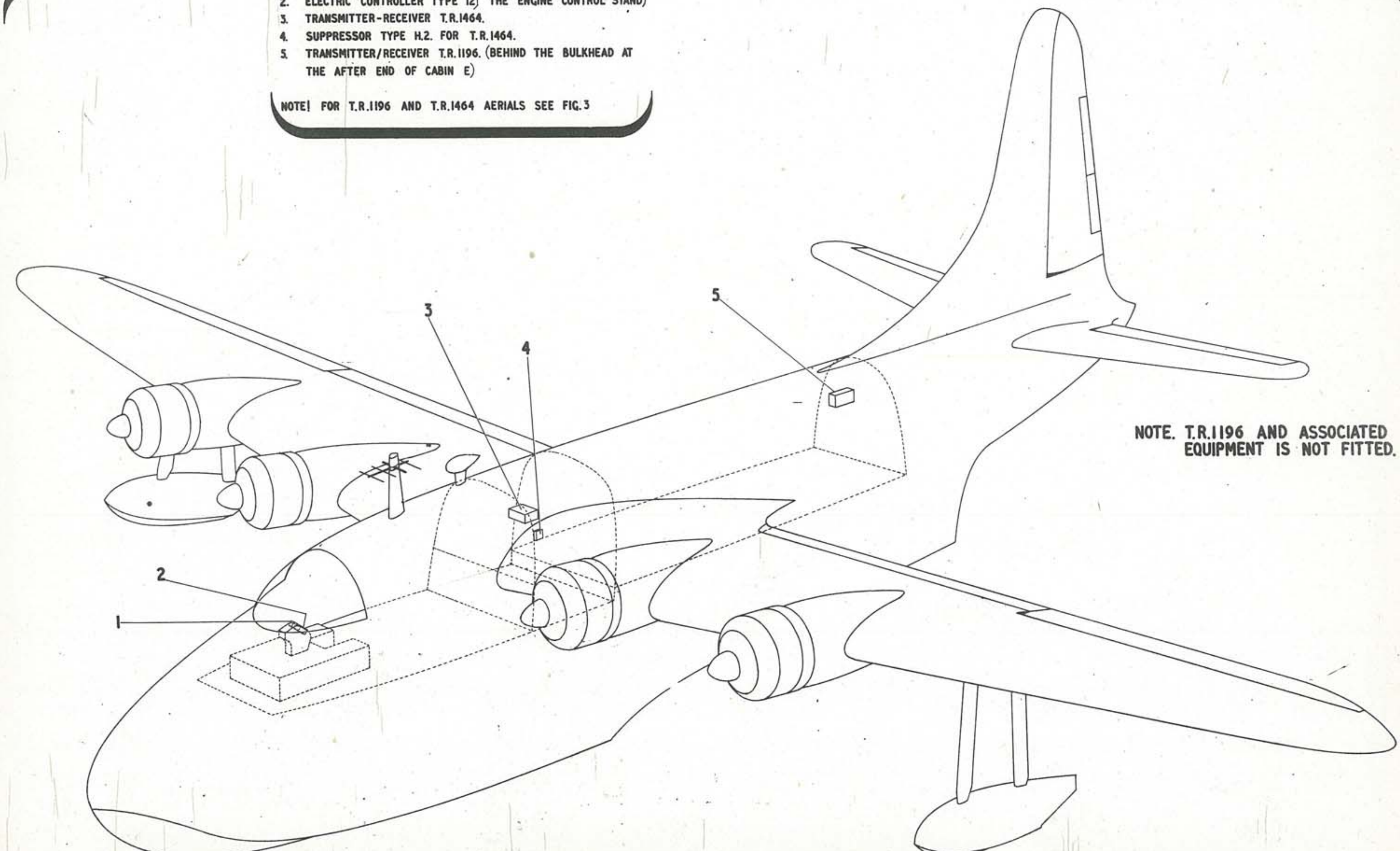


TELEPHONE CIRCUIT

FIG. 8

1. ELECTRIC CONTROLLER TYPE 4 } (ON STARBOARD SIDE OF
2. ELECTRIC CONTROLLER TYPE 12 } THE ENGINE CONTROL STAND)
3. TRANSMITTER-RECEIVER T.R.1464.
4. SUPPRESSOR TYPE H.2. FOR T.R.1464.
5. TRANSMITTER/RECEIVER T.R.1196. (BEHIND THE BULKHEAD AT THE AFTER END OF CABIN E)

NOTE! FOR T.R.1196 AND T.R.1464 AERIALS SEE FIG.3



NOTE. T.R.1196 AND ASSOCIATED EQUIPMENT IS NOT FITTED.

AIRPORT R.T. CONTROL EQUIPMENT - LOCATION

FIG. 9

WIRING DIAGRAM

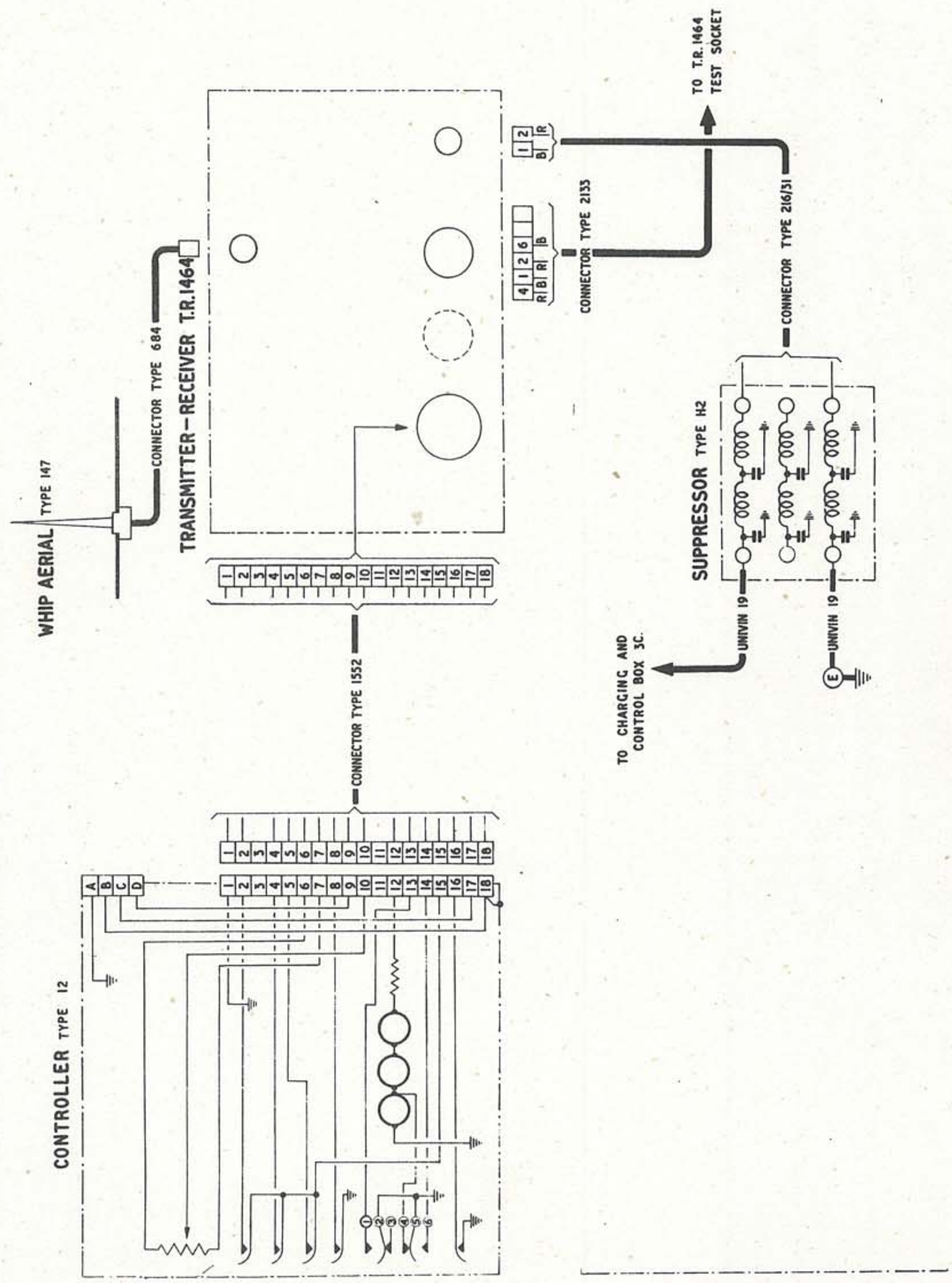
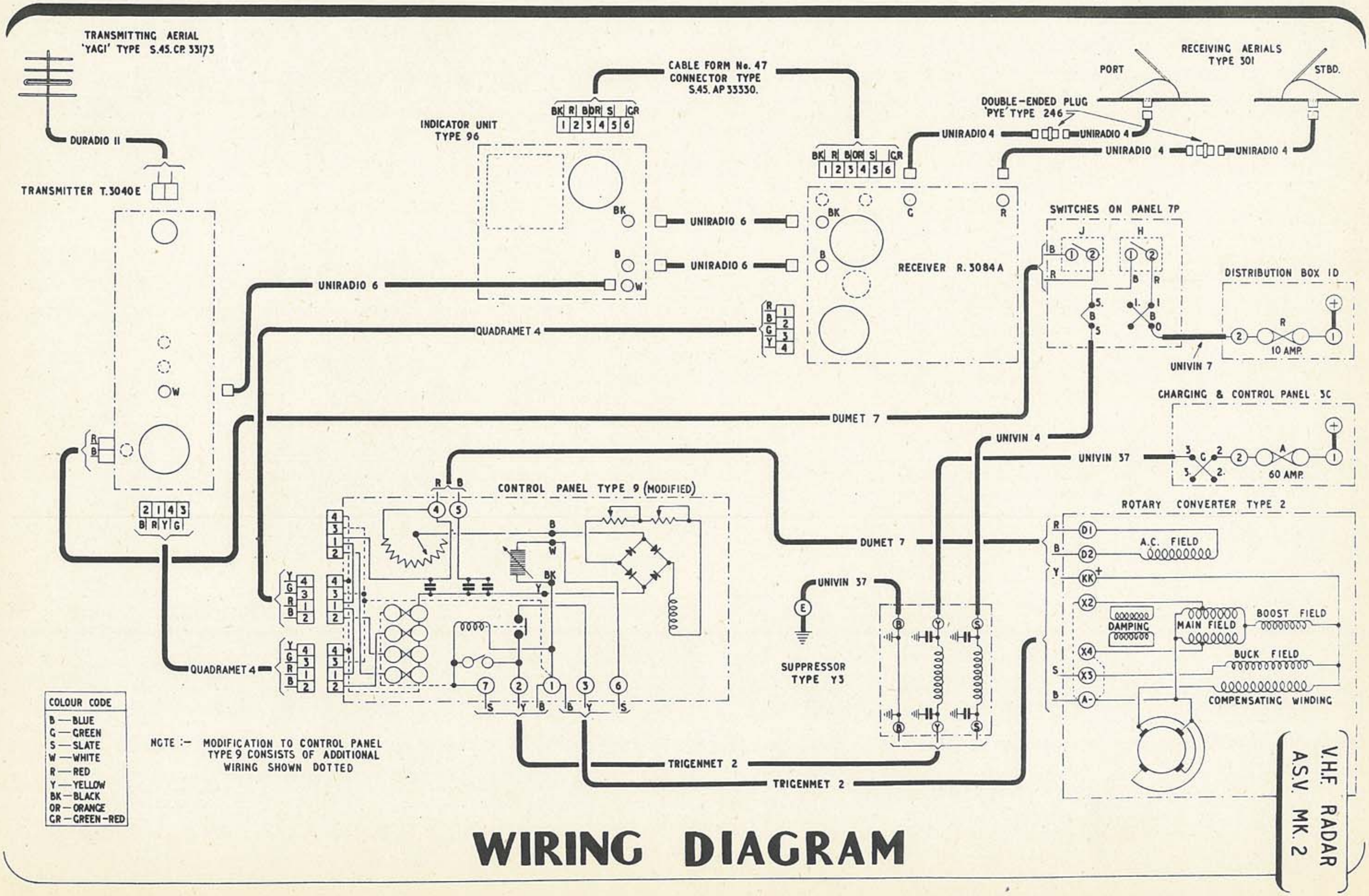


FIG.11

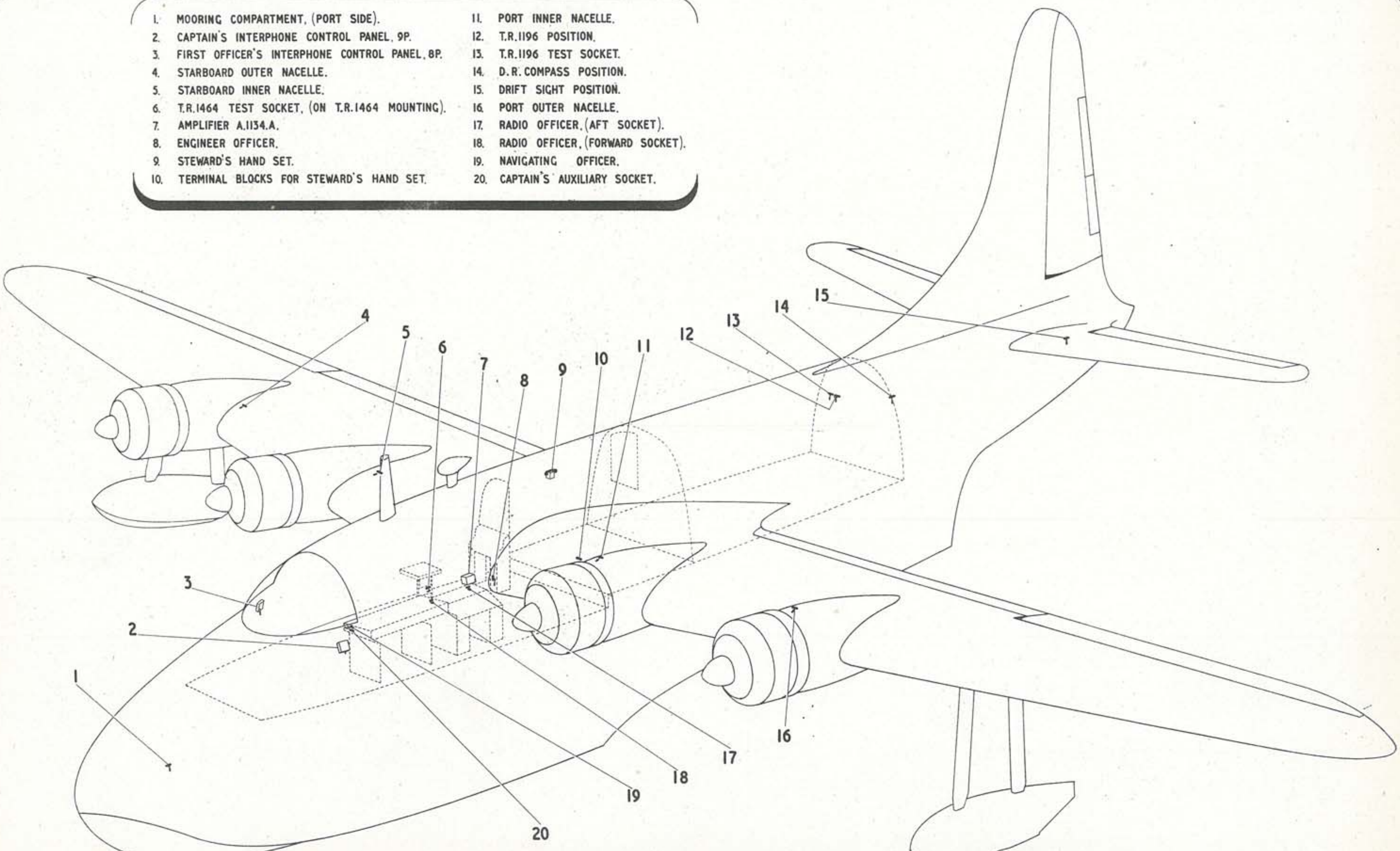
RSSO/TP/107	
ISSUE	DATE
1	22.11.47
2	21.3.51



WIRING DIAGRAM

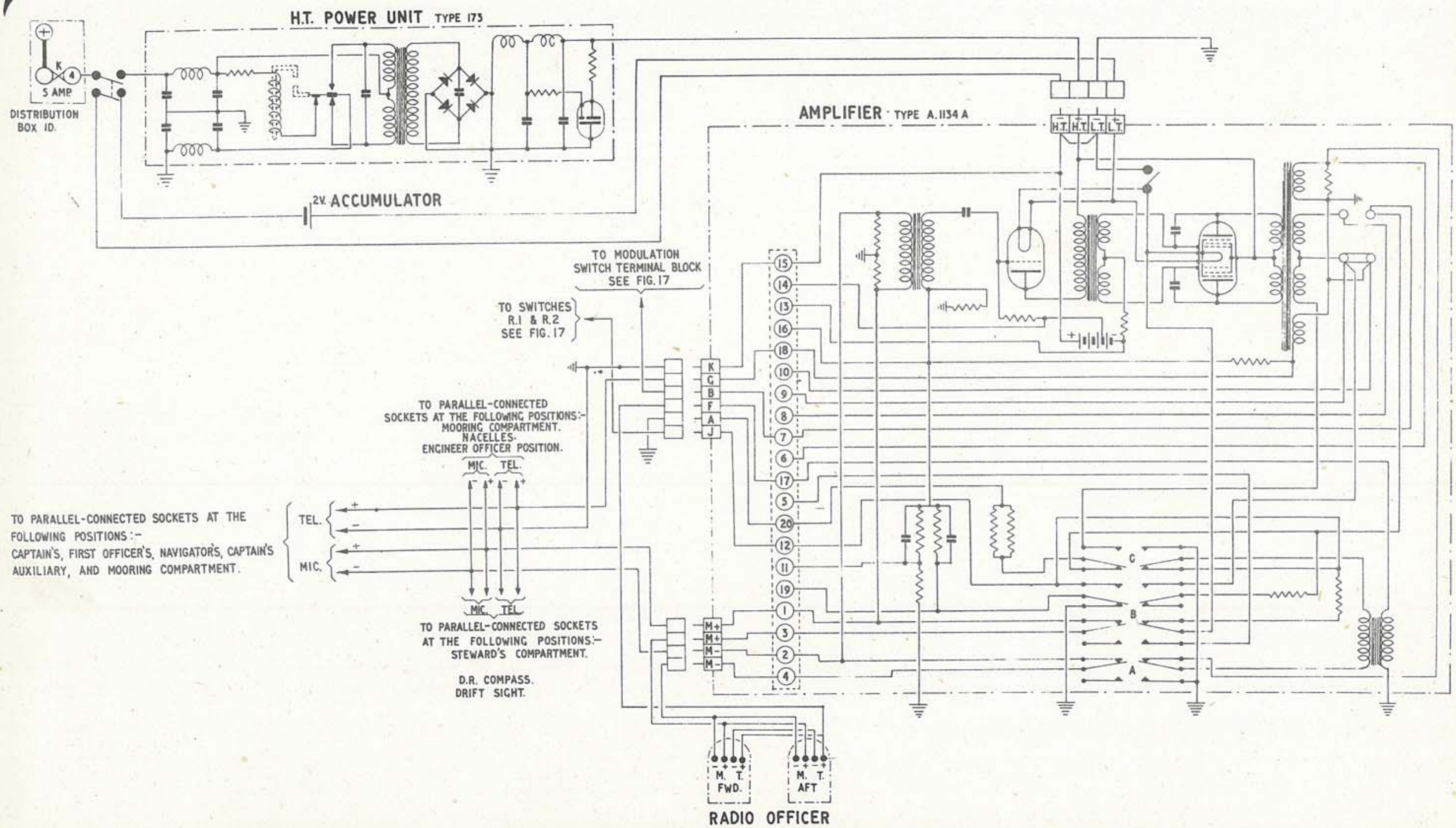
FIG. 13

1. MOORING COMPARTMENT, (PORT SIDE).
2. CAPTAIN'S INTERPHONE CONTROL PANEL, 9P.
3. FIRST OFFICER'S INTERPHONE CONTROL PANEL, 8P.
4. STARBOARD OUTER NACELLE.
5. STARBOARD INNER NACELLE.
6. T.R.1464 TEST SOCKET, (ON T.R.1464 MOUNTING).
7. AMPLIFIER A.1134.A.
8. ENGINEER OFFICER.
9. STEWARD'S HAND SET.
10. TERMINAL BLOCKS FOR STEWARD'S HAND SET.
11. PORT INNER NACELLE.
12. T.R.1196 POSITION.
13. T.R.1196 TEST SOCKET.
14. D.R. COMPASS POSITION.
15. DRIFT SIGHT POSITION.
16. PORT OUTER NACELLE.
17. RADIO OFFICER, (AFT SOCKET).
18. RADIO OFFICER, (FORWARD SOCKET).
19. NAVIGATING OFFICER.
20. CAPTAIN'S AUXILIARY SOCKET.



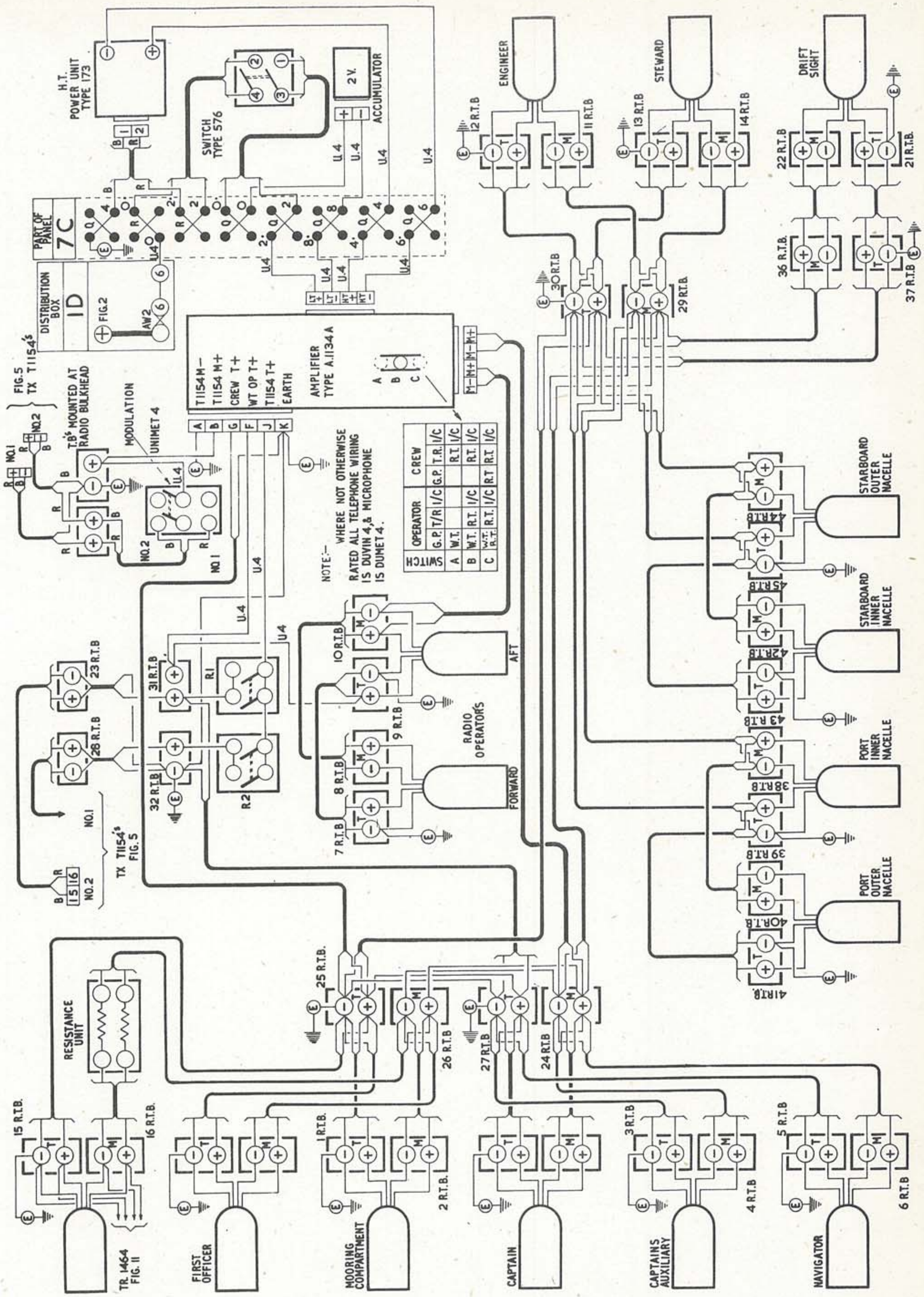
INTERPHONE EQUIPMENT - LOCATION

FIG. 14



AMPLIFIER—POWER SUPPLY AND SWITCHING

FIG. 15



WIRING DIAGRAM

FIG. 17

SOLENT 3

MAINTENANCE MANUAL

SECTION 7

VACUUM SYSTEM

Contents

Illustrations

Prepared by Short Brothers and Harland Ltd.

DESCRIPTION

1. The flying instruments are operated from the suction side of either of two vacuum pumps type B.3X Mk. 2, fitted on the accessory gearbox of engines No. 2 and 3 respectively.

In the starboard wing the pipeline is routed along the forward face of the front spar-truss from a vacuum relief valve on the pump to one side of a changeover cock fitted above the engine priming panel at the E/O's station.

In the port wing the pipeline is routed along the front spar-truss from a relief valve on the pump to the hull side, thence down to floor level, along the rear face of the front spar-frame and up to connect to the changeover cock.

From the changeover cock a pipeline extends down to floor level, thence along the rear face of the front spar-frame and the port side of the flight deck to connect to the flying instruments (Direction Indicator, Turn and Bank Indicator and Artificial Horizon) on each side of the pilot's instrument panel.

Another pipeline, from a connection at the instrument panel, extends aft by the side of the main pipe run, to a vacuum gauge fitted beside the changeover cock.

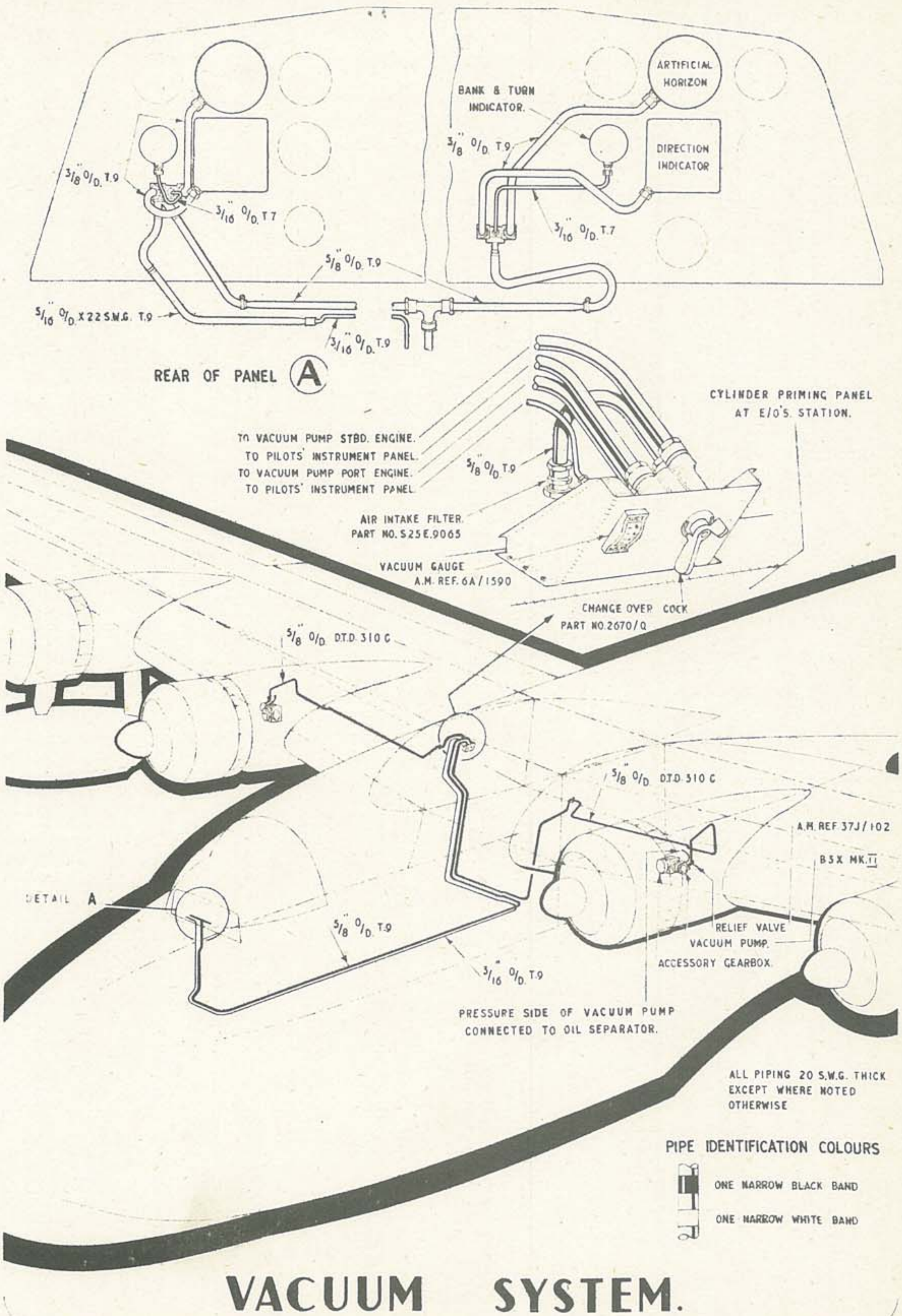
MAINTENANCE

2. General -

Servicing information, including relief valve adjustment, lubrication, and the causes of and remedies for pump failures is given in the pump manufacturer's handbook.

3. Removal of Vacuum Pump -

Reference should be made to Sect. 9, fig. 13 which illustrates and describes the method of removing a vacuum pump from the accessory gearbox. When the pump has been taken off, the quill drive should be removed and a blanking cover fitted on the gearbox.



VACUUM SYSTEM.

FIG. 1

SOLENT 3

MAINTENANCE MANUAL

SECTION 8

INSTRUMENTS

Contents

Illustrations

Prepared by Short Brothers and Harland Ltd. Feb. 1951.

1. General. -

The following tabulation gives the instruments fitted on the aircraft and includes the manufactuer's name (where possible) and part numbers. The list also gives indication of any duplication.

INSTRUMENT	No. OFF	MANUFACTURER	PART No.	POSITION
Artificial Horizon Mk. 1B	2		AM.Ref.6A/1599	Pilot's instrument panel.
Altimeter	2		BOAC code EKBM/1000	Pilot's instrument panel.
Altimeter Mk. 4A	2		AM.Ref. 6A/1273	One on E/O's side panel. One on N/O's panel.
Automatic Controls. -				
Relay Mk. 8	1		AM.Ref. 6H/1375	
Control cock Mk. 4B	1		6H/1925	
Pitch control Mk. 8	1		6H/612	
Clutch cable distributor Mk. 4	1		6H/488	
Air drier Mk. 6	1		6H/500	
Pressure filter Mk.1	1		6H/340	
Combined pressure gauge Mk. 1 (fluorescent).	1		6H/2174	
Clutch lever Mk. 4	1		6H/571	
Oil reservoir Mk. 5	1		6H/1250	
Water drain trap	1		6H/1700	
Servo motor Mk. 4	2		6H/1030	
Air-intake throttle Mk. 5	1		6H/1185	
Gyro unit Mk. 8 *	1		6H/2402	
Automatic valve Mk. 4	1		6H/1546	
Follow-up tension spring Mk. 4	2		6H/1147	
Follow-up cable guide Mk. 4	4		6H/551	
Fork ends	2		6H/544	
Casing stops (long socket)	3		6H/1	
Cable nipple	2		29/1170	
Cable nipple $\frac{3}{8}$" dia.	2		6H/7	
Cable casing stops, Type A.	8		29/1903	
Casing stops D.E. Type R.	5		29/1798	
Cable nipple $\frac{1}{4}$" dia.	1		AM.Ref.6H/6	
Follow-up Cable nipple	2		6H/5	
Compass - Type O.6	1		AM.Ref.6A/473	Stowed on the forward end of R/O's desk structure.
Holder	1		6A/388	

Instruments	No. off	Manufacturer	Part No.	Position
Compass - Type P.10	2		AM.Ref.6A/1671	One at each side of control cabin.
Compass - Astro Mk.2A	1		6A/11740	Stowed at the starboard side of the front spar-frame.
Standards Type 0.5A	2		6A/3660	
Controller - T.K.S. (Aerofoil de-icing)	1	T.K.S. Ltd.	27700	E/O's side panel.
Clock	1	Smith's Inst.Co.	V.304 or AM.Ref.6A/676	Pilot's instrument panel.
Clock	1	Smith's Inst.Co.	V.304	On E/O's side panel.
	1		V.308	On N/O's panel.
Cock $\frac{5}{8}$" B.S.P. (Vacuum system)	1	Aircraftings Ltd.	2670Q	Starboard side of hull at E/O's station.
Drift Recorder Mk.2	1		AM.Ref.6B/258	Hull side at N/O's station.
Fore-and-aft Level Type B.	2		AM.Ref.6A/389	One on pilot's instrument panel. One on E/O's main panel.
Gauge-Fuel Pressure	4	Smith's Inst.Co.	263 P.G.	E/O's main panel
Transmitter	4	Smith's Inst.Co.	164 P.G.	
Gauge-Oil Pressure Type 11E	2	Smith's Inst.Co.	AM.Ref.6A/1178 (40' capillary)	E/O's main panel
	2	Smith's Inst.Co.	AM.Ref.6A/1179 (50' capillary)	E/O's main panel
Transmitter (oil pressure)	4	Smith's Inst.Co.	288 P.G.	E/O's main panel
Gauge-Oil Temp.Mk.2A (Fluorescent)	4		AM.Ref.6A/1479	E/O's main panel
Gauge-Cyl. Temp.	4	Sangamo Weston		E/O's main panel
Gauge - Carb. Temp. Mk. 1 (Fluorescent)	4		AM.Ref.6A/1756	E/O's main panel
Gauge - Engine Synchroscope	1	Kelvin, Bottomley & Baird	KB.300/01 or Kollsman type 635/01/7760	Pilot's instrument panel.
Gauge - Manifold Pressure	8	Smith's Inst.Co.	67 B.G.	Four on pilot's instrument panel. Four on E/O's main panel.
Gauge - Suction	1		AM.Ref.6A/1590	Starboard side of hull at E/O's station.

Instrument	No. off	Manufacturer	Part No.	Position
Gauge - Fuel Contents	2	Smith's Inst. Co.	Tank No. 1 Type 175, No. 772 FG.	E/O's main panel.
	2	Smith's Inst. Co.	Tank No. 2 Type 176, No.773 FG.	E/O's main panel.
	2	Smith's Inst. Co.	Tank No. 3 Type 177, No.774 FG.	E/O's main panel.
	2	Smith's Inst. Co.	Tank No.4 Type 168, No.831 FG.	E/O's main panel.
	2	Smith's Inst. Co.	Tank No. 5 Type 169, No.833 FG.	E/O's main panel.
	2	Smith's Inst. Co.	Tank No. 6 Type 170, No.738 FG.	E/O's main panel.
Tank Units.	2	Smith's Inst. Co.	Tank No. 1 Type 132, No.527 FG.	
	2	Smith's Inst. Co.	Tank No. 2 Type 131, No.526 FG.	
	2	Smith's Inst. Co.	Tank No. 3 Type 133, No.528 FG.	
	2	Smith's Inst. Co.	Tank No. 4 Type 187, No.830 FG.	
	2	Smith's Inst. Co.	Tank No. 5 Type 188, No.832 FG.	
	2	Smith's Inst. Co.	Tank No. 6 Type 189, No.737 FG.	
Gauge - Oil Contents	4	Smith's Inst. Co.	1467 FG.	E/O's main panel.
Tank unit	4	Smith's Inst. Co.	1466 FG.	
Gauge - Torquemeter	4	Negretti & Zambra		Hull side at E/O's station.
Indicator - Air Speed	4	Kelvin, Bottomley & Baird.	KB.217/01	Two on pilot's instrument panel. One on E/O's side panel. One on N/O's panel.
Indicator - R.P.M. Mk. 4 B	4		AM.Ref.6A/1299	Below engine priming panel. at E/O's station.
Indicator - R.P.M.	4	Kelvin, Bottomley & Baird.	KB/100/02	Pilot's instrument panel.
Indicator - Rate-of-climb.	2		BOAC/EKBE/1001	Pilot's instrument panel.
Indicator - Aileron Trimming Tab Duplex Type.	1	Evershed and Vignoles.	RX.2669	Pilot's instrument panel.
Transmitter (controlling)	1	Evershed and Vignoles	RX.2393	
Transmitter (resistance)	1	Evershed and Vignoles.	RY.2659	
Indicator - Direction	2	Reid & Sigrist	AM.Ref.6A/1209	Pilot's instrument panel.

Instrument	No. off	Manufacturer	Part No.	Position
Indicator - Turn & Bank	2	Reid & Sigrist	Ball Inclinometer Type.	Pilot's instrument panel.
Indicator - Cowl Gill	2		AM.Ref.6A/2148	E/O's side panel.
Transmitter Type 'B'	4	Smith's Inst.Co.	129 PL.	
Switches	4	Rotax	D.1401	
Indicator - Rate of Flow	1	George Kent Ltd.	12-100 G.P.H.	E/O's main panel.
Selector Switch	1	Sangamo Weston	S.18	E/O's main panel.
Indicator - Flap Position	1	Smith's Inst. Co.	1 F.L.	Pilot's instrument panel.
Resistance	1	Smith's Inst.Co.	R.S.1	
Potentiometer (Trans)	1	Smith's Inst.Co.	X.44807/4	
Meter - 'Gallons Gone'	2	George Kent Ltd.	AM.Ref.6A/1746	E/O's main panel.
Transmitter		George Kent Ltd.	MA.4011	
Pressure Head Mk. 8M *	2	Kelvin, Bottomley & Baird	AM.Ref.6A/2176	Aerial mast.
Static Vent Type F	2		AM.Ref.6A/1686	Each side of hull just below flight deck.
Stiffening Plate	2		AM.Ref.6A/1820	
Sextant Mk. 9 BM	1		AM.Ref.6B/313	N/O's station.
Thermometer - Direct Reading Mk. 1	1		AM.Ref.6A/1439	N/O's station.
Thermometer - Outside Air Temp.	1	Weston.	606	E/O's main panel.
Thermometer - Air Temp.	1		AM.Ref.6A/1636	Pilot's instrument panel.
Thermometer - (Cabin Heating System)	2	Cambridge Inst. Co.	A.15282	E/O's side panel.
Vent - Air (Vacuum System)	1	Short Brothers & Harland Ltd.	S25.E.9065	Starboard side of hull at E/O's station.

INSTRUMENT SYSTEM

2. Pressure-head Installation -

Fig. 1 shows that the pressure side of the A.S.I's, and V.G. recorder are connected to two pressure-heads in the aerial mast, and that the static side of the instruments are connected to static vents fitted one one each side of the hull, just below the flight deck.

From a T-piece near the base of the aerial mast, the pipeline branches to port and starboard; on the port side it is carried forward to the A.S.I. on the N/O's panel, and the instruments on the pilot's panel; on the starboard side, the pipeline branches to the A.S.I. on the E/O's side panel and to a 4-way cock and V.G. recorder mounted high up on the forward face of the front spar-frame.

The pipelines from the static vents extend forward to the instruments on the pilot's panel. From a 4-way connection at the instrument panel the pipeline extends aft beside the pressure pipeline to the instruments on the N/O's panel. The pipeline then crosses, beside the pressure line, to the starboard side then passes aft and branches to the instruments on the E/O's side panel and the 4-way cock and V.G. recorder at the front spar-frame.

3. Pressure-head Heaters -

The pressure-heads are heated by separate elements the control switches being fitted on the electrical panel at the port side of the control cabin.

NOTE... To avoid burning out the elements the switches must always be OFF when the aircraft is not flying.

4. Instrument Lighting -

Instrument lighting, including the ultra violet installation for the pilot's instruments is dealt with in Sect. 5.

INSTRUMENTS AT CREW STATIONS

5. The following instruments are fitted in the control cabin. -

Artificial Horizons Mk. 1B.
Altimeters
Automatic Controls
Compasses - Type P.10
Clock
Fore-and-aft level.
Gauge - Engine Synchroscope
Gauges - Manifold Pressure
Indicators - Air Speed
Indicators - R.P.M.
Indicators - Rate of Climb
Indicators - Aileron Trimming Tab
Indicators - Direction
Indicators - Turn and Bank
Indicator - Flap Position
Thermometer - Air Temp.

6. The following instruments are fitted at the navigating officer's station. -

Altimeter Mk. 4A
Clock
Compass - Type C.6
Indicator - Air Speed
Sextant Mk. 9 BM
Thermometer - Direct Reading Mk. 1

7. The following instruments are fitted at the engineer officer's station.

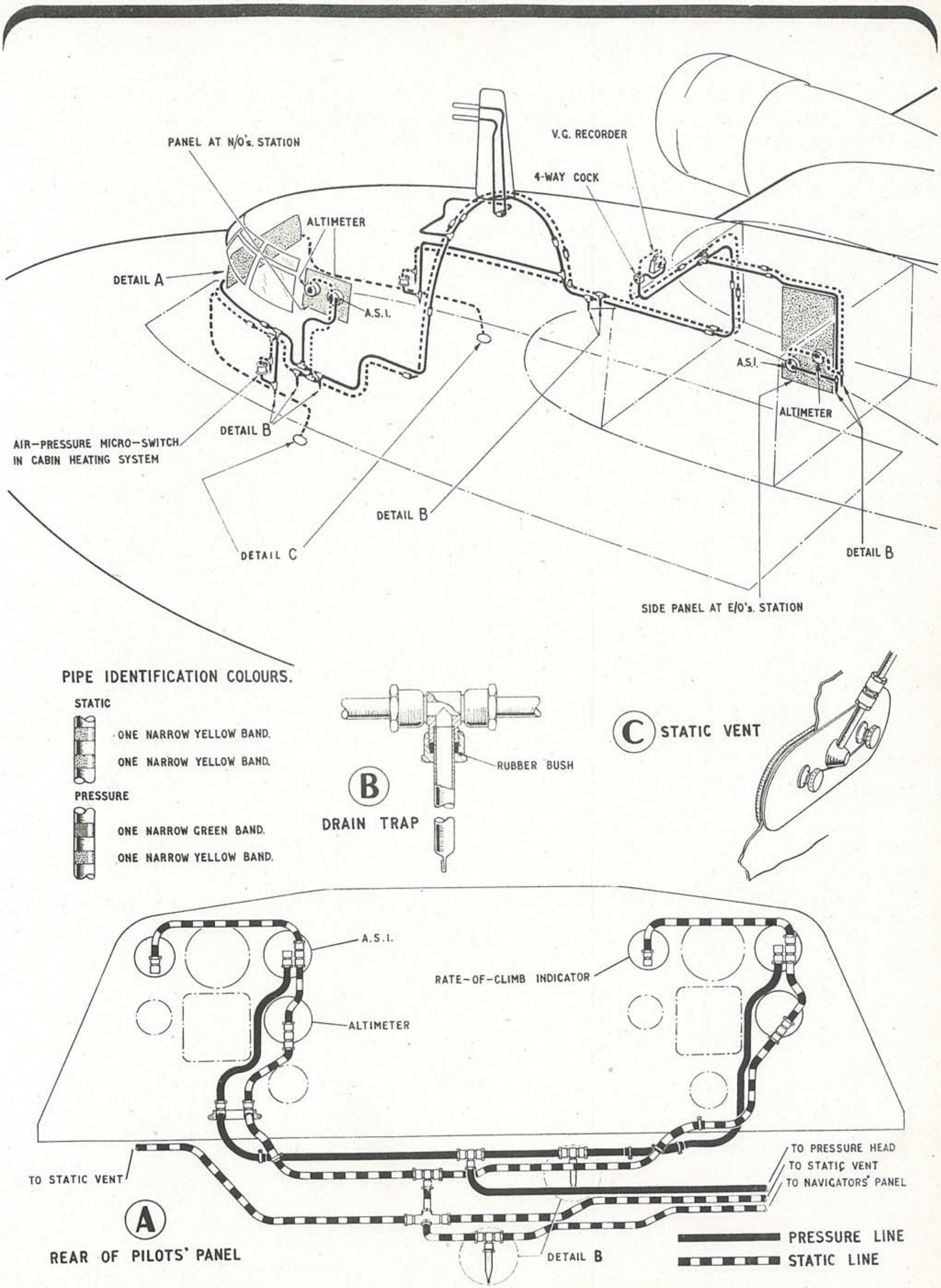
Altimeter Mk. 4 A
Clock
Controller - T.K.S. (Aerofoil De-icing)
Fore-and-aft level Type B
Gauges - Fuel Pressure
- Oil Pressure
- Oil Temp.
- Cylinder Temp.
- Carburettor Temp.
- Manifold Pressure
- Suction
- Fuel Contents
- Oil Contents
Gauges - Torquemeter
Indicator - Air Speed
Indicators - R.P.M.
Indicators - Cowling Gills
Indicator - Rate of Flow
Meters - 'Gallons Gone'
Thermometer - Outside Air Temp.
Thermometers - Cabin Heating System.

MAINTENANCE

8. For maintenance information on the various instruments, reference should be made to the appropriate Air Publications or manufacturer's handbooks quoted in the list of Ancillary and Proprietary Equipment given in Sect. 1.

Draining points in the instrument system pipelines are indicated in fig. 1.

Maintenance of the R.A.E. Mk. 8 Automatic controls is covered in Air Publication 1469C.



INSTRUMENT SYSTEM.

FIG. 1

SOLENT 3

MAINTENANCE MANUAL

SECTION 9

ENGINE INSTALLATION

Contents

Prepared by Short Brothers & Harland Ltd. Feb. 1951.

Illustrations

DESCRIPTION

1. General -

The Hercules 637 engines incorporating special 7-point mounting rings are fitted on monocoque nacelles built on to the leading edge of the main plane. The Hobson - R.A.E. fuel injector type B.1/B.H.6, single speed superchargers, and Bristol torquemeters are also incorporated.

An accessory gearbox, shaft-driven from the engine, is fitted on the rear face of the nacelle firewall of engines No. 1, 2 and 3. The engine installation is illustrated in figs. 1 and 2.

The accessories and their services are as follows. -

Engine	Accessory		Service
No. 1	Generator D.C. 6 Kw., Type P.2	-	All electrical installations.
No. 2	Generator D.C. 6 Kw., Type P.2	-	All electrical installations.
	Vacuum Pump Type B.3x Mk. 2	-	Flying instruments.
	Air Compressor Type A.G. Mk. 1	-	Automatic pilot
No. 3	Generator D.C. 6 Kw., Type P.2	-	All electrical installations.
	Vacuum Pump Type B.3x Mk. 2	-	Flying instruments

2. Propellers. -

de Havilland propellers type C.D./80/446/4 are fitted. These are four-bladed hydromatic and fully feathering with type CAY 5100 double acting constant speed units. The oil supply for the feathering pumps (mounted at the rear side of the main plane front spar-trusses) is taken from the main oil tanks, approximately 2 gall. reserve of oil being allowed for this purpose. From the pumps the oil passes through "Purolator" filters to the C.S.U's.

3. Throttle Controls (Fig. 4) -

The control for each engine consists of tie-rods and cables formed into two closed circuits, one from the lever in the control cabin to a cable drum at the hull side in the centre section, and one from another drum in the wing root to a drum on the forward face of the nacelle firewall. A push-rod connects the cable drum in the centre section to the cable drum in the wing root, and the final connection to the engine is also made by push-rod.

A spring-loaded plunger on each control lever engages a notched cam on the control stand to locate the control at the RATED BOOST position. A friction-type damper is fitted and operates on all four levers, the control handwheel being located on the port side of the control stand.

Duplicate levers are connected into the control runs and are located in the roof, just aft of the front spar-frame to enable the engineer to synchronise the engines by the torquemeters.

4. Propeller Controls (Fig. 5)

The propeller controls are similar to the throttle controls but the final connection to the constant speed unit on the engine is made by "Teleflex" cable.

The propeller feathering push-switches are fitted on a panel at the forward end of the control cabin roof.

5. Air Intake Shutters (Fig. 6) -

The temperature of air entering the induction system can be controlled to HOT or COLD by shutters fitted in the air intakes.

The shutters are controlled by cable from four handwheels fitted, above the E/O's seat, at the front spar-frame.

The control runs extend outboard over a series of pulleys and through pulley banks on the main plane front spar-truss to connect to a cable drum on the rear face of each firewall.

From this drum the connection to the shutter is made by two push-rods interconnected by a toggle lever.

The controls are spring-loaded to the COLD position but a plunger fitted in each control handwheel engages in a quadrant to retain the controls in the HOT position when required.

6. Cowling Gills -

The gills fitted at the trailing edge of the engine cowling are operated by an electric motor fitted in the lower part of the nacelle.

The motor is coupled to the gill ring by a universally-jointed shaft and the control switches and gill position indicators are fitted on the E/O's side panel.

7. Slow Running Cut-out Controls -

The spring-loaded lever of the cut-off valve on the injector is coupled by a push-rod and a spring-loaded linkage unit to an electric actuator in which a small electric motor drives a screw-jack. The actuator is controlled by a switch on the panel in the control cabin roof. The linkage unit is fitted to ensure that the cut-off valve is seating correctly when the control is in the STOP position.

NOTE.... The valves must be in the cut-off (STOP) position all the time the engines are not running.

8. Engine Starting System - (Electrical)

Normally the engines are started electrically the motors being controlled by push-switches fitted on the engine control stand.

Safety switches, operated by the maintenance platforms on each side of the engine nacelles are connected in series with the appropriate starting relay operating coil so that an engine cannot be started electrically until the maintenance doors are closed. Further details of the system are given in Sect. 5, Chap. 4.

9. Engine Starting System (Manual)

The engines can be started by hand from the maintenance platforms. Two winding handles are stowed on the rear face of the front spar-frame.

For hand starting, the appropriate booster coil isolating switch and ignition switch must be closed and the main starter-button pressed to energise the booster coil circuit while the engine is being turned.

10. Ignition System -

Each engine is fitted with a pair of Rotax magnetos controlled by earthing switches on the control cabin roof panel.

B.T.H. type booster coils are fitted and are controlled by the engine starter push-switches. Isolating switches on the E/O's main panel are provided to break the booster coil circuit when it is required to turn an engine without starting it.

The procedure to be adopted when hand starting an engine is given in para. 9.

11 Oil specification. - Aero-Shell 100B (for winter and summer use)
OR
Intava 1 AA 745, 1 AA 810
OR
D.E.D. 2472 A/2 (Winter)
D.E.D. 2472 B/2 (Summer)

NOTE ..... Aero-Shell 100B must be used and only in extreme emergency should any of the above alternatives be used. In such a case it is necessary to drain completely and flush the oil system before using an alternative oil.

12. Oil Tankages -

One tank per engine. -

Engine Oil	Feathering Reserve	Air Space	Total
$30\frac{1}{2}$ gall.	2 gall.	5 gall.	$37\frac{1}{2}$ gall.

13. Oil System (Fig. 7)

Each engine has a self-contained oil system; a typical installation is shown in fig. 7. The tank, fitted with a partial circulating chamber (hot-pot) is mounted between the main plane spar-trusses, at the rear of the engine nacelle. The oil cooler, fitted in the main plane leading edge has a flap fitted in the outlet duct to regulate the airflow through the cooler. The flap is controlled by cable from a handwheel in the E/O's control stand.

Fig. 8 illustrates the control run to each cooler.

A high-initial-oil-pressure device is incorporated in the engine-driven feed pump and, when in operation, by-passes the surplus oil to the scavenge pump for return to the tank, when the oil has attained normal working temperature, the device automatically cuts out and the surplus oil is by-passed to the suction side of the feed pump.

To safeguard the scavenge system and oil cooler against damage from high pressures attained when starting from cold under cold weather conditions, a balanced scavenge by-pass valve is fitted in the oil return pipe between the engine and cooler.

When this valve is in operation, the majority of the scavenge oil is returned direct to the tank but as soon as the oil warms up and the pressure drops to normal, the valve closes and the scavenge oil is returned to the tank through the cooler in the normal way.

The oil tanks can be replenished from a tanker at the rear of the aircraft, a series of eye-bolts being positioned along the hull roof for securing the supply line during filling operations.

A filler cap key is stowed in the roof of the centre section, immediately forward of the rear spar-frame.

MAINTENANCE

Starting and Warming up -

14. Before Starting -

14.1 Check engine magneto switches OFF
14.2. Check cowling gills and oil cooler flaps as required.
14.3. Check propeller control levers in max. r.p.m. position
14.4. Check throttle levers approx. 1" open.
14.5. Check air intake heat control in COLD AIR.
14.6. Check all tank cocks and cross feed cock OFF
14.7. Have each engine turned slowly by the hand turning gear through at least two revolutions of the propeller to guard against the possibility of hydraulic shock damage.

15. Starting -

15.1. Switch all engine cut-offs to STOP position.
15.2. Turn ON master engine cocks.
15.3. Turn ON No. 1, 2 and 3 fuel tanks cocks (port and starboard)
15.4. Switch ON backing pumps for 30 secs. to prime the injector.
15.5. Switch OFF backing pumps.
15.6. Select engines in turn on the priming cocks and prime the induction system with 1 to 3 strokes of the pump. In very cold conditions more priming fuel may be used.
15.7. Switch 'on' the booster coils
15.8. Switch 'on' the magneto switches
15.9. Press the engine starter-buttons in turn
15.10. Switch the engine cut-offs to RUN as each engine starts.
15.11. Check oil pressure as each engine starts.
15.12. Switch 'off' booster coils
15.13. Ground/Flight switch to FLIGHT
15.14. Turn OFF priming cocks.

16. Warming up -

Whilst warming up at 1000 - 1200 r.p.m. check each magneto in turn as a precautionary measure. When the oil inlet temperature has reached 15°C and not more than 40°C carry out the ground checks.

PRECAUTION.... On ground running, the cylinder head temperature must not be allowed to exceed 280°C.

Ground Checks After Installation

17. After warming up and before opening the throttle further, momentarily switch 'off' both magnetos together to check that their earth wires are properly connected. Maximum r.p.m. for this check is 1200.

During the following runs, check that all instruments and accessories are functioning correctly. It may be impracticable to follow the sequence of checks quoted and more than one engine run may be necessary. Check also that all fuel supply routes will feed the engine.

18. R.P.M. -

When the engine has reached normal operating temperature, open the throttle to give 30" Hg. manifold pressure. Carefully observe and record the r.p.m. at this boost, together with the atmospheric pressure of the day. In order to allow for discrepancies caused by day-to-day variations in atmospheric and wind pressures and air temperatures, it is recommended that whenever practicable this test be repeated two or three times, on different days, and the mean of all the readings recorded.

On subsequent ground checks on this engine/propeller combination the r.p.m. should be within 50 of this figure, and an engine should not be opened up to a higher power unless this check has been satisfactorily completed. The check will prevent an engine with a cylinder completely out of operation being passed as satisfactory; such a condition might not be revealed by later checks.

NOTE.... Although this check is sufficient in the British Isles to ensure that all cylinders are operating satisfactorily, the engine speed registered in localities of different atmospheric pressures may be misleading. In low barometric conditions the observed r.p.m. can be expected to be higher than normal, and in high barometric conditions the r.p.m. may be lower than normal. It has been suggested that, providing the propeller is not constant-speeding, for approximately every 20 millibars decrease in atmospheric pressure an increase of 1% in r.p.m. may be expected, and vice versa.

19. Propeller Operation -

At 30" Hg. manifold pressure exercise the propeller by moving the propeller control lever over its full governing range several times until the engine r.p.m. follows the propeller lever movement. When a satisfactory response to the propeller control lever has been obtained, close the throttle and set the propeller control lever to approximately the mid position.

Open the throttle gradually until further opening causes no increase in r.p.m. Small movements of the throttle from this position without variation in r.p.m. will indicate satisfactory governing and ensure that the constant speed unit control valve is free.

20. Ignition -

At 30" Hg. manifold pressure, test each magneto in turn.

If there is marked vibration, the engine should be shut down and the cause investigated.

Momentarily open the throttle to the take-off setting, note the boost, r.p.m. and oil pressure and then throttle back to rated boost. If the engine speed has not decreased, throttle back further until the r.p.m. falls below the take-off figure (indicating that the propeller is not constant-speeding) and test each magneto in turn. If the single ignition drop exceeds 50 r.p.m. or if there is any rough running, the engine should be considered unserviceable and the cause investigated.

21. Oil Pressure -

The oil pressure should be checked at 2,400 r.p.m. and at an inlet temperature of 70°C. When slow-running with hot oil, the pressure may fall as low as 45 lb/sq.in. but the engine should be shut down if the pressure falls below the permissible minimum at or above 1,400 r.p.m. at normal temperatures.

22. Fuel Pressure -

Open up to rated boost and move the propeller control lever to give rated r.p.m., and check the fuel pressure.

23. Slow Running -

Check that the slow-running speed is about 600 - 700 r.p.m. When making this check the oil temperature should not exceed 40°C.

24. Propeller Feathering -

Run at about 1000 r.p.m. and move the propeller control lever through the gate into the feathering position, press and release the feathering button. Feathering should take 10 to 15 seconds and the button should then snap out.

Run with the propeller feathered for 10 seconds to clear the sump of oil. Move the propeller control lever to the minimum r.p.m. position; press and release the button.

To completely unfeather the propeller it may be necessary to open the throttle slightly after the r.p.m. have ceased to rise. The button should then snap out.

25. After Shutting Down -

Remove the propeller dome and check the tightness of the propeller retaining nut.

Ground Checks After Periodical Inspection (other than daily)

26. Carry out 15, 16 and 17.

27. R.P.M. -

Open the throttle to give 30" Hg. manifold pressure and check that the r.p.m. obtained are the same as the recorded figure for that particular engine/propeller combination. The engine should not be opened up to a higher power until this check has been carried out successfully.

28. Carry out checks as in 19, 20 and 21.

Routine Pre-flight Checks -

29. Carry out 15, 16, 17, 19, 20 and 27.

Ground Checks After Last Flight of Day or Night -

30. Carry out 16, 17 and 27.

Removal Notes

31. General -

Figs. 9 to 15 illustrate the methods for removing and assembling the engine and accessories. Generally only the removal is dealt with as re-assembly is usually a reversal of these operations. Special points are covered either by a note on the illustration or in one of the following paragraphs.

The numerical sequence of the operations given in the illustrations is the recommended order for dismantling.

The operation numbers are enclosed in circles only where the points at which the operations are to be carried out are illustrated. Certain general instructions for removal are given in paras. 32 - 35; these instructions should be borne in mind when consulting the illustrations.

When re-assembling, in addition to the operations covered by the illustrations, any bonding, locking or sealing should be carefully restored to its original condition.

32. Control Cables -

When disconnecting a cable, a weight should be attached to the end before releasing the cable. This will prevent it from slipping out of pulleys or unwinding from cable drums.

33. Capillaries. -

Capillaries must not be broken. When removing components through which they pass, disconnect the capillary at the engine end or remove the instrument from the instrument panel, withdraw the unit complete and coil the capillary, (with a minimum radius of 6") in a convenient and safe position. It will generally be found easier to remove the capillary from the engine end.

34. Propeller Removal -

Propeller removal is described and illustrated in fig. 9. For further information reference should be made to Air Publication 1538 D.

35. Engine Removal -

When removing an engine, reference should be made to fig. 3 which gives the location of the pipes and controls at the firewall. Blanking caps must be fitted over all engine connections, pipe ends, etc., as and when these items are disconnected.

28. [illegible] 19, 20 and 21.

Engine Propeller Change -

29. Carry out 15, 16, 17, 19, 20 and 21.

Engine Change after [illegible] -

30. Carry out 16, 17 and 21.

General Data -

31. General -

Figs. 9 to 11 illustrate the method for removing and assembling the [illegible]. Generally only the removal is dealt with, as re-assembly is [illegible]. Special points are covered either by notes on the illustration or in one of the following paragraphs.

The sequence [illegible] of the operations given in the illustrations is [illegible].

The operation numbers [illegible] only where the points [illegible] are illustrated. Certain general instructions [illegible] are given in paras. 31 - 37; these instructions should be borne in mind when consulting the illustrations.

When [illegible], in addition to the operations covered by the illustrations, [illegible] should be carefully restored to its original condition.

32. Control Cables -

[illegible] should be attached to the [illegible] before the cable [illegible] will prevent it from slipping out of pulleys or [illegible].

33. Capillaries -

Capillaries [illegible]. When removing components through which they pass, [illegible] at the engine end or [illegible] and coil the capillary, [illegible] position. It will generally be found [illegible] the capillary from the engine end.

34. Propeller Removal -

Propeller removal is described and illustrated in Fig. 9. [illegible] should be made to Air Publication [illegible].

35. [illegible] -

When [illegible] should be [illegible] to Fig. 3 which gives the [illegible] of the [illegible]. [illegible]

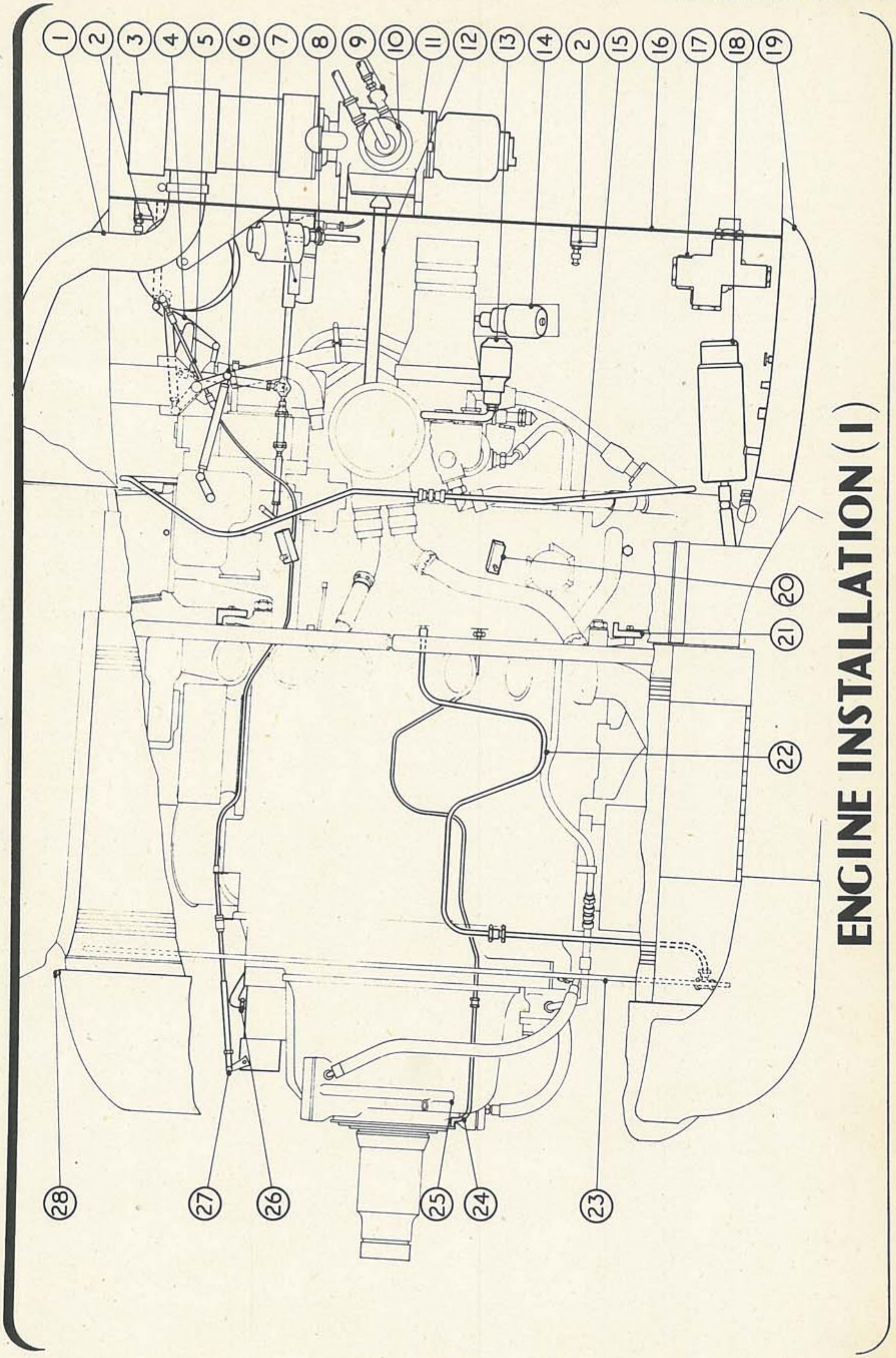

ENGINE INSTALLATION (1)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 2 15 16 17 18 19
20
21
22
23 24 25 26 27 28

FIG. 1

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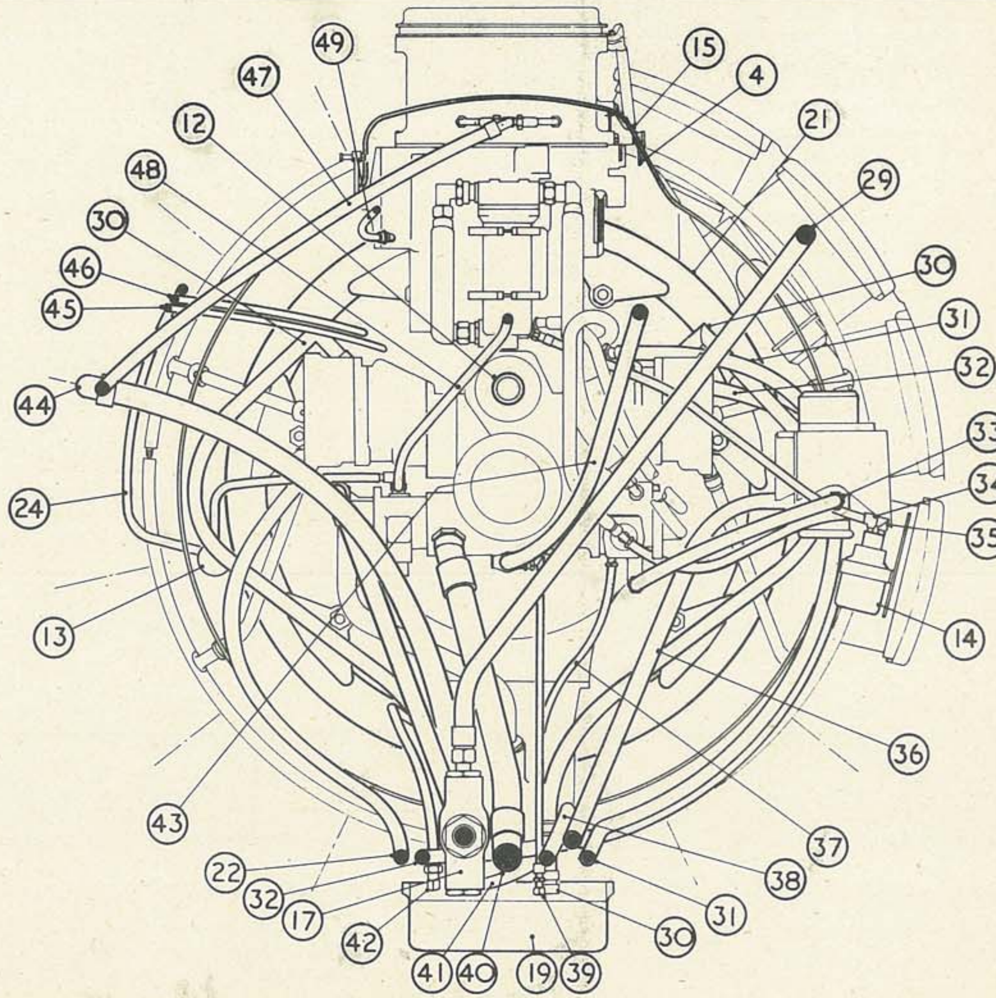
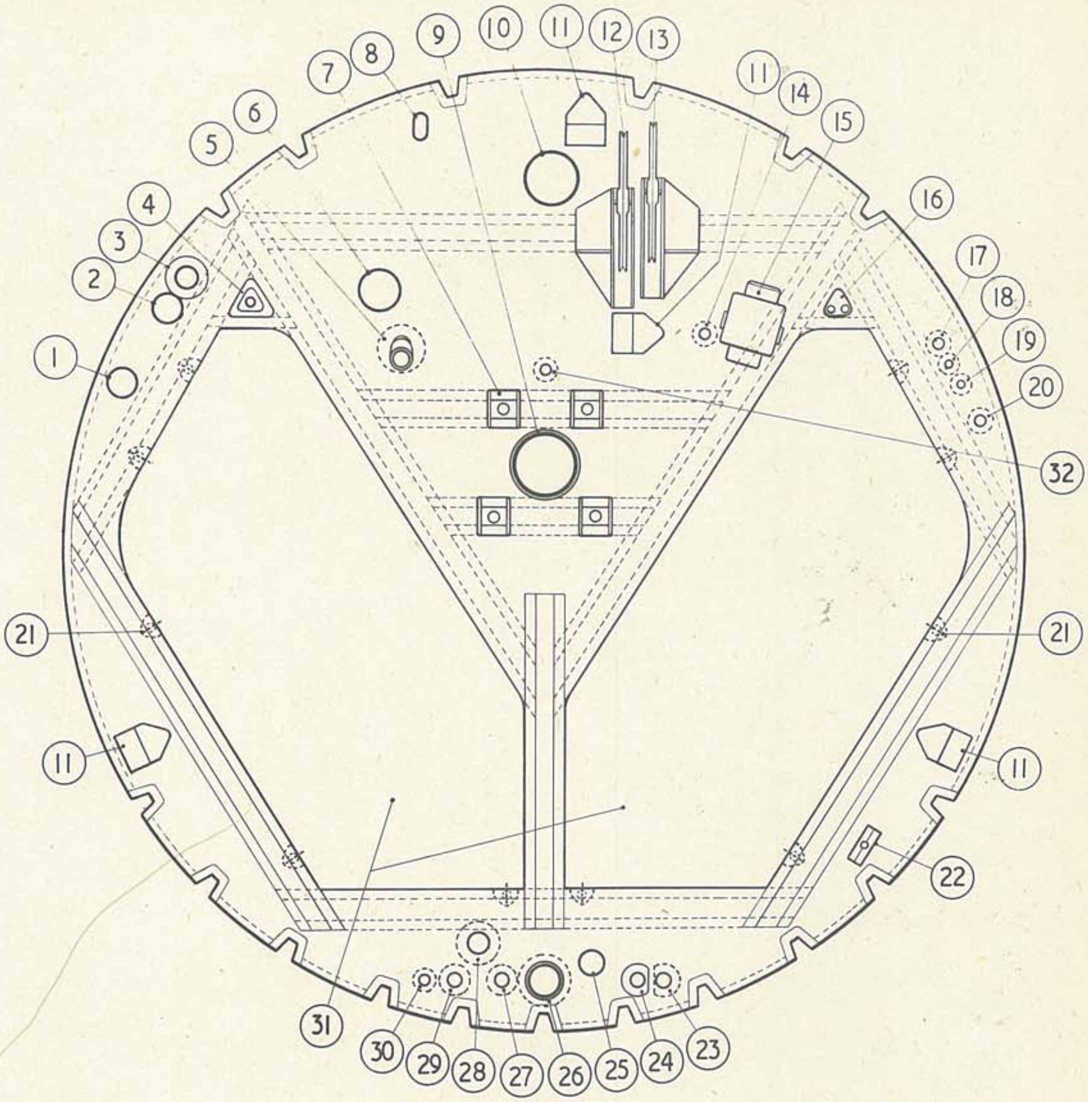
1. AIR INTAKE FOR GENERATOR COOLING.
2. FLAME SWITCH.
3. GENERATOR 6 K.W. (ENGINES NO. 1, 2 & 3.)
4. AIR INTAKE SHUTTER CONTROLS.
5. PROPELLER PITCH CONTROLS.
6. THROTTLE CONTROLS.
7. SLOW-RUNNING CUT-OUT CONTROLS.
8. ENGINE R.P.M. GENERATOR.
9. PRESSURE RELIEF VALVE.
10. VACUUM PUMP. (ENGINES NO. 2 & 3.)
11. AUXILIARY GEARBOX. (ENGINES NO. 1, 2 & 3.)
12. GEARBOX DRIVE SHAFT.
13. OIL PRESSURE TRANSMITTER.
14. FUEL PRESSURE TRANSMITTER.
15. GRAVINER FIRE EXTINGUISHER REAR SPRAY-RING.
16. FIREWALL.
17. SCAVENGE OIL BY-PASS VALVE.
18. COWL-GILL MOTOR.
19. DRAIN TANK.
20. FLAME SWITCHES.
21. ENGINE MOUNTING RING.
22. FEED PIPE TO FRONT FIRE EXTINGUISHER SPRAY-RING.
23. GRAVINER FIRE EXTINGUISHER FRONT SPRAY-RING.
24. PROPELLER DE-ICING FLUID PIPE.
25. CONNECTION FOR TORQUE-METER PRESSURE PIPING.
26. PROPELLER FEATHERING OIL PIPE.
27. PROPELLER PITCH CONTROLS.
28. SAFETY-BELT EYEBOLT.
29. OIL PIPE TO COOLER.
30. ENGINE BREATHER PIPE.
31. INDUCTION FIRE EXTINGUISHER PIPE.
32. PROPELLER FEATHERING.
33. FUEL PIPE FROM FLOWMETER TRANSMITTFR TO PUMP.
34. FUEL PRESSURE TRANSMITTER MANIFOLD FEED.
35. FUEL PRESSURE TRANSMITTER DIFFERENTIAL.
36. MAIN FUEL FEED PIPE.
37. FUEL METERING PUMP DRAIN PIPE.
38. PIPE TO FIRE EXTINGUISHER REAR SPRAY-RING.
39. DRAIN PIPE FROM ACCESSORIES.
40. MAIN OIL FEED PIPE.
41. INDUCTION DRAIN PIPE.
42. ENGINE OIL SUMP OVERFLOW PIPE.
43. OIL TANK VENT PIPE.
44. DRAIN TANK VENT PIPE.
45. ENGINE PRIMING PIPE.
46. BOOST PRESSURE PIPE.
47. THROTTLE DE-ICING PIPE.
48. OIL PRESSURE CAPILLARY.
49. PRIMING SPILL PIPE.



ENGINE INSTALLATION (2)

FIG. 2



LOOKING AFT

1 ELECTRICAL CABLES - GENERAL SERVICES
2 ELECTRICAL CABLES - GENERAL SERVICES
3 OIL RETURN—VIA COOLER
4 CYLINDER TEMPERATURE CABLES
5 OIL VENT PIPE
6 STARTER CABLES
7 ACCESSORY GEARBOX MOUNTING
8 CARBURETTOR AIR SHUTTER CONTROL
9 ACCESSORY GEARBOX DRIVE SHAFT
10 GENERATOR COOLING DUCT
11 FLAME SWITCHES — 4
12 THROTTLE CONTROL CABLE DRUM
13 PROPELLER CONTROL CABLE DRUM
14 PRIMING SPILL PIPE
15 R.P.M. GENERATOR
16 IGNITION CABLES
17 PROPELLER DE-ICING PIPE
18 ENGINE PRIMING PIPE
19 BOOST PRESSURE PIPE
20 THROTTLE DE-ICING PIPE
21 DOOR FASTENERS—AFT SIDE
22 TORQUE-METER CAPILLARY
23 FIRE EXTINGUISHER PIPE — FRONT SPRAY RING
24 PROPELLER FEATHERING PIPE
25 OIL RETURN—VIA SCAVENGE BY-PASS
26 OIL PIPE-MAIN FEED
27 FIRE EXTINGUISHER PIPE — REAR SPRAY RING
28 FUEL PUMP PIPE
29 FIRE EXTINGUISHER PIPE — TO INDUCTION CASING
30 OIL DRAIN PIPE
31 ACCESS DOORS — AFT SIDE
32 OIL PRESSURE CAPILLARY

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FIREWALLS

FIG. 3

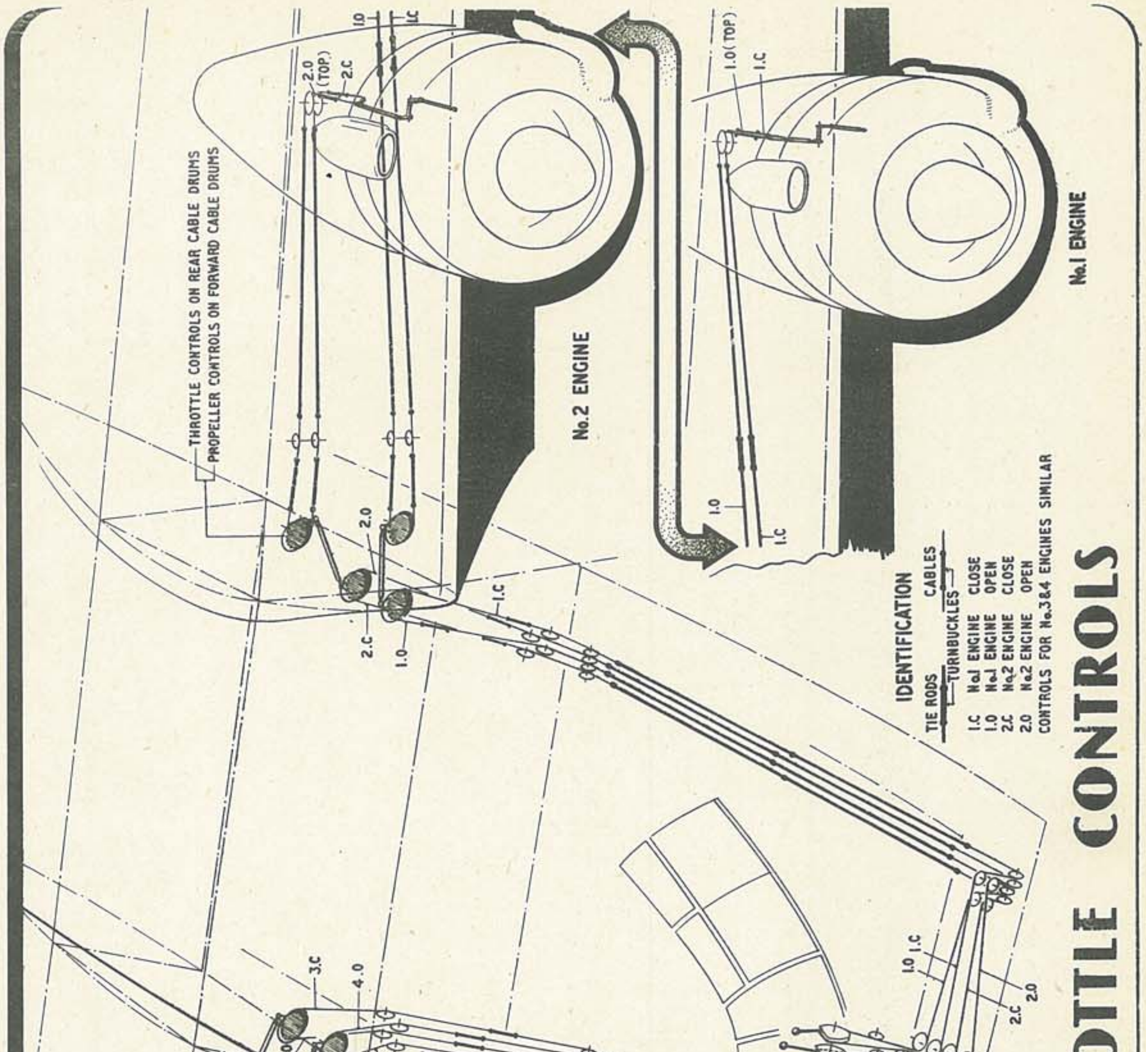
THROTTLE CONTROLS
IDENTIFICATION
TIE RODS
TURNBUCKLES
CABLES
1.C No.1 ENGINE CLOSE
1.O No.1 ENGINE OPEN
2.C No.2 ENGINE CLOSE
2.O No.2 ENGINE OPEN
CONTROLS FOR No.3&4 ENGINES SIMILAR
THROTTLE CONTROLS ON REAR CABLE DRUMS
PROPELLER CONTROLS ON FORWARD CABLE DRUMS
CABLE DRUM ON FORWARD FACE OF FIREWALL
No.1 ENGINE
No.2 ENGINE
No.3 ENGINE
No.4 ENGINE
1.O (TOP)
2.O (TOP)
1.C
1.O
2.C
2.O
3.C
3.O
4.C
4.O

FIG. 4

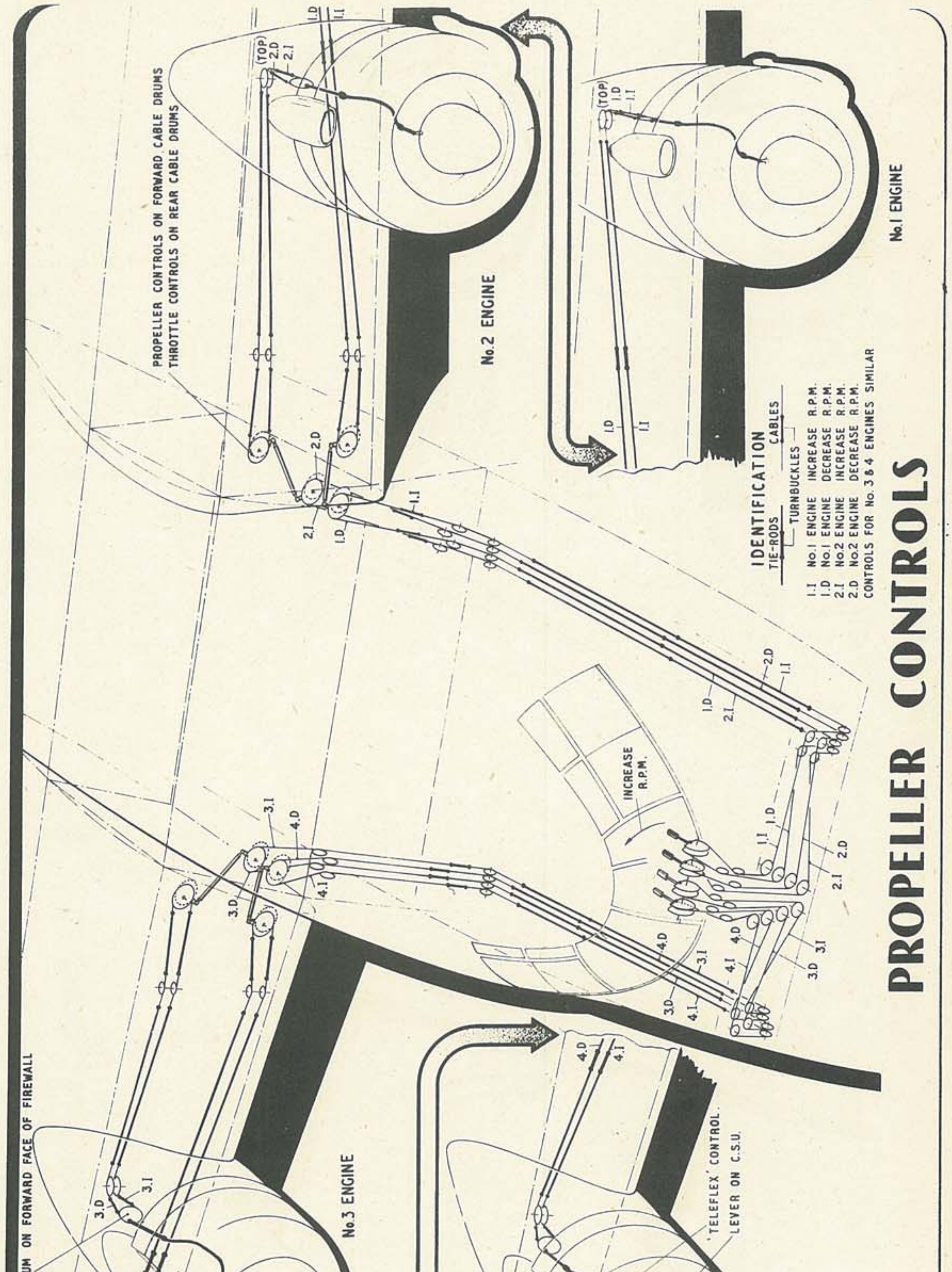

FIG. 5

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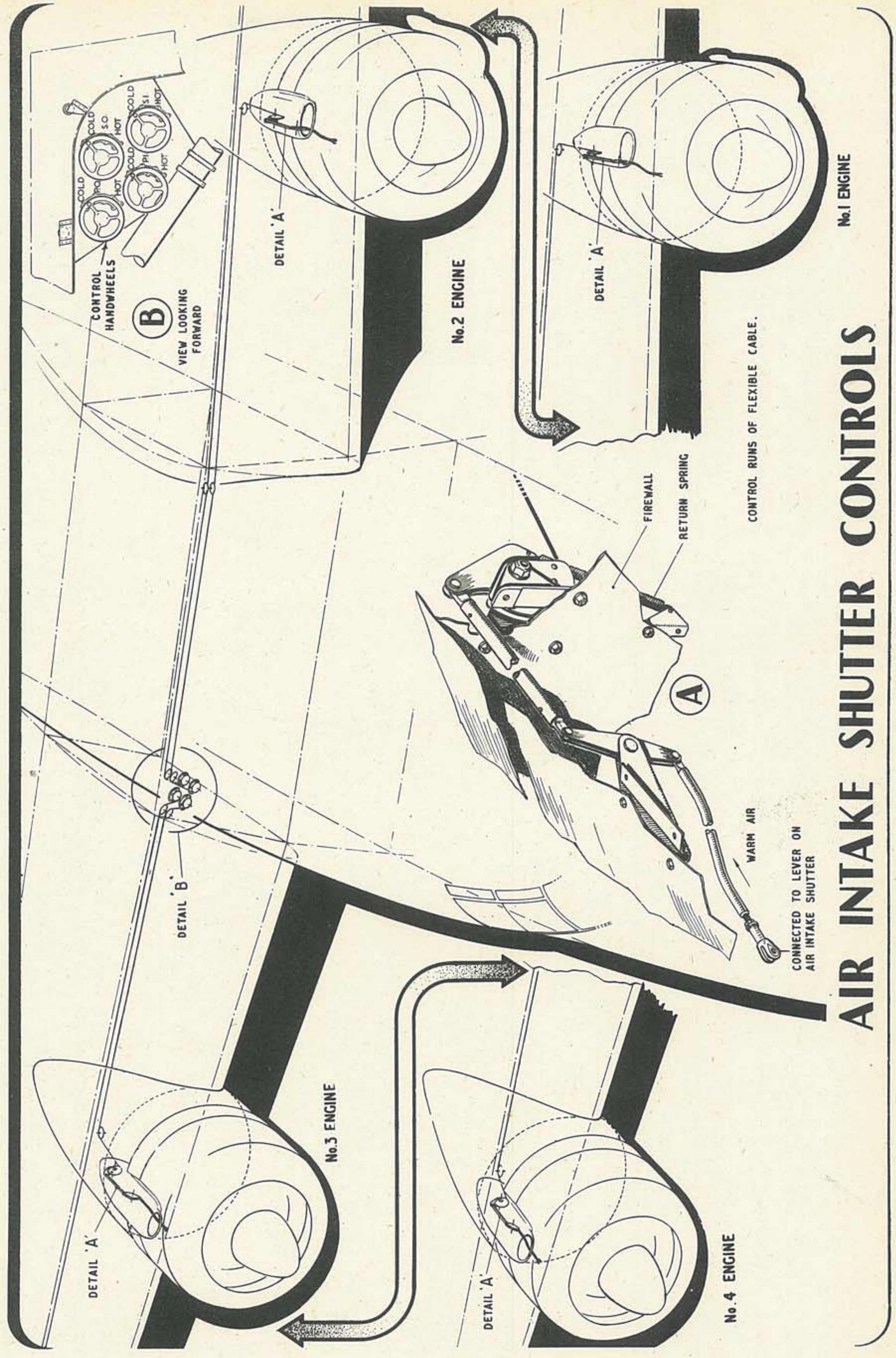

FIG.6

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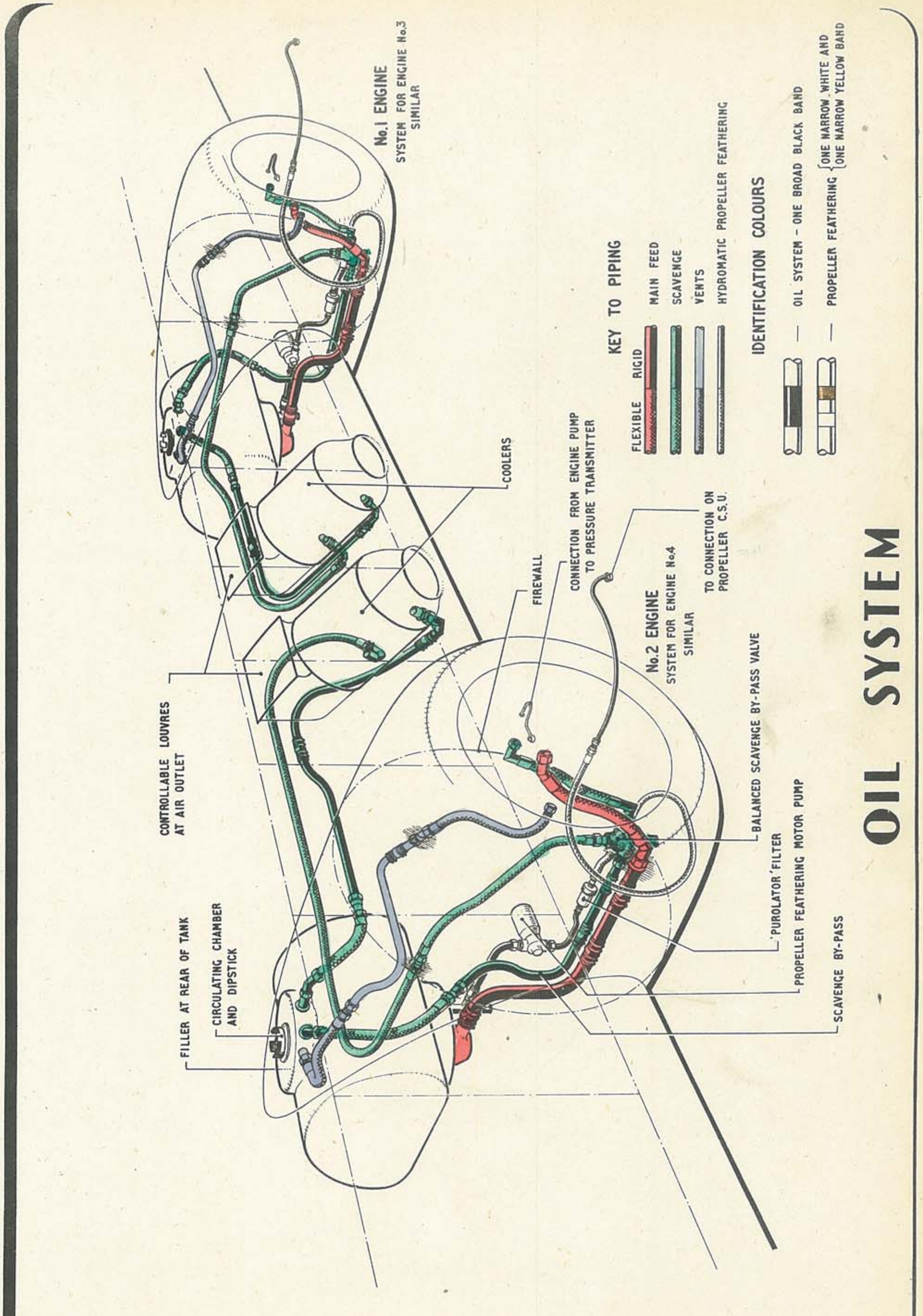
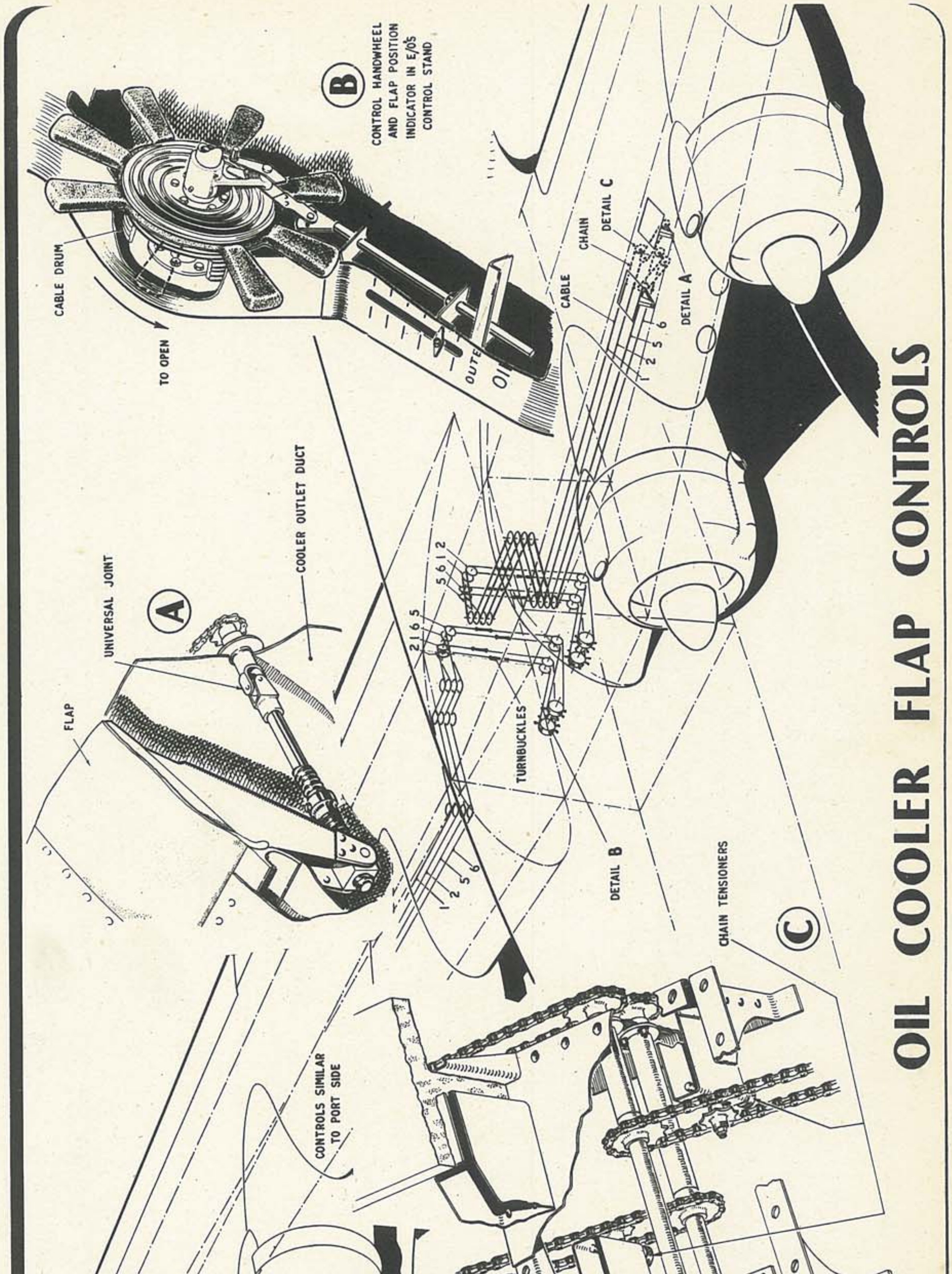

OIL SYSTEM
No.1 ENGINE
SYSTEM FOR ENGINE No.3 SIMILAR
No.2 ENGINE
SYSTEM FOR ENGINE No.4 SIMILAR
KEY TO PIPING
FLEXIBLE
RIGID
MAIN FEED
SCAVENGE
VENTS
HYDROMATIC PROPELLER FEATHERING
IDENTIFICATION COLOURS
OIL SYSTEM - ONE BROAD BLACK BAND
PROPELLER FEATHERING {ONE NARROW WHITE AND ONE NARROW YELLOW BAND
COOLERS
FIREWALL
CONNECTION FROM ENGINE PUMP TO PRESSURE TRANSMITTER
TO CONNECTION ON PROPELLER C.S.U.
CONTROLLABLE LOUVRES AT AIR OUTLET
FILLER AT REAR OF TANK
CIRCULATING CHAMBER AND DIPSTICK
BALANCED SCAVENGE BY-PASS VALVE
'PUROLATOR' FILTER
PROPELLER FEATHERING MOTOR PUMP
SCAVENGE BY-PASS

FIG.7



OIL COOLER FLAP CONTROLS

FIG. 8

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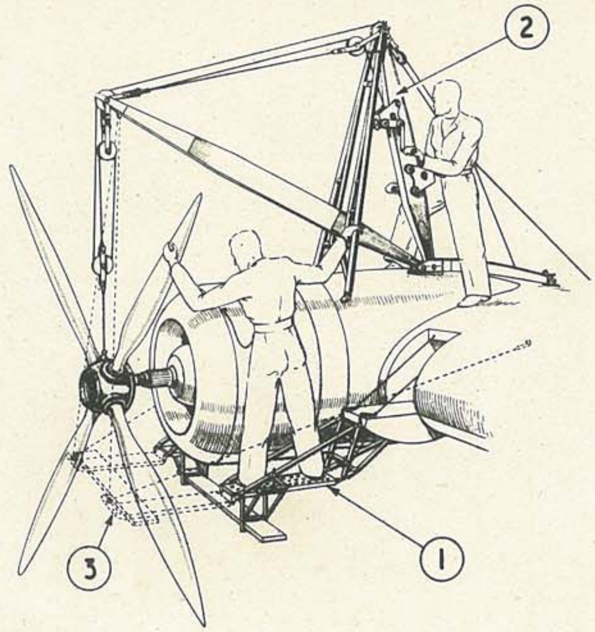
3	[illegible]

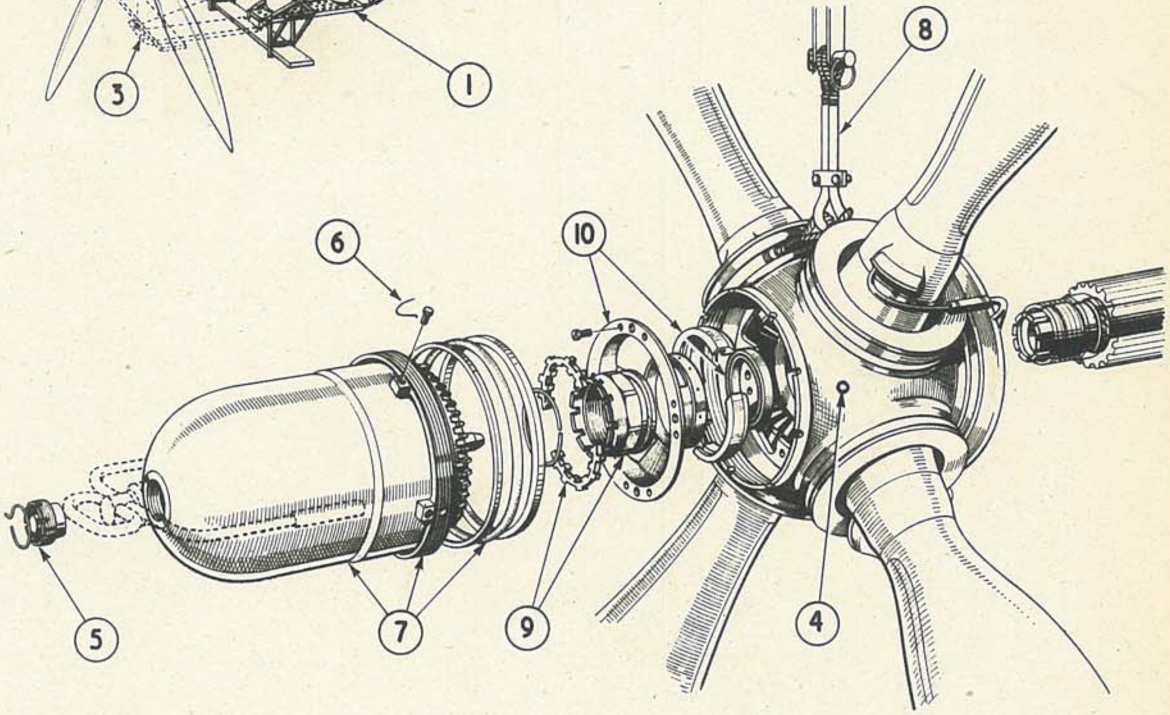


(1) ERECT MAINTENANCE CRADLES AS SHOWN IN SECT. 13. FIG. 5.

(2) ERECT ENGINE DERRICK AS SHOWN IN SECT. 13. FIG. 9.

(3) FIT CRADLE EXTENSIONS AND ATTACH SUSPENSION CABLES TO LUGS AT TOP OF ENGINE DERRICK JIB.

(4) USING SUITABLE LEVERS, TURN PROPELLER BLADES TO FINE PITCH POSITION TO ENSURE CORRECT MESHING OF GEARS ON RE-ASSEMBLY AND TO DRAIN OIL FROM DOME. RESIDUAL OIL CAN BE DRAINED FROM PLUG HOLE IN HUB.



(5) WITHDRAW LOCKWIRE AND REMOVE DOME PLUG NUT – SPANNER PC. 2000.

(6) REMOVE LOCKWIRE AND DOME RETAINING NUT LOCKSCREW.

(7) FIT DOME HANDLING BAR AND ADAPTOR – PC. 1518./PC. 2027.– (SHOWN IN DOTTED LINES) AND UNSCREW DOME RETAINING NUT. REMOVE DOME ASSEMBLY, LIFTING OFF SQUARELY FOR 6" TO AVOID DAMAGE, AND WITHDRAW OIL SEAL AND SUPPORT RINGS FROM HUB BARREL.

(8) FIT PROPELLER SLING, TAKING CARE TO AVOID DAMAGING DE-ICING ASSEMBLY. TAKE UP SLACK IN HOISTING CABLE.

(9) REMOVE CIRCLIP, LOCKING RING HALVES AND HUB NUT – SPANNER PC. 1379. AS NUT IS UNSCREWED, THE FRONT CONE WILL CONTACT THE FRONT SUPPORT PLATE AND ACT AS HUB EXTRACTOR.

(10) REMOVE FRONT SUPPORT PLATE AND EXTRACT TWO HALVES OF FRONT CONE AND OIL SEAL.

11. REMOVE EXTENSION CRADLES. EASE PROPELLER FROM SHAFT AND LOWER TO GROUND.

NOTE:- FOR FURTHER DISMANTLING, i.e.:- OIL TRANSFER HOUSING AND OIL PIPES, REFERENCE SHOULD BE MADE TO A.P. 1538.D. VOL. I. SECT. 2. CHAP. 4.

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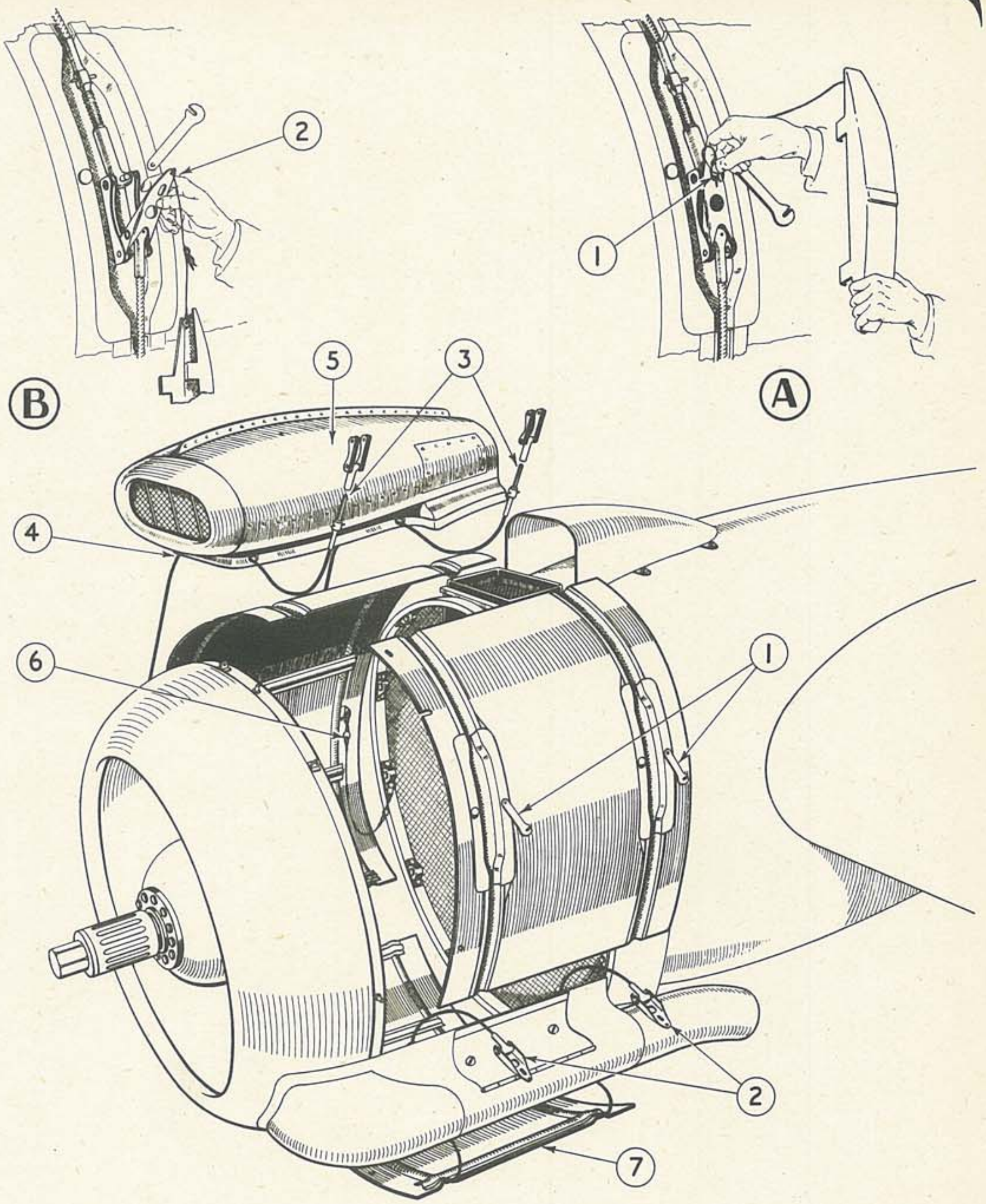
PROPELLER REMOVAL

FIG. 9.



1 — REMOVE COVERS AND WITHDRAW PINS, (SEE DETAIL. "A".)

2 — RELEASE COUPLINGS, (SEE DETAIL. "B".)

3 — UNSCREW TENSION-BARS AND REMOVE COUPLINGS.

4 — REMOVE CABLES FROM AIR INTAKE.

5 — REMOVE AIR INTAKE.

6 — UNCOUPLE 3 RETAINING CABLES.

7 — REMOVE 3 COWLING PANELS.

COWLING AND AIR INTAKE REMOVAL

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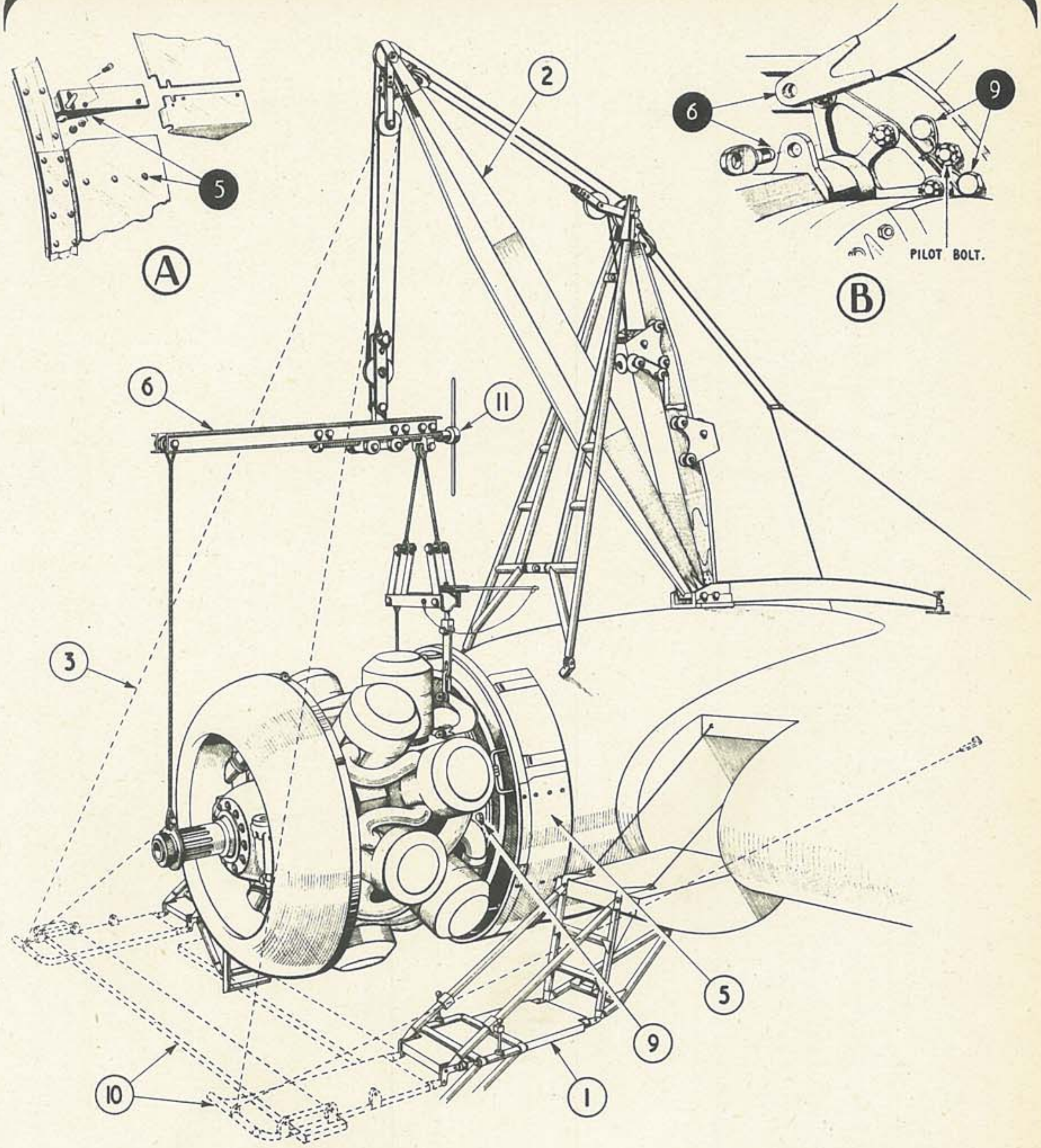
FIG. 10.



1. ERECT MAINTENANCE CRADLES AS SHOWN IN SECT. 13. FIG. 5.
2. ERECT ENGINE DERRICK AS SHOWN IN SECT. 13. FIG. 9.
3. FIT EXTENSION CRADLES, (SHOWN IN DOTTED LINES,) AND ATTACH SUSPENSION CABLES TO LUGS AT TOP OF ENGINE DERRICK JIB.
4. REMOVE ENGINE COWLINGS AND AIR INTAKE AS SHOWN IN SECT. 9. FIG. 10.
5. LIFT RETAINING STUDS AND REMOVE SCREWS TO RELEASE GILL PLATES. (DETAIL "A".)
6. FIT ENGINE SLING AND ATTACH TO PROPELLER SHAFT AND ENGINE LIFTING EYES. (DETAIL "B".) TAKE UP SLACK IN CABLES.
7. DISCONNECT CONTROLS AND SERVICES BETWEEN ENGINE AND FIREWALL. LIST OF SERVICES, ETC., SHOWN IN SECT. 9. FIG. 3.
8. DISCONNECT ACCESSORY GEAR BOX DRIVE BY REMOVING 6 SCREWS FROM FORWARD END AND 4 BOLTS FROM REAR END OF SHAFT.
9. REMOVE 16 ATTACHMENT BOLTS AND 2 PILOT BOLTS FROM MOUNTING RING. (DETAIL "B".)
10. REMOVE EXTENSION CRADLES.
11. REMOVE ENGINE FROM NACELLE AND LEVEL OFF BY TURNING HANDLE ON REAR END OF SLINGING BEAM.
12. LOWER ENGINE TO GROUND.

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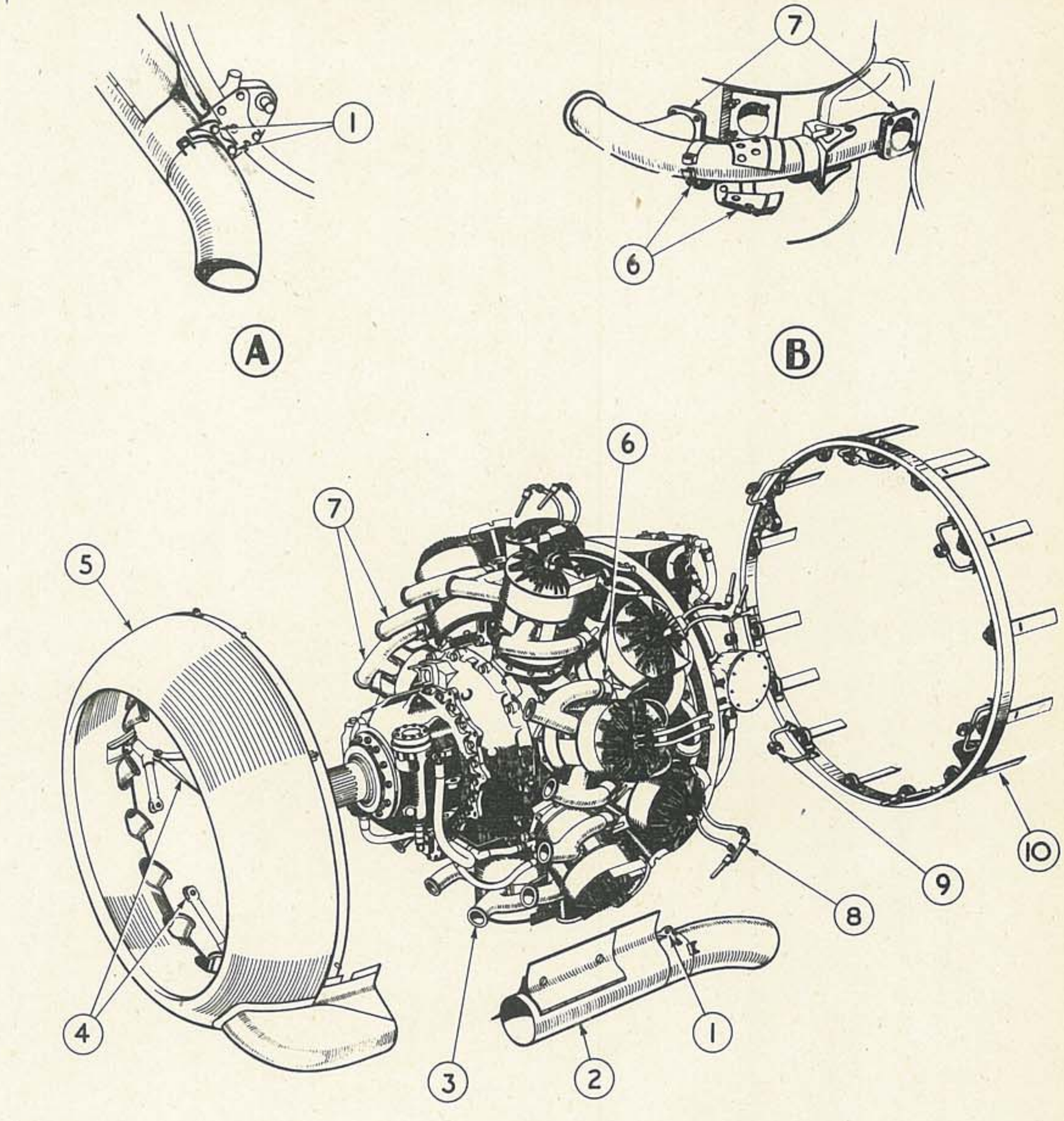
ENGINE REMOVAL

FIG. 11.



(1) REMOVE 2 ATTACHMENT BOLTS ON GILL RING. (SEE DETAIL "A".)

(2) WITHDRAW EXHAUST PIPE FROM MANIFOLD AND REMOVE.

(3) REMOVE FLANGE COUPLINGS FROM 14 EXHAUST PIPES.

(4) RELEASE SPLIT PIN AND BOLT AND REMOVE 2 NUTS TO DISCONNECT EACH TRIPOD MOUNTING.

(5) REMOVE EXHAUST MANIFOLD.

(6) RELEASE CLIPS AND REMOVE EXHAUST MUFFS. (SEE DETAIL "B".)

(7) DISCONNECT EXHAUST PIPES AND REMOVE. (SEE DETAIL "B".)

(8) WITHDRAW IGNITION LEADS IN WAY OF GILL RING MOUNTINGS.

(9) REMOVE BOLTS FROM GILL RING MOUNTINGS.

(10) REMOVE GILL RING.

EXHAUST SYSTEM AND COWL GILL RING REMOVAL

FIG. 12.

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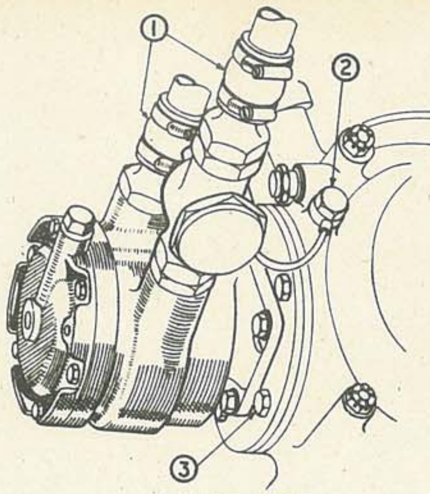
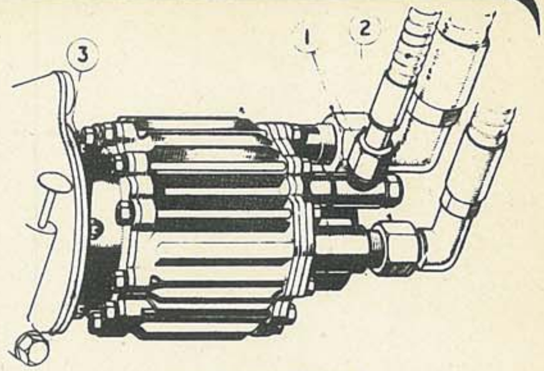


VACUUM PUMP

ENGINES No.2 & 3

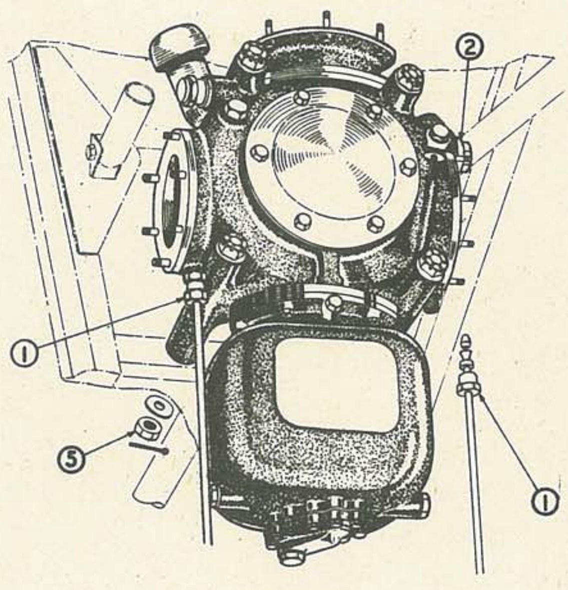
1. DISCONNECT HOSE COUPLINGS
2. DISCONNECT OIL FEED PIPE
3. REMOVE 6 NUTS AND WASHERS
4. REMOVE PUMP
5. REMOVE QUILL DRIVE
6. FIT BLANKING COVER ON GEARBOX



AIR COMPRESSOR

ENGINE No 2

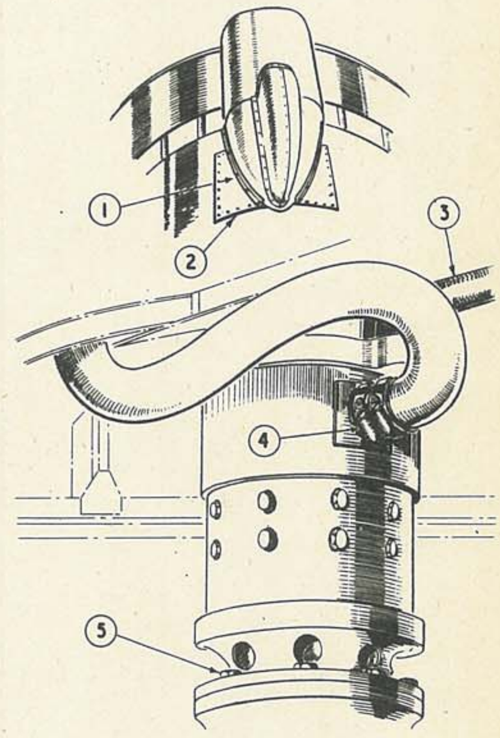
1. DISCONNECT AIR PIPES
2. DISCONNECT OIL PIPE
3. REMOVE 6 NUTS AND WASHERS
4. REMOVE COMPRESSOR



GEARBOX

ENGINES No1,2 & 3

1. DISCONNECT OIL DRAIN PIPES
2. DISCONNECT OIL RETURN PIPE
3. REMOVE 4 BOLTS, NUTS & TABWASHERS FROM FLANGED COUPLING AT GEARBOX END OF DRIVE SHAFT
4. SUPPORT GEARBOX
5. REMOVE 4 SPLIT PINS, NUTS AND WASHERS (FORWARD FACE OF FIREWALL)
6. REMOVE GEARBOX



D.C. GENERATOR

ENGINES NO.1.2 & 3

1. TAKE OUT 10 2BA. BOLTS AND REMOVE AIR INTAKE FAIRING
2. TAKE OUT SCREWS AND REMOVE ACCESS PANEL
3. DISCONNECT ELECTRICAL CABLE
4. SLACKEN JUBILEE CLIPS TO RELEASE AIR INTAKE
5. REMOVE 8 NUTS AND WASHERS
6. REMOVE GENERATOR THROUGH HATCH

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ACCESSORIES REMOVAL

FIG. 13

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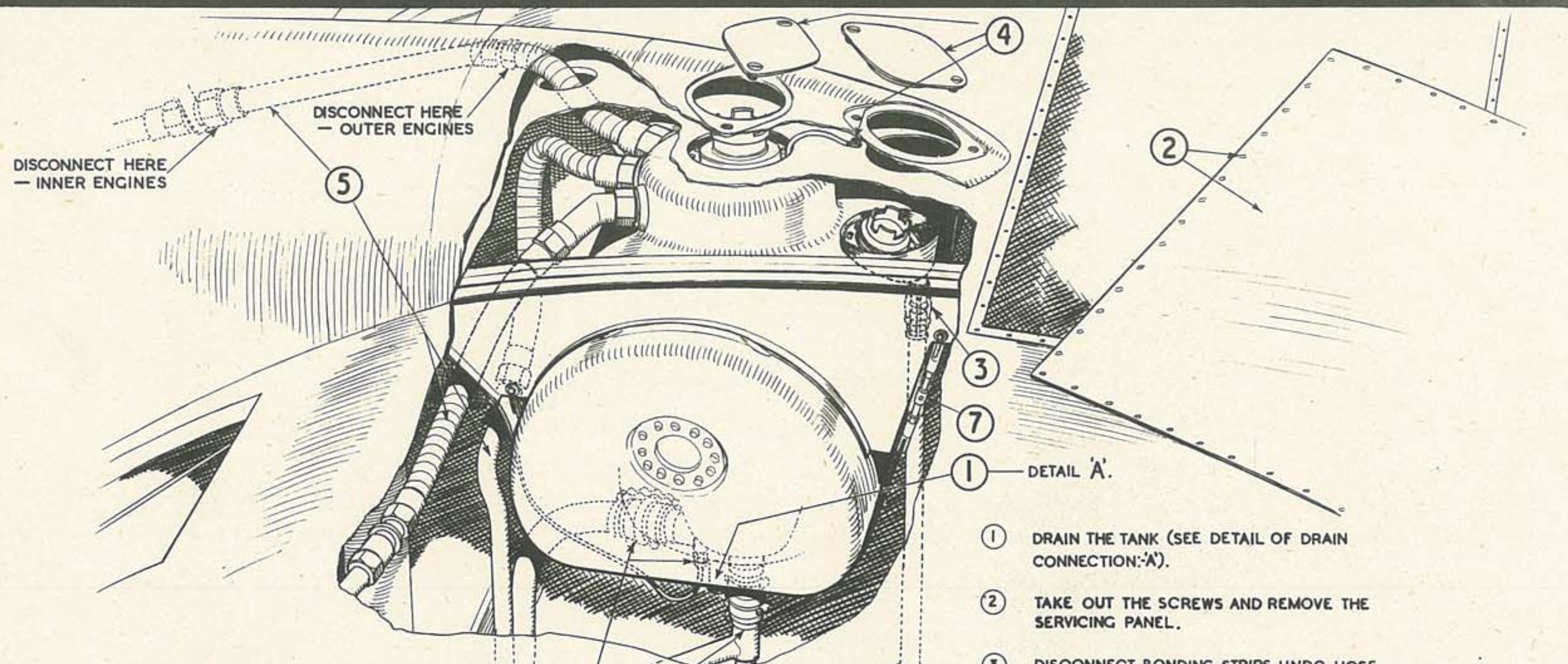
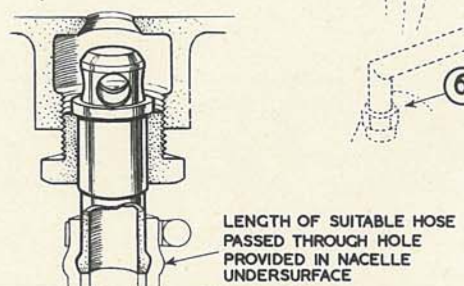


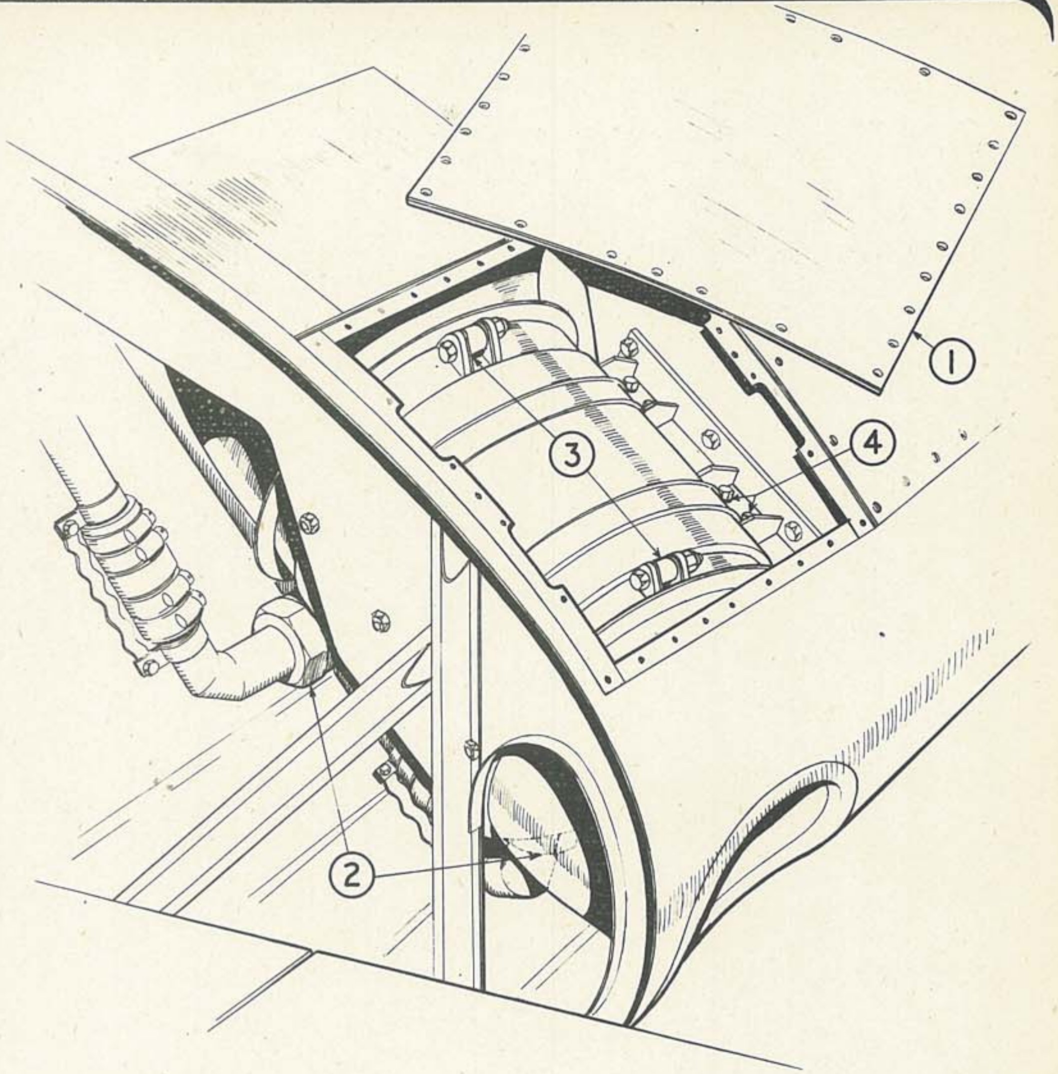


DRAIN CONNECTION Ⓐ

1. DRAIN THE TANK (SEE DETAIL OF DRAIN CONNECTION:-'A').
2. TAKE OUT THE SCREWS AND REMOVE THE SERVICING PANEL.
3. DISCONNECT BONDING STRIPS, UNDO HOSE COUPLINGS, AND REMOVE OIL TANK FILLER DRAIN PIPE.
4. — REMOVE THE SERVICING PANELS AND DISCONNECT THE BONDING WIRE
5. — FROM THE MAINTENANCE PLATFORMS, DISCONNECT THE OIL COOLER PIPE, THE SCAVENGE PIPE AND THE VENT PIPE
6. — DISCONNECT THE MAIN FEED PIPE, THE PROPELLER FEATHERING FEED PIPE AND THE OIL THERMOMETER CABLE.
7. — SUPPORT THE TANK, DISCONNECT THE TANK STRAPS, EASE THE TANK CLEAR OF THE MOUNTINGS AND REMOVE THROUGH SERVICING PANEL APERTURE

OIL TANK REMOVAL

FIG. 14



(1) FROM THE MAINTENANCE PLATFORM, TAKE OUT SCREWS AND REMOVE THE SERVICING PANEL

(2) DISCONNECT THE OIL PIPES

(3) REMOVE THE NUTS, BOLTS, DISTANCE PIECES AND PACKING PIECES, AND REMOVE THE STRAPS

(4) REMOVE THE BOLTS AND WASHERS FROM THE SUPPORT BRACKETS

5 LIFT THE COOLER OUT

OIL COOLER REMOVAL

FIG. 15

RS50/TP 107
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SOLENT 3

MAINTENANCE MANUAL

SECTION 10

FUEL SYSTEM

Contents

Illustrations

Prepared by Short Brothers and Harland Ltd. Feb. 1951.

DESCRIPTION

1. General. -

A diagram of the fuel system is given in fig. 1. Six tanks in each wing are located, five between the spar-trusses and one in the trailing edge. Their individual capacities are as follows. -

From inboard.

Tank No. 1 Port and Starboard 529 gall. each	between the spar-trusses
Tank No. 2 Port and Starboard 348 gall. each	
Tank No. 3 Port and Starboard 131 gall. each	
Tank No. 4 Port and Starboard 97 gall. each	
Tank No. 5 Port and Starboard 74 gall. each	
Tank No. 6 Port and Starboard 141 gall. each	in the trailing edge

2. Tanks. -

The tanks are constructed of de Bergue riveted light alloy sheet. Each tank is reinforced internally by vertical tubular stays, some of which are interconnected by light alloy baffle plates by means of clips riveted to the baffles. The stay tube through the centre of the tank is extended at each end to locate and secure the tank in the wing. The top of the tank is reinforced where the inspection covers, filler cap, relief valve and fuel gauge mountings are secured by bolts or studs and Langite jointing washers. The sump is similarly secured to the tank bottom.

The tanks rest on wooden grids between the lower spar-booms and drag members. The centre stay fits into a socket in the wing and is secured by a Simmonds nut fitted through a hole in the under surface of the wing. A removable cover is fitted over the tank flush with the upper surface of the wing. The top end of the centre stay tube, projecting through the bottom of a well in this cover, is secured there by another Simmonds nut, and a small removable cover is fitted over the well. Retaining pads, fitted to the inside of the main cover engage on the top of the tank.

3. System. -

In each wing the tanks are coupled by flexible pipes to a common collector-box fitted to the under surface of the wing at the wing-root trailing edge. Two electrically-driven backing pumps are installed in the base of the collector-box and the fuel is fed to the suction side of the pumps.

A pressure feed line is taken from each pump through non-return valves, to junction pieces and then extend outboard as one pipeline to a junction located between fuel tanks No. 1 and 2.

From this junction two pipelines pass forward and outboard respectively, through carburettor cocks and fuel filters, to a connection at each engine firewall.

Forward of the firewall, the pipeline passes to a fuel flowmeter, fitted at the starboard side of the nacelle, thence to the engine-driven fuel pump which incorporates a small radial vaned impellor. This impellor rotates at the same speed as the pump i.e. 7/6ths. engine speed and provides a metering pressure proportional to the square of engine speed so that the fuel flow through the metering orifice is directly proportional to engine speed.

A "Desynn" type fuel pressure transmitter, fitted adjacent to the flowmeter, is connected to the pressure manifold of the fuel pump. Should the backing pumps fail, transmitter units fitted at the pressure side of the pumps will operate warning lamps on the E/O's panel.

If necessary, the port and starboard systems can be interconnected through a cross-feed pipe extending across the hull from the pressure side of the backing pumps, a cock in the cross-feed pipe being positioned in the starboard wing-root.

4. Controls -

The tank cocks and cross feed cock are connected by cable to operating levers fitted in the E/O's control stand. Fig. 2 is a semi-schematic drawing of the cable runs and, to assist in rigging, shows the positions of cables in fairleads and pulley banks.

The master cocks are controlled by cable from levers in the control cabin roof, and the slow running cut-off valves are operated electrically from switches on a panel in the control cabin roof.

5. Contents Gauges -

The fuel system is equipped with twelve Smith's "Desynn" type electrically-operated contents gauges. Each fuel tank is fitted with a float mechanically coupled through gearing to an electrical transmitter which is connected to an electrically-operated indicator on the E/O's main panel. The transmitter is also connected to the aircraft electrical supply services.

6. Refuelling -

The fuel tanks can be replenished either by pressure through a pipeline from a connection in the tail end of the hull, or direct through the individual tank fillers. A filler cap key is stowed in the roof of the centre section, immediately forward of the rear spar-frame, and dipsticks for the fuel tanks are stowed in a cannister fitted in the roof of the centre section, being accessible from the forward side of the front spar-frame. Access to the refuelling connection from inside the hull is provided by a removable hatch on the starboard side below the tail plane.

The pressure refuelling pipeline extends forward along the starboard side of the hull to a point just aft of the centre section and then branches to junction boxes fitted one in each wing-root.

From each junction box two pipelines pass outboard (one to tanks No.1, 2 and 3, and one to tanks No. 4, 5 and 6) connecting to shut-off valves fitted one in the top of each tank.

The main cocks are fitted one at the inlet side of each junction box, and a cock is fitted in the pipeline to tanks No.4, 5 and 6 for isolating these tanks when it is required to replenish tanks No. 1, 2 and 3 only.

Refuelling Procedure. -

6.1. Remove the blanking cap from the tail refuelling connection and connect the Bowser lines through a 3-way branch.

6.2. For replenishing tanks No. 1, 2 and 3 only
Turn ON main cocks
Check that the isolation cocks (for tanks No.4, 5 and 6 are OFF.

For replenishing all tanks
Turn ON main cocks.
Turn ON isolation cocks

6.3. When refueling has been completed, drain the pipelines, turn cocks OFF, disconnect the Bowser and replace the refuelling connection blanking cap.

7. Off-loading -

The main fuel system is connected to the refuelling line for off-loading fuel from the tanks; a short pipeline from each collector box connects to a cock at each of the refuelling junction boxes.

Off-loading Procedure -

6.1. Remove the blanking cap from the refuelling connection and connect Bowser pipelines.

6.2. Turn ON main refuelling cocks.

6.3. Check that the isolation cocks are OFF

6.4. Turn ON the off-loading cocks

6.5. Turn ON the required tank cocks.

6.6. When off-loading has been completed, turn OFF the off-loading cock and tank cocks.

6.7. Drain the pipelines and turn OFF the main cocks.

6.8. Disconnect the Bowser and replace the refuelling connection blanking cap.

8. Engine Priming System -

A schematic diagram of the engine priming and A.G.P. tank filling system is given in fig. 4; the fuel lines to the injectors are primed by the backing pumps in the main fuel system. An induction-type hand pump (Ki-gass) is used for engine priming and a diaphragm-type (wobble) hand pump for filling the A.G.P. tank. These pumps, together with selector cocks, are fitted on a panel at the starboard side of the hull at the E/O's station.

Fuel is drawn from a connection in the pipeline feeding from No.1 tank to the collector box in the starboard wing and passes through a selector cock to feed either the engine priming pump or the A.G.P. tank filling pump. Another cock is fitted to permit the use of either normal or high volatility fuel for engine priming, a short length of pipe being provided for the supply of the latter from a portable container.

Two 3-way cocks (one for port and one for starboard) are fitted for selecting individual engines.

MAINTENANCE

Removal Notes

9. Removing Fuel Tanks and Backing Pumps -

Fig. 5 and 6 illustrate the method for removing and refitting the fuel tanks, and fig. 7 the removal and refitting of the backing pumps. Generally only the removal is dealt with as re-assembly is usually a reversal of these operations. The numerical sequence of the operations given in the illustrations is the recommended order for dismantling, the operation numbers being enclosed in circles only when the points at which the operations to be carried out are illustrated.

When re-assembling, in addition to the operations covered by the illustrations, any bonding, locking or sealing should be carefully restored to its original condition.

10. Dismantling Vent Valves -

Figs. 8, 9 and 10 illustrate the dismantling of the fuel tank vent valves for replacement of damaged components, and also give the part numbers to facilitate the ordering of spares.

11. Tank Sumps -

For the removal of the filters for cleaning, the operations are described in fig. 11.

12. Contents Gauges -

The removal procedure for the transmitter units is given in Sect. 5.

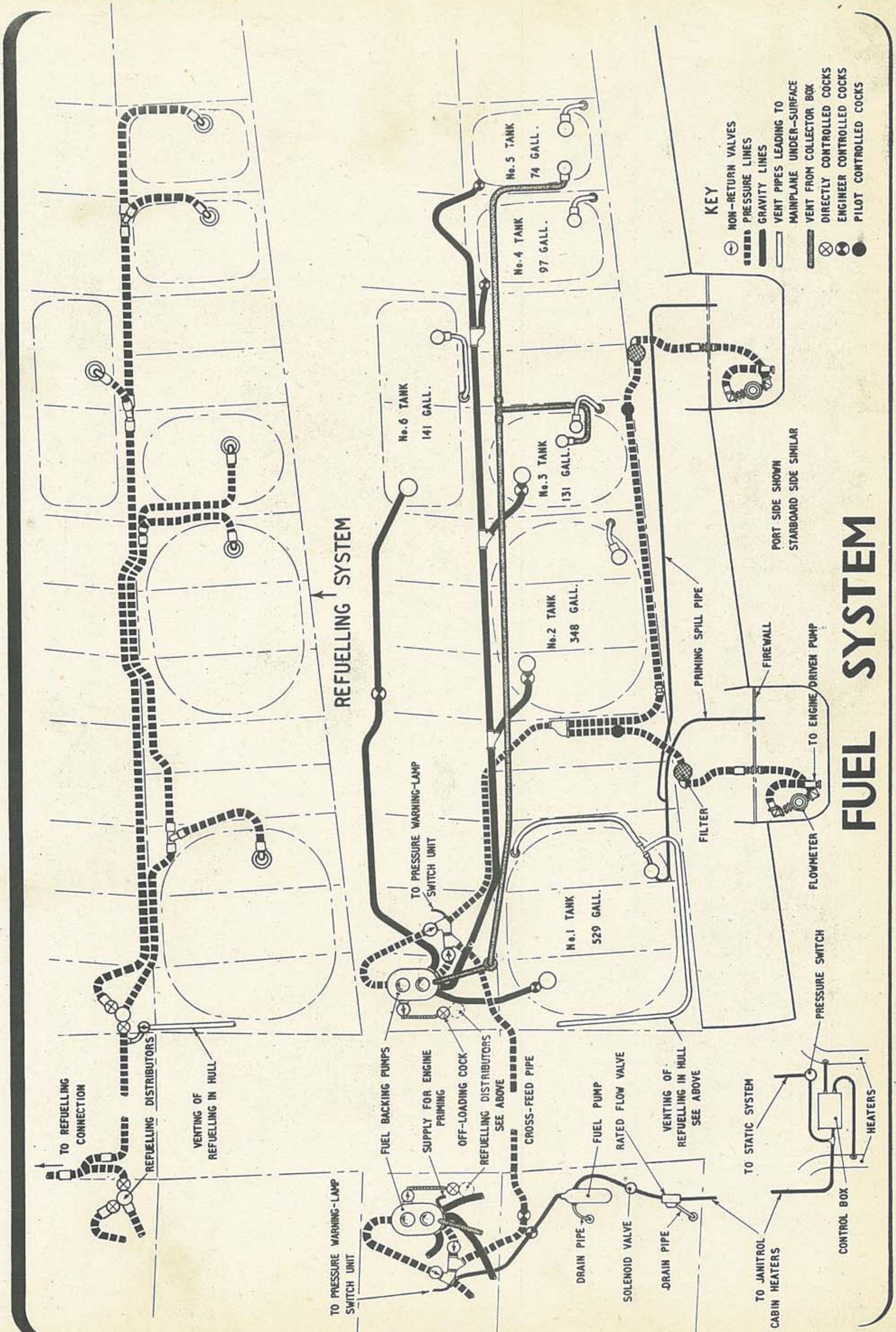
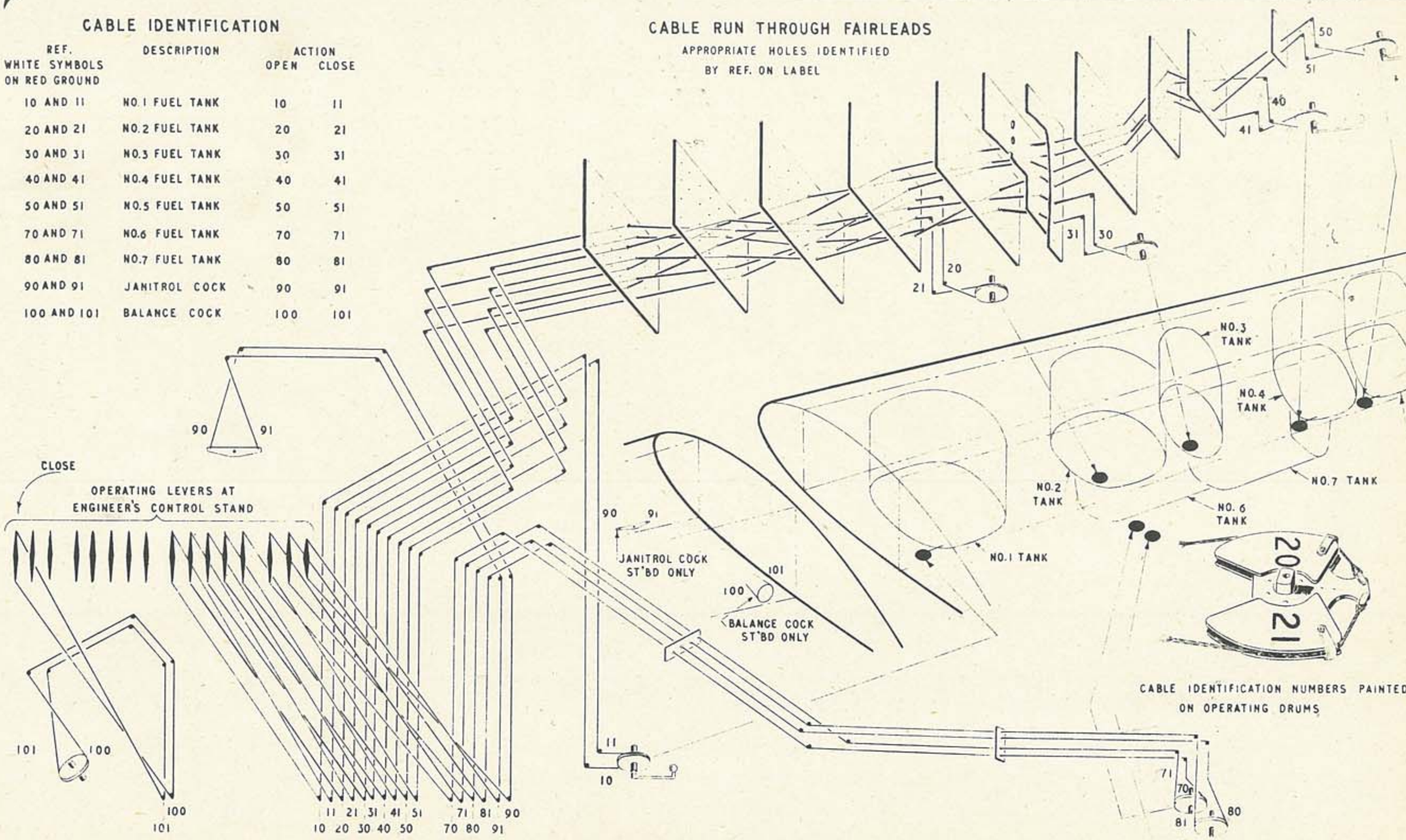

FUEL SYSTEM
KEY
NON-RETURN VALVES
PRESSURE LINES
GRAVITY LINES
VENT PIPES LEADING TO MAINPLANE UNDER-SURFACE
VENT FROM COLLECTOR BOX
DIRECTLY CONTROLLED COCKS
ENGINEER CONTROLLED COCKS
PILOT CONTROLLED COCKS
PORT SIDE SHOWN
STARBOARD SIDE SIMILAR
No.5 TANK 74 GALL.
No.4 TANK 97 GALL.
No.6 TANK 141 GALL.
No.3 TANK 131 GALL.
No.2 TANK 348 GALL.
No.1 TANK 529 GALL.
REFUELLING SYSTEM
PRIMING SPILL PIPE
FIREWALL
TO ENGINE DRIVEN PUMP
FILTER
FLOWMETER
PRESSURE SWITCH
TO PRESSURE WARNING-LAMP SWITCH UNIT
TO REFUELLING CONNECTION
REFUELLING DISTRIBUTORS
VENTING OF REFUELLING IN HULL
FUEL BACKING PUMPS
SUPPLY FOR ENGINE PRIMING
OFF-LOADING COCK
REFUELLING DISTRIBUTORS SEE ABOVE
CROSS-FEED PIPE
FUEL PUMP
RATED FLOW VALVE
VENTING OF REFUELLING IN HULL SEE ABOVE
TO STATIC SYSTEM
HEATERS
TO PRESSURE WARNING-LAMP SWITCH UNIT
DRAIN PIPE
SOLENOID VALVE
DRAIN PIPE
TO JANITROL CABIN HEATERS
CONTROL BOX

FIG. 1

ISSUE DATE MAR 48

CABLE IDENTIFICATION

REF. WHITE SYMBOLS ON RED GROUND	DESCRIPTION	ACTION OPEN	ACTION CLOSE
10 AND 11	NO.1 FUEL TANK	10	11
20 AND 21	NO.2 FUEL TANK	20	21
30 AND 31	NO.3 FUEL TANK	30	31
40 AND 41	NO.4 FUEL TANK	40	41
50 AND 51	NO.5 FUEL TANK	50	51
70 AND 71	NO.6 FUEL TANK	70	71
80 AND 81	NO.7 FUEL TANK	80	81
90 AND 91	JANITROL COCK	90	91
100 AND 101	BALANCE COCK	100	101



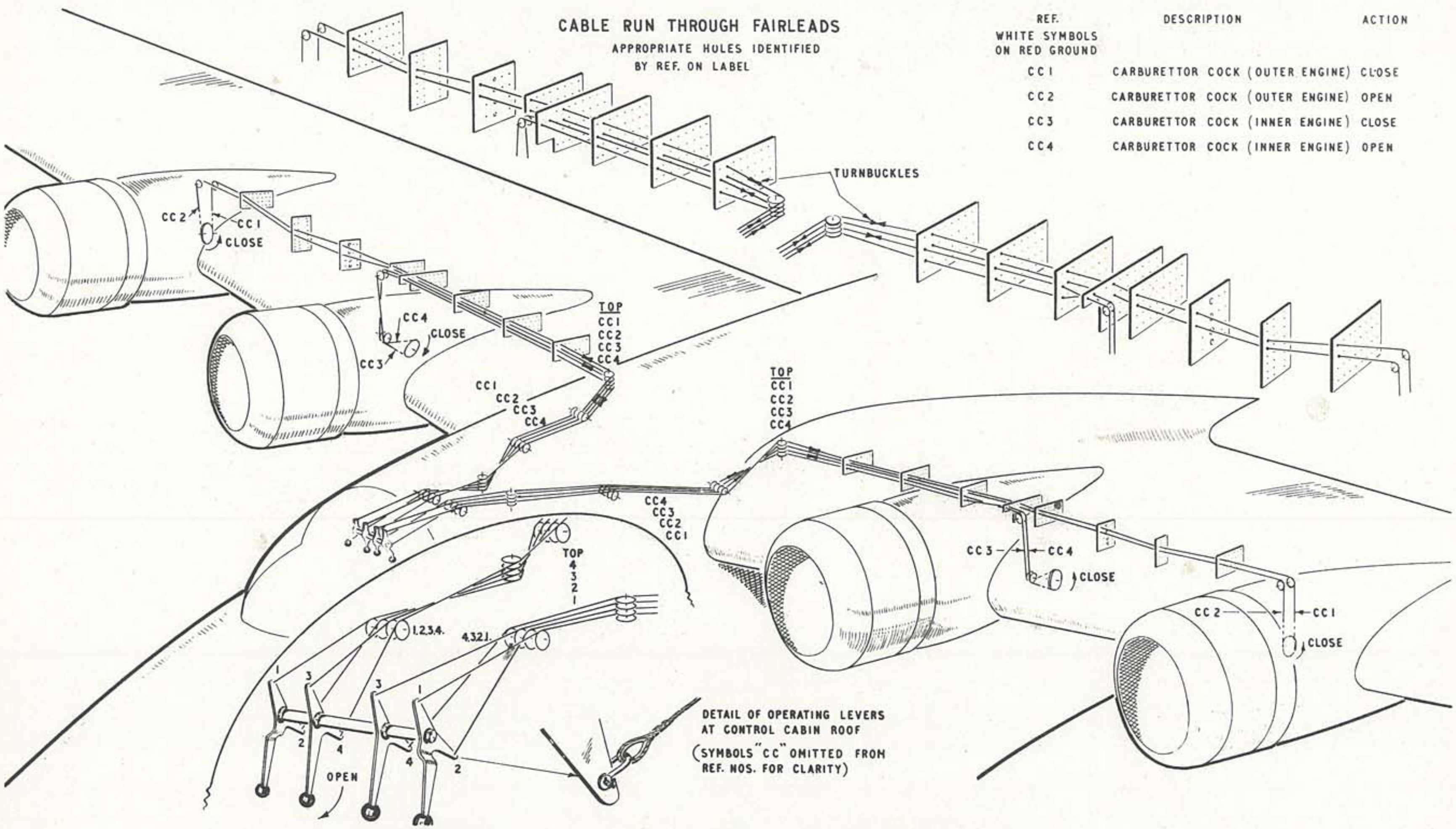
FUEL COCK CONTROLS

FIG. 2

RS50/TP/107
ISSUE DATE
1 MAR. '48

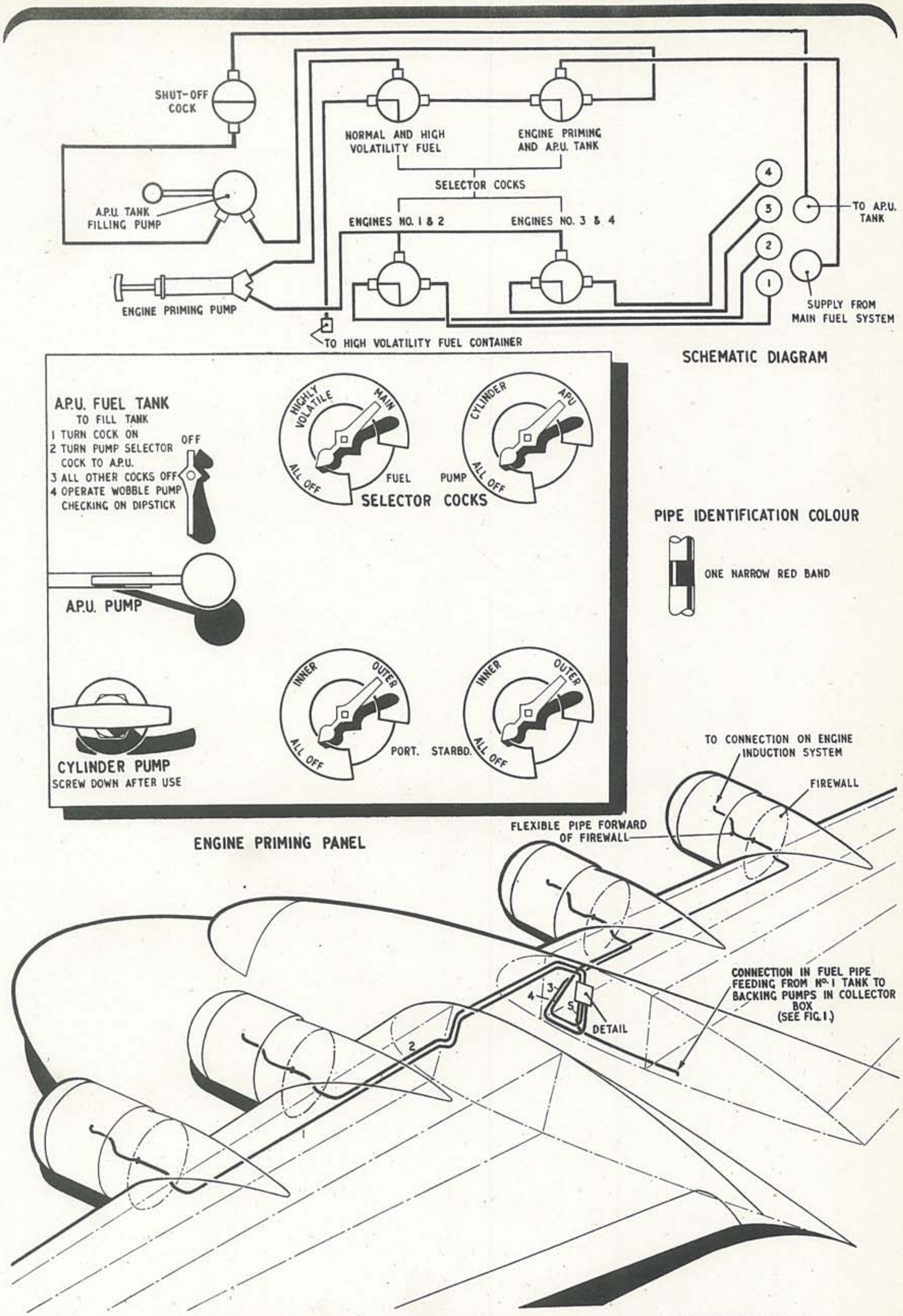
CABLE IDENTIFICATION

REF. WHITE SYMBOLS ON RED GROUND	DESCRIPTION	ACTION
CC1	CARBURETTOR COCK (OUTER ENGINE)	CLOSE
CC2	CARBURETTOR COCK (OUTER ENGINE)	OPEN
CC3	CARBURETTOR COCK (INNER ENGINE)	CLOSE
CC4	CARBURETTOR COCK (INNER ENGINE)	OPEN



MASTER COCK CONTROLS

FIG. 3



ENGINE PRIMING SYSTEM

FIG. 4

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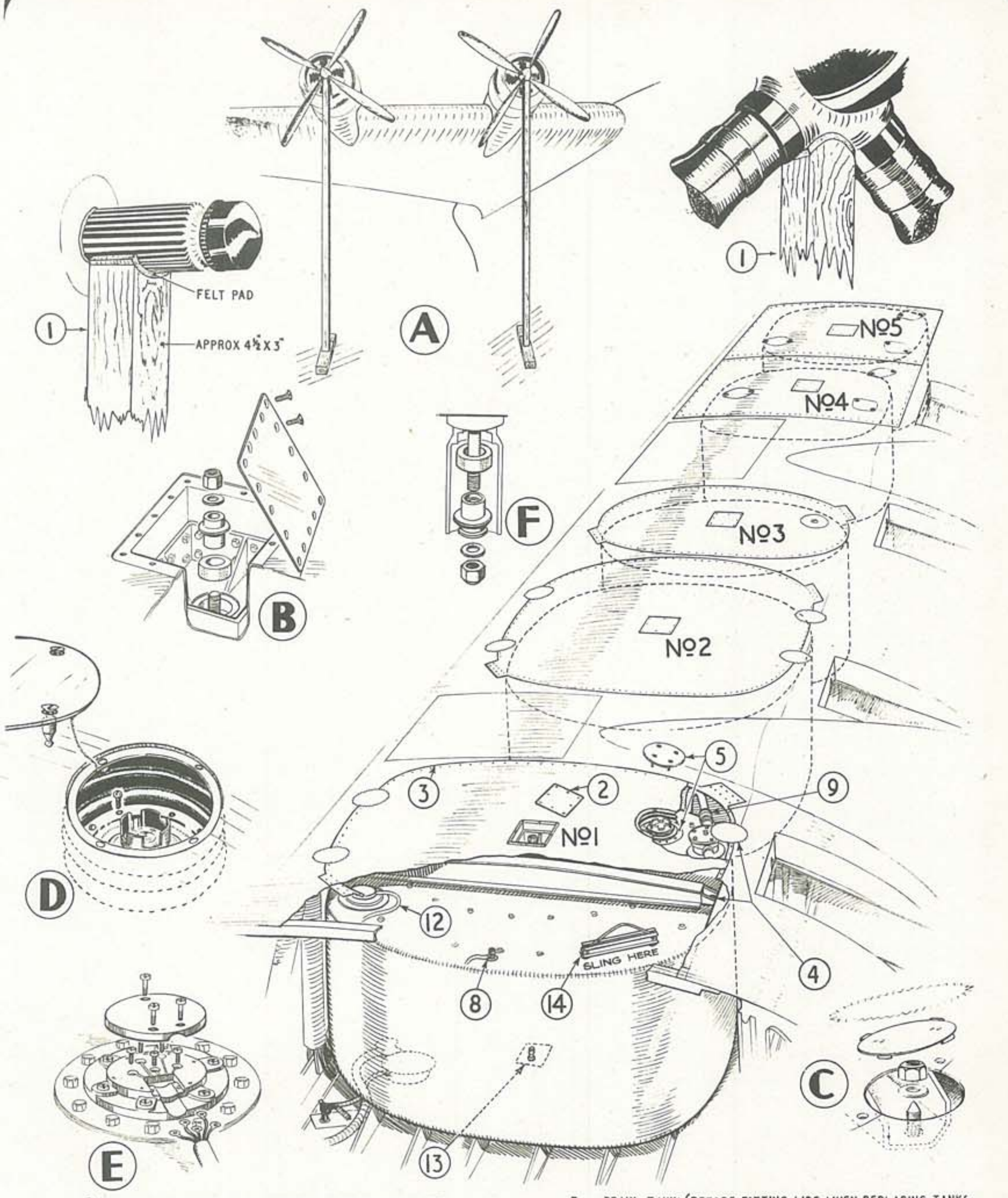
3	2 JUNE '47



1 — BEFORE ATTEMPTING TO REMOVE TANKS SUPPORT THE MAIN PLANE WITH A STRUT PLACED UNDER HUB OF PROPELLER OR WITH PROPELLER REMOVED, UNDER SPLINES ON PROPELLER SHAFT. (SEE DETAIL 'A')

2 — REMOVE COVER FROM CENTRE OF TANK LID, & REMOVE NUT AND BUSH FROM CENTRAL STAY. (SEE DETAIL 'B')

3 — TAKE OUT ALL FIXING SCREWS ROUND EDGE OF TANK.

4 — TANKS Nº 1 & 2 ONLY:— LIFT FABRIC PATCHES AND COVERS OVER DRAG MEMBER ATTACHMENT POINTS, AND REMOVE NUTS DISCLOSED. (SEE DETAIL 'C')

5 — REMOVE COVERS OVER FILLER CAPS, & REMOVE SCREWS CONNECTING ANTI-SPILL POCKETS TO TANKS. (SEE DETAIL 'D')

6 — LIFT TANK LID CLEAR.

7 — DRAIN TANK: (BEFORE FITTING LIDS, WHEN REPLACING TANKS, PARTIALLY FILL TO ENSURE CORRECT SEATING ON BEARERS.)

8 — DISCONECT BONDING WIRES.

9 — DISCONNECT VENT PIPE.

10 — DISCONNECT MAIN COCK CONTROLS, & FUEL PIPES.

11 — DISCONNECT MOISTURE DRAIN PIPES.

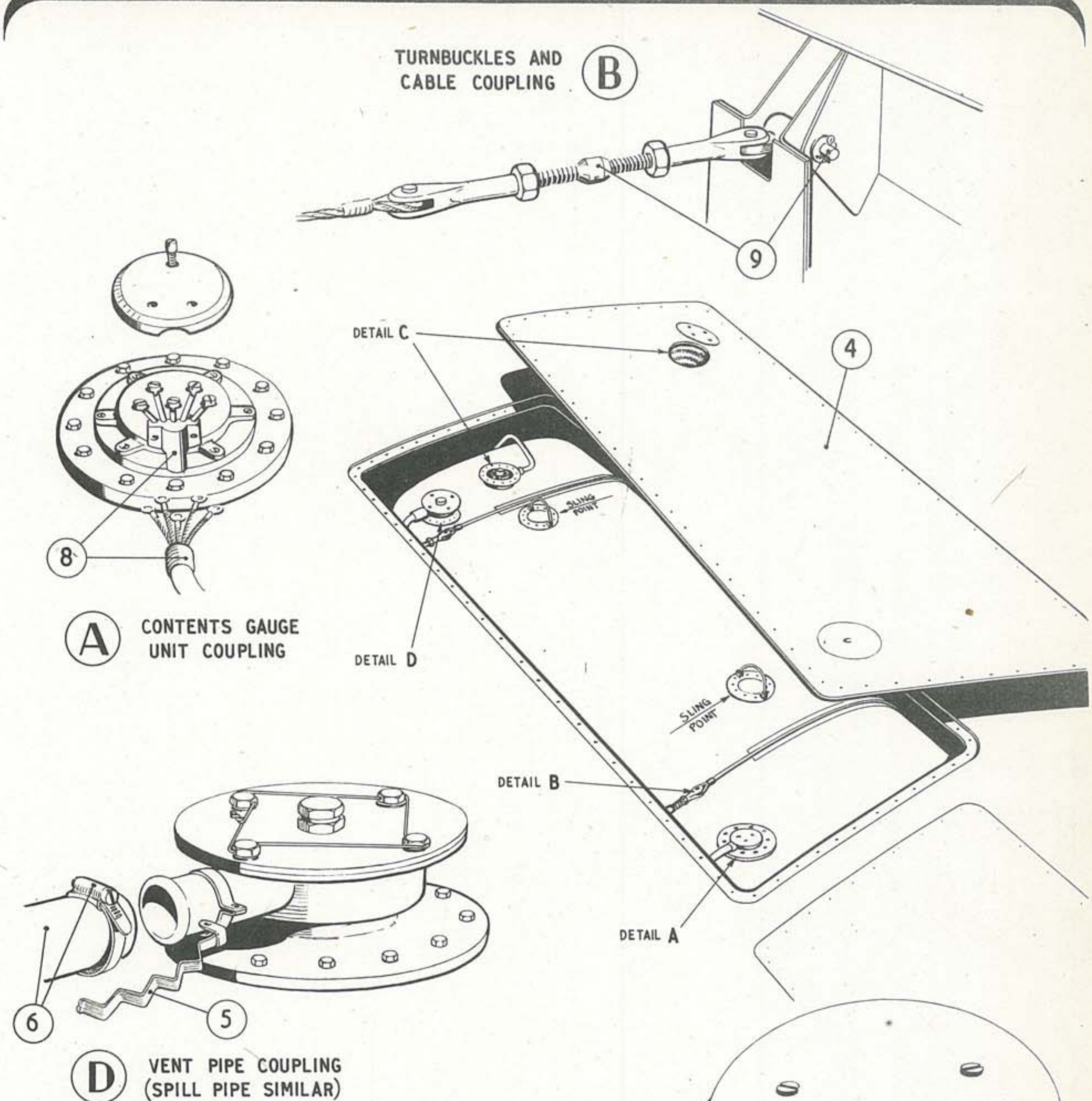
12 — DISCONNECT ELECTRICAL CABLE FROM CONTENTS GAUGE UNIT. (SEE DETAIL 'E')

13 — REMOVE NUTS & BUSHES FROM BOTTOM OF CENTRAL STAY — ACCESS HOLE IN PLANE UNDERSURFACE. (SEE DETAIL 'F')

14 — LIFT TANK CLEAR USING SLINGING ATTACHMENTS MARKED THUS:- SLING HERE.

REMOVAL OF FUEL TANKS Nº 1 to 5

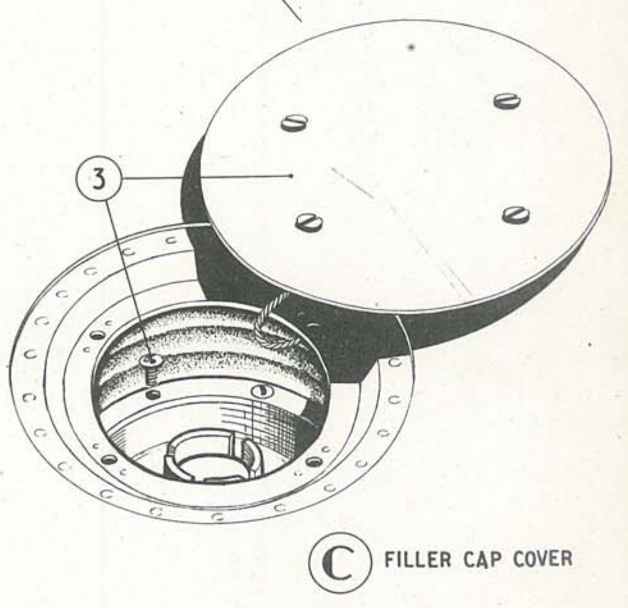
FIG. 5



1. BEFORE ATTEMPTING TO REMOVE TANKS, PLACE SUPPORTS UNDER PROPELLER HUBS OR, WITH PROPELLERS REMOVED UNDER SPLINES OF PROPELLER SHAFT (SEE FIG.5)
2. DRAIN TANK THROUGH OFF-LOADING SYSTEM. WHEN REPLACING TANK, PARTIALLY FILL TO ENSURE CORRECT SEATING ON BEARERS BEFORE FIXING HOLDING DOWN CABLES.
3. REMOVE COVER OVER FILLER CAP AND TAKE OUT SCREWS CONNECTING ANTI-SPILL POCKET TO TANK. (DETAIL C)
4. REMOVE TANK COVER BY TAKING OUT FIXING SCREWS ROUND THE EDGES.
5. DISCONNECT BONDING STRIPS (DETAIL D)
6. DISCONNECT VENT & SPILL PIPES (DETAIL D)
7. DISCONNECT FUEL PIPE FROM TANK SUMP. ACCESS DOOR ON UNDER SIDE OF MAINPLANE (SEE FIG.11)
8. DISCONNECT ELECTRICAL CABLE FROM CONTENTS GAUGE UNIT (DETAIL. A)
9. SLACKEN HOLDING DOWN CABLES BY MEANS OF THE TURNBUCKLES AND REMOVE SPLIT PIN, WASHER AND PIN TO RELEASE CABLE ENDS. (DETAIL B)
10. LIFT TANK CLEAR USING SLING ATTACHMENTS MARKED :—SLING POINT

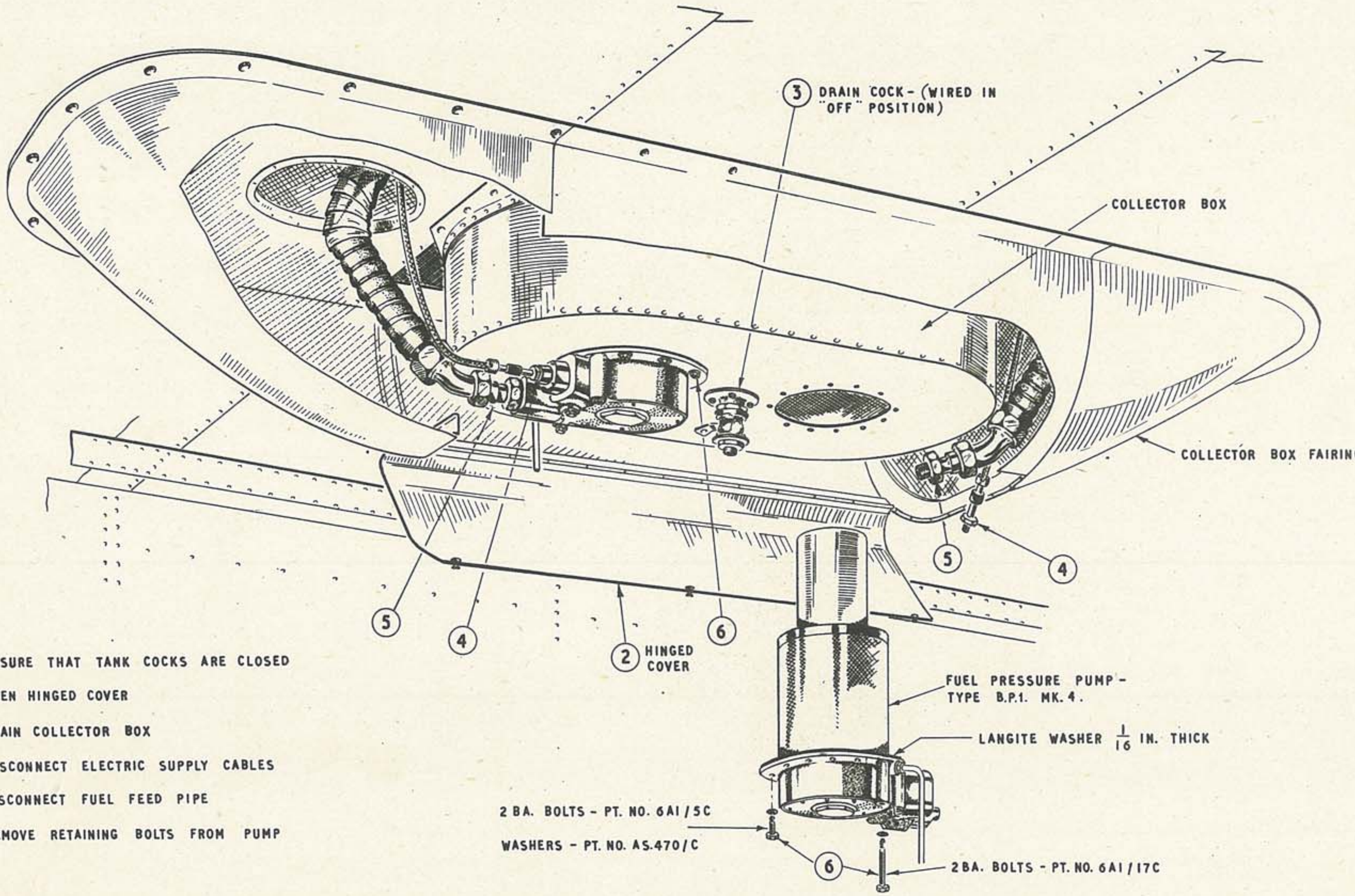
NOTE

AFTER REMOVAL THE TANK MUST BE SUPPORTED AT WHITE MARKINGS ONLY.



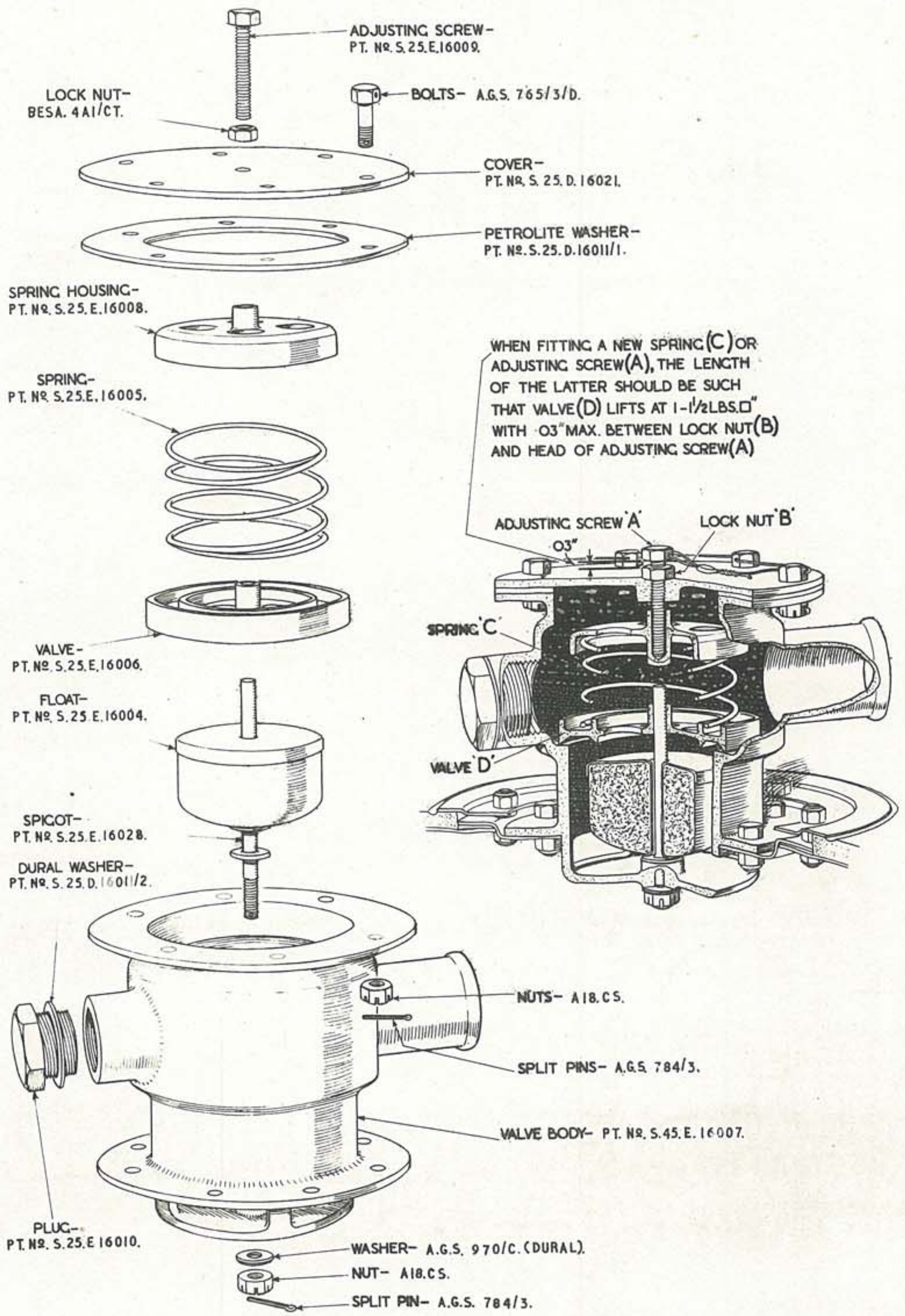
REMOVAL OF FUEL TANK Nº 6

FIG. 6



1 ENSURE THAT TANK COCKS ARE CLOSED
2 OPEN HINGED COVER
3 DRAIN COLLECTOR BOX
4 DISCONNECT ELECTRIC SUPPLY CABLES
5 DISCONNECT FUEL FEED PIPE
6 REMOVE RETAINING BOLTS FROM PUMP

REMOVING BACKING PUMPS



VENT VALVE (TANKS No. 1, 2 & 3)

FIG. 8

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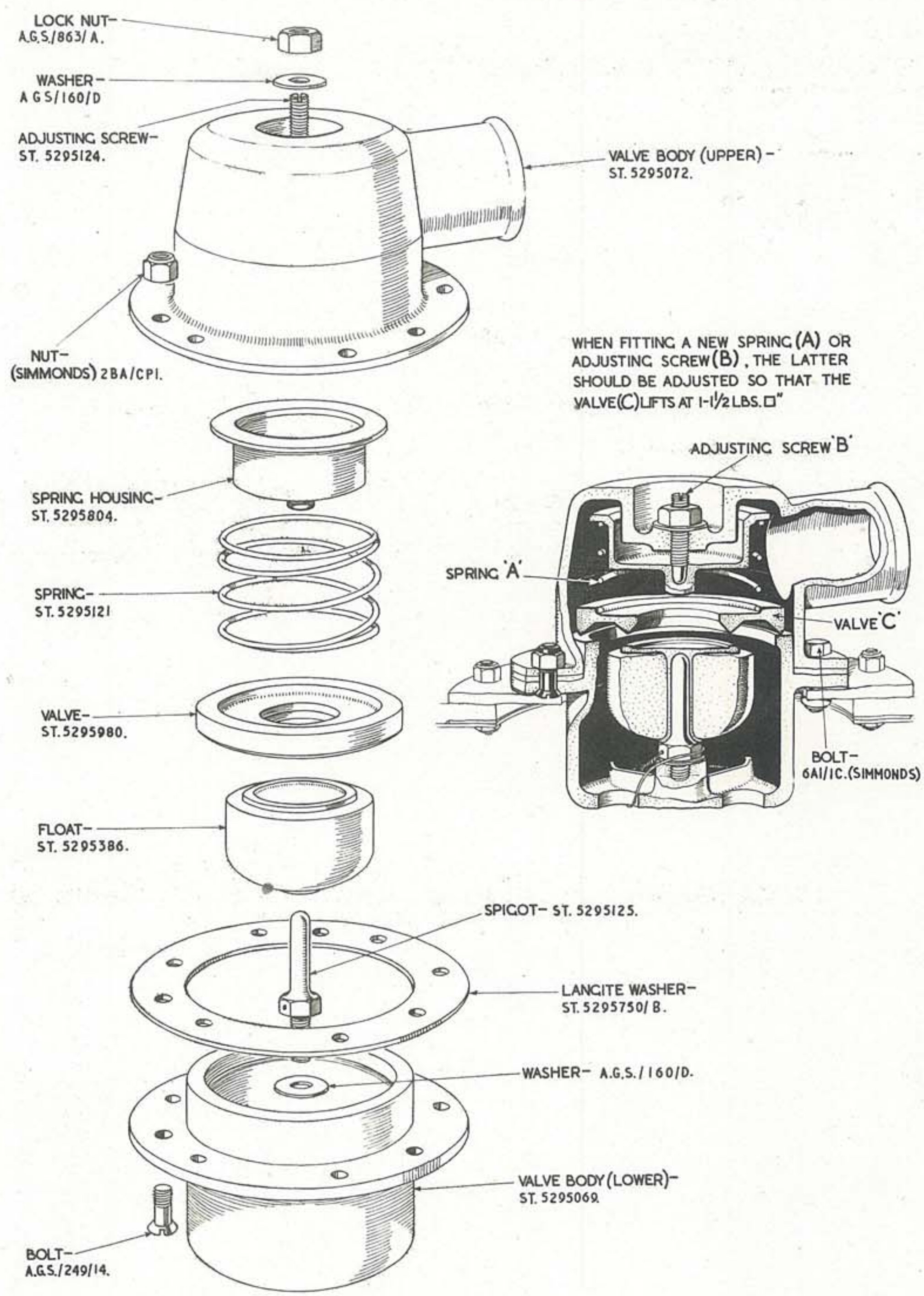

VENT VALVE (TANKS Nº 4 & 5)

FIG. 9

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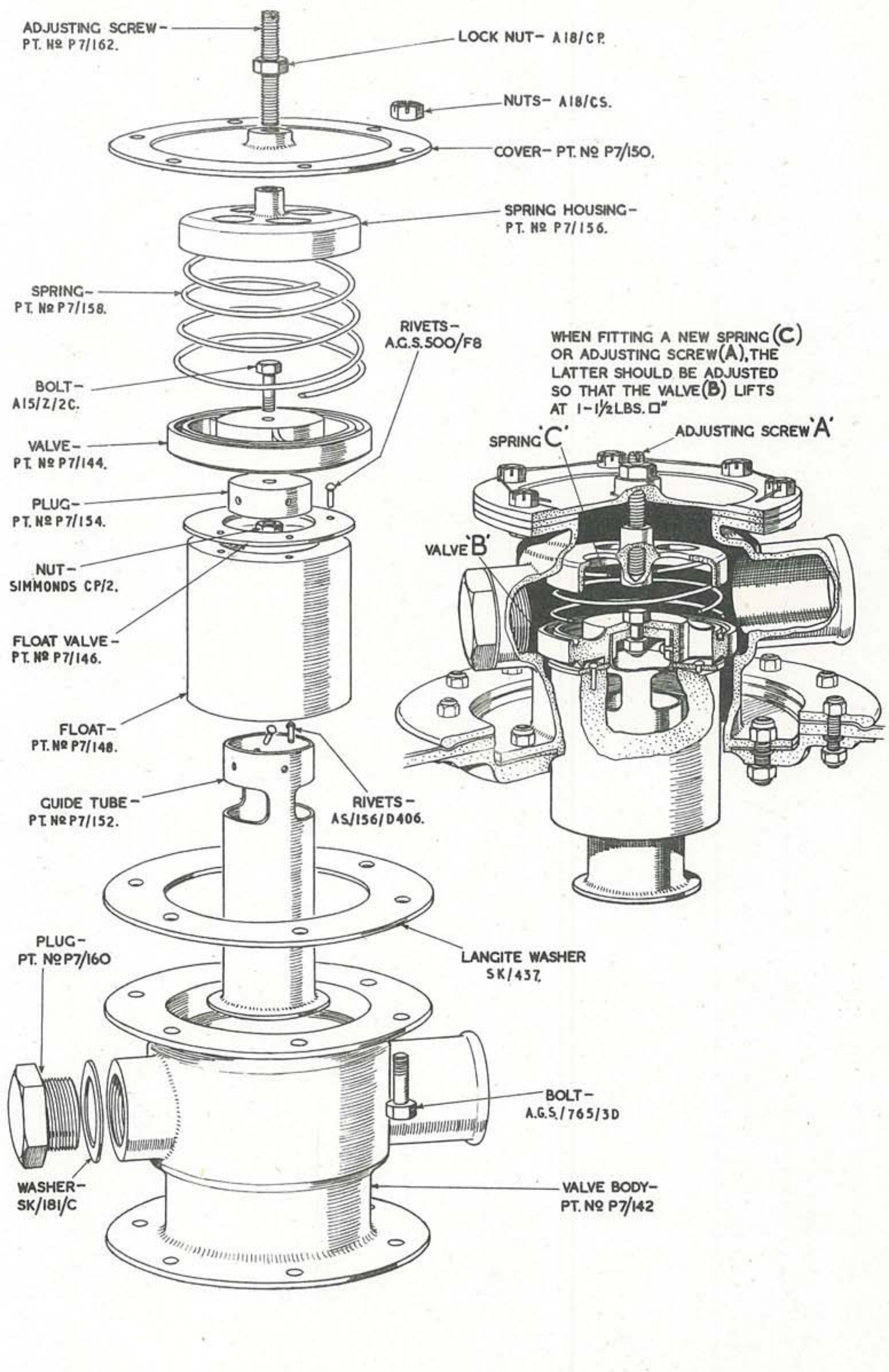

VENT VALVE TANK No 6

FIG. 10

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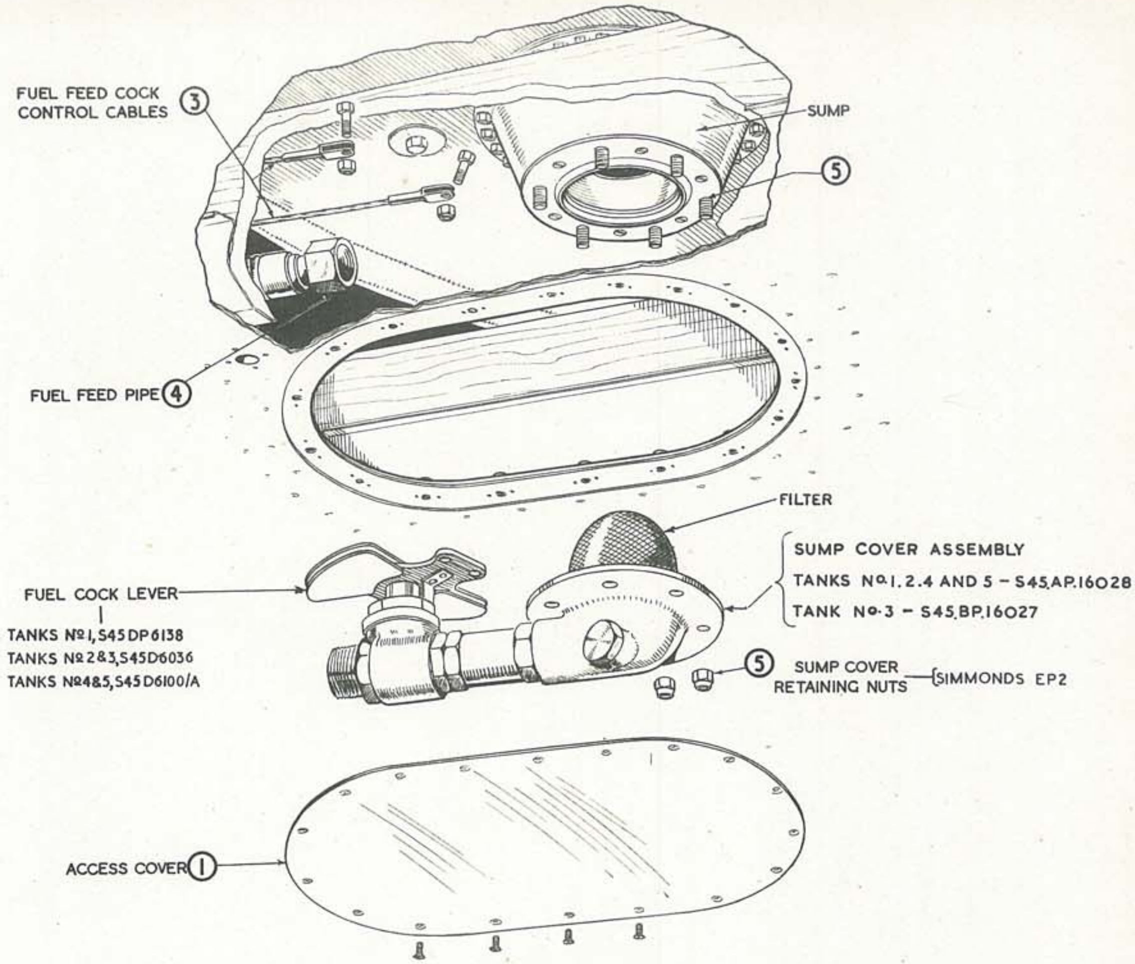
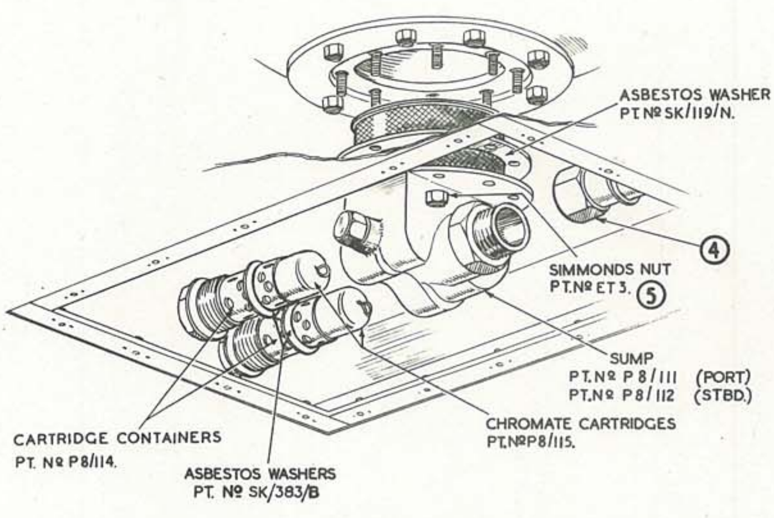


TANKS Nº 1, 2, 3, 4, & 5



(1) REMOVE ACCESS COVER

2 SLACKEN OFF COCK CONTROL CABLES (TANKS Nº 2, 3 & 6)

(3) DISCONNECT CABLES OR PUSH ROD FROM OPERATING LEVERS

(4) DISCONNECT FUEL FEED PIPE

(5) REMOVE RETAINING NUTS FROM SUMP

TANK Nº 6

TANK SUMPS

FIG. 11

SOLENT 3

MAINTENANCE MANUAL

SECTION 11

DE-ICING EQUIPMENT

Contents

Illustrations

Prepared by Short Brothers and Harland Ltd. Feb. 1951.

DESCRIPTION

1. General -

De-icing equipment is provided for the aerofoils, propellers, carburettors and pilot's windscreen. A tank fitted in the trailing edge of the port wing, supplies fluid for all the de-icing services. A vertical bulkhead divides the tank into two sections, the larger of which (55 gall.) supplies the aerofoil and propeller systems; the other (30 gall.) supplies the carburettor and windscreen systems.

A dipstick for the de-icing tank is stowed, with the fuel tank dipsticks, in the roof of the centre section.

2. Fluid Specifications -

Carburettor and Windscreen De-icing - B.S.S.3D9
Aerofoil and Propeller De-icing - H.63A

3. Aerofoil De-icing (Fig. 1) -

The T.K.S/Dunlop system is installed. In this system de-icing fluid is pumped to distributor overshoes (Dunlop) fitted on the aerofiol leading edges. From the leading edges the fluid is spread over the remainder of the aerofoil by the action of the airflow. On this aircraft, overshoes are fitted to the outer sections of the main plane leading edges and the leading edges of the tail plane and fin.

The de-icing fluid is contained in a tank mounted in the trailing edge of the port wing and the pump, with an integral electric motor, is mounted above the flight deck on the port side just aft of the front spar-frame. The pump motor control unit is fitted at the top of the E/O's side panel.

When the EMERGENCY switch is closed, the system provides a very high rate of flow to combat abnormal icing conditions.

From the tank, the fluid is supplied to the pump through a shut-off cock (at the port side of the centre section) and a T.K.S. type filter mounted on the propeller de-icing pump panel (see para. 4). For the main plane, pipelines extend outboard from the pump, along the front spar-trusses to the overshoe connections; for the tail unit, pipelines extend aft from the pump, along the port side of the upper deck then outboard to the overshoes on the tail plane and fin.

4. Propeller De-icing (Fig. 2)

De-icing fluid drawn from the aerofoil de-icing tank is supplied to slinger rings at the propeller hubs by two electric pumps fitted on a panel at the port side of the centre section opposite the E/O's station; the pumps supply the two inner and the two outer propellers respectively. Overshoes are fitted on the propellers to distribute the de-icing fluid along the leading edge of the blades from the slinger rings.

From the tank, feed pipes pass to the two pumps through a shut-off cock at the hull side and a T.K.S. type filter mounted on the pump panel. From the pumps, pipelines extend forward to the front spar-frame, then outboard along the main plane front spar-trusses to the propeller slinger rings.

The rate of delivery of the fluid is controlled by two rheostats on the E/O's side panel; two indicator lamps on this panel show when the motors are 'on.'

5. Carburettor De-icing (Fig. 3) -

Fluid from the inboard section of the tank (para. 1) is pumped to a connection on the throttle shutter boxes by two electrically-driven pumps fitted between fuel tanks No. 1 and 2 in the port wing. The pumps are controlled from the E/O's side panel and each time the switches are pressed will function for 30 seconds.

From the tank the supply line passes inboard to a shut-off cock at the port side of the centre section, thence outboard to branch, through two filters, to the pumps. The pipeline from the outboard pump passes forward to the main plane front spar-truss then branches to the two port throttle boxes; the pipeline from the inboard pump extends inboard along the main plane front spar-truss, then passes across the hull at floor level to the starboard wing. In the starboard wing the pipeline passes outboard along the front spar-truss then branches to the connections on the starboard throttle boxes.

NOTE... On certain aircraft the electrically-driven pumps are replaced by hand pumps which are fitted on the hull side at the engineers station. The maximum period of operation of these pumps is limited to 30 secs. with a maximum rate of 120 strokes per minute.

To ensure a 2 gall. reserve of fluid for carburettor de-icing, a stack pipe is fitted at the tank sump, in the supply line to the windscreen de-icing hand pump.

6. Windscreen De-icing (Fig. 4) -

De-icing fluid from the appropriate compartment in the de-icing tank (para. 1) is pumped to spray pipes forward of the coupe by hand pump. From a connection at the tank sump the pipeline passes to a shut-off cock at the hull side thence forward along the port side of the hull to a hand pump fitted, below the pilot's instrument panel, at the port side of the engine control stand.

From a needle metering-valve fitted at the pump, the pipeline extends forward and branches to two spray pipes which project from the hull forward of the coupe. The hand pump is of the spring-loaded type, a catch being provided to lock the plunger at the beginning of the operative stroke when the pump is not in use.

7. Pressure-head Heaters -

The pressure heads in the aerial mast are heated by separate elements, the control switches being fitted on the electrical panel in the control cabin roof.

NOTE.... To avoid burning out the elements the switches must always be OFF when the aircraft is not flying.

8. Air Intake Heat Controls -

The controls to the air intake shutters are described and illustrated in Sect. 9.

MAINTENANCE

9. The overhaul and maintenance of the T.K.S. aerofoil de-icing equipment is covered in the manufacturer's handbook.

Maintenance of the windscreen de-icing equipment and the propeller and carburettor de-icing equipment is dealt with in Air Publications 1464D and 1464C respectively.

There is also a manufacturer's handbook available for the carburettor de-icing pumps.

The positions of removable panels provided in the aerofoils for access to the de-icing equipment are shown in Sect. 2, Fig. 7 and 8. An access hole is provided in the front spar-frame bulkhead to facilitate servicing of the sump of the aerofoil de-icing pump.

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ISSUE	DATE
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2	SEPT '47

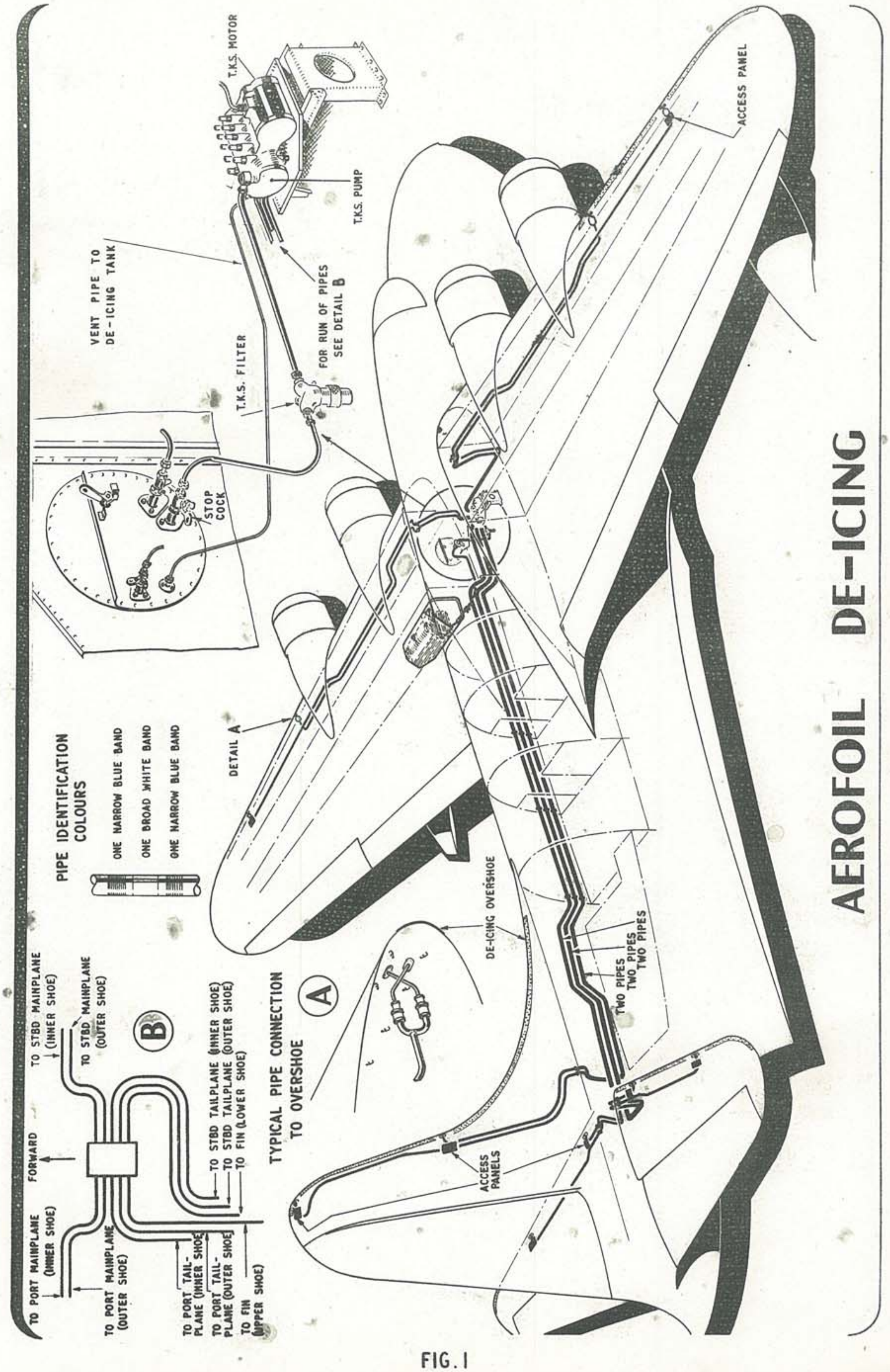

FIG. I

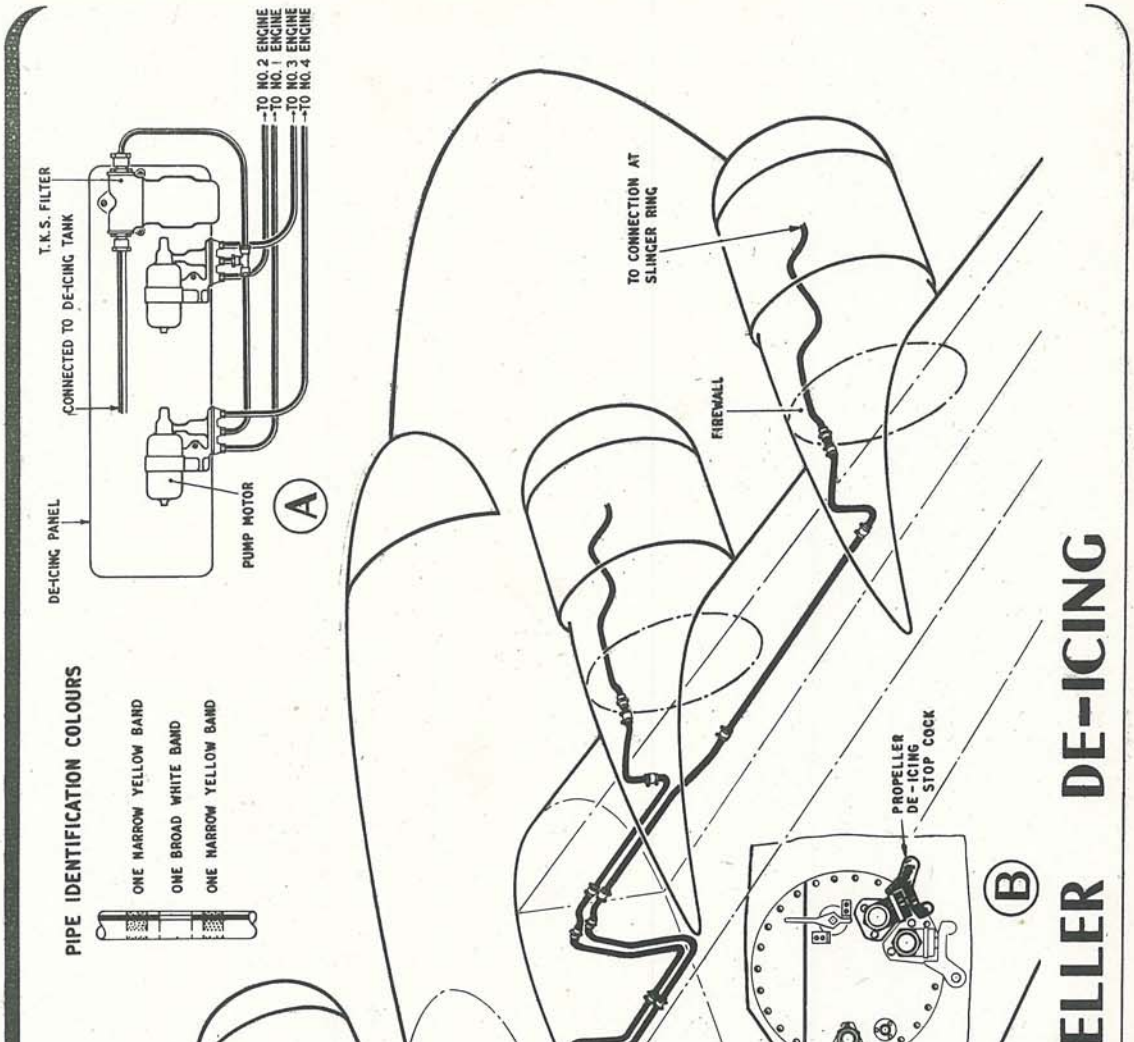

FIG. 2

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2	SEPT 47

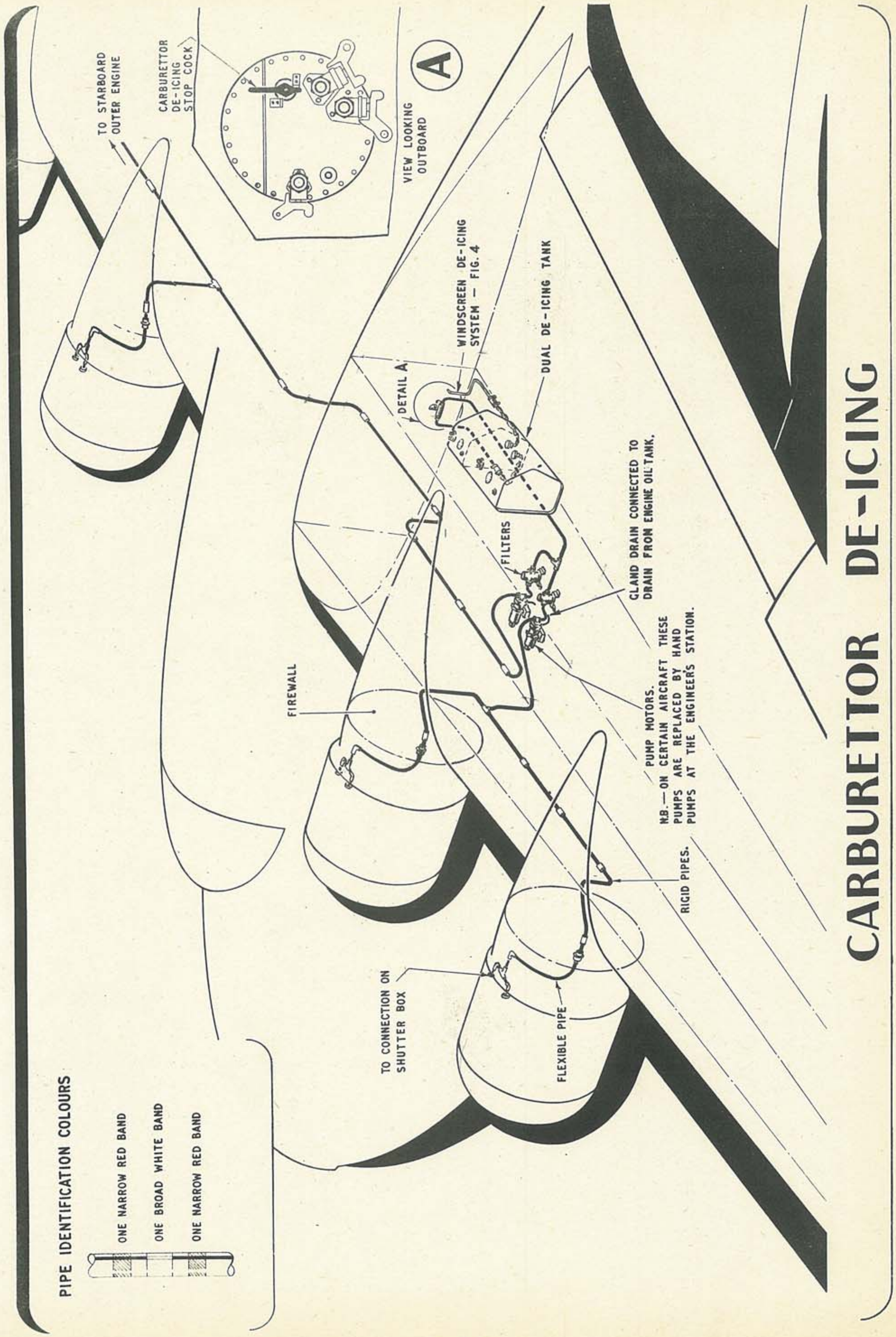
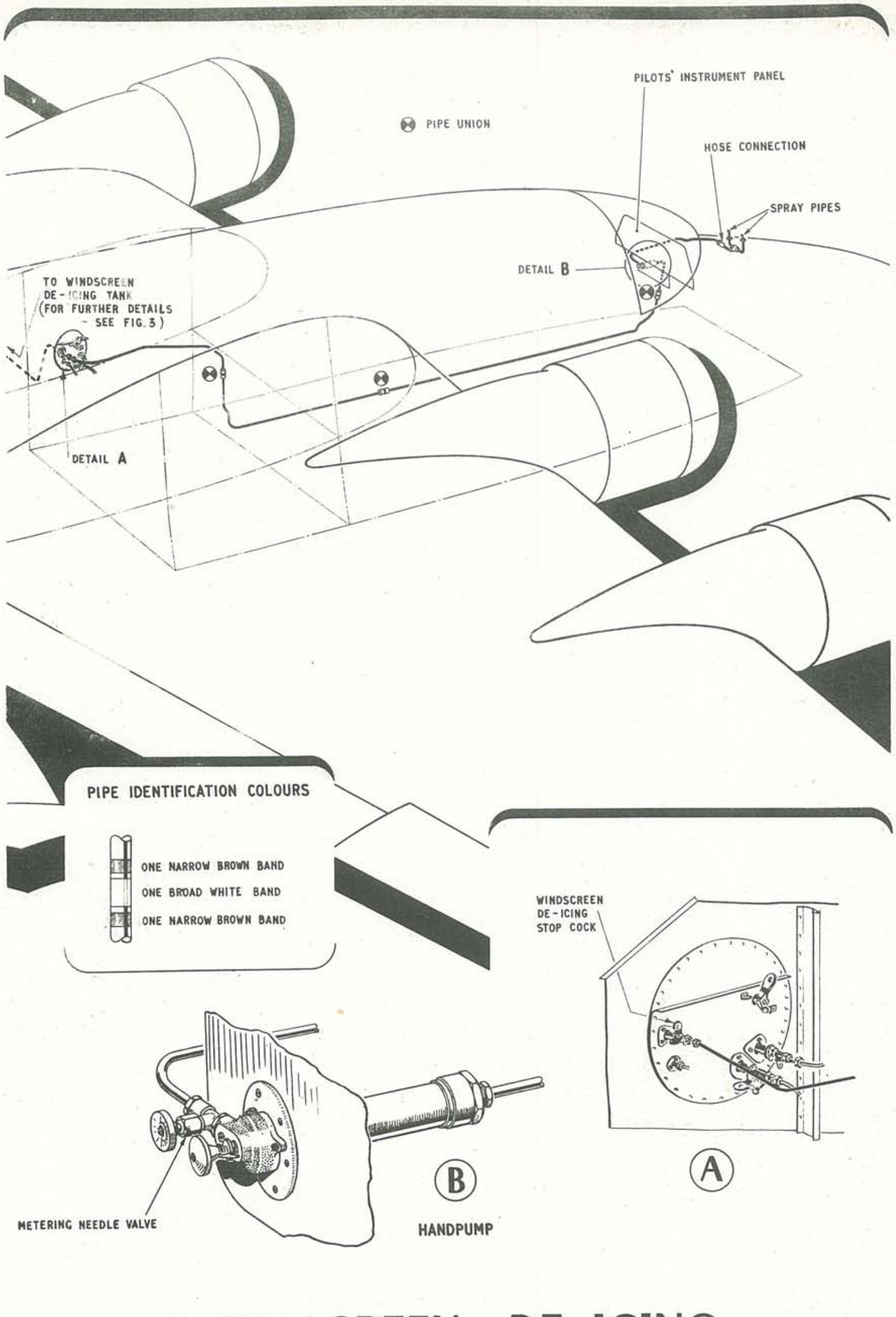

CARBURETTOR DE-ICING
TO STARBOARD OUTER ENGINE
CARBURETTOR DE-ICING STOP COCK
VIEW LOOKING OUTBOARD
A
WINDSCREEN DE-ICING SYSTEM — FIG. 4
DUAL DE-ICING TANK
DETAIL A
GLAND DRAIN CONNECTED TO DRAIN FROM ENGINE OIL TANK.
FILTERS
PUMP MOTORS.
N.B.— ON CERTAIN AIRCRAFT THESE PUMPS ARE REPLACED BY HAND PUMPS AT THE ENGINEER'S STATION.
FIREWALL
RIGID PIPES.
TO CONNECTION ON SHUTTER BOX
FLEXIBLE PIPE
PIPE IDENTIFICATION COLOURS
ONE NARROW RED BAND
ONE BROAD WHITE BAND
ONE NARROW RED BAND

FIG. 3



WINDSCREEN DE-ICING

FIG.4

SOLENT 3

MAINTENANCE MANUAL

SECTION 12

GENERAL EQUIPMENT

Contents

Illustrations

Prepared by Short Brothers and Harland Ltd. Feb. 1951.

DESCRIPTION

1. Ventilating Systems -

1. Heated Air -

Two combustion-type heaters are used to supply heated air to various parts of the hull through a series of ducts, air being supplied under ram pressure from air intake scoops in the nose of the aircraft. The heaters, which are fitted one on each side of the hull at the forward end of the control cabin, are supplied with fuel from the main fuel system, two electrically-driven fuel pumps being fitted in the starboard wing-root to provide the necessary pressure.

The heaters are controlled electrically by the E/O after the automatic closing of an air-pressure micro-switch (connected in the A.S.I. line) when the aircraft attains a speed of 80 kts.

A thermal switch in the ducting aft of each heater automatically cuts off the fuel if the temperature of the air reaches 350°F, and a master cut-off cock fitted in the fuel line is operated manually by cable from the E/O's station.

From two air-intake scoops fitted one on each side of the hull in No. 1 hold, ducts pass aft through rain traps and air filters to the heaters. From the heaters the ducts extend to butterfly valves located one on each side of the control cabin.

A spill valve is fitted in the ducting aft of each butterfly valve for by-passing the cold airflow overboard while the heater is not in operation. Aft of the spill valves the ducting passes along each side of the upper deck branching to adjustable outlets, near floor level in the cabins, dressing-rooms and at all crew stations. A supply of air is also made available for the de-misting of the coupe windows and the astro dome (see fig. 1).

To assist equal distribution of heated air to all cabins, controllable dampers are fitted where the main ducts branch to the outlets in the forward cabins (A and B). The dampers are located at each side of the flight deck.

2. Cold Air -

A system of ducts is installed whereby cold air is distributed to the various compartments in the hull. An air inlet, with a butterfly control valve and removable filter, is fitted in the leading edge of the starboard wing at the root.

From the inlet, ducting enters the hull at the starboard side of the centre section, then branches forward and aft along the upper deck to adjustable ventilators in all cabins, toilets, and in the pantry and lounge (see fig. 1).

3. Extraction -

Foul air is drawn from various compartments on the lower deck by ducting connected to discharge ducts in each wing. The system is automatic in operation, the outlets being fitted in the low-pressure area at the wing roots.

The extractors on the lower deck are positioned in the ceilings of the following compartments. -

Cabin A, Cabin B, Gent's dressing room, Gent's toilets,
Cabin C, Promenade Cabin, Ladies' dressing room, and
Ladies' toilet.

On the upper deck two extractors in the ceiling of the **pantry** have individual outlet cowls fitted in the hull roof, and extractors in the ceilings of cabins D, E and F are connected by ducting to an outlet cowl in the hull roof above cabin D.

4. Oxygen System

Fig. 2 gives the geographical layout of the system. From a charging valve, fitted forward of the freight loading door in No. 2 hold, the high-pressure pipeline extends forward along the port side of the hull to the centre section then crosses, below the upper deck, to the starboard side to connect through a filter and non-return valves to seven Mk.10 oxygen cylinders (each of 2250 litres capacity) in the cupboard between the gentlemen's toilets.

From the cylinders the high-pressure line passes through non-return valves to a shut-off valve at the starboard side of the hull at the E/O's station, thence forward through a filter to a regulator unit fitted at the starboard side immediately aft of the front spar-frame. From the regulator, pipelines branch through 3-way connectors and are routed to supply sockets located as follows. -

Single-point Sockets
Port side of control cabin (Captain's)
Starboard side of control cabin (F/O)
Crew rest station
N/O's station
R/O's station
E/O's station (Mk. 6A socket)
Each side of **pantry** (stewards)
Two at port side of cabins C,D,E and F.
Two at each side of promenade cabin
In each gent's toilet.
In ladies' toilet
Port side (forward) of cabin A.
Port side (aft) of cabin B.

Twin-point Sockets
Two at starboard side of Cabins A, B, C, D, E and F.
Port side (aft) of cabin A.
Port side (forward) of cabin B.

5. Watertight Doors -

Watertight doors are provided at the positions shown in fig. 3. Each door, with the exception of the one between cabins 'A' and 'B' and the one at the forward end of the promenade cabin, forms the lower half of a normal communicating door, the upper half being free to open when the watertight door is locked in position; the locking mechanisms are illustrated in fig. 3.

The watertight door between cabins 'A' and 'B' lifts off its hinges and is stowed at the starboard side of the forward bulkhead of cabin B when not in use. The watertight door at the forward end of the promenade cabin also lifts off its hinges and is stowed in the adjacent alcove on the starboard side of the hull when not in use.

6. Dinghies -

Provision is made for carrying four 'J' type dinghies in blow-out stowages, two in the upper surface of each wing at the root. A pack containing various items of emergency equipment can be stowed with each dinghy; in addition a dinghy radio transmitter and kite aerial can be stowed with the inner dinghy on the starboard side.

The dinghies can be released either electrically, from release switches fitted on the electrical panel at the port side of the control cabin, or manually by cable from handgrips fitted two on each side of the hull roof forward of the centre section. These handgrips are also accessible from outside after removing "rip-off" patches.

7. Lifebelts -

A total of 60 (including ten spare) "Auliffe" lifebelts for passengers and crew are stowed at the following positions. -

Passengers. -

Cabin A	4 in a container at the port side of the forward bulkhead. 3 in a container at the starboard side of the forward bulkhead. 3 in a container on the starboard side of the rear bulkhead (for cabin B)
Cabin B	- 4 in a container at the port side of the rear bulkhead.
Cabin C	- 3 in a container at the port side of the forward bulkhead. 3 in a container at the port side of the rear bulkhead.
Promenade Cabin	- 4 in a cupboard at the port side of the forward bulkhead.
Cabins D,E & F.	- 3 in each of two containers, one on the port and one on the starboard side of the forward bulkhead of cabin D. Similarly 3 on each side between cabins D & E and 3 on each side between cabins E & F.
Crew	
Captain F/O	- At the forward port side of the control cabin floor. - At the forward stbd. side of the control cabin floor.
N/O & R/O	- 2 on the forward end of the R/O's desk structure.
E/O	- Beside his seat on the front spar-frame bulkhead.
Stewards	- 2 on the forward end of the crockery stowage in the pantry.
Rest Station	- On the front spar-frame behind the rest chair.

The ten spare lifebelts are stowed in a container in the roof above the flight deck and are obtainable from outside through the roof hatch at the front spar-frame.

8. Fire Extinguishers - Aircraft -

Hand fire extinguishers are provided, Pyrene C.T.C. on the flight deck, and in the **pantry**, and Graviner Water-Glycol elsewhere. Stowages are located at the following positions. -

Lower Deck		
No. 1 Hold	-	On the port side of the rear bulkhead.
No. 2 Hold	-	On the port side of the forward bulkhead.
Cabin A	-	Above the lifebelt stowage at the starboard side of the forward bulkhead. Above the lifebelt stowage at the starboard side of the rear bulkhead.
Cabin B	-	Above the lifebelt stowage at the port side of the rear bulkhead.
Cabin C	-	Above the lifebelt stowage at the port side of the rear bulkhead.
Promenade Cabin	-	In the cupboard at the port side of the forward bulkhead.
Ladies Dressing-room	-	Starboard side of the forward bulkhead.
Upper Deck		
Flight Deck	-	On the aft support of the E/O's side panel. Beside lifebelt stowage at E/O's station. On the forward end of the crew baggage locker.
Pantry	-	Above the lifebelt stowage on the forward end of the crockery cabinet.
Cabins D,E & F.	-	Beside the port lifebelt stowage at the forward bulkhead of cabin D. Beside the starboard lifebelt stowage between cabins D and E. Beside the port lifebelt stowage between cabins E and F.

9. Fire Extinguishers - Engine -

Fig. 4 illustrates the Graviner system fitted in No. 2 engine nacelle and is typical for all four engines.

Fire warning lamps contained in the feathering push-button switches are operated by flame switches in the engine nacelles (5 in the nacelle nose, and 4 on the front face of the firewall). When any one of the warning lamps lights up, its automatically places the fire circuit for the induction system bottle (No.1) under the control of the feathering switch.

When the appropriate feathering switch is actuated, it causes the induction system bottle to be discharged immediately. The front and rear spraying bottles (No. 3 and 2 respectively) may then be discharged by pressing the appropriate extinguisher button when feathering has been completed.

If it is not required to feather the propeller, all three bottles can be discharged simultaneously by pressing the appropriate extinguisher switch, but this should not be carried out until the engine has ceased rotating.

The bottles are also discharged simultaneously on a crash landing, by duplicated inertia switches wired in series and located on the bulkhead forward of the pilot's instrument panel.

Spring-loaded fire access panels are provided on the port side of the nose of each engine nacelle, and give access to the auxiliary compartment forward of the firewall for dealing with ground fires.

10. Domestic Equipment -

The pantry contains the following equipment.-

10.1. Two Crittall electric ovens for re-heating frozen food.
10.2. One dry-ice refrigerator.
10.3. One 2-gallon Jackson hot-water urn for heating water for beverage or washing purposes.

The usual miscellaneous pantry fittings are also provided, and two transportable containers for stowing additional food are stowed in the freight compartment.

11. Domestic Water Systems -

Two fresh-water tanks, each of 15 gall. capacity are fitted, one in the roof of the centre section and one at the forward end of the pantry. The tanks are interconnected and supply the wash basins in the ladies' and gentlemen's dressing rooms. The sink in the pantry is supplied with fresh water through a separate pipeline from the upper tank.

An additional five-gallon tank of drinking water is stowed in the pantry.

A separate water heater (electric) is provided for each of the wash-basins in the dressing rooms.

The ladies' and gentlemen's toilets are flushed with water pumped from a 25 gall. tank fitted below the floor of cabin 'C'.

12. Auxiliary Generating Plant -

An 'Alco' 500 watt charging set is mounted on the starboard side of the upper deck, immediately aft of the E/O's station. A 1¼ h.p. single-cylinder, air-cooled 4-stroke petrol engine drives a 500 watt D.C. generator for charging the aircraft accumulators.

The fuel tank is fitted in the starboard wing root and is replenished from the main fuel system by means of a hand pump on the engine priming panel at the starboard side of the centre section. The fuel cock is located at the hull side above the engine, and the charging controls are fitted at the back of the E/O's side panel.

MAINTENANCE

13. Cabin Heating System -

For maintenance notes on the cabin heaters, reference should be made to the manufacturer's handbook.

14. Oxygen System -

The charging valve is threaded $\frac{1}{4}$" B.S.P. and the system is charged at a pressure of 1,900 lb/sq.in.

The maintenance of oxygen equipment is fully covered in A.P.1275.A.

15. Dinghies

Inspection - General -

This inspection should be carried out at the intervals stated in the basic Routine Inspection Schedule and the following procedure should be adopted.

15.1. Remove the dinghy from its stowage and disconnect the CO_2 cylinder and operating head from the dinghy.

15.2. Check CO_2 contents of the cylinder as described in A.P.1182.C.

15.3. Examine the operating head in accordance with A.P.1182.C

15.4. Examine fabric for deterioration due to light, presence of grease, or chafing, particularly near seams and patches.

15.5. Valves should be examined in accordance with A.P.1182.C

15.6. Replace the dinghy in its stowage and check the connections of the manual release.

16. Inspection - Inflation Test -

This should be carried out as required by the basic Routine Inspection Schedule and the following procedure adopted. -

16.1. Carry out the general inspection (15.1 to 15.5. above)

16.2. Inflate with air and connect to a 'U' tube as described in A.P.1182.C. Test pressure should be 2 lb/sq.in. with a permissible drop of 7 in. in one hour.

17. Deflation -

After dinghies have been satisfactorily tested, they should be liberally dusted with French chalk and deflated. An important point to remember is that, if a dinghy is deflated and stored for a while before stowing, air will almost certainly re-enter owing to the porosity of the fabric, and, although the dinghy may have been completely deflated originally, sufficient air will re-enter to be a source of possible danger at altitude.

This air will expand and may cause the dinghy to burst open its stowage whilst the aircraft is in flight.

Unless a dinghy is deflated and placed directly into its stowage, it must be coupled again to a deflating pump to ensure that all air is withdrawn. Deflation should always be continued until the creases appear as knife edges.

18. Folding -

The method of folding the 'J' type dinghy for stowage in the main plane is illustrated in fig. 5. All surfaces of the dinghy must be dry and liberally dusted with French chalk before stowing.

19. Fire Extinguishing System -

For maintenance information on the Graviner engine fire extinguisher system, reference should be made to the manufacturer's manaul. Test requirements are set out in A.P. 9570.

20. Domestic Water Systems -

The fresh water tanks can be drained through the waste pipeline of the wash basins in the gentlemen's dressing room; the drain cock is situated below the aft basin.

The upper tank can, if required, be drained separately through the waste pipeline from the pantry sink, the drain cock being located under the sink.

The tanks supplying the wash basins are replenished through a filler in the upper tank, access being provided by a removable cover in the top of the hull immediately aft of the centre section. The tank supplying flushing water for the toilets can be replenished either through the filler on the tank, accessible by a removable panel in the floor of cabin 'C', or from outside through a filler on the starboard side of the hull between cabin 'C' and the promenade cabin. Before replenishing the tank through the latter point it should be checked that the filler cap on the tank is secure, and that the valves of the toilets are closed.

The pipelines of the water systems are tested at a pressure of 10 lb/sq.in.

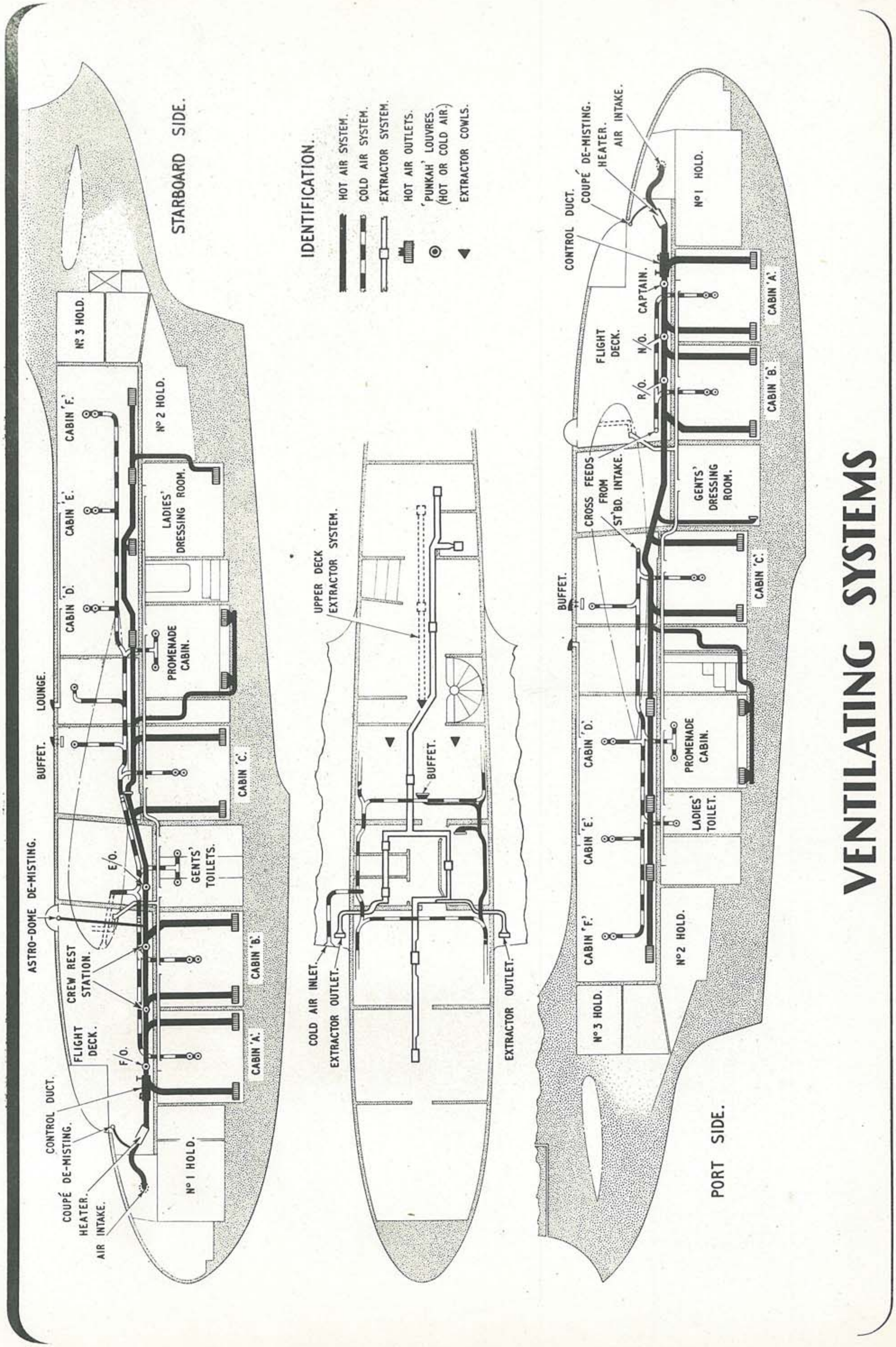

VENTILATING SYSTEMS
STARBOARD SIDE.
IDENTIFICATION.
HOT AIR SYSTEM.
COLD AIR SYSTEM.
EXTRACTOR SYSTEM.
HOT AIR OUTLETS.
'PUNKAH' LOUVRES. (HOT OR COLD AIR.)
EXTRACTOR COWLS.
Nº 3 HOLD.
Nº 2 HOLD.
Nº 1 HOLD.
CABIN 'F.'
CABIN 'E.'
CABIN 'D.'
CABIN 'C.'
CABIN 'B.'
CABIN 'A.'
LADIES' DRESSING ROOM.
PROMENADE CABIN.
LOUNGE.
BUFFET.
GENTS' TOILETS.
ASTRO-DOME DE-MISTING.
CREW REST STATION.
E/O.
F/O.
FLIGHT DECK.
CONTROL DUCT.
COUPÉ DE-MISTING.
HEATER.
AIR INTAKE.
UPPER DECK EXTRACTOR SYSTEM.
COLD AIR INLET.
EXTRACTOR OUTLET.
CAPTAIN.
N/O.
R/O.
CROSS FEEDS FROM ST'BD. INTAKE.
GENTS' DRESSING ROOM.
LADIES' TOILET.
PORT SIDE.

FIG. 1.

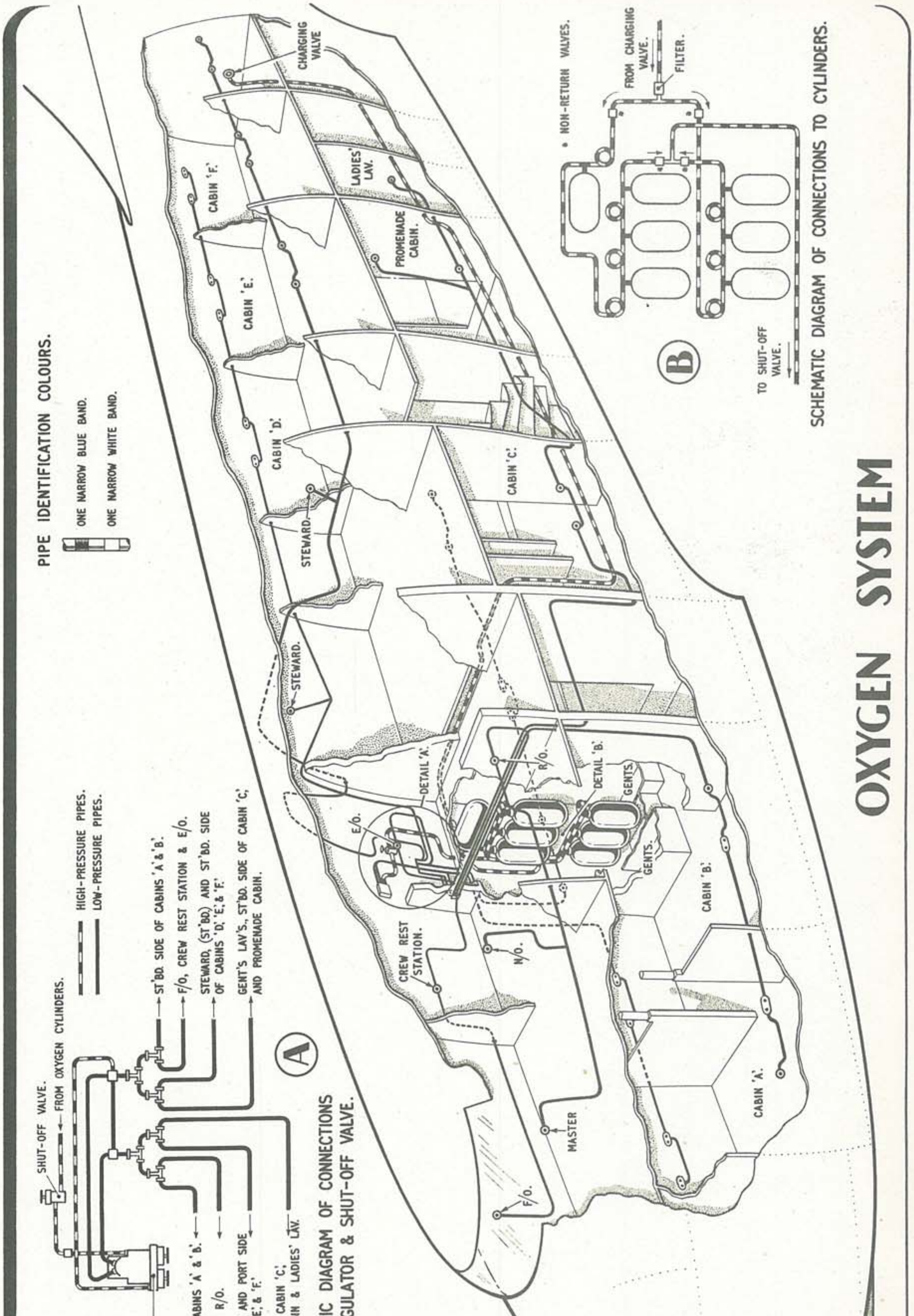


FIG. 2.

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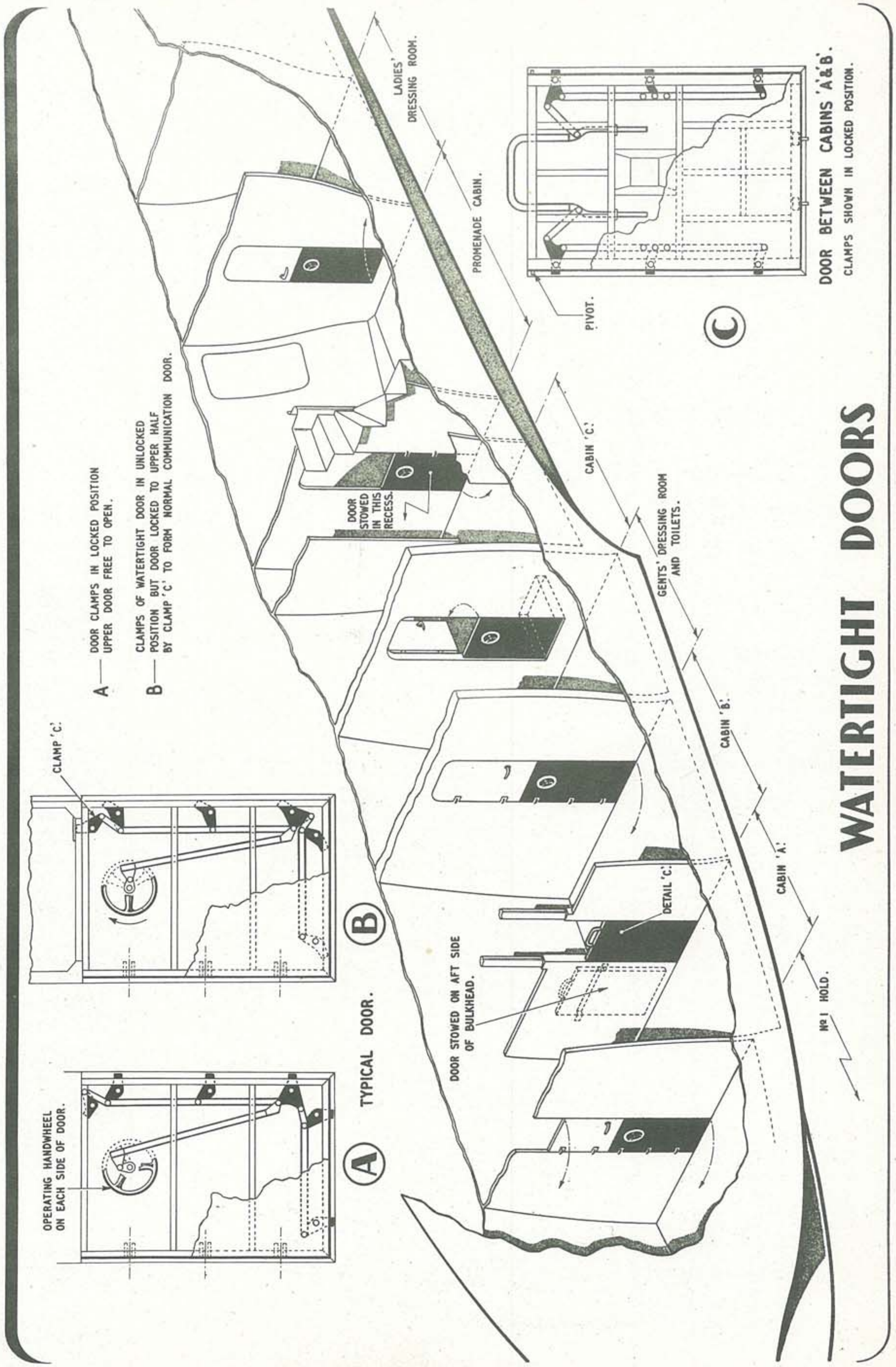
1.	SEPT. 1948.



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1	SEPT. 1948.

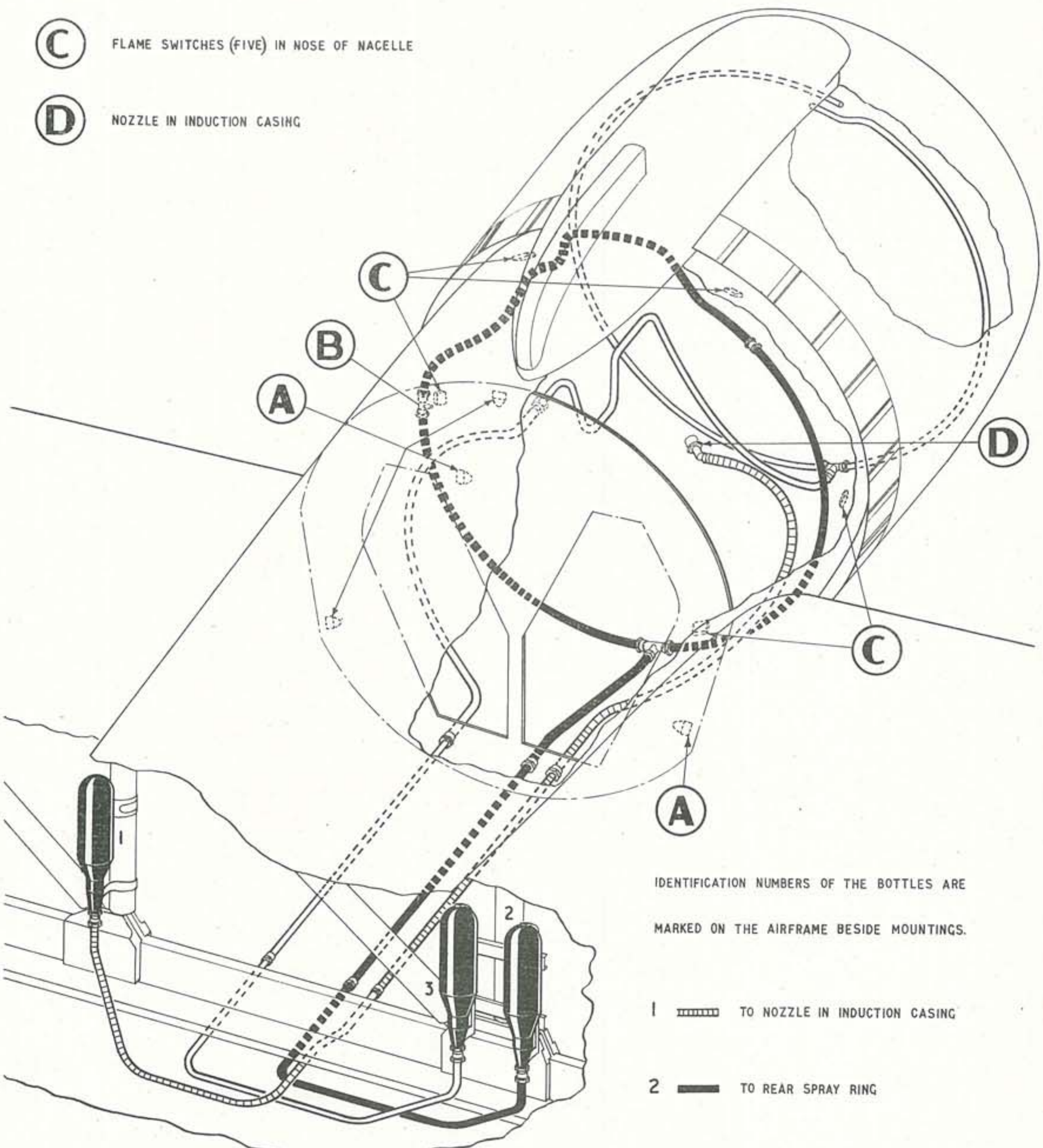
FIG. 3.

(A) FLAME SWITCHES (FOUR) ON FORWARD FACE OF FIREWALL

(B) AIR PIPE CONNECTION FOR CLEANING PURPOSES

(C) FLAME SWITCHES (FIVE) IN NOSE OF NACELLE

(D) NOZZLE IN INDUCTION CASING



IDENTIFICATION NUMBERS OF THE BOTTLES ARE MARKED ON THE AIRFRAME BESIDE MOUNTINGS.

1 TO NOZZLE IN INDUCTION CASING

2 TO REAR SPRAY RING

3 TO FRONT SPRAY RING

TYPICAL INSTALLATION

No.2. ENGINE SHOWN

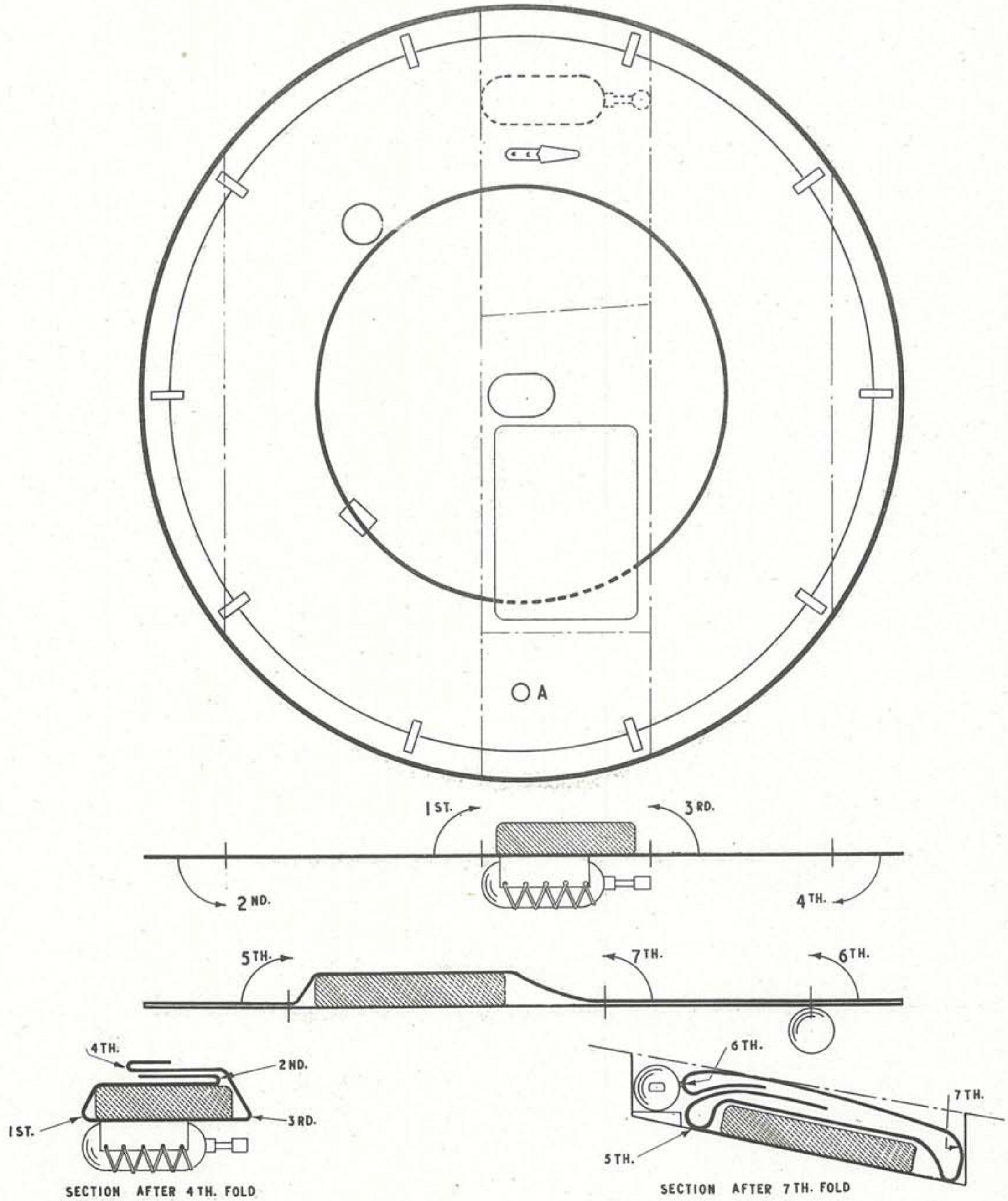
PIPE IDENTIFICATION COLOURS

1 NARROW WHITE 1 NARROW RED

ENGINE FIRE EXTINGUISHERS

FIG. 4

RSSO/TP/1067
ISSUE 1 DATE JAN 47



BEFORE FOLDING

COMPLETELY DEFLATE DINGHY WITH PUMP AND REMOVE DUST CAP FROM SAFETY TOPPING VALVE. (A)

AFTER FOLDING

1. CHECK CO_2 AND ELECTRIC CONNECTIONS ARE CORRECTLY MADE AND CYLINDER CORRECTLY SEATED ON BEARERS.
2. SECURE FREE END OF DINGHY PAINTER TO INTERIOR OF STOWAGE.
3. WHEN FITTING STOWAGE COVER, ENSURE THAT NO PART OF DINGHY EXCEPT CYLINDER HOUSING, IS TRAPPED BETWEEN CYLINDER CRUTCHES. STOWAGE COVER MUST SEAT WITHOUT NECESSITY FOR MORE THAN LIGHT HAND PRESSURE.

FOLDING TYPE 'J' DINGHY

FIG. 5

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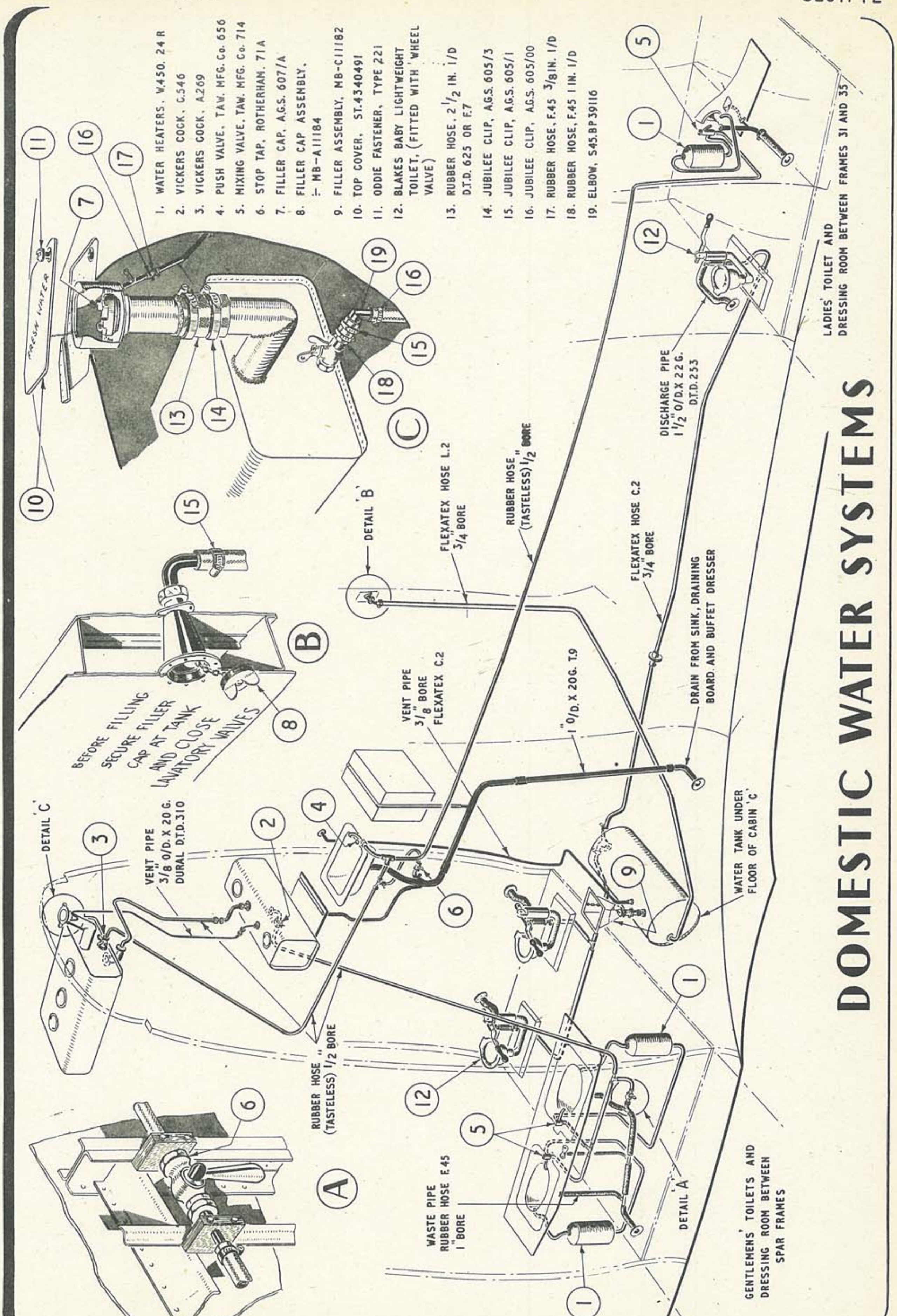


FIG.6

1	12·2·47
2	NOV. 48
3	FEB. 49

SOLENT 3

MAINTENANCE MANUAL

SECTION 13

GROUND EQUIPMENT

Contents

Illustrations

Prepared by Short Brothers & Harland Ltd. Feb. 1951.

1. General

This section describes and illustrates the ground equipment available and, where necessary, gives any special point regarding maintenance. Illustrations showing the equipment in use are included, the necessary operational notes being given in the illustrations. A complete list of the ground equipment, together with the part numbers, is given at the end of the section.

2. Weight Limits -

When using the beaching gear or jacking trestles, the following are the limiting conditions of the weight. -

2.1. There must be no personal effects on board.

2.2. Fuel must not exceed 1,100 gall.

2.3. Personnel should be limited to one, but if it is essential that more than one person be on board, the quantity of fuel allowed in 2.2. must be reduced accordingly, i.e. 25 gall. per person.

3. Beaching Gear -

For beaching, the aircraft is supported amidships by two main struts positioned, one on each side of the hull, under the main plane front spar-trusses, and at the aft end of the planing bottom the aircraft is supported by a tail trolley.

Each of the main struts is of welded steel construction and is mounted on two wheels fitted with pneumatic tyres. The axle pivots about the strut in a horizontal plane but can be locked in various positions by means of drop catches.

Tracking poles which fit into the axle ends are provided for turning the wheels when on land.

The construction of the main struts is illustrated in fig. 1, and the method of fitting them to the aircraft is shown in fig.3 .

The tail trolley, with bearers shaped to the contours of the hull, is mainly of welded steel construction and is mounted on two pairs of wheels fitted with pneumatic tyres. The axles pivot horizontally but can be locked in various positions and the two pairs of wheels are coupled by cable between drums fitted at the top of the wheel struts. Tracking poles, fitted in a similar manner to those for the main struts, are also provided. The trolley is illustrated in fig. 2 and the method of fitting to the aircraft is shown in fig. 4.

WARNING.... At all times when the aircraft is on the beaching gear, the following precautions should be taken against static electricity. A length of chain or cable should be suspended from the aircraft or beaching gear with about 2 feet of the free end making contact with the ground. The other end should be in good metallic contact with the aircraft or beaching gear, contact over grease or paint is unsatisfactory.

4. Beaching Gear Tyre Pressures -

The tyres of the main struts should be maintained at a pressure of 95 lb/ sq.in. and those of the tail trolley at a pressure of 90 lb/sq.in.

5. Maintenance Cradles

For servicing engines and propellers, four cradles of tubular construction are provided to fit on the leading edge maintenance platforms. For access to the propellers and lower cylinders, extensions to carry light-alloy platforms can be fitted to the cradles. This equipment is illustrated in fig. 5.

WARNING.... The number of personnel on each cradle or platform at any one time MUST be limited to two. Failure to observe this may result in damage to the aircraft.

6. Safety Belt -

A safety belt is available for the use of personnel servicing engines and propellers. The belt is fitted with flexible cables for attachment to eye-bolts provided on the engine nose cowl.

7. Jacking Trestles -

Fig. 6 illustrates one of the two hydraulic jacking trestles used for removing the beaching gear on land. Fig. 7 shows the equipment in use and gives the necessary operating instructions. The following points should be observed when using the trestles. -

7.1. Warning - Only strengthened trestles incorporating Mod. 1032 and 1152 are to be used (see note on fig. 6)

7.2. The conditions of weight must be as defined in para. 2.

7.3. The port and starboard trestles must be operated simultaneously, as far as possible, to keep the aircraft on an even keel.

7.4. When detaching the beaching gear, the main struts should be removed before the tail trolley.

7.5. When re-fitting the beaching gear, the tail trolley should be fitted before the main struts.

8. Filling Jacking Trestle Oil Reservoir -

With the hydraulic ram in the fully down position, fill the reservoir as follows. -

8.1. Open the taps located one at each end of the supply pipe.

8.2. Open the release valve.

8.3. Remove the vent plug from the side of the pump body.

8.4. Remove the filler cap from the top of the reservoir and fill with oil type 10. H.D. until it exudes from the vent hole.

8.5. Replace the vent plug and then completely fill the reservoir.

8.6. Replace the filler cap and screw home the release valve.

The oil filter in the filler orifice can be removed for cleaning after detaching the trestle bracing member immediately above the filler cap.

9. Storage of Jacking Trestles -

The taps in the oil pipe between reservoir and pump body should be closed when the trestles are in storage.

10. Tail Trolley Jacking Trestles -

Jacking trestles are provided for use under the tail trolley to set the hull to the rigging position. These trestles and the method of use are illustrated in Sect. 2, fig. 9.

11. Beaching Gear Wheel Changing -

Special lifting beams are provided for use with standard 8-ton jacks to raise the main struts or tail trolley for changing wheels. Fig. 8 shows the equipment in use and gives the necessary operating instructions.

12. Beaching Gear Removal - See para. 7.

13. Engine Derrick -

A derrick is provided to fit on the engine nacelles for the removal of propellers and engines. Fig. 9 illustrates the derrick and gives the necessary instructions for erection.

14. Fin Maintenance Ladder -

Attachments are provided on the fin for fitting a ladder to facilitate servicing operations. The ladder is of tubular construction and is shown in position in fig. 10.

15. Tail Plane Access Ladder -

A ladder is provided to give access to the tail plane when the aircraft is water-borne. The ladder, which hooks into a hand-hole in the dorsal fin is illustrated in fig. 11.

16. Towing Gear -

Towing cables and tractor attachment fittings are provided for forward towing and side tracking the aircraft. The gear is illustrated in fig. 12 and 13 respectively.

NOTE .... The beaching gear main struts should be jacked while turning the wheels to the side tracking position.

17. Rigging Boards -

Rigging boards are available for checking the main plane incidence, tail plane incidence and dihedral, and for setting ailerons. The part numbers of these items are given in the list at the end of this section and illustrations showing the equipment in use are given in Sect. 2.

18. Low-level Tail Trolley -

A special low trolley is available to reduce to a minimum the overall height of the aircraft (top of fin) for housing purposes. A strop, which fits round the tail end of the hull is provided for lifting the aircraft when fitting the low tail trolley.

19. Protective Covers

Covers are provided for the coupé, engines and pressure-heads (see fig. 15). The pressure-head covers are normally stowed on the aircraft in a canvas bag fitted on the forward face of the front spar-frame bulkhead, adjacent to the crew rest chair.

LIST OF GROUND AND ANCILLARY EQUIPMENT

Description	No. per A/C.	Part No.	Remarks
Beaching Gear			
Main Strut (port)	1	S45.C.30002	Illustrated in fig. 1.
Main Strut (stbd.)	1	S45.C.30003	
Tail Trolley	1	S45.C.30004	Illustrated in fig. 2.
Low-level Tail Trolley	1	S45.C.30001	Illustrated in fig. 14.
Engine and Propeller Changing Gear			
Engine and Propeller changing gear complete	1	S45.CP.30123	Illustrated in fig. 9.
Including - Engine sling	1	S45.CP.30100	
Extension handle	1	S45.B.30109	For operating the adjustable beam of the engine sling.
Guard for propeller hub	1	S45.BP.30759	For protecting the splines of the propeller shaft when lowering the propeller.
Propeller sling	1	S45.AP.30732	
Engine Maintenance Cradles			
Inner Engine - Cradle No. 1	1	S45.C.30402	Fit on leading edge maintenance platforms
Inner Engine - Cradle No. 2	1	S45.C.30403	
Outer Engine - Cradle No. 3	1	S45.C.30401	
Outer Engine - Cradle No. 4	1	S45.C.30400	
Auxiliary Cradles	4	S45.C.30206	For access to propellers and lower cylinders.
Extension Platforms	4	S45.C.30205	Fit on leading edge maintenance platforms for access to propellers.
Support cable - (inner nacelle)	2	S45.B.30208/A)	) Support extension platforms from engine derrick.
Support cable - (outer nacelle)	2	S45.B.30208/B)	
Bracing cable and	1	S45.B.30208/E)	) From the inboard platform of the inner nacelle to the hull.
Eye-bolt	1	S45.D.30216)	

Description	No.per A/C.	Part No.	Remarks
Bracing cable	1	S45.B.30209/A	From the outboard platform of the inner nacelle to the main plane.
Bracing cable	1	S45.B.30209/B	From the inboard platform of the outer nacelle to the main plane.
Bracing cable	1	S45.B.30209/C	From the outboard platform of the outer nacelle to the main plane.
Platform Jib	2	S45.C.30201	For suspension of the extension platforms.
Support cables	2	S45.B.30208/C	For inner nacelle platform jib.
Support cables	2	S45.B.30208/D	For outer nacelle platform jib.
Gang Planks	2	S25.C.30204	For use on maintenance cradles, auxiliary cradles, and extension platforms.
Jacking Equipment			
Jacking Trestles	2	S25.C.31012	For removal of beaching gear.
Jacking Trestles (tail trolley)	2	S45.B.31000)	For setting aircraft to the rigging position.
Jacking Block (8 in.)	1	S45.A.31001)	
Jacking Block (15 in.)	1	S45.A.31000)	
Jacking Beam	2	S45.A.31002)	For changing wheels of beaching gear.
Jack - 8 ton screw-pillar type.		AM. Ref.4Q/1204)	
Jack - Skyhi (25 ton)		M.G. 424	For jacking beaching gear main struts while turning wheels to side-tracking position.
Ladders			
Fin and Rudder Maintenance	1	S45.C.30203	
Tail Plane	1	S45.CP.30407	Provides access to tail plane while aircraft is water-borne.
Lifting Strop			
Tail	1	S45.CP.31002	For lifting aircraft when fitting special low-level tail trolley.

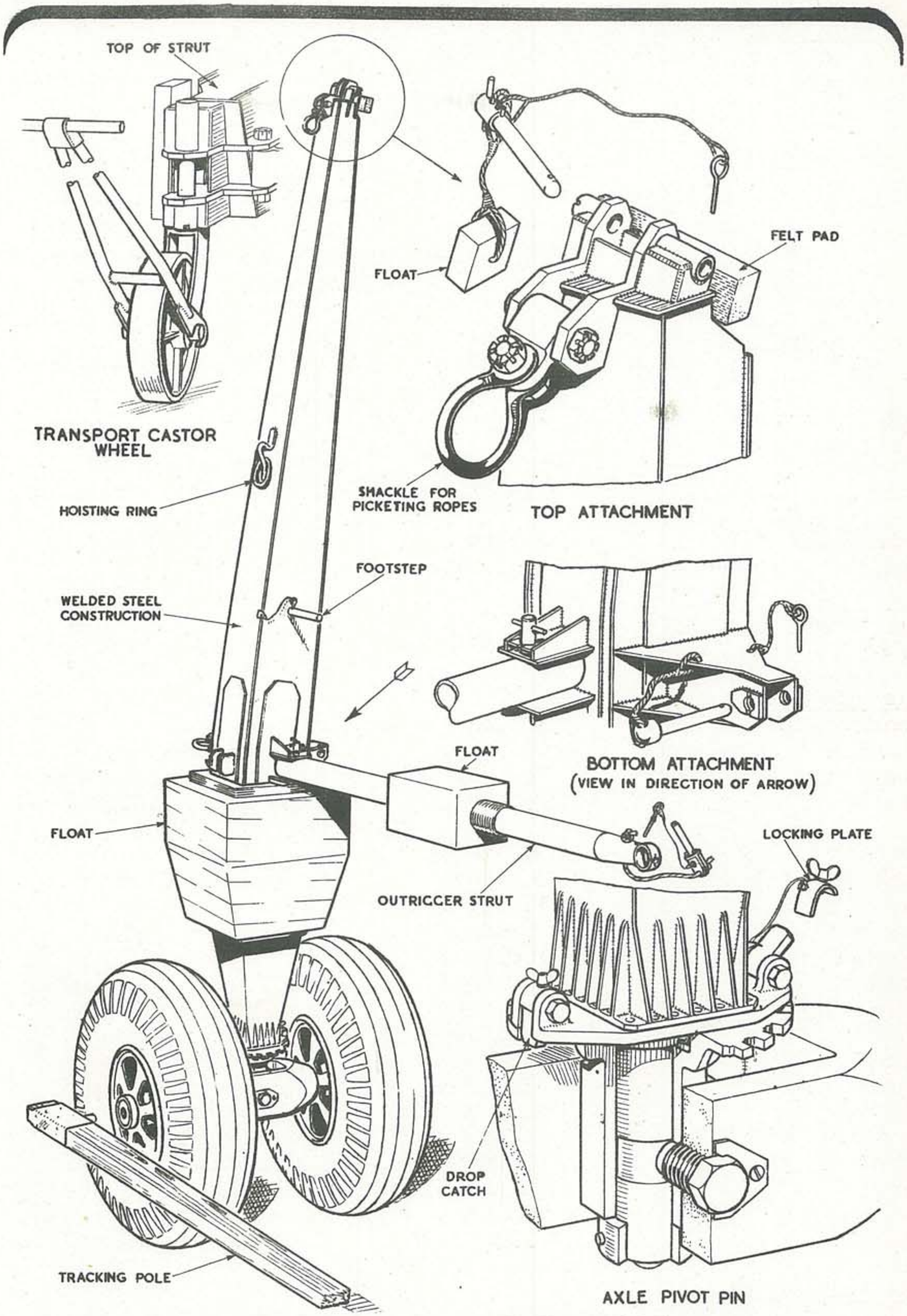
Description	No. per A/C.	Part No.	Remarks
Rigging Boards			
Tail Plane Incidence			
Port inner	1	S45.B.23302	
Port outer	1	S45.B.23304	
Stbd. inner	1	S45.B.23303	
Stbd. outer	1	S45.B.23305	
Main Plane Incidence			
Port inner	1	S25.A.29102	
Port outer	1	S25.A.29100	
Stbd. inner	1	S25.A.29103	
Stbd. outer	1	S25.A.29101	
Tail Plane Dihedral	1	S45.A.23275	
Main Plane Profile Boards. -			
Inner	1)		
Outer	1)	S45.C.229000	For setting ailerons
Safety Belt	1	S25.A.30219	For personnel servicing engines and propellers.
Towing Gear			
Forward Towing	1	S45.C.60	
Side Tracking (front fittings)	1	S45.C.67	
Side Tracking (rear fittings)	1	S45.B.75	
Covers			
Coupé	1	S25.B.38309	
Engine (Port)	2	S45.CP.38302	
(Stbd.)	2	S45.CP.38303	
Pressure Head	2	A.S.2423	

LIST OF SPECIAL TOOLS

Description	Part No.	Remarks
Key	S25.AV.1143 (S.B.& H. Ltd.)	For beaching gear attachment lugs in hull.
Key - fuel tank filler	S45.DP.30219 (S.B.& H. Ltd.)	
Spanner	S25.D.30506 (S.B.& H. Ltd.)	For top fitting of beaching gear main strut.
Engine tools		
Screwdriver	F.B.97332	
Box spanner	F.B.63076	2 B.A. Universal
Box spanner	F.B.26407	¼" B.S.F.
Spanner	F.B.26464	2 B.A. x 4 B.A.
Spanner	F.B.26463	¼" x 5/16" B.S.F. for oil pump
Spanner	F.B.26462	5/16" x ⅜" B.S.F.
Spanner	F.B.26461	7/16" x ½" B.S.F.

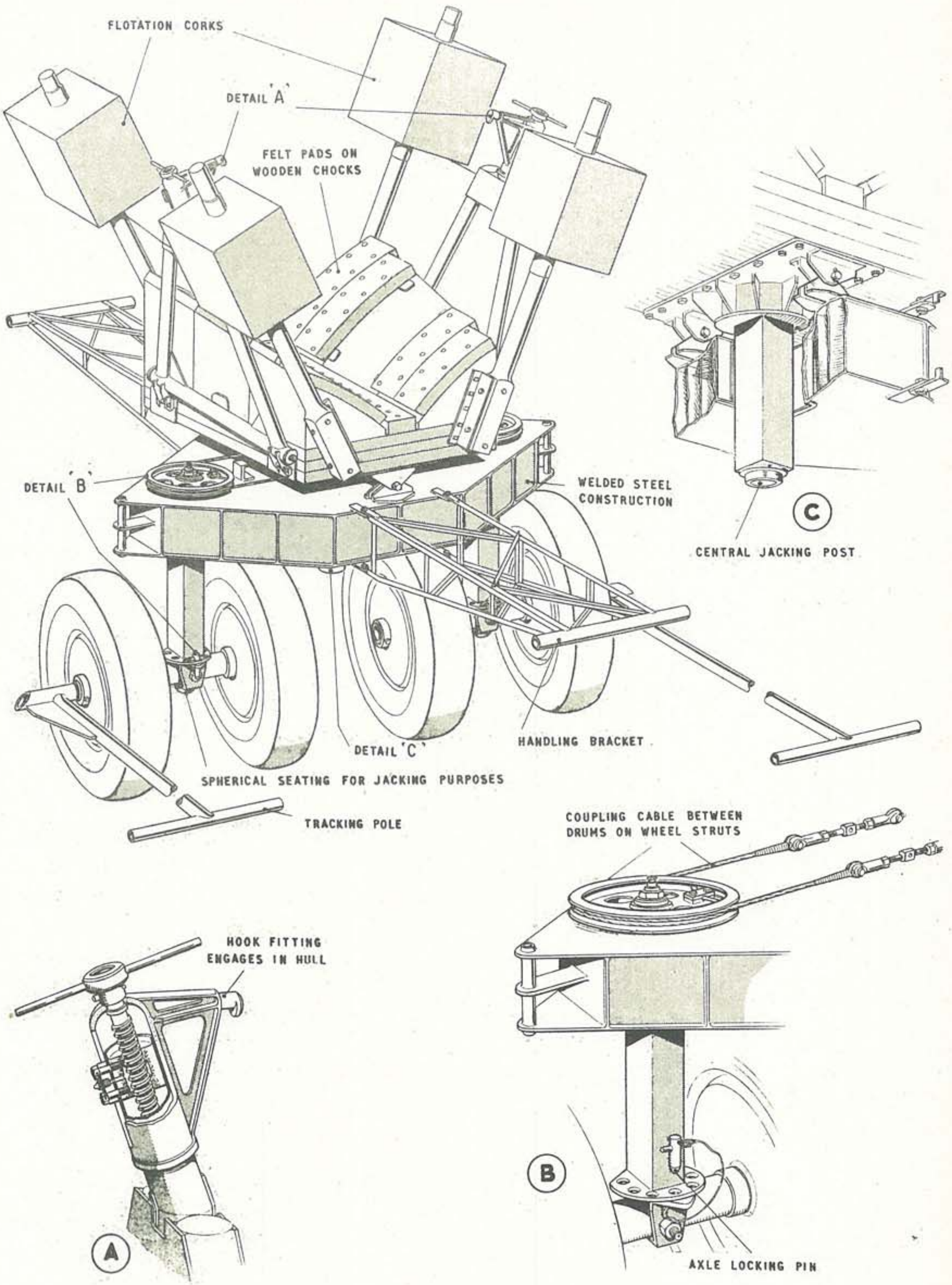
Description	Part No.	Remarks
Spanner	F.B.26460	9/16" x $\frac{5}{8}$" B.S.F.
Spanner	F.B.26459	11/16" x $\frac{3}{4}$" B.S.F. for oil pump.
Spanner	F.B.113476	$\frac{7}{8}$" x 1" B.S.F.
Box spanner	F.B.5427	2 B.A. x $\frac{1}{4}$"
Tommy bar	F.B.2319	$\frac{1}{4}$" dia.
Box spanner	F.B.63029	5/16" B.S.F. Universal
Spanner	F.B.97255	For oil sump nuts
Spannner	F.B.136944/2	For sparking plugs
or	F.B.154184	
Spanner	F.B.92635/3	For sparking plug elbow
Box spanner	F.B.79969	7/16" B.S.F.
Box spanner	F.B.26582	$\frac{1}{2}$" B.S.F.
Box spanner	F.B.7781/2	9/16" x $\frac{5}{8}$" B.S.F.
Tommy bar	F.B.26808	$\frac{3}{8}$" dia.
Tommy bar	F.B.26456	$\frac{1}{2}$" dia.
Oil gun	F.B.19160	"Enots"
Grease Gun	F.B.42462	"Tecalemit" (type T26)
Tools - Cylinders & Sleeves		
Hook	F.B.65993	For locking plate
Holder	F.B.66001	For cylinder sleeve
Indicator	F.B.105192	
Spindle	F.B.10593	For indicator
Pilot	F.B.123832	For cylinder sleeve
Spanner	F.B.90137	For induction belt bolt.
Spanner	F.B.154194	For induction pipe retaining nut.
Ring Spanner	F.B.154193	For induction pipe
Adaptor	F.B.90121	Ratchet
Handle	F.B.90130	Spanner
Spanner	F.B.90120/2	Cylinder head nuts (extended)
Spanner end	F.B.90120/2-1	Spare for F.B.90120/2
Spanner	F.B.90132	Cylinder nuts
Spanner	F.B.136945	For cylinder holding down nuts (R.H.)
Spanner	F.B.136946	For cylinder holding down nuts (L.H.)
Wrench	F.B.90119/3	"Sunner" tension
Spanner	F.B.123831	Sleeve ball housing and cylinder head nuts.
Shank	F.B.113481	For spanner F.B.123831
Tool	F.B.79940	For cylinder head ring
Tool	F.B.57399	For cylinder assembly
Tool	F.B.77670	For removing sleeve contracting ring.
Spanner	F.B.69551	Exhaust Snout nut
Tools - Rear Cover		
Extractor	F.B.65986	For distance piece (auxiliary drive)
Tube spanner	F.B.105140/2	
Box spanner	F.B.35234	4 B.A. for Tachometer casing screws.
Spanner	F.B.57389	Union body/union nut.
Extractor tool	F.B.87017	Tachometer casing

Description	Part No.	Remarks
Tools - Oil Sump		
Spanner	F.B.123805	For oil drain pipe.
Box spanner	F.B.137065	1¼" B.S.F. for drain valve body.
Tools - Piston		
Clip	F.B.66014	Compress piston/cylinder head ring.
Pliers	F.B.57411/2	For gudgeon pin circlips
Tool	F.B.113312	For assembling gudgeon pin circlips.
Tools - Crankcase		
Protector	F.B.66061	Crankcase and connecting rods (14 per set)
Tools - Magneto		
Extractor	F.B.53304	ATD coupling/magneto spindle
Holder	F.B.113477	Automatic advance/retard coupling.
Clutch	F.B.154151	Backlash on magneto
Magneto trimming box	S.E.1080	
Tools - Reduction Gear		
Wrench	F.B.66062	For turning engine.
Tools - Propeller		
Spanner	P.C.2000	Dome plug nut
Spanner	P.C.1730	Dome retaining nut
Spanner	P.C.1379	Propeller retaining nut
Tommy bar	P.C.1029	For spanners P.C.1730 and P.C. 1379.
Extractor	P.C.1565	Stop rings.
Extractor	P.C.1125	Oil transfer sleeve
Spanner	P.C.1368	Oil transfer tube
Tommy bar	P.C.1384	For spanner P.C.1368
Extractor	P.C.1566	Lock plate
Spanner	P.C.1091	C.S.U. max. r.p.m. stop
Handle	P.C.1518	Dome lifting
or	P.C.2035	Dome lifting C/W cap
Adaptor	P.C.2027	Dome lifting handle
Spanner	P.C.1890	Distributor housing
Extractor	P.C.2001	Dome plug
Tommy bar	P.C.1018	Valve housing wrench
Spanner	P.C.1794	C.S.U. retaining nuts
Stand	P.C.1609	For assembly
Plug	P.C.1773	Spider alignment
Spanner	P.C.1377	Blade retaining nuts
Tools - Miscellaneous		
Spanners	S.P.1	For flushing pump top of Blakes toilet.



BEACHING GEAR MAIN STRUT

FIG. 1



BEACHING GEAR TAIL TROLLEY

FIG. 2

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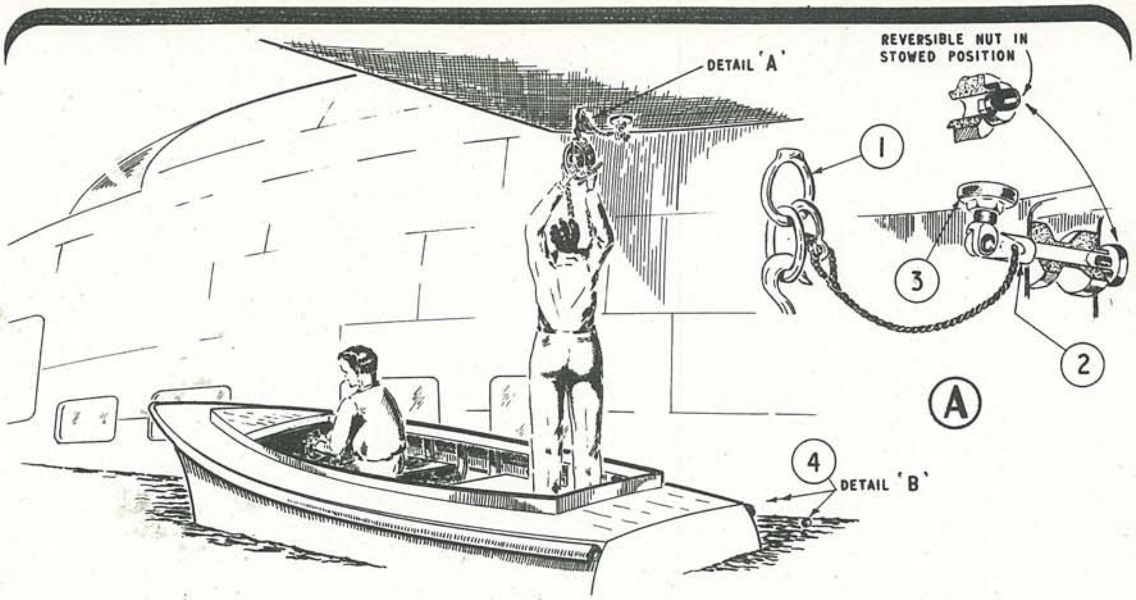
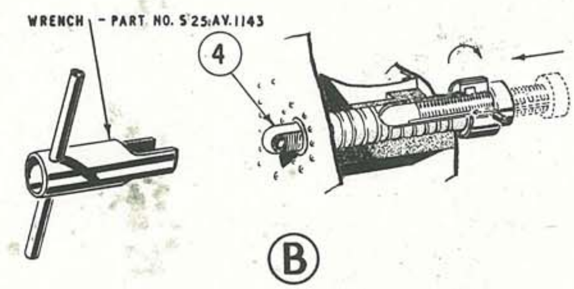
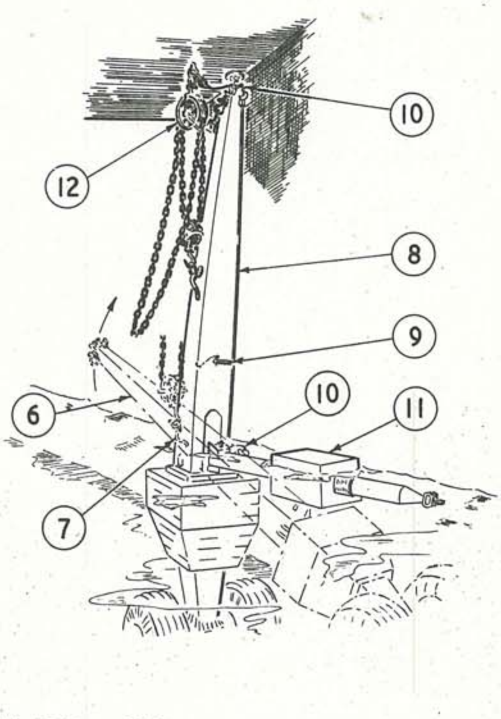


ACCESS TO UNDER SURFACE OF MAIN PLANE

(a) PREPARATION OF AIRCRAFT

1. FIT RING BOLT AND ATTACH BLOCK AND TACKLE
2. INSERT FIXING PIN AND SECURE WITH REVERSIBLE NUT
3. SCREW UP KNURLED CAP AGAINST UNDER SURFACE OF THE MAIN PLANE (HAND TIGHT)
4. SCREW OUT THE ATTACHMENT LUGS TO THEIR FULLEST EXTENT





(b) PREPARATION OF CHASSIS

5 REMOVE TRANSPORT CASTOR WHEEL

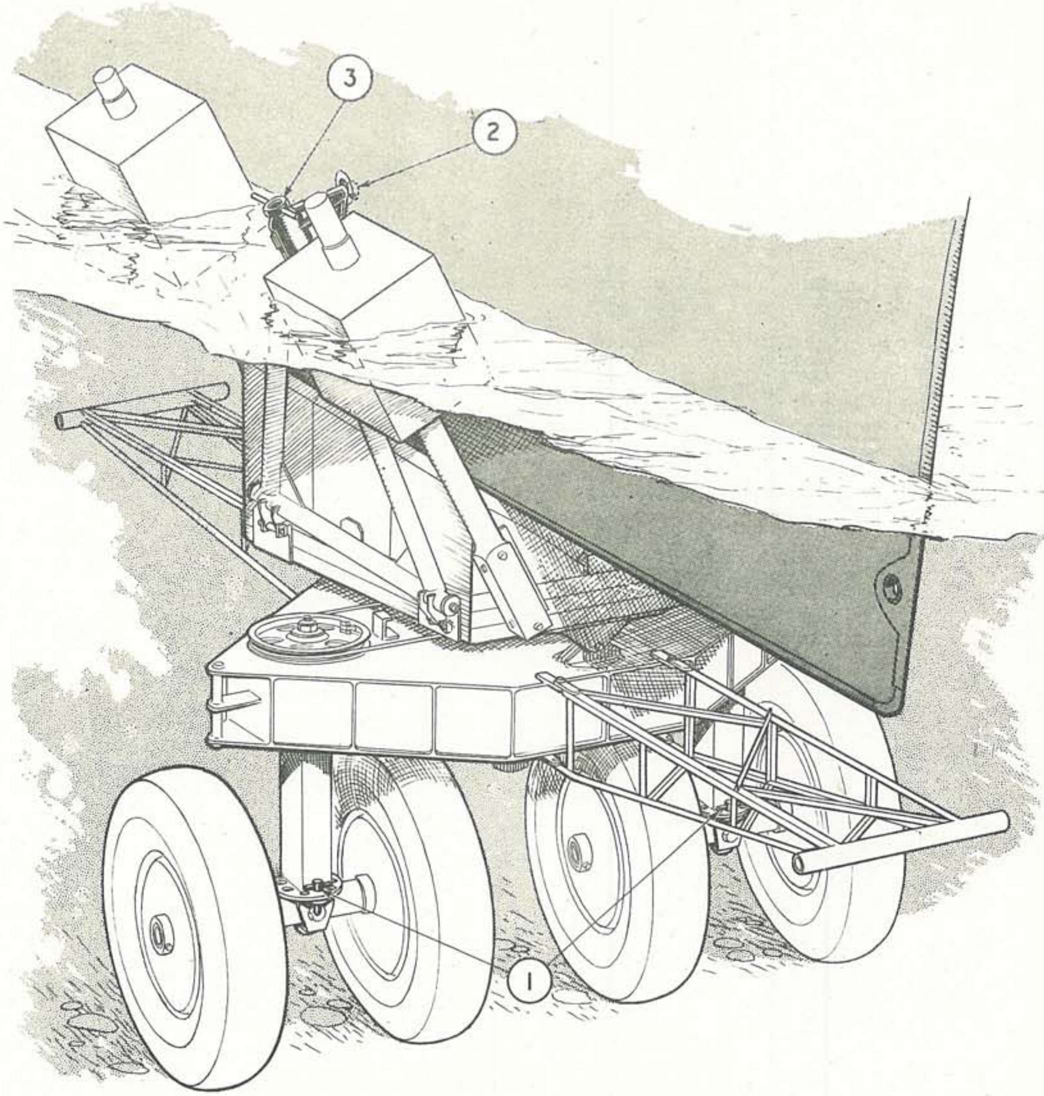
6. TEMPORARILY REMOVE FOOTSTEP, FLOAT CHASSIS TO AIRCRAFT AND MANOEUVRE IT ALONGSIDE WITH STRUT INCLINED FORWARD AS SHOWN

(C) ATTACHMENT OF MAIN STRUTS

7. COUPLE BLOCK AND TACKLE TO RING ON STRUT
8. HOIST TO VERTICAL POSITION
9. FIT FOOTSTEP
10. INSERT BOTTOM AND TOP FIXING PINS USING FOOTSTEP FOR ACCESS TO LATTER
11. ATTACH OUT-RIGGER STRUT
12. REMOVE BLOCK AND TACKLE

BEACHING (1)

FIG. 3



①— ENSURE THAT LOCKING PINS ARE IN POSITION WITH THE WHEELS FORE-AND-AFT

②— FLOAT THE TROLLEY TO THE AIRCRAFT AND MANOEUVRE IT UNDER THE REAR STEP SO THAT THE HOOK ATTACHMENT FITTINGS CAN BE ENGAGED IN THE EYES IN THE HULL

③— TURN HANDSCREWS CLOCKWISE TO SECURE TROLLEY

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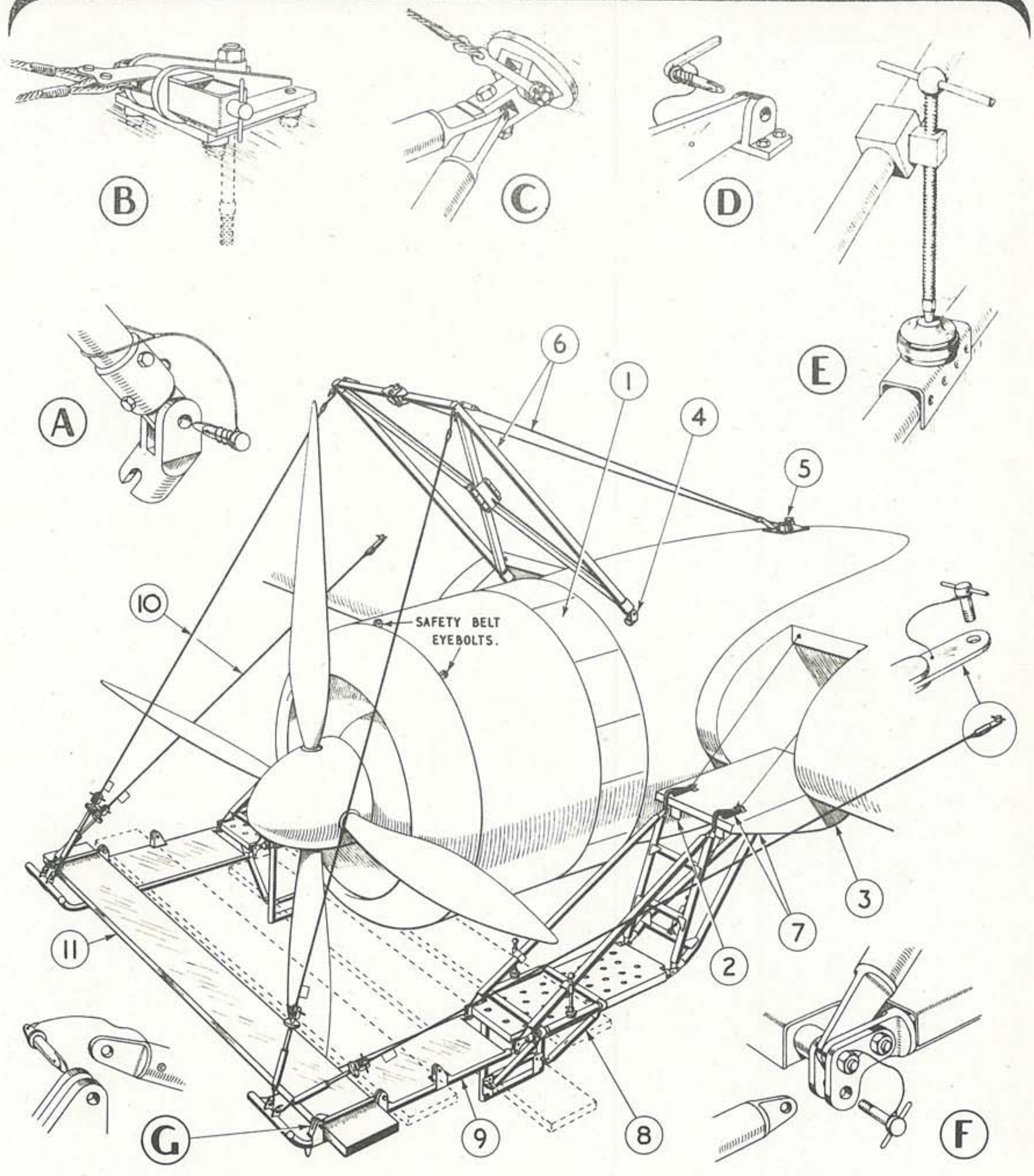
BEACHING(2)

FIG. 4



1. CLOSE COWLING GILLS.
2. OPEN THE COVERS OVER MAINTENANCE PLATFORM FASTENERS.
3. UNSCREW FASTENER HANDWHEELS AND LOWER PLATFORMS.
4. INSERT PLUGS IN SOCKETS ON NACELLE (DETAIL "A").
5. FIT REAR ANCHORAGE TO NACELLE (DETAIL "B").
6. ERECT PLATFORM JIB AND ATTACH ANCHOR CABLES.
7. FIT THE CRADLES (DETAILS "C" & "D").
8. FIT AUXILIARY CRADLES AND SECURE WITH CLAMPS (DETAIL "E").
9. FIT CRADLE EXTENSIONS (DETAIL "F").
10. ATTACH SUSPENSION AND BRACING CABLES.
11. GANG PLANK CAN BE FITTED AS SHOWN, OR IN EITHER OF ALTERNATIVE POSITIONS, (SHOWN IN DOTTED LINES). SECURE WITH STRAP (DETAIL "G"), OR CLAMP (DETAIL "E").

MAINTENANCE CRADLES

FIG 5.

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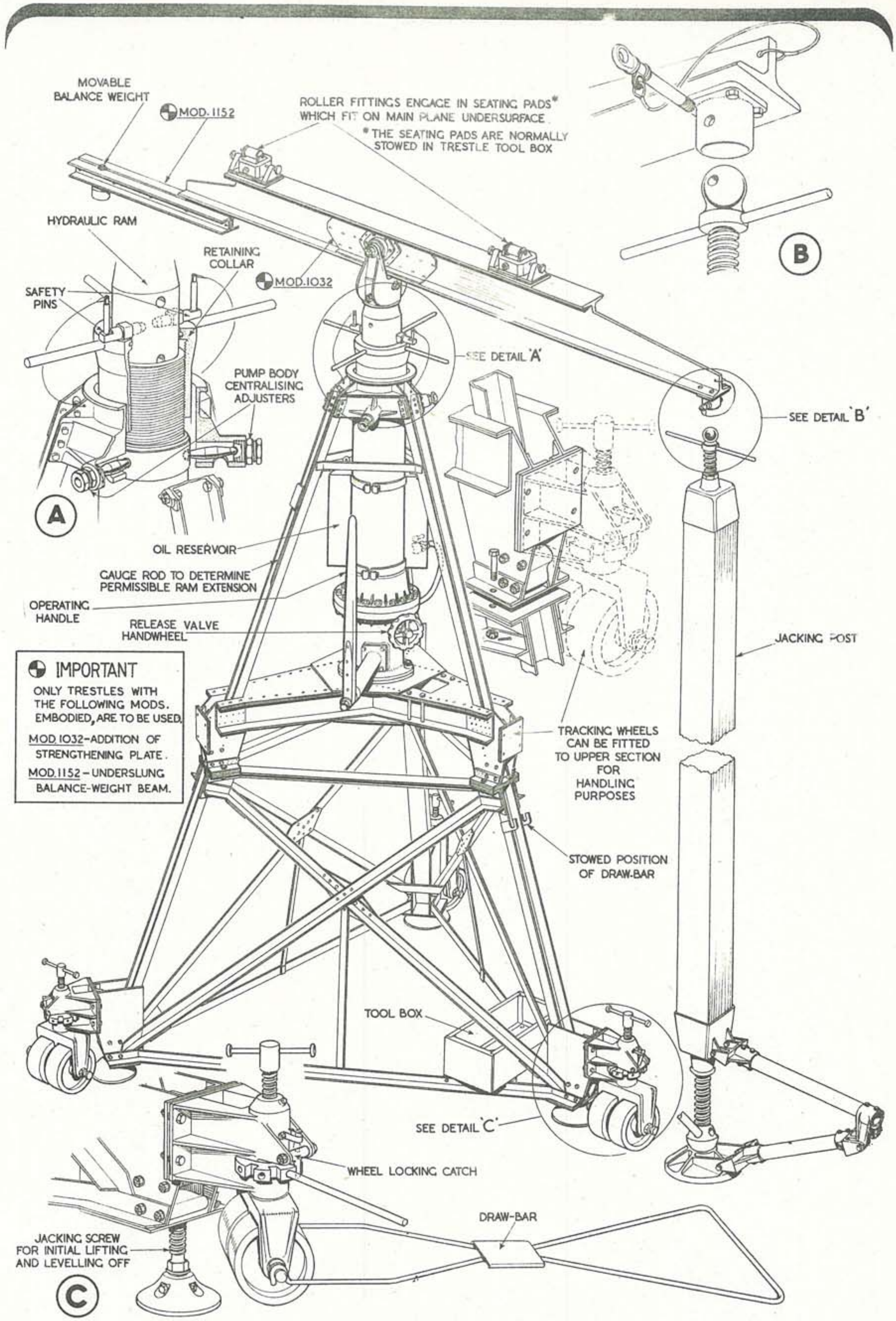

JACKING TRESTLE

FIG. 6

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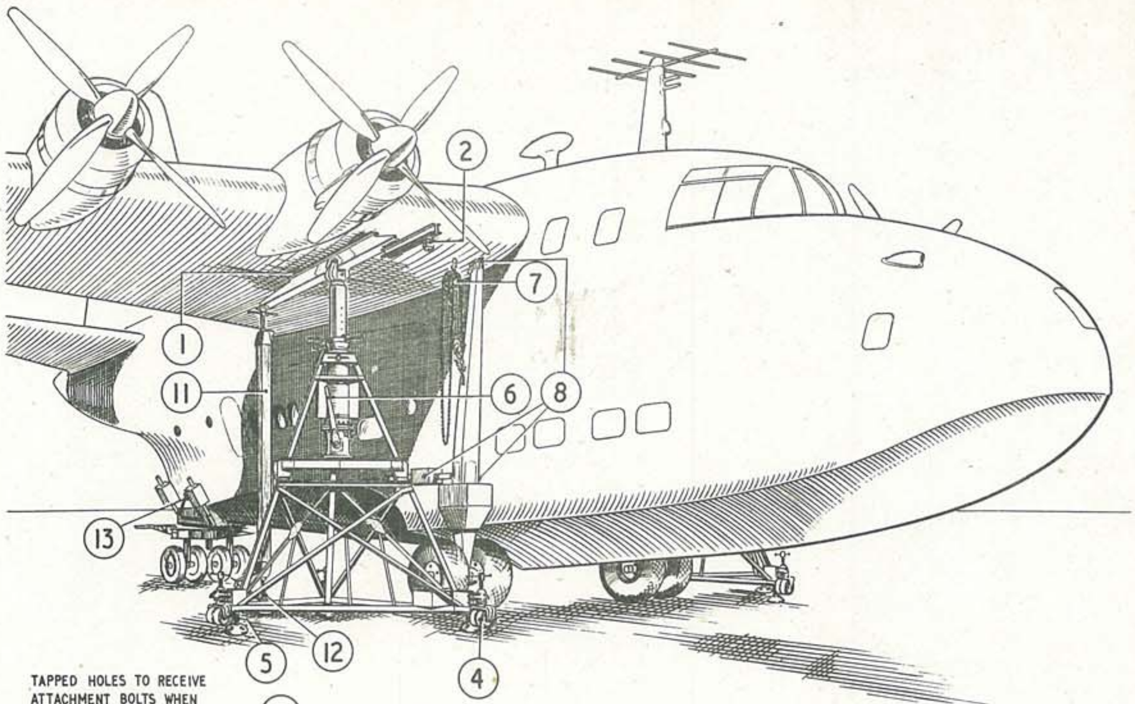

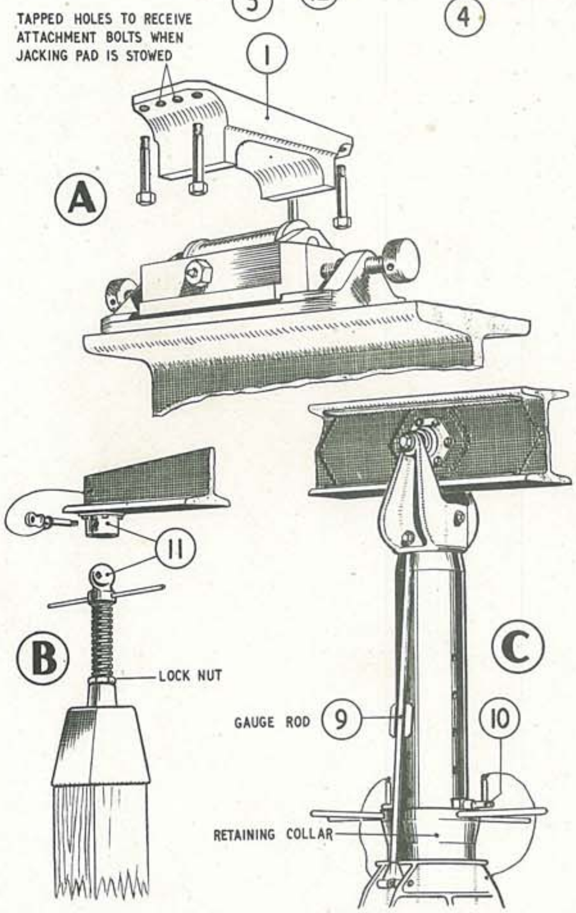

1. BOLT THE JACKING PADS (STOWED IN TRESTLE TOOL BOX) TO MAIN PLANE UNDERSURFACE (DETAIL **A**)
2. BALANCE PIVOTED BEAM BY ADJUSTING MOVABLE WEIGHT.
3. WHEEL TRESTLES INTO POSITION SO THAT ROLLERS ON BEAM ARE DIRECTLY BELOW PADS ON MAIN PLANE.
4. SCREW UP TRACKING WHEELS SO THAT TRESTLES REST ON ADJUSTABLE FEET.
5. OPERATE SCREW-JACKS AT BASE TO RAISE AND LEVEL OFF.
6. OPERATE PUMP HANDLE TO RAISE RAM, CHECKING THAT ROLLERS ON BEAM ENTER PADS ON MAIN PLANE. RAISE RAM TO JUST TAKE THE LOAD OFF BEACHING GEAR MAIN STRUTS.
7. ATTACH BLOCK AND TACKLE TO RING BOLT ON MAIN PLANE AND COUPLE TO RING ON STRUT. TAKE UP SLACK IN CHAIN.
8. REMOVE OUTRIGGER AND TOP AND BOTTOM FIXING PINS. EASE STRUT AWAY FROM HULL AND LOWER TO GROUND.
9. SWING GAUGE ROD INTO POSITION (DETAIL **C**) AND OPERATE PUMP HANDLE TO RAISE AIRCRAFT TO THE REQUIRED HEIGHT. **NOTE...** THE RAM HAS REACHED THE MAX. PERMISSIBLE EXTENSION WHEN THE GAUGE ROD JUST FITS UNDER THE SHOULDER OF THE TOP FORK
10. INSERT THE SAFETY PINS INTO LOWEST HOLES IN RAM AND SCREW UP RETAINING COLLAR UNTIL IT TOUCHES THE PINS (DETAIL **C**) **WARNING...** THE RETAINING COLLAR SHOULD NEVER BE RAISED TO FULLY EXPOSE THE RED LINE ABOVE THE TOP CASTING.
11. POSITION JACKING POST UNDER SOCKET AT AFT END OF BEAM AND OPERATE UPPER JACK UNTIL BALL END ENTERS SOCKET. INSERT LOCKING PIN AND SCREW DOWN LOCK NUT (DETAIL **B**)
12. OPERATE LOWER JACK UNTIL THE LOAD IS JUST FELT.
13. RELEASE TAIL TROLLEY ATTACHMENTS FROM HULL SIDE
14. LOWER JACKING TRESTLE RAM GRADUALLY UNTIL TAIL END OF HULL IS CLEAR OF TAIL TROLLEY.

BEACHING GEAR REMOVAL

FIG. 7

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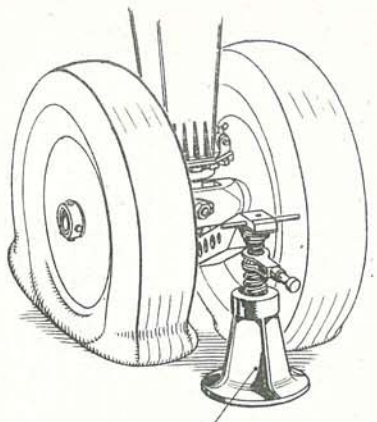

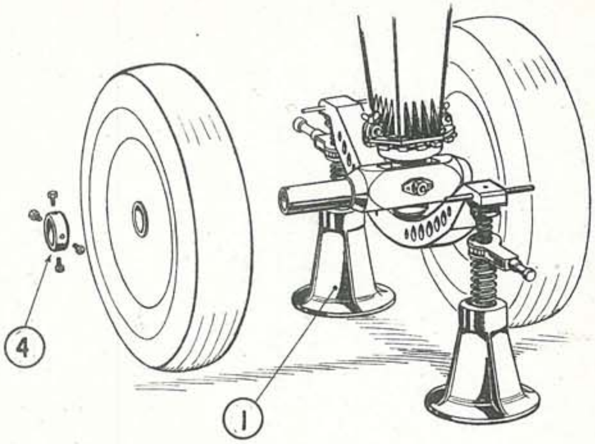

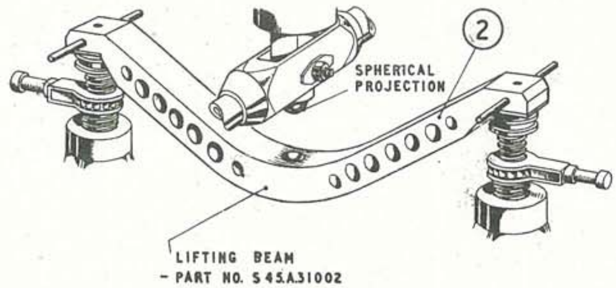

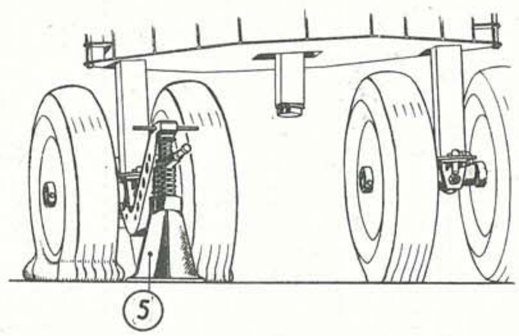

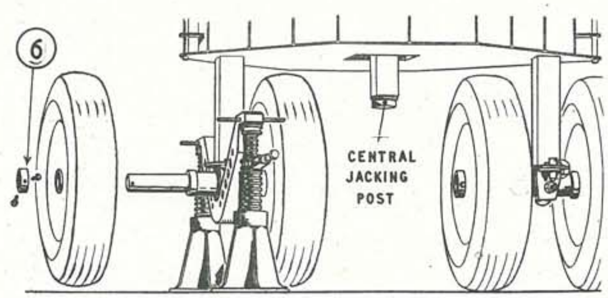

MAIN STRUT

(1) — POSITION JACKS. ONE ON EACH SIDE OF THE AXLE

(2) — PLACE THE LIFTING BEAM ON JACKS AND POSITION SO THAT SEATING ON BEAM IS DIRECTLY UNDER SPHERICAL PROJECTION ON STRUT

3 — OPERATE JACKS TO RAISE STRUT TO REQUIRED HEIGHT

(4) — REMOVE BOLTS AND WHEEL RETAINING COLLAR

TAIL TROLLEY

(a) WITH ONE TYRE FLAT

(5) — PLACE JACKS AND LIFTING BEAM UNDER TROLLEY STRUT, AND POSITION AS FOR THE MAIN STRUT (SEE (2) ABOVE)

(6) — OPERATE JACKS TO REQUIRED HEIGHT AND REMOVE BOLTS AND WHEEL RETAINING COLLAR

(b) WITH TWO TYRES FLAT ON THE SAME AXLE

7 — PLACE A JACK UNDER THE CENTRAL JACKING POST AND RAISE TROLLEY ABOUT 2 INCHES

8 — PLACE JACKS AND LIFTING BEAM IN POSITION (SEE (2)) AND PROCEED AS ABOVE

BEACHING GEAR WHEEL CHANGING

FIG. 8

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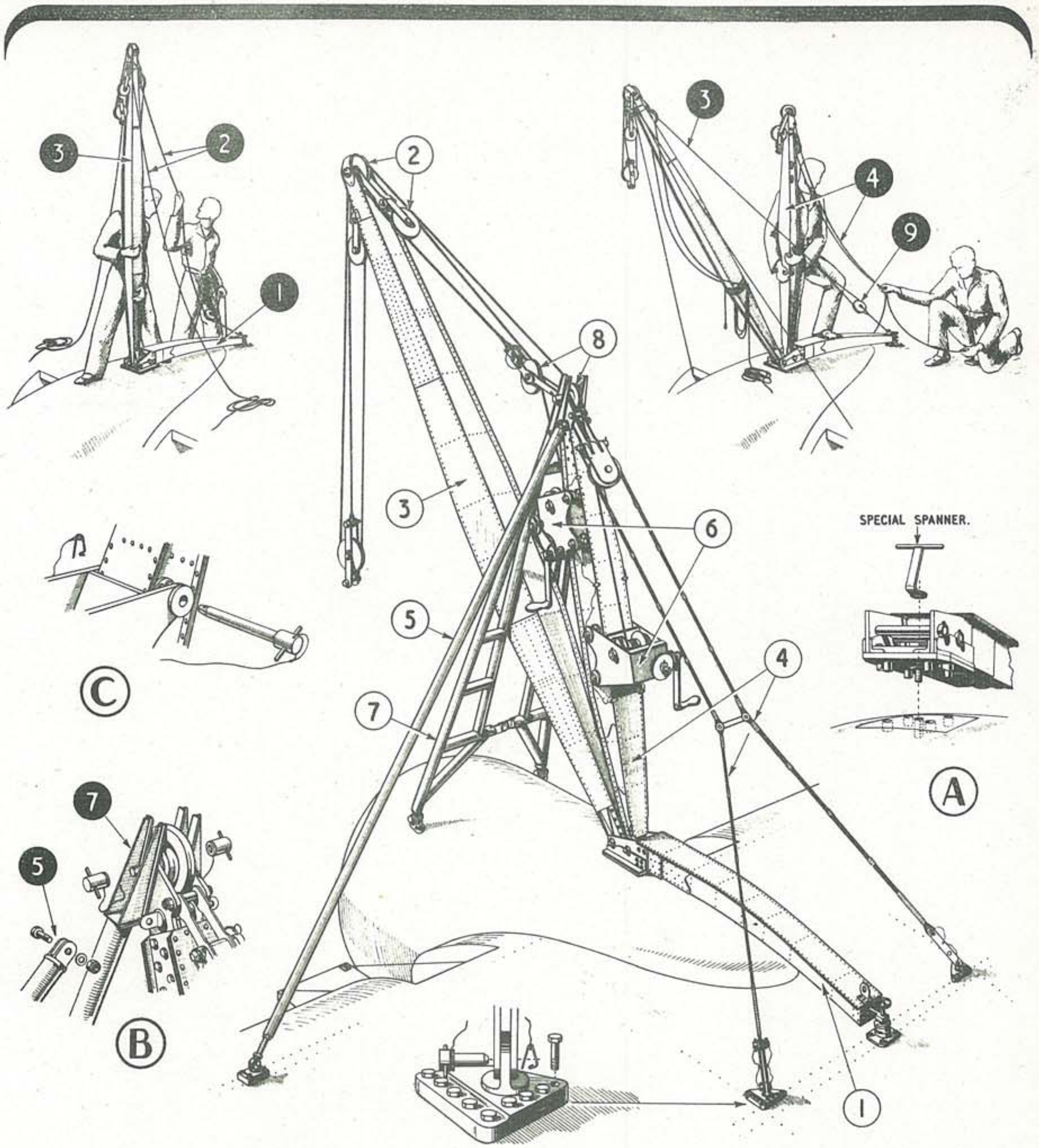

(1) REMOVE COVER PLATE ON NACELLE AND FIT BALANCE BEAM, ENSURING THAT THE BEAM LIES VERTICALLY ON NACELLE BY CHECKING WITH THE SADDLE PINS. (DETAIL "A".)

(2) DETACH HOISTING AND LUFFING CABLES FROM WINCHES AND FIT CABLES ON JIB PULLEYS. FIT A TWO-TO-ONE PURCHASE BLOCK AND ½" DIA. HEMP ROPE BETWEEN HEAD OF JIB AND REAR END OF BALANCE BEAM. FIT TWO STEADYING ROPES (1" CIRCUM.) TO HEAD OF JIB.

(3) LIFT JIB VERTICALLY AND LOCATE FORK FITTING AT BASE ON FORWARD PIN OF BALANCE BEAM. OPERATE BLOCK AND TACKLE TO LOWER JIB HEAD OVER ENGINE. TIE TACKLE SECURELY.

(4) ERECT MAIN POST ON REAR PIN AT HEAD OF BALANCE BEAM AND ATTACH ENDS OF BRACING CABLES TO MAIN PLANE REAR SPAR.

(5) FIT TUBULAR STRUT BETWEEN HEAD OF MAIN POST AND WING LIFTING POINT. (DETAIL "B".)

(6) FIT WINCHES TO MAIN POST. (DETAIL "C".)

(7) REMOVE PLUGS FROM NACELLE NOSE AND ERECT "A" FRAME, (WHICH IS IN HALVES TO FACILITATE FITTING,) TO HEAD OF MAIN POST. (DETAIL "B").

(8) PLACE HOISTING AND LUFFING CABLES OVER APPROPRIATE PULLEYS ON MAIN POST AND ATTACH THE ENDS TO THEIR RESPECTIVE WINDING DRUMS ON WINCHES. CABLES MUST ALWAYS BE PLACED ON DRUMS TO LIE CLOSE TO MAIN POST.

(9) TAKE LOAD ON LUFFING WINCH AND SLACKEN OFF BLOCK AND TACKLE.

ENGINE DERRICK

FIG. 9.

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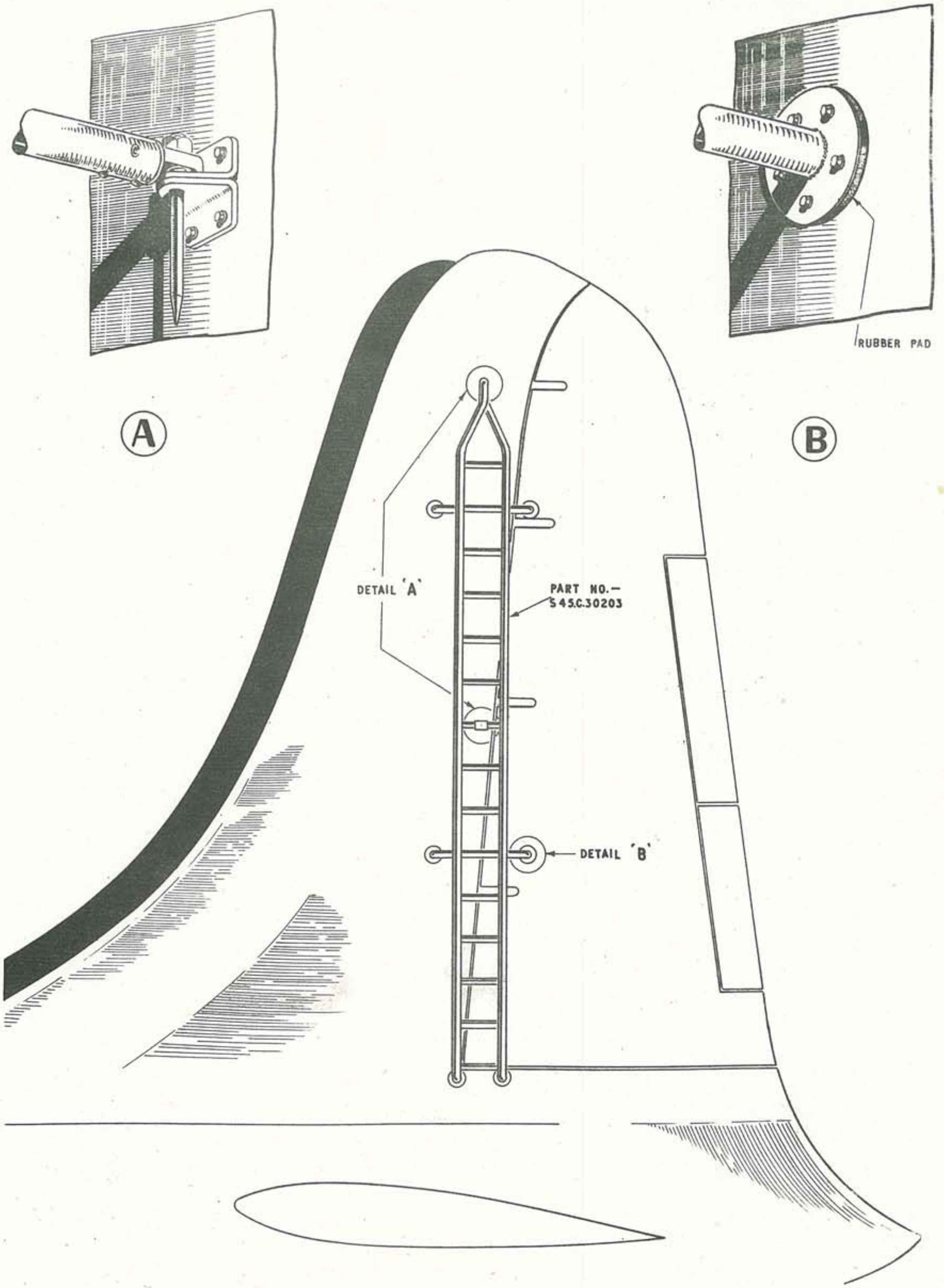

FIN MAINTENANCE LADDER

FIG. 10

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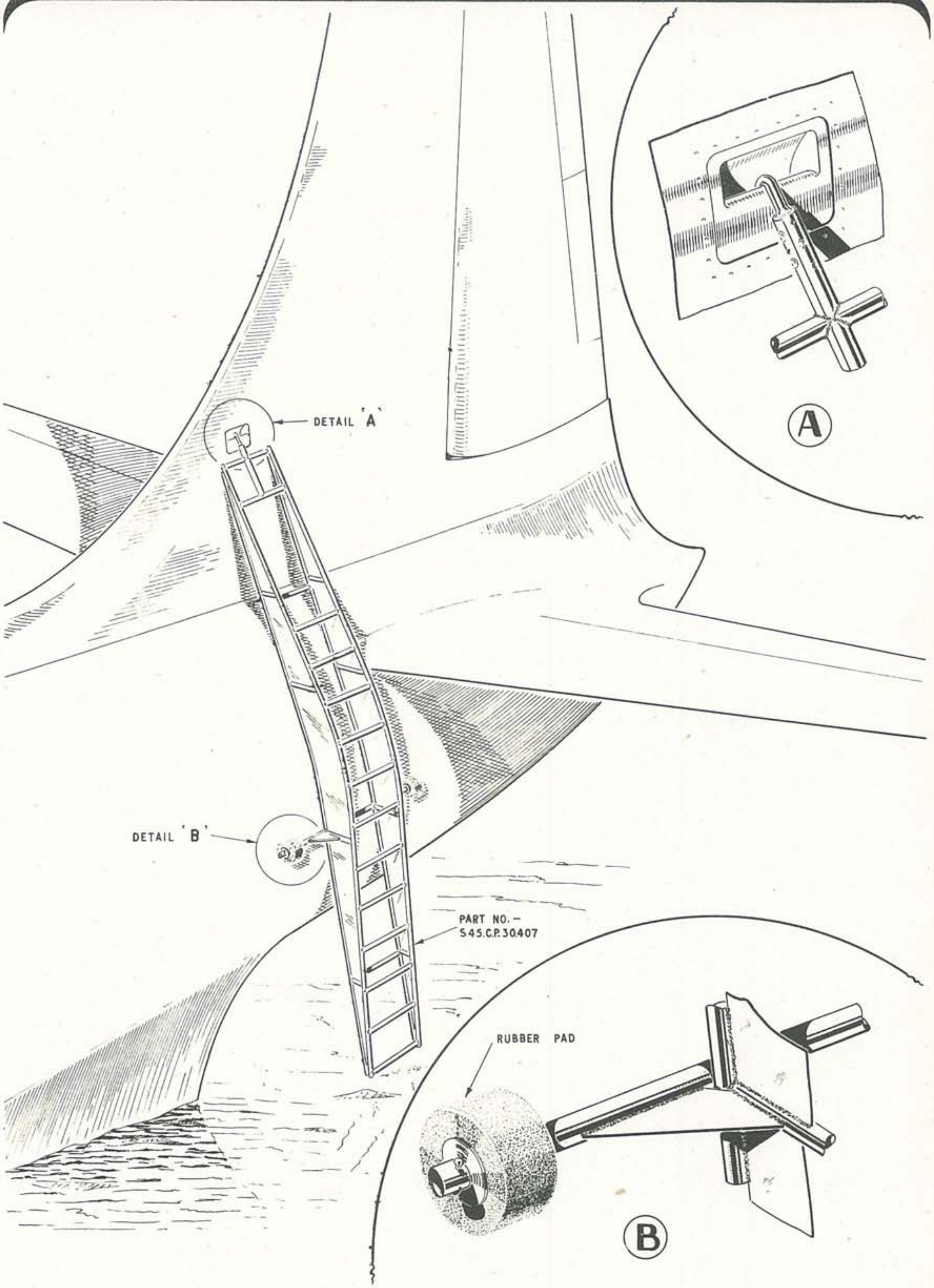

TAIL PLANE ACCESS LADDER

FIG. 11

R550/TP/107
ISSUE	DATE
1	12·12·47

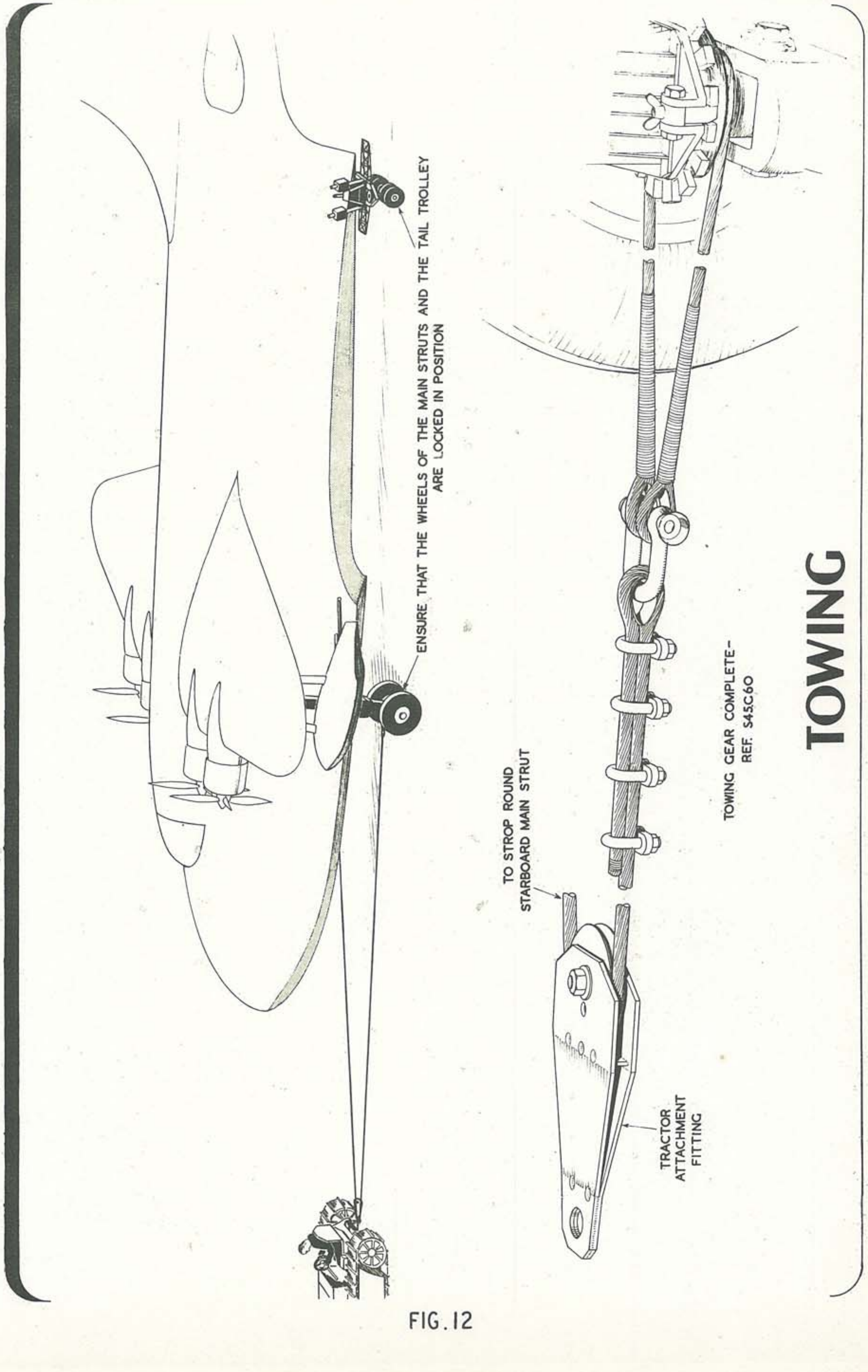
ENSURE THAT THE WHEELS OF THE MAIN STRUTS AND THE TAIL TROLLEY
ARE LOCKED IN POSITION
TO STROP ROUND
STARBOARD MAIN STRUT
TOWING GEAR COMPLETE-
REF. S45C60
TRACTOR
ATTACHMENT
FITTING
TOWING

FIG. 12

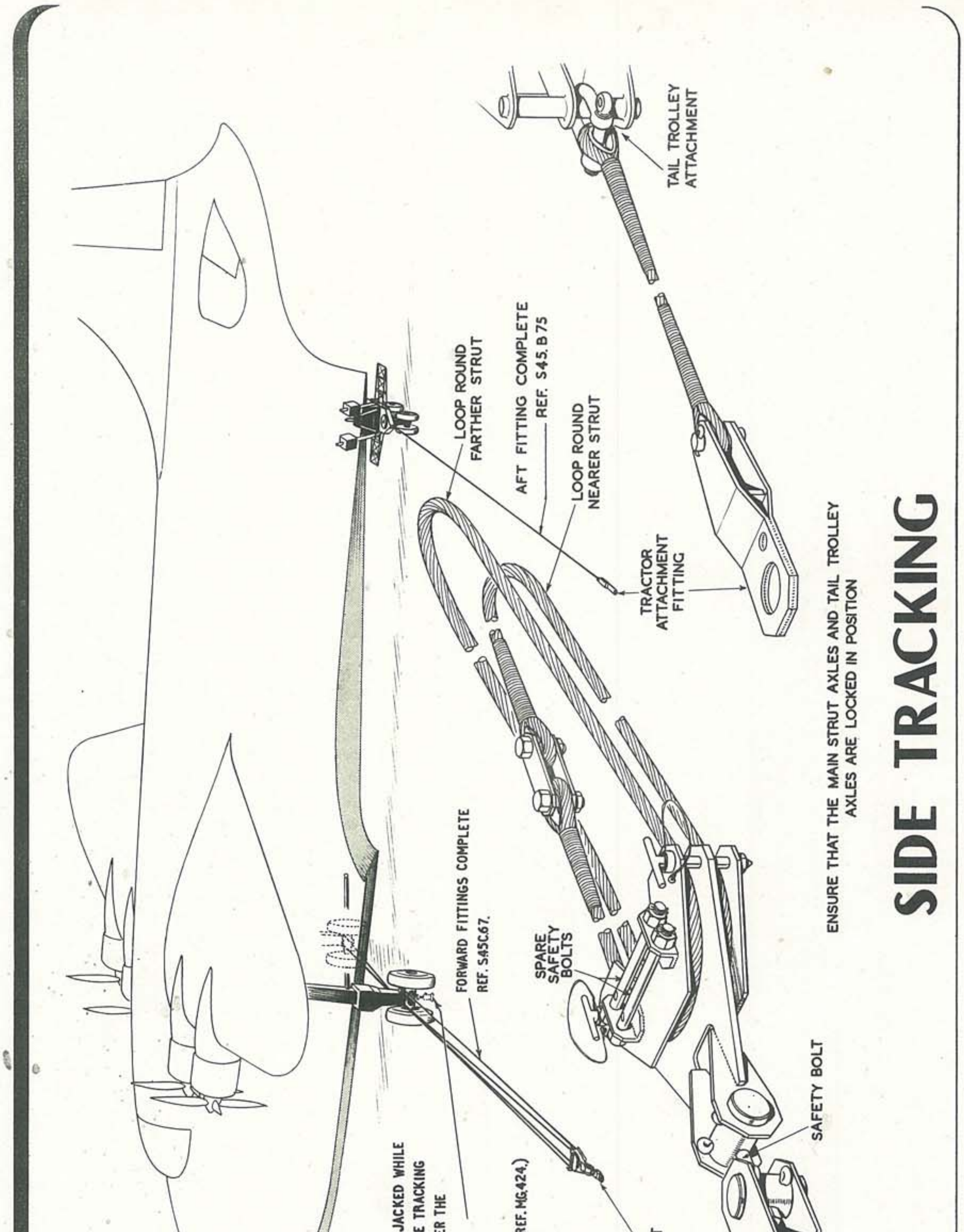

FIG. 13

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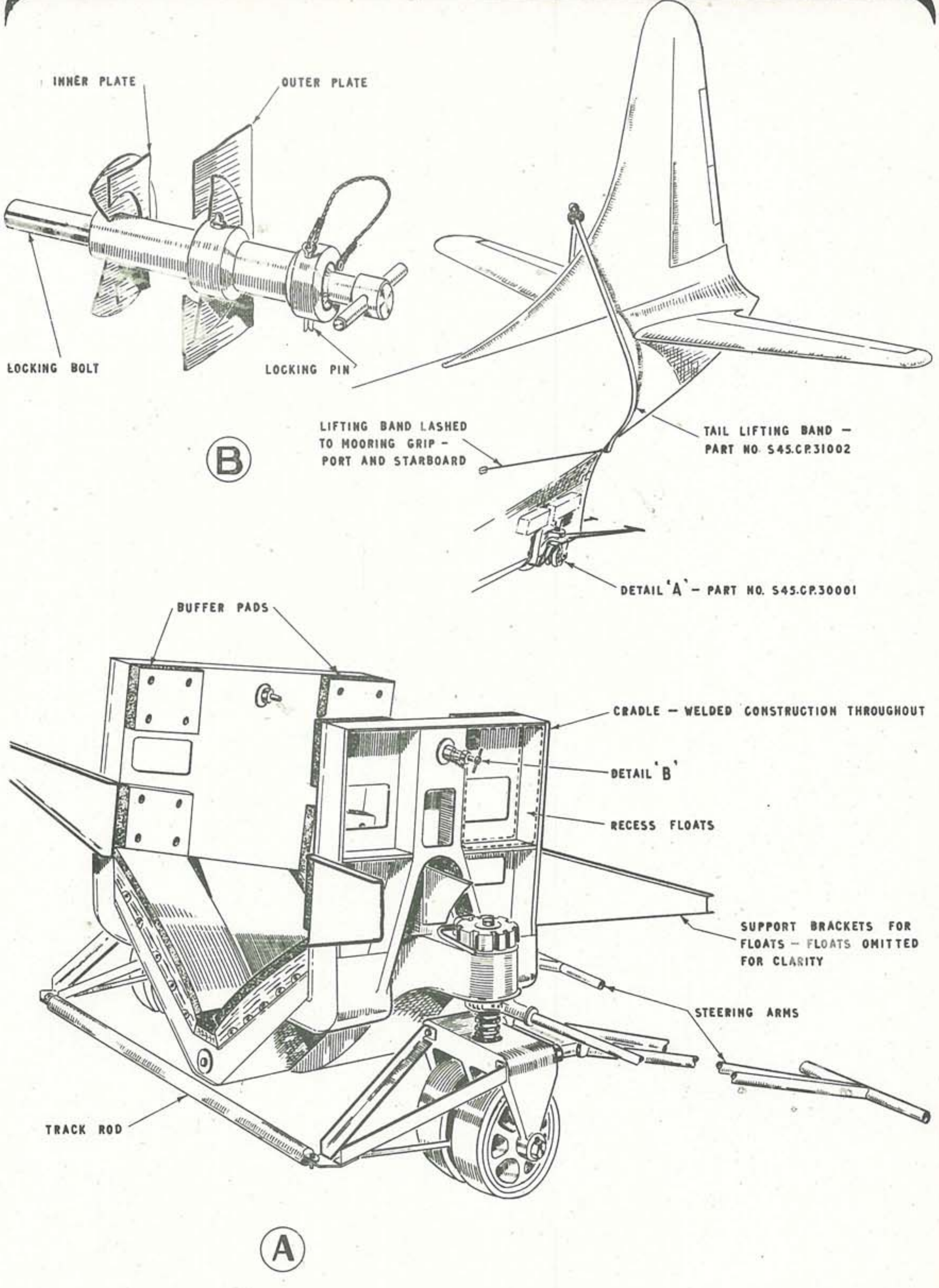

LOW LEVEL TAIL TROLLEY

FIG. 14

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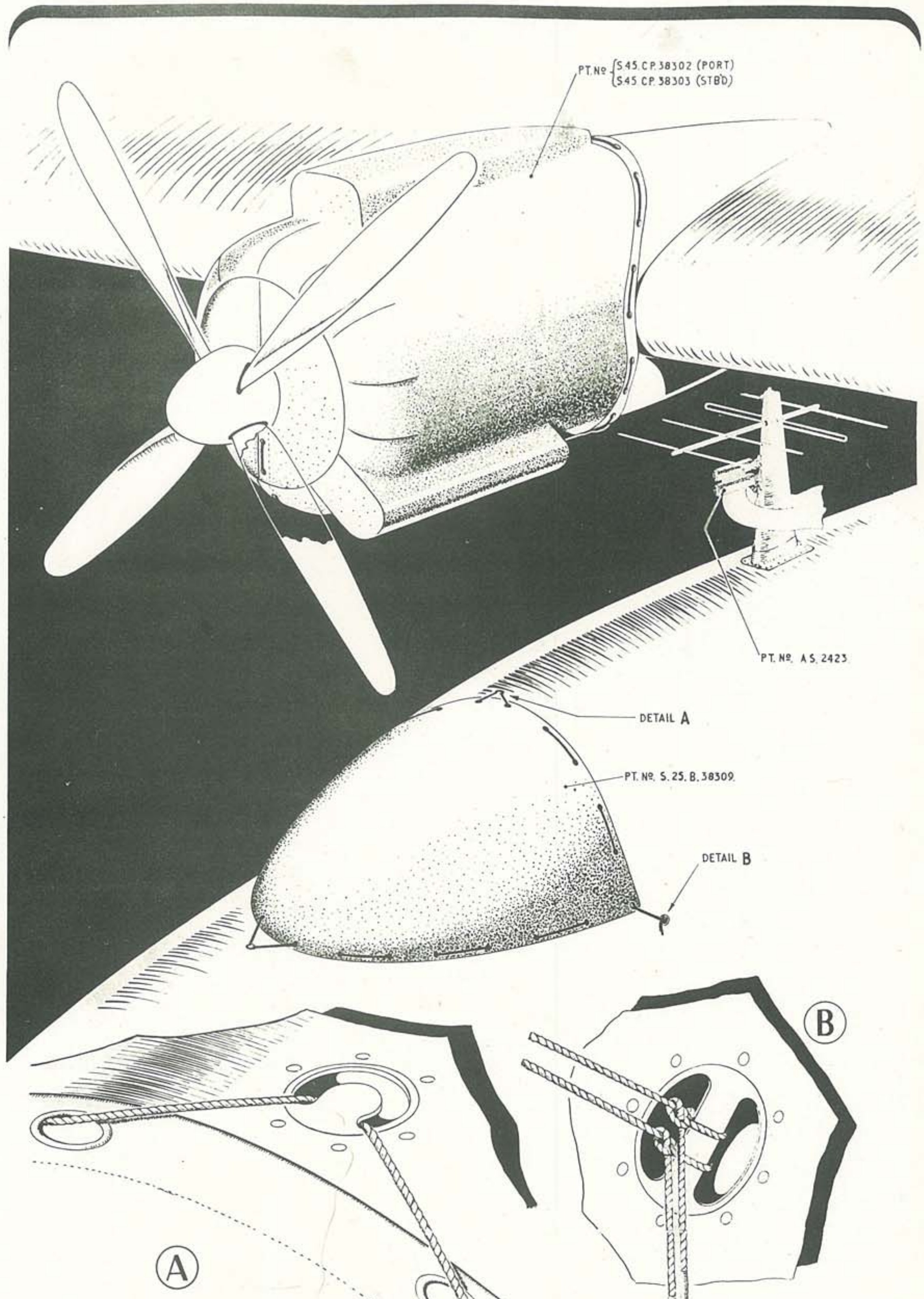

PROTECTIVE COVERS

FIG. 15

RSSO/TP/106/7
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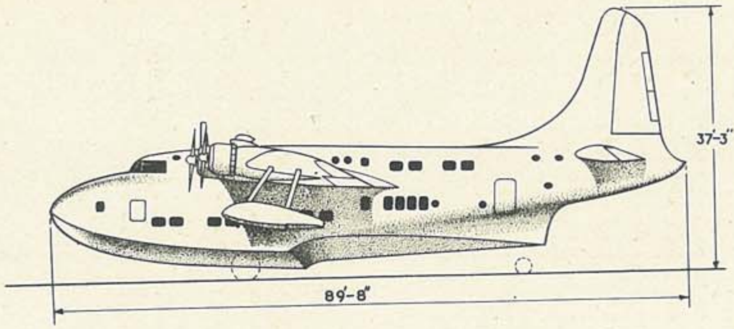
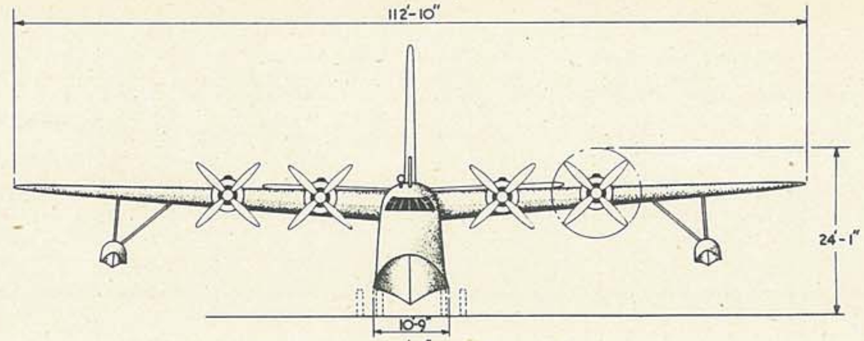
S O L E N T   3

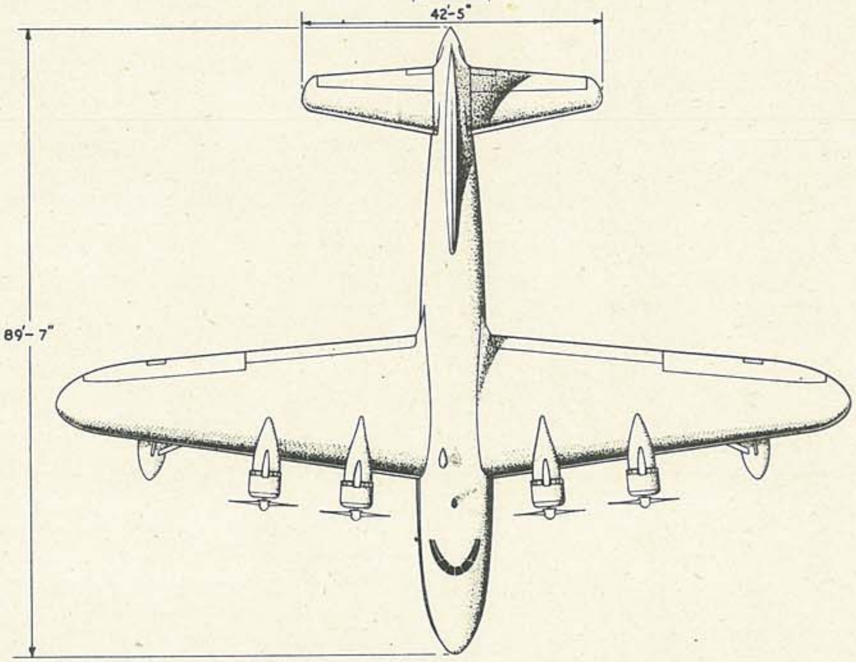
Four Hercules 637 Engines

F L I G H T   N O T E S

Short Brothers and Harland Limited. Belfast.







MAIN PLANE

AEROFOIL SECTION	GÖTTINGEN 436 MODIFIED
INCIDENCE : AERODYNAMIC CHORD TO HULL DATUM	6°-9'
DIHEDRAL : TOP FRONT SPAR-BOOM	0°-50'
AREAS :	
MAIN PLANES TOTAL INCLUDING FLAPS AND AILERONS	1487·60 SQ.FT.
FLAPS TOTAL	286·24 SQ.FT.
AILERONS TOTAL INCLUDING TRIMMING TABS	134·40 SQ.FT.
AILERON TRIMMING TABS TOTAL	2·39 SQ.FT.

TAIL PLANE

AEROFOIL SECTION	R.A.F. 30 MODIFIED
INCIDENCE : AERODYNAMIC CHORD TO HULL DATUM	4°-0'
DIHEDRAL : TOP FRONT SPAR-BOOM	4°-15'
AREAS :	
TAIL PLANE TOTAL INCLUDING ELEVATORS	265·79 SQ.FT.
ELEVATORS TOTAL INCLUDING TRIMMING TABS	102·29 SQ.FT.
ELEVATOR TRIMMING TAB (PORT) AND ANTI-BALANCE TAB (STBD.) 2·27 SQ.FT. EACH	4·54 SQ.FT.

FIN AND RUDDER

AEROFOIL SECTION	R.A.F. 30 MODIFIED
AREAS :	
FIN INCLUDING DORSAL FIN AND RUDDER	195·00 SQ.FT.
RUDDER INCLUDING TRIMMING AND BALANCE TABS	82·18 SQ.FT.
RUDDER TRIMMING TAB	4·55 SQ.FT.
RUDDER ANTI-BALANCE TAB	3·41 SQ.FT.

GENERAL ARRANGEMENT

1. GENERAL

The Solent aircraft is an all metal, high-wing cantilever monoplane flying boat with a two step planing bottom; the front step is faired into the after-body, and the rear step is formed into a vertical knife edge which fairs into the rear sections of the hull.

Power is supplied by four Hercules 637 engines each giving 1690 B.H.P. at take-off. de Havilland four-bladed, hydromatic, fully feathering propellers with constant-speed control are fitted.

The hull, which is of monocoque construction, is divided into upper and lower decks with the control cabin and crew stations on the upper deck.

The main plane has Gouge-type extended chord flaps and Frise-type ailerons. A dorsal fin and a dihedral tail plane are fitted. Pilot-operated trimming tabs are fitted to the ailerons, port elevator and the rudder, and anti-balance tabs are fitted to the starboard elevator and the rudder.

The main plane flaps are electrically operated but provision is made for emergency manual operation.

The aircraft accommodates 39 passengers and a minimum crew of four comprising:- Captain, 1st officer, wireless officer and flight engineer

2. AIRFRAME

2.1. DIMENSIONS

Span of main plane	112 ft. 10 in.
Aspect ratio	7.53
Overall length (on beaching chassis)	89 ft. 8 in.
Overall height (over fin) on beaching gear	37 ft. 3 in.
Maximum beam	10 ft. 9 in.
Draught at 78,000 lb.	5 ft. 6 in.
Distance between wing-tip float and hull	34 ft. 6 in.
Track of beaching chassis (centre of outer wheels)	14 ft. 9 in.
Depth of water (minimum) required for beaching	6 ft. 9 in.

2.2. WEIGHTS

	Lb.	Kg.
Maximum take-off weight permitted by C. of A............	78,000	35,380
Emergency landing weight	78,000	35,380
Normal maximum	71,500	32,432
Beaching weight	61,000	27,670
Hull loading maximum (i.e. weight of aircraft less fuel, oil and de-icing fluid)	66,500	30,164
Tare approx.	48,500	22,000

2.3. LOADING

Wing loading at take-off at A.U.W. 78,000 lb. - 46 lb/sq.ft.
Power loading at take-off at S.L.
A.U.W. 78,000 lb - 1690 B.H.P. per engine.......... 11.55 lb/B.H.P.
Span loading at take-off ....691 lb/ft.

2.4. FLYING LIMITATIONS

Maximum speed	250 Knots I.A.S.
Maximum speed flaps fully out	141 Knots I.A.S.
Maximum speed auto-pilot IN	200 Knots I.A.S.

3. ENGINE

Manufacturer	Bristol Aeroplane Company
Type	Hercules 637 V series 14-cylinder twin row air-cooled sleeve valve radial. Single speed geared super-charger.
Fuel	100-130 Octane (Spec.D.E.D. 2475)
Oil	Aero-Shell 100B (for winter and summer use) OR Intava 1 AA 745, 1AA 810 or D.E.D.2472A/2 (Winter) D.E.D.2472B/2 (Summer)

NOTE... Aero-Shell 100B must be used and only in extreme emergency should any of the above alternatives be used. In such a case it is necessary to drain completely and flush the oil system before using an alternative oil.

4. PROPELLER

Make and type .... (CD 80/446/1-/2-/3-/4 or CD 108/446/1 split barrel)	de Havilland hydromatic four blade low pressure barrel, fully feathering.
Diameter	12 ft.3 in.
Pitch range	26° fine, 91° feathered.

5. ENGINE LIMITATIONS

Oil pressure	Minimum 70 lb/sq.in. Normal 80 lb/sq.in.
Fuel pressure	Absolute Min. 23.5 lb/sq.in. (at this pressure, powers are limited to weak mixture cruising only). Working range 27-30 lb/sq.in.
Slow running R.P.M.	600 inners 450- 500 outers
Min. R.P.M. - C.S.U. setting	1600
Overspeed R.P.M.	3120 (20 sec. limit)
B.M.E.P.	Constant 335.6
Torque meter constant	1017

B.M.E.P. .... = $\frac{\text{B.H.P.} \times 335.6}{\text{R.P.M.}}$

B.M.E.P. .... = Torque reading ÷ 3

B.H.P. .... = Torque meter pressure x R.P.M. ÷ 1017

Average fuel consumption

Mean weight	R.P.M.	Altitude	Speed	Consumption
65,000 lb.	2,000	10,000 ft.	158 Kts. I.A.S.	218 gall/hr.

Average oil consumption
at cruising R.P.M. range .... 4 - 6 pints per hour

Cylinder head temp. at
start of take-off .... 120°C min. 170°C max.

Conditions	R.P.M.	Manifold pressure "Hg.Abs	Cyl. hd. temp. °C			Oil temp. °C			B.H.P. (Corrected)
			Min.	Desired	Max.	Min.	Normal	Max.	
At start of take-off	-	-	120	-	170	15	-	70	-
During take-off (5 mins. limit)	2,800	46.25	-	-	310	15	-	100	1570 to 1700 at S.L.
Max. climbing (1 hour)	2,200 *	43.75	-	-	300	-	-	90	-
Max. cruise (RICH MIXTURE)	2,400	43.75	-	200/240	280	-	-	80	-
Cruise (LEAN MIXTURE)	1,850 to 2,250	36.00	-	200/240	280	-	65/70	80	-
Warming engines	1,100 1,200	-	-	120	-	15	-	40	-
Taxying	Max. 1,200	-	-	below 170	280	15	-	80	-
Run-up	Power check	3"Hg. below atmospheric pressure	120	below 170	280	15	-	40	-
Stopping	slow running R.P.M.	-	-	-	180	-	-	-	-
Rated power	2,400	43.75	120	240	280	-	-	80	-

* Note... Climb above full throttle height, i.e. boost dropping 43.75" Hg. 2,400 R.P.M. may be used if required to obtain the minimum I.A.S. of 140 Knots. Throttle lever fully forward.

6. RECOMMENDATIONS

WEAK MIXTURE cruising power should NOT exceed 1,000 B.H.P.
WEAK MIXTURE cruising boost should NOT exceed 36" Hg.
BACKING PUMPS should be used when
(a) Priming carburetters prior to starting
(b) During take-off and climb (all pumps 'ON')
(c) Cruising. One pump per side, pumps to be changed over every hour. (Running times to be logged)
(d) During cross feeding of fuel from port or starboard wing, only pumps on the delivering side to be 'ON'

FLOWMETERS switched ON for all engine running, except for take-off and landing during which flowmeters are by-passed.

IGNITION NOT to be tested during flight. Serious risk of an internal engine fire.

FLAPS must not be run out at aircraft speeds in excess of 140 knots I.A.S.

OIL COOLER SHUTTERS a maximum of ¼ open for take-off and landing.

PROPELLER FEATHERING and STARTING MASTER SWITCH 'ON' when engines are running, including during take-off and all flight conditions.

FUEL - Wherever possible at least 50 gallons should be left in tanks No.4 and 5 to act as a damper for any possible vibration in the main plane.

7. LOADING

7.1. Cabin

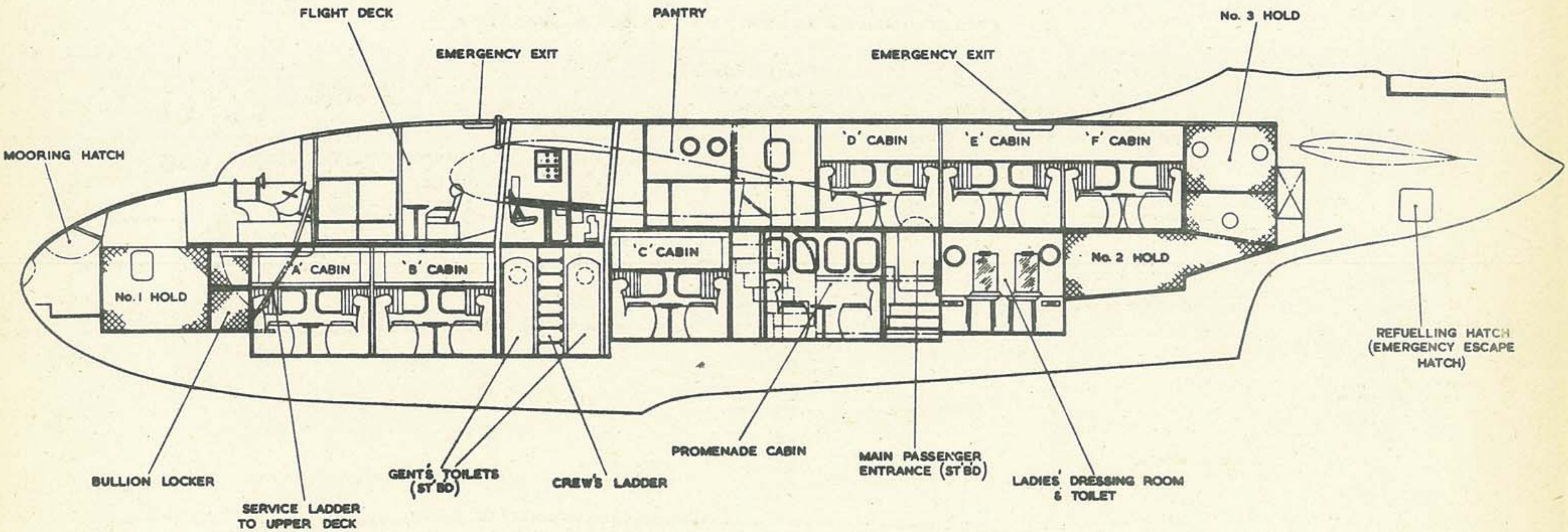
Cabin		Seat Passengers	Bunks	Maximum Permissible Load		Maximum Floor Loading	
				lb.	Kg.	lb/sq.ft.	Kg/sq.ft
Lower Deck	A	7		2,250	1,020	150	68
	B	7		2,250	1,020	150	68
	C	6		1,764	800	100	45
	Promenade	2	1	1,296	588	150	68
Upper Deck	D	6		1,058	480	75	34
	E	6		1,345	610	75	34
	F	6		1,168	530	75	34
	Steward & Pantry		-	591	268	75	34
	Locker	-	-	231	105	75	35

7.2. Hold

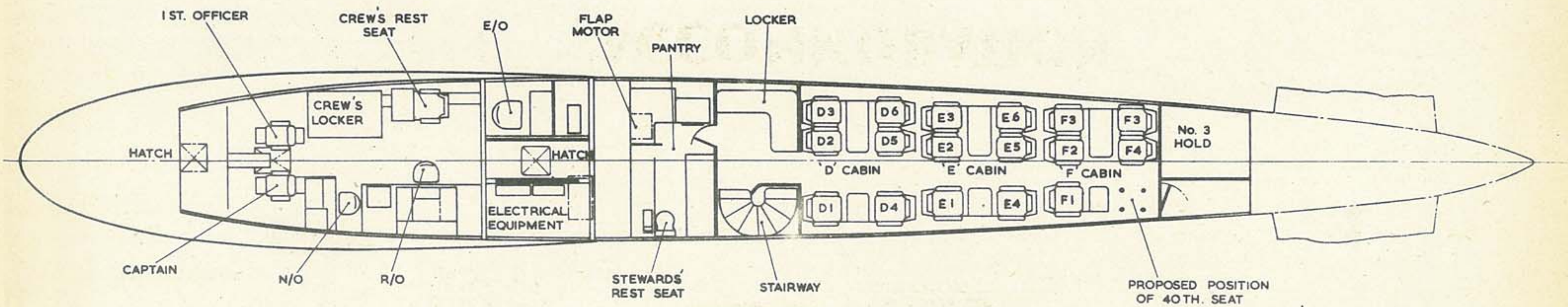
Compartment		Cubic capacity	Available Area	Maximum Permissible Load		Maximum Floor Loading	
		Cu.ft.	sq. ft.	lb.	Kg.	lb/sq.ft.	Kg/sq.ft.
Lower Deck	No. 1	160	27	3,527	1,600	160	73
	Bullion Hold	17.0	7.5	1,444	655	205	93
	Lower Bullion Hold	15	7	414	188	75	34
	'C' Cabin Bilge Locker	16	7	265	120	44	20
	Wardrobe Stbd.	36	6	500	227	150	68
	No. 2	90	24	1,204	546	99	45
Upper Deck	No. 3	-	-	904	410	75	34
	Crews Locker			705	320	75	34

8. ACCOMMODATION

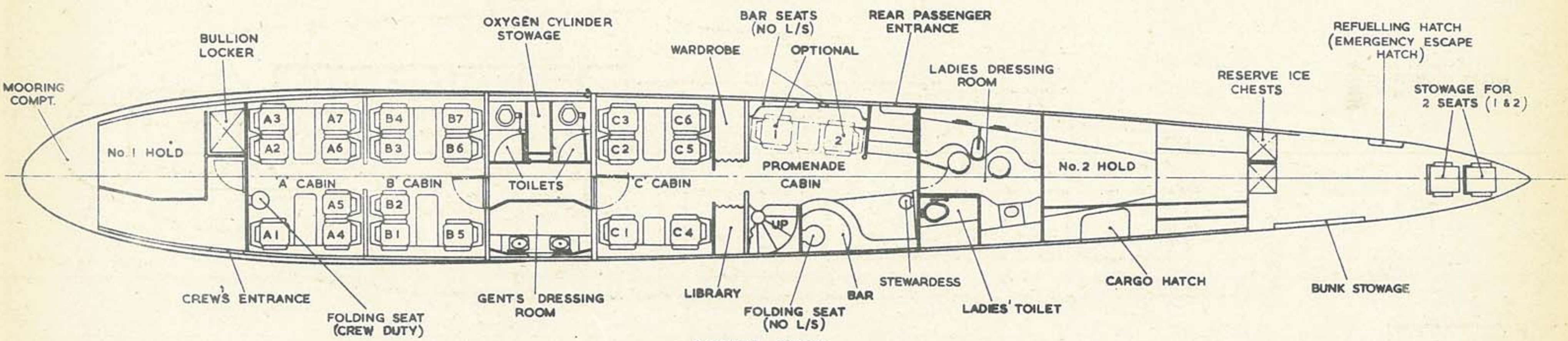
8.1. Crew
1 rest chair at starboard side of flight deck.
Steward's rest chair at port side of galley
Clothing stowage between Radio Officer's desk and front spar-frame.
Luggage locker starboard side of flight deck.
Engineer's tool locker beneath crew's luggage locker.
Navigation Equipment locker beneath crew's luggage locker.



ACCOMMODATION



UPPER DECK



LOWER DECK

UNLESS OTHERWISE STATED, ALL SEATS SHOWN ARE FITTED WITH LAPSTRAPS.

ACCOMMODATION

8.2. Passenger

	Seats	Bunks	Remarks
Lower Deck	2 double on starboard side.	-	Lapstraps fitted
Cabin A	1 single on port side and 1 double	-	Lapstraps fitted
Cabin B	7	-	Lapstraps fitted to each seat
Gent's Toilet	-	-	2 on starboard side centre section
Gent's Dressing Room	-	-	On port side opposite toilets. 2 washbasins
Cabin C	6	-	Lapstraps fitted to each seat
Promenade Cabin	2	1 on Port side	Main entrance door on starboard side. Stairway to upper deck on port side. Lapstraps fitted to each seat.
Ladies' Dressing Room	2	-	2 dressing tables 1 lavatory 1 washbasin No Lapstraps fitted
Promenade Cabin	2	1 on Port side	Main entrance door on starboard side. Stairways to upper deck on port side. Lapatraps fitted to each seat.
Ladies' Dressing Room	2	-	2 Dressing tables 1 lavatory 1 washbasin No Lapstraps fitted
Upper Deck Stewards Locker	-	-	-
Cabin D	6	-	Lapstraps fitted to each seat
Cabin E	6	-	Lapstraps fitted to each seat
Cabin F	6	-	Lapstraps fitted to each seat

NOTE.... For take-off and landing, stewards and extra crew member (if carried) can be positioned as follows, dependent on loading conditions.

Crew member	-	Rest Chair on flight deck (Lapstrap fitted)
Stewardess	-	Seat in Promenade (Lapstrap fitted)
1st Steward	-	Seat in A Cabin (Lapstrap fitted)
2nd Steward	-	Seat in Galley (Lapstrap fitted)

9. FLYING CONTROLS

Dual flying controls operated from two rudder bars and handwheel type control columns.

Automatic controls are fitted

Main plane flaps operated by an electric motor, provision being made for emergency manual operation.

Aileron, rudder and elevator trimming tabs are operated from a control unit in the control cabin roof.

9.1. Locking of controls

A locking handle is fitted into a slot in the floor aft of the captain's seat.

9.2. Aileron controls

A control tensioner is operated from a gearbox with a manually operated handwheel located on the forward face of the rear spar-frame bulkhead aft of the engineer's control stand.

9.3. Rudder controls

An automatic tensioner is fitted to compensate for any expansion or contraction in the control runs resulting from temperature changes.

9.4. Elevator controls

An automatic control tensioner similar to that in the rudder control is fitted on the elevator torque-tube.

9.5. Rudder trimming and anti-balance tabs

The tabs are inset in the rudder trailing edge.
The automatically operated anti-balance tab is fitted to increase the effort required to move the basically lightly operated control.

9.6. Elevator trimming and anti-balance tabs

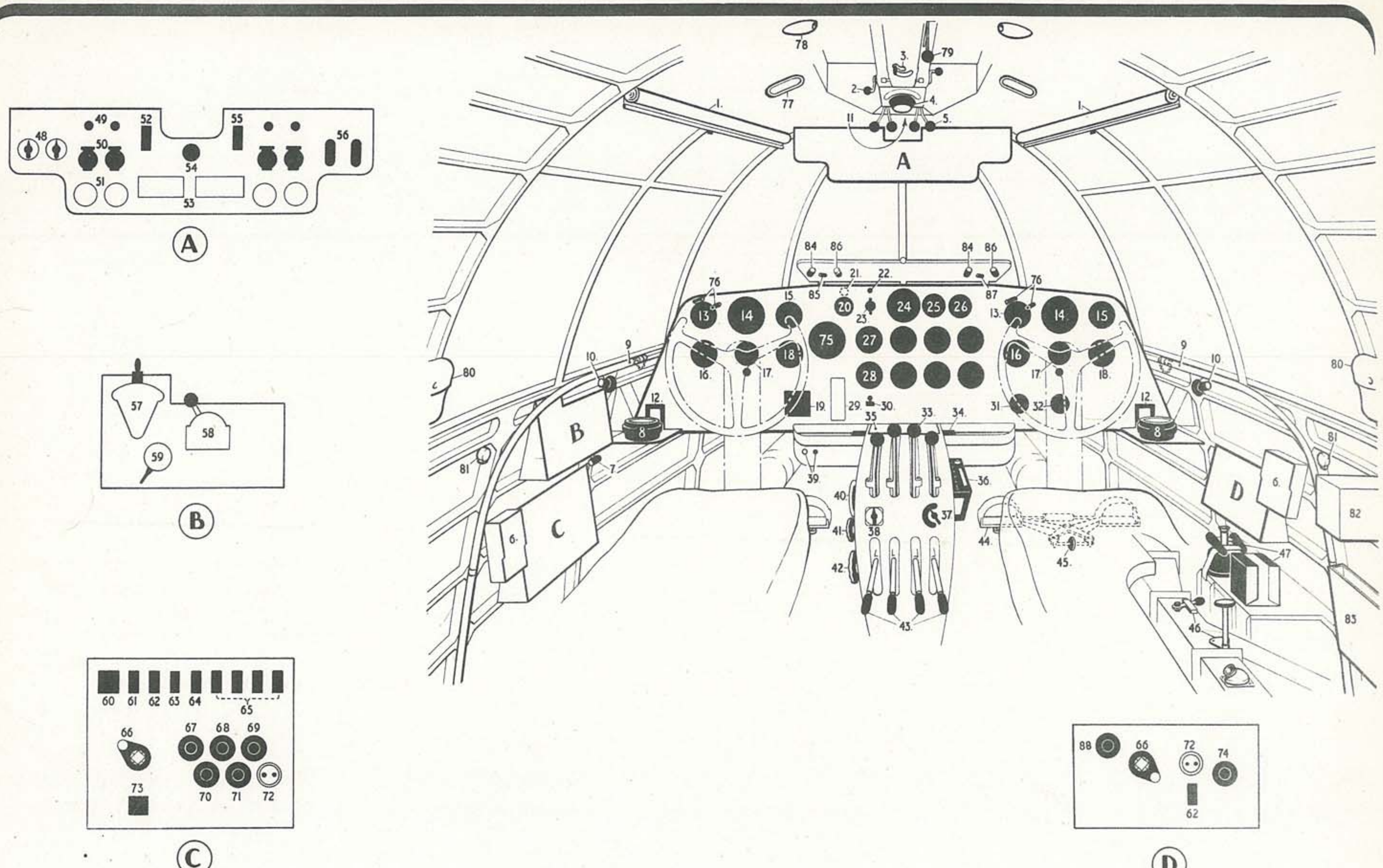
A trimming tab is inset in the trailing edge of the port elevator.

An automatically operated anti-balance tab is fitted in the starboard elevator to increase the effort required to move the basically light control.

9.7. Aileron trimming tab control

The aileron trimming tabs are operated by the Evershed Powerotor system. The electric motor and tab actuating gear is controlled from a rotary switch adjacent to the rudder and elevator tab control box in the cabin roof.

In addition to the controllable tabs, fixed trim tabs are fitted at the inboard end of the trailing edge. These are adjustable only on the ground and are set at flight trials.



CONTROL CABIN

Key to CONTROL CABIN

1. Roller sun blind
2. Elevator trimming tab controls
3. Rudder trimming tab controls
4. Aileron trimming tab controls
5. Engine master cock controls
6. Interphone control box
7. Panel lamp (red) port electrical panel
8. P.10 compass
9. Air duct - windscreen de-misting
10. Compass lamp - (ultra violet)
11. Instrument panel lamps (red) - forward end of roof
12. Compass deviation card holder
13. Air speed indicator

46. Butterfly valve and spill valve controls - cabin heating system
47. Signalling lamp and glasses

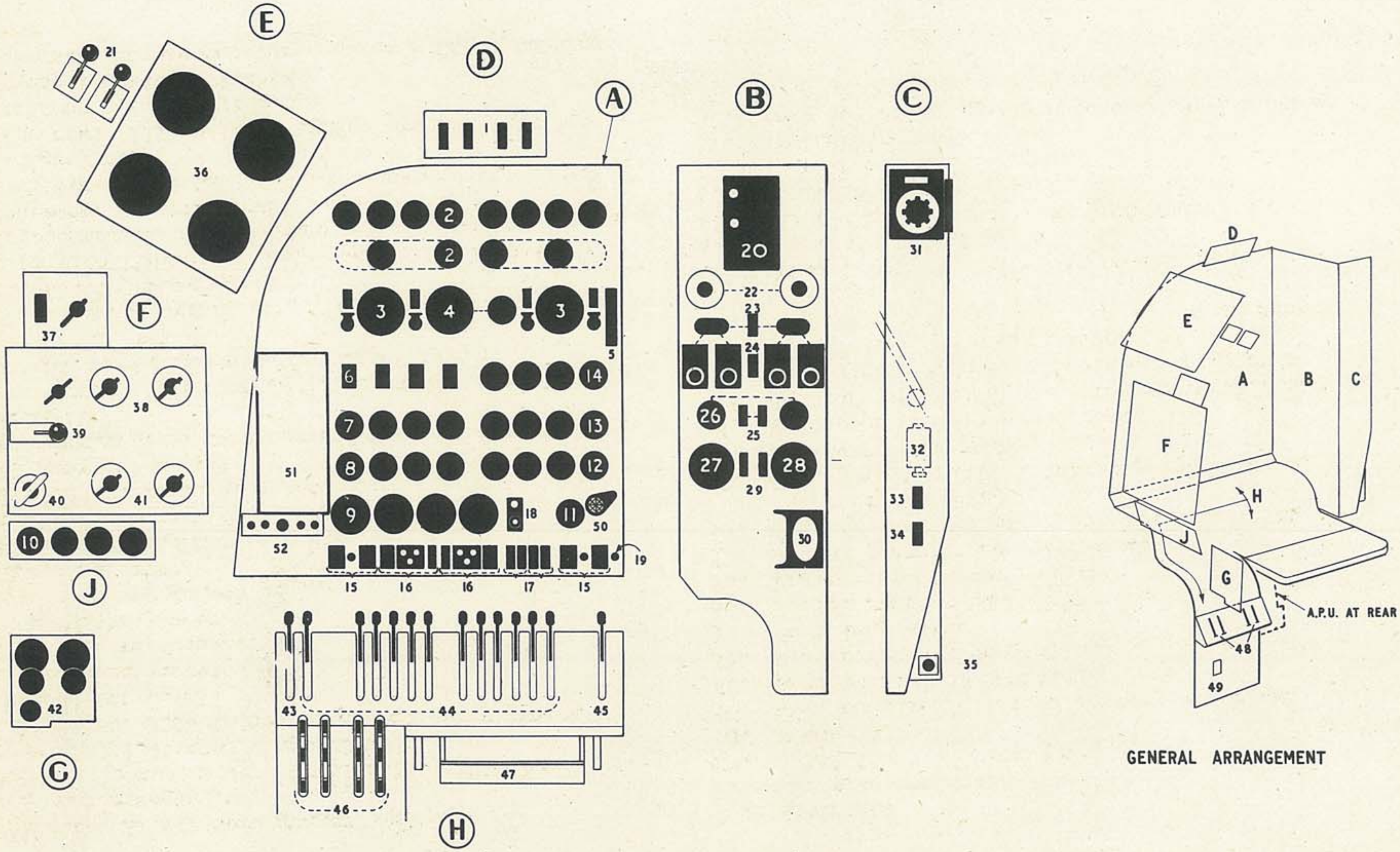
48. Landing lamp switches
49. Slow running cut-out switches
50. Engine fire extinguisher push-switches

Panel 51. Propeller feathering switches with inset fire warning lamps

A. 52. Switch for passenger notice - FASTEN LAP STRAPS
53. Ignition switches
54. Push-button STEWARD
55. Switch for passenger notice - NO SMOKING
56. Switches for pressure-head heaters

Key to ENGINEER OFFICER'S STATION

1. Duplicate oil pressure gauges
2. Fuel contents gauges
3. Fuel consumption meters (two) **selector** switches (four) and indicator lamps (four)
4. Fuel RATE OF FLOW indicator and selector switch
5. Fore-and-aft level
6. Oil pressure gauges
7. Oil temperature gauges
8. Oil contents gauges
9. Boost pressure gauges
10. R.P.M. indicators
11. Outside air temperature gauge
12. Carburettor temperature gauges
13. Cylinder temperature gauges
14. Fuel pressure gauges
15. Fuel backing pump switches and fuel pressure warning lamp
16. Master switch, heat control, starting push-switch and indicator lamps - Cabin heater system
17. Booster coil switches
18. Fuel pressure warning lamp and pump starting switch-cabin heater system
19. Current flow indicator lamp - electrical system
20. T.K.S. controller - Aerofoil de-icing system
21. Carburettor de-icing hand pumps
22. Control rheostats and indicator lamps - Propeller de-icing system
23. Engine cowl gill position indicators and switches
24. Switch for cabin pilot lamps
25. Emergency igniter switches
26. Heater unit air temperature gauges - Cabin heating system
27. Altimeter
28. Air speed indicator
29. Panel flood lamp switches
30. Clock
31. D.R. Compass Variation setting corrector
32. Anglepoise lamp mounting
33. Switch for Anglepoise lamp
34. Roof lamp switch
35. A.G.P. starter push-button
36. Engine torquemeter gauges
37. Vacuum gauge and control cock
38. Priming fuel selector cock and A.G.P. fuel cock (tank replenishing)
39. Hand pump for A.G.P. tank replenishing
40. Engine priming hand pump
41. Engine priming selector cocks
42. Shut off valve and regulator - Oxygen system
43. Fuel system cross-feed cock control lever
44. Fuel tank cock control levers
45. Emergency shut-off cock lever - Cabin heater fuel system
46. Control hand wheels - Oil cooler flaps
47. Log book stowage box
48. Oil cooler flap position indicators
49. Interphone socket
50. Interphone call lamp
51. Engineer's panel fuses
52. Test socket and push-switches - Fuel backing pump circuits



ENGINEER OFFICER'S STATION

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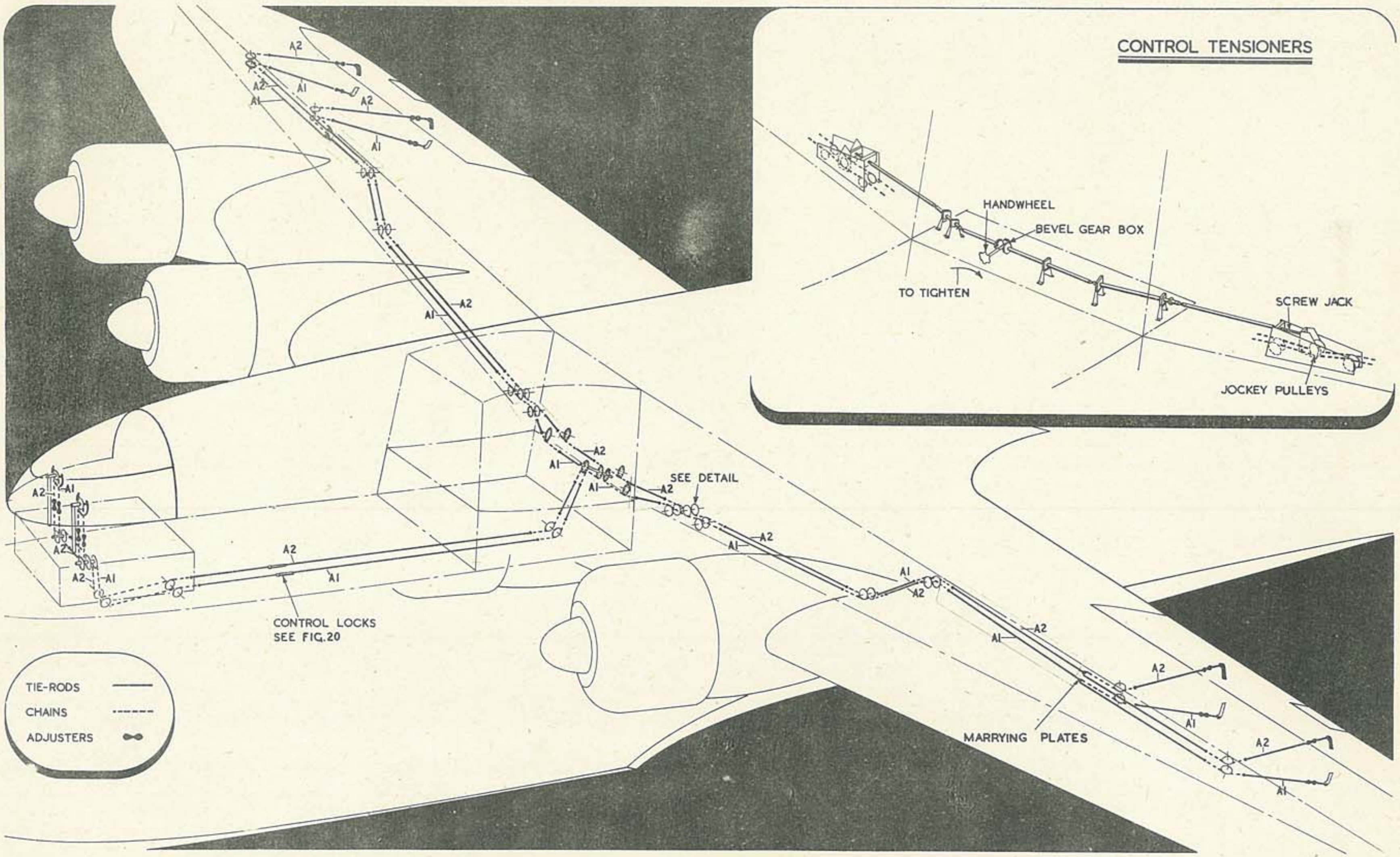

AILERON CONTROLS

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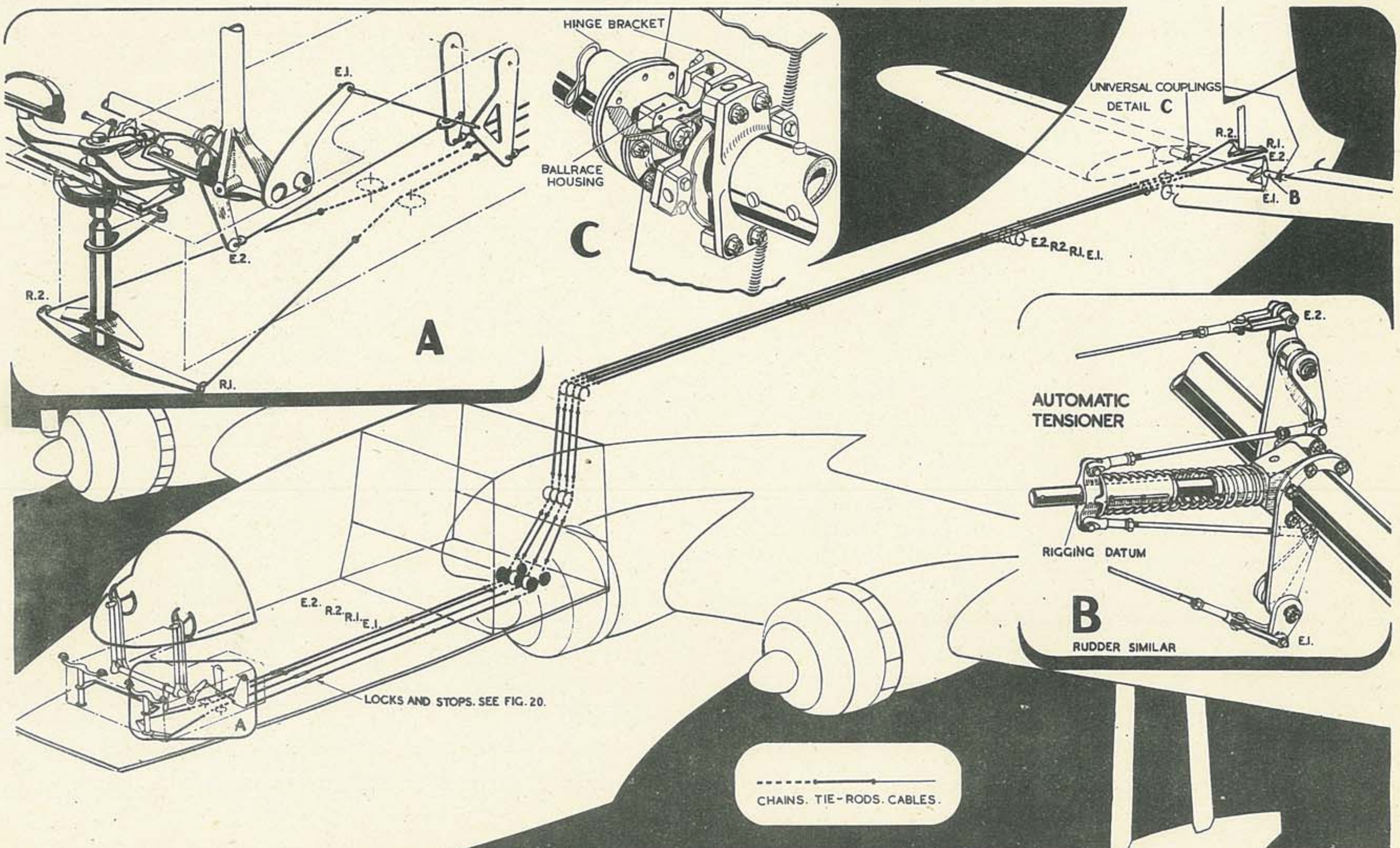
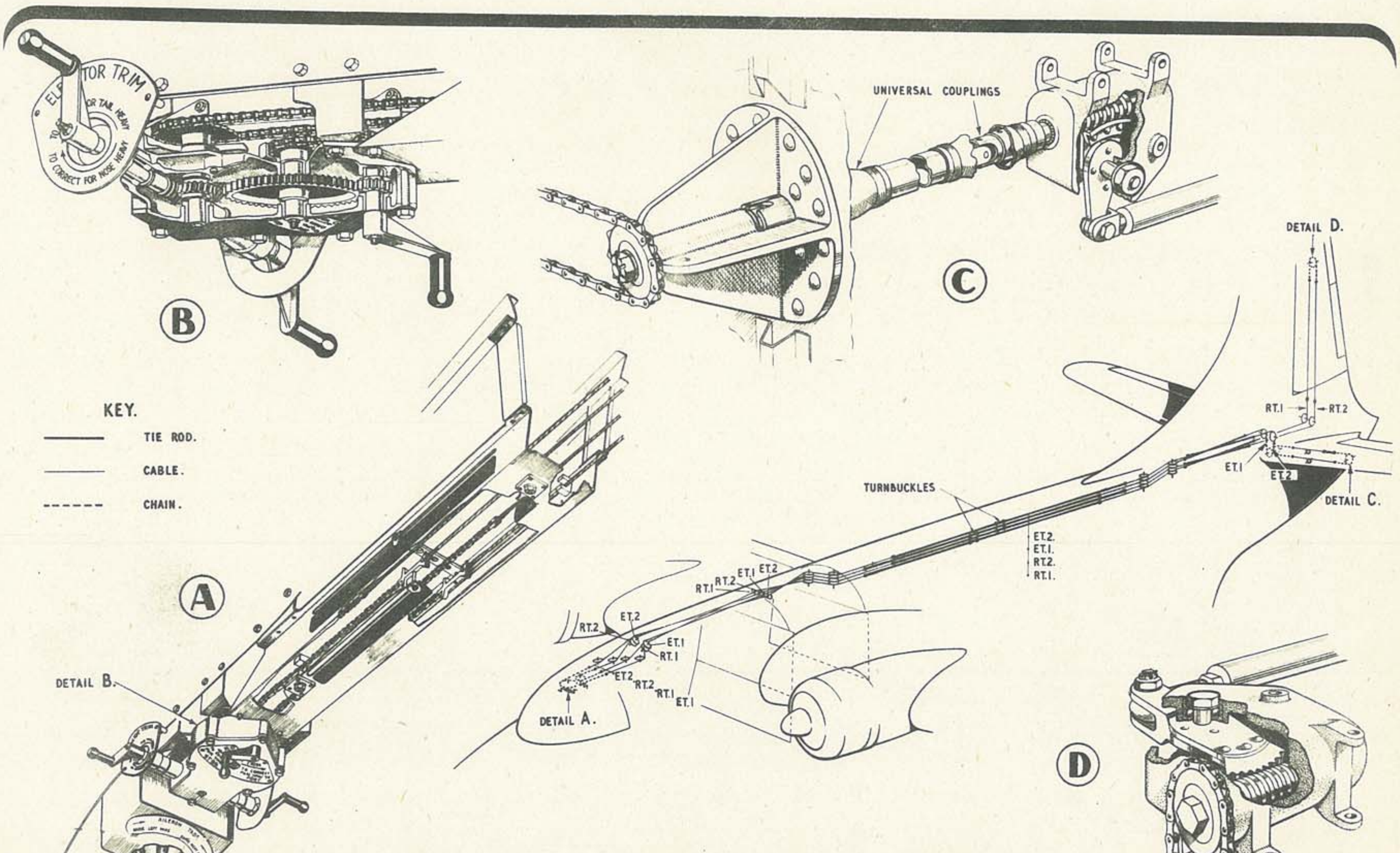


RUDDER AND ELEVATOR CONTROLS



TRIMMING TAB CONTROLS

NOTE: FOR AILERON TRIMMING TABS SEE FIG. 4.

9.8. Flap controls

The flaps are electrically operated by a motor and gearbox. The motor is controlled by a 3-way switch IN-OFF-OUT. This switch is located on the pilot's instrument panel; also fitted is a position indicator and a 1/3 out warning RED lamp. Two limit switches cut out the motor at the IN and fully OUT positions of the flaps.

In the event of an electrical failure, the flaps can be operated manually after disengaging the motor drive.

9.9. Automatic controls

R.A.E. Mk. 8A Automatic pilot is fitted and operated from an engine-driven compressor on the accessory gearbox of No. 2 engine.

LOCATION AND OPERATION REFERENCE TABLE

Control	Type and location in aircraft	Operation
Aileron and Elevator	Two handwheel type control columns. Control cabin.	
Aileron control tensioner	Handwheel. Forward face of rear spar-frame aft of engineer's control stand	Turn handwheel clockwise to tension controls.
Rudder	Two rudder bars in control cabin	
Rudder control damper	Lever. Port side of cabin adjacent to captain's seat	Lever in forward position - damper engaged - backward-disengaged.
Elevator trimming tab (port elevator)	Control box and position indicator in cabin roof. Crank handles one on each side of control box	Operate in natural direction.
Elevator anti-balance tab (starboard elevator)	Handwheel starboard side of hull immediately aft of the tail plane rear spar-frame	THIS CONTROL IS LOCKED AFTER FLIGHT TRIALS AND MUST NOT BE DISTURBED
Rudder trimming tab	Crank handle on control box. Position indicator in control cabin roof.	Turn handle clockwise to correct yaw to starboard.
Aileron trimming tabs.	Rotary switch on control box. Position indicator on pilot's instrument panel	Clockwise to raise port wing.

Control	Type and location in aircraft	Operation
Flaps (electrical)	Switch and position indicator on pilot's instrument panel	Indicator lamp shows RED when flaps are 1/3 OUT and remains ON until they are returned past this position.
Flaps (emergency manual operation)	Winding handle stowed on the bulkhead below the gearbox. The gearbox is under a sound proof cover below the preparation table at the forward end of the pantry.	Undo fasteners and lift preparation table; lift flap of soundproof cover, disengage clutch by pulling knurled barrel away from gearbox and rotating top of barrel aft; fit winding handle and turn clockwise to wind flaps IN.
Automatic controls	Clutch lever and control cock on a panel at the port side of the control cabin. Pitch control on the port side of the engine control stand. Combined trim and pressure gauge in the centre of the pilot's instrument panel. COMPASS CONTROL - JINK TURN switch between throttle and propeller levers	The 1st. officer operates the cut-out cock between the throttle and propeller levers on the throttle control stand.
Rudder control damper on the floor forward of the port rudder bar.		By Bowden cable from a lever on the clutch lever panel
Control surface locks.	Locking handle fitted with six projecting pins is stowed in the cover of the control locking device.	Controls are locked by inserting the pins in a slot in the control duct aft of the captain's seat structure.

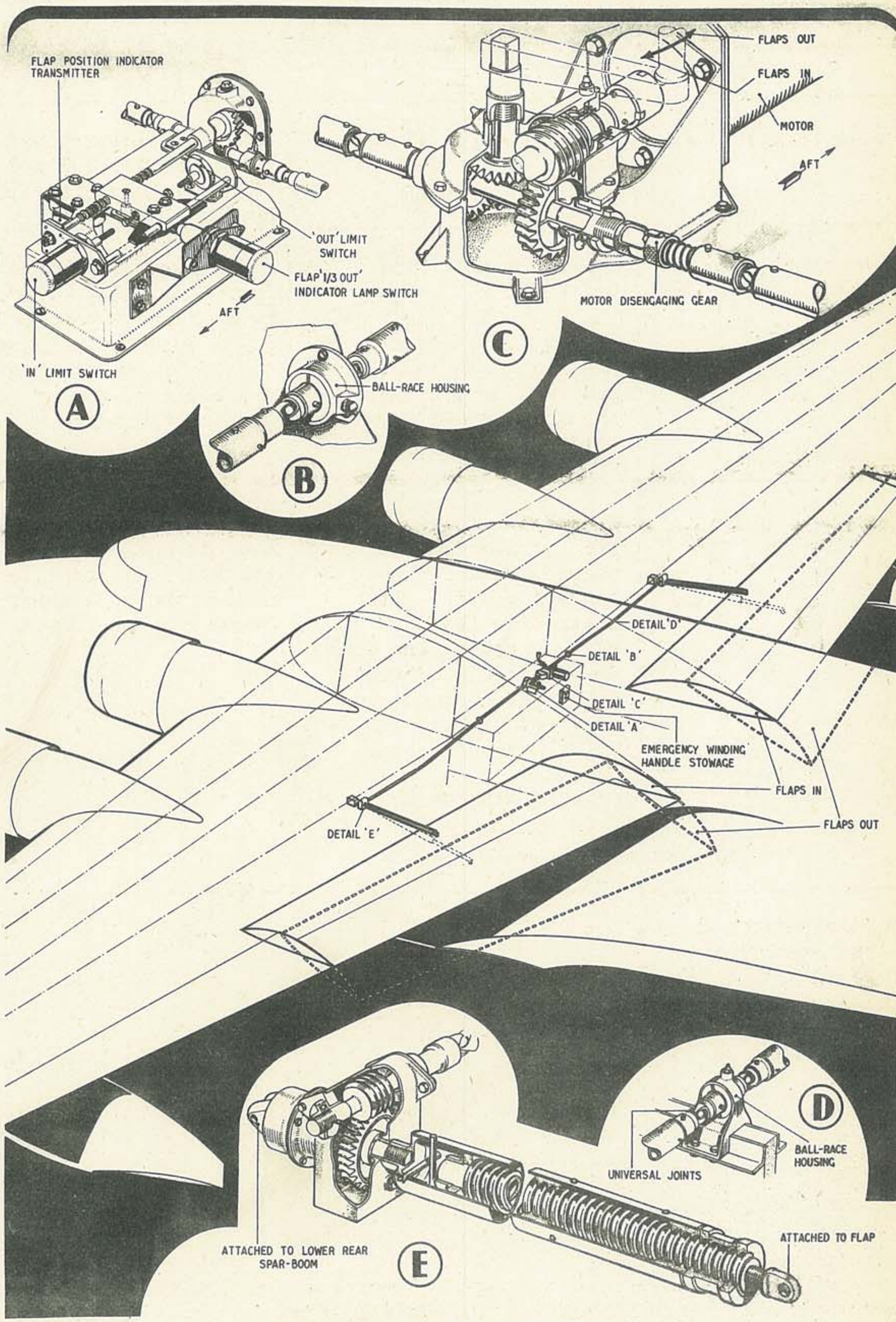
10. ENGINE CONTROLS

10.1. Throttle controls

Tie-rod and cable-operated, with a spring-loaded plunger on each throttle lever to engage a notched cam on the control stand for locating the lever at the E.C.B. position. Friction-type damper fitted to operate on all four levers.

10.2. Propeller controls

Tie-rod and cable-operated, similar to throttle; also friction damper.



FLAP CONTROLS

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10.3. Feathering

Propeller feathering push-buttons, incorporating fire warning lamps, are fitted on a panel in cabin roof. The propeller lever quadrant has a 'gate' at the minimum R.P.M. position. When feathering, the levers are depressed and moved through the 'gate' to the full travel.

10.4. Air intake shutters

Hot or cold air is available by operation of individually controlled shutters fitted to the air intake.

10.5. Cowling gills

These are operated by an electric motor and controlled by limit switches at the travel extremities. RED indicator lamps show when the gill motors are running.

10.6. Engine cut off

Operated by Rotax electric actuator.

NOTE.... This control when operated to OFF will stop an engine running at any throttle setting. The correct use is to stop an engine when running at slow running R.P.M.

10.7. Oil cooler flaps

These are controlled by cable from four handwheels, one for each engine, in the engineer's control stand.

LOCATION AND OPERATION REFERENCE TABLE

Controls	Type and location in aircraft	Operation
Throttle	Four levers in control stand in centre of control cabin. Friction-type damper fitted with handwheel on port side of control stand.	Levers forward full throttle. Cable and tie-rod operated.
Propeller pitch control levers	Four levers in control stand. Friction-type damper fitted; hand-wheel at port side of control stand. Feathering push-switches on panel in control cabin roof.	Levers moved upwards to INCREASE R.P.M.
Cowling gills	Four switches on side panel of engineer's control stand.	Pull OUT for OFF, IN for INDICATOR and LEFT or RIGHT for OPEN or CLOSE. Red indicator lamps show when motors are running.

Control	Type and location in aircraft	Operation
Air intake shutters	Four handwheels on panel rear starboard side of front spar-frame	Controls spring-loaded to Cold Air position but catches enable levers to be retained in Hot Air position when required.
Starter switches and booster coils	Four push-switches under spring-loaded flap in top of engine control stand.	Booster coils are controlled by starter buttons unless isolated by switches on engineer's main panel.
Ignition	Two switches per engine fitted on main panel in control cabin roof.	Bridge plates enable switches to be operated together if necessary.
Engine cut-off	Mounted on the roof panel in control cabin.	Electric motor and screw-jack combined in single Rotax electric actuator unit.
Oil cooler flaps	Handwheels, one for each engine in the starboard, side of the engineer's control stand, with indicator below each handwheel.	By cable, roller chain and screw-jack.

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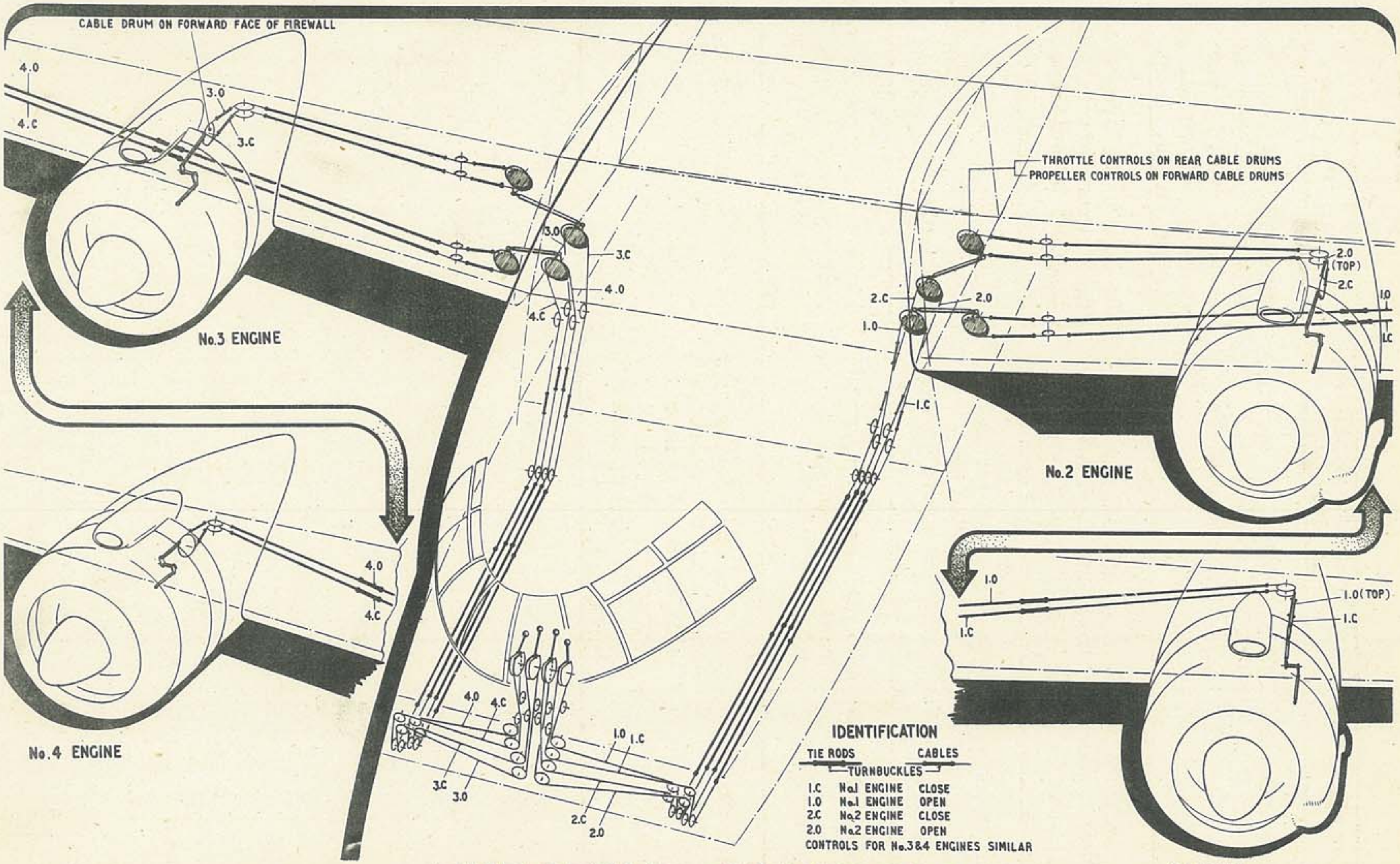

THROTTLE CONTROLS

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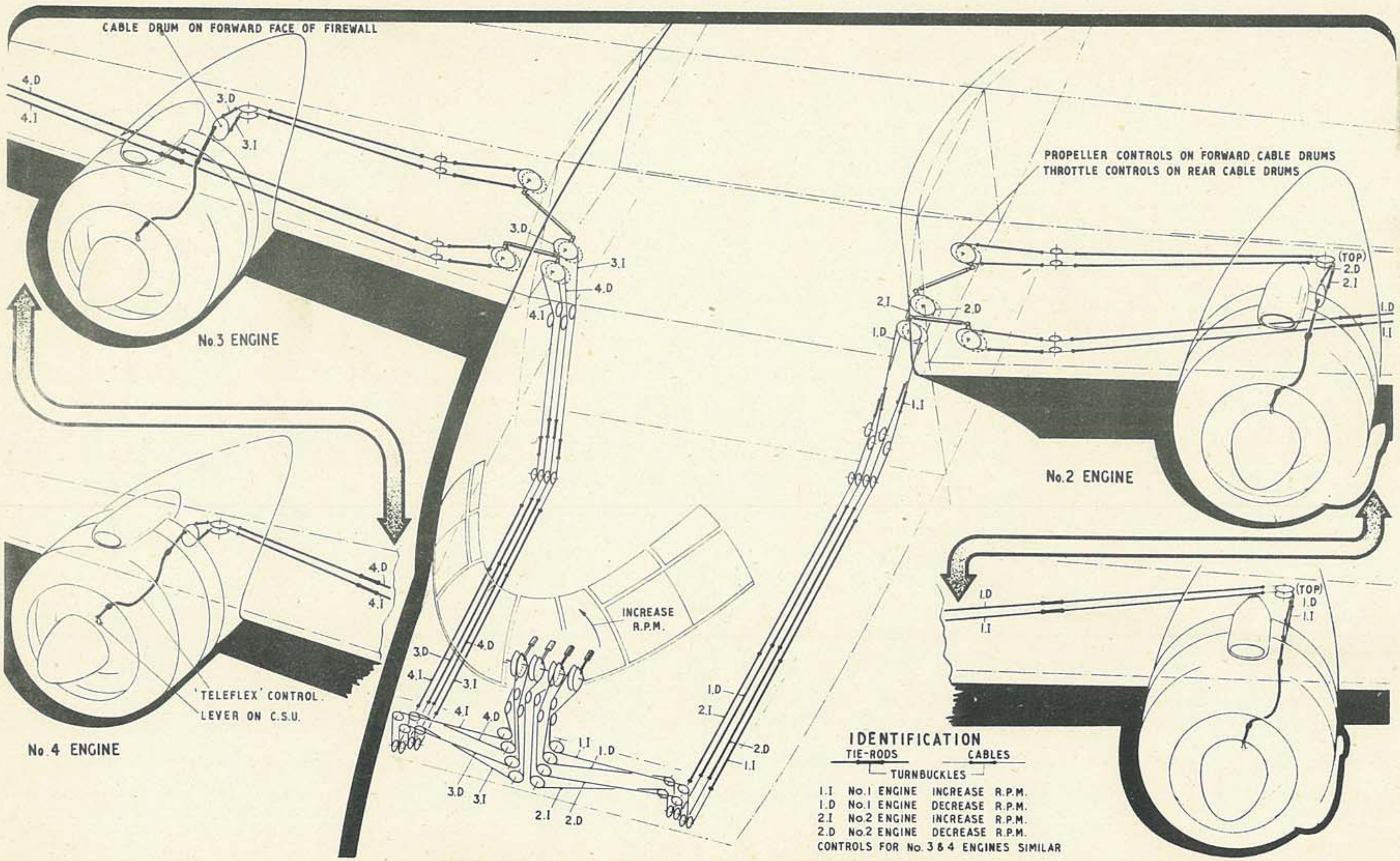


PROPELLER CONTROLS

11. FUEL SYSTEM

11.1. Tankage

12 fuel tanks

Total capacity	2,640 Imp. gall.
Tank No. 1 port and starboard	529 gall. each
Tank No. 2 port and starboard	348 gall. each
Tank No. 3 port and starboard	131 gall. each
Tank No. 4 port and starboard	97 gall. each
Tank No. 5 port and starboard	74 gall. each
Tank No. 6 port and starboard	141 gall. each
Fuel specification	100/130 octane (D.E.D.2475)

11.2. Operation

The tanks are located as follows. -

Five between the spar trusses in each wing	10
One fitted at each trailing edge	2

Two electrically driven backing pumps are installed in the base of each collector box and the fuel is fed to the suction side of these pumps.

Fuel at pressure passes through a filter at the injector also a pipe line for the Desynn type fuel pressure transmitter fitted to the injector inlet connection.

Tank cocks are remotely operated by a bank of levers at the base of the Engineer's panel.

Fuel pressure warning lamps controlled by transmitter units fitted at the pressure side of the backing pumps indicate their operation.

Kent Flowmeter registers gallons gone. The Flowmeters can be switched OFF and "BY PASSED" by operation of the switches adjacent to the indicators.

Rate of Flow indicator also fitted - Selector Switch for Nos. 1, 2, 3 and 4 engines.

Fuel Management

Fuel tanks are used in groups as follows. -

Ground Running)
Take-off) Tanks 1, 2 and 3 (Port and
Climb) Starboard) ON.

Start of Cruise Tanks 4, 5 and 6 (Port and Starboard) ON.
Tanks 1, 2 and 3 (Port and Starboard) OFF.

When tanks 4, 5 and 6 have been used change to tanks 1, 2 and 3 for remainder of flight. Under calm conditions turn off each emptying tank at 20 galls.

11.4. Priming

Fuel lines and injector are primed by the backing pumps in the fuel system.

An induction type Ki-gas hand pump is used for engine priming.

A diaphragm (wobble) type hand pump is used for filling the A.G.P. tank.

The Ki-gas and wobble pumps, together with selector cocks are fitted on a panel at the starboard side of the hull at the Engineer Officer's station.

Fuel is drawn from a connection in the pipe feeding from No. 1 tank (Starboard)

Two three-way cocks are fitted for selecting individual engines.

11.5. Refuelling

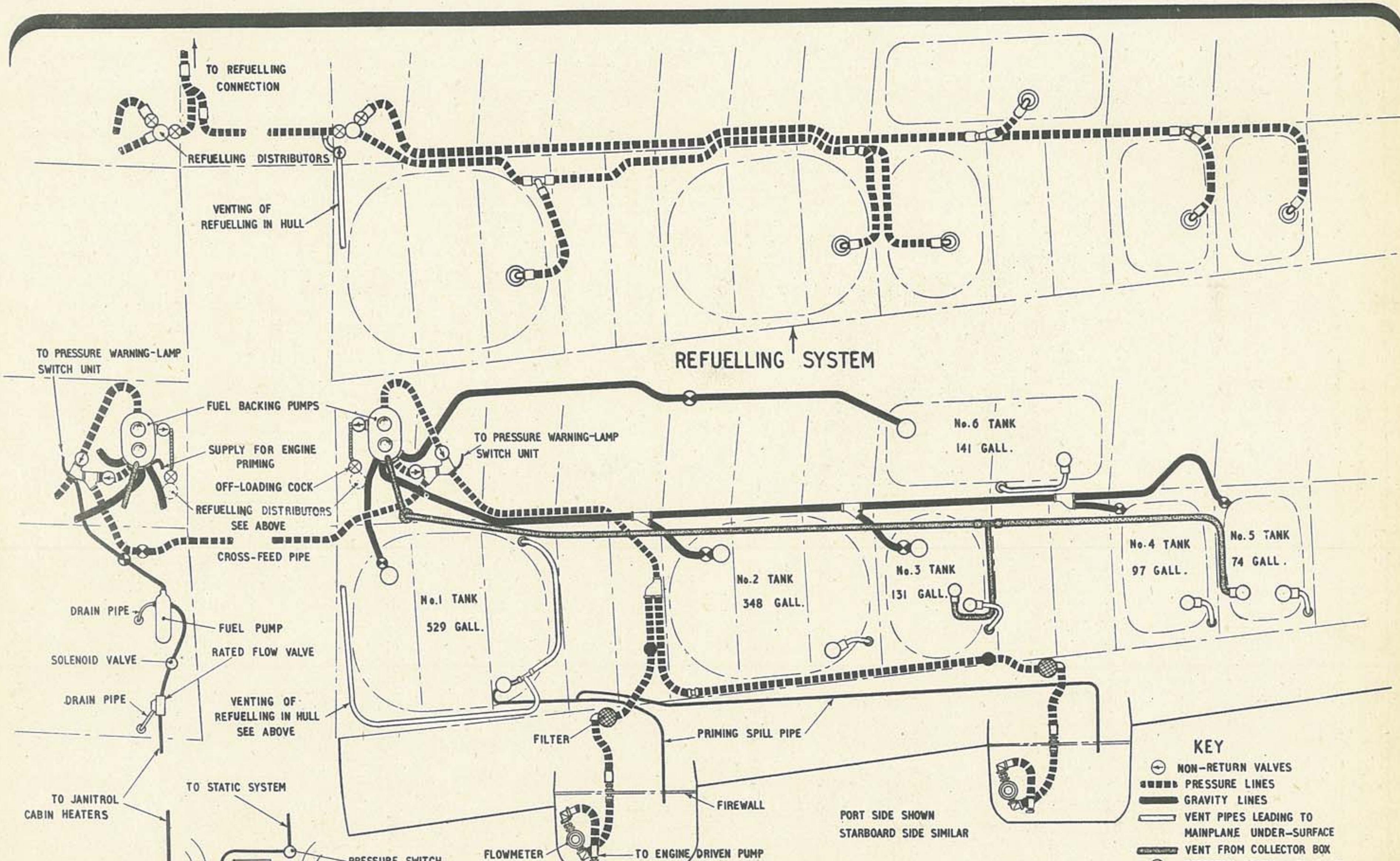
Tanks can be filled either by pressure through a pipe line from a connection in the tail unit, starboard side of hull,or direct through the individual tank filler caps.

Refuelling valves are fitted to each tank, which cut off the refuelling supply when the tanks are filled to their correct level.

The tail exit position enables the refueller aboard the aircraft to couple-up the refuelling launch hoses to the aircraft adaptor. A key for the adaptor is stowed forward of this exit.

11.6. Refuelling (Pressure) Procedure.

(a) All electrical services OFF
(b) No smoking
(c) Refuelling launch moored at tail
(d) Ensure that a water check has been carried out
(e) Dip tanks to record fuel required
(f) Fit Y-coupling to refuelling adaptor (Starboard side tail unit)
(g) Open MAIN refuelling cock in wing root. (Port and Starboard)
(h) Check that the drain cock and cock for tanks 4, 5 and 6 are closed (Port and Starboard).
(i) Open Y-coupling valve and commence pumping
(j) Open cocks for 4, 5 and 6 if required when tanks 1, 2, and 3 are full.
(k) Refuelling completed. Close Y-coupling valve. Stop pumping.
(l) Set refuelling launch valve to drain and open Y-coupling valve.


TO REFUELLING CONNECTION
REFUELLING DISTRIBUTORS
VENTING OF REFUELLING IN HULL
REFUELLING SYSTEM
TO PRESSURE WARNING-LAMP SWITCH UNIT
FUEL BACKING PUMPS
SUPPLY FOR ENGINE PRIMING
OFF-LOADING COCK
REFUELLING DISTRIBUTORS SEE ABOVE
CROSS-FEED PIPE
TO PRESSURE WARNING-LAMP SWITCH UNIT
No.6 TANK 141 GALL.
No.1 TANK 529 GALL.
No.2 TANK 348 GALL.
No.3 TANK 131 GALL.
No.4 TANK 97 GALL.
No.5 TANK 74 GALL.
DRAIN PIPE
FUEL PUMP
SOLENOID VALVE
RATED FLOW VALVE
DRAIN PIPE
VENTING OF REFUELLING IN HULL SEE ABOVE
FILTER
PRIMING SPILL PIPE
TO JANITROL CABIN HEATERS
TO STATIC SYSTEM
FIREWALL
PORT SIDE SHOWN STARBOARD SIDE SIMILAR
PRESSURE SWITCH
FLOWMETER
TO ENGINE DRIVEN PUMP
CONTROL BOX
HEATERS
KEY
NON-RETURN VALVES
PRESSURE LINES
GRAVITY LINES
VENT PIPES LEADING TO MAINPLANE UNDER-SURFACE
VENT FROM COLLECTOR BOX
DIRECTLY CONTROLLED COCKS
ENGINEER CONTROLLED COCKS
PILOT CONTROLLED COCKS

FUEL SYSTEM

(m) Allow sufficient time for aircraft pipe line to drain
(n) Dip tanks.
(o) Turn OFF all refuelling cocks in wing root.
(p) Close Y-coupling valve. Remove and refit aircraft adaptor cap.

11.7. Refuelling (Overwing) Emergency Conditions only

(a) Electrical services OFF
(b) No smoking
(c) Refuelling launch moored at tail
(d) Foam Fire Extinguisher on wing
(e) Bond hoses to aircraft
(f) Dip tanks for quantity of fuel required
(g) Remove tank caps and fit chamois leather and funnel, bonding funnel to aircraft.
(h) Pass the first 20 gallons through the chamois leather and check for water
(i) If no water is present refuelling may continue direct from hose to tank. If water is present all petrol must pass through the chamois leather.
(j) Ensure that the required air space is left in the tanks when filled.
(k) Dip tanks for quantity uplifted and total on board
(l) Refit tank caps, dipstick caps and tank top covers.

11.8. Off-Loading Fuel - Procedure

The off-loading system is by the normal tank line and cock to collector box via the tail connection.

(a) Electrical services OFF
(b) No smoking
(c) Petrol Barge moored at tail
(d) Fit Y-coupling to tail connection
(e) Dip tanks to be drained as check on quantity to be off-loaded.
(f) Open MAIN refuelling cock in wing to be drained
(g) Open DRAIN cock in wing root.
(h) Open tank cock of tank to be off-loaded
(i) Open Y-coupling valve and launch valve to DRAIN
(j) When off-loading completed close tank cock and drain cock.
(k) Dip tanks for quantity off-loaded and total in aircraft.
(l) Close MAIN refuelling cock after the time required to drain the aircraft pipe line.
(m) Close Y-coupling valve, remove coupling and refit connection cover.

11.9. Fuel System Vents

A pipe line is fitted to each collector box leading up to the surface of the wing and connected to Tanks No. 3 and 5.

This ensures that the system is always clear of airlocks from tanks to backing pumps.

Fitted to each tank top is a combined vent and overflow valve. This vents the tanks and also prevents fuel loss from surge.

The outlet of the valve is connected to the underneath surface of the wings.

NOTE: When refuelling through the individual tank fillers provision is made for any split fuel to be drained clear of wing. This is done by the fitting of a concertina connection between the tank top and wing; the fuel being drained by a pipe from the concertina to the lower surface of wing.

12. OIL SYSTEM

12.1. Tankage

Each engine oil tank contains the following. -

Engine oil	$30\frac{1}{2}$ gall.
Feathering reserve	2 gall.
Air space	5 gall.
Total for each engine	$37\frac{1}{2}$ gall.

Oil specification. - Aero-Shell 100B or Intava 1AA 745 X 1AA 810
D.E.D.2472A/2 Winter
D.E.D.2472B/2 Summer

NOTE.... Aero-Shell 100B must be used and only in extreme emergency should any of the above alternatives be used. In such a case it is necessary to drain completely and flush the oil system before using an alternative oil.

12.2. Operation

Each engine has a self-contained oil system.

The tank is fitted with a partial circulating chamber (hot pot) sump filter and dipstick. It is mounted in the main plane spar trusses at the rear of each engine nacelle.

The main outlet feeds oil to the suction side of the engine pump.

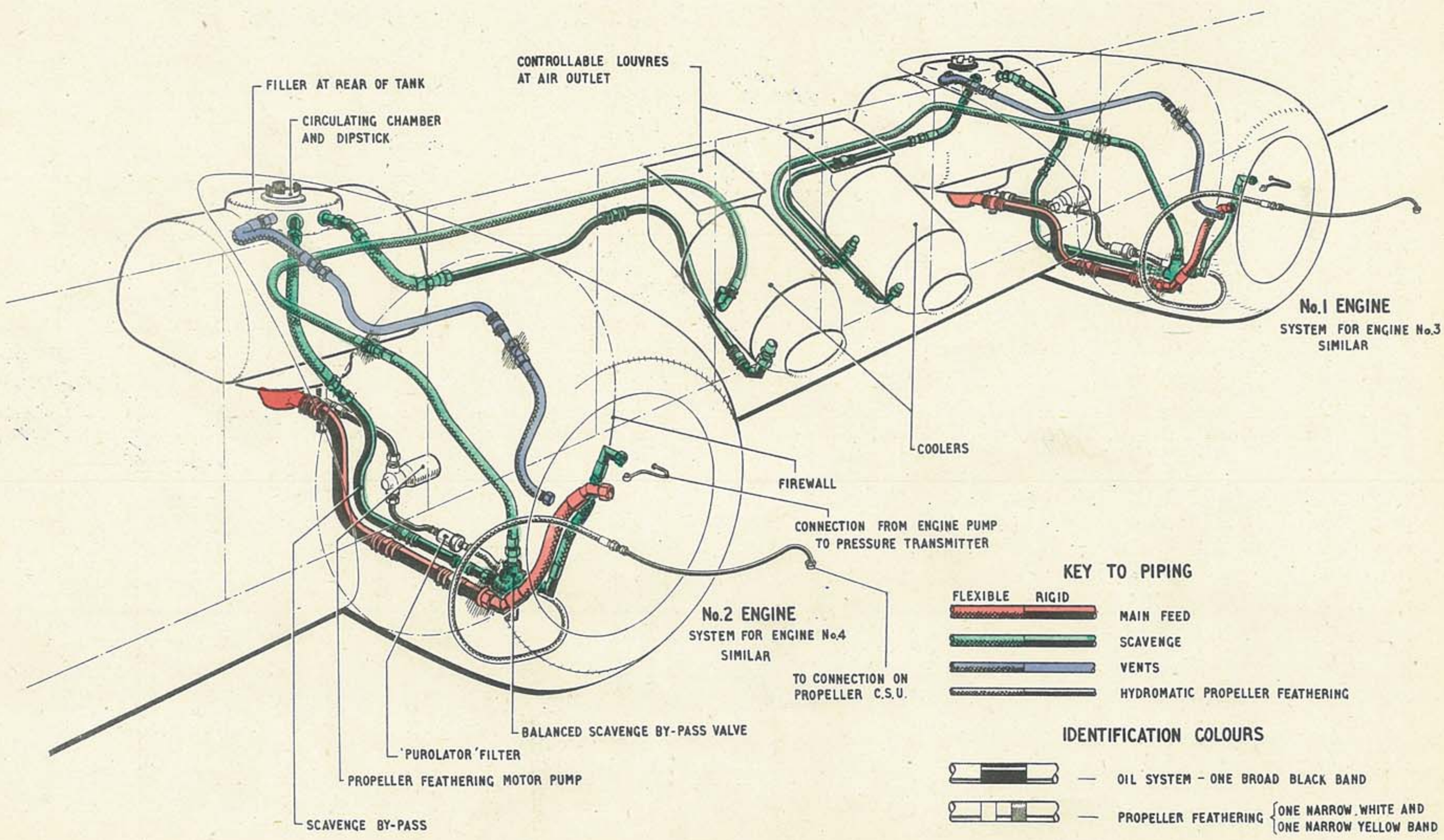
An outlet is provided for the propeller feathering pump.

A balanced scavenge by-pass valve is fitted to safeguard against oil cooler damage from high initial starting pressures.

12.3. Propeller feathering system

The oil supply for the feathering pump is taken from the base of the oil tank, approximately two gallons reserve of oil being allowed for this purpose.

From the pumps oil passes through purolator filters to the C.S.U. and propellers.


FILLER AT REAR OF TANK
CIRCULATING CHAMBER AND DIPSTICK
CONTROLLABLE LOUVRES AT AIR OUTLET
No.1 ENGINE
SYSTEM FOR ENGINE No.3 SIMILAR
COOLERS
FIREWALL
CONNECTION FROM ENGINE PUMP TO PRESSURE TRANSMITTER
No.2 ENGINE
SYSTEM FOR ENGINE No.4 SIMILAR
TO CONNECTION ON PROPELLER C.S.U.
BALANCED SCAVENGE BY-PASS VALVE
'PUROLATOR' FILTER
PROPELLER FEATHERING MOTOR PUMP
SCAVENGE BY-PASS
KEY TO PIPING
FLEXIBLE
RIGID
MAIN FEED
SCAVENGE
VENTS
HYDROMATIC PROPELLER FEATHERING
IDENTIFICATION COLOURS
— OIL SYSTEM - ONE BROAD BLACK BAND
— PROPELLER FEATHERING {ONE NARROW WHITE AND ONE NARROW YELLOW BAND

OIL SYSTEM

12.4. Replenishing tanks

Oil tanks can be replenished from a tanker at the rear of the aircraft. Eye fittings are positioned on top of the hull for lashing the oil hose from launch.

Oil spilt during the filling is drained from tank top anti-spill fitting by a pipe line to undersurface of wing.

13. VACUUM SYSTEM

The following flying instruments are operated from the suction side of either of two vacuum pumps fitted on engines No. 2 and 3.

Directional Indicator
Turn and Bank Indicator
Artificial Horizon

A change-over cock is fitted on the hull side above the Engineer Officer's priming panel.

A vacuum gauge is fitted adjacent to the changeover cock.

14. DE-ICING SYSTEMS

14.1. Tankage

One tank divided by vertical bulkhead into two sections. -

Fluid available for Aerofoils	) 55 gall. type H.63A or	
Propellers	) Aero-Shell compound No.7	
Fluid available for Carburettors)	30 gall. type D.T.D.389	
Windscreen)		

14.2. Equipment

De-icing equipment is provided for . -

(a) Aerofoils
(b) Propellers
(c) Carburettors
(d) Pilot's windscreen

A small panel with stop cocks for the above services is located at the port wing-root bulkhead.

For operation of de-icers all stop cocks ON

14.3. Aerfoil de-icing

T.K.S. Dunlop De-icing system is installed. In this system de-icing fluid is pumped to distributor overshoes fitted on the aerofoil leading edge. Kilfrost de-icer paste may be used in place of the T.K.S. system.

A T.K.S. de-icer control panel is mounted at the E/O's side panel, consisting of two tumbler switches, one for manual operation and the other for Emergency. Indicator lights are fitted, one green signifying "Pump" operation and one red signifying "Emergency" operation.

Manual. Control switch starts the pump which gives $1\frac{1}{2}$ minutes at full flood and then operates intermittently in a sequence of 1 ON and 4 OFF (1 min. cycle).

Green light shows when pump is running.

Emergency. Operation of this switch is for emergency only. The pump runs continuously giving a flood flow of de-icing fluid. When operating in the Emergency position both rend and green lamps are alight.

Consumption.	Manual.	Approx.	$3\frac{1}{2}$ galls. per hour
	Emergency	"	16 galls. per hour

Recommended Practice

On a flight of long duration when icing conditions are anticipated switch on the Emergency for 30 seconds every two hours. This will ensure that the system is fully primed and ready for immediate use at all times.

Before flight Emergency switch to ON position. GREEN and RED indicator lamps showing. Run for two minutes. Providing the system is primed daily this will give sufficient time for the fluid to exude from all overshoes.

Check functioning of system under normal or intermittent running by switching on Manual; motor will commence running, (green indicator light showing) within four to five seconds. It will run continuously for 50-90 seconds, this being the "initial ON".

After a short while the motor will again commence running and from this point onwards will operate on the Normal time cycle of 1 ON and 4 OFF.

14.4. Propeller de-icing

De-icing fluid drawn from the aerofoil de-icing tank is supplied to slinger rings at the back of the propeller hubs. Overshoes are fitted on the propellers to assist in even distribution of the fluid along the leading edges of the blades.

The rate of fluid delivery is controlled by two rheostats on the Engineer Officer's side panel, one for inner engines and one for outer engines.

Two indicator lamps on this panel show when the motors are ON.

Consumption.	All Engines.	Minimum.	4 galls per hour
	All Engines.	"Full ON"	16 galls. per hour

Recommended Practice

When icing conditions are anticipated it is advisable to run the de-icer pumps and "wet" the blade surfaces.

When propeller icing is encountered run the pumps "Full on" for a period of 3 to 5 minutes then reduce to half speed.

If the propellers again ice up turn the pumps full on and increase the engine R.P.M. to Max. Cruising.

14.5. Carburettor de-icing

Hand wobble pumps are now being fitted in place of the electrically driven pumps, and are positioned on the starboard side of the E/O's station. Two pumps are fitted, one serving the outboard engines, and the other serving the inboards.

Each pump has its selector cock fitted adjacent, enabling one or both engines served by the particular pump to be supplied with fluid. The rate of flow of the de-icing fluid to each engine is decreased when two engines are supplied simultaneously by the one pump.

In an emergency all four engines can be supplied at the same time by operating both hand pumps simultaneously.

Recommended Practice

When icing conditions are anticipated it is advisable to operate both pumps (with selector cocks in position to supply all engines) to prime all pipe lines.

Should there be a drop in engine power, and icing is suspected, operate hand wobble pumps at a speed not exceeding 120 strokes/min, for a maximum period of 30 secs. If engine power does not return to normal at the end of this period the hand pumps should be again operated after an interval of 30 secs.

NOTE.... So that the maximum rate of flow to each engine is not exceeded, it is essential that the pumps are not operated at a speed exceeding 120 strokes/min. At this speed the pump delivers 700 cc-750 cc per min. to each engine. Continued operation of either pump must not exceed 30 secs.

Maximum Duration of Operation

The amounts of de-icing fluid (DTD.389) carried for carburettor and windscreen de-icing are as follows :-

Winter Schedule

9 gallons (8 gallons Carburettor)
(1 gallon Windscreen)

Summer Schedule

8 gallons Carburettor

Fluid consumption when operating pumps in accordance with the above instructions i.e. 30 sec. intervals between 30 sec. periods of operation is 5 gallons per hour per engine. At this rate of consumption, the maximum duration of operation will be :-

for 1 engine		1.6 hours
for 4 engines simultaneously	(Reduced rate (of flow	0.7 hours approx.

To ensure a two-gallon reserve of fluid for carburettor de-icing, a stack pipe is fitted at the tank sump in the supply line to the windscreen de-icing hand pump.

14.6. Windscreen de-icing

De-icing fluid is drawn from the carburettors de-icing tank and pumped by a hand operated pump to spread pipes forward of the coupe. The hand pump is fitted below the Pilot's instrument panel at the port side of the engine control stand. This pump is fitted with a variable rate of flow valve.

14.7. Pressure-head heaters

The pressure heads are heated by separate elements, the control switches being fitted on the cockpit roof panel.

WARNING: Switches must be turned OFF after landing to avoid burning out the elements.

15. VENTILATION SYSTEM

15.1. Hot or cold air

Two combustion type air heaters supply heated air to various parts of the hull through a series of ducts, air being supplied under ram pressure from air intake scoops in the aircraft nose.

The heaters are supplied with fuel from the pressure side of an electrically driven pump situated in the starboard wing.

They are controlled electrically by the engineer after an air pressure micro-switch closes when the aircraft attains a speed of 80 knots.

A thermal-switch automatically cuts off the fuel if the air temperature reaches 350°F. An emergency shut-off cock fitted in the fuel line is operated manually by cable from the engineer's control stand.

With the heater switched OFF, the ducting can be used to deliver cold air.

Adjustable ventilation outlets

Lower deck

Cabin A	Two near floor level on each side
Cabin B	Similar to Cabin A.
Cabin C	Similar to Cabin A.
Gent's Dressing Room	One near floor level in rear bulkhead
Promenade Cabin	Two near floor level on each side for chairs or lower bunks.
Ladies' Dressing Room ...	One near floor level on starboard side for chairs.

Upper Deck (aft)

Galley	One near floor level in centre of forward bulkhead.
Cabins D, E & F.	Eight near floor level, four each side.

Flight deck

Captain............	One on port side of control cabin
First Officer	One on starboard side of control cabin
Navigating Officer..	One on port side of hull
Radio Officer	One on port side of hull
Engineer Officer ...	One on starboard side of hull
Crew Rest Chairs ...	One on starboard side of hull

Dampers are located at each side of the flight deck to assist in equal distribution of hot air to all cabins.

15.2. Operating instructions for Dragonfly type heater

The heaters must not be used until the aircraft is airborne, and it is important that the butterfly valves, in the ducting adjacent to the pilot's seat, are open. and the spill valves are set to "Spill" overboard before starting the heaters. The fuel is taken from the starboard fuel system by means of a fuel pump to give the necessary pressure.

The following is the sequence of operations for starting the system.

(a) Ensure Domestic Supply "ON" push button has been pressed to close circuit breaker, this will be indicated by lamp located between push buttons.

(b) Open the butterfly valves (Pilots)

(c) Set spill valves to spill overboard (Pilot)

(d) Turn on heater Master Cut off cock (E/O)

(e) Set Cabin heater switch to HIGH

(f) Switch on Master Switch (E/O)

(g) Press PUMP START button (E/O)

This will close the relay which operates the fuel pump and the bulkhead solenoid valves. This push switch should be held on until the fuel pressure light is illuminated.

(h) Switch on heater switch (E/O)

(i) Press START buttons (E/O). The spark plug warning lamp will be illuminated, until the spark plug thermal switch operates. The period of operation of the spark plug should not exceed two minutes. The heaters automatically start under boost condition and they automatically revert to normal operation for HIGH. This operation is controlled by the boost thermal cut out switch.

(j) If under condition for boosted supply the temperature of the air does not rise sufficiently, reduce the air flow by partially closing butterfly valves.

(k) Set SPILL valves to "HEAT ON TO CABINS" (Pilot)

NOTE... It is imperative that the boost condition is only continuously used under extreme heat requirements. The butterfly valve should be partially closed if necessary under normal conditions, to ensure that the heaters operate under the control HIGH & LOW heat.

If, owing to excessive temperature rise, the overheat thermal switch operates, the green lamp which is ON during normal operation, will be extinguished and the heater will not restart automatically. Therefore, after the cause of overheating has been rectified, operations b to k must be repeated.

15.3. Cold air

An intake in the starboard wing leading edge inboard of the inner engine is fitted with a controllable butterfly valve and filter screen. A detachable side panel starboard side of hull at rest seat position gives access to the butterfly valve.

A system of ducts is installed for cold air distribution to adjustable ventilators in all cabins, toilets, and in the pantry and lounge.

15.4. Air extraction

Foul air is drawn from compartments on the lower deck by ducting connected to discharge ducts in each wing. The system is automatic in operation, the outlets being fitted in the low-pressure area at the wing roots.

The extractors on the lower deck are positioned in the ceilings of the following compartments -

Cabins A and B, gent's dressing room, gent's toilets,
Cabin C, promendade cabin, ladies dressing room and ladies' toilet.

On the upper deck two extractors in the ceiling of the pantry have individual outlet cowls fitted in the hull roof, and extractors in the ceilings of cabins D, E and F are connected by ducting to an outlet cowl in the hull roof above cabin D.

16. OXYGEN

Seven oxygen cylinders, containing 2250 litres each, are carried in the cupboard between the gents' lavatories.

From the cylinders a high pressure line passes through non-return valves to a shut-off valve at the starboard side of the hull at the Engineer's station. A charging point for replenishing oxygen is located at port side of bulkhead in No. 2 and 3 holds.

From the bottles the oxygen passes through a high pressure refilling non-return valve to the regulator in the Engineer's panel. A low pressure system connects the regulator with the various points in the aircraft.

The supply of oxygen is controlled by means of the cocks on the regulator at the Engineer's position. To turn on the supply the main cock and the cock beneath the bottle contents indicator gauge must be turned to their full extent in an anti-clockwise direction. The third cock regulates the flow for altitude, the dial of which is calibrated in thousands of feet.

It may take some seconds for the needle of the altitude regulator to react to the supply but this is normal. When the system is not in use all three cocks must be turned FULLY OFF.

It is most important that the cocks be operated in accordance with these instructions in order to ensure a leak does not occur as oxygen leaks are dangerous.

To obtain supply

(a) Main cocks to be operated as above.

(b) All crew members plug in at their respective positions and breathe.

Endurance in minutes (based on continuous used by number of persons shown).

Altitude Feet	Solent 42 Persons	48 Persons
10,000	320	280
15,000	221	194
20,000	188	164

Oxygen Supply Points

Starboard Side.

Upper deck

(a) Engineer's Station
(b) Crew Rest Chair
(c) First Officer's postion
(d) Single point socket for steward for pantry lounge
(e) Twin point sockets at chair positions in cabins D, E and F.
(f) Twin point sockets at chair positions in cabins A and B.

Lower Deck

(g) Single point sockets in each gents' lavatory
(h) Single point sockets lower bunk positions in promenade cabin
(i) Twin point sockets at chair positions in Cabin C.

Port Side

Upper deck

(a) Single point sockets at Radio Officer's, Navigation Officer's and Captain's positions.
(b) Single point sockets for Steward and chair positions in Cabins D, E and F.

Lower Deck

(c) Single and twin point sockets at chair positions A and B.
(d) Single point sockets at chair positions in Cabin C, bunk positions in promenade cabin and Ladies' Dressing Room.

All supply sockets at chair positions are fitted on the hull side.

17.

FIRST CHECK (F/O)

1.	No-smoking indicators	ON	(F/O)
2.	Freight hatches and emergency exits	Secured	(F/O)
3.	Pressure-head covers	Removed and stowed	(E/O)
4.	Static vent plugs	Removed and stowed	(E/O)
5.	Fuel, oil, de-icing fluid and oxygen	Check contents	(E/O)
6.	Main switches and flap circuit broken	ON	(E/O)
7.	Engineer's check	See individual check list	
8.	Clocks, altimeters, D.R. compass and repeater	Checked ON	(N/O)
9.	Navigator's check	See individual check list	
10.	W/T switches	ON	(W/O)
11.	Wireless officer's check	See individual check list	
12.	Steward's check		

18.

SECOND CHECK (Capt.)

1.	Hatches and First and Kit	Checked and secured	(F/O)
2.	Control lock	OUT	(F/O or N/O)
3.	Control tension and movement	Check	(Capt.)
4.	Trim tabs	Check and set	(F/O)
5.	Engine master (carburettor) cocks	ON	(Capt.)
6.	Fuel tank cocks	1, 2 and 3 ON	(E/O)
7.	Engine cut-outs	OFF	(F/O)
8.	Switches	OFF	(F/O)
9.	Flaps - Indicator	ON	(E/O)
	Operation	Checked	
	Position	IN	
10.	Propellers	Fully fine (INCREASE R.P.M.)	(E/O)
11.	Auto-pilot - Clutch	IN	(Capt.)
	Rudder lock	OUT	
	Control cock	OUT	

19.

STARTING CHECK

1.	Switches	OFF	(Capt. or F/O)
2.	Engine cut-outs	OFF	
3.	Throttles	Set	

20.

TAXYING CHECK

1.	Switches	Checked	(F/O)
2.	Instruments	Instruments working gyros set	(Capt. or F/O)
3.	Auto-pilot	Pressure and Vacuum	(Capt.)
4.	D.R. compass	ON	(N/O or F/O)
5.	Wireless check	(W/O)	
6.	Watertight doors	Closed (steward)	
7.	Engines. - Air intakes	COLD	
	Temperatures and pressures	Check correct	(E/O)

8. Running up - Switches correct .... Powers correct) Pressures checked) (E/O) Generators checked) Vacuum correct)

21. TAKE-OFF CHECK

1.	Flaps	1/3 OUT and OFF	(F/O)
2.	Rudder and elevator	Set to	Capt.
3.	Ailerons	Set to	Capt.
4.	Fuel	ON	Capt.
5.	Pressure-head heaters	ON if necessary	Capt.
6.	Passenger's indicator's	ON	Capt.
7.	Propellers	Fine pitch - dampers on	Capt.
8.	Auto-pilot	OUT	Capt.
9.	Compass and gyros	Working checked	(Capt. & F/O)
10.	Engines	No. 1, 2 and 3 fuel tanks ON Air intakes COLD AIR Backing pumps ON Oil cooler shutters 1/4 open Flowmeters OFF	(E/O)

22. DEPARTURE CHECK

1.	Steaming light	OFF	(Capt.)
2.	Flaps	IN and OFF	(F/O)
3.	Passenger's indicators	OFF or ON as required	(Capt.)

23. APPROACH CHECK

1.	Passenger's indicators	ON	(F/O)
2.	Altimeters	Set	(Capt. and F/O)
3.	Auto-pilot	OUT Lock off	(Capt.)
4.	Wireless	Check	(W/O)
5.	Engineer's check	See individual check list	
6.	Watertight doors	Closed (steward)	
7.	Propellers	R.P.M.	
8.	Flaps	Going out - OUT	
9.	Coolers	Shutters and gills	(E/O)

24. TAXYING CHECK

1.	Steaming light	ON	(Capt.)
2.	Pressure-head heaters	OFF	(F/O)
3.	Flaps	IN	(F/O)
4.	Engines	Temperatures and pressures correct for stopping engines	(E/O)

25. FINAL CHECK

1.	Navigation lights	OFF	(Capt.)
2.	Fuel	OFF	(F/O)
3.	Propellers	Trimmed	(F/O)
4.	JINK switch	OFF	(F/O)
5.	Instrument lamps	OFF	(Capt. & F/O)
6.	Gyros	Caged	(Capt. & F/O)

7. Controls .... Locked (N/O or E/O)
8. Windows and hatches .... Closed (N/O or E/O)
9. Engineer's check ....(
10. Navigator's check ....(See individual
11. Wireless operator's check ....(check lists

INDIVIDUAL CHECK LISTS

26. NAVIGATOR - First check

1. All navigation equipment, maps, charts etc. present and stowed
2. Altimeters set, clocks adjusted and wound
3. Compass repeaters synchronized
First course set on all compasses

Final check

1. All navigation equipment, maps, charts etc., stowed
2. D.R.C. switched OFF
3. A.S.V. switched OFF
4. Astro hatch closed
5. Chart table cover in position

27. WIRELESS OPERATOR

First check

1. Check marine equipment
2. Cursory check of transmitters
3. Cursory check of receivers
4. Visual check of aerials
5. Inter-com. operational
6. Head sets in position
7. All documents available
8. Cursory check on D.F.
9. V.H.F. R/T operational

Approach check

1. Trailing aerial in

Final check

1. Aerials earthed
2. All switches OFF
3. Waterproof covers in position

28. ENGINEER

First check

1. Removal of covers from pressure-heads, engines etc. and removal of static vent plugs.
2. Operation of navigation lights
3. Fuel and oil on board in agreement with load sheet etc.
4. All pressure refuelling cocks closed and locked
5. De-icing services for operation and quantity of fluid
6. Battery voltage, cabin lights, and signalling system.

7. Gill and oil cooler shutters for operation and adjust to correct position for starting i.e. gills open, oil cooler shutters as required.
8. Backing pumps for operation and priming carburettor (cut-out in OFF position)
9. Booster coil switches OFF
10. Tail release hook locking pin removed

Approach check

1. Fuel tanks No. 1, 2 and 3 ON
2. Flowmeters OFF
3. Backing pumps ON
4. Domestic master switch OFF
5. Cabin heaters OFF

Final check

1. All fuel cocks OFF
2. All electrical circuits switched OFF
3. If at night, ensure that main domestic switch is OFF but that compartment dim lights are ON

29. STEWARD

First check

1. All necessary food, flasks, bedding, rugs, crockery etc., are actually on board the aircraft and properly stowed.
2. Cabins and toilets clean and tidy, and their equipment correct.
3. Cabin signalling system and lights functioning

Taxying check

1. All doors and hatches closed and locked
2. All passengers in correct seats with lapstraps fitted and lifebelt, etc., instruction completed.
3. Stewards at correct stations
4. All water-tight doors closed and fastened

Approach check

1. All passengers in correct seats with lapstraps fitted
2. Stewards at correct stations
3. All water-tight doors closed and fastened

30. PREPARATION FOR TAKE-OFF

30.1. Control settings

Set controls as follows. -

Pilot	Cut-out control	OFF
	Ignition	OFF
	Propeller	Max. R.P.M. position
	Throttle	1" open
	Master (carburettor) cocks	ON
Engineering	Fuel tanks	Port and starboard tanks No. 1, 2 and 3 ON
	Cross-feed cock	CLOSED
	Cowl gills	OPEN (unless O.A.T. is below 0°C when gills should be opened after 2 minutes running).
	Intake shutters	COLD AIR position
	Oil cooler shutters	According to temperatures
	Electric master switches	GROUND/FLIGHT TO FLIGHT position. Feathering master switch ON.
	WHEN GROUND BATTERIES ARE USED FOR STARTING, THE GROUND/FLIGHT SWITCH MUST BE IN THE GROUND POSITION	

30.2. Starting procedure

1. Prime fuel lines and injector by operating backing pumps for 30 secs .... E/O
2. Fill priming lines by operating Ki-gass pump .... E/O
3. Test for hydraulic locking .... pilot
4. Switch ON ignition and press starter button .... pilot
5. When engines are turning, switch ON booster coil and prime engine by operating Ki-gass pump .... E/O
6. When the engine fires on the priming mixture switch ON the cut-out control .... pilot
7. Run the engines at the lowest steady R.P.M. for a short period before increasing to 1100-1200 R.P.M. for warming up .... pilot
8. Check that the oil pressures rise immediately .... E/O

NOTE ..... Should it be necessary to stop an engine immediately after starting during very cold weather, it is essential to run it until a cylinder-head temperature of 120° is reached.

30.3. Slipping moorings

1. It is recommended that the outboard engines are started, the moorings slipped, and the inboard engines started during taxying.
2. The best taxying speed for prolonged taxying is 1200 R.P.M. other speeds may be used but the limiting temperature of 280°C must not be exceeded. Engines must not be shut down at temperatures above 180°C.

30.4. Check during taxying

1. D.R. compass switched ON and SETTING
2. Vacuum pumps for operation
3. Directional gyro and artificial horizon
4. Auto-pilot air pressure 60-65 lb/sq.in.
5. Individual operation of backing pumps
6. Pressure-head heaters switched ON if necessary

30.5. Warming engines

When the outside air temperature is below + 10°C select hot air for warming up. Run engines at 1100-1200 R.P.M. until oil temperature reaches 15°C and the cylinder-head temperature 120°C. Check all gauges and instruments for normal reading. During warm-up carry out initial ignition check.

30.6. Engine run-up

1. With minimum cylinder-head temperature of 120°C and oil temperature 15°C open the throttle to give a static boost reading of - 3".
2. Exercise the propeller to give variations of 300-400 R.P.M.
3. Return the propeller to maximum R.P.M. position. Check R.P.M. at a static boost reading of - 3".
4. Repeat the check on all four engines. Compare these R.P.M. figures with each other and with the power check figure in the technical log. A variation of ± 50 R.P.M. is the limit stated by the manufacturers under static conditions, but due to the fact that the run-up will usually be carried out while taxying under varying wind conditions, the ± 50 R.P.M. should not be taken as a hard and fast figure. Due allowance must be made and more importance given to the comparison between engines.
5. After completing the power check with satisfactory results, check the ignition switches at static boost and propeller in fully fine pitch; observe the engines during the ignition check for vibration and R.P.M. drop.
   A drop of 50 R.P.M. attended by vibration, should cause an engine to be suspected.
   In case of doubt, where the R.P.M. drop exceeds 50 R.P.M. and there is no vibration, it is permissible to open the throttle to the rated boost. Retract the throttle slightly which should cause a slight drop in R.P.M. signifying that the propeller is at the fine pitch stops.
   Check the switches again; if the R.P.M. drop exceeds 50 R.P.M. and/or vibration exists, the engine must be considered unserviceable.

30.7. Checks at - 3" static boost

1. Oil pressure .... 80 lb/sq.in.
2. Fuel pressure .... 23.5 lb/sq.in. - obsolute minimum *
   27 - 30 - working range
3. Air pressure .... 60 - 65 lb/sq.in.
4. Vacuum pressure .... 3.5 - 4 lb/sq.in.
5. Generators cut-in and charging.
   Ensure generators are cut-out by operating the circuit-breakers when R.P.M. is being reduced after run-up.

* At this pressure, powers are limited to weak cruising only.

30.8
Checks prior to take-off

Pilot
1. Controls free, rudder damper disengaged
2. Trim as required
3. Propeller - Maximum R.P.M. position
4. Auto-pilot clutch IN, control cock OUT
5. Flaps 1/3 OUT
6. D.R. compass NORMAL position
7. Directional gyro uncaged and set
8. Cylinder-head temperature below 170°C
   Oil temperature below 70°C
9. Gills closed. Oil cooler shutters closed, or open 1/4 (Max.) if required.
10. Air intake shutters COLD AIR
11. Backing pumps ON
12. Propeller feathering master switch ON
13. Generator circuit-breakers engaged
14. Tank cocks No. 1, 2 and 3 (Port and Starboard) ON.

31. TAKE-OFF AND CLIMB

31.1. Take-off into wind -

Control column neutral and full aileron against wing which has the float in the water.

Open up all four engines SLOWLY with one continuous motion.

The aircraft has a tendency to swing to the right, this being more noticeable under calm conditions, and high altitude.

Differential throttle opening should not be necessary.

The unsticking speed of the aircraft at 75,000 lb. is approximately 85-190 knots I.A.S.

31.2. Take-off across wind -

The same as into wind except for aileron control maximum aileron control should be used until the into wind wing is well down, this position should be held with decreasing control until the aircraft is off the water.

As the rudder control is not sufficiently effective at low speeds, differential throttle control is generally necessary, but is to be avoided as far as possible as it increases the take-off run.

31.3. Initial climb after take-off

When 120 knots I.A.S. has been reached, set the throttles at rated boost i.e. 43.75" and R.P.M. at 2200.

Flaps to be retracted at the pilot's discretion after the safety speed of 120 knots I.A.S. has been reached.

31.4. Climb

Throttles set at rated boost, R.P.M. 2,200
Climb at 140 knots (min.) I.A.S

If necessary at higher altitudes, increase climbing R.P.M. to 2,400.

32. OPERATING PROCEDURE

Condition	R.P.M.	Knots - I.A.S.	Induction pressure "Hg. (Max.)	Throttle lever position
Take-off and initial climb	2,800	Until 120 knots is reached	$46\frac{1}{2}$	Fully forward
Climb	2,200	140 (min.)	$43\frac{3}{4}$	To give required boost
Climb above full throttle height i.e. boost dropping below $43\frac{3}{4}$ "	2,400 if required	140 (min.)	Maximum boost	Fully forward
Cruising Density altitude	1,850 to 2,250		36"	
2,500 ft- 5,000 ft.		155		Above full throttle height retracting until induction pressure just falls.
5,000 - 7,500		152		
7,500 -10,000		145		
10,000 -12,000		142		

NOTES.... 1. It may not be possible to maintain 142 knots above 10,000 ft. owing to the maximum cruising R.P.M. restriction of 2,250, i.e. maximum obtainable I.A.S. up to 142 should be maintained. Where B.H.Ps of more than 1,000 are found necessary to maintain the above airspeeds, adopt constant power of 1,000 until required air speed is obtained. Final approach and landing R.P.M.2250 (2,400 to be used for the absolute shortest possible time).
Use minimum R.P.M. always so long as I.A.S. is above the minimum quoted.

2. Power check. - 3" lower than the atmospheric pressure of the day (this is to avoid undue running at R.P.Ms of 2250 - 2400) Ignition checks and propeller exercising to be carried out at this condition.

3. R.P.M. between 2,250 and 2,400 are not to be used.

33. AUTOMATIC PILOT - R.A.E. TYPE Mk. 8A

33.1. Checks prior to take-off

(a) Clutch lever in the IN position. (Lever fully forward)
(b) Move control column to extremities fore and aft and the ailerons left and right to ensure that the clutches are engaged.
(c) Rudder lock in OFF position and rudder quite free. Check by moving through full travel.
(d) All engines running and 60 lb/sq.in. indicated on pressure gauge. Check free movement of aileron and elevator control surfaces with the control cock both in SPIN and OUT position.

(e) Control cock to <u>OUT</u> prior to take-off.
(f) Switch on D.R. Compass.

33.2. Engagement of controls

(a) As soon as convenient after take-off set control cock to SPIN. After not less than five minutes with the control cock in this position the Automatic Pilot will be ready for use.
(b) Set pitch control to desired pitch attitude of the aircraft.
(c) Trim the aircraft hands and feet off at desired speed and course.
(d) Rudder trim is important. Rudder lock should be engaged.
(e) Set control switch to COMPASS
(f) After control cock has been in SPIN for five minutes move it to IN, checking engagement by feel of control column which should resist movement.
(g) Should it be necessary to adjust or reset the controls rudder lock must be disengaged during the adjustment and immediately re-engaged afterwards. Should the aircraft wander from the desired pitch attitude allow it to settle before making adjustment to the pitch control. All adjustments should be made slowly.

33.3. Turns with automatic control - slow

Small alterations to course may be made while control switch is at COMPASS by re-setting the adjustable pointer of the Pilot's repeater. The rate at which the aircraft alters course will be $3 - 5^{\circ}$ per minute.

Turns with automatic control - fast

(a) Set repeater pointer to desired course and turn the control switch to JINK AND TURN position. A bank turn of approximately Rate $\frac{3}{4}$ will develop. When the aircraft is about 15° short of the desired heading return the control switch to COMPASS

(b) During a fast turn it is necessary to adjust the pitch control to hold up the nose of the aircraft while turning.

33.4. Failure of D.R. compass

Should the D.R. compass fail the pilot's repeater can still be used as a turning switch.

Operation

(a) Switch OFF D.R. compass
(b) Align pointer with lubber line and put control switch OFF
(c) Slow turn - displace the repeater pointer approximately 10° in required direction.
(d) Set selector switch to COMPASS
(e) Turn switch OFF and re-align the pointer when the new heading is reached.
(f) To effect a rate $\frac{3}{4}$ turn operation as above, but set control switch to JINK/TURN anticipating the over-swing by placing the control switch OFF approximately 15° before the new heading is reached.

33.5. Change of fore and aft attitude

The fore and aft attitude of the aircraft while under automatic control can be altered by operation of the pitch control provided.

The manual trimmer must not be used to change attitude.

"The correct way to eliminate this trouble is by use of the rudder trim control and not by the aileron control. There is no adjustment on the Auto-Pilot Unit similar to that on the Mk.IV".

33.6. Use of automatic control with one or more engines out

Operation

(a) If the compressor is mounted on the engine which is OUT the automatic pilot will also be inoperative.
(b) Move the control cock handle to SPIN to disengage the automatic pilot.
(c) Feather propeller of unserviceable engine or engines.
(d) Trim rudder. If full rudder bias is insufficient, assist by pressure on the rudder bar.
(e) Move control cock from SPIN to IN position to re-engage automatic pilot.

The automatic pilot will operate satisfactorily in a four engined aircraft with two engines out on the same side providing the rudder trim is correct.

33.7. Operation of automatic control immediately prior to landing

(a) Control cock to OUT position
(b) Control switch to OFF position
(c) Clutches disengaged
(d) Rudder lock disengaged

33.8. Recommended precautions

(a) Check clutches for engagement before take-off
(b) Allow five minutes in SPIN position
(c) Do not disengage clutches in the air except in an emergency.
(d) Do not use the manual elevator trimmer to change attitude when the automatic pilot is engaged.
(e) An emergency cock is fitted to the engine control stand for operation by the First Officer to regain manual control. This cock must be at the IN position for normal operation.

34. CONTROL SETTINGS FOR CRUISING

34.1. The throttles are adjusted on all four engines to give an equal torque meter reading of the required power.

34.2. Reminders

(a) The highest permissible torque meter reading and the lowest R.P.M. will produce the best power setting.

(b) When flying above full throttle height for a particular combination of Boost and R.P.M. an increase in power is obtained by retraction of the throttles.

(c) When flying above full throttle height variation in the respective engine powers may be observed. This variation is acceptable unless rudder trim is necessary, in which case power is reduced to the lowest engine.

(d) Recommended Maximum Boost and R.P.M. for weak mixture cruising is 36.00"Hg. 2250 R.P.M.

(e) With torque meter readings equal and R.P.M. synchronised on all four engines 2" Hg. variation between engines is permissible.

(f) Vibration period of 2250 to 2400 R.P.M. This range of R.P.M. must not be used. Where R.P.M. above 2250 is required, select 2400 R.P.M.

35. POWER DESCENT

Recommended descent en route is at a rate of approximately 400 feet per minute with an aircraft attitude of 1° nose up.

Set R.P.M. and power depending on the gross weight of the aircraft to give an I.A.S. of 150 knots and rate of descent at 400 - 500 ft. per minute, with no appreciable change of attitude from normal cruising position.

36. APPROACH

36.1. Fuel tanks Nos. 1, 2 and 3 ON (Port and Starboard). All other tanks OFF.

36.2. Backing pumps switched ON

36.3. "Initial approach should be at 140 knots I.A.S. when across wind. Immediately before turning onto approach leg set R.P.M. to 2250. For the shortest possible time before alighting increase R.P.M. to 2400".

36.4. On completion of turn lower flaps and reduce speed to 110/120 knots I.A.S.

NOTE....(a) Prior to final approach the oil cooler shutters may be fully open to cool the oil and closed to ¼ open for final approach and landing.
(b) Cowl gills closed for final approach
(c) Flowmeters by-passed for alightings.

37. NORMAL ALIGHTING

37.1. Reduction in speed is slow down to 100 **I.A.S.** after which it becomes rapid. Below 90 **I.A.S.** it becomes very rapid with an increased rate of descent.

For this reason it is advantageous to increase throttles slightly at 90 **I.A.S.** to give a smooth touch-down in a tail down attitude between 75-80 knots according to weight of aircraft.

37.2. After touch-down throttles should be closed.

37.3. Control column eased forward to allow the aircraft to assume natural hydroplaning position.

37.4. Towards the end of the run as the nose begins to rise, open outboard throttles slowly to maintain aileron control and to prevent water striking the elevators.

37.5. Under calm conditions coarser use of the throttle is necessary.

37.6. Flaps should be switched in and airscrew moved to FULLY FINE immediately on touch-down.

38. ALIGHTING ON GLASSY WATER

38.1. A normal approach should be made.

38.2. At approximately 100 feet, check rate of descent which should then be regulated to 200 - 300 ft. per minute using engines to control it .

38.3. The aircraft can be "flown on" reducing speed to 75-80 knots I.A.S. Throttles should be gently adjusted with change of trim at the final rate of descent of 100 feet per minute.

38.4. Alighting at speeds in excess of 90 I.A.S. with the aircraft in a nose down position the throttles should not be touched or the control column eased back; otherwise violent porpoising may result.

38.5. Throttles should only be closed when the air speed is below 75 I.A.S.

38.6. When porpoising occurs during an alighting run a small application of power will give full elevator control.

39. NIGHT OPERATION

39.1. Take-off normal

39.2. Alighting similar to alighting on glassy surface

40. CROSS WIND ALIGHTING

40.1. Landing cross wind as normal approach and touch-down

Drift is to be taken up by putting the windward wing down and keeping the aircraft straight by the rudder, as necessary.

After touch-down direction is maintained with the rudder and differential use of the engines, care being taken to prevent the wind getting underneath the windward wing. To do this the wing should be held slightly down until the aircraft comes off the step.

41. SWELL CONDITIONS

41.1. Swell take-offs should be carried out along the swell providing wind strength is not above 8 knots.

Into swell, start take-off using normal procedure for take-off, exercising care in noting the difference between the rising and lowering of the nose due to short swell or chop (rapid motion) and the longer period of nose rising and lowering due to the long swell (slow motion). The aircraft must be held on the water until flying speed is reached. It is fatal to be bounced off as each bounce gets bigger and will eventually split the bottom or break an engine off. Therefore, check rise and fall of the nose by easing back the control column. When the nose action has been checked move the control column forward until the flying boat assumes natural take-off attitude. Never keep the control column hard back as this produces the incorrect angle of attack; heavy seas will hit the planing bottom too far aft resulting in the following; damage to plates and step, increased take-off run, aircraft leaving the water below the stall, producing bouncing.

41.2. Swell landing Always land along swell providing wind is not above 8 to 10 knots.

Landing into swell. Normal approach full flap, level out at 15 to 20 feet, ease control column back as speed falls off, increase power if required. Aircraft should commence to stall at 80 to 85 knots (fully laden). With the control column hard back, angle of attack level, and using power to control the rate of descent, touch-down on the crest of the swell. On making contact with the water close throttles and ease control column forward running down the trough and keep the boat on the water. Reduced forward speed is MOST desirable in these conditions.

42. ROUGH WATER AND HIGH WIND

42.1 Take-off, rough water and high wind

Turn into wind with engines slow running, then wait for maximum amount of backward sailing wind will give. Open up engines to full power and, with control in central position, commence take-off. Very little forward speed is noticed at first and only about 50 yards covered before the throttles are fully open. In order to prevent the nose rising, ease the control column slightly forward thus ensuring that heavy seas are taken on the nose and not on the planing bottom. When aircraft is running level, ease stick back to central position until flying speed has been attained, when the aircraft can be allowed to become airborne.

Great care should be taken to avoid becoming airborne before flying speed has been attained as severe damage can result when the aircraft drops back onto a rough sea or swell after being thrown off.

NOTE... Use of flaps dependent on wind force.

42.2. Landing, rough water and high wind. Procedure same as landing into swell, with careful check on drift; rough water and drift will remove a float.

43. STOPPING ENGINES

Normally the two inboard engines are stopped during the taxy up to the moorings. The two outer engines being "cut" as soon as the aircraft is moored. Consideration to engine handling during the taxy will ensure the CHT° are below the max. limit of 180°C before stopping. To stop an engine reduce to slow running R.P.M. and operate cut-off to OFF position. When engine has stopped switch OFF ignition switches and turn OFF fuel by operating carburettor cock.

44. GROUND HANDLING

44.1. Towing

For normal forward towing the retractable mooring bollard in the nose of the aircraft can be used, but for towing to a slipway for beaching, a cable should be shackled to the eye at the rear step. This cable can then be used to haul the aircraft up the slipway, steering by the tail trolley when necessary.

NOTE... The tail-release hook must not be used for hauling the aircraft up the slipway.

44.2. Mooring equipment

The following list gives the location of the mooring equipment provided and, where necessary, gives any special point regarding the method of use.

(a)	Retractable mooring bollard fitted in the nose.	To extend the bollard, grip both handles (one on each side of the mounting bracket) and push them towards each other to release the catch, then still holding the handles, push forward as far as possible and release the handles, which will then spring outwards and lock the bollard in position.
(b)	Fixed mooring cable shackled to a fitting on the keelson; stowed externally along the stem.	
(c)	Mooring cable (4ft. 6 in. long) stowed in a canvas bag at the port side of the mooring compartment	For mooring, this cable is shackled to the fixed cable at the stem for attachment to the buoy pendants.
(d)	"Danforth" type anchor	Stowed on the mooring compartment bulkhead at approximately the centre-line.
(e)	Anchor rope (20 fathoms of 3 in.)	Stowed under the floor below the anchor.
(f)	Slip-line (16 ft. of 3 in.)	Stowed in the nose below the bollard.
(g)	Two drogues	Stowed in a double container on the starboard side.

(h) Heaving lines (50 ft. of 1 in.)	Stowed on the starboard side below drogues.
(i) Release hook fitted in the tail end of the hull and operated by cable from a lever in the roof of the control cabin.	This hook is used, when manoeuvring space is limited, for tail mooring and for running up engines. To prevent accidental operation of release lever in cockpit a pin is fitted at tail release mechanism, locking operating linkage and hook in the closed position. The pin is secured to the adjacent tail release mechanism frame.
(j) Grabit type boat hook	Stowed on the port side of No. 1 hold.

44.3. Bilging

(a) Hull A hand pump and hoses are stowed at the top of the rear bulkhead of the mooring compartment. Access to the watertight compartments of the planing bottom is provided by small removable covers in the floor panels. A screwed connection for the discharge hose is fitted at the starboard side of the hull in the aft gentlemen's lavatory in the centre section. This, the only screwed connection provided, is used when removing bilge-water from the amidships compartments; when bilging the forward and rear compartments, use is made of the entrance and freight loading doors.

Eight bilges in hull and five in each float. A bilge-water dipstick is stowed at the starboard side of the door in the forward bulkhead of No.1 hold, and a calibration chart is fitted high up in the centre of the bulkhead. The calibration chart gives equivalent capacities for measurements on the dipstick.

NOTE.... To take a reading, the dipstick is placed on the upper flange of the keelson at the positions given on the calibration chart. The capacities of the individual bilges, from the bottom of the hull to the top of the keelson, are quoted on the chart.

(b) Wing-tip floats

Bilge-water can be removed from the floats by means of the hand pump used for hull bilging. The suction hose can be inserted through the inspection holes, provided with "press in" rubber covers, in the upper surface of the float.

45. FLIGHT EMERGENCY PROCEDURES

45.1. Baulked landing

At light load the aircraft will climb with flaps fully out but at heavy loads the flaps should be extended only one third. Flap operation is slow and the change of trim very slight.

Recommended practice.

In the event of a baulked landing flaps should be raised to the 1/3 out position immediately after opening up to full take-off power.

45.2. Engine failure during take-off

With the flaps one third extended full load safety speed at maximum take-off power is 120 Knots I.A.S.

With safety speed attained the aircraft will climb slowly on any three engines with 1/3 flap, providing the propeller of the dead engine is feathered.

Flaps may be safely raised at 200 feet.

Failure of an outer engine BELOW the safety speed; partly close the throttle of the complementary outer engine to regain control. At heavy loads with this reduced power a landing should be made straight ahead if possible, the two inner engines being used to control the rate of descent.

45.3. Engine failure during cruise

Feather the propeller of the dead engine; at full load the aircraft will maintain height on any three engines.

45.4. Three-engine operation

Engine failure or indication of an imminent engine failure - feather the propeller immediately.

For three-engine operation an I.A.S. of 140 KNOTS is maintained below 8000 ft. pressure altitude.

As available trim is sufficient to correct yawing the R.P.M. of the working engines should be synchronised.

45.5. Landing with one engine failed

The aircraft is fully controllable and not difficult to land.

Use a slightly higher approach speed, in the case of a failed outer engine rudder trim should be wound OFF before reducing power when alighting.

45.6. Feathering procedure

(a) Close throttle and move propeller control to feathering, through the gate and down to the lower position.
(b) Press feathering button and operate engine cut-off control
(c) When engine has stopped turn off fuel and switch off ignition
(d) Close cowl gills and oil cooler shutter of dead engine.

45.7. Unfeathering procedure

Warning. To reduce the possibility of an internal engine fire the throttle must be in the CLOSED position when unfeathering.

When a propeller has been feathered in sub-zero conditions and the engine becomes thoroughly cold there is a danger of the sleeves seizing on re-starting. Under such conditions descent should be made to an O.A.T. of +10°C before unfeathering.

Control settings for unfeathering

(a) Throttle closed
(b) Propeller control to minimum R.P.M. position
(c) Ignition switched ON
(d) Carburettor fuel cock ON
(e) Press feathering button (do not hold in).
(f) Switch backing pump ON
(g) Switch engine cut-off to RUN
(h) Check oil pressure when engine has started and ensure that the C.H.T. and oil temperatures are satisfactory before increasing engine power.
(i) Switch backing pump OFF, if not required.

45.8. Emergency flap operation

In the event of electrical failure the flaps can be operated manually.

Action

(a) Lift the table top at the forward starboard side of the pantry.
(b) Lift the flap on the top of the flap motor sound-proof box and disengage the clutch by pulling the knurled barrel away from the gearbox and rotating the top of the barrel aft.
(c) Fit winding handle stowed on the bulkhead below the gearbox, and turn clockwise to wind flaps in.

45.9. Engine fire during starting

An engine fire during starting usually means a fire in carburettor intake.

Action.

(a) Operate engine cut-off control to OFF position
(b) Turn OFF carburettor fuel cock
(c) Keep engine turning on starter

If this fails and fire continues to build up operate the respective fire extinguisher button. Further attacks can be made by fire fighting personnel. Access doors for this purpose are fitted port side of the nacelle.

45.10. Engine fire during flight

An engine fire should be indicated by the fire warning lamps. These lights are incorporated in the feathering buttons.

With the fire warning light ON pressing the feathering button will automatically discharge ONE of the three extinguisher bottles into the volute casing.

The two remaining bottles are discharged by operating the Graviner Fire push button.

Action

(a) Carry out feathering procedure
(b) When the engine has STOPPED press the Graviner push button.
(c) Keep cockpit windows closed and eliminate as much draught and ventilation as possible from the wings.
(d) Turn off cabin heater.

45.11. Fire in hull

Action

(a) Clear compartment of passengers
(b) Attack the fire with the aircraft hand extinguishers.
(c) Reduce all draught and ventilation to a minimum
(d) Switch off electrical services.

After a fire has been extinguished inspect and check the extent of the damage. If possible ascertain the cause of the fire.

Where a pyrene or methyl-bromide extinguisher has been used thoroughly ventilate the compartment before accommodating any passengers.

45.12. Fuel cross feeding

The following procedure should be adopted for cross feeding fuel.

(a) Cross feed cock on E/O's panel "ON"
(b) Backing pumps in operation on the side fuel is being fed from
(c) Backing pumps "OFF" on the side fuel is being fed to
(d) Select cock for tank or tanks to feed from
(e) All fuel tank cocks "OFF" on the opposite side.

(f) It is recommended that three tanks are in operation on the side from which fuel is being fed. Tests have, however, been made and it has been found that fuel can be fed from one tank only in emergency.

45.13. Emergency operation of fuel system

With the existing procedure for operating the above fuel system, i.e. running fuel tanks down to the minimum dip stick reading or to a minimum of 20 gallons per tank, it means that there is at least 240 gallons spread over 12 tanks.

In the case of emergency where fuel is running short the following procedure should be adopted. -

(a) Place fuel tanks 6, 5 and 4 into operation. Fuel will then feed into one common tank.
(b) Take tanks out of operation as they reach zero leaving one tank with fuel in it.
(c) Place tanks, 3, 2 and 1 into operation with this tank and repeat the same procedure, i.e. taking tanks out of operation as they reach zero and finishing with all fuel in No. 1 tank.

46. FLIGHT EMERGENCY EQUIPMENT

46.1 Engine fire extinguisher systems

12 Fire Extinguisher Bottles per aircraft, three for each nacelle located in the wing directly rearwards of nacelles.

In each nacelle the bottles supply -

(a) Spray ring at the front of the engine
(b) Spray ring at the rear of the engine
(c) A third bottle discharges into the volute casing near the carburettor attachment mounting.

Operation of nacelle extinguishers

First method. Operated during feathering action - when the fire warning lamps are on, pressing the feathering button will automatically discharge one bottle into the volute casing, the remaining two being discharged by operation of the Graviner push button.

Second method. Independent of feathering action - the Graviner push buttons are fitted to the cockpit roof panel; pressing any one button will operate all three extinguisher bottles for that particular nacelle.

Third method Two inertia crash switches are fitted to Frame 5 - a crash or violent landing operates these switches when all extinguishers to each nacelle are automatically discharged.

The two inertia switches are electrically wired requiring operation of both to discharge the fire extinguisher.

Flame switches There are 36 flame switches per aircraft; nine fitted to each nacelle.

Four at the nacelle bulkhead; five at the nose of nacelle.

The latter are fitted radially with the operating heads projecting through the cowl.

Operation Intense heat near a flame switch causes the switch to close an electrical circuit. This action lights the fire warning lights mounted in the propeller feathering buttons.

46.2. Hand fire extinguishers

Water glycol hand operated extinguishers are fitted in the cabin and holds. They are effective against normal fires but not petrol or oil fires.

Located as follows. -

(a) A Cabin .... Starboard side forward bulkhead below doorway.
(b) B Cabin .... Port side, rear bulkhead
(c) C Cabin .... Port side, rear bulkhead
(d) Promenade .... Cupboard beneath clock
(e) D. Cabin .... Forward end of compartment, Port side.
(f) E Cabin .... Front end of compartment, Starboard side.
(g) F. Cabin .... Front end of compartment, Port side
(h) Ladies' Toilet .... Front bulkhead starboard side.
(i) No. 1 Hold .... Port side
(j) Nos. 2 & 3 holds .... Front bulkhead port side.

Pyrene hand operated extinguishers are fitted in the following positions. -

Flight deck .... Starboard side of cockpit, rear of second pilot's seat
Flight deck .... Rear side of front truss, adjacent to Engineer Officer's seat
Pantry .... Front end of table at starboard side.

46.3. Lifebelts

Auliffe type lifebelts are stowed in containers in the following positions.

A Cabin .... Two containers fitted on the floor, one at rear end port side and one at forward end starboard side.
B Cabin .... Two containers fitted on the floor, one at forward and one at rear end of cabin, port side.
C Cabin .... Two containers fitted on the floor, one on the forward and one on the rear bulkhead, port side.
Promenade .... Stowed in cupboard beneath clock
D Cabin .... Two containers fitted on the floor, one at each side of gangway front end of compartment.
E.Cabin .... Two containers fitted on the floor, one at each side of gangway at front end of compartment.
F Cabin .... Two containers fitted on the floor, one at each side of ganagway at front end of compartment. Ten extra lifebelts are stowed in a container in the roof above the flight deck and can be obtained from outside if required, through the roof hatch at the front spar-frame.

Flight deck .... Captain and First Officer
Navigator
Radio Officer
Engineer Officer

46.4. First aid outfits

For minor cuts, abrasions etc., a "Holdall" first aid kit is issued to the Steward and kept in the Pantry.

For major emergencies a medical equipment box is stowed on the starboard side of the upper deck between the seats of cabins E and F.

46.5. Signal pistol

Stowed in a box at the rear of the first officer's seat with signal cartridges.

46.6. Signalling lamp

An Aldis type signalling lamp and a case containing red and green glasses is stowed at the starboard side of the control cabin. Power sockets are fitted one at each side of the control cabin, on the pilot's electrical panels, and one on the electrical panel at the port side of the centre section. The latter point is convenient for using the lamp in the astro dome.

46.7. Crash axe

Stowed in the hull roof at the port side of the front spar frame. The axe is also accessible from outside by removal of a rip-off patch.

46.8. Lifelines

Stowed on flight deck, one for port or starboard wings and one for use along the hull and E cabin exit. Attachment points are fitted along main planes and hull. The lifelines are provided with snap hooks.

47. EMERGENCY EXITS

47.1. Windows

In all passenger cabins, promenade cabin and at starboard side of flight deck.

Action. Push out type jettisoned by a sharp blow towards one edge with hand or foot.

47.2. Crew entrance door

Port side, below control cabin.

Action. Opens inwards. - Three clamps and door latch. The clamps can be operated from outside by a key stowed in a pocket in the door. A rip-off patch covers the pocket. A yale type lock is fitted for use when the aircraft is left unattended.

47.3. Passengers' entrance door

Starboard side of promenade cabin.

Action. Opens inwards. Five clamps and a door latch. Clamp key provided as for crew entrance door. Completely removable for passengers entrance or exit.

47.4. Roof hatch

Rear end of cabin E. Accessible from folding ladder stowed in the roof aft of rear bulkhead.

Action. To release hatch PUSH bar upwards. Can be opened from outside by ripping off patch and PULLING bar upwards.

To extend ladder pull forward out of stowage box to full extent, open ladder by pulling on the lower portion, and hinge downwards.

47.5. Astro dome

Just forward of centre section.

Action. Opens inwards; toggle handle fitted. A hand pump clipped to the hatch is provided for inflating a rubber sealing ring. The initial movement of the toggle handle mechanism towards the open position operates an air release valve.

The hatch can be opened from outside by a key stowed in a pocket under a rip-off patch nearby.

47.6. Tail exit

An emergency hatch in the hull tail unit, starboard side, is situated immediately below the tail plane, operated by a handle, door opening inwards.

47.7. Watertight doors

With the exception of the doors between Cabins A and B and the one on the forward end of the Promenade cabin each door forms the lower half of a normal communication door; the upper half being free to open when the watertight door is locked in position.

The watertight door between Cabins A and B is removable and when not in use is stowed rear of the seats starboard side of Cabin B.

The watertight door at the forward end of the promenade cabin lifts off its hinges and is stowed in the adjacent alcove at the starboard side when not in use.

48. LEADING PARTICULARS

System	24 volt D.C. single-pole
Wiring	S.B.A.C. with Crabtree type fuse blocks.

GENERATORS

Type	24 volt 6 K.W. type P No. 2.
Number	Three in parallel

AUXILIARY GENERATING PLANT

Type	Lyon "Alco Featherweight"
Engine	Single-cylinder 4-stroke air-cooled 1½ h.p.
Generator	500 watt type HZC

ACCUMULATORS

Type	Exide type 6 FZ, 17-3, 60 Ah.
Number	Four in series-parallel
Voltage regulators	Three type 23 and one master regulator type 32.

49. POWER SUPPLY

49.1. Under normal flying conditions three generators, driven by engines 1, 2 and 3, provide the power for the electrical and radio installations. In addition to supplying the normal load, the generators charge four series-parallel connected 12 volt 60 ampere hour accumulators.

49.2. The generator output voltages are controlled by carbon-pile voltage regulators type 23, which are themselves controlled by a master regulator type 32. On referring to the diagram it will be seen that the master regulator operates by varying the resistance between the voltage coils of the generator voltage regulators and earth. It will also be seen that, in the event of the master regulator carbon-pile becoming "open-circuit" the resistance to earth will be immediately increased to that of the diverter resistance, thereby causing an undesirable rise in output voltage. When this happens the safety resistance may be substituted for the carbon-pile by turning the switch marked "NORMAL" and "EMERGENCY" to the latter position thereby reducing the voltage to approximately normal.

49.3. The generators are protected against "short circuit" conditions by 200 amp. circuit breakers (type D) whose main contacts are fitted with thermal trip mechanisms.

49.4 These circuit breakers are connected in the main generator feeds to the accumulator bus-bar and are brought into operation by the central unit, on the battery master switch, which completes the earth return for their operating coils. The positive feeds to these operating coils are controlled by the contacts of B.T.H. type A differential cut-outs. Each circuit breaker is provided with a re-set switch which, in one position, connects the supply from the cut-out contacts to the coil of the circuit breaker and completes the controlling circuit between the generator voltage regulator and the master voltage regulator. In its other position the switch breaks the controlling circuit and "earths" the main coil of the generator voltage regulator and at the same time breaks the circuit breaker coil circuit to allow its armature to be released to pick up the main contact arm when it has been tripped on overload. An additional earth return for the coils of the circuit breakers is controlled by an emergency switch, normally kept at the open position. This switch is intended for use when the failure of one or more of the relays to close on load indicates that there may be a disconnection in the normal circuit. The generator field circuits are protected by 15 amp. circuit breakers type A.

49.5. The auxiliary generating plant is of the "Alco" Featherweight type, fitted with a 24-volt 500 watt generator, type HZC. The control gear for the generator is housed in a box at the Engineer Officer's position and consists of an ammeter, a cut-out, a main fuse and manually operated field rheostat.

49.6. There are two methods of starting the A.G.P., one by manual cranking handle and the other by an electrical push button fitted at forward end of the A.G.P. control box.

49.7. When using the latter method first ensure that the resistance is set to approximately half-way position.

49.8. The A.G.P. Starter push button is connected direct to the accumulator bus-bar and is not affected by the G/F Switch. (Battery master switch).

49.9. The main bus-bar may be disconnected from the accumulators and connected to the external supply socket by means of the battery master switch. It will also be appreciated that, providing no external source of supply is plugged into the socket, the disconnection of the accumulators from the bus-bar will render the installation "dead". As already stated a further function of the battery master switch is to break the earth return circuit for the operating coils of the circuit breakers.

50. DISTRIBUTION SYSTEM

General

59.1. The panels and boxes **see location diagram** comprising the distribution equipment are, for identification purposes, grouped according to their functions, each group being referenced as follows. -

- C - Charging or control boxes.
- D - Distribution boxes
- J - Junction boxes
- P - Panels (Instruments)

In each group the reference letter is prefixed by a number to indicate the individual box or panel in that group.

Charging and control boxes

50.2. The generators are provided with their own charging and control boxes to house their voltage regulators, cut-outs and circuit breakers. These boxes are connected to the generators in the following order. -

- 1C - Generator on engine No. 2.
- 2C - Generator on engine No. 3.
- 3C - Generator on engine No. 1.

50.3. The main bus-bar, to which the controlled outputs from 2C and 3C are also connected, is mounted in 1C. In addition 1C contains the master voltage regulator and its safety resistance switch field circuit breakers and main circuit breaker re-set buttons for the generators on engines 1 and 2. From the foregoing it will be seen that 1C may be regarded as the master control box, and for this reason it is mounted on the port side of the centre section so that it faces, and is easily accessible from, the Engineer Officer's position. Box 2C which is mounted just aft of 1C carries, in addition to its charging equipment, the ammeter and field circuit breaker for the generator on engine No. 3, main circuit breaker emergency switch, and the manually operated circuit breakers for the engine instrument services.

50.4. The third control box, 3C, contains in addition to the charging equipment for the generator on engine No. 1, the auxiliary radio and domestic supply circuit breakers also the feathering and domestic interlocking relay. As the equipment in this box is all remotely controlled and requires no attention during flight, it is mounted below 1C and 2C.

50.5. With the exception of those for emergency services, radio power supplies and engine instruments, all fuses are contained in three distribution boxes. These boxes (referenced 1D, 2D and 3D) are mounted: 1D and 2D on the port and starboard sides respectively of the door in the rear spar frame bulkhead and 3D on the partition at the aft end of the Radio Officer's station (See Location diagram. The feeds from the charging and control boxes to the distribution boxes are as follows.

1D - One feed directly from the bus-bar in 2C.

2D - Two feeds from 2C, one directly from the bus-bar and the other via the cabin lighting master switch. A third feed to this box is taken from 3C and controlled by the domestic circuit breaker therein.

3D - A double feed directly from the bus-bar in 2C.

50.6. The Crabtree type fuse blocks in the boxes are referenced alphabetically, and the fuses numerically from 1 to 6. Tables 1 to 8 at the end of this Section give the rating, type, block reference letter and number of each fuse. This information is also provided on the aircraft, in both alphabetical and box order, on charts attached to the underside of the desk flap at the Engineer Officer's station. Those fuses not contained in the distribution boxes are located as follows. -

Emergency service 1C
Domestic heating...................2C
Radio Power Supplies 3C
Engine Instruments 4P

50.7. Junction boxes are included in the wiring system to provide breakdown points at structural attachment positions (viz. wing roots, fire walls etc.,) and, where necessary, to allow the cables to radiate to the various items of equipment. The boxes, the locations of which are given in the location diagram. contain S.B.A.C. type terminal blocks referenced in the same way as the fuses.

50.8. The majority of those electrical controls not fitted on the pilot's instrument panel are grouped on smaller panels, located at the various crew positions as shown in the location diagram.

1P - Captain's electrical panel
2P - First Officer's electrical panel
3P - Control cabin roof panel
4P - Engineer Officer's main panel
5P - Master switch panel
6P - Engineer Officer's side panel

50.9. These panels are fitted with terminal blocks to provide breakdown points in the wiring to the components mounted on them. In addition to the terminal blocks a complete distribution box is built into 4P to carry the fuses for the engine service circuits.

51.. FLIGHT SERVICES

51.1. Propeller feathering
The feathering pump motors are switched by relays located: those for the port meters in 1C and those for the starboard in 2C. These relays are controlled by solenoid type push switches, mounted on the Pilot's roof panel, which are themselves automatically controlled, when the feathering operation is complete, by pressure-operated cut-out switches fitted on the propeller constant-speed units.

51.2. Electrically, the feathering operation for an engine is as follows: The feathering push switch is pressed and held in that position by its retaining coil. This coil receives its fused positive supply through its own subsidiary contact on the switch, and its earth return through the pressure-operated cut-out switch. The closing of the feathering switch applies the positive supply to the operating coil of the pump motor relay, the other end of which is permanently earthed, thereby causing the relay contacts to close and the motor to run until the propeller is fully feathered. At this stage the pressure in the hydraulic system will have built up sufficiently to open the cut-out contacts to release the feathering push switch and stop the motor by allowing its relay to open. To unfeather a propeller, the feathering switch is pressed and releases automatically when the required engine speed is reached.

51.3. The common feed to the propeller feathering and engine starting relays is controlled by a master switch on panel 5P. A B.O.A.C. type current flow relay, whose contacts complete the feed to a warning lamp on panel 4P when current flows in the motor circuit, is fitted in the feed between the master switch and the accumulator. Thus, if after a feathering or starting operation is completed, the lamp (by remaining illuminated) indicates that a relay is sticking, the master switch may be opened to isolate all the relays until the one at fault is located and its contacts opened.

Flap motor and indicators

51.4. The flaps are operated by screw-jacks driven by a torque shaft which is, in turn, driven through a gearbox by a split-field series-wound motor. The windings of this motor are switched, as shown in the diagram by a pair of relays mounted in 2C. Selection of either the IN or OUT field winding of the motor is by means of a two-way-and-off switch, on the pilot's instrument panel. This switch completes the positive feed to the operating coil of the relay, through the contacts of the appropriate limit switch. The other end of the relay operating coil being earthed, the relay contacts close to complete the main supply from the manually operated circuit breaker (on 2C) to the motor winding, causing the motor to run until the mechanism opens the contacts of its limit switch. (For details of the operating mechanisms of the flaps, limit switches and motor, reference should be made to Section 2.)

51.5. The flap position indicator system is of the Smith's three-wire type, fully described in A.P.1275.A. The segment of the meter scale traversed by the pointer from the "fully-in" to the "one-third-out" position is painted. This system is supplemented by a lamp which is illuminated when the flaps are one-third or more out. The one-third-out indicator lamp is controlled by a trip switch, operated by a ramp driven by the screw in the switch gear-box. This screw, which is driven from the torque shaft, also operates the limit switches and the transmitter for the indicator system.

Aileron trimming tab control

51.6. The aileron trimming tabs are operated by the Evershed Powerotor system, which consists of a controlling transmitter, mounted in the control cabin roof, and a motor and gearbox for each tab. The motors, which are of the step-by-step type, rotate in synchronism with one another. The underlying principle of the system is that if an electric motor has its stator windings energised singly or in groups in sequence, the rotor will take up a definite position with each arrangement, according to the energisation of coils. On this aircraft the coils of two such motors are suitably arranged and are supplied with current, in proper sequence, from a rotary switch type transmitter as shown in the diagram. From the foregoing it will be seen that the speed of the angular movement of the tabs will be in direct proportion to the speed of the transmitter handle. The transmitter is the only control for the system, as its handle, which is of the "dead man" type, completes the circuit by closing the built-in ON-OFF switch as soon as it is turned. Continuous indication of the position of each tab is provided by an indicator mounted on the pilot's instrument panel, in which a pair of pointers move over an edgewise duplex scale. The indicator system is of the three-wire type, similar to that used for the flaps, in which the pointers follow the movement of transmitters driven by the tab actuating mechanisms. This circuit is not provided with an ON-OFF switch; it is only switched off when the battery master switch is set to "GROUND".

Automatic controls and D.R. compass

51.7. This installation consists of the Mark VIII automatic control system operating in conjunction with the normal D.R. compass circuit. The electrical equipment for the two systems is located as follows. -

Automatic controls

Main control switch............	Engine control stand
Relay box	Just forward of the port rudder bar.

D.R. compass

Master compass	On the port side of the promenade compartment below the staircase.
Pilot's repeater	Pilot's instrument panel
Navigator's repeater	(On a small panel on the
Control panel	(Navigating table

Pressure head heating

51.8. The supplies to the heaters in the two pressure heads, fitted at the top of the radio aerial mast, are controlled by a pair of switches on the cockpit roof panel. A lamp, incorporated in its switch, is connected in parallel with each heater.

Aerofoil de-icing

51.9. For aerofoil de-icing the T.K.S. system is installed. The de-icing fluid is supplied to the distributors by a ten-unit pump whose driving motor is controlled by a T.K.S. type 3 controller, mounted on the Engineer Officer's side panel 6P. On referring to the diagram it will be seen that there are two switches on the controller. The MANUAL switch is used to bring the system under pilot's control for intermittent operation. The closing of the EMERGENCY switch causes the system to provide a very high continuous rate of flow to combat abnormal icing conditions. The electrical operation of the system, under the control of the above switches, is as follows. -

(a) MANUAL. On referring to the diagram it will be seen that when this switch is closed it completes the positive supply to the filament of the vacuum hot-wire relay switch; the other end of this filament being connected to earth through the contacts (normally closed) of the regulator thermal switch. After approximately five seconds the contacts of the hot-wire relay close to put the pump motor and the green lamp in circuit. Further reference to the diagram will show that the closing of the MANUAL switch also completes, through the barretter, the positive supply to the bi-metal strip heater of the delay thermal switch.

(b) After about one minute the delay thermal switch heats sufficiently to close its contacts and place the regulator thermal relay in circuit. This latter will, after an interval, heat up sufficiently to open its contacts and break the earth return for the filament of the vacuum hot-wire relay switch, thereby breaking the feed to the motor and the green lamp.

(c) Following a further predetermined interval the bi-metal strip of the regulator thermal switch will cool, thereby allowing its contacts to close and remake the circuit for the filament of the vacuum hot-wire relay. The contacts of this relay will then close to restart the motor and illuminate the green lamp. The above sequence of operations will be repeated at regular intervals, under the control of the regulator thermal switch, until the MANUAL switch is opened.

(d) EMERGENCY. A brief glance at the diagram will show that the closing of this switch connects the supply directly to the motor and to both the red and green lamps. The motor will, therefore, run continuously and provide a very high rate of flow.

Propeller de-icing

51.10. The propellers are supplied with de-icing fluid in pairs (inners and outers) by two electrically driven pumps. These pumps are mounted, with their suppressors, on the port side of the centre section and are controlled by switch/rheostats on the Engineer Officer's side panel, 6P. Indication that the motors are in circuit is provided by lamps connected in parallel with the motors and their rheostats.

Outside air temperature gauge

51.11. This installation consists of a Wheatstone Bridge Type circuit. The resistance bulb is mounted on the hull side just below the starboard wing. The case which contains the galvanometer calibrated in °C and the remaining arms of the Bridge is mounted on the Engineer Officer's main panel 4P.

52. ENGINE SERVICES

Starter motors

52.1. The main feeds to the starter motors are switched by relays housed:- those for the port engines in 1C and those for the starboard in 2C. The feeds from the push switches, on the engine control stand, to the coils of the relays are interrupted by safety switches operated by the maintenance doors in the leading edge of the main plane. These switches are arranged so that the starter relay control circuit for any engine is only complete when both its maintenance doors are properly closed, thus preventing the inadvertent starting of the engine during servicing operations. It should be noted that these motors have the same main supply feed as the feathering pump motors and are, consequently, under the control of the same "Hydro and Starter" master switch. A current flow indicator lamp is fitted to the port lower corner of the Engineer Officer's panel which is operated when the starter or feathering motors are in use.

Booster coils

52.2. The booster coils which are of the L.T. type, take their supplies directly from the engine starter push switches to ensure that they operate simultaneously with the starter motors. The feeds are not controlled by the safety switches, but they are, however, provided with isolating switches, on the Engineer Officer's main panel 4P, to allow a coil to be taken out of circuit when it is required to turn, but not start, an engine. When an engine is started by hand its booster coil may be used by first opening the engine starting and propeller feathering switch, on the master switch panel 5P, and then pressing the engine starting push switch until the engine is started

R.P.M. indicators

52.3. In addition to the normal Kollsman type of three-phase R.P.M. generator and indicator for each engine, this installation provides a duplicate indicator for engine No. 3 and a synchroscope with its selector switch. The duplicate indicator is mounted on the Engineer Officer's main panel 4P, and the remaining indicators, synchroscope and switch are mounted on the pilot's instrument panel. The synchroscope is permanently connected into the circuit for engine No. 1, which, for this installation, is regarded as the master.

52.4. When this engine has been set at the required speed the others may be switched, in turn, so that their speeds may be compared with and adjusted to that of the master.

NOTE ... A complete set of duplicate indicators may be fitted at the Engineer Officer's position.

Cylinder temperature gauges

52.5. The thermocouples for this installation are, on each engine, fitted to cylinder No. 14. The gauges, to which the thermocouples are connected by copper-constantan leads, are mounted on the Engineer Officer's main panel, 4P.

Cowl gill motors and indicators

52.6. The motors which operate the cowl gills are of the series-wound split-field type, the drive to the gill mechanism being through a gearbox containing a four-stage epicyclic reduction system. Limit switches are contained in the gearbox to change the motor field at the end of the travel of the final shaft. Creepage of the final shaft, due to air pressure on the gill surfaces, is prevented by a solenoid-operated brake on the motor shaft, spring-loaded in the "ON" position and released when the motor is running. The motors are controlled by switches mounted on the Engineer Officer's side panel, 6P, each of which incorporates an ON-OFF switch and a two-way-and-off switch. To operate one of these switches, the knob is pushed to close the ON-OFF contacts, and turned to select either of the two-way-and-off contacts. The ON-OFF portion of the switch completes the positive feed to the indicator circuit and to the two-way-and-off switch, which in turn completes the supply to the required motor field.

52.7. A lamp mounted with the switch assembly is connected in parallel with each motor brake solenoid to show when that motor is running. The position indicators, mounted adjacent to the control switches, are of the Desynn double miniature type, whose transmitters are driven by the gill operating mechanism. This system is quite standard and is fully described in AP.1275.

Carburettor temperature gauges

52.8. These gauges are of similar type to that used for outside air temperature measurements. The resistance bulbs are fitted in the carburettor air intakes and the gauges are mounted on the Engineer Officer's main panel, 4P.

53. FUEL AND OIL SYSTEMS

Fuel contents gauges

53.1. The gauges, which are of the Desynn type, are mounted on the Engineer Officer's main panel, 4P, and their transmitters are fitted in the fuel tanks. The four positive supplies for the circuit are taken directly from fuses on 4P. As no ON-OFF switch is provided for this installation the gauges remain operative until either the circuit breakers in 2C are opened or the battery master switch is set to GROUND.

Fuel flow meters

53.2. The "gallons gone" indicators, which are of the veeder or counter type, driven by impulses from transmitters in the engine fuel lines, are mounted on the Engineer Officer's main panel 4P. Mounted on either side of each indicator case are on the ON-OFF switch and warning lamp for each of the two counters contained therein. A solenoid, which, when energised, closes a by-pass valve, is connected in parallel with the impulse switch in the transmitter, so that when the latter is switched off the fuel will by-pass the working chamber.

In addition to the "gallons gone" indicators a rate of flow indicator is fitted to the Engineer Officer's panel. A selector switch is mounted adjacent to this indicator for selecting any engine.

Fuel pumps and fuel pressure warning lamps

53.3. In each wing the fuel supply from the tanks is boosted by a pair of pumps, working individually or in tandem, in the fuel collector box supplying both engines. On the pressure side of each pair of pumps is fitted a diaphragm-operated switch, whose contacts close to complete the circuit for a warning lamp when the pressure falls below the safe working level. The warning lamps and their switches are mounted with the motor switches on the Engineer Officer's main panel, 4P. The two ON-OFF switches for each warning lamp are connected in parallel, and each is mechanically ganged to one of the motor switches for the same wing, thereby ensuring that a motor cannot be in circuit without its appropriate warning lamp.

Fuel pressure gauges

53.4. The fuel pressure gauges, which are of the Desynn type, are mounted on the Engineer Officer's main panel, 4P, and their transmitters are fitted to the pressure manifolds on the engines. As in the case of that for fuel contents gauges, this circuit is not provided with an ON-OFF switch; it is only controlled by the battery master switch and the circuit breakers in 2C.

Fuel cut-off controls

53.5. The cut-off valves in the engine fuel feeds are opened and closed by Rotax type actuators. Each actuator is a complete self-contained assembly consisting of a split-field reversible motor driving, through a gearbox, a screw-jack. Switches, to select either the "run" or "stop" field winding of the motor are mounted on the control cabin roof panel, 3P. The limit switches for changing the motor fields at the end of the travel of their screw-jacks are also contained in the actuators.

Oil contents gauges

53.6. The oil contents gauges are mounted on the Engineer Officer's main panel, 4P, and their transmitters are fitted in the oil tanks. These gauges are of similar type (Desynn) to those used for fuel contents and, like them, are not provided with an ON-OFF switch.

Oil pressure gauges

53.7. The gauges for this installation are mounted on the Engineer Officer's main panel, 4P, the transmitters being mounted on the port sides of the nacelles and connected to the engine oil pumps. In all other respects this installation is similar to that for fuel pressure.

Oil temperature gauges

53.8. This installation is similar to that described in para. 51.11. Outside Air Temperature Gauges, the gauges being fitted on the Engineer Officer's main panel, 4P, and the resistance bulbs in the oil tank sumps. The gauges are, however, of the Mark II type, which operate on the ratiometer principle. In this type of gauge two coils are wound on the moving coil former and connected so that the torques produced in them are in opposition. The moving coil former, to which the pointer is attached is arranged so that it rotates in a non-uniform magnetic field. The positive supply is connected to the two coils through a limiting resistance, one coil being earthed through a fixed resistance and the other through the resistance bulb. From the foregoing it will be seen that any change in the resistance of the bulb due to temperature will affect the balance of the circuit, causing the pointer to move over the calibrated scale. No ON-OFF switch is provided for this installation, its control being as described in the foregoing paragraphs.

54. EMERGENCY SERVICES

Fire warning lamps

54.1. Located in knobs of feathering switches. These lamps are permanently earthed, the positive supply being completed by the closing of any one of the flame switches. The closing of any flame switch causes the fire warning lamp to light. In addition to the lamps lighting, the positive supply to a relay switch is completed and the final completion of the intake extinguishers electrical circuit is made when the feathering button is pressed. These relay switches are housed in control box 6C. The spray. ring extinguishers may be discharged, on completion of the feathering operation, by pressing the extinguisher button.

Fire extinguishers

54.2. Three Methyl-Bromide extinguishers for each engine are located at the front truss immediately rearwards of each nacelle.

Inertia switches

54.3. Two inertia switches to operate all extinguishers are located at rear side of bulkhead at front of cockpit. These are electrically wired so that both switches must close to operate extinguishers.

55. INTERIOR LIGHTING

Flight deck lighting (general)

55.1. Roof light above rest seat switch adjacent to seat - roof light at control cabinets and roof light above batteries - switch at panel 6P. One light at Rear Spar bulkhead - directly controlled with built-in switch at lamp.

Cockpit lighting

55.2. Roof Lights - one at port side of roof controlled by switch at Captain's side panel 1P; one at starboard side of roof controlled by switch at First Officer's side panel 2P.

Instrument panel

55.3. Consists of ultra-violet lighting and a system of red lighting. Ultra-violet - six lamps, four mounted on the lighting screen situated and hinged, top of main panel and one each at the port and starboard sides of the hull directed on to the panel. These lights are controlled as follows. -

Port lamp on lighting screen and port lamp at hull side- Rheostat switch on Captain's panel 2P.

Two centre lamps on lighting screen - Rheostat (marked centre U/V lights) at First Officer's panel 2P.

Starboard lamp on lighting screen and starboard lamp at hull side - Rheostat switch at First Officer's panel 2P.

Red lighting

55.4. Consists of 4 lamps - two on lighting screen and one at each side of panel. The port light on the screen and the port light on the instrument panel are controlled by one Rheostat switch on Captain's panel 1P. The starboard light on screen and the starboard light on the instrument panel are controlled by one Rheostat switch on First Officer's panel 2P.

Compass lighting

55.5. One light mounted above each P10 compass - controlled by an ON-OFF switch at Captain's panel 1P.

Captain's panel 1P

55.6. One light for panel controlled by ON-OFF switch mounted on panel.

Navigator's station

55.7. Strip lighting and a small panel light - controlled by switches on panel 7P.

Radio station

55.8. One G.E.C. berth type lamp and two radio instrument lamps controlled by switches at Radio Officer's side panel.

Engineer's station

55.9. Two G.E.C. berth type lamps - switches on Engineer Officer's side panel. Angle-poise - switch at forward face of Engineer Officer's side panel.

Cabin lights

55.10. The main lights are controlled by switches located in each cabin, these switches are three-way - DIM - OFF - BRIGHT .

Reading lights

55.11. Small hidden lamps located in roof above each passenger seat. Switches for these lamps are located adjacent to each seat.

Sockets for inspection lamps and drift sight

55.12. The inspection lamp sockets are located at those positions where, for servicing operations, a lamp may be required. The sockets are all supplied from the same fuse and are located as follows: in the mooring compartment, on the port side of the extreme rear compartment, and one in each engine nacelle. As a precautionary measure the latter sockets are isolated, when not in use, by a switch on the Engineer Officer's side panel, 6P.

Intercommunication call lamps

55.13. Each member of the crew is provided with an intercommunication call lamp box located as follows. -

(a)	Mooring compartment.........	On the port side of the hull just forward of the bulkhead
(b)	Captain	On panel 1P.
(c)	First Officer	On panel 2P.
(d)	Navigating Officer	On panel 7P.
(e)	Engineer Officer	On panel 4P.
(f)	Radio Officer	On bulkhead aft of desk
(g)	Tail Unit	On port side of hull tail unit

Each of these boxes contains a push switch in series with a lamp. The lamps are all connected together in parallel on one side to earth, and the other through any of the switches to fused positive. Thus when any switch is pressed all the lamps will be illuminated.

Steward's call lamp

55.14. This installation consists of a lamp indicator and a buzzer in the galley, operated by push switches located: on panel 3P in cabins A, B, C, D, E and Promenade, and in the Ladies' and Gentlemen's dressing rooms. The circuit is arranged so that when a switch is pressed, its lamp on the indicator is illuminated and the buzzer sounds. This is achieved by operating the lamps and the buzzer by double-pole relays so that the pressing of a switch completes the positive supply to the operating coil of the relay concerned, causing its contacts to close and complete the positive supplies to its lamp and the buzzer.

Passenger warning indicators

55.15. Indicators to warn passengers to "fit oxygen masks", "no smoking" and "fasten lap-straps" are fitted in Cabins A, B. C, D, E, the Promenade and the Galley. These three notices are illuminated by separate sets of lamps controlled by three switches.

The control switches are located as follows. Oxygen switch at Captain's panel 1P - No Smoking and Fasten Lap-straps on roof panel 3P.

Lighting available when the ground/flight master switch is in the ground position. (See facing page).

Crew boarding lights

55.16. 3 lights - two in No. 1 hold and one in roof of flight deck. These are dual-controlled by one switch at the bulkhead near front entrance and one switch at Captain's panel 1P.

Passenger entrance light

55.17. One light mounted in roof at rear entrance - switch at bulkhead rear entrance.

Dim lights in cabins

55.18. Dim lights in all cabins controlled by a switch in each cabin.

Passage way and step lights

55.19. Controlled by switch at port side of passage way adjacent to Gent's rear lavatory.

Stairway light

55.20. Switch mounted on wall at foot of stairway.

Nos. 2 and 3 hold lights

55.21 Dual-controlled by one switch mounted at roof just aft of rear door in "E" Cabin and one switch mounted at port side hull aft of freight door.

Mooring light

55.22. Switch mounted forward of front entrance at port side, can be operated from outside or inside aircraft.

Signalling sockets (Aldis lamp)

55.23. Sockets are positioned at the Captain's panel 1P, the First Officer's panel 2P, and at the charging and control box 1C - No switch fitted, circuit directly connected to battery positive.

Engineer's emergency lighting

55.24. Switch at Engineer Officer's side panel controls one light in each cabin.

Charging control panel and battery roof light

55.25. Switch mounted at forward face of Engineer Officer's side panel.

56. EXTERIOR LIGHTING

Landing lamps

56.1. The two K type 350 watt landing lamps, fitted one in each wing, are controlled by switches on the Captain's roof panel. The two K type 350 watt landing lamps, fitted one in each wing, are controlled by switches on the Captain's roof panel. The switches have three positions and are marked "EXTEND", "STOP" and "RETRACT". Each of these lamps is extended and retracted by a reversible series-wound motor, fitted with a solenoid-operated brake and built into the lamp assembly. The feed to each lamp filament is separate from those for motor control and is completed by a carbon brush, on an arm attached to the lamp, which makes contact with a copper strip as the lamp begins to extend. The lamp may be set at any position by manipulation of the switch; that is, the switch is turned to either "EXTEND" or "RETRACT" according to requirements and when the desired position of the lamp is obtained the switch is turned to "STOP".

1. EXTEND — This brings the lamp down from its stowed position. After approximately 40° movement the lamp is switched "ON". Maximum travel is governed by a limit switch.

STOP — This stops the lamp at any desired position.

RETRACT — This returns the lamp to its stowed position when it is automatically switched "OFF".

56.2. The solenoid brake is held in the "OFF" position by the motor current, which, as soon as it is switched off, allows the brake to operate and prevent motor overrun.

NOTE.. When the lamp is no longer required and has been retracted, the switch may be left in either the "RETRACT" or "STOP" positions; if left in the latter position ensure that the lamp is first fully retracted.

Navigation and steaming lamps

56.3. The steaming lamp is mounted behind a window near the head of the radio aerial mast and is controlled by a switch on the Captain's electrical panel, 1P. The navigation (tail and wing tip) lamps are controlled by a one-way-and-off switch adjacent to the steaming lamp switch. Both switches are connected to the same fused positive supply, the navigation lamp switch connecting the supply direct.

Mooring lamp and signalling lamp sockets

56.4. The mooring lamp is mounted in the top of the main aerial mast and is controlled, from either inside or outside the aircraft by a watertight switch mounted on the side of the hull near the forward entrance door. The two signalling lamp sockets are mounted one on the Captain's, and the other on the First Officer's electrical panels 1P and 2P respectively. Both inspection lamp sockets and the mooring lamp share the same fuse, which is mounted in 1C and is connected directly to accumulator positive. It will thus be seen that these circuits are not controlled by the battery master switch and are, therefore, always operative.

57. HEATING SERVICES

Daniel's "Dragonfly" heater

57.1. For cabin heating a pair of spray type 62,500 B.T.U/HR Daniel "Dragonfly" heaters are installed one on each side of the hull just forward of, and below, the pilot's instrument panel. A special arrangement of boosted output is provided whereby if conditions cause the duct temperature to drop below

135°F then the fuel pressure applied to the jet is increased from 10 P.S.I. to 18 P.S.I. which increases the output to 84,000 B.T.U/HR per heater. The ventilating air supply enters the aircraft via scoops which are located one on each side of the hull and combustion air enters via composite scoops and exhaust outlets. The ventilating air is ducted to the burner end of the heater, and thence to the hot air distribution system. Air enters the combustion chamber via combustion air regulators (these regulators being designed to provide a constant mass flow irrespective of speed and altitude) and the exhausts are connected to the outlet connections on the composite scoops. This arrangement is made so that the exhaust heat prevents the small combustion air intakes from being iced up. Fuel is fed to the unit by an electrically driven pump, situated in the starboard wing via a heater fuel control unit, the purpose of which is to govern the operation of the heater by controlling the fuel pressure applied to the jet. The electrical control of the system is as follows. -

57.2.
Closure of the Master Switch puts electrical supply to the air and fuel pressure switches. The air pressure switch closes at an air speed of 80 knots, and the fuel pressure switch is closed when the desired pressure from the pump has been reached. The electrical circuit to the heater switches is completed and if they have been switched on, electrical power is available to operate the two heaters. An indicating light in series with the fuel pressure switch is provided to give indication of adequate fuel pressure. Start switch should not be operated if fuel pressure light is not illuminated.
Operation of the start push button closes the spark plug circuit, main fuel valve circuit, the supply (boost) valve circuit, the supply (low heat) valve circuit and, if its switch is closed, the restriction (high heat) valve circuit.

When combustion has commenced and the air temperature reaches 120°F. contacts in the Thermo Switch Control Unit open and break the spark plug circuit. An additional pair of contacts in the boost thermostat will open and break the boost supply circuit at a predetermined temp. (Approx. 160°F) and the system then operates under normal electrical control for "HIGH" and "LOW". A further pair of contacts in the overheat thermostat switch will open and shut down the whole system should a temperature of 350°F. be reached.

The air pressure switches automatically close the whole system down if the Master Switch is inadvertently left on while alighting.

<u>NOTE</u>... The supply for this installation is subject to the conditions given in the section on "Domestic Supply" and Propeller Feathering Interlock".

<u>Water heaters</u>

57.3. Three G.E.C. type water heaters are installed - one in the Ladies' and one in each of the Gentlemen's Dressing Rooms. The supplies for the elements of these heaters are controlled by switches on the panel in the galley, which each complete the supply to the operating coil and contacts of a relay for one of the heaters. The earth returns for these relay coils are controlled by thermostats in the heaters themselves.

Cooker

57.4. The supply for the cooker is controlled by a switch mounted on the panel in the galley. When this switch is closed it energizes the operating coil of the domestic circuit breaker in 2C, causing its contacts to close and complete the supply to the cooker.

NOTE... This circuit is subject to those conditions given in the section on "Domestic Supply and Propeller Feathering Interlock".

Urn supply

57.5. The hot-water supply for domestic purposes is provided by an electrically heated urn mounted on the port side of the galley. The supply to the urn is controlled by a circuit breaker housed in 2C and controlled in turn by a pair of push switches on the panel in the galley. When the ON switch is pressed it energizes the operating coil of the circuit breaker, causing its contacts to close. The main contacts then complete the supply to the urn and the auxiliary contacts complete a separate positive supply, through a resistance, to the operating coil. This latter supply is via the contacts (normally closed) of the OFF switch. It will thus be seen that the circuit breaker will remain closed until the OFF switch is pressed. An indicator lamp, connected in parallel with the urn, is mounted on the panel with the switches.

NOTE... This circuit is subject to those conditions given in the following paragraph.

Domestic supply and propeller feathering interlock

57.6. To ensure that the domestic load is not on the system during a feathering operation, the interlocking circuit in **the diagram** is installed. Reference to this diagram shows that the "holding-in" circuit of the circuit breaker in 3C (which supplies the control fuses for cabin heating, cooker and urn supply) is controlled by an interlock relay. The contracts of this relay are normally closed and are only opened when a positive supply from any of the feathering push switches energizes its operating coil. From the diagram it will be seen that the opening of the relay will have the same effect on the circuit as the pressing of the STOP push switch. It is therefore necessary to press the START AND RESET push switch to re-close the circuit breaker after a feathering operation. An indicator lamp mounted with the push switches on the master switch panel, 5P, is connected between the switched side of the main circuit breaker contact and earth.

58. INTRODUCTION AND OPERATIONAL FACILITIES

58.1. General

The following is a brief description of the various radio installation together with their L.T. supplies and aerial systems. The chart gives the operational facilities afforded by each separate installation to the various members of the crew.

58.2. Main L.T. supplies

(a) The radio L.T. feeds are taken from the main bus-bars of the aircraft 24-volt earth-return system. The supply to these bus-bars from the battery is controlled by the battery master switch, mounted on charging and control box 1C.

(b) The supplies for A.S.V. and the interphone amplifier are taken from the bus-bars direct, those for the remaining installations being controlled by circuit breakers located as follows. -

Circuit breaker for. -

T.1154 and R.1155 No. 1 installation) T.1154 and R.1155 No. 2 installation)	Charging and control box 1C
TR.1464	Charging and control box 3C

(c) The feeds from above circuit breakers, whose contacts are provided with thermal trip mechanisms for overload or short-circuit conditions, are also controlled from the radio station by isolating switches mounted on the bulkhead at the aft end of the desk.

58.3. Aerial system

(a) The port, or upper, fixed aerial is normally connected to the main communication equipment, viz. No. 1 T.1154/R.1155 installation. A trailing aerial, with its winch mounted under the radio officer's desk, is provided for emergency use in the event of the port fixed aerial becoming defective.

(b) The rotatable D.F. loop is controlled from the radio station and is mounted over the flight deck just forward of the centre section.

(c) The whip type aerial for the V.H.F. transmitter/receiver T.R.1464 is mounted so that it projects through the hull roof just above cabin D.

(d) The V.H.F. Radar (A.S.V. Mk. 2) transmitting aerial is mounted on the mast just forward of the D.F. loop, and the receiving aerials are positioned one on each side of the hull just forward of, and below the cockpit window.

58.4. Main communications equipment

The two separate T.1154 and R.1155 installations are mounted with the transmitters above the receivers, No. 1 at the aft end and No. 2 at the forward end of the radio station. The No. 1 installation constitutes the normal main communication equipment, the transmitter for No.2 installation being used as a standby. For further details of this installation, see para. 59.

58.5. Marconator and D.F. loop

For taking D.F. bearings the receiver (R.1155N) of No. 2 installation is used in conjunction with a Marconator and the D.F. loop aerial. With this equipment bearings may be taken relative to either the aircraft's head or the D.R. compass. For further details see para.60.

Airport R.T. control equipment

The transmitter/receiver type T.R.1464 is installed for airport control. This installation provides two-way (V.H.F.) R.T. communication on four push-button selected channels in the 100-124mc band. For further details see para.61

58.7. V.H.F. radar (A.S.V. Mk. 2) equipment

(a) For this installation a transmitter type T.219 and a receiver type R.219 are used in conjunction with an indicator type 96. The transmitter operates on a frequency of 219 mc/s into the Yagi aerial mounted on the mast just forward of the D.F. loop. The receiver, operating from the port and starboard stub aerials, is tunable from approximately 215 mc/s. to 221 mc/s.

(b) The cathode ray tube indicator is so constructed as to give visual indication of land masses and their distance up to 50 miles, also homing and distance indications on suitable radar beacons up to 120 miles. Results depend largely on the height of the aircraft. For further details see para. 62.

58.8. Interphone equipment

(a) The interphone system consists of parallel-connected sockets located throughout the aircraft as follows. -

Captain's station	Mooring compartment
First Officer's station	Each engine nacelle
Radio Officer's station (2)	D.R. compass position
Navigating Officer's station	
Engineer Officer's station	Captain's auxiliary
Galley	TR.1464 Test Point

(b) The sockets are used in conjunction with an amplifier type A.1134A, which receives its L.T. supply from a 2-folt accumulator andits H.T. from a vibrator unit connected to the 24-volt supply. With the exception of those at the Radio Officer's Station and T.R.1464 Test Point, all the sockets are permanently connected into the amplifier circuit. For further details see para. 63.

58.9. Equipment spares

A box which carries spare valves etc., is placed in the Radio Spares locker situated behind 2nd pilot's cabin.

RADIO FUSES

Box	Fuse No.	Ampere Rating	Type	Circuit
1C	W5	5	S	Londex relay - generator engine No. 2
2C	U2	5	S	Londex relay - generator engine No. 3.
3C	A2	60	M	A.S.V. - power
	B6	5	S	Londex relay - generator engine No. 1
	D6	20	S	T.R.1464
1D	K2	5	S	T.1154 and R.1155 No. 1 - control
	K4	5	S	A.1134 H.T. power unit
	R2	5	S	A.S.V. - control
	R4	5	S	Auxiliary radio control
	R6	5	S	T.1154 and R.1155 No. 2 control

59. MAIN COMMUNICATIONS EQUIPMENT

59.1. Equipment

The installation consists of the following units. -

Two transmitters, type T.1154H or M (Modified)
Receiver, type R.1155B or N. (two off)
Two H.F. ammeters, type C
Aerial change-over switch, type 484 (Marconi) (two off)
Aerial change-over switch, type C.30177
Trailing aerial winch, Marconi type AD/W7
Trailing aerial fairlead
Two H.T. power units, type 33A or 33B
Two L.T. power units, type 35A
Transmitting key, Marconi type 486
Two relays, type L.
Two Londex relays, type 220
Two resistance units, type 52A
Three type B circuit breakers and control buttons (one extra for T.R.1464 installations).

59.2. Station - Description

(a) The main communication equipment is mounted above the radio desk, the transmitters on a panel attached to the hull frames and the receivers on a framework sloping from the outboard edge of the desk to the hull side. The two T.1154/R.1155 installations are located. - No.1 at the aft and No.2 at the forward end of the station. The former installation constitutes the main communication equipment, with the transmitter of the latter installation as a stand-by. The receiver of No. 2 installation is used for D.F. as described in para. 60.

(b) The H.T. and L.T. power units are mounted behind detachable covers in compartments below each end of the desk. The aerial ammeters and change-over switches are mounted on a panel above the transmitters, the trailing aerial winch and fairlead being positioned in the knee-hole beneath the desk.

(c) On the forward side of the bulkhead at the aft end of the station are mounted the following controls. -

Isolating switches for. -
Both T.1154/R.1155 installations
Auxilliary radio supplies (T.R.1464)
Switches for lamps illuminating the radio equipment
Switch for interphone amplifier and telephone switches
Intercommunication call light unit
T.1154 No. 1 and No, 2 modulation Switch

Fitted on the aft side of the same bulkhead, is the radio services panel 7C, which carries the Londex relays, their resistance units, and the keying selector switches

(d) The "tel-mic" sockets for the station are mounted, one on each side of the radio officer, on the inboard edge of the desk.

59.3. Aerial System

(a) Under normal conditions the communications installation is used in conjunction with either the port fixed main aerial, the port and starboard fixed aerials in parallel or the trailing aerial.

(b) There are three aerial change-over switches, two of Type 484 and one Rotary Type C30177.
No. 1 type 484, positioned above No. 1 transmitter, selects either the main fixed aerial or the trailing aerial (at the same time earthing the unused one).
No. 2 type 484, positioned above the No. 2 transmitter, switches the aerial out-put lead from the Rotary switch, C30177, to either H.F. or M.F. on No. 2 Transmitter.
The left hand control on the Rotary Switch, C30177, switches the output from No. 2 type 484 switch to the following positions. -

H.F. Terminal)
M.F. Terminal) on Transmitter No. 1

The aerial lead on transmitter No. 2 via No.2 type 484 switch earth.

The right hand control on the rotary switch performs a similar function in switching on starboard fixed aerial to these same positions.

59.4. Transmitters

(a) The two T.1154H or M (modified) type transmitters, connected to the aerials as stated in the previous paragraph, provide C.W., M.C.W. and R.T. (in conjunction with the A.1134A amplifier) facilities on the following frequency bands. -

Range 1 .... 16.7 mc/s to 8.7 mc/s - Blue
Range 2 .... 8.7 mc/s to 4.5 mc/s - Blue
Range 3 .... 4.5 mc/s to 2.35 mc/s - Red
Range 4 .... 500 kc/s to 200 kc/s - Yellow

The keying circuit is modified, in the transmitters, this modification consists of removing the 6.3 volt lead from terminal + 2 on the keying relay and linking that terminal with the one marked + 1. This permits the relay to operate when the master switch is at STAND BY.

(b) A panel, attached to the hull side above the desk, carries the blocks, which are slotted to take the bars on the transmitter shock absorber mountings. The transmitters are fitted to the panel by first inserting the lower ends of the bars into the bottom blocks and then the upper (hooked) ends into the top blocks. When the bars are fully home their locking screws are tightened into the top blocks.

(c) The external arrangement of the keying circuit, (see Maintenance Manual) is such that the key is automatically connected to whichever transmitter is in operation. This is achieved by connecting the key to the transmitter by means of a pair of relays (mounted on distribution panel 7C) whose coils are energized in parallel with those on the starter relays in the L.T. power units. Thus, when a transmitter and its power units are switched on the contacts of its keying selector relay close to connect the key to it. Two 5 amp. fuses for both key relays have been added. The fuse boxes are in both HT/LT.PU installation 1 and 2 housing.

(d) Particulars of the valves used in the transmitter are tabulated below. -

No. used	Type	Stores Ref.	Description	Function
2	VT.105 CV.1105	10E/216 10CV/1105	Indirectly heated triode	Master oscillator and modulator.
2	VT.104 CV.1104	10E/215 10CV/1104	Directly heated pentode	Power amplifier.

59.5. Receiver

(a) The R.1155N receiver provides C.W., M.C.W. and R.T. communiation facilities over the following frequency bands. -

Range 1 .... 18.5 mc/s to 7.5 mc/s
Range 2 .... 7.5 mc/s to 3.0 mc/s
Range 2A .... 3.3 mc/s to 1.5 mc/s
Range 3 .... 1,500 kc/s to 600 kc/s.
Range 4 .... 500 kc/s to 200 kc/s

(b) The receiver of No. 2 installation provides D.F. facilities on ranges 2, 3 and 4, as described in para.60. As these receivers are indentical, either may be replaced by the other in emergency. It should be noted that in the event of failure of the D.F. receiver it must be removed and replaced by the other, as the cables are not of sufficient length to permit interchanging them.

(c) The method of mounting the receivers is similar to that for the transmitters, the blocks being fitted on the framework between the desk and the hull side.

(d) Particulars of the valves used in the receiver are tabulated below. -

No. used	Type		Description	
2	(VR.99A (CV.1581	10E/757 10CV/1581	Triode-hexode	Visual D.F. switching
3	(VR.100 (CV.1100	10E/278 10CV/1100	Variable-mu pentode	R.F. amplifier and I.F. amplifiers
1	(VR.99 (CV.1099	10E/277 10CV/1099	Triode-hexode	Frequency changer
2	(VR.101 (CV.1101	10E/280 10CV/1101	Double diode triode	A.V.C. and B.F.O. speech diode, visual meter limiter and output.
1	(VI.102 (CV.1102	10E/279 10CV/1102	Double triode	Visual meter switching
1	(VI.103 (CV.1103	10E/305 10CV/1103	-	Tuning indicator

59.6. Main L.T. supply

(a) The separate L.T. feeds for the two installations are controlled by manually operated circuit breakers which are located in charging-and-control box 1C. The feeds from these breakers are also controlled by isolating switches mounted on the bulkhead at the aft end of the desk.

(b) The two power units, types 33A and 35A, are stowed in cupboards at each end of the desk, below their transmitters and receivers. Their mountings in each case consist of a pair of blocks slotted to take the flanges on the underside of the power unit, the forward, or inboard, one having a pair of tapped holes to take the captive locking screws on the unit. For further details of this equipment, see A.P.2548A, Vol. I.

60. DIRECTION FINDING EQUIPMENT

60.1. Equipment

(a) The equipment for this installation, is as follows. -

D.F. all-wave receiver, type R.1155N
Rotating loop aerial, type 3
Marconator radio compass
Manual controller for Rotating loop aerial type 3.
L.T. power unit, type 35A.
Resistance unit, type 52A
Londex relay, type 220.

(b) The receiver, type R.1155N, being part of No. 2 installation, is installed immediately below No. 2 transmitter. Details of this receiver will be found in para.59.5 D.F. facilities are provided on ranges 3 and 4, and communication facilities on the frequency bands previously stated in para. 59.
Note. If not "L" or "N" Ranges 3, 4 and 5 give D/F facilities

(c) The Marconator, which operates in synchronism with the manual loop orientation, is mounted beside the D.F. receiver. This instrument is equipped with a loop azimuth indicator operated by the loop flexible drive cable and controller, which is mounted at the inboard edge of the desk to the right of the radio officer.
Indication is provided against a fixed scale 0-360° and a D.R. compass repeater scale. Inside the fixed scale is a further scale which can be used to determine drift.

On the instrument face, inside the above scales, is a left/right indicator needle which operates in such a manner as to make "sense" indication of the received signals non-ambiguous. Also on the instrument face is a signal strength indicator disc which indicates visually the reception of a transmission.

A quadrantal error adjustable compensator cam is contained in the mechanism of the instrument. This cam is adjusted to the aircraft's quadrantal error; the apparent bearing of the received signal is automatically compensated to give the correct reading of the bearing of the received transmission relative to the aircraft's head.

The instrument is provided with variable illumination from 6.3-volt lamps which take their supplies from the type 35A power unit.

For further details of the Marconator radio compass, see Marconi publication ref. No. T.1929.

(d) The output from the receiver is also arranged to provide audible homing signals on the telephone at the R/O position.

(e) The D.F. installation, including the manual control of the loop and Marconator, is entirely controlled from the radio station.

60.2. Operation

(a) To bring the D.F. equipment into operation for "bearings". -

Close circuit-breaker No. 2 installation by closing the isolating switch.
Set transmitter master switch No. 2 installation to "Std-Bi".
Ensure that the fixed aerial is correctly switched to No. 2 installation and that the H.F. is selected by means of type 484 switch on transmitter 2.
Turn receiver range switch to required range.
Turn receiver master switch to "Omni" and tune receiver; identify station required by using the tuning indicator for final adjustment.
Select "Balance" on master switch and adjust meter balance control until Marconator visual indicator needle is central. Adjust meter amplitude control on receiver until the Marconator signal strength indicator lies centrally in its aperture.
Switch to "Filter in" on receiver.
Re-adjust balance if necessary.
Turn master switch to "Visual" position. The needle of the Marconator visual indicator will not move unless the cursor of the main is indicating the true or reciprocal bearing of the required station. In this case it is necessary to "Off Set" the needles to ascertain the true bearing.
If the Marconator needle moves to the right or left, rotate the needle of the controller so that the cursor is MOVED TOWARDS THE NEEDLE.
When the cursor and the needle are in line, read off the true and relative bearings from the outer and inner scales respectively. The bearings will have been automatically corrected for quadrantal error by previous cam adjustment.

(b) Homing

Repeat the first ten operations as given in previous paragraph.
Rotate the loop aerial until its indicator registers 0° on the Marconator fixed scale.
Homing may now be carried out by observation of the Marconator and passing verbal course adjustment instructions to the pilot.

61. AIRPORT R.T. CONTROL EQUIPMENT

61.1. Installation description

(a) The equipment which operates in the V.H.F. bands comprises the following main units:-

Transmitter-receiver T.R.1464
Controller, type 12.
Whip aerial, type 147
Suppressor, type H.2

(b) The transmitter-receiver T.R.1464 is mounted in the centre section over the charging and control box 1C just aft of the front spar frame. It is held in a rubber-mounted tray, from which it may be removed by loosening the two knurled fixing nuts, whose flanges engage with the feet on the front of the set.

(c) The remote controller, type 12, is fitted on the starboard side of the engine control stand.

(d) The aerial system comprises a whip aerial, type 147, mounted on the centre line of the aircraft, above cabin D. A co-axial cable (connector type 684) connects the aerial to the transmitter-receiver. A removable moulded cover is fitted to base of aerial for inspection purposes.

61.2. Main units-desciption

(a) The transmitter, receiver and power unit are mounted on a main chassis framework, inter-circuit connections being by soldered joints. Dust covers of extremely light gauge mild steel are provided for the above chassis and for the front panel. The equipment operates on any one of four pre-determined fixed channels within the 100 to 124 mc/s band.

(b) Transmitter - Operationally this unit is remotely controlled and is pre-set by means of special test equipment prior to flight. The tuning is accomplished by means of a motor which operates cams to operate the pre-setting mechanism. This latter rotates the tuning condensers to whichever channel is selected.

(c) Stabilization of frequency is by crystal control; the frequency to which transmitter crystals should be cut is obtained by dividing the radiated frequency by 18.

The crystals are plugged into sockets on the front panel, each bearing the reference letter, i.e. A, B, C, D of the channel it serves. Access to the sockets is gained by removing the front dust cover.

(d) Particulars of the valves used in the transmitter are tabulated below. -

No. used	Type	Stores Ref.	Description	Function
1	CV.1091	10CV/1091	R.F. pentode	Crystal oscillator and trebler
5	CV.1501 or VT.501A	10CV/1501 10E/784	R.F. beam tetrode	Frequency doubler, push-pull trebler, and push-pull PA output
1	CV.1067	10CV/1067	Triode	Second A.F.
2	VT.52	10E/11398	Pentode	Modulator

(e) Receiver - The receiver unit is a superheterodyne with an intermediate frequency of 9.72 mc/s, the local oscillator voltage being derived from a two-stage crystal oscillator. The four crystals are plugged into sockets on the front panel adjacent to those for the transmitter, each being cut to a frequency of 540 kc/s less than the corresponding transmitter crystal frequency. The receiver is remotely controlled with the transmitter and has the same frequency coverage.

(f) Particulars of the valves used in the receiver are tabulated below. -

No. used	Type	Stores Ref	Description	Function
5	CV.1091	10CV/1091	R.F. pentode	Receiver R.F. mixer, crystal oscillator and trebler sextupler and third I.F.
2	VR.53	10E/11399	Variable-mu pentode	Controlled I.F. stages.
1.	VR.54 CV.1054	10E/11400 10CV/1054	Double diode	Detector and A.V.C.
1	VR.56 CV.1056	10E/11402 10CV/1056	Pentode	First A.F.

(g) Power unit - The power supply for this equipment is taken from the aircraft 24-volt D.C. system. The heater circuits are fed via a voltage-regulator type 6, and the high-tension and grid-bias voltages are provided by a rotary transformer, type 79. These items with associated filters are mounted on the chassis at the rear of the unit with the BA marker amplifier, the latter being unused on this aircraft. A 500 M/A fuse is located in the HT circuit within the power unit.

Current consumption. 6 amps on "Receive", plus 2 amps for motor surge when changing channels; $8\frac{1}{2}$ amps when transmitting.

(h) Controller Electric, Type 12 - This controller, which remotely actuates the transmitter-receiver, carries the following controls.

Four push buttons marked 'A', 'B', 'C', 'D' .... For frequency selection

One push button .... For 'OFF' position

One three-way switch .... 1. Marked 'T' for Transmit (Left)
2. 'VOL' for receiver. (Right)
3. Centre position marked 'R' for full volume

One volume control .... Marked 'VOL'. As above.

One dimmer control .... A knurled screw which, when turned, regulates the illumination of the buttons.

(i) The five push buttons are of translucent material and, when pressed, those marked 'A', 'B', 'C', and 'D' glow. This is achieved by a pair of pilot lamps provided with dimming cups which may be screwed down over them by means of the dimmer screw. The illumination of a depressed button is received indirectly from these pilot lamps, shields being arranged to prevent illumination of the buttons not depressed.

61.3. Operation

(a) The transmitter-receiver is pre-set on the ground for frequency adjustment, and only the operation of the button switches on the controller is necessary in flight.

(b) The electric controller is normally switched to the 'Receive' position. Transmission takes place with the T.R. switch held over in the 'Transmit' position. For details of tuning procedure to be carried out on the ground prior to flight, see A.P. 2528B.

62. V.H.F. RADAR (A.S.V. Mk. 2), EQUIPMENT

62.1. Installation description

(a) The installation consists of the following major items of equipment. -

Transmitter, type T.219
Receiver R.219
Indicator, type 96
Control panel, type 9
Rotary converter, type 2
Suppressor, type Y.3
Two 'ON-OFF' switches (Ref.5C/3497)
Transmitting aerial - 'Yagi' type S45.CP.33173
Two receiving aerials, type 301.

(b) As this installation is solely a navigational aid it is located at the navigation station, where it is under the control of the navigating officer.

(c) The transmitter is carried in a tray on a shock absorber mounting attached to the floor under the table. The complete unit may be removed from the tray after first loosening the two knurled nuts whose flanges engage with the feet on the front panel. Also on the front panel is the H.T. switch which is locked in 'OFF' position. Control of H.T. is obtained by means of a remote switch marked 'Transmitter' on Instrument Panel 7P.

(d) The receiver, mounted behind the facia on the table, is fitted to a shock absorber mounting.

The following controls are fitted to the panel front. -

Tuning control	Main control for receiver.
Motor 'ON-OFF' switch	Normally in 'ON' position
Remote/control	Should always be to 'Local' on this installation.

(e) The indicator is positioned on a shock absorber mounting which is fitted to slide on rails attached to a structure projecting over the forward end of the table. This arrangement allows the visor to be moved into the most comfortable position when in use.

The following controls are fitted to the indicator. -

Range switch. - Four range scales are available, namely, 3, 12, 30, and 120 nautical miles, and by rotation of this switch the desired selection is made.
By extending the range switch knob outwards a series of range calibration marks can be applied to the time base. Their appearance is arranged at the following positions: at 1/4 mile intervals on the 3-mile range, with the first mark at 1/2 mile; 1 mile intervals on the 12-mile range 5-mile intervals on the 30 mile range; and 10-mile intervals on the 120-mile range.

Range scale illumination - The perspex protection plate in front of the cathode ray tube is provided with edge lighting. The intensity of illumination is controlled by a variable resistance, the knob of which is to the left of the cathode ray tube.

Range 3 and 30 miles LEFT HAND illumination bulb lights only
" 12 "120 " RIGHT HAND illumination bulb lights only

Gain control - For use in obtaining the desired signal amplitude.
Brilliance control - For adjusting the light level of the cathode ray tube picture.
Focus control - Used in conjunction with the brilliance control to secure a clear picture.

(f) The control panel is fitted at the aft end of the station on a shock-absorber mounting. This panel houses the relay for the rotary converter and the voltage regulators for its A.C. output. The fuses for the transmitter and receiver A.C. supplies and D.C. supply to transmitter cooling fan are accessible by first releasing the clips which hold the cover in place on the front of the panel and then removing the lid on the A.M. type fuse box. The relay is controlled by a switch on the instrument panel 7P, above the table. The switch on the front of the control panel also completes the relay coil circuit, but as it is normally unused it is kept as "OPEN"

(g) The rotary converter is bolted to the floor under the outboard and of the table. The D.C. consumption of the converter is 40 amps and 24 volts, and the A.C. output is 6.25 amps at 80 volts, with a frequency of 1,200 c.p.s.

(h) The aerial system consists of a pair of receiving aerials mounted one on each side of the nose, and a "Yagi"type transmitting aerial on the mast just aft of the coupe roof.

(i) Particulars of the valves used in the various units are tabulated below. -

Transmitter.

No. used	Type	Stores Ref.	Description	Function
2	(VT.90 (CV.1090	10E/97 10CV/1090	Directly - heated triode	Transmitter
2	(VU.111 (CV.1111	10E/146 10CV/1111	Half-wave rectifier	Voltage doubler

62.2. Receiver

No. used	Type	Stores Ref.	Description	Function
2	VR.136 / CV.1136	10E/386 / 10CV/1136	R.F. pentode	R.F. amplifier
7	VR.91 / CV.1091	10E/92 / 10CV/1091	R.F. pentode	Mixer, video amplifier I.F. amplifiers.
1	VR.137 / CV.1137	10E/394 / 10CV/1137	R.F. triode	Local oscillator
1	VR.92 / CV.1092	10E/105 / 10CV/1092	Diode	Diode
1	VU.39A / CV.1569	10E/574 / 10CV/1569	Full-wave rectifier	
1	VU.134 / CV.1134	10E/100 / 10CV/1134	Half-wave rectifier	

62.3 Indicator

No. used	Type	Stores Ref.
6	VR.65 / CV.1065	10E/11446 / 10CV/1065
1	VR.92 / CV.1092	10E/105 / 10CV/1092
3	VR.54 / CV.1054	10E/11400 / 10CV/1054
1	Tube VCR.97 / Tube CV.1097	10E/222 / 10CV/1097

62.4. Operation

To operate the equipment the following procedure should be carried out. -

(a) Close the power switch on the instrument panel and make the following checks. -

That transmitter cooling fan is running by placing hand over air intake on right-hand side of transmitter.

That transmitter filaments are glowing (these may be observed through the louvres)

Ensure that LOCAL-REMOTE switch on receiver is at "LOCAL".

Allow 30 seconds for warming-up of receiver and indicator unit. After this period a vertical "trace" should be visible on the latter unit.

(b) Close H.T. switch on instrument panel marked "transmitter" and observe milliammeter reading; this should be approximately 4.5. If in excess of 8 ma. switch off and do not attempt to use the equipment until it has been serviced.

If the equipment is working correctly operation (b) should produce pictures on the indicator C.R.T. screen, whose size, brilliance and focus may be adjusted by the appropriate controls on the indicator.

(c) A.S.V. reception can be classified under two headings, namely, (a) Echo Reception without Aid from a Ground Beacon, and (b) Responder Signal Reception

62.5. Echo Reception without aid from a ground beacon

When flying over sea plane echoes are obtainable from ships, islands and coastlines, and take the form of elongated horizontal peaks on either side of the vertical trace. These equally disposed about the base of the trace decreasing in length horizontally are returns from sea or land immediately below and ahead of the aircraft. Similar lines of rapidly changing amplitude will also be observed super-imposed on this trace; this is caused through receiver noise and is known as "grass".

Adjust the receiver tuning slowly to the same frequency as the transmitted pulse, using limited "gain" to obviate bad definition. Maximum strength of transmitted pulse and ground returns should be obtained at the bottom of the trace.

Range measurements are made from the bottom of the trace to the lower edge of the echo. Returns from an object dead ahead of the aircraft will produce a pattern equally disposed about the trace at a distance up the screen proportionally to the range of that object. This range may be determined by operation of range switch and reading the appropriate scale. Should such an object be to the port or starboard of "Dead ahead", the pattern on the vertical trace will be to the left or right respectively. In such cases a rough estimate can be made of the direction of the object by comparing the amplitude of returns on either side of the vertical trace.

This information is only reliable when the aircraft is flying level. There is a possibility of sense reversal when aircraft is banking steeply and receiver aerial considerably screened.

62.6. Responder Signal Reception

With the assistance of a ground or responder beacon, signals a far greater ranges can be obtained with the aircraft equipment.

The procedure for reception is the same for that given in the above paragraphs. One point to note is that in the case of responder beacons it is sometimes necessary to retune slightly the receiver in order to obtain the best reception from re-radiated pulses that may be of a slightly higher frequency. Such adjustments have the advantage of producing a signal devoid of noises and primary returns.

63. INTERPHONE EQUIPMENT

63.1. Installation description

(a) This installation consists of the following major items of equipment.

Amplifier A.1134A
H.T. power unit, type 173
Two-volt accumulator
Tel-mic sockets (13)
Tel-mic head-set

(b) The amplifier is fitted between the transmitters on the panel at the radio station, its H.T. unit behind the aft main L.T. power unit, and its 2-volt accumulator in a stowage box on the aft side of the radio bulkhead. The supply to the H.T. power unit and the 2-volt feed to the amplifier are controlled by a double-pole switch on the forward side of the radio bulkhead on the left-hand side of the radio officer.

(c) Particulars of the valves used in the amplifier are as follows. -

No. used	Type	Stores Ref.	Description	Function
1	(VR.21 (CV.1021	10E/7738 10CV/1021	Triode	Class A voltage amplifier
1	(VR.35 (CV.1035	10E/9779 10CV/1035	Twin Pentode	Class B, Q.P.P. power amplifier

(d) The interphone sockets are connected in parallel (**see Maintenance Manual**). Three switches marked R.1, R.2 and R.T. respectively are provided at the radio station. The former switch (R.1) breaks the No. 1 receiver output to the Radio Officer's sockets, while switch R.2 breaks the D.F. receiver output to the Radio Officer's position.

The third switch marked R.T. switches the input modulation to either transmitter.

Microphones used are of the electro-magnetic type.

63.2. Operation

(a) To bring the amplifier into operation. -

Close switch marked "I/C Power" on the radio bulkhead.
Close "ON-OFF" switch on amplifier.

(Note. A slight "Chirp" will be heard when the latter switch is opened or closed; this is a transient effect due to the warming up of the valve filaments and is quite normal).

(b) For normal interphone operation. -

Set key switch on interphone amplifier to "B" and lock by means of locking strip.

The above provides interphone facilities for all stations and C.W. and M.C.W. operation (on the T.1154/R.1155) for radio officer only. When the key-switch is set to "C" the amplifier is used to modulate the main transmitter for R.T. The "A" position of the key-switch is normally unused.

<u>IMPORTANT</u>. - Both "ON-OFF" switches should be opened before leaving the aircraft, as the battery master switch does not control the 2-volt supply.

(c) Telephone Switch R.1 on left of Radio Officer's seat connects the headphones to No. 1 Receiver.

SOLENT 3

MAINTENANCE MANUAL

INSPECTION SCHEDULE

Contents

Prepared by Short Brothers and Harland Ltd.

INTRODUCTION

The typical inspection schedules given herein are intended as a basis on which operators can formulate schedules in accordance with the requirements of the governing authority.

These schedules, with the exception of those for the power plants and automatic pilot, have been divided as follows:-

Pre-flight or departure
Check 1 - After every 15 flying hours.
Check 2 - After every 30 flying hours.
Check 3 - After every 60 flying hours.
Check 4 - After every 120 flying hours.

The operator should add items to the schedule as necessary to cover special installations or equipment, and to include the provisions of any regulations, national or local, in force at the time. This schedule should therefore not be used for any specific aircraft without the authority of the governing body.

The Certificate of Safety for flight includes a certification that all maintenance and inspection has been carried out in accordance with the approved maintenance schedules. It will be necessary therefore to refer to the journey log book, to the technical flight log, or to the engine and aircraft log books, if available, to confirm that this has in fact been carried out.

When compiling a schedule for a particular aircraft, reference should be made to the aircraft's log books for details of any modification which may affect the basic schedule.

The basic schedules given herein are made out on a cumulative basis, Check 1 being the first, and the necessary items being added for each of the more comprehensive checks. Operators are advised, however, to prepare fully detailed schedules for each particular inspection period with provision for signatures against each item, as this ensures a closer check that the operation has been completed.

NOTE ... The basic inspection schedules for the power plants and the automatic pilot are divided into periods recommended by the manufacturers and should not be extended except as outlined in the following paragraph.

The periods at which checks are carried out may be extended as experience dictates, subject to the approval of the governing authority. The periods stated on this page will be amended from time to time in the light of manufacturers established evidence. Where the hours quoted in this schedule are different from those in accessory manuals this schedule should be taken as the latest established data for such items fitted to this type of aircraft. The figures quoted in the accessory manuals are for initial guidance. Operators wishing to extend overhaul periods should obtain approval and provide evidence as required by the local governing authority.

DEPARTURE

AIRFRAME

1. Rectify any defects reported at the termination of the previous flight.

2. Remove the covers from the propellers, engines, coupe and pressure-heads.

3. Remove the plugs from the static vents.

4. Check the cabin heater and fuel lines for signs of leakage.

5. Check the contents of the aerofoil and propeller de-icing fluid tank; top up with fluid H.63A if necessary.

6. Check the contents of the windscreen de-icing fluid tank; B.S.S. 3D.9 fluid.

7. Prime the aerofoil de-icing system (see Sect.11 - Pre-flight Check)

8. Visually check the tension of the flying controls. Check controls for full and free movement.

9. Set the trimming tab controls to neutral.

10. Check the operation of the flaps, paying particular attention to the correct adjustment of the IN and OUT limit switches.

11. Ensure that the fresh water tank is clean and full.

12. Check that the hull compartments and the wing-tip floats are bilged; record the quantity of water, if any, removed from each compartment.

13. Check the mooring equipment for condition, function and security of stowage.

14. Check that the life-belts and first-aid kits are intact.

15. Check that the dinghies and accessory emergency equipment are intact.

16. Ensure that all hand fire extinguishers are in position.

17. Ensure that the control locking device is removed from the controls and securely stowed.

18. Ensure that all compartments and entrances to them are free from obstruction

19. Ensure that the maintenance platforms in the main plane leading edge, entrance doors and all escape hatches are closed and secure.

20. Check the toilets for cleanliness.

INSPECTION SCHEDULE

POWER PLANTS DEPARTURE

1. Rectify any defects reported at the termination of the previous flight.

2. Check that the firewall doors are in position and secure.

3. Ensure that the nacelles are free from loose articles.

4. Ensure that all cowling panels and cowling gills are undamaged and secure.

5. Check generally for fuel and oil leakage.

6. Replensih fuel and oil tanks as necessary and ensure that the filler caps are replaced and secured.

   NOTE.... Check the contents gauges to see whether the readings before and after replenishment agree with the amount of fuel added.

7. Examine the propellers for external damage.

8. Check the operation of the cowling gill mechanism and the position indicator.

9. Check the operation of the air intake shutters and controls.

10. Check the operation of the oil cooler flaps and controls.

11. Make a full engine run-up and test.

INSTRUMENTS:- DEPARTURE

1. Rectify any defects reported at the terminationcf the previous flight.

2. Visually inspect all instruments for condition, security and correct setting.

AUTOMATIC PILOT DEPARTURE

See page 29.

DEPARTURE

ELECTRICAL

1. Rectify any defects reported at the termination of the previous flight.
2. Check the accumulator voltage and connections.
3. Note that the circuit breakers remain closed on load.
4. Check operation of cut-outs during engine run.
5. Note that pointers on voltmeters and ammeters are not sticking.
6. Check that 100% spare fuses are carried.
7. Examine flap motor and gearbox - if dirty or wet, clean and re-grease
8. Check flap operation.
9. Check operation of aileron trimming tab controls and note that indicator is reading correctly.
10. Carry out pre-flight check on aerofoil de-icing as described in Sect. 5. Chap. 2 of maintenance manual.
11. Check that propeller de-icing motors are running and that lamp filaments are intact.
12. Check operation of platform safety switches by opening engine starting master switch and pressing starter push switches noting that relays close.
13. Check operation of cowl gill motors and note that indicators are reading correctly.
14. Check operation of air intake temperature gauges.
15. Note that fuel contents gauges are reading correctly.
16. Note that fuel flowmeters are reading correctly.
17. Note that fuel pressure gauges are reading correctly.
18. Test fuel backing pump motors as described in Sect. 5, Chap. 2 of the maintenance manual, at the same time note that the warning lamp filaments are intact.
19. Note that oil contents gauges are reading correctly.

20. Check readings of oil temperature gauges before and during engine run.

21. If all, or part, of the next flight is to take place at night check the operation of the following :-

Landing lamps
Navigation lamps
Flight deck lighting
Main cabin lighting
Reading lamps
Freight compartment lighting
Boarding lamps and emergency cabin lighting.

22. Check signalling lamp and spares.

23. Check stewards call lamps, from all positions.

24. Check lamps in passenger briefing indicators.

25. Check elements in order in:- cooker, urns, and immersion heaters.

For the Radio Departure Check see

RADIO INSTALLATION Page 42.

AIRFRAME CHECK No. 1 (15 HOURS)

1. Examine the hull sheeting for possible damage.

2. Examine the wing-tip floats externally for damage.

3. Examine the wing-tip float struts for damage and security; check the tension of the bracing cables.

4. Check the bilges of the hull and wing-tip floats; remove bilge-water if necessary.

5. Examine all escape hatches, doors and windows.

6. Examine all maintenance doors for condition and security.

7. Examine all removable covers on the wings for condition and security.

8. Examine the coupe windows for damage and check the sliding windows for security and freedom of movement.

9. Check the condition and security of the watertight doors.

10. Check all flying controls for correct tension and freedom of movement over the whole range.
Reset the trimming tabs to 'zero'.

11. Examine the streamline bracing wires, between the tail plane spar-frames, for condition and security.

12. Check the main plane flaps for full and free movement, and ensure that the flap position indicator functions in agreement with the flap and that the limit switches operate correctly.

13. Check the flap screw-jacks and worm gearboxes for condition. Clean, oil and grease as necessary.

14. Check the security of instrument panels and correction cards.

15. Examine all aircraft instruments for condition, security, and correct setting.

16. Check engine and propeller control cables for condition and tension.

17. Examine the tail release hook gear for condition.

18. Examine all marine equipment for condition and security.

19. Ensure that the fresh water tank is clean and full.

20. Ensure that all filler caps and covers are secure after refuelling.

21. Check the cleanliness of passenger cabins; examine window panels for damage and clean as necessary.

22. Check the cleanliness of the buffet and equipment.

23. Ensure that the hand fire extinguishers are securely stowed and that they have not been operated.

AIRFRAME CHECK No.1
(CONTD.)

24. Examine the dinghy blow-out stowages externally for damage and check that the CO_2 cylinders show no signs of inadvertent discharge.

NOTE ... If the neck of the operating head shows red, the cylinder has been discharged.

25. Check the condition of the de-icing distributors on the aerofoils.

26. Examine the auxiliary generating plant for condition and security. Top up the fuel tank.

AIRFRAME CHECK No. 2 (30 HOURS)

In addition carry out check No. 1

1. Examine all flying controls throughout the hull for wear, safety and freedom of operation.
Check all cables for wear and fraying. Ensure that all pulleys and sprockets operate freely and that chains are well lubricated.
Check fork ends and pins for wear.

2. Check the security and movement of all controls in the control cabin and at the flight engineer's station. Ensure the full and free movement of all controls.

3. Examine all emergency equipment in the aircraft for condition and accessibility. Ensure that the oxygen equipment is complete. Check all fire extinguishers for leaks and serviceability.

4. Examine the cabin heater system for condition and security. Check the operation of the electrical equipment and the operation of all valves, ducts and louvres.

5. Examine the cold air system throughout for condition and security. Check the operation of all valves, ducts and louvres.

6. Examine all escape hatches for condition and ease of operation. Ensure that all catches are serviceable and easy to operate.
Examine all windows for clarity of vision.
Check the condition of the 'push-out' type windows.

7. Examine all chairs and lap straps for condition and security.

8. Visually inspect the Verey pistol for condition and stowage. Examine the cartridges for condition; check number.

9. Examine the tail release hook gear for condition and security. Check the condition and run of cable throughout the aircraft.

10. Check the operation and flushing of the toilet wash basins. Check the fresh water tank for security of mounting and condition of the tank and piping. Replenish the tank if necessary.

11. Examine the fin, rudder and elevators for general condition, operation and attachment. Check the trimming tab hinges and tab operating gear for condition and operation; grease.

12. Examine the pressure-heads for condition and security.

13. Examine the aileron controls in the wings for wear, general condition, security and lubrication. Ensure that all pulleys, chains and sprockets operate freely. Check the security of all attachments.

14. Examine all throttle and propeller control cables for general condition and wear at fairleads and pulleys. Examine pulley banks and fairleads for freedom of operation and security. Check the operation of all controls.

AIRFRAME CHECK No.2 (CONTD.)

15. Examine the flap controls and attachment points throughout for operation and security. Check the limit switches for operation and security. Examine bearings, couplings and torque-tubes throughout for wear and lubrication. Examine the flap runners and bearings for wear and lubrication.

16. Examine the oil cooler flap control cables for wear at fairleads and pulleys and for general condition throughout. Check pulleys and fairleads for operation and security. Examine all fork ends and pins for wear and safety. Examine the operating screw-jacks and drive chains and sprockets for wear and operation.
Check the operation and travel of the flaps.

17. Examine the float attachments from inside the wings for condition and security.

18. Examine the upper and lower surfaces and interior of the wings for general condition. Check the internal structure for security and condition.

19. Examine the leading edge maintenance doors for security of attachments and condition of retaining cables and rubber seals.

20. Examine engine nacelles for cracks and general damage.

21. Examine all navigation lights for security and cleanliness.

22. Examine the ailerons for damage and security of attachment.

23. Examine the main plane flaps for loose rivets, cracks and general damage.

24. Examine the wing-tip floats, check the bracing wires for tension, security and general condition.

25. Check all bonding for condition and security.

NOTE ... For all lubrication on this routine use Anti-freeze grease D.T.D.577 and Anti-freeze oil D.T.D.417A or approved equivalents.

AIRFRAME CHECK No.3 (60 HOURS)

In addition carry out checks No.1 and 2

1. Examine all de-icing pipe-lines and connections for leaks.

2. Examine the tail unit externally for damage.

3. Inspect the metal sealing strips at the wing roots for security.

4. Examine the ailerons, as far as possible, internally for signs of damage and corrosion.

5. Check the flying controls and ensure that fouling cannot occur through incorrect tension, foreign matter or incorrectly stowed equipment.

6. Examine the wing-tip floats, for corrosion externally.

7. Examine the engine nacelle structures internally and externally for fractures and corrosion.

8. Lubricate the engine maintenance door hinges and locking gear.

9. Examine for security and excessive wear and lubricate the pin joints of the elevator and rudder trimming tab operating rods.

10. Clean the scroll of the oil cooler flap control handwheel and inspect the indicator linkage for security. Lubricate the scroll, link pins and bearings as necessary.

11. Examine the engine and propeller control cable drum push-pull-rod joints for excessive wear and security; lubricate as necessary.

12. Examine the engine and propeller control cables for security of attachment to the levers in the control stand.

13. Remove and clean the cabin heater jet and filter (see Sect.12)

AIRFRAME CHECK No. 4
(120 HOURS)

In addition carry out checks No. 1, 2 and 3

1. Clean out the interiors of the wing-tip floats with fresh water and examine them internally for damage and corrosion.

2. Clean out the hull bilges with fresh water. Examine the hull internally and externally for damage and corrosion.

3. Examine all structural members of the hull for damage, distortion and security.

4. Examine all removable, panels, cabin windows, port-lights, doors and floor panels for damage. Ensure that all locking devices function correctly, and lubricate as necessary.

5. Examine the tail plane and fin as far as possible internally for signs of damage, corrosion and security of the bracing wires and struts.

6. Examine the elevators and rudder as far as possible internally for signs of damage and corrosion.

7. Examine the levator and rudder hinge brackets for security of attachment to elevators and rudder.

8. Inspect the rudder anti-balance tab operating gear for security. Lubricate the sliding tube and pivots.

9. Examine for security and lubricate the elevator and rudder trimming tab gearboxes.

10. Examine the tail plane and fin for security of attachment to the hull and ensure that the attachment fittings are undamaged and secure.

11. Examine the main plane internally for corrosion and damage to spars and ribs. Ensure that all bracing wires are secure.

12. Examine the aileron hinge brackets for security of attachment to the ailerons.

13. Examine the control columns for security and lubricate the universal joints. Lubricate the hand wheel bearings. Clean and lightly lubricate the control column chains and sprockets; check the chains for correct adjustment and security.

14. Clean and lightly lubricate the control column interconnecting chains and sprockets. Check the chains for correct adjustment and security.

    Lubricate the aileron control bearings immediately aft of the port control column.

15. Lubricate the bearings of the elevator intermediate levers.

16. Clean and lubricate the rudder bar pivots and adjusting gear.

AIRFRAME CHECK No.4 (CONTD.)

17. Remove all removable panels over control systems in the hull and check controls throughout for safety and condition.

18. Throughly clean all chains, sprockets and pulleys throughout the control systems and after inspection relubricate.

19. Top up flap gearboxes and screw-jacks. Clean off any signs of corrosion on screw-jack casing and cover with Anti-freeze grease. Check the adjustment of the limit switches and $\frac{1}{3}$rd out position switch.

20. Thoroughly examine the screw-jack attachments at spar and flap for condition and security.

21. Examine all hatch seals for condition, and treat with french chalk.

22. Remove covers from float attachment strut fittings, clean fittings, and relubricate with Anti-freeze grease.

23. Examine the rudder and elevator torque-shaft flanges for cracks.

24. Examine beaching gear attachments for condition, security and operation. Clean off all grease and re-grease.

25. Check mooring and anchoring equipment for correct functioning and serviceability.

26. Examine the wing-root attachment fittings.

27. Examine the flap rooler arms for condition and security.

28. Check the condition of the rudder and elevator trimming tab control box and lubricate.

29. Check the flying control locks and stops for correct functioning.

30. With the control columns and rudder bars in the neutral position, check the control surfaces for the correct settings.

31. With the aileron, rudder and elevator trimming tab indicators at the zero position, check the control surfaces for the correct settings.

32. Examine the aerofoil de-icing distributors and remove surface dirt from the gauze surface (See Sect.11)

33. Remove the de-icing fluid filters for cleaning; wash out in hot water (See Sect. 11).

34. Examine the de-icing fluid tank, pipelines and connections for damage and security.

INSPECTION SCHEDULE

POWER PLANT CHECK No.1 (15 HOURS)

Rectify any defects reported at the termination of the previous flight.

GENERAL

1. Inspect the power plant generally for the security of clips, support brackets etc., and for freedom from oil and fuel leaks.

2. Drain the collector tank of the drainage/breather system and clean its filter.

3. Check the cooling duct to the generators for security, condition and freedom from obstruction.

4. Inspect all cables and conduits for freedom from fraying or deterioration of the insulation.

5. Inspect the accessory gearbox for leakage. Check the oil level and examine the accessory pipe-lines for security.

FUEL SYSTEM

1. Check the quantity of fuel in the tanks and note the contents gauge readings while the tanks are being filled. Check the replacement and security of the fuel caps and access panels.

2. Check that all fuel tank vents are clear and check the tank cocks for correct operation.

3. It is recommended that the sump of the A.G.S. filter is checked for water and that the element should be cleaned (See Sect.11). Do not disturb the Vokes filter secured to the carburettor unless necessity is indicated by the fuel pressure gauge.

4. Check all pipe-lines and fuel system units for fuel leakage with the backing pumps in operation (One minute maximum when engines are stopped). Ensure that the fuel cut-off is in the STOP position during this check.

5. Check all fuel system controls for freedom of movement.

6. Before the run-up ensure that the pressure gauge is at zero.

7. Drain any water or sediment from the fuel tank sumps and collector boxes.

OIL SYSTEM

1. Check the amount of oil consumed and fill the tanks as required.

2. Check that the oil filler caps and access covers are replaced and secured.

3. Check the oil cooler for obstruction of the air passages and for security and leaks.

4. Inspect the pipe-line joints and hose for leakage and security. Check the pipes for condition.

5. Check the operation of the oil cooler flaps and position indicators.

POWER PLANT CHECK No.1 - OIL SYSTEM (CONTD.)

6. Examine all joints in the pressure transmission pipe-line of the torquemeters for leakage.

COOLING SYSTEM

1. Inspect the cylinder baffles, head air seals, heat isolation cuffs and cowling for condition and security.

2. Check the operation of the cowling gill mechanism and the recording of the position indicator.

PROPELLER

1. Inspect the propeller and its accessories in accordance with the manufacturer's schedule.

FIRE EXTINGUISHER SYSTEM

1. Check the condition and security of the methyl - bromide containers and examine for leaks as indicated by orange-coloured stains. Do not confuse the orange band which may be painted on the containers, with leakage stains.

2. Check the security and condition of the cables, spray-rings and pipe-lines.

3. Inspect the external condition of all flame switches.

EXHAUST SYSTEM

Examine the system generally for condition and security.

AIR INTAKE SYSTEM.

Check the security of the intake scoop and its toggle fasteners and ensure that the scoop is not obstructed.

DE-ICING SYSTEM.

Check the system pipe-lines and de-icing fluid distributors for condition and security.

CONTROLS.

1. Check all controls for correct function, security and freedom of operation.

2. Check the action of the engine and propeller controls friction dampers.

FINAL INSPECTION AFTER CHECK No.1

Before engine run

1. Inspect all cowlings and inspection panels for cleanliness and security.

2. Check the engine priming pump motor for operation.

POWER PLANT CHECK No.1
FINAL INSPECTION (CONTD.)

During engine run

1. Check that all routes of fuel supply can feed the engine. Check the action of the fuel pressure warning lamps and gauges.

2. Check the functioning of all engine instruments.

3. Check the output of the generator and the operation of the cut-out and voltage regulator.
   NOTE ... The ground batteries should be disconnected for this test.

4. Check that the vacuum pumps are operating satisfactorily by moving the change-over cock from one setting to the other and noting the recording on the gauge.

5. Carry out routine pre-flight checks, for the granting of a certificate of safety for flight.

After engine run

1. Top up the propeller de-icing tank if this system is in use.

2. Carry out a final check for any oil or fuel leaks.

POWER PLANT CHECK No.2 (___ HOURS)

The following checks should be made in addition to those called for in check No.1.

FUEL SYSTEM

1. Inspect all flexible pipes for condition and security of wire locking.

2. Check the system controls for wear and security.

3. Examine the engine-driven fuel pump for security and leaks.

4. Remove, inspect and clean the priming system filter.

5. Examine all fuel tanks for security and leaks.
   Remove and clean the fuel filters.

   NOTE ... When the filters are dismantled ensure that the gauzes are undamaged and do not use rag for cleaning. Ensure that the filters are secured on reassembly.

OIL SYSTEM

1. Remove, inspect and clean the engine oil sump and oil tank filters.

COOLING SYSTEM

1. Inspect the cylinder baffle system for condition and security. Ensure that there is adequate clearance between the baffles and the induction belts.

2. Lubricate the gill mechanism with approved grease through the nipples provided.

3. Top up the gill drive gearbox with approved grease through the nipple provided.

4. Inspect the H.T. lead protectors for condition and security.

PROPELLER

Inspect the propeller, and its accessories in accordance with the manufacturer's inspection schedule.

FIRE EXTINGUISHER SYSTEM

Remove and weigh the methyl-bromide containers.
Renew the containers if the weight is not correct.
Check spray rings for corrosion.

IGNITION SYSTEM

1. Check the attachment of all leads to the sparking plugs.

2. Inspect the complete harness and magnetos externally for general condition and security.

3. Check that the magneto vents are clear.

ELECTRICAL SYSTEM

1. Check the security and condition of the r.p.m. generator drive and leads.

2. Check the security and condition of the cylinder head thermo - couple and lead.

3. Check the security and condition of the air intake thermometer.

4. Check the security of the oil and fuel pressure transmitters.

5. Check the 'At Rest' datum setting of all instruments.

AIR INTAKE SYSTEM

1. Check by hand, the free-swinging override action of the warm air shutter.

2. Lubricate all controls and spindles.

CONTROLS

1. Lubricate all engine controls where applicable with approved anti-freezing grease.

2. Lubricate the control ball-end connections and the constant speed governor unit M.R.C. control with approved anti-freeze grease.

3. Inspect all engine controls for damage.

GENERAL

Wash down and dry off the complete engine installation, but keep magnetos, electric motors, and indicators free from cleaning fluid.

FINAL INSPECTION AFTER CHECK No.2

In addition to the checks called for in the Final Inspection after check No.1, carry out the following:-

<u>During engine run:-</u>

1. Carry out the full feathering and unfeathering check.

2. Check with the engine running at T.O.B. and the fuel backing pumps switched off, that the carburettor fuel pressure gauge records 30 p.s.i., and the carburettor fuel pressure warning lamp is extinguished.
If the pressure is not 30 p.s.i., and the warning lamp lights, the Vokes fuel filter element must be replaced with a cleaned and tested element and the check repeated.

3. Carry out "Ground Checks After Periodical Inspection" as detailed in Sect. 6.

POWER PLANT CHECK No.3 (... HOURS)

The following checks should be made in addition to those called for in checks No. 1 and 2.

FUEL SYSTEM

1. Top up the carburettor can chamber with clean engine oil.

2. Lubricate the carburettor bearings through the appropriate nipples using approved grease, and the linkage with clean engine oil.

OIL SYSTEM

1. Inspect the oil tank for condition and security.

2. Dismantle, inspect and clean the Purolater filter in the propeller feathering pipe-line.

3. Check the security, condition and bonding of all pipes.

PROPELLER

1. Inspect the propeller and its accessories in accordance with the manufacturers inspection schedule.

2. Check the lightness of the constant speed governor unit.

FIRE EXTINGUISHER SYSTEM

1. Clear the spray rings with compressed air.

2. Check the flame switches for operation and cables for continuity.

IGNITION SYSTEM

1. Inspect the H.T. lead terminals for security of their buttons and condition of the insulating sleeves. Clean off any deposit.

2. Check the H.T. leads for continuity and for insulation.

ELECTRICAL SYSTEM

1. Examine the brush gear of the generator and blow off any dust accumulation. Check the seating of the brushes.

2. Inspect the brush gear of the starter motor and blow off any dust accumulation. Check the seating of the brushes.

3. Examine the starter hand-turning gear for condition. Replace any worn pins.

ACCESSORY GEARBOX

Inspect the gearbox flexible drive coupling for deterioration and faulty bonding of the metal-to-rubber joints.

POWER PLANT MOUNTING.

Inspect the power plant mounting structure
Inspect all nuts and locking devices for security and condition.

FINAL INSPECTION AFTER CHECK No.3

Carry out the Final Inspection as detailed for checks No. 1 and 2.

AFTER 150 FLYING HOURS

Carry out the inspection called for in Check No.2.

NOTE ... To ensure maximum periods between overhauls with minimum sludge deposits in the system it is recommended that lubricating oil should be changed at the inspection period coinciding most nearly with the completion of each 200 hours flying under normal conditions. If the aircraft is operating under adverse conditions, more frequent changes should be made. Should six months elapse without the aircraft completing this number of flying hours, it is recommended that the oil be changed regardless of the number of flying hours.

POWER PLANT CHECK No.4 ([illegible] HOURS)

The following checks should be carried out in addition to those called for in checks No. 1, 2 and 3.

FUEL SYSTEM.

1. Drain the fuel tanks and inspect them internally for condition. Inspect the backing pumps.

2. Check the fuel cock controls for chafing and wear.

OIL SYSTEM

Drain the oil tank and inspect it for security and condition. (See note under AFTER 150 FLYING HOURS)

PROPELLER

Inspect the propeller and its accessories in accordance with the manufacturer's inspection schedule.

DE-ICING SYSTEM

1. Drain and flush the system with hot distilled water.

2. Check the flow to the propeller system.

IGNITION SYSTEM

1. Inspect the magneto for condition of the cam pad wicks and service the wick wells.

2. Lubricate the magneto rocker arm pivots with approved grease. Inspect the contact points and springs for condition.

3. Check the contact-breaker gaps.

4. Clean and inspect the inside of the magneto distributor boards.

5. Check the security of all internal screws and electrical connections and ensure that the assembly is scrupulously clean.

6. Remove the sparking plugs and fit a serviced and tested set.

7. Disconnect the magneto harness connectors; inspect for condition and clean as necessary.

ACCESSORIES

1. Clean the vacuum pump relief valve gauze. Remove and clean the oil separator.

2. Remove the R.P.M. indicator generator flexible drive for inspection, cleaning and lubrication.

FINAL INSPECTION AFTER CHECK No.4.

Carry out the Final Inspection as detailed for checks No. 1 and 2.

When a time expired engine has been removed for overhaul, an inspection should be carried out on the power plant and those items of the aircraft affecting engine operations, as follows:-

MOUNTING STRUCTURE

1. Examine the pick-up points and attachment bolts for wear, and the bolt holes for size and elongation.

2. Examine the struts for bowing and distortion.

3. Inspect the firewall for corrosion, distortion and cracks. Check the security of the stiffeners.

4. Inspect all fairleads in the firewall and check the security of brackets and mounting straps.

5. Check all cowl struts and clips for condition and security to mounting struts and cowl formers.

6. Inspect the webbing on formers for condition and security.

COWL GILL MECHANISM

1. Remove the gill motor for a functional check.

2. Overhaul the gill ring mechanism

EXHAUST SYSTEM

1. Examine the exhaust manifold, pipes and securing clips for damage and corrosion.

ENGINE AND ACCESSORY COWL PANELS

1. Examine the upper and lower fixed panels, hinged side panels, support struts and accessory panel hinges for wear, distortion and cracks.

2. Inspect the quick-release fasteners for wear and spring tension; also the support strut clips.

SHOULDER COWL

1. Examine all cowl sections for corrosion or cracks.

2. Inspect all fairleads for condition and security.

OIL SYSTEM

1. Remove the tank, withdraw and wash the filter and inspect for damage to frame, element and seal.

2. Flush out the oil tank and inspect for general condition.

3. Examine the tank securing straps and the mounting pads for condition and security.

POWER PLANT ENGINE CHANGE

OIL SYSTEM (Contd.)

4. Examine the tank caps for condition and damage to threads. Inspect washers for condition.

5. Inspect the cooler air scoop and cooler fairing for condition.

6. Inspect and service the oil cooler as detailed in Sect. 9 of this manual.

7. Examine the oil cooler securing straps and mounting pads for condition and security.

8. Examine the cooler flap and operating mechanism for condition and wear.

9. Inspect all flexible and rigid pipes for condition and signs of chafing at securing positions. Check unions, nipples and union nuts for damage.

10. Examine all hose connections and securing clips for condition.

11. Remove the oil pressure transmitter and warning lamp switch for a functional check.

12. Inspect all bonding devices for condition and security.

FUEL SYSTEM

1. Inspect the power plant fuel system pipes for chafing, kinking, damage, shrinkage and security.

2. Check the setting of the carburettor fuel pressure warning switch.

3. Drain the fuel tanks and inspect them internally for condition.

4. Fit new or reconditioned backing pumps.

5. Check that all fuel tank vents are clear.

6. Inspect the A.G.S. filter ans sump for water. Replace the element and sump and wire-lock.

FEATHERING SYSTEM

1. Remove the feathering pump motor unit for performance test.

2. Examine all pipes for condition and signs of chafing at securing points.

3. Dismantle, inspect and clean the Purolator filter in the propeller feathering line.

R.P.M. INDICATOR

1. Remove the R.P.M. indicator generator for a functional test.

2. Remove the generator flexible drive for inspection, cleaning and re-lubrication.

FIRE EXTINGUISHER SYSTEM

1. Inspect all leads for fraying and chafing at clip positions.

2. Inspect the flame switch boxes for condition.

3. Check the continuity of the complete system and test the fire extinguisher bottles and flame switches to the manufacturer's requirements.

AIR INTAKE

1. Remove the actuator motor and submit to a functional check.

2. Examine the shutter for sealing, condition and wear on the spindle.

ELECTRICAL SYSTEM

1. Examine the suppressor box for damage or cracks and for security.

2. Remove the cover and inspect the interior for cleanliness and for security of the terminals.

3. Examine all leads for insulation and continuity.

4. Inspect the generator cables, sockets, plugs, and cooler ducts for condition.

DE-ICING SYSTEMS.

1. Drain and flush the complete systems.

2. Refill the tanks.

3. Inspect all pipes and pipe joints for condition.

ACCESSORY GEARBOX

1. Inspect the accessory gearbox and drive (Maintenance information is given in Sect.9)

VACUUM SYSTEM AND CONSTANT SPEED UNIT

1. Inspect all pipes and pipe joints for condition.

NOSE COWL

1. Examine the nose cowl sections, joint plates and bolts for condition. Inspect the bipod brackets for condition and wear in the bolt holes.

INSTRUMENT CHECK No.1 (15 HOURS)

1. Inspect the A.S.I. pressure-heads for damage.

2. Check the automatic pilot for correct operation.

3. Check all instruments for security and correct setting.

INSTRUMENT CHECK No. 2 (30 HRS.)

In addition carry out check No.1

1. Inspect the A.S.I. pressure-heads for condition and security.

2. Ensure that the air vents of the static system pipe-line are free from obstruction.

3. Drain off any accumulation of moisture from the pressure and static pipe-lines.
NOTE ... If the moisture is considerable or is frozen, disconnect the pipe-lines at the relevant instruments and clear the pipes by using a hot air blower. Check for leaks when the pipe-lines are reconnected.

4. Check that the air thermometer records approximately the temperature of the day.

5. Inspect the drift recorder for damage and security of mounting. Clean the instrument as necessary, care being taken not to foul the pointer.

6. Examine the pilot's compasses for damage. Ensure that the grid ring moves freely and check that the lock functions correctly.

7. Ensure that the compass deviation card is legible and secure.

8. Examine the astro compass for damage and clean the screens and star sight lens as necessary.

9. Examine the 0.6 compass for damage and ensure that the prism is clean; ensure that the illuminating system is serviceable.

10. Inspect all instruments for damaged glasses and for flecking of luminous compounds from the dials and pointers. Ensure that the bezels of the instruments are tight. Clean the glass fronts.

11. Examine the automatic pilot servo motors for security.

12. Examine the automatic pilot gyro and amplifier units for security.

INSTRUMENT CHECK No.3 (60 HOURS)

In addition carry out checks No. 1 and 2.

1. Clean the filter of the vacuum change-over cock.

2. Inspect the air filters of the Direction Indicators, Artificial Horizons and Turn and Bank Indicators for cleanliness, and renew as necessary.

3. Check the fuel pressure warning unit for correct adjustment.

4. Inspect the engine-speed indicator generator for security of mounting.

5. Examine for defects and lubricate the flexible drive of the engine-speed indicator generator.
NOTE ... Use high temperature grease.

6. Inspect the outer casing of the engine-speed indicator generator flexible drive for damage; check the end connections for security.

7. Check the boost gauge reading against barometric pressure.

8. Check the zero setting of the cylinder temperature gauge on open circuit; adjust as necessary.
Ensure that the cylinder temperature gauge thermo-couple is properly fitted and that the cable connections are intact.

9. Clean the filters in each fuel meter transmitter.
Ensure that the cover washer is serviceable.
NOTE ... Ensure that the filter is replaced with the spring facing the cover plate.

10. Inspect the ventilating chamber of each fuel meter transmitter for signs of fuel leakage through the packing gland.

11. Ensure that the fuel meter transmitters are securely mounted and that the cable conduit connections are secure.

12. Examine the pilot's compasses for damage and the bowl for bubbles and discolouration. Ensure that the anti-vibration devices function correctly and that the compass and corrector box are securely fitted.

13. Check the drift recorder for correct alignment.

14. Clean and lightly lubricate the moving parts of the astro compass ; wipe off excess lubricant.

15. Inspect all instruments and the cable and pipe-line connections for security.

16. Inspect all flexible pipes for kinks, damage due to chafing and for deterioration.

INSTRUMENT CHECK No.3 (CONTD.)

17. Inspect the capillary tubing of all relevant instruments for chafing against other components, particularly where the tubing is in free lengths or is coiled.

18. Check that the electrical servicing personnel have included the electrical components of instruments in the routine inspections of the electrical installation.

INSTRUMENT CHECK No.4 (120 HOURS)

In addition carry out checks No.1, 2 and 3.

1. Check the calibration of the main plane flap position indicator.

2. Remove the engine cowling gill position indicators and transmitter units and check for correct functioning by means of a Desynn test set.

3. Check the calibration of the fuel contents gauges when the tanks are being filled, or by means of a Desynn test set.

4. Remove the fuel contents gauge transmitter units and check for correct functioning by means of a Desynn test set.

5. Check the calibration of the oil thermometers.

6. Dismantle and clean the suction regulating valve and check for distortion and sticking. Re-assemble the valve and test for correct functioning.

7. Check the calibration of the suction gauge.

8. Remove the Turn and Bank Indicators, Artificial Horizons and Direction Indicators for calibration check and test.

9. Check the calibration of the oil pressure gauges.

10. Inspect the gearbox of the engine-speed indicator generator for lubrication and replenish as necessary with high temperature grease.

11. Check the calibration of the engine speed indicator.

12. Examine the instrument flying panels for damage.

13. Remove the Altimeters, Rate of Climb Indicators and Air Speed Indicators for Calibration check and test.

14. Test the insulation resistance of the A.S.I. pressure-head heating element.

15. Check the calibration of the air thermometer.

16. Inspect all instrument pipe-lines for damage and security.

17. In collaboration with the electrical servicing personnel, inspect all electrical instrument cables for damage, and the insulation for deterioration.

AUTOMATIC PILOT Mk. VIII

BETWEEN FLIGHT INSPECTION

1. Filters are to be cleaned by washing in clean petrol or thinners (unleaded). If necessary further cleaning may be done with the aid of a soft brush. Do not use rag.

2. The cover of the gyroscopic unit must not be removed during the course of a Between Flight inspection except for the purpose of investigating the cause of malfunctioning.

3. Ensure that the clutch lever is in the IN position.

   Note - Move the aircraft aileron and elevator controls, until the tongues of the clutches are felt to engage in the slots of the clutch plates.

4. Ensure that :-

   (i) The control cock is in the OUT position or when this is not used, the SPIN position.

   (ii) The control switch is in the OFF position.

   (iii) The pitch control is set at ZERO

5. Remove all moisture from the interior of the air drier and recharge with silica-gel as necessary.

DAILY INSPECTION

x 1. Inspect the oil cooler and its pipe connections for security and signs of leakage.

x 2 Ensure that the unions of the engine driven air compressor are tight and correctly locked.

3 Ensure that :-

   (i) The control cock works freely and is left in the OUT position or, when this is not used the SPIN position.

   (ii) The pitch control works freely and is secure.

(iii) The pitch control arm, located behind the gyroscope unit follows the movement of the pitch control smoothly in either direction.

Note. Leave the pitch control in the ZERO position.

x 4. Apply one drop of oil, anti-freezing to each of the following components of the gyroscopic unit :-

(i) Valve pistons

(ii) Follow-up connecting rod bearings

(iii) Eccentric operating shafts

(iv) Valve casing slides

(v) Attitude spindle

(vi) Centralizer spindle

(vii) Rotor bearings

(viii) Gimbal ring pivots

(ix) Valve locator spring and fairey piston rod

Note. When carrying out the above operations draw back the centralizer and gently move the inner and outer rings, thereby ensuring that the valves are free and that the oil penetrates to the required surfaces.

5. Check the functioning of the relay box as follows:-

(i) Set the control switch to COMPASS

(ii) Move the pilot's repeater pointer slowly from right to left of the lubber line. A click should be heard as the pointer passes approximately one degree on either side of the lubber line, that is, as the right and left relay armatures make contact on each side of the $1\frac{1}{2}$ degrees to $2\frac{1}{2}$ degrees dead gap.

(iii) Move the repeater pointer to the lubber line and ensure that it is in the dead gap. No clicks should be heard while switching from OFF to COMPASS on the control switch.

(iv) Set the control switch to OFF.

* 6. Examine the clutch lever for security and ensure that it works freely.

  Note With the clutch lever in the IN position the clutch of the servo motors must engage fully. With the clutch lever in the OUT position, the clutches must have a minimum clearance of 0.05 inches.

* 7. Examine the aileron and elevator motors for security.

* 8. Examine the gyroscope unit for security.

* 9. Inspect the Bowden control cables for security and check for correct adjustment.

10. Fill the oil reservoir to the correct level and replace the filler plug securely. Check the drain plug for correct locking.

11. Remove all moisture from the interior of the Air drier and recharge with silica-gel, as necessary.

* 12. Drain the water trap (when fitted) and ensure that the drain plug or cock is securely locked.

Note. Operations marked thus * need not be done more than once per week when the aircraft has not flown since the last completed Daily Inspection.

25 HOURS INSPECTION

1. Examine for security and lubricate the pin joints of the aileron elevator and rudder auto-pilot connecting rods.

2. Inspect the air compressor flange joint for signs of oil leakage. Ensure that the securing nuts are tight.

3. Clean the filters in the air and oil inlet banjo connections on the air compressor.

4. Examine the air pressure filter and its pipeline connections for security. (Note:- the filter must not be dismantled).

5. Drain and flush out reservoir, clean the filter and housing. Refill the reservoir with new oil.

6. Ensure that all the flexible piping in the gyroscopic unit is serviceable and secure. Examine the rubber for signs of deterioration and the braiding for fraying and breakage.

7. Check the overhaul date and the flying hours of the following components and substitute new or overhauled units, where appropriate :-

   (i) Gyro Unit

   (ii) Relay Box

   (iii) Servo Motor

8. Examine the gyro unit anti-vibration mountings when fitted for splits and other damage and for deterioration.

9. Remove the gyroscopic unit cover and examine the sealing ring for damage and deterioration.

10. Remove the cover of the relay box and apply one drop of oil, anti-freezing.

11. Check that at both extremes of aileron and elevator movement, the travel of the servo-motor is less than that of the appropriate control surfaces.

    NOTE: When the clutches are engaged the range of the aileron and elevator control movement is limited by the servo-motor stops and not by the aircraft control stops.

    This check must also be made after any alteration to the rigging of the elevator or aileron control surfaces.

12. Lubricate the aileron and elevator servo-motors at the nipples provided.

13. Examine all components for security and ensure that the pipe line connections are tight.

14. Examine all flexible pipe lines for chafing and signs of deterioration.

15. Inspect the Bowden control cables for fraying and security and lubricate as far as possible by running oil (anti-freezing) between the cable and the casing.

16. Conduct a visual inspection of the auto-pilot wiring for serviceability.

100 HOURS INSPECTION

1. Clean the external filters of the gyroscopic unit and the filter in the supply connection of the relay box.

   (Note: Servicing of the internal filters should not be attempted).

2. Examine the tongues and slots of the clutch mechanism on the servo-motors for excessive wear.

3. Examine all pipe lines for damage and security. Ensure that unions are tight.

4. Remove, dismantle, clean and lubricate as necessary the following components.

   (i) Control cock

   (ii) Clutch lever

   (iii) Test cock

   Note: The clutch lever and the cam plate assembly at the front of the control cock should be treated with low temperature grease. Grease must not be used on the valve assembly beneath the back plate of the control cock, or inside the test cock.

5. Check the calibration of the air pressure gauge.

6. Remove and clean the suction filter.

   (Note: Do not dismantle the filter).

7. In conjunction with the electrical check, conduct an insulation test of the auto pilot wiring.

8. Conduct a ground test of the automatic pilot.

ELECTRICAL CHECK No. 1 (15 HOURS)

1. Examine generators for connections and condition.
2. Check operation of all circuit breakers.
3. Check that outside air temperature gauge is reading correctly.
4. Check ignition wiring harness for condition and security.
5. Check R.P.M. generator for condition and ensure that connections are tight.
6. Examine condition of cylinder thermo-couples.
7. Check operation of fuel flow meter solenoids.
8. Check that fire warning lamp filaments are intact.
9. Check that inertia switches are correctly set and that their connections are tight.
10. Make the following checks on the cabin heating system.

Fuel control unit solenoid valves
Bulkhead fuel valve
} For operation and connections

Sparking plug - Cleanliness and gap.

ELECTRICAL CHECK No.2 (30 HOURS)

1. Check S.G. of accumulator acid.
2. Examine voltage regulators for connections, security and condition.
3. Check zeros on ammeters and voltmeter.
4. Examine connections on A.G.P. generator and cut-out.
5. Check propeller feathering motor connections and condition.
6. Check flap motor connections and condition.
7. Check that flap limit and trip switches are secure and their connections are tight on the terminal blocks.
8. Check that the aileron trim tab motors are in good condition and the connections are tight.
9. Check that propeller de-icing motors are secure and are not overheating.
10. Check connections at pressure head and examine pressure head warning lamps and change if glass is found to be blackened.
11. Check engine starter motor connections for condition and security.
12. Check the operation and alignment of the platform safety switches.
13. Check operation, connections, and security of the booster coils.
14. Examine fuel pressure warning lamps and change if glasses are found to be blackened.
15. Check fuel pressure warning lamp switches for connections and security.
16. Check connections to cowl gill operating motors for condition and security.
17. Examine flame switches for condition and security of connections.
18. Check connections to, and operation of, cabin heating ram air pressure switch.
19. Check connections to, and operation of, fuel pressure switch.
20. Check connections and security of duplex thermostatic switch.

ELECTRICAL CHECK No. 3 (60 HOURS)

1. Examine the structure in the vicinity of the accumulators for corrosion.
2. Inspect connections, security, and condition of all circuit breakers.
3. Examine commutators of generators and clean if necessary, at the same time examine brushes for wear.
4. Check connections of feathering motor relays and push switches.
5. Examine commutator and brush gear of flap motor - clean if necessary.
6. Examine connections of flap motor relays for security.
7. Check calibration of aileron trim tab indicators.
8. Check connections of airframe de-icing components for condition and security.
9. Check propeller de-icing rheostat for loose turns and contact.
10. Check outside air temperature gauge resistance bulb for connections and security.
11. Examine engine starter motor commutators and brush gear, - clean if necessary.
12. Examine connections of engine starter motor relays.
13. Check insulation resistance of booster coils.
14. Examine cowl gill motor commutators, limit switches, and connections - clean if necessary.
15. Examine air intake temperature gauge resistance bulbs for connection, condition, and security.
16. Check engine cylinder temperature gauge indicators for connections and zero settings.
17. Examine connections of fuel contents transmitters.
18. Check operation, connections, and security of fuel pressure transmitters.
19. Check operation and alignment of fuel cut-off actuators.
20. Check connections of oil contents transmitters.
21. Check connections of oil temperature resistance bulbs.
22. Examine mooring lamp and change if glass is blackened.

23. Examine passenger briefing notices and change any lamps with blackened glasses.

24. Check cabin heater relays for connections and security.

25. Check connections and operation of cooker circuit breaker.

26. Check condition and security of cooker heating elements.

27. Examine urn indicator lamps and change any with blackened glasses.

ELECTRICAL CHECK No. 4 (120 HOURS)

1. Carry out check given in Sect. 5, Chap. 2 of maintenance manual on the main power supply system.
2. Examine commutator of generator on A.G.P. and clean if necessary.
3. Examine A.G.P. cut-out contacts.
4. Check that all fuses are a good fit in their clips.
5. Check connections to all master switches.
6. Examine commutator and brush gear of propeller feathering motor and clean if necessary.
7. Examine contacts of feathering relays.
8. Examine contacts of flap relays.
9. Carry out flap circuit check in Sect. 5, Chap. 2 of maintenance manual.
10. Check security and connections of flap two-way-and-off switch
11. Examine brush gear on aileron trim tab transmitter (pilot's)
12. Lubricate gear box of aileron trim tab motor as in Sect. 5, Chap. 2 of maintenance manual.
13. Examine commutator and brush gear of propeller de-icing motor.
14. Check outside air temperature gauge for connections and security.
15. Examine contacts of engine starter relays.
16. Examine contacts and connections of engine starter push switches.
17. Check magnetos.
18. Check contacts and connections on cowl gill motor control switches.
19. Check calibration of cowl gill indicators.
20. Check connections and brush gear on cowl gill motors as in maintenance manual Sect. 5, Chap. 2.
21. Check connections on cowl gill transmitters.
22. Check air intake temperature gauges for accuracy and connections.
23. Check ful contents gauges for connections and security.
24. Check that the floats of the fuel contents transmitters are free.

ELECTRICAL CHECK No. 4 (120 HOURS) (Contd.)

25. Check the switch contacts on the fuel flow meter transmitters for freedom of movement and connections for condition and security.

26. Examine fuel pressure gauges for security and connections.

27. Examine fuel backing pump motors for connections and security.

28. Check setting of fuel backing pump pressure switches.

29. Examine the commutator and brush gear of the fuel cut-off actuators - clean if necessary.

30. Check setting of fuel pressure warning lamp switches.

31. Note that oil contents transmitter floats are free.

32. Check connections, security and accuracy of oil temperature gauges.

33. Check connections, security and operation of fire extinguisher relays.

34. Carry out circuit check on fire extinguisher system as laid down in Sect. 5 Chap. 2 of maintenance manual.

35. Check, by weighing them, that the fire extinguisher bottles contain a correct amount of fluid.

36. Check dinghy inflation circuit as laid down in Sect. 5, Chap. 2 of maintenance manual and at the same time examine operating head for condition and connections.

37. Examine emergency cabin lamps for security in sockets and change any which are found to have blackened glass.

38. Check landing lamp unit for security and its contact surfaces for cleanliness.

39. Clean navigation lamp glass and examine lamps for security and replace any with blackened glass.

40. Check the following lamps and replace any with blackened glass:-

Flight deck
Main cabin
Reading lamps
Freight compartment
Boarding lamps

41. Check contacts of cabin heating ignition coil.

42. Remove duplex thermostatic switches and test them.

43. Examine contacts of cabin heater relays.

44. Check cabin and heater temperature indicators for accuracy and connections.

45. Check contacts of cooker circuit breaker.

46. Note condition of cooker indicator lamps change any with blackened glasses.

47. Check urn thermostats.

48. Check immersion heater relay contacts and thermostats.

RADIO AND RADAR

1. Rectify any defects reported at termination of previous flight.
2. Check T.1154 transmitters and communications R.1155 for function (R.T. and W/T) and security.
3. Check condition of trailing aerial and operation of winch.
4. Visually check main aerials.
5. Check D.F. receiver R.1155 for functioning in conjunction with Marconator and D.F. loop.
6. Check T.R.1464 for functioning and security.
7. Check whip aerial for condition and security.
8. Check functioning of A.S.V. transmitter T.219, receiver R.219 and indicator type 96.
9. Check security of transmitting and receiving aerials.
10. Check operation of amplifier A.1134A at each interphone socket.
11. Ensure that charged 2 volt accumulators are carried (Check voltage on load).

CHECK No. 1 (15 HOURS)

RADIO AND RADAR

Fixed wire type aerials

1. Examine the aerial masts for damage and security.

2. Examine the fixed aerials for sag, wear and security of attachment.

3. Examine the fixed aerial lead-in insulators for damage and ensure that they are clean and secure.

4. Test the fixed aerial straining springs for correct functioning and freedom of operation. Ensure that the insulators are clean and secure.

Trailing aerial and winch, type 5

5. Test the aerial winch for correct functioning; check the action of the brake lever. Replenish the grease trap as necessary with grease, anti-freezing (Stores Ref. 34A/174).

6. Run out approximately twenty feet of trailing aerial and examine the wire for kinking, fraying and security of the weight attachment.

7. Ensure that the trailing aerial is free in the fairlead. Clean and inspect the fairlead for cracks and security. Check the extension and retraction of the fairlead where applicable.

8. Examine the screw thread of the trailing aerial winch wire clamp for defects. Clean the plunger block and test for freedom of movement.

9. Examine the aerial winch bonding for cleanliness and security.

Direction finding aerial

10. Inspect the D/F loop for damage and security.

11. Operate the D/F loop and ensure that full range of movement is obtainable.

12. Ensure that the correct quadrantal error calibrations for the D/F loop are clearly marked on the drum scale.
    Note. - Alternatively, ensure that the correct calibration card is available in the aircraft.

Connector cables and fixed wiring

13. Examine all connector cables of the wireless installation for damage. Ensure that all plugs are secure in their appropriate sockets and that the locking rings on connectors are tight.

14. Examine the aerial connectors for signs of chafing and the matching unit for security.

15. Ensure that all Jones type connectors are correctly inserted and pressed home firmly.

16. Inspect the Mic/Tel leads for security of connections to the terminal blocks.

17. Inspect all Mic/Tel sockets for damage and their connections for security. Ensure that the strain is borne by the checkcord at all attitudes of the sockets.

General

18. Clean off all moisture, oil and dirt from the wireless equipment particularly from the terminal blocks and Mic/Tel sockets.

19. Ensure that all wireless spares, including the spare trailing aerial reel and weight, are serviceable and properly stowed.

20. Ensure that all fuses and spares are serviceable and of the correct value.

21. Inspect the morse tapping key for damage and test for correct mechanical functioning.

22. Ensure that all wireless equipment is switched off.

Transmitter T.1154 and receivers R.1155

NOTES. - The inspections detailed for receiver R.1155 are to be applied to both transmitters and receivers.

The T.1154s and R.1155s should be switched on only when the A.P.U. is charging or an external battery is connected to the aircraft.

23. Inspect the suspension brackets and mounting units of the installation for security.

24. Inspect the power units, their mountings and covers for security. Ensure that the locking screws on the power unit connectors are tight.

25. Ensure that the connector locking bars on the transmitter and receiver are in position.

26. Ensure that the channel frequency allocations and "click stop" markings are clear. Remark where necessary.

27. Inspect the valves and screens of the transmitter for security.

28. Inspect the type 52 resistance on radio supply panel 7P for security of mounting and examine for signs of over-heating or fracture. Ensure that the connections are secure and make good electrical contact.

29. Switch on the H.T. and L.T. power units for both installations and ensure that they run smoothly and silently. Check the power unit circuit breakers for correct functioning.

30. Check the D/F interlock plug for security.

31. Conduct a functional test of the transmitter on all ranges and in all positions of the selector switch. Check for correct meter readings and ensure that sidetoneis available.

32. Operate the morse tapping key and check the action of the keying relay.

33. Check for correct operation of pilot controlled R/T.

34. Check the reception on frequency ranges 1 and 2, with the aerial selector switch at NORMAL and the master switch at OMNI or A.V.C.

35. Check the reception on M/F ranges 3, 4 and 5 with the aerial selector switch at M/F on FIXED AERIAL.

36. Check for correct functioning of the heterodyne oscillator. Tune the receiver by the calibration on the dial to 280 Kc/s when a continuous note should be heard in the telephones.

37. Carry out full check on Marconator as described in Manufacturer's Accessory Manual.

Transmitter/receiver T.R.1464

38. Inspect the transmitter-receiver and electric controller for external damage and check for security and correct fitment.

39. Switch to RECEIVE and check the change-over mechanism for correct operation by depressing the push-button for the positions in which crystals are fitted. Check that pilot lamps are illuminated when button is depressed.

40. Check the sensitivity by noise level and make a brief test of two-way communication on each frequency in use.

41. Switch to TRANSMIT and check aurally that the relays operate; observe the change in note of the power unit generator. Check the key switch for spring bias on TRANSMIT.

42. Test the operation of the PRESS-TO-SPEAK switches.

43. Ensure that the OFF button on the controller is depressed and that the T/R switch is in the RECEIVE position.

Amplifier A.1134A and I/C system

44. Inspect the amplifier for external damage and check for security and sorrect fitment.

45. Remove the existing L.T. accumulator. Fit a fully charged L.T. accumulator and test the voltage on load.

46. Ensure that a spare fully charged L.T. accumulator is available in the aircraft.

47. Check operation of power unit.

48. Ensure that the accumulator and power unit are secure in their stowages. Examine for signs of spilt electrolyte.

49. Inspect the supply connections and all plugs and sockets for cleanliness and security. Ensure that the 10-pin plug is held securely in place by the spring clip.

50. Ensure that the cable screening is bonded where a break is made at the terminal points.

51. Switch on the amplifier and test the three-position key switch for correct functioning.

52. Conduct a test of the I/C circuits at all crew stations and ensure that the noise level is not abnormal.

A.S.V.

53. Check all aerials for connection and security.

54. Check all cables for connections and security.

55. Note that the rotary converter runs quietly and check its output voltage.

56. Carry out full operational check as described in Maintenance Manual.