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THE SUNDERLAND I AEROPLANE (BOAT SEAPLANE)

FOUR PEGASUS XXII ENGINES

Promulgated for the information and guidance of all concerned.

By Command of the Air Council,

DONALD BANKS.

AIR MINISTRY.

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LEADING PARTICULARS

Type ... ... Four-engined monoplane boat seaplane

Duty ... ... Oversea reconnaissance

MAIN DIMENSIONS

Span ... ... 112 ft. 9.5 in.

Overall length ... ... 85 ft. 4.1 in.

Height (aeroplane on beaching chassis) .. 32 ft. 1.5 in.

Main plane -

Aerofoil section ... ... Göttingen 436 (modified)

Chord (theoretical, at centre-line of aeroplane) 22 ft. 0.69 in.

Chord (theoretical, at tip) ... .. 8 ft. 6 in.

Chord (mean aerodynamic)... ... .. 15 ft. 8.5 in.

Incidence (aerofoil datum) ... .. 5° 0' ± 15'

Incidence (aerodynamic chord) ... .. 6° 9'

Dihedral (top surface of front truss). 0° 50' ± 30'

Dihedral (spar axis) ... . 3° 0'

Sweepback (normal to hull datum) .. 4° 15'

Sweepback (normal to main plane) .. 4° 0'

Tail plane and elevators -

Aerofoil section ... ... R.A.F. 30

Span ... ... 35 ft. 9 in.

Chord (at root) ... ... 9 ft. 3 in.

Chord (theoretical, at tip) ... .. 4 ft. 5.62 in.

Chord (mean aerodynamic)... ... .. 7 ft. 2.4 in.

Incidence (to datum) ... . 4° ± 15'

Incidence (to thrust line) ... .. 0° 51'

Dihedral (normal to hull).. ... .. 0° ± 30'

Fin and rudder -

Aerofoil section ... ... R.A.F. 30

Height .. .. 15 ft. 1.5 in.

Chord (at root) ... ... 12 ft. 6 in.

Chord (theoretical, at tip)	6 ft. 0.44 in.
Chord (mean aerodynamic)...	9 ft. 9 in.
Hull -	
Length, overall	85 ft. 4.1 in.
Beam, maximum	10 ft. 2.3 in.
Depth, maximum	17 ft. 6 in.
Draft, normal load	4 ft. 5.15 in.
Draft, overload	4 ft. 7.07 in.
Wing tip floats -	
Length, overall	14 ft. 3.75 in.
Beam, maximum	3 ft. 7.6 in.
Depth, maximum	3 ft. 2.55 in.
Buoyancy	5,000 lb.

AREAS

Main planes, with ailerons and tabs	1487.6 sq.ft. total
Ailerons (two)	67.2 sq.ft. each
Flaps (two)	143.1 sq.ft. each
Tail plane, with elevators	206 sq.ft. total
Elevators, with tabs (two)	42.25 sq.ft. each
Trimming tabs (two).	1.42 sq.ft. each
Fin, with rudder	136.2 sq. ft. total
Rudder, with tabs	55.2 sq.ft.
Rudder servo tab	1.0 sq.ft.
Rudder trimming tab	0.92 sq.ft.

RANGES OF MOVEMENT OF CONTROL SURFACES

Ailerons	Up. 18° 30', down 18° 30'
Aileron droop	See para. 210
Main plane flaps (total movement) ...	25° 0' ± 30'
Elevators	Up 19° 30'; down 19° 30'
Elevator trimming tabs	Up 14° 0'; down 14° 0'
Rudder	22° 30' port and starboard

Rudder servo tab (relative to rudder).	13° 40' port and starboard
Rudder trimming tab	14° 0' port and starboard

ENGINES

Name	Pegasus XXII
Number	Four
Type	9-cylinder, air-cooled supercharged radial
Fuel used	Specification D.T.D.230
Fuel pump relief valve spring	Part No.P.B.55561

ENGINE OPERATIONAL LIMITATIONS

For these limitations reference should be made to A.P.1451G, Vol.I.

AIRSCREWS

Type	3-bladed, metal, 2-pitch
Diameter	12 ft. 9 in.

TANK CAPACITIES

Fuel -

Main inner tanks (two)	529 gall. each
Main centre tanks (two)	355½ gall. each.
Overload outer tanks (two) ...	132½ gall. each
Total fuel, normal load	1520 gall.
Total fuel, overload	2034 gall.

Oil -

Normal capacity (four tanks) ...	23 gall. each
Overload capacity	32 gall. each
Total oil, normal load	92 gall.
overload	128 gall.
Total air space, with overload ..	10 gall.

PRESSURE HEAD

The position and angular setting of the pressure head is shown in fig.28.

LIST OF SPECIAL GEAR AND TOOLS

Carried in aeroplane

	No. off
Bolts, holding down, for spare engine crate	4
Cradle, maintenance	4
Funnel, filling, fuel	1
Funnel, filling, oil	1
Fitting, engine hoist	1
Gun, lubricating, and fittings	1
Hose, refuelling	2
Hose, bilging	1
Handles, engine turning	2
Key, door clamp handle	1
Key, fuel filler cap	1
Kit, engine tool	1
Kit, airscrew tool	1
Kit, emergency tool	1
Ladder, fin jury	1
Plank, gang, maintenance	2
Rope, hand, safety	2
Tool, tension, engine hatch door	1

Ancillary equipment

	No. off
Beam, derrick attachment, airscrew changing	1
Beam, bent, beaching chassis, and tail trolley wheel changing	2
Boards, incidence and dihedral	8
Cradle, spare engine	1
Cradle, non-magnetic aeroplane	1
Chassis, beaching port	1
Chassis, beaching, starboard	1
Derrick, engine and airscrew changing	1

	No. off
Gantry, tail plane lifting (service issue)	2
Gantry, main plane lifting (service issue)	2
Jack, hydraulic	2
Jack, screw	4
Sling, engine	1
Sling, airscrew	1
Sling, aeroplane	1
Trolley, universal aeroplane	1
Trolley, tail	1
Trestle, jacking, tail trolley, small	1
Trestle, jacking, tail trolley, large	1

INTRODUCTION

1. The Sunderland I is an all metal boat seaplane of cantilever monoplane form powered with four Pegasus XXII engines and is designed for oversea reconnaissance.

2. The hull is divided into an upper and a lower deck. A compartment on the lower deck in the bows of the aeroplane incorporates a power-driven gun turret and has also bomb-aiming and mooring equipment; the turret is retractable to permit mooring operations. On the upper deck aft of the bow compartment is the pilots' compartment which has side-by-side dual controls for the two pilots and is reached by means of a communicating ladder from the lower deck. Aft of the pilots, on the port side there is the wireless operator's station and on the starboard side, the navigator's seat and table and the engineer's station. Below the pilots' compartment is the lavatory and the wardroom. The galley is partitioned off from the wardroom and also serves as a drogue-operating station. There is a ladder from the galley to the engineer's compartment. Aft of the galley is the crew's forward compartment, in which the main bomb load is carried, and the crew's aft compartment. Further aft, approximately on a level with the upper deck, is the platform for the amidships gun stations. In the extreme tail of the hull is another power-driven turret similar to the front turret; it is reached by a catwalk in continuation of the main flooring.

3. The hull framework is constructed of aluminium-coated light-alloy and is covered by sheeting of the same material; the framework consists of channel-section frames interconnected by longitudinal Z-section stiffeners. Each main plane has a single spar consisting of a front and rear truss braced together and is covered with light-alloy sheeting. Ailerons of the Frise type are fitted to the main planes, and inboard of the ailerons are flaps operated by an electric motor. The tail unit has a monoplane tail plane, a single fin, elevators and a rudder; the trailing portions of the elevators and rudder are fabric covered.

4. The rudder and elevator controls are duplicated throughout but the aileron circuit consists of a single run. Spring-loaded oil-filled dashpots are fitted to the levers of the main control surfaces to prevent sag in the control runs owing to variations in temperature. Fixed trimming tabs are fitted to the aileron, and pilot-operated tabs to the rudder and elevators; an automatic servo tab is also fitted to the rudder. Mark IV automatic controls are fitted.

5. The four engines are mounted in monocoque nacelles built into the leading edge of the main planes and are fitted with 3-bladed variable pitch airscrews. The engine main controls are operated by an Exactor hydraulic system. Three fuel tanks are mounted in the main planes on each side of the aeroplane and constitute an independent fuel system for the two engines on that side. Provision is made for jettisoning 52% of the maximum fuel capacity. The oil tank for each engine is mounted inside the engine nacelle. An auxiliary power unit for bilging, refuelling and accumulator charging services is mounted in the starboard main plane nosing close to the hull side.

6. The main bomb load is carried in the crew's forward compartment on bomb carriages which are moved outboard along beams on the underside of the main planes on each side for releasing the bomb load. At the bow gun turret, and at the amidships gun station, port and starboard, is a Vickers gun and in the tail gun turret are fitted four Browning guns. Various pyrotechnics are also provided. The electrical installation has two separate systems, a 12-volt system for general services and a 24-volt system for engine starting and flap operation. Other equipment carried in the aeroplane includes an F.24 camera for both oblique and vertical photography, parachutes, first-aid outfits, a cooker and domestic utensils, awnings and ventilators, full marine equipment (an anchor, two dinghies, drogues, a boat hook etc.), flame floats, sea-markers and distress signals. A boiler for the heating system is fitted on the exhaust pipe of the port inner engine and a Graviner fire extinguisher system is installed. A beaching chassis and tail trolley and hydraulic jacking trestles are provided for handling the aeroplane.

CHAPTER I

HULL

General

7. The hull framework is constructed mainly of aluminium-coated light-alloy (Specification D.T.D. 275), anodically-treated before being rivoted in position, and is covered by sheeting of the same material. The skeleton framework consists of a series of channel-section vertical frames interconnected by longitudinal intercostal Z-section stiffeners; certain frames are stiffened by the addition of a second channel placed back-to-back with the first, thus forming an H-section.

8. The hull is divided into an upper and lower deck, with a communicating ladder from the lower deck to the pilots' compartment and one from the galley to the engineer's compartment. Equipment in the hull is illustrated in figs.2-4 and is described in Chapter VI.

Construction

9. The planing bottom portion of each hull frame consists of Z-section members braced by stiffeners, one of which forms the main floor bearer in each case. To support the upper deck, certain frames have additional members fitted, and support pillars are placed at intervals along the hull on each side of the gangway.

10. The frames are slotted to fit over the main centre keelson, which is the only continuous member in the hull and extends from the stem to the rear step. All the skin stiffeners terminate at the frames and are attached to them by angle lugs and tie plates. Braced double frames are fitted amidships to carry the stub joints to which the main planes are attached; similar construction is employed at the tail end for the attachment of the tail plane and fin.

11. The skin sheeting is riveted to the framework longitudinally, and the vertical laps are staggered. All rivets are countersunk on the outer surface of the hull and laps and seams are joggled to give a flush exterior finish. Division of the hull is made just aft of the rear step but, when the two portions are fitted together, a permanent riveted joint is made. The main step of the planing bottom is shaped to a broad V in plan view and the rear step fairs into a vertical knife-edge.

12. Internally, the hull is divided by a number of watertight partial bulkheads of such a height as to permit flooding of a compartment without overflow into the adjoining compartments. In order to provide a reasonable gangway, parts of these bulkheads are hinged and are normally swung back against the faces of the bulkheads. For access to the hull bottom, all floors are arranged to be readily removable.

Accommodation

13. The hull is divided into an upper and lower deck (see figs.2 and 3), and there is a ladder from the lower deck to the pilots' compartment and another from the galley to the engineer's compartment.

14. On the upper deck, in front of the main plane is the compartment for the two pilots. Immediately behind the pilot on the port side is located the wireless operator's desk, seat and instrument panel and on the opposite side is the navigator's seat and table, with the engineer's position aft of this. On the lower deck is the mooring compartment which incorporates the retractable front gun turret and provision for bomb aiming through a door in the bow. Aft of the mooring compartment on the starboard side is the lavatory and wash basin and on the port side a gangway leads into the officer's wardroom which has a fitted table and two bunks. The galley is partitioned off from the wardroom and is fitted with comprehensive domestic equipment. A door in the aft bulkhead of the galley opens into the crew's compartment which also serves as the bomb-loading station. The port and starboard amidships gun stations are positioned some distance aft of the crew's compartment and consist of a standing platform built across the hull approximately on a level with the upper deck. Access to the gun platforms is provided by means of a ladder fixed on the port side or, alternatively, from the upper deck by means of the maintenance gang planks in their stowed position. At the extreme tail end is situated the tail gun station in a power-driven turret similar to that in the bow. Access is by means of a catwalk in continuation of the main flooring.

15. Pilots' seats.- The pilots' seats are adjustable in a vertical plane. The movement is transmitted through a lever and ratchet gear, the centre of the lever being fixed to the seat and the lever pivoting on the seat pedestal. Parallel linkage is employed to secure the seat top to the pedestal. A small button in the end of the lever must be pressed to free the ratchet before the seat can be raised or lowered.

16. Doors and hatches.- Two entrance doors are provided, one near the nose on the port side, the other on the starboard side forward of the rear step. In addition there are the following hatches:- an engineer's hatch in the top of the hull between the main plane root joints, a compass bearing hatch situated at each port and starboard navigator's footwell, a port and starboard drogue hatch in the galley, and a tail escape door on the starboard side forward of the tail gun station. The bomb-aiming aperture is provided by a small door in the bow beneath the front gun turret.

CHAPTER II

TAIL UNIT

General

17. The tail unit consists of a cantilever tail plane and a vertical fin, each attached to eyes built into double frames in the hull structure. The elevators are hinged to the tail plane and are interconnected by a tubular torque shaft which passes through the hull and carries the main control levers. The rudder is hinged to the fin, and a torque tube extends into the hull and is hinged to a large built-up metal bracket riveted to the roof. This torque tube carries the rudder control levers fixed to a sleeve at its base.

Tail plane and fin

18. The tail plane and fin are all-metal structures built up round a spar formed by two pairs of tapering T-section extrusions which are braced by tubular members to form a front and rear truss. The trusses are connected by wire-bracing fitted diagonally at each drag member to prevent distortion. Double channel-section drag members are inserted at regular intervals between the trusses and are shaped to the profile of the aerofoil. The nose portion consists of shaped metal diaphragms secured to the front truss. Thin light-alloy sheets are used to cover the components, with stiffeners riveted inside the structure for rigidity. All riveting is countersunk on the outer surface and all laps and seams are joggled to give a flush exterior surface. Two eye-plates are bolted to the fin to serve as attachment points for the rudder hinge inspection ladder.

19. The fixing of the tail plane and fin to the stub section on the hull is made at the root ends of the spar booms which are secured to the fittings on the hull by bolts in expanding bushes. The bushes ensure that there can be no chatter at the joints.

Rudder and elevators

20. The rudder and elevators each consist of a channel-section spar to which are secured flanged-plate nose and tail ribs shaped to the profile. The surfaces are covered with light-alloy from the nose to the spar, the tail portion from the spar to the trailing edge being covered with fabric.

21. Trimming tabs.- At the bottom of the rudder and at each inboard end of the elevators is fitted a pilot-operated trimming tab constructed of mahogany and hinged to the main surfaces by small nickel-plated brass butts. The tabs are operated by a tubular push-rod connected to a worm and worm-wheel fixed to the spars (see paras.46 and 47).

22. Rudder servo tab.- Near the top of the rudder is fitted an automatic servo tab to assist in the manual operation of the rudder. The tab is operated by a pivoted piston tube attached at its forward end to the fin and at the aft end to the tab. Movement of the rudder automatically actuates the tab as shown in fig.7.

23. Rudder mass-balance.- The mass-balance consists of a lead weight inside the rudder nosing, at the centre hinge. The weight is shaped to the rudder profile and is secured on the tubular spigot by a collar and nuts and bolts. For access to the mass-balance, the nose portion of the rudder in the vicinity is made easily detachable by means of bolts and Simmonds nuts.

24. Hinges.- The elevators are hinged to the tail plane by three ball-bearing hinges on each side of the centre-line; the rudder is hung on five hinges, of which the upper three are similar to those used on the elevators and the remaining two are fitted between the rudder torque tube and a bearing bracket inside the hull. Owing to the inaccessibility of the servo and trimming tab hinges, grouped lubrication nipples are fitted inside the hull; they are connected to junction boxes inside the tail plane and fin and thence to the hinges by small bore copper tubing.

CHAPTER III

MAIN PLANES

General

25. Each main plane is an all-metal cantilever structure secured to double frames in the hull at the spar boom roots by forged stainless steel stub fittings and large diameter bolts. The single spar consists of two pairs of tapering extrusions braced vertically and diagonally to form a front and a rear truss; the trusses are connected by diagonal and drag bracing. Ailerons of the Frise type are fitted and inboard of these are flaps operated by an electric motor. Built into the leading edge of the main planes are the engine nacelles, which are of monocoque construction. On either side of each engine nacelle a portion of the main plane nosing is hinged and may be swung down to form a platform for engine maintenance (<u>see</u> para.220). A wing tip float is fitted to each main plane and is connected by a wire-braced tube structure to the spars.

26. In the nosing of the starboard main plane, adjacent to the hull side, is a fireproof compartment for the auxiliary power unit (<u>see</u> paras.118-120). Three fuel tanks (<u>see</u> para.78) are carried in each main plane, between the front and rear trusses. On the underside of the main planes for some distance outboard of the hull are the beams along which the bomb carriages move outboard before releasing the bomb load (<u>see</u> para.125). Two swivelling landing lamps (<u>see</u> paras.157 and 158) are fitted in the outboard section of the port main plane nosing, and navigation lamps and three downward identification lamps (<u>see</u> paras.152-155) are fitted at the wing tips and behind the inner engine nacelles, respectively.

Main plane construction

27. The main plane construction is generally similar to that of the tail plane and fin. The single spar is formed by two pairs of tapering T-section extrusions braced vertically and diagonally with tubes to form a front and rear truss. To prevent distortion of the structure, diagonal bracing is fitted between the trusses, connecting each drag member joint. Drag members are inserted at regular intervals between the trusses, each consisting of a smaller T-section extrusion shaped to the main plane profile. The nosing is built up round a series of flanged plate diaphragms attached to the front truss and tail ribs continue the profile from the rear truss to the trailing edge.

28. The skeleton structure is completely covered with thin light-alloy sheets flush riveted externally and with the plate seams joggled to lie flush on the outer surface. The wing tip is completely detachable for transport purposes by unscrewing the bolts spaced round the sides of the removable wing panel, detaching the panel and releasing the bolts in the wing tip attachment angles and from the spar joint plates at the connection to the spar extension pieces.

Aileron construction

29. The Frise type ailerons are built up from flanged light-alloy nose and tail ribs which are secured to a spar consisting of two channel-sections fitted intercostally and connected by diaphragms at each rib connection. From the nosing to the spar, thin light-alloy sheets are employed to cover the component, and from the spar to the trailing edge fabric covering is used. On each aileron there are five hinges, similar to those on the elevators, and control levers are fitted to two of the hinges.

30. Mass-balance.- Just inboard of hinge lever No.4 is the aileron mass-balance which consists of a lead weight shaped to the aileron profile and secured in a box inside the nosing. The nosing at this point is removable by unscrewing the bolts spaced round the cover plate, to give access to the weight.

31. Trimming tabs.- Fitted to each trailing edge approximately midway along the aileron span, is a small fixed aluminium trimming tab secured by tubular rivets. The tab is set after flight trials to counteract any tendency for the aeroplane to fly one wing low with the controls neutral (see para.211).

Flap construction

32. The main plane flaps are metal covered and each consist of three braced longitudinal members interspersed with transverse ribs, the plating being strengthened and supported by Z-section stiffeners. A flush outer surface is obtained by countersunk riveting and plate joggling similar to the main planes.

33. Each flap has four troughs fitted with metal channel-section runners that follow the shape of the top side of the flap contour. Four arms, having ball races attached and fixed to specially strengthened main plane tail ribs, support the flap at these runners. To ensure that no lateral binding can take place, a further set of ball races is fixed at right angles to the former and engage in the sides of the runners. A wooden strip secured to the flap nosing butts up to a similar strip fitted to the main plane and seals the gap when the flap is fully in. For a description of the flap control reference should be made to paras.50-53.

Wing tip floats

34. The wing tip floats are constructed of aluminium-coated light-alloy (Specification D.T.D. 275), joggling and flush riveting being employed to give a smooth exterior similar to the hull. The framework consists of channel-section frames connected by intercostal stiffeners with a centre keel running from stem to stern. Quick-release flush-fitting manholes and covers are provided for internal inspection and are removed by inserting a screw driver in the slotted fasteners and giving half a turn in either direction. Bilge pump connections and drain plugs are also fitted to lie flush with the skin sheeting.

35. Each wing tip float is attached to the main plane by a pair of tubular struts, one to the main plane front truss and the other to the rear truss. The struts are braced diagonally with streamline

wires, and side loads on the float are transmitted through flexible stainless steel cables from each bottom strut joint to points on the lower spar boom inboard and outboard of the float strut attachments.

CHAPTER IV

FLYING CONTROLS

General

36. All the flying controls are orthodox in design and operati The rudder and elevator runs are duplicated throughout but the ailer circuit consists of a single run. Chain pulleys and sprockets that change the direction of the control runs through large angles are fitted with ball bearings, and small roller fairleads with plain bus bearings are used where the angle of deviation is small. Spring-loaded oil-filled dashpots are fitted to the levers of all the main control surfaces for the purpose of preventing sag in the control ru owing to variations in temperature, etc. Dual controls for the sec pilot are fitted and are normally considered to be permanent. Mk.I automatic controls are also fitted.

Control pedestals

37. The control columns and rudder bars are pivoted on built-u structures that also serve to carry the pilots' seats. Both the po and the starboard pedestals are of similar construction, consisting of four channel-sections connected by flanged diaphragms and stiffen to form a large box. Additional channel members are fitted at the aft end for the seat support, and the safety belt attachment lugs ar also fixed to a strong point on the structure. Inside the port pedestal are fitted the independent elevator intermediate levers and also chain sprockets to take the control run from the rudder bar.

Dual controls

38. Dual control for the second pilot is fitted and is normall considered to be permanent. The aileron controls are coupled by a chain and tie-rod between the main torque shafts, the rudder control by a tubular push-rod between the levers, and the elevator controls by a large diameter shaft between the port and starboard units.

Control locks and stops

39. Locks and stops are fitted to the main flying controls and are situated in the control duct just aft of the port pilot's seat pedestal. The controls are normally locked in the neutral positio but there is an additional "down" position for the elevator control, for use when the aeroplane is at its moorings. The locking system consists of a handle carrying six prongs which is inserted through two extruded channel-section members fitted across the control duct, at the same time passing through eye-links integral with the control rods (see figs.5-7). To prevent the pilot from taking-off with the controls locked, a tube is fitted to the locking handle and is arranged so that the pilot cannot get into his seat when the locking handle is in position. The device is stowed on the starboard side of the starboard pilot's pedestal when the aeroplane is in flight.

40. The control stops consist of plates fitted near the locking links and registering against the two channel-section members (see figs.5-7). To remove the operating load from the control surfaces, the channels are free to move in a fore-and-aft direction but their movement is limited by rubber buffers fitted between the duct and the ends of the channels.

Elevator control

41. Elevator control is by normal fore-and-aft movement of the control column about the fork joint at its base. Vertical levers are attached to the sides of the joint and are connected by tie-rods to independent intermediate levers inside the control pedestal (see fig.5). Chains, tie-rods, and cables continue the control circuit to the elevator operating levers pinned to the torque shaft at the tail end of the hull.

Aileron control

42. Aileron control is effected by rotation of a handwheel mounted at the top of the control column. The drive is transmitted by an endless chain from the handwheel sprocket to another sprocket riveted to the forward fitting of a swivelling fork joint at the base of the column, thence through the joint to a third sprocket attached to the aileron torque tube (see fig.6). Chains and tie-rods connect the control unit to a right-angle drive at the rear spar frame thus forming a complete circuit between the control handwheel and the drive unit.

43. The aileron right-angled drive consists of three sprockets rigidly attached to a common spindle. The upper sprocket is connected to the handwheel and the intermediate and lower sprockets continue the drive through chains and tie-rods along the top and bottom rear spar booms to the port and starboard ailerons respectively. To ensure watertightness where the control rods emerge from the main plane, the lower pair are fitted with rubberized fabric bags and the upper rods pass through rubber sealing strips attached to the component.

Rudder control

44. The rudder bars are fitted to the forward ends of the control pedestals. Link mechanism is arranged to give parallel motion over the whole range of movement, and, by rotation of a starwheel mounted between the pedals, the foot pedals are adjustable in the fore-and-aft direction to suit pilots of different stature. Twin runs of tie-rod and chain connect levers at the base of the rudder bar with operating levers fixed to the bottom of the rudder torque tube at the tail end of the hull. An automatic servo tab is fitted on the rudder and assists the manual operation of the control (see fig.7 and para.22).

Dashpots

45. Spring-loaded oil-filled dashpots are fitted to the levers of all main control surfaces for the purpose of preventing sag in the control runs due to variations in temperature, etc. Each dashpot consists of a barrel and piston with a spring fitted to the piston rod that tends to prevent extension of the dashpot under load.

two 3-way cocks; the cocks are fitted between the oil reservoir and the compressor and have stops arranged to ensure that the pipeline between these components is always open. The functioning of the compressor depends upon an unbroken lubrication circuit between it and one or the other of the reservoirs, and on no account should the compressor be fitted and run on the engine unless the circuit is complete and the reservoirs are fully charged with oil.

57. An oil cooler is fitted in the delivery pipe from the compressor, and there is a thermometer jacket between the compressor and the cooler. The jacket is connected by a capillary tubing to the thermometer on the panel in the engineer's compartment. The temperature reading must not exceed 90°C. under any conditions of flight.

58. A test cock is provided in the pipe from the air drier and is used for ground testing the apparatus with compressed air from an outside source.

59. The copper pipes in the system must be clean internally before they are installed and all pipes, pipe joints, etc., must withstand a test pressure of 80 lb. per sq.in. without leakage. To allow for movement of the engine in its mounting and also to resist vibration, lengths of flexible hose are fitted to connect the oil inlet, air inlet and delivery unions on the compressor to similar unions on the face of the fireproof bulkhead.

60. The rudder and elevator servo motors are attached to stiffeners on the upper deck just forward of the port pilot's control pedestal and are connected by chains and tie-rods to the actuating levers on the rudder bar and control column. The aileron servo motor is fixed to the back of the port pedestal and is connected by an endless chain to a sprocket on the rear end of the aileron torque tube.

61. The aileron gyro unit is attached to a channel-section beam on the port side of the hull opposite the aileron servo motor. The unit is fitted parallel to the centre-line of the aeroplane with the horizontal axis 6° 35' to the hull datum, and provision is made for a 1½° lateral adjustment in the vertical plane. The rudder and elevator unit is permanently fixed on the port side opposite the elevator motor and is arranged so that the unit is parallel to the centre-line and truly vertical when the aeroplane is horizontal laterally, and its horizontal axis is level at the cruising speed of the aeroplane.

62. The servo motor clutches, and the speed and attitude mechanism on the gyro unit, are operated by bowden cables from the pilot's control lever. The pilot may also control the bomb-aimer's steering instrument by means of bowden cables. Bowden cable is similarly employed to transmit the follow-up motion between the servo motors and the gyro units. It is essential that the cables should be as short as possible and free from kinks and sharp bends, especially the follow-up cables that are arranged so that rotation of the gyro units does not affect the follow-up system. The cables should be lubricated with oil and graphite before being inserted in their casings.

63. <u>Fitting of sprockets to servo motors.</u>- In order to fit the operating sprockets to a servo motor, it is first necessary to dismantle the clutch and the follow-up pulley, as follows:-

(i) Remove the split-pins and withdraw the clutch spindle, item (A) in fig.12, remove the nut (B), turn the clutch levers and withdraw the spindle (C). The clutch may then be removed.

(ii) Remove the shaft plug (D); the clutch rod (E) and the spring (F) may then be withdrawn.

(iii) Using the extractor supplied, withdraw the clutch assembly.

(iv) Insert two 4 B.A. screws in the follow-up pulley (G) and withdraw it complete with its fixing (H).

(v) Remove the screws (J), withdraw the cable stop plate (K), and remove and discard the nut (L) and the keeper plate (M), taking great care to avoid damage to the friction washer (N).

64. To fit the operating sprocket to the servo motor shaft, proceed as follows:-

(i) Place the cable stop plate (K) on its spigot and position it so that the cable stops give the required direction for the follow-up cables.

(ii) Select the three holes in the cable stop plate nearest to those in the servo cylinder (twelve settings are available) and insert the three screws (J), locking them with 20 s.w.g. locking wire after final tightening. <u>The screws (R) and (S) must not be interfered with.</u>

(iii) Set the servo motor in its mid-stroke position (i.e., with the large shaft key uppermost as shown in fig.12) and offer up the follow-up pulley and its fixing, selecting the position of the fixing pins so that the cable nipple slot is diametrically opposite the cable stops.

(iv) Push the follow-up pulley and its fixing into place; if the fixing is tight on the shaft splines the assembly tool supplied should be used.

(v) Assemble the control sprocket on the servo clutch plate (V) and secure it by the six screws (P), locking the screws with 20 s.w.g. locking wire after final tightening.

(vi) Push the clutch plate into place, using the assembly tool supplied if the splines are tight.

(vii) Complete the assembly by reversing the instructions contained in sub-paras.(i) and (ii) of the previous paragraph, taking care to replace the clutch spring and to lock the shaft plug (D) with the lock washer (U).

(viii) Fit the chain guard to the follow-up pulley casing, adjust it to suit the control run and insert the three screws (T), locking them with 20 s.w.g. locking wire after final tightening.

65. Connection of servo motor to flying controls.- Before attempting to connect the servo motors to their respective circuits, the main controls must be locked in the neutral position as described in para.39. Care must be taken to ensure that the couplings are free from backlash and lost motion, that undue wear and backlash will not develop with use, and that the mid-travel position of the servo motor coincides with the mid-travel position of the respective control surface. The connections are illustrated in fig.13.

66. To connect up the rudder automatic control, proceed as follows:-

(i) Set the datum mark on the servo clutch plate so that the motor is in the mid-stroke position.

(ii) Fit the control chain mid-way round the servo motor sprocket and connect the tension rods to the rudder bar lever shackles.

(iii) Turn the tension rods to take up the slack in the control circuit and lock them by screwing up the locknuts.

(iv) After final checking and adjustment, lock the tension rods with 16 s.w.g. locking wire.

67. To connect up the elevator automatic control, proceed as follows:-

(i) Set the datum mark on the servo clutch plate so that the motor is in the mid-stroke position.

(ii) Fit the control chain mid-way round the servo motor sprocket and attach the other chain to the upper control column lever.

(iii) Insert and connect up the swaged tie-rods and turn them to take up the slack in the control circuit.

(iv) After final checking and adjustment, lock the tie-rods by screwing up the locknuts.

68. To connect up the aileron automatic control, proceed as follows:-

(i) Set the datum mark on the servo clutch plate so that the motor is in the mid-stroke position.

(ii) Fit the control chain mid-way round the servo motor sprocket and aileron torque-shaft sprocket and connect up with the tension rods; the shorter chain should be fitted round the aileron torque shaft sprocket.

(iii) Turn the tension rods to take up the slack in the control circuit and lock them by screwing up the locknuts.

(iv) After final checking and adjustment, lock the tension rods with 16 s.w.g. locking wire.

CHAPTER V

ENGINE INSTALLATION

General

69. The aeroplane is powered with four Pegasus XXII engines (see A.P.1451G, Vol.I) which are mounted in monocoque nacelles built into the leading edge of the main planes. Three fuel tanks are mounted on each side of the aeroplane between the spar trusses and constitute an independent self-contained fuel system for the two engines on that side; the outer tanks are overload tanks. Provision is made for jettisoning 52% of the maximum fuel capacity. Each engine has a separate oil system supplied from a tank inside the engine nacelle. The engines may be started either by hand or electrically.

70. The engines are fitted with 3-bladed variable pitch airscrews of which a full description is given in A.P.1538, Vol.I. Besides the starter motor, engine-speed indicator generator, airscrew pitch governor and fuel pump fitted to each engine, the following components are fitted to the other engines:-

Starboard outer	Starboard inner	Port inner	Port outer
Vacuum pump	24-volt generator Dual gun pump	12-volt generator Air compressor	Vacuum pump

The 12-volt and 24-volt generators and the engine-speed indicator generators are driven by flexible shafting.

71. An auxiliary power unit for bilging, refuelling and accumulator charging services is carried in a fireproof compartment in the starboard main plane nosing close to the hull side. A boiler for the heating system (see paras.172-174) is fitted on the exhaust outlet pipe of the port inner engine.

Engine nacelles, mountings and cowlings

72. The engine nacelles are of monocoque construction and are built into the leading edge of the main planes. Each nacelle is formed by seven annular frames intersected by V-section skin stiffeners spaced round the circumference. The nacelles are covered with light-alloy sheets, joggled at plate laps and seams and secured by rivets flush-countersunk on the outer surface.

73. The engine mounting provides a torsionally-flexible assembly by means of special rubber bushes bonded to sleeves secured in the engine and airframe mounting attachments.

74. Each engine cowling consists of three light-alloy panels, supported from the cylinder heads and exhaust collector ring and secured together by hook and eye joints and quick-release fasteners. Each panel is fitted with check cables to prevent loss when the panels are released.

75. Controllable gill cowling is fitted to each engine and forms an extension to the cowling proper. By varying the exit annulus, the airflow through the cowling is regulated so that cooling drag power is reduced to the requirements of the particular flight conditions. Control of the gill openings is effected from the port and starboard sides of the engineer's compartment by means of handles attached to gear wheels that drive a series of universally-jointed torque shafts extending out to each engine nacelle. The control run is continued through a worm gear at the rear of the nacelles by further torque tubes, and finally connects to the control chains that operate the gill cowling. An indicator is incorporated in each gear box to show the position of the gills. When ground running, taxying, taking-off or climbing, the gills should be in the open position for maximum cooling effect, while for normal cruising conditions they should be in the closed position for minimum drag, the design permitting the circulation of sufficient air for cooling under these conditions.

Exhaust system

76. The exhaust collector rings form the leading edge of the cowling and are independently supported from the engines. Each exhaust system has a single circular-section outlet pipe which enters the main plane nosing and emerges from the top surface of the main plane; the outlet pipe for the port inner engine is fitted with the boiler for the heating system (see paras. 172-174).

Fuel system

77. In each main plane is fitted an independent fuel system for the two engines on that side.

78. Three oval-shaped fuel tanks are mounted in each main plane between the spar trusses on a wooden grid fitted between the bottom booms, and are secured in position by spigoted fittings bearing on rubber bushes. When the tanks are in position the covering of the main plane top surface is completed by flush-fitting stressed-skin covers fixed to brackets built out from the spar booms.

79. The three tanks on each side are connected by lengths of Superflexit hose to a common distributor box (see fig. 14). A single delivery pipe connects the distributor to a branch union from which the fuel is led to the carburettors of the inner and outer engines through a fuel filter, the engine pump and a pressure-reducing valve. The pressure-reducing valve is set at 2½ to 3 lb. per sq.in. A pilot-controlled cock is fitted between each fuel pump and the pressure-reducing valve; the other cocks at the distributor box and the tank sumps are operated by the engineer.

80. Each fuel tank is vented to atmosphere by a pipe extending from a relief valve on the top of the tank to an opening in the lower surface of the main plane. The valve is set to function at 1 to 1½ lb. per sq.in., although it is permissible for the float valve seating just to show signs of leakage at ½ lb. per sq.in.

81. Fuel loads.- For the normal range condition, the fuel load is 1,520 gallons, 470 gallons in each inner tank and 290 gallons

in each middle tank. For the overload condition, the fuel load is 2,034 gallons, all the tanks being filled to capacity, and, as the inner tanks only are fitted with jettison valves (see para.88), the fuel should be withdrawn from the outer, overload tanks first in order that a greater percentage of the fuel may be jettisoned in an emergency.

82. Operation of fuel cocks.- For the normal range condition, cocks 1, 2, 3 and 5 (see fig.14) should be open and cock 4 should be closed. For the overload condition, cocks 1, 3 and 4 should be open and cocks 2 and 5 closed until the overload tanks are emptied, when cocks 2 and 5 should be opened and cock 4 closed immediately; it is essential that the cocks are opened and closed in the order given.

83. Fuel contents gauges.- The six fuel contents gauges on the engineer's instrument panel are of the Telelevel mechanical type, in which the position of a float on a guide rod in the fuel tank is registered on a calibrated dial; A flexible cable attached to the dial drum has, at its other end, a small conical plunger that, when in contact with the float resting on the surface of the fuel, locks the float and the movable index plate at the same time. To obtain a reading, the indicator handle on the instrument should be moved slowly and gently in the "down" direction until the locking action is felt, when the position of the index dial will register the true fuel content. Before rotating the handle in the "down" direction it is always advisable to give it a slight turn in the "up" direction to release the float should it still be locked in position from the last reading. A chart for correction of the gauge readings for "on water - wing tip up" and "on water - wing tip down" cases is stowed in the engineer's table. Fuller information regarding this type of fuel contents gauge is given in A.P.1275, Vol.I, Instrument Manual.

84. Priming system.- The top three cylinders of each engine are primed for starting purposes. Vaporized fuel is injected by means of a pump located in a recess in the engineer's compartment on each side of the aeroplane. The fuel is sucked from a connection on the main fuel branch piece and delivered direct to the engine cylinders through small bore copper tubing and lengths of Superflexit hose (see fig.14).

85. The carburettors are primed by operation of a diaphragm type hand pump adjacent to the engine priming pump on each side. Fuel is drawn from the inlet side and delivered to the outlet side of the main fuel branch piece and travels thence through the normal fuel system to the carburettors, the engine pump being by-passed by means of a length of hose and a non-return valve. Incorporated in the pipeline, on the starboard side only, is a cock, operation of which permits fuel to be drawn from the main system and delivered to the auxiliary power unit supply tank (see para.120) by operation of the carburettor priming pump. Other hand-operated cocks are fitted to enable the engineer to select the requisite engine to be primed (see para.111, sub-para.(viii)).

86. Refuelling.- The aeroplane may be refuelled from an outside supply by utilizing the auxiliary power unit (see paras.118-120) and its pump to deliver fuel under pressure to the tanks. A connection for this purpose is provided on the inlet side of the auxiliary power unit and the fuel is pumped thence through a non-return valve to two screw-down valves that isolate either the port or the starboard fuel system

in each middle tank. For the overload condition, the fuel load is 2,034 gallons, all the tanks being filled to capacity, and, as the inner tanks only are fitted with jettison valves (see para.88), the fuel should be withdrawn from the outer, overload tanks first in order that a greater percentage of the fuel may be jettisoned in an emergency.

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should then be reconnected. If, after operating the control several times, it is spongy at the end of the stroke, the presence of air in the system is indicated. The air should be expelled by raising the piston in each unit and slackening back each pipe union in turn; the force of the spring will then expel the contents of the cylinder.

98. The oil-tightness of the system (apart from pipe joints) is maintained by a special gland ring situated at the top of each master and actuating unit cylinder, and by a cork-faced valve situated in the underside of each reservoir. Great care should be taken to ensure that pipe lines are perfectly clean before installation, otherwise foreign matter finding its way to the valves may cause leakage into the reservoir, which is indicated by creeping of the operating lever. If this occurs, the valves should be cleaned through the plugs fitted to the underside of each reservoir. In order to obtain maximum efficiency from new gland rings, they should be soaked, before fitting, for about three hours in the oil used in the system; they should not be soaked too long as this tends to make them swell and consequently difficult to fit. It should be remembered that, owing to the tendency of any hydraulic system to form an adhesive film if left at rest, the initial movement of the control levers may be stiffer than is experienced under normal operating conditions.

99. <u>Air intake shutters</u>.- Each engine air intake is fitted with separate hot and cold air inlets, admission of air to the carburettor being controlled by spring-loaded shutters. Operating cables from the engineer's table pass over various pulleys and connect to levers fitted on the air intakes. The shutters are normally maintained in the "unheated air" position but a spring hook fitted to each operating lever may be used to keep the shutters in the "heated air" position.

100. <u>Slow-running cut-out control</u>.- The engines are fitted with valves that cut off the fuel supply to the slow-running jets. The valves are operated by the pilot from levers mounted on the roof beam, the movement being transmitted by means of flexible cables in the hull and main planes to actuating levers on each engine. The valves are spring-loaded and self-returning and great care should be taken to ensure that the springs are working effectively as failure of them to do so will cause engine starting to be very difficult or even impossible.

101. <u>Airscrew pitch control</u>.- The airscrew pitch control enables the airscrews to be set either in fine or in coarse pitch. The control is operated by means of cables connected to levers on the pilots' throttle box and led over pulleys and through fairleads to further lever arms mounted in each engine nacelle. Connection between these levers and the valve on the rear cover of the engine is made by means of a short length of Arens push-pull control. An adjustable stop is incorporated to remove the operating loads from the valve and to prevent damage to it.

102. To check the functioning of the airscrew control, the engine should be throttled back to approximately 1,500 r.p.m. in fine pitch, and the control operated and changed to the coarse pitch (cruising) setting. This should cause the r.p.m. to drop somewhat if the pitch-operating mechanism is working correctly.

103. Automatic boost override control.- The automatic boost control on the engines limits the maximum boost obtained under full throttle flight conditions but a device is incorporated that permits overriding of the automatic control and allows an increase in the maximum boost obtainable for take-off at full throttle. The override is operated by the mixture control lever by moving it rearwards from the "normal" to the "rich" or "override" position. When the mixture control is moved to this position not only is the boost control affected but the mixture delivered to the engine is also automatically enriched.

Instruments

104. Full descriptions of the boost gauges and the engine-speed indicators fitted to the engines will be found in A.P.1275, Vol.I, Instrument Manual. Cylinder temperature gauges are fitted to the No.1 cylinder of each engine.

105. Engine cylinder temperature gauges.- Four temperature gauges or pyrometers are mounted on the engineer's instrument panel and give direct readings of the engine cylinder temperatures. In each case the attachment to the engine is made by means of a special thimble couple located on No.1 cylinder and connected to the gauges by twin Constantan cable. The electrical resistance of the cables between the couples and the gauges is standardized and the lengths of the cables must not be altered as the calibration of the pyrometers will be affected. For the same reason the cables must not be interchanged.

106. Engine-speed indicators.- The generators for the engine-speed indicators are mounted at the forward side of each fireproof bulkhead, on the nacelles, and are driven by flexible shafting. Electric cable connects the generators to the indicators, which are fitted to the pilots' instrument panel.

107. Boost gauges.- Four boost gauges are mounted on the pilots' instrument panel and are connected to the respective engines by copper tubing. Forward of the instrument panel, four traps are fitted in each pipeline to prevent liquid fuel from entering the gauges. A small drain cock is fitted on the bottom of each trap; it is normally locked in the "off" position but should be opened and drained at intervals as found necessary.

Engine starting gear

108. Each engine is fitted with a 24-volt electric starter motor geared direct to the crankshaft. The engine starter pushbuttons are mounted in a recess on top of the engine throttle box and the magnetic relay switches are situated inside the control panel for the 24-volt electrical system (see para.1604). The wiring diagram for the starter motors is included in fig.26.

109. Provision is also made for the use of external accumulators for engine starting. A special 2-pin socket is stowed in the galley adjacent to the port drogue hatch and to connect the external accumulator, the plug should be inserted as far as it will go without forcing and then turned clockwise until it goes right home; turning the plug clockwise automatically disconnects the accumulator from the starting

(ii) Raise the stop between the bomb support beams and move the port bomb carriage from the port beam to the starboard beam.

(iii) Attach the bomb hoist winch adaptor to the starboard support beam at the third diaphragm bay.

(iv) Bolt the bomb hoist winch to the adaptor and screw up the steady pads.

(v) Remove the bomb hoist pulley from its stowage and thread the winch cable through the guide tube and over the pulley.

(vi) Slide the hoist pulley into the guides on the port bomb carriage and push it along until the cable drum hangs vertically over the centre of the carriage, ensuring that the locking plunger springs home.

(vii) Withdraw the pin from the hole in the carriage and rotate the hoist winch to lower the cable plug.

(viii) Attach the engine hoist adaptor fitting to the cable drum with the pin attached. The pin must be inserted from the outboard side.

(ix) Fit the engine sling to the adaptor fitting so that the long sides of the beam face aft.

(x) Remove the bunks in the crew's quarters and also the floors, excepting the narrow strips down the starboard side and against the forward bulkhead.

(xi) Place the engine stand in position on the floor bearer and secure it with the bolts stowed with the hatch tension tool.

(xii) List the aeroplane until it rests on the port wing tip float.

(xiii) Propel the port bomb carriage outboard and rotate the hoist winch to lower the engine sling.

117. The spare engine may now be hoisted and loaded, as follows:-

(i) Fasten the sling to the spare engine, with the cable loop (which should be well padded) round the airscrew shaft and the shackles connected to the eyebolts on the rear crankcase. The engine should face aft.

(ii) Rotate the winch and hoist the engine until the adaptor plug is within the bomb carriage, and operate the lever to engage the locking pin in the hole in the adaptor plug.

(iii) Propel the bomb carriage and engine inboard through the hatch, at the same time taking up any slack in the hoisting cable.

(iv) List the aeroplane until it rests on the starboard wing tip float.

(v) Lower the engine until it is level with the attachment plate and swing it over into position by hand.

Auxiliary power unit

118. The auxiliary power unit, type II (air-cooled), is fully described in A.P.1507A, Vol.I. The following paragraphs deal with the unit as a particular installation in this aeroplane.

119. The unit is mounted on rubber feet in a fireproof compartment in the starboard main plane nosing close to the hull side. A double door for access to the unit forms part of the leading edge. By sliding each clamp bolt, inserting a finger tip in the recess, and lifting the drawbar to release the spring-loaded handles, the handles may be turned until they are in line, thus enabling the doors to be opened. A small platform is fitted to the lower door; it is designed to ta e the weight of one person only and the weight of more than one person will result in straining of the door and damage to the structure.

120. The unit consists of an A.B.C. twin-cylinder air-cooled four-stroke engine driving bilge and refuelling pumps and also a dynamotor that is used for accumulator charging or engine starting. Access to the bilge and refuelling connections is effected through the inboard engine maintenance door, and the throttle lever and pump drive clutch levers can be operated through doors in the nosing forward of the unit. A small fuel tank of three gallons capacity is fitted between the fireproof compartment and the hull side, the supply cock being fitted with an extension tube and handle to enable it to be operated from inside the aeroplane. The tank is provided with a standard filler orifice, and a union on top of the tank connects to a feed pipe for alternative fuel filling from the starboard main engine priming system using the carburettor priming pump (see para.85 and fig.14). A dipstick for ascertaining the contents of the tank is housed inside the filler neck. The oil tank is filled through a filler neck at the rear of the engine crankcase.

CHAPTER VI

EQUIPMENT

General

121. Stowages of the various items of equipment are indicated on the load distribution diagrams, figs.2 and 3, and a key to these diagrams is given in fig.4. Ground and marine equipment is described in Chapter VII.

ARMAMENT

General

122. The main bomb load is carried in the crew's quarters on bomb carriages which are moved outboard along beams on the underside of the main planes on each side for releasing the bomb load. At the bow gun turret and at the amidships gun station, port and starboard, is a Vicker's .303 in. type K gun and in the tail gun turret are fitted four Browning guns. Various pyrotechnics are also provided.

Bombs

123. The main bomb load (see para.127) is carried on No.1 and No.2 Universal carriers normally secured to bomb carriages in the crew's quarters. For releasing the bomb load, the carriages, which are channel-shaped structures, are propelled out along beams on the underside of the main planes on each side by means of a worm and rack mechanism operated from a handle on the hull side. The bombs are loaded (see paras.128-130) by means of a winch mounted between the hull beams. Stowage is also provided for 16 practice bombs, 8 on each side of the hull in the crew's aft compartment.

124. A stowage plate for a Mk.IXC course-setting bomb sight is fixed to the starboard side of the mooring compartment and stowage for a Mk.IIA or Mk.IIB plan range-finder is provided at the navigator's right hand.

125. Bomb carriages.- Secured to the underside of the upper deck just aft of the rear main plane spar frame are two built-up light-alloy box beams that extend athwartships on each side from the centre-line of the aeroplane to some distance outboard of the hull. The external portions of the beams are housed inside the main plane structure and lie flush with the lower surface of the aerofoil. Along the bottom edges of the beams, rollers are mounted at regular intervals. The bomb carriages are suspended from these rollers and are propelled by a worm-and-rack mechanism driven by a run of chain to the operating handles mounted on the hull side. Slots are cut in the lower surface of the main plane to allow passage of the bomb carriage and are normally covered by sliding metal strips which are secured to one end of the carriage and automatically wind over drums in the main plane when the carriage is propelled outboard.

126. Bomb doors.- On each side of the hull in the crew's quarters is fitted a large door to give entrance and exit to the bombs and their support carriages. To open the door, release the four over-centre catches spaced along the lower edge, grasp the central handle and pull the door inboard so that the guide rollers clear the stops. The door may now be pulled down on its runners until it reaches the bottom of them and then pushed to allow the rollers to enter the guide block. With the doors in the "down" position, fit the small elastic retaining cord to its hook on the coaming to prevent accidental slipping of the doors. When shutting the door it is imperative to retain a grip on the handle otherwise the door will slam into position with resultant damage to the door rollers, guides, or structure.

127. Alternative bomb loads.- Besides 16 - 11½ lb. practice bombs, 8 stowed on each side of the crew's aft compartment, the following alternative main bomb loads may be carried on the bomb carriages:-

8	-	100 lb. A.S.
or 8	-	112 lb. (Mk.VIIC, tail drum).
or 8	-	120 lb. G.P.
or 8	-	250 lb. A.S.
or 8	-	250 lb. G.P.
or 8	-	250 lb. S.A.P.
or 8	-	250 lb. L.C.
or 4	-	250 lb. B.
or 4	-	450 lb. A.P.
or 4	-	500 lb. G.P.
or 4	-	500 lb. S.A.P.
or 4	-	500 lb. A.S.
or 4	-	250 lb. containers (for small bombs).

128. Bomb loading.- The bombs are loaded by means of a hoisting cable running from a winch mounted between the hull beams. The cable runs over a guide pulley that slides inside the bomb carriage and through a safety lock to the bomb carrier attachment eye. Folding platforms are fitted at the bomb hatches and may be used when making the electrical connections from plugs on the carriages to sockets on the beams.

129. To load bombs on the port side (see fig.19), proceed as follows:-

(i) Lower both sliding hatches in the hull side (see para.126) and propel the bomb carriages a fair distance outboard.

(ii) Suspend the bomb hoist winch in the gap between the carriage support beams so that the winch drum is edge-on to port. Secure it thus by the knurled nut and bolt and screw up the adjustable steady pads until they register firmly against the underside of the starboard beam.

(iii) Remove the hoist pulley from the bomb carriage and thread the winch cable through the guide tube, over the pulley and through the slotted guides.

(iv) Slide the hoist pulley into the carriage guides and push them along until the cable plug hangs vertically over the centre of the bomb carrier. When sliding the hoist pulley in the guide rails, ensure that the cable plug is clear of the carriage and, when the hoist pulley reaches the loading position, see that the pulley locking plunger springs home.

(v) Rotate the winch wheel to lower the cable until the plug appears below the bomb carriage, remove the drop-nose pin in the socket on the adaptor beam supporting the bomb carrier, drop the cable plug into the socket and replace the pin.

(vi) Withdraw the adaptor beam spring pins so that the beam and the bomb carrier are supported only by the winch cable.

(vii) Lower the carrier by rotating the winch and attach the bomb. Great care must be taken to avoid raising the bomb fuze arms during this operation.

(viii) Hoist the carrier and bomb, engage the spring pins in the catches on the underside of the carriage and remove the cable plug from the socket.

(ix) Load the remaining bombs on the port side by rotating the winch so that the cable plug is again clear of the carriage, lifting the locking lever of the hoist pulley to withdraw the plunger, sliding along to next position and repeating the operations described in sub-paras.(v)-(viii) in each case.

130. To load bombs on the starboard side, proceed as follows:-

(i) When the port bomb carriage is loaded, remove the hoist pulley and cable from the port carriage guides, and reverse the winch by slackening off the steady pads, turning until the cable is edge-on to starboard and re-screwing the pads to secure it in position.

(ii) Slide the hoist pulley into the starboard carriage guides and repeat the operations detailed in sub-paras.(iv)-(ix) of the previous paragraph.

(iii) When the requisite bomb load is attached, remove the hoist pulley, disengage the winch cable, remove and stow the hoist winch, wind the bomb carriages inboard to the stops and close the hatches.

131. Bomb sight door.- To open the bomb sight door in the bow, it is only necessary to release the two over-centre catches at base of door and push the tubular handle. When the door has reached the "fully-open" position, it should be locked by means of the two small ball-headed catches at the top of the handle. In certain cases it will be found unnecessary to open the door to its fullest extent and a slip fastening is incorporated on the door to pick up the handle cross tube before the door reaches the "fully-open" position. Additional range for the bomb-aimer may be obtained by opening the small hinged flap below the main bomb sight door. The flap is secured by thumbscrews which are easily accessible.

132. A small flap on the front gunner's floor in the bow compartment serves as a seat for the bomb-aimer and, when it is used as such, a footrest must be placed in position below the floor to prevent the bomb-aimer from overbalancing. The footrest is stowed on top of the small fixed floor on the starboard side and the flap is operated by releasing hand catches fitted at each corner.

Guns

133. A Vickers .303 in. type K gun is fitted to the power-operated turret in the bows of the aeroplane and two similar guns are fitted, one on the port and one on the starboard side, at the gun station amidships. Four Browning guns are fitted in another power-operated turret in the extreme tail of the aeroplane. A full description of the power-operated turrets and their hydraulic operating systems will be given in A.P.1659A, Vol.I, which is not published at the time of writing, but a short description of the operating system is given in paras.136-139.

134. Retractable front gun turret.- The front gun turret is retractable to permit mooring operations to be carried out from the bow compartment (see para.189). When the turret is in its foremost position it is secured there by five handscrews equally spaced round the circumference of the gun ring. The front gunner's floor in the bow compartment is hinged to serve a dual purpose. In the "down" position the floor is used for mooring operations and when it is hinged up it serves as a footrest for the gunner. To operate the hinged floor, turn the anti-rattle fastener fitted to the forward edge, then lift the large flap in the centre of the floor and raise the two hand catches thus disclosed. The floor may then be swung up and over until the catches register in the reverse position.

135. Amidships gun station covers.- Before fitting the covers to the amidships gun station, the guns must be stowed and the windshield lowered to the flush position by rotating the centre handle to operate the windshield catches. To fit the cover, insert it in the opening, top first, and register the top and aft sides of the cover on the blocks provided for this purpose. Place the support tube ball-end in its socket on the seat support rail and straighten the tube until the centre spring catch locks home.

136. Turret hydraulic operating system.- The bow and tail guns and turrets are each operated by an independent hydraulic oil system. The oil is circulated at the normal working pressure of 350 lb. per sq.in. by a dual pump driven by the starboard inner engine.

137. For the front gun turret, the pressure line is led to a recuperator fitted opposite the forward entrance door and then passes to an arrangement of articulating pipes that allow the front turret to be retracted. From the forward end of these pipes the pressure line is led to a rotating service joint fitted to the top of the gun turret. The return system passes through a similar articulating mechanism to the recuperator and then to a felt filter on the starboard side of the front spar frame. This filter is in turn connected to a combined relief valve and filter mounted on the front spar truss behind the starboard inner engine and the oil finally passes back to the pump through special high pressure petroflex piping.

138. For the rear turret, the system is similar to that for the front turret except for the omission of the articulating pipe. The recuperator is fitted adjacent to the tail turret and the rotating service joint is situated in the turret footwell.

139. Filling the hydraulic system.- Insufficiency of oil and the presence of air in the system are indicated when it becomes possible to depress the plungers that project from the top of the recuperator barrel. The air must be expelled and the system filled by unscrewing the filler cap in the barrel, filling the chamber with oil and operating the pump lever. Refilling and pumping should be continued until the plunger becomes fully extended and incompressible. The system should be filled with an equal mixture, by volume, of oil, lubricating, anti-freezing, type A (Stores Ref.34A/43 and 46) and oil, lubricating, mineral (Stores Ref.34A/32 and 33). The filler cap should always be replaced after filling the system with oil. The functioning of the oil pump depends upon an unbroken lubrication circuit and therefore on no account should the pump be fitted and run on the engine unless both the services supply systems are complete and filled with oil.

140. Gun sight illumination.- Optical gun sight illumination is provided for the guns. For the front turret, the supply is taken along the articulated pipes and enters the turret at the top close to the rotational axis. A plug and socket is included in the cable run along the articulated pipes to facilitate the removal of the turret. The supplies for the amidship guns are provided by spring-loaded drums that allow the cable to run off and on as required. The rear turret supply is introduced by a plug and socket and flexible cable that enters the turret from below. A wiring diagram for the gun sight illumination is included in fig.23.

Pyrotechnics

141. Stowage for a total of 20 - 4½ in. reconnaissance flares is arranged in three groups - seven on the port side of the upper deck above the bomb compartment, nine similarly on the starboard side and the remaining four just aft of the port amidships gun station. The flares are launched (see fig.21) from a manually-operated chute that swings into position over the opening in the hull bottom that is normally used for vertical photography.

142. Nine marine distress signals are placed in three groups - three on the starboard side of the mooring compartment, three on the roof adjacent to the engineer's hatchway and three near the rear entrance door above the dinghy stowage. Stowages for a signal pistol, 20 signal cartridges (12 red, 4 green and 4 white) and 6 brown smoke puffs are fitted at the top of the starboard pilot's control pedestal, and attached to the hull side nearby is a box for 20 pistol flares. Flame floats and sea markers are also provided (see para.183).

143. Two forced landing flares are stowed in chutes on the port side of the crew's aft compartment. The flares may be independently released by the pilot by means of a system of flexible cables between a quick-release mechanism above the port pilot's seat and a double catch fitted to each chute. Operation of the release gear allows the flare to emerge through a flap in the hull side which automatically returns to the closed position when the flare is clear of the aeroplane.

ELECTRICAL

General

144. The aeroplane has two separate electrical systems, a 12-volt system for general services and a 24-volt system for engine starting and flap operation. Wiring diagrams for the 12-volt system are given in figs.22 to 24 and for the 24-volt system in fig.25.

12-volt system

145. The 12-volt system is provided with two generators, a 12-volt 500-watt generator directly coupled to the port inner engine and a 12-volt 350-watt dynamotor directly coupled to the auxiliary power unit (see paras.118-120). The dynamotor is employed to start the auxiliary power unit, power being derived from a 12-volt 40-amp. hr. accumulator; a pushbutton switch on the main control panel is provided for this purpose. The cables from both generators are run to the main control panel which is situated immediately behind the wireless operator on the front spar frame. A generator change-over switch is provided for controlling these two generators.

146. Besides the services described in the following paragraphs, the 12-volt system also provides power for the following:-

(i) Drogue signals (see para.191).

(ii) Flap position indicator (see para.53).

(iii) Camera electrical control (see para.171).

(iv) Bomb electrical gear.

(v) Heating of A.S.I. pressure head (see para.168).

(vi) Automatic controls (see para.55).

(vii) Optical gun sights (see para.140).

147. Generator and dynamotor control.- The main engine-driven generator control (see fig.22) consists of a standard accumulator cut-out, a fixed resistance, a half-charge switch, a 0-20 voltmeter and a 20-0-20 ammeter.

148. The dynamotor control (see fig.22) consists of a rheostat for voltage regulation and is coupled to the 12-volt, 40-amp. hr. accumulator, the accumulator cut-out, voltmeter and ammeter referred to in the previous paragraph.

149. Accumulators.- Whenever an accumulator is removed from the aeroplane the loads must be connected to the special dummy terminal block provided. It is imperative that the engine should not be run unless the accumulator loads are properly connected to the accumulator or to the special terminal block. This terminal block will be found adjacent to the accumulator stowage, and is wired to the system in such a way as to prevent excitation of the generator if the aeroplane is flown without an accumulator. This is effected by connecting the

accumulator negative lead to the generator positive lead through a resistance, thereby converting the generator control winding into a powerful shunt winding of de-magnetizing polarity, when the control switch is in the "charge" position. It is immaterial which way round the connections are made as the two dummy terminals are electrically connected. A small resistance (about 1 ohm) is incorporated in the terminal block to limit the short circuit current that would flow owing to residual generator voltage with the control switch in the "off" position. A faulty connection in this circuit will lead to excessive voltage and damage to the generator and any services connected to it if the control switch is inadvertently placed in the "charge" position.

150. The 2-volt accumulators (five in number) are coupled in series and are charged automatically by either generator (<u>see</u> fig.22). The main switch, rheostat and ammeter are on the main control panel.

151. <u>Fuses</u>.- The fuses for all the 12-volt circuits are located in the 12-volt control box at the front spar frame. Each circuit is numbered and a list of the fuses, giving the circuit number and the capacity of the fuse, is provided on a label fixed to the inboard face of the 24-volt control box (<u>see</u> para.163).

152. <u>Navigation and identification lamps, etc</u>.- The port, starboard and tail navigation lamps and the steaming lamp are controlled by switches on the pilots' instrument panel; the steaming lamp is mounted inside the wireless aerial mast.

153. The mooring lamp (a single white hemispherical lamp) is incorporated with the awning mast which plugs into a socket on top of the hull just aft of the rear spar frame on the centre-line of the aeroplane. There is a 2-pin socket for this lamp in the top sheeting inside the aeroplane just forward of the rear spar; the switch for the lamp is located adjacent to the forward entrance hatch and is operated from outside the hull. The stowage position for the mast is in the forward compartment on the starboard side.

154. The upward identification lamp is mounted on top of the hull on the centre-line of the aeroplane just aft of the pilots' compartment; the downward identification lamps - one red, one green and one clear - on either side of the aeroplane are fitted on the lower surface of the main plane slightly aft of the rear spar and inboard of the inner engines. In flight the downward identification lamps are accessible by entering the main plane from the hull or, if the aeroplane is beached, by removal of the transparent panels beneath the lamps.

155. The wiring diagram for the identification lamps is given in fig.24. The switchbox and morsing key for all the identification lamps, and a 3-unit switchbox for the downward lamps are mounted on the pilots' instrument panel.

156. <u>Interior lighting</u>.- A wiring diagram for the interior lighting is included in fig.23. In the aft portion of the hull, 2-way switching is provided. On the aft side of the bulkhead dividing the crew's quarters, 2-way switch, in conjunction with a

similar switch at the aft entrance hatch, controls the cabin lamp over this compartment and also a lamp amidships. Another 2-way switch at the aft entrance hatch, in conjunction with a switch on the port side just forward of the tail gun turret, controls a lamp at the flare launching chute and also a lamp for the tail gunner.

157. Landing lamps.- Two swivelling landing lamps (see A.P.1095) are mounted in the leading edge of the port plane outboard of the outer engine nacelle. They are controlled by a 2-way and "off" change-over switch mounted on the side of the engine throttle box. A change-over switch operates two magnetic relay switches situated inside the control panel (see fig.22).

158. The movement of the lamps is controlled from a lever mounted on the pilots' throttle box by twin runs of flexible cable over pulleys to a lever mounted on an adjacent drag member. A single run of cable is connected between the lever and the lamp and passes round pulleys fixed to the port front spar boom. Return movement of the lamps is effected by means of tension springs fixed to each lamp casing. The lamps are accessible by removing the transparent windows in the nosing or alternatively, by entering the main plane structure through the outboard maintenance door.

24-volt system

159. The 24-volt electrical system provides current for the flap operating motor (see para.52), the engine starting motor (see para.108) and the flame switches for the fire extinguishing system (see para.176).

160. A 24-volt 500-watt generator is directly coupled to the starboard inner engine and the cable from the generator is led through a control panel situated on the front spar frame below that for the 12-volt system.

161. Generator control.- The control consists of a change-over switch, an accumulator cut-out, a resistance unit for half-charge conditions, an 0 - 40 voltmeter and a 10-0-10 ammeter.

162. Accumulators.- The accumulators consist of two 12-volt accumulators connected in series. They may be charged separately by the 12-volt dynamotor by changing over the accumulator leads. Whenever an accumulator is removed from the aeroplane the leads must be connected to the dummy terminal block provided adjacent to the accumulator stowage. It is imperative that the engine should not be run unless the accumulators are properly connected to the accumulator or to the special terminal block.

163. Fuses.- The fuses for all the 24-volt circuits are located in the 24-volt control box at the front spar frame. Each circuit is numbered and a list of the fuses giving the circuit number and the capacity of the fuse is provided on the label on the inboard face of the box (see also para.151).

Bonding

164. A bonding diagram is given in fig.26.

FLYING AND NAVIGATIONAL INSTRUMENTS

General

165. A standard flying instrument panel is fitted on the port side of the pilots' instrument panel and the instruments are operated by a vacuum system from engine-driven pumps. A rate-of-climb indicator on the port pilot's panel, and altimeters and airspeed indicators, at various points, are connected to the pressure head on the aerial mast.

Flying instruments

166. The main flying instruments are fitted to various instrument panels and are driven by a vacuum and a pressure head piping system (*see* paras.167 and 168). The flying instrument panel is fitted on anti-vibration mountings on the port side of the pilots' panel and has fitted to it a turn indicator, an artificial horizon and a direction indicator; an additional turn indicator is fitted to a panel on the starboard side of the instrument panel. A rate-of-climb indicator is fitted on the port pilot's panel and an altimeter and airspeed indicator are fitted to the navigator's, the bomb-aimer's and the port and starboard pilot's instrument panels. In addition to these items, a course-and-height indicator is stowed on the left-hand side of the port pilot's seat, a fore-and-aft level is positioned on the starboard pilot's instrument panel and Mk.II and Mk.III luminous clocks are fitted to the pilots' and navigator's panels, respectively. An air temperature thermometer is housed in a recess on the starboard side of the hull below the navigator's panel and is connected to a temperature gauge on the navigator's instrument panel.

167. Vacuum system.- The instruments on the flying instrument panel are driven by vacuum systems (*see* fig.27) from pumps on each port and starboard outer engine. Lubrication of the pumps is effected by a feed pipe from the engine supply, the oil passing through the pumps to separators secured inside the nacelle, and draining back to the engine sump. Fitted to the air suction connection on each pump is a relief valve which is adjustable to give the required vacuum and is connected to control cocks on either side of the engineer's compartment; the cocks are employed to isolate the port or starboard system as required. The vacuum pipes lead direct from the cocks to the instruments and a gauge is fitted to the pipeline and is positioned so that it is visible to the port pilot. On no account should the pumps be fitted and run on the engine unless the oil supply and drain pipe are properly connected up.

168. Pressure head piping.- The rate-of-climb indicator, the altimeters and the airspeed indicators are operated by an air pressure system (*see* fig.29) through tubes connected to the pressure head at the top of the aerial mast. Lengths of rubber hose are inserted in the system to enable the pilots' flying instrument panel to be quickly and easily detached from the main panel. The position and angular setting of the pressure head is shown in fig.28. The pressure head is electrically heated from the 12-volt system; the supply is taken from a terminal block (*see* fig.23) at the top of the aerial mast and a switch is mounted on the port side of the hull within easy reach of the pilot.

Navigational instruments

169. The compasses fitted comprise a P.4 compass at the port pilot's knee level, a P.6 compass at the starboard pilot's knee level, an O.6 hand bearing compass and holder stowed on the starboard side of the front spar frame, and an O.2 compass stowed above the navigator's table and interchangeable at both the port and starboard observation hatches. A stowage box for a Mk.I height-and-airspeed computor is provided on the starboard side of the mooring compartment near the nose and stowage for a Mk.VIII sextant is attached to the hull side above the navigator's table. Writing pads are provided for the pilots and the bomb-aimer and a yacht type clock is fitted to the forward bulkhead in the wardroom.

MISCELLANEOUS

Photographic equipment

170. An F.24 camera is normally stowed at the vertical photography station (see fig.31). A tubular mounting is also provided (see fig.30) which enables the camera to be used for oblique photography at either the port or starboard side of the crew's after quarters. For sighting purposes a ring and bead device is fitted in the pilots' compartment to enable the aeroplane to be accurately banked. The sight is stowed on the starboard side of the compartment just below the coaming.

171. The electrical supply for the camera (see fig.32) is obtained from the 12-volt system (see paras.145-151), either by means of 2-way sockets suitably located or from 5-way sockets on flexible leads. Stowage bags are provided for the leads when not in use.

Heating, ventilation and extraction system

172. The heating and ventilating systems (see fig.33) consist of two separate pipe circuits throughout the aeroplane, one delivering cold air through independent louvres and the other supplying warm air through a number of distributors positioned at or about floor level. The heating of the air is effected by means of steam generated in a muff type boiler round the exhaust pipe on the port inner engine and delivered to a combined air heater and condenser that is fixed to the roof in the engineer's compartment. A closed system is obtained between the heater and boiler by a pipe that conveys the condensate back to the boiler. A steam regulating valve is incorporated in the steam delivery pipe near the heater, operation of which increases or decreases the volume of steam entering the heater thereby affecting the temperature of the air supply. A safety valve is also fitted to the delivery pipe and is set to function at 4 lb. per sq.in., the normal working pressure of the system being approximately ½ lb. per sq.in. The water system may be drained by operating a small cock fitted in the pipeline, and filling is effected through a filler neck on the side of the air heater.

173. Fresh air for the ventilating and heating systems enters the leading edge of the port main plane at the root, at a point outside the airscrew disc, a grill being fitted to prevent the entry of large objects. An air filter is positioned just behind the grill with a butterfly valve between, to cut off the air supply when the filter is

extracted for cleaning, etc. A trap and drain tube is fitted to the main trunk aft of the filter and any liquid entering is discharged through the lower surface of the main plane. The trunking then enters the hull between the spar frames and divides into an inner and outer pipe, [illegible] the air heater, and the latter runs direct to the individual louvres. The amount of hot air entering the system is regulated by a valve positioned behind the air heater.

174. Before flight, ensure that the system contains the requisite quantity of water by filling through the filler neck on the side of the heater. During flight, control the temperature of the air by operation of the steam valve, leaving all the air valves fully open, and periodically inspect the air filter and clean it if necessary. <u>In certain cases it may be found that sufficient heat is not obtained even with the steam valve fully open. If this occurs it is permissible to close slightly the air valve behind the heater until the required temperature is reached but steam must not be allowed to issue from the heater vent pipe, otherwise loss of water will occur and result in failure of the system.</u> Whilst running up, taxying or landing, ensure that the air valves are open and the steam valve is shut.

175. An extraction system entirely automatic in operation takes air from the galley, wardroom and lavatory. The system consists of metal ducts that terminate at a point of low pressure on the upper surface of the starboard main plane. A drain tube is fitted to the outlet pipe to prevent water from entering the system.

<u>Fire extinguishing system</u>

176. This system comprises a fire extinguisher container and piping in each engine nacelle. The extinguishers can be brought into action by any one of three methods. First by pushbuttons situated on the roof over the pilot's head, or by an automatic multiple crash switch located in the bottom of the hull, near the nose, on the port side. The third method by which the extinguishers may be brought into action is by either of the two flame switches which are fixed on the forward side of each fireproof bulkhead, one near the top and one near the bottom (<u>see</u> fig.34).

177. Three methyl bromide No.3 fire extinguishers are carried in the hull, one on the lower deck at the galley aft bulkhead, one on the upper deck on the bulkhead aft of the engineer, and one on the starboard side of the hull just forward of the rear entrance door.

<u>Bilging system</u>

178. The main bilge pipe (<u>see</u> figs.35 and 36) runs longitudinally through the hull and is connected to small branch pipes from the various watertight compartments. The branch pipes are fitted with hand-operated stop valves. The suction pipe connecting the main bilge line to the auxiliary power unit pump (<u>see</u> paras.118-120) runs by way of the front spar frame, and has a coarse mesh filter positioned on the starboard side of the galley. A delivery pipe is connected to the outlet side of the power unit pump and bilge water is discharged through the lower surface of the main plane.

179. Alternatively, a hand-operated portable pump is supplied, the suction hose of which is attached to a connection in the main pipe at the crew's quarters. The connection is furnished with a blanking cap which should be removed only when the hand pump is employed. The discharge hose fits another connection on the starboard side of the hull and must always be connected before commencing bilging operations. If required, the hand pump may be detached from its stowage, fitted with a variety of nozzles stowed adjacent and employed to remove local bilge water. The hand pump is also used to remove bilge water from the wing tip floats (see para.34 and fig.37) and should be connected to the rubber tubing (stowed near the nozzles) for bilging operations from a dinghy.

Parachutes and safety harness

180. Stowage boxes for parachutes are fitted in the mooring compartment above the anchor, on the forward side of the port amidships gun station, on the forward side of the starboard amidships gun station, on the tail escape door, at the forward end of the navigator's table and behind the wireless operator's seat (two). Stowage for a seat type parachute is incorporated in both the port and starboard pilots' seat structure.

181. Safety harness belts are fitted to the port and starboard pilot's, wireless operator's, navigator's and engineer's seats, and also the tail gunner's rest seat and turret seat and the bow turret seat.

First-aid outfits

182. Stowages for three first-aid outfits are provided on the upper deck at the rear spar frame.

Sea markers and flame floats

183. Stowage for 12 aluminium sea markers is fitted to the starboard side of the pilots' compartment and racks for 8 flame floats are attached to the top of the starboard control pedestal and between the pedestal and the hull side. Stowage for an additional 12 flame floats is fixed to the rear portion of the upper deck and a rack for either 10 aluminium sea markers or 10 flame or 10 smoke floats is fitted on the crate for the reconnaissance flares (see para.141).

Galley equipment

184. Full domestic equipment is located in a compartment between the officers' wardroom and the crew's quarters. A portable cooking locker incorporating a sink, a No.1 Clyde cooker, a draining rack and a fresh water tank are positioned on the after bulkhead and trays for cooking utensils, a food cupboard, a waste bin, a paraffin tank and two water tanks are placed at the forward bulkhead. The crockery stowage is fitted above the food cupboard and two extra water tanks are stowed on the floor. On the port side of the galley is fixed an ice-chest.

Lavatory

186. The lavatory and wash basin are fitted in a compartment that opens off from the starboard side of the mooring compartment. A tank fitted to the roof supplies the lavatory and is filled by a pump and permanent suction pipe from the planing bottom. The wash basin is supplied from a tank fitted on the forward side of the front bulkhead and is refilled by hand.

CHAPTER VII

GROUND AND MARINE EQUIPMENT

MARINE EQUIPMENT

General

186. The aeroplane is provided with all the necessary marine equipment including a boat-hook, drogues, oars and two dinghies - one stowed in the afterpart of the hull and the other stowed in the mooring compartment.

Mooring gear

187. A retractable main mooring bollard is fitted in the bow and a large fixed eye for anchoring purposes is incorporated in the rear step of the hull. The main mooring eye is situated on the keel near the bow and the towing pennant stowed in the mooring compartment may be fitted to the eye through the bomb sight door. Alternative anchor mooring is provided by a Mk.XIIA ground anchor stowed on the port side of the bow compartment and attached to an anchor chain running over a winch into a locker built beneath the floor (see fig.41). The chain is fixed to a strong point on the keel and a chain stopper, secured similarly in front of the chain fixing, maybe attached to the chain at any point and so permit any desired length of chain to be paid out.

188. The main mooring bollard (see fig.41) is on the port side of the bow compartment and is permanently fixed at its lowest point to the hull structure by a fork joint. To erect the bollard, first remove the drop-nosed pin from the stowage bracket and hinge the top half of the bracket over. Lay hold of the bollard at the top end (aft end in stowed position), swing it over horizontally until clear of the floor and hoist upward and forward to the recess in the deck coaming. Engage the handscrews on either side of the bollard and adjust the tubular stay to pick up the hole in the coaming. Fix the stay in position with a similar handscrew.

189. The front gun turret is retractable to permit mooring operations to be carried out from the bow compartment. Movement is effected by means of a handle inside the hull geared to a cross-shaft athwartships, which is positioned on the roof just aft of the fully retracted position. Chain sprockets are pinned to each end of the cross shaft which takes a run of cable and chain forward to the sliding scuttle.

Drogues and signalling system

190. The drogues are stowed on the port and starboard sides of the galley. Their use is illustrated in fig.42.

191. A drogue signalling system, of which the wiring diagram is included in fig.23, is installed. It comprises a 3-unit selector switchbox adjacent to the pilot's left hand, a 3-unit receiver switchbox in the galley, with an adjacent buzzer wired in parallel, and five single

unit indicator lamps, complete with pushbuttons, for the bow gunner, pilot and wireless operator, and in the bomb compartment and the aft quarters; the last lamp is situated on the underside of the amidships gun deck. Each of the single unit lamps, with the exception of the pilot's, has a buzzer adjacent to and connected in parallel with it.

Awnings and ventilators

192. A large awning is provided for use while on the water in tropical climates. When erected, the awning covers the pilots' compartment and also a large part of the hull (see fig.39). Waterproof covers are supplied for the bow and tail gun stations, the engines and also the variable pitch mechanism on the airscrew hubs. Six ventilator scoops are stowed behind the port amidships gun station and may be used at any of the opening portlights to assist in ventilating the hull under tropical conditions.

GROUND EQUIPMENT

Beaching chassis and tail trolley

193. The beaching chassis (see fig.40) has a port and starboard unit, each consisting of a central strut with a detachable tubular outrigger arm at approximately a third of the way along its length and mounted on two Dunlop wheels fitted with pneumatic tyres. A flotation cylinder is built on to the main strut just above the wheels and the outrigger is supported by a similar cylinder midway. For stowage or handling on the slipway the main units are arranged to take a horizontal position and a castor wheel is attached to the upper end of the main strut to facilitate transport. In this attitude the chassis may be run down the slipway to the water, axle first, the castor wheel removed and a rope hitched round the top of the strut ready for towing out to the aeroplane.

194. Attachment of chassis to aeroplane.- The procedure for attaching the chassis to the aeroplane is as follows:-

(i) Fit and screw up the ring bolt into the lower front spar boom just outboard of the root, and hang the block and tackle on it.

(ii) Insert the main fixing pin at the top of the spar frame and secure it by the reversible nut on the inside. The nut is screwed on to the inside of the sprocket when not in use.

(iii) Screw up the knurled cap on the fixing pin until contact with the spar boom is just made, and lock with the nut. A spanner is provided for this purpose but it should not be used unless absolutely necessary.

(iv) Screw out the front and rear lower attachment pins to the full distance governed by the stops. The distance between the hull side and the hole in the pins should be approximately 2 in.

(v) Float the chassis out to the aeroplane and manoeuvre it down the side of the hull with the top end of the strut inclined forward as shown in fig.40.

(vi) Connect the block and tackle to the ring on the main strut, haul the chassis to a vertical position, and fit the tubular stop. To avoid possible damage to the hull it is advisable always to remove the stop before attempting to raise or lower the chassis.

(vii) Remove the rubber buffer from the top of the main strut, haul the chassis to the correct position, and insert the main top and bottom fixing pins.

(viii) Tow or carry the detachable strut out to the aeroplane, and fix it between the main strut and the hull by the attachment pins.

(ix) Remove the chain block and tackle.

195. Tail trolley.- The tail trolley is arranged to float an inch or two higher than the correct depth for attaching at the rear step, but it will be found comparatively simple to float the trolley to the stern and draw it forward to the correct position. The attachments on the trolley should be positioned in fittings on the hull structure and the handwheels turned to fix the trolley in position. The handles should not be overtightened. A drop catch is fitted to lock the trolley steering arm fore-and-aft but control may be arranged by forming a rope loop round the arm, passing the rope through the aft towing eye and withdrawing the catch.

196. Handling the aeroplane.- In order to move the aeroplane sideways to any desired position, the main axles are pivoted laterally. The wheels can be turned by raising a pair of drop catches in each slotted capstan plate and fitting a tracking pole in its socket on the axle. The tail trolley is rotatable in a normal manner about its rolling base and handling ropes can be attached to the rear towing eye and to each main strut above the wheels.

197. Removal of chassis and trolley.- For removal of the chassis and trolley, spherical projections will be found at the base of each beaching chassis strut and on a collar at each tail trolley wheel. These are used to locate a special beam used in conjunction with standard 8-ton screw jacks. Trestles are also supplied to support the trolley temporarily so that the jacks and beams may be removed if required.

Hydraulic jacking trestles

198. Each jacking trestle consists of a tripod framework built up from channel- and angle-section iron and fitted with a hydraulic oil ram mechanism at its upper end. A balanced beam is pivoted at the top of the ram and two roller fittings pick up special seating pads affixed to the underside of the main plane. The top portion of the tripod, complete with ram and beam, may be easily detached from the rest of the structure for transport purposes. Tracking wheels are fitted to each tripod foot to enable the trestle to be run under the aeroplane, or for handling in the hangar. The wheels may be locked at the desired angle of travel by means of drop catches and capstans. Attached also to the trestle foot are screw devices employed to raise the trestle initially, and also to level it off before lifting the aeroplane. The ram is raised by operation of a pump handle at the base of the casing and the oil is contained in a tank fixed higher

up the shaft. A socket is secured to the rear end of the beam for insertion of a ball-headed adjustable jacking post, which is employed when raising the tail to remove the tail trolley, for setting the aeroplane to the rigging attitude or for fitting the non-magnetic cradle (see para. 202).

199. Operation of jacking trestles.- Personnel operating the hydraulic jacks should endeavour to control the port and starboard units simultaneously and thus keep the aeroplane level laterally. For simplicity, the following operational notes apply to a single jack:-

(i) Position the front and rear jacking pads on the lower surface of the main plane at the spar booms. The jacking pads are stowed in the trestle tool box.

(ii) Balance the pivoted bearing beam at the top of the ram, by fore-and-aft adjustment of the sliding weight.

(iii) Wheel the trestle into position so that the beam lies fore-and-aft and the roller fittings are directly beneath the pads on the main plane.

(iv) Screw up the tracking wheels clear of the ground, so that the trestle rests on the adjustable foot.

(v) Raise the trestle initially and set it level by rotating the nuts on the adjustors. A spanner for this purpose is stowed in the trestle tool box.

(vi) Inspect the oil level in the reservoir and fill if necessary (see para. 201).

(vii) Slowly operate the pump handle to raise the ram to the main plane and ensure that the roller supports on the beam enter the pads fitted to the main plane.

(viii) Swing the rod gauge into position and continue pumping until the aeroplane reaches the desired height. The ram has reached its maximum permissible extension when the rod gauge fits beneath the shoulder of the top fork.

(ix) Insert the safety pins in the lowest possible holes in the ram shaft and screw up the adjustable collar until it just touches the pins. The danger mark, a red line painted on the collar, must never be allowed to appear above the tripod apex casting.

200. Fitting of jacking post.- To fit the jacking post, with the hydraulic rams extended, proceed as follows:-

(i) Position the post beneath the socket at the end of the ram beam.

(ii) Rotate the upper screw until the ball enters the socket and insert the locking pin to prevent further rotation.

(iii) Turn the lower adjustor with the tommy bar supplied until the load is just felt.

(iv) Gradually lower the hydraulic ram until the tail takes up the required position.

Note.- It is of the utmost importance when removing or attaching the beaching gear using the jacking trestles, that the beaching legs are always removed first and the trolley is fitted first, owing to variation of the C.G. position if they are fitted contrary to these instructions.

201. Filling oil reservoir.- To fill the oil reservoirs, proceed as follows:-

(i) Open both taps at the ends of the oil connecting pipe.

(ii) Release the lowering screw handwheel.

(iii) Unscrew and extract the vent plug in the side of the pump body.

(iv) Remove the filler cap at the top of the reservoir and fill with oil, anti-freezing, type A (Stores Ref. 34A/43 and 46) until it begins to run from the vent hole.

(v) Replace the vent plug and completely fill the reservoir.

(vi) Replace the filler cap and screw up the lowering handwheel.

Note.- The connecting pipe taps should be left open until the trestle is prepared for storage, and then shut to prevent possible oil leakage. An oil filter is incorporated in the filler and to remove it for cleaning it will be necessary to detach the tripod bracing angle immediately above the filler cap.

Fitting of non-magnetic cradle

202. With the aeroplane on the beaching chassis and tail trolley, the non-magnetic cradle should be fitted for compass adjustment, as follows:-

(i) Jack up the aeroplane as described in para. 199 and remove the beaching chassis.

(ii) Disconnect the tail trolley attachments, raise the tail clear as described in para. 200, and remove the trolley.

Note.- The hydraulic jacks should raise the aeroplane high enough to enable the non-magnetic cradle to be wheeled into position.

(iii) Fit the 8-ton jacks (supplied for chassis and tail trolley wheel changing) under the jacking points provided on the cradle and raise the cradle until it becomes possible to slide the wheel axles from their housings.

(iv) Operate the jacks and lower the cradle back to turntable.

Note.- The steel tie-rods, normally fitted to the cradle for connection to the hull, must be detached to avoid interference with the aeroplane compasses.

(v) Slowly lower the aeroplane on to the cradle by turning the releasing valves on the sides of the hydraulic rams.

(vi) Remove the jacking trestles and posts.

Removal of universal beaching trolley

203. With the aeroplane on the non-magnetic cradle and trolley, the universal beaching trolley may be removed as follows:-

(i) Unscrew and extract the ten bolts securing the cradle to the trolley and remove the positioning chain.

(ii) Connect the tie-rods on the cradle to the beaching chassis fittings on the hull (see para.194).

(iii) Fit the hydraulic jacking trestles and raise the aeroplane clear of the universal trolley.

(iv) Remove the cradle wheels and lower the aeroplane to the ground.

(v) Remove the jacking trestles and tie-rods.

Aeroplane slinging

204. The aeroplane sling should be attached to the two points on the centre-line of the hull between the main planes (see fig.39). Flush-fitting covers at each position must be removed to give access to the slinging fittings. The main connecting pins are normally fitted in the sling forks and retained by split-pins and these should be opened only sufficiently to prevent them from falling out.

CHAPTER VIII

RIGGING, DISMANTLING AND MAINTENANCE

RIGGING

Hull

205. For checking longitudinal and transverse levels, nine datum blocks are fitted inside the hull. The blocks are positioned in groups of three, as shown in fig.43, and are located as follows:-

(i) Starboard side, lower deck in wardroom (forward).

(ii) Starboard side, lower deck in wardroom (aft).

(iii) Port side, lower deck in wardroom (aft).

(iv) Port side, in crew's quarters, above bunk (aft).

(v) Port side, below amidships gun station platform.

(vi) Starboard side, below amidships gun station platform.

(vii) Port side, front tail plane spar frame.

(viii) Port side, aft of front tail plane spar frame.

(ix) Starboard side, front tail plane spar frame.

206. When checking the hull for rigging position, the straightedges should be placed longitudinally and transversely on the datum blocks and a spirit level used for checking purposes. The hull will be in correct rigging position when the straightedges are horizontal.

Aerofoils

207. The main planes and tail unit should be periodically checked for squareness and symmetry by the use of rigging lines between the various datum marks on the hull and aerofoils as shown in fig.46. In addition, the dihedral and incidence settings should be checked by means of the boards supplied, as shown in fig.44.

208. To check the main or tail plane incidence, place the appropriate pair of incidence boards on the locating marks painted on the upper surface of the aerofoil, place a clinometer longitudinally on each board and read off the incidence. To check the transverse level of the tail plane, place the boards on similar locating points on the upper surface of the aerofoil, lay a straightedge transversely on the boards at the positions marked, and place a clinometer on the straightedge. When checking the dihedral of the main planes, the boards may be dispensed with and a straightedge carefully placed along the top front spar boom; place a clinometer anywhere along the length of the straightedge and read off the dihedral.

Flying controls

209. The ranges of movement of the control surfaces are shown in figs.6 to 10 and are also listed in the Leading Particulars at the beginning of this publication. After re-adjustment or re-assembly of any control circuit, great care must be taken to ensure freedom from backlash and lost motion, and checks must be carried out to ensure that the neutral positions of the handwheels, rudder bars and control columns coincide with the midtravel settings of the ailerons, rudder, and elevators respectively; in the neutral position, the control column is 3° forward of the vertical. When the controls are correctly fitted and tensioned up, the dashpot piston rod should extend approximately 1½ in. from the barrel.

210. Aileron droop.- It is very important that the ailerons should not be set with downward droop and also that the upward droop should not be greater than that indicated in fig.45. The maximum upward droop, angle (x), between the points (a) and (b) should be equal to half the angle (y) between the centre of the nose radius (c) in the neutral position (d) and the intersection point (e) of the centre (c) and the lower main plane profile.

211. Trimming tabs.- The fixed aileron trimming tabs should be set as necessary after flight trials and should need no further adjustment. The same conditions apply in the case of the aileron trimming tabs as those given for the ailerons, i.e., the tabs must never be set downwards. After re-connecting or re-adjusting the elevator and rudder trimming tabs, great care must be taken to ensure that, in the neutral position, the centre-line of the tab is in direct alignment with the centre-line of the respective control surface.

DISMANTLING

General

212. Before attempting to remove any control surface or aerofoil, it will be necessary to fit or position supporting trestles or slings. The removal of a main plane is a major operation and, if plenty of lifting tackle is not available, it may be necessary to remove the engines, fuel tanks, flaps and ailerons in order to reduce the weight.

Rudder

213. A jury ladder to assist in dismantling the rudder is stowed along the starboard side of the catwalk between the main upper deck and the amidships gun station; the ladder should be connected to the eyeplates on the fin. The procedure for removing the rudder is as follows:-

(i) Disconnect the trimming tab control chain behind the rudder torque tube in the hull.

(ii) Release the rudder extension tube at the upper sleeve by carefully extracting the taper pins.

(iii) Disconnect the trimming tab lubrication pipes at the unions near the upper torque tube sleeve.

(iv) Release the servo tab operating shaft at the rudder hinge.

(v) Remove the split-pins, unscrew the nuts and extract the four bolts securing each rudder hinge plate to the fin hinge arm.

Note.- It is not necessary to disconnect the main flying controls or the torque shaft hinges.

Elevators

214. To remove the elevators, proceed as follows:-

(i) Disconnect the continuous trimming tab control chain behind the elevator torque tube in the hull.

(ii) Release the elevator extension tube at the hull side by carefully extracting the taper pins.

(iii) Disconnect the trimming tab lubrication pipes at the unions near the torque tube sleeves.

(iv) Remove the split-pins, unscrew the nuts and extract the four bolts securing each elevator hinge plate to the tail plane hinge arm.

Note.- It is not necessary to disconnect the main flying controls or the torque shaft hinges.

Tail plane and fin

215. The procedures for removal of the tail plane and of the fin are similar, as follows:-

(i) Remove the elevator or the rudder.

(ii) Strip off the fabric closing strip at the root of the component to disclose the spar joints.

(iii) Disconnect each joint by unscrewing the nuts on the joint spindle, extracting the retaining collars, and carefully tapping the spindle to remove the expanding bushes.

(iv) Remove the split joint bush.

Ailerons

216. To remove an aileron, proceed as follows:-

(i) Disconnect the aileron controls at the forward ends of the dashpots.

(ii) Disconnect the bonding wire at the tip of the aileron.

(iii) Remove the access cover on the top surface at the outer hinge by extracting the screws round the perimeter of the cover and release the hinge disclosed by unbolting the spindle.

(iv) Hoist of the remaining hinges by removing the split-pins, unscrewing the nuts and extracting the three bolts securing each hinge support plate to the main plane hinge rib.

Main plane flaps

217. A main plane flap may be removed by detaching the operating screw through the detachable panel on the underside of the flap, unscrewing the bolts and removing the stops at the ends of the roller channels and allowing the flap to roll off.

Fuel tanks

218. To remove a fuel tank, proceed as follows:-

(i) Drain the tank.

(ii) Remove the manhole in the centre of the tank lid on the top surface.

(iii) Unscrew the nut and detach the special bush on the centre stay of the tank top.

(iv) Unbolt and remove all the fixing screws spaced round the cover, extract the tapered bolts in the ends of the transverse drag members and remove the members and the cover complete.

(v) Disconnect the fuel tank bonding wires.

(vi) Disconnect the fuel gauge controls, and the vent pipe on the tank top and also the main feed pipes at the tank sump.

(vii) Disconnect the jettison pipe (inner tank only).

(viii) Disconnect the cock control cables (middle and overload tanks only).

(ix) Unscrew the nut and detach the special bush on the centre stay at the tank bottom. An access hole is provided in the lower surface of the main plane for this purpose.

(x) Remove the tank by hoisting it with the slings fitted to each tank top.

Wing tip floats

219. To remove a wing tip float and its supporting structure, proceed as follows:-

(i) Release the bracing cables on the inboard and outboard sides of the float.

(ii) Remove the transparent fairings at the top of each support strut.

(iii) Slacken off the locknuts and remove the streamline bracing wires.

(iv) Unscrew the nuts and extract the joint pins at the top of the support struts.

Airscrews and engines

220. Personnel working on the engines or airscrews should fit the special safety belt that attaches to eyebolts on the engines, and the safety handlines should be fitted between the retractable posts in each engine nacelle (see fig.49). On each side of the engine nacelles, a part of the main plane nosing is hinged and may be swung down to form standing platforms. The doors can be opened by unscrewing the hand-wheels beneath circular covers in the top surface of the main plane. Before opening the maintenance doors ensure that the cowling gills are closed; when the doors are opened, switches incorporated in them break the engine ignition circuits.

221. To remove an airscrew, proceed as follows:-

(i) Open the maintenance doors on each side of engine nacelle and fit the maintenance cradles and gang plank (see fig.49).

(ii) Erect the hoisting derrick on the nacelle and secure it at each attachment point with the handscrews (see fig.47).

(iii) Fit the winch on the top surface of the main plane behind the engine nacelle, insert the securing bolts and tighten up.

(iv) Attach the airscrew hoist beam to the derrick by the centre hook and eyebolt at the base.

(v) Remove the pulley spindle bolt at the apex of the derrick, pass the hoisting cable and hook over the guide roller, derrick pulley and beam pulley and replace the spindle bolt.

(vi) Disconnect the airscrew pitch control.

(vii) Fit the airscrew sling to two blades by forming a loop in the cable and passing the ends through the loop.

(viii) Attach the hoist cable hook to the eye-ends of the airscrew sling and rotate the winch to take up slack in the cable.

(ix) Release the airscrew from the engine hub and ease it away from the engine by rotating the derrick screw adjuster.

(x) Lower the airscrew clear of the aeroplane by rotating the winch handwheel.

222. To remove an engine, proceed as follows:-

(i) Remove the airscrew.

(ii) Detach the airscrew hoist beam from the derrick and refit the hoist cable over the derrick pulley (see fig.48).

(iii) Remove the engine detachable cowling panels.

(iv) Disconnect all pipelines, control wires, rods and chains at the rear of the engine through the maintenance doors and sliding panels in the fireproof bulkhead.

(v) Disconnect the exhaust tail pipe.

(vi) Fit the engine sling, with the cable loop (which should be well padded) round the airscrew shaft and the shackles connected to the eyebolts on the rear crankcase.

(vii) Attach the hoist cable hook to the engine sling crossbar and rotate the winch handwheel to take up slack in the cable.

(viii) Extract the split-pin and unscrew the nut at each point securing the engine mounting to the nacelle mounting plate. The bolts fixing the mounting plate to the nacelle must not be interfered with.

(ix) Remove the gang plank.

(x) Ease the engine (complete with exhaust ring and gill cowling) away from the nacelle, using the screw adjustor integral with the derrick.

(xi) Lower the engine clear of the aeroplane by rotating the winch handwheel.

<u>Main planes</u>

223. A main plane should be removed as follows:-

(i) If the lifting tackle available is not adequate for removal of the main plane complete, remove the engines, fuel tank, ailerons, flaps and wing tip floats.

(ii) Remove both bomb support carriages and dismantle the worm traversing gear.

(iii) Unscrew the fixing bolts and remove the main plane root fillet fairing.

(iv) Disconnect all pipes, control wires, rods and chains, etc., at the hull side.

(v) Unscrew the nuts and extract the bolts between the drag angles on the hull side and main plane.

(vi) Remove the bolts securing the bomb carriage support beam to the large attachment plate on hull.

(vii) Release each main plane root joint by extracting all bolts and screws between the spar boom flanges and web and the stub end forgings.

<u>NOTES ON MAINTENANCE</u>

<u>Flying control dashpots</u>

224. The flying control dashpots should be filled periodically with anti-freezing oil, type B (Stores Ref.34A/55 and 56), or anti-freezing oil, type A (Stores Ref.34A/45 and 46), using one of the filler holes as an air vent. <u>It is imperative to ensure that no air remains in the dashpot barrel after filling.</u>

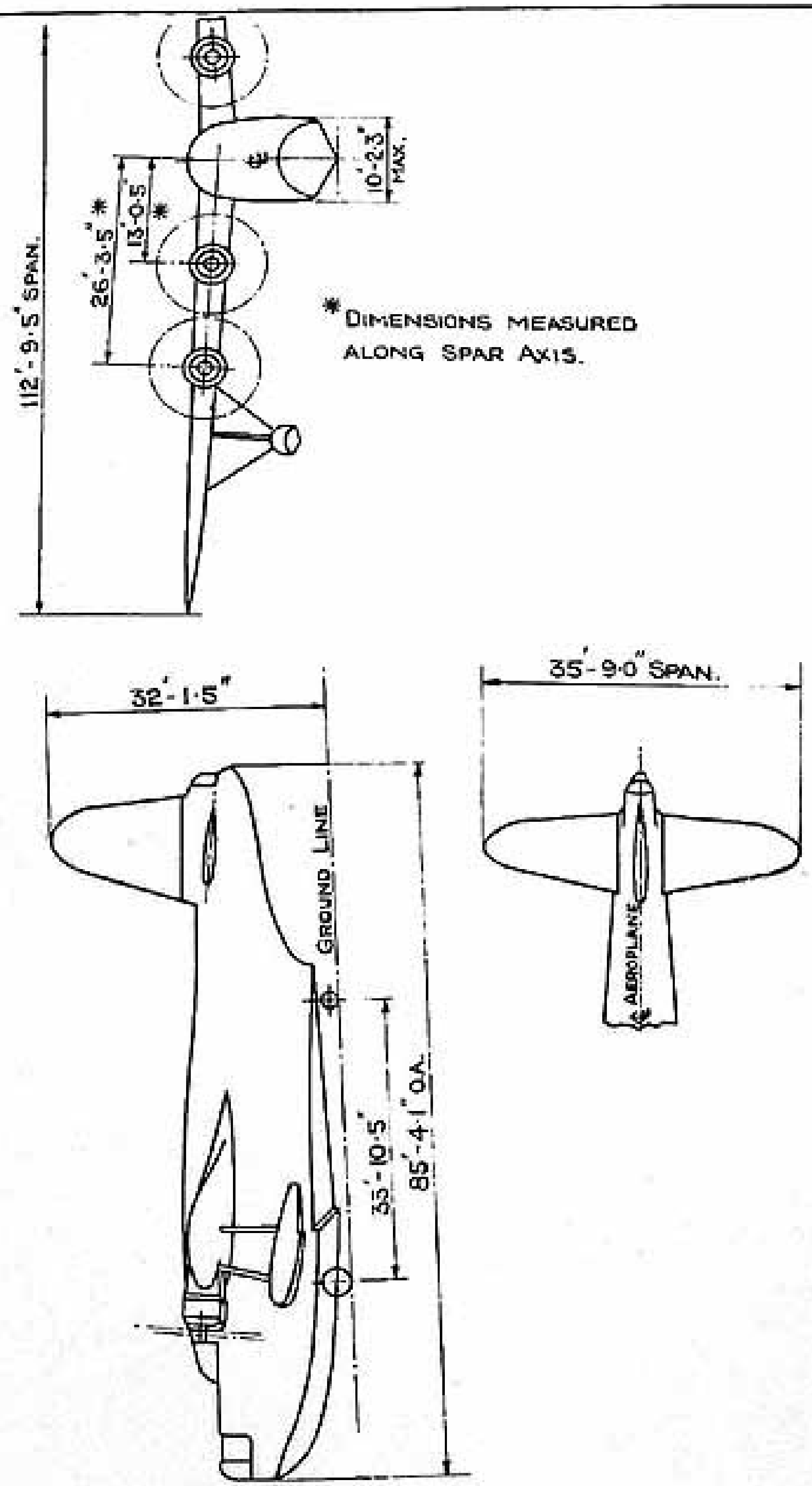
Lubrication

225. A lubrication diagram is given in fig.50. Some points to be noted in connection with lubrication are as follows:-

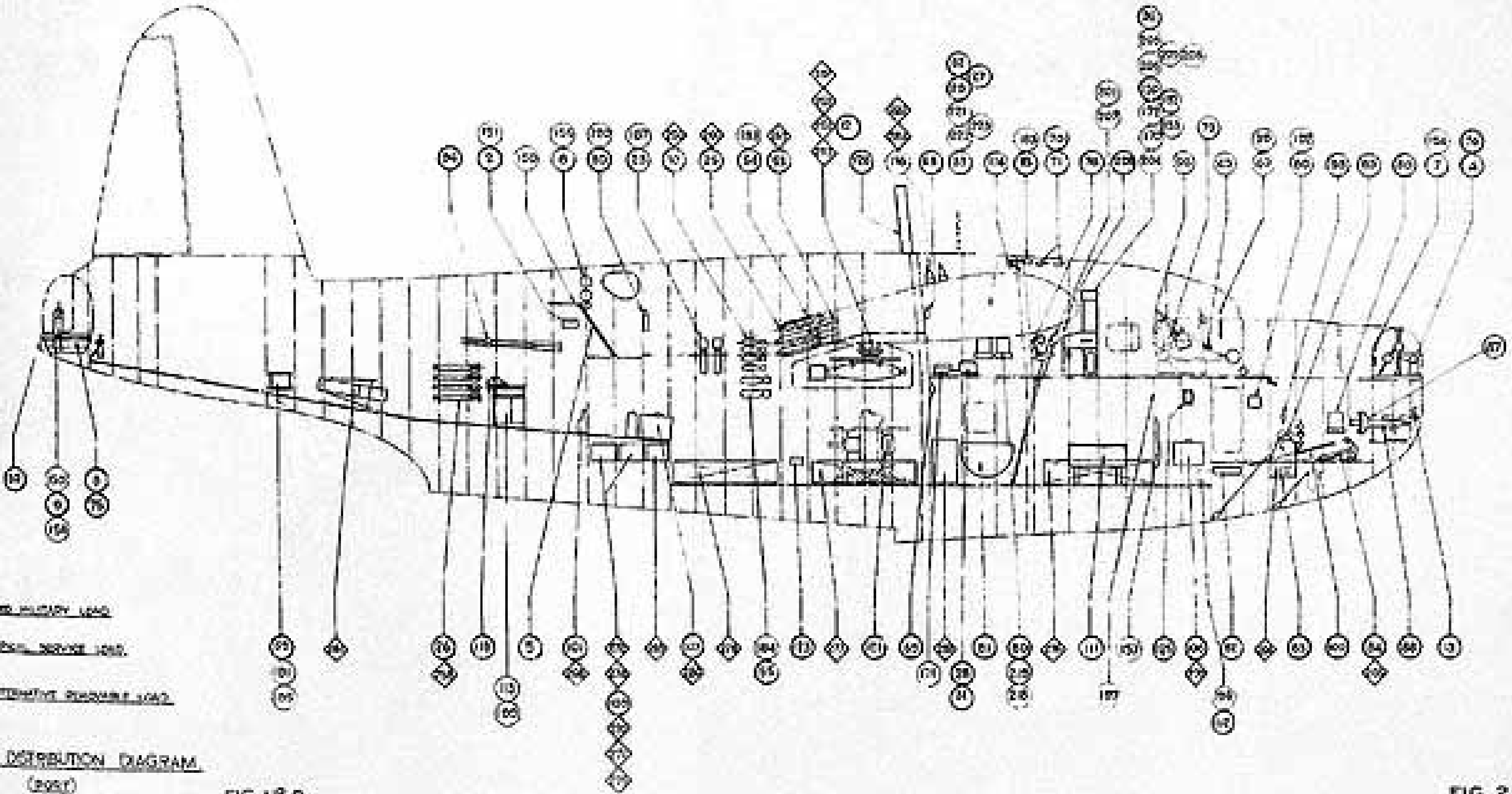
(i) The elevator, rudder and aileron main hinges are packed with anti-freezing grease (Stores Ref.34A/49) on assembly and need no further lubrication.

(ii) Owing to the inaccessibility of the trimming and servo tab hinges, grouped nipples are fitted inside the hull and are connected, through a junction box, to the hinges by small bore copper tubing. For the rudder, two nipples are fitted on the forward side of the lower torque tube sleeve and for the elevators the nipples are fitted on similar sleeves on the torque shaft across the hull. It is important that the lengths of the pipes from the junction boxes to the hinges are all identical to ensure that the hinges are lubricated simultaneously. Anti-freezing oil, type B (Stores Ref.34A/55 and 56) should be used.

(iii) The main flap drive and screw gearbox sumps must be recharged periodically to the level of the filler plugs with anti-freezing oil, type B.



MAIN DIMENSIONS. FIG. Nº 1.



○ FIXED MILITARY LOAD

○ TYPICAL SERVICE LOAD

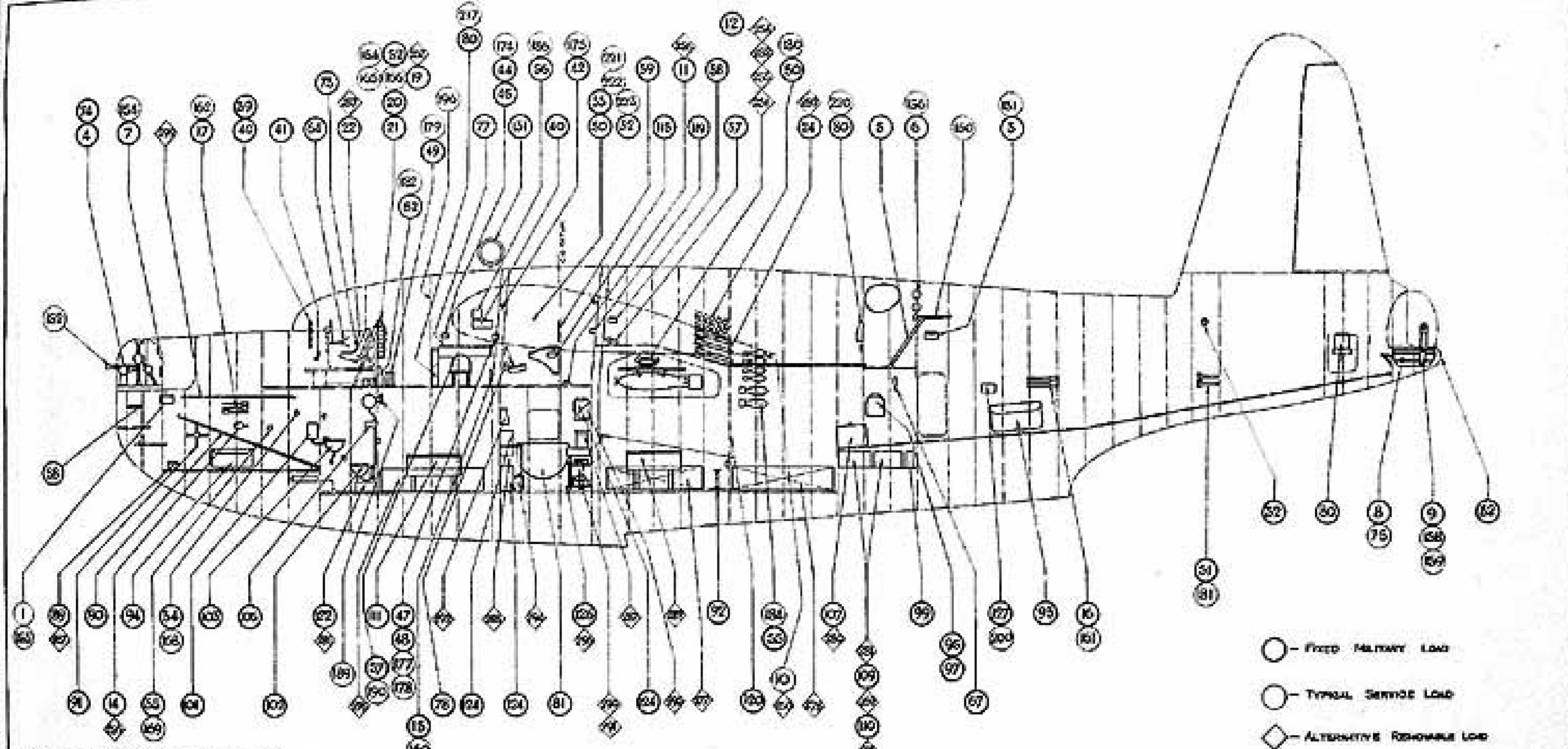
◇ ALTERNATIVE REMOVABLE LOAD

LOAD DISTRIBUTION DIAGRAM

(PORT)

FIG. Nº 2.

FIG. 2.



LOAD DISTRIBUTION DIAGRAM.
(STARBOARD)

FIG. No 3.

FIG. 3.

B.T.P.C.338/61

MILITARY LOAD (FIXED)

ITEM	DESCRIPTION
1	STOWAGE FOR HOLDALL (BOW)
2	STOWAGE FOR HOLDALL [illegible]
3	STOWAGE FOR HOLDALL [illegible]
4	FRONT TURRET
5	MID GUN MOUNTINGS (2)
6	MID GUN AMMUNITION PODS (2)
7	FIXED GUN AMMUNITION PODS (2)
8	REAR TURRET
9	AMMUNITION BOXES REAR GUN
10	STOWAGE FOR PRACTICE BOMBS [illegible]
11	BOMB WINCH STOWAGE & FITTINGS
12	FIXED BOMB & FUSING GEAR
13	BOMB SIGHT MOUNTING
14	BOMB SIGHT STOWAGE
15	STOWAGE FOR BINOCULARS
16	DISTRESS SIGNAL STOWAGE
17	DISTRESS SIGNAL STOWAGE
18	DISTRESS SIGNAL STOWAGE
19	SIGNAL PISTOL STOWAGE
20	PISTOL CARTRIDGE STOWAGE
21	PISTOL CARTRIDGE STOWAGE
22	STOWAGE FOR PISTOL FLARES
23	LAUNCHING TUBE [illegible]
24	G.S. FLARE STOWAGE (STARB'D)
25	G.S. FLARE STOWAGE (PORT)
26	G.S. FLARE STOWAGE (AFT)
27	ENGINE DRIVEN GENERATOR [illegible]
28	ACCUMULATORS 12V. 40 A.H. [illegible]
29	LANDING LIGHTS AND CONTROLS
30	ENGINE DRIVEN GENERATOR [illegible]
31	ACCUMULATORS 12V. 40 A.H. (2)
32	[illegible]
33	[illegible]
34	SIGNALLING LAMP STOWAGE
35	SLATE BOX STOWAGE
36	ACCUMULATOR CHARGING [illegible]
37	FLAP MOTOR ACCESSORIES
38	FLAP MOTOR HANDLE STOWAGE
39	ENGINE INSTRUMENTS
40	FLYING INSTRUMENTS
41	P.4 COMPASS
42	HOLDER FOR O.6 COMPASS
43	P.4 COMPASS
44	MOUNTING FOR O.2 COMPASS
45	STOWAGE FOR O.2 COMPASS
46	POSITION CARD HOLDERS
47	STOWAGE FOR COMPUTOR
48	STOWAGE FOR PROTRACTOR
49	STOWAGE FOR [illegible]
50	STOWAGE FOR [illegible] SEAMARKERS
51	STOWAGE FOR [illegible] SEAMARKERS
52	STOWAGE FOR FLAME FLOATS (2)
53	STOWAGE FOR FLAME FLOATS
54	STOWAGE FOR SMOKE FLOATS
55	STOWAGE FOR SMOKE FLOATS
56	STOWAGE FOR SEXTANT
57	CHART TABLE
58	HOLDER FOR BOMB AIMERS PAD
59	CAMERA MOUNTING
60	STOWAGE FOR [illegible] & CONTROL
61	CAMERA CABLE
62	CAMERA WEIGHT PLATES
63	CAMERA DRIVE
64	STOWAGE FOR RING & BEAD SIGHT
65	[illegible] ELECTRICAL FITTINGS [illegible]
66	AUTOMATIC CONTROLS [illegible]
67	FIRE EXTINGUISHER & BRACKET
68	FIRE EXTINGUISHER & BRACKET
69	FIRE EXTINGUISHER & BRACKET
70	FIRE EXTINGUISHER & BRACKET
71	FIRE EXTINGUISHER & BRACKET
72	[illegible]
73	[illegible] BELTS - TYPE 'B'
74	[illegible] HARNESS BELT

ITEM	DESCRIPTION
75	TAIL GUNNERS BELT
76	W/T OPERATORS BELT
77	NAVIGATORS BELT
78	ENGINEERS BELT
79	[illegible] ANCHORAGES
80	PARACHUTE STOWAGES
81	DROGUES & STOWAGES
82	SPARE DROGUE & SATCHEL
83	ANCHOR FIXING
84	ANCHOR STOWAGE
85	CHAIN LOCKER
86	SAND BAGS
87	ROLLER FAIRLEAD
88	FIXED TOWING FITTINGS
89	STOWAGE FOR TOWING PENNANT
90	BOAT HOOK & STOWAGE
91	[illegible] & STOWAGE
92	BILGE PUMP & NOZZLE STOWAGE
93	[illegible]
94	[illegible]
95	FOOT BELLOWS & STOWAGE
96	OARS & STOWAGE
97	[illegible]
98	HAND BELL & STOWAGE
99	LEAK STOPPERS & STOWAGE
100	FLAGMAST & HALYARD
101	STOWAGE FOR WINDSCOOPS
102	LAVATORY & PUMP
103	WASH BASIN
104	TANK FOR WASHING WATER
105	[illegible]
106	SUITCASE STOWAGE (FORD)
107	SUITCASE STOWAGE (AFT)
108	FIXED FITTINGS FOR HAMMOCKS
109	STOWAGE FOR HAMMOCKS
110	DEAD LIGHTS
111	WARDROOM TABLE
112	STOWAGE FOR SPARES
113	STOWAGE FOR TOOLKIT
114	FIREMANS AXE & STOWAGE
115	RACK FOR ENGINEERS LOG BOOK
116	STOWAGE FOR FUEL FUNNEL
117	FIXED FITTINGS FOR BLIND FLYING HOOD
118	VICE FITTERS
119	FIRST AID OUTFITS & STOWAGES
120	ASHTRAYS
121	STOWAGE FOR SPARE ENGINE CRADLE
122	STOWAGE FOR REFUELLING HOSE
123	STOWAGE FOR ENGINE & BOMB HOIST [illegible]
124	WATER TANKS [illegible]
125	[illegible] LOCKER
126	STOWAGE FOR PARAFFIN TANK
127	STOWAGE FOR RATIONS
128	FIXED AERIAL MAST
129	WIRELESS AERIAL & INSULATORS
130	FIXED WIRELESS EQUIPMENT
131	D.F. LOOP & ACCESSORIES
132	EMERGENCY WIRELESS EQUIPT
133	FIXED INTERCOMMUNICATION EQUIPT
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TYPICAL SERVICE LOAD (REMOVABLE)

ITEM	DESCRIPTION
150	[illegible]
151	MID GUN HOLDALLS
152	[illegible]
153	FORWARD GUN HOLDALL
154	AMMUNITION FORD GUN
155	AMMUNITION MID GUN
156	AMMUNITION MID GUN
157	BROWNING GUNS (4)
158	REAR GUN SIGHT [illegible]
159	AMMUNITION REAR GUN
160	RANGE FINDER & CASE
161	DISTRESS SIGNALS [illegible]
162	DISTRESS SIGNALS (3)
163	DISTRESS SIGNALS (3)
164	SIGNAL PISTOL
165	SIGNAL CARTRIDGES (30)
166	SMOKE PUFFS [illegible]
167	PARACHUTE FLARES (2)
168	BINOCULARS & [illegible] GLASSES
169	BOX FOR SPARE GLASSES
170	ACCUMULATORS 12V 20 A.H. [illegible]
171	ACCUMULATORS 2V 20 A.H. [illegible]
172	MOTOR GENERATOR [illegible]
173	INDICATOR COURSE & HEIGHT
174	COMPASS TYPE O.2
175	COMPASS TYPE O.6
176	STANDARDS TYPE O.6
177	COMPUTOR HEIGHT & AIR SPEED
178	PROTRACTOR 10"
179	SEAMARKERS MK. I [illegible]
180	SEAMARKERS H.T.V. TYPE [illegible]
181	SEAMARKERS H.T.V. TYPE [illegible]
182	FLAME FLOATS [illegible]
183	SMOKE FLOATS [illegible]
184	SMOKE FLOATS [illegible]
185	CALCULATOR COURSE & SPEED
186	SEXTANT MK [illegible]
187	DIVIDERS, MATHEMATICAL
188	PAD [illegible] TYPE FOR PILOT
189	CLOCK, YACHT TYPE
190	LITERATURE
191	CAMERA GEAR STOWED AFT
192	CAMERA GEAR STOWED FORD
193	[illegible]
194	CAMERA, LENSE ETC
195	[illegible]
196	NIGHT FLYING SCREEN
197	CURTAIN OFFICERS QUARTERS
198	SPARES PLUGS ETC
199	TOOL KIT EMERGENCY
200	CONTAINER FOR EMERGENCY RATIONS
201	WEIGHT AERIAL, BEAD TYPE
202	WIRE AERIAL
203	H.T. TRANSFORMING UNIT
204	WIRELESS EQUIPMENT
205	[illegible]
206	CABLE ELECTRIC
207	REEL AERIAL - TYPE 'B'
208	EMERGENCY W/T EQUIPMENT
209	INTERCOMMUNICATION EQUIPMENT
210	FIRST PILOT & PARACHUTE
211	SECOND PILOT & PARACHUTE
212	NAVIGATOR
213	W/T OPERATOR
214	ENGINEER
215	TORCH IN BOMB COMPARTMENT
216	TORCH IN WARD ROOM
217	PARACHUTE NAVIGATOR
218	PARACHUTE W/T OPERATOR
219	PARACHUTE ENGINEER
220	PARACHUTE MID GUNNERS
221	FUEL [illegible]
222	FUEL [illegible]
223	OIL [illegible]

ITEM	DESCRIPTION
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[illegible]

ITEM	DESCRIPTION
250	BOMBS PRACTICE [illegible]
251	BOMBS IN ACCORDANCE WITH APPENDIX [illegible]
252	CARRIERS BOMBS UNIVERSAL [illegible]
253	CARRIERS FOR [illegible]
254	REMOVABLE FITTINGS FOR CARRIERS
255	BOMB WINCH
256	BOMB SIGHT
257	PISTOL FLARES [illegible]
258	G.S. FLARES AFT [illegible]
259	G.S. FLARES STARB'D [illegible]
260	G.S. FLARES PORT [illegible]
261	FLARE CHUTE
262	FLAME FLOATS - FORD [illegible]
263	FLAME FLOATS - AFT [illegible]
264	MAGNETO SAFETY - TYPE 'C'
265	ANCHOR GROUND
266	ANCHOR CHAIN & [illegible]
267	TOWING PENNANT
268	WINDSCOOPS
269	COVER [illegible]
270	COVER TAIL TURRET
271	COVER FRONT TURRET
272	COVERS, ENGINE [illegible]
273	COVERS, AIRSCREW HUB [illegible]
274	COVERS, [illegible]
275	[illegible]
276	[illegible]
277	[illegible]
278	[illegible]
279	SUITCASES (FORWARD)
280	SUITCASES (AFT)
281	HAMMOCKS
282	FUEL FUNNEL
283	HOOD, BLIND FLYING
284	FUNNEL, OIL
285	AEROPLANE LOADING DIAGRAM
286	[illegible]
287	OIL STOVE & FUNNEL
288	COOKING TABLE & CUPBOARD
289	CREWS TABLE
290	COOKING UTENSILS
291	LOCKER FOR COOKING UTENSILS
292	EATING UTENSILS & RACK
293	ICE BOX
294	WASTE BOX
295	PLATE DRAINING RACK
296	PARAFFIN TANK
297	EMERGENCY [illegible]
298	INSPECTION LAMP & LEADS
299	DETACHABLE [illegible]

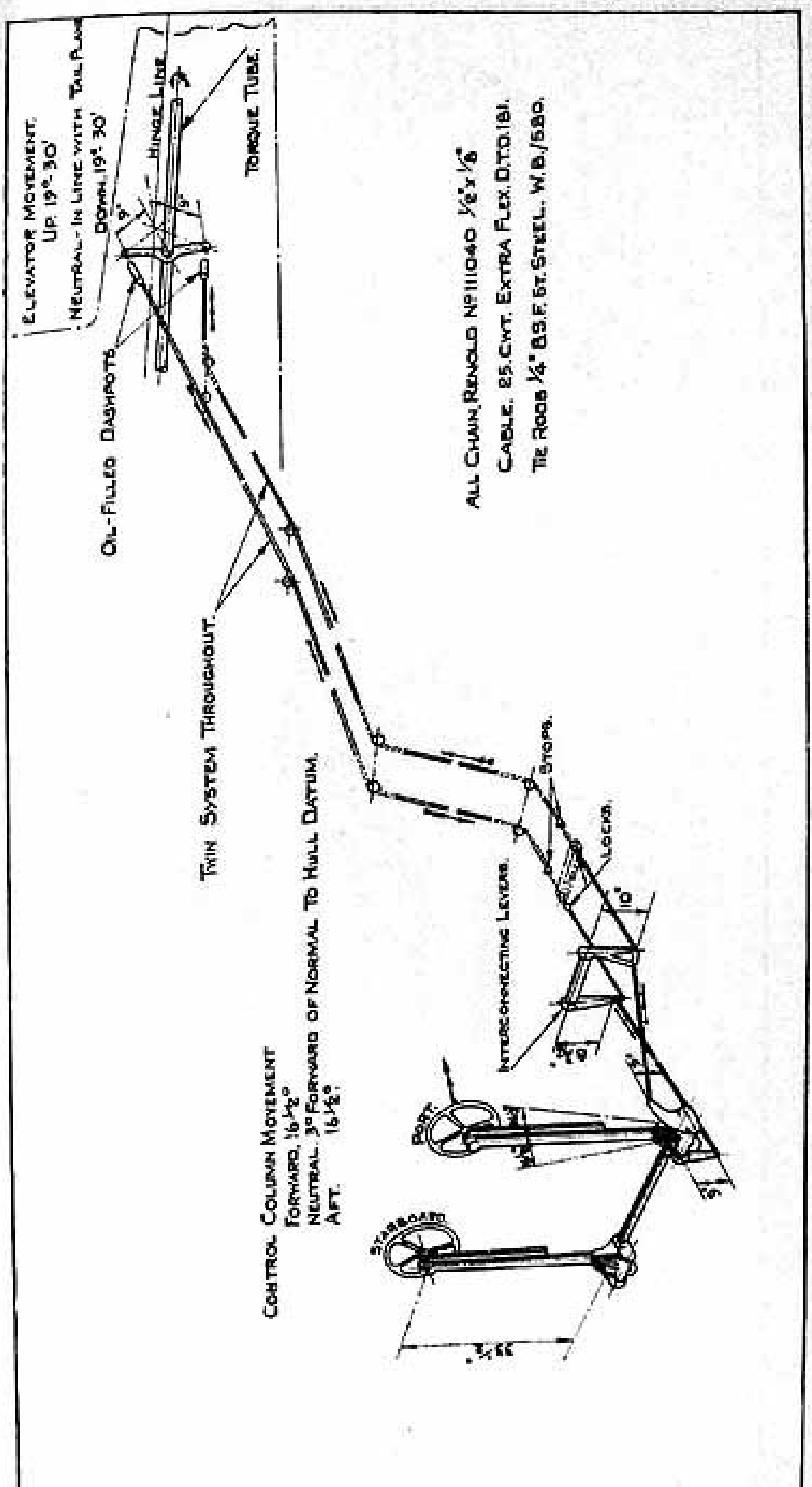
C.G. LIMITS OF AEROPLANE ARE 10·1" TO 27·1" AFT OF DATUM POINT I.E.; 52·8" TO 69·8" AFT OF LEADING EDGE OF MEAN AERODYNAMIC CHORD (28.5 TO 37.5% M.A.C.) LENGTH OF M.A.C. IS 185.5"

NORMAL C.G. IS 19·2" AFT AND 49·5" BELOW DATUM. (I.E.; 31·7% M.A.C.)

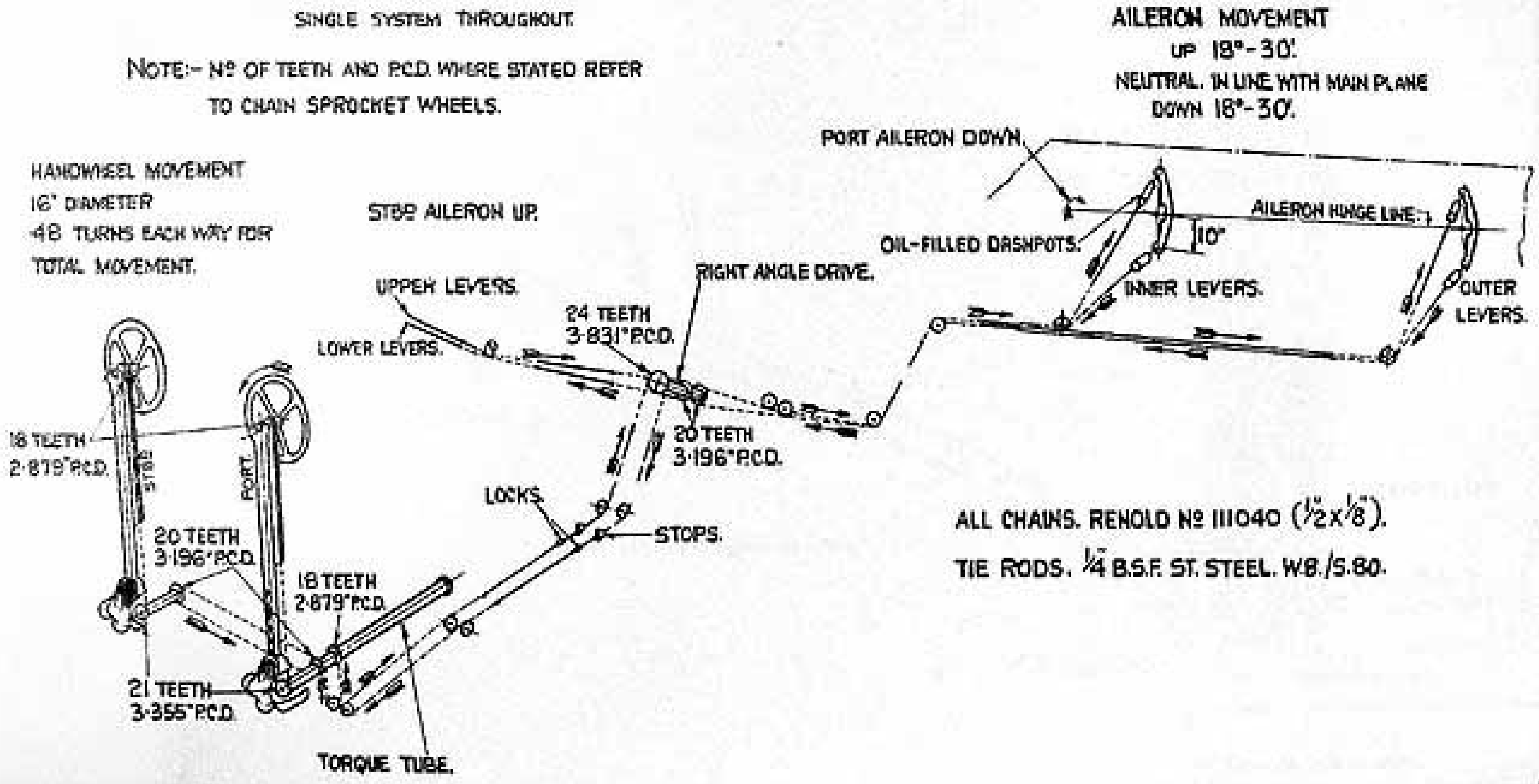
THE C.G. DATUM POINT IS SITUATED ON TOP OF HULL ON LINE OF SYMMETRY OF AEROPLANE 3·55" AFT & 2·34" ABOVE THE LEADING EDGE OF MAIN PLANE DATUM CHORD (WHICH IS 24·25" FROM LINE OF SYMMETRY) MEASURED PARALLEL AND NORMAL RESPECTIVELY TO HULL DATUM

KEY TO LOAD DISTRIBUTION DIAGRAMS

FIG. 4

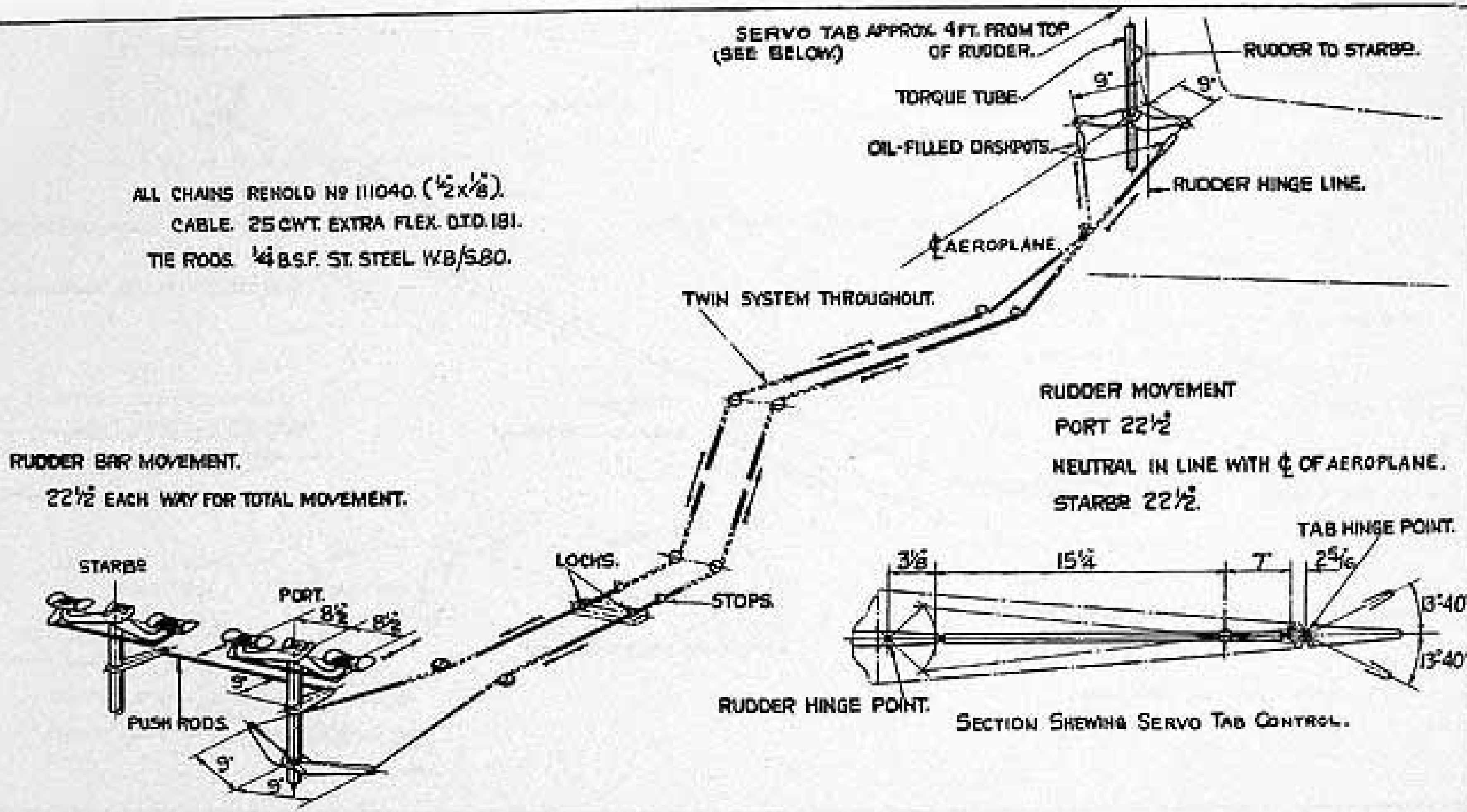


ELEVATOR CONTROL. FIG. No 5.



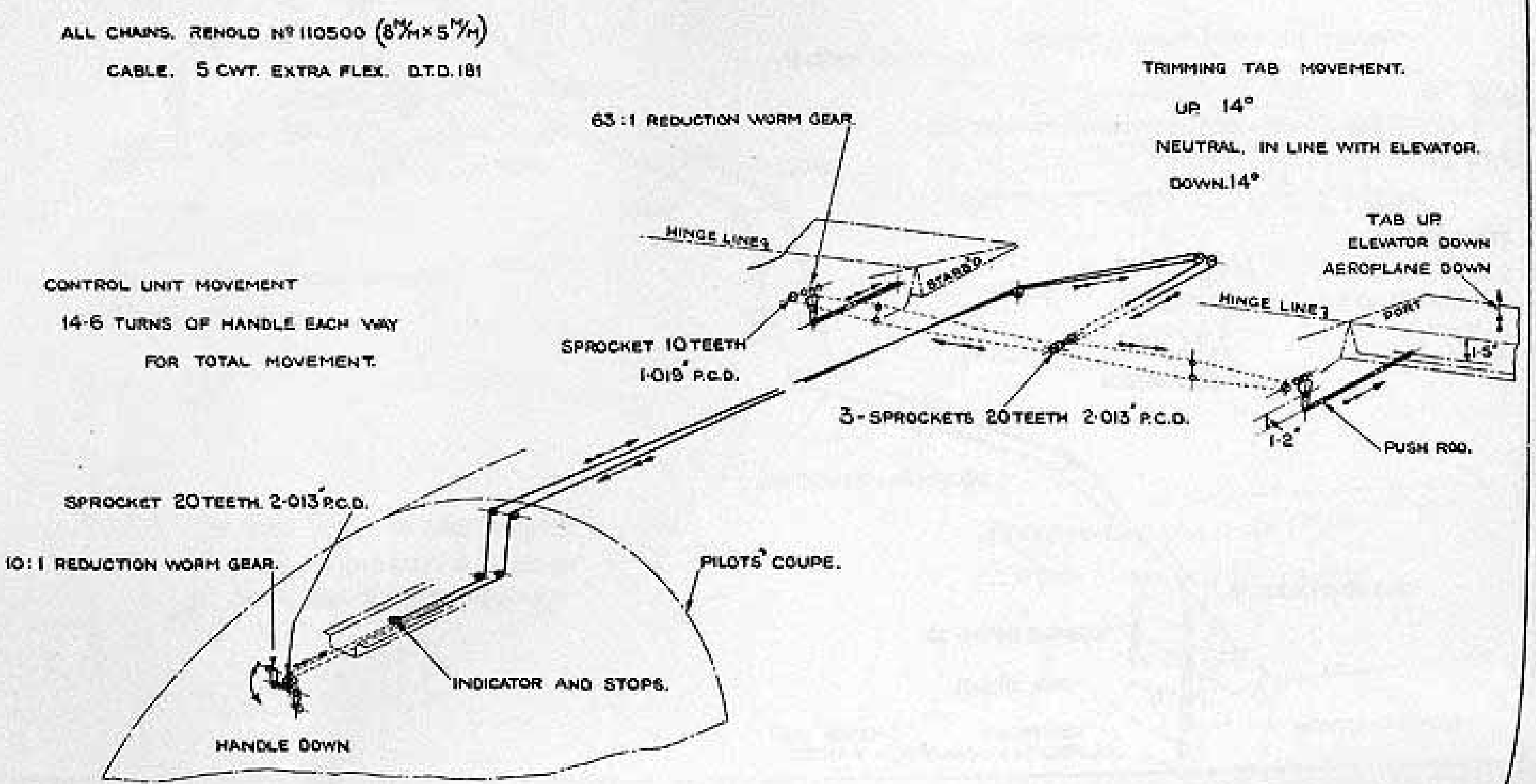
AILERON CONTROL.

FIG: Nº 6.



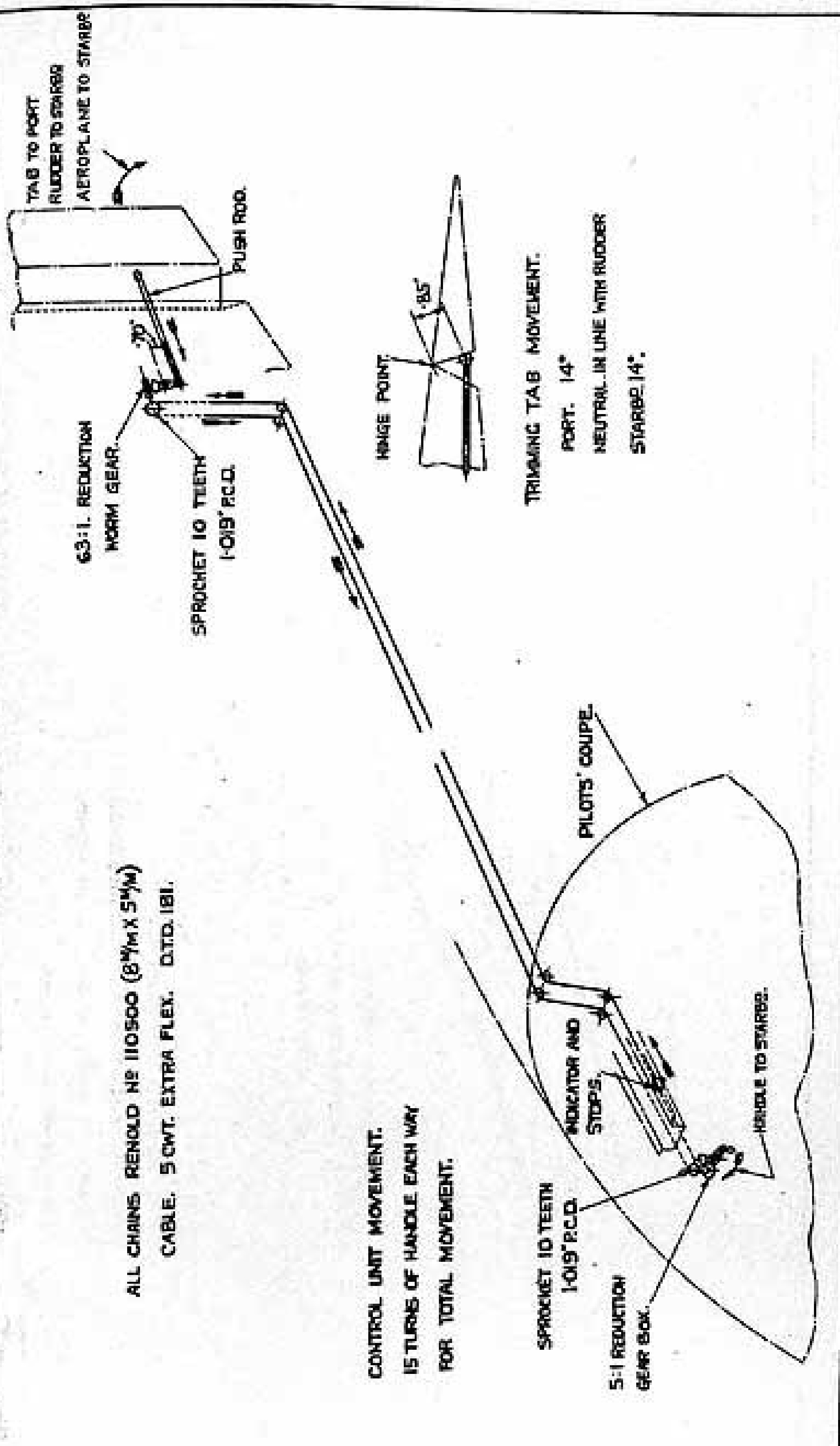
RUDDER CONTROL.

FIG: Nº 7.



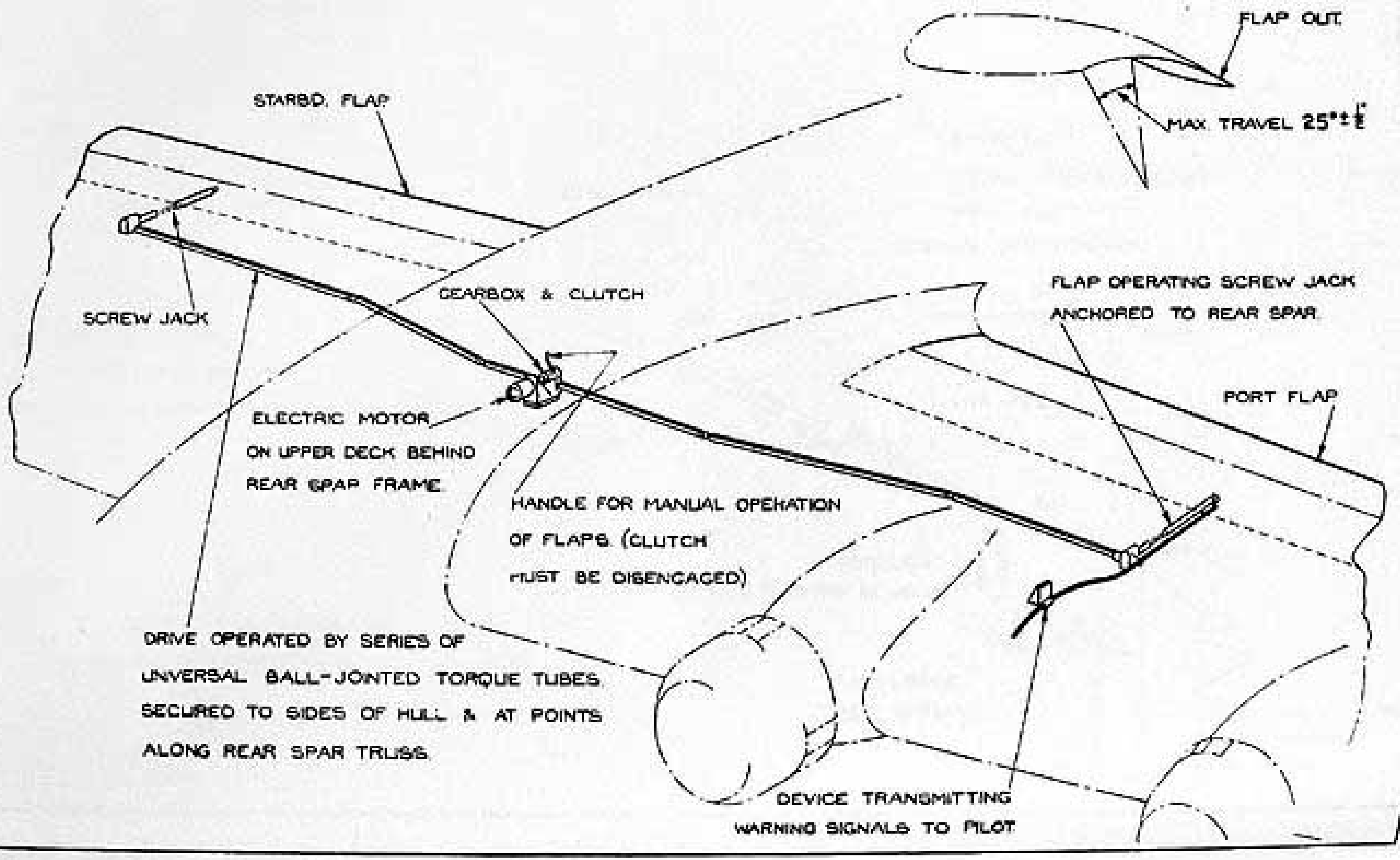
ELEVATOR TRIMMING TAB CONTROL.

FIG. Nº 8

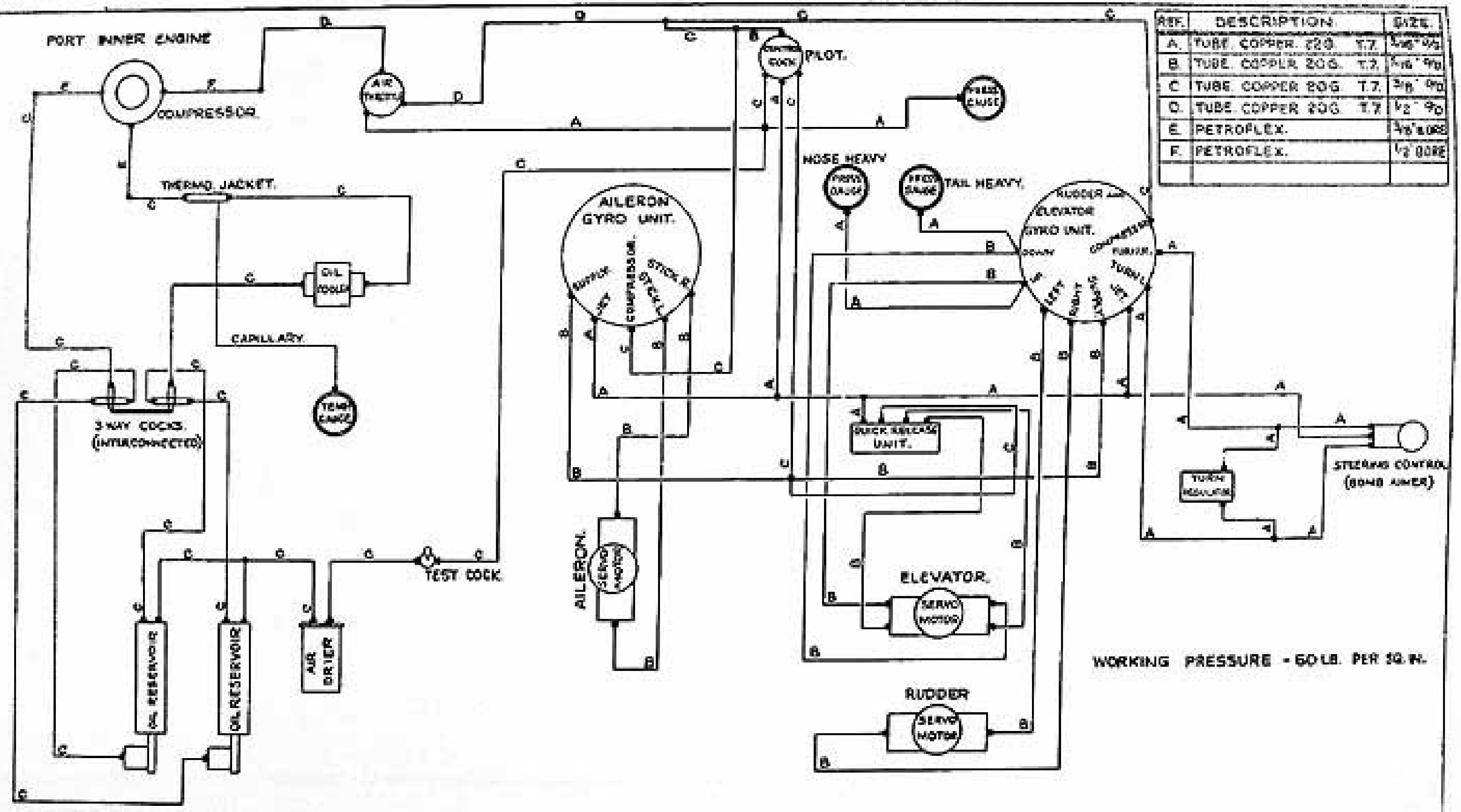


RUDDER TRIMMING TAB CONTROL.

FIG: No 9.



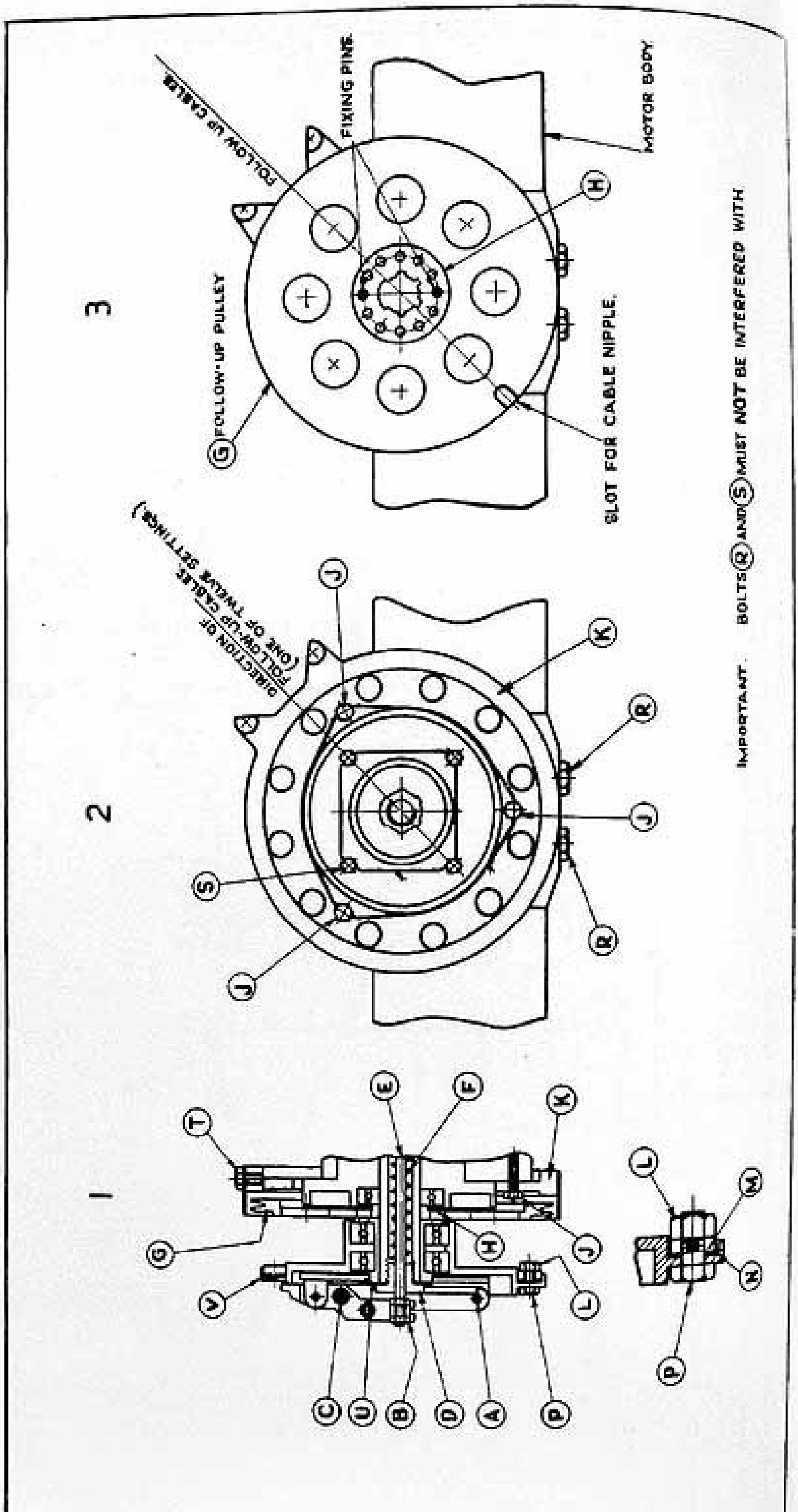
MAIN PLANE FLAP CONTROL FIG No.10.



REF.	DESCRIPTION.	SIZE.
A.	TUBE. COPPER. 22G. T.7.	3/16" O/D
B.	TUBE. COPPER. 20G. T.7.	5/16" O/D
C.	TUBE. COPPER. 20G. T.7.	3/8" O/D
D.	TUBE. COPPER. 20G. T.7.	1/2" O/D
E.	PETROFLEX.	3/8" BORE
F.	PETROFLEX.	1/2" BORE

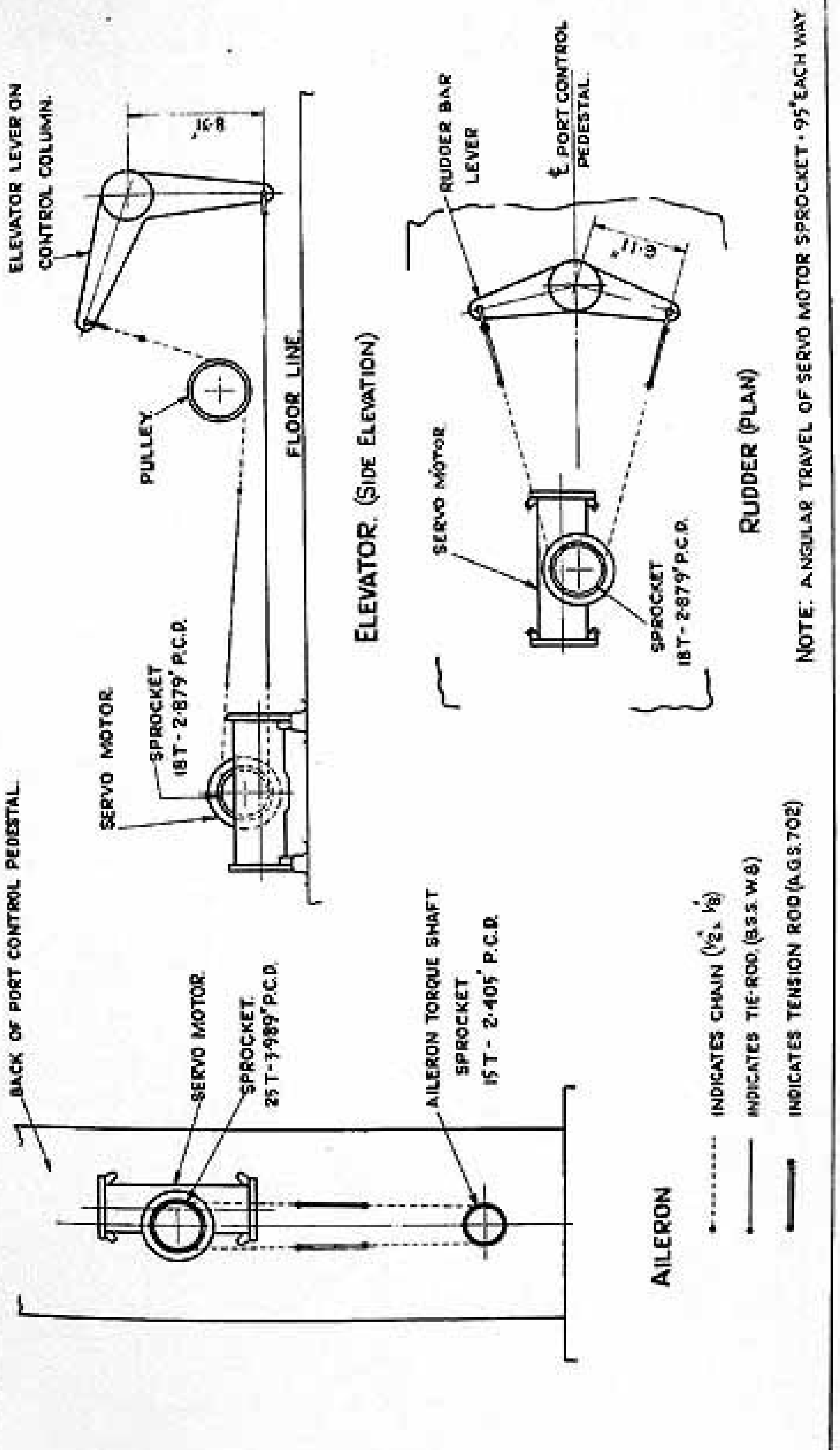
AUTOMATIC CONTROLS MK. IV.

FIG. No 11.



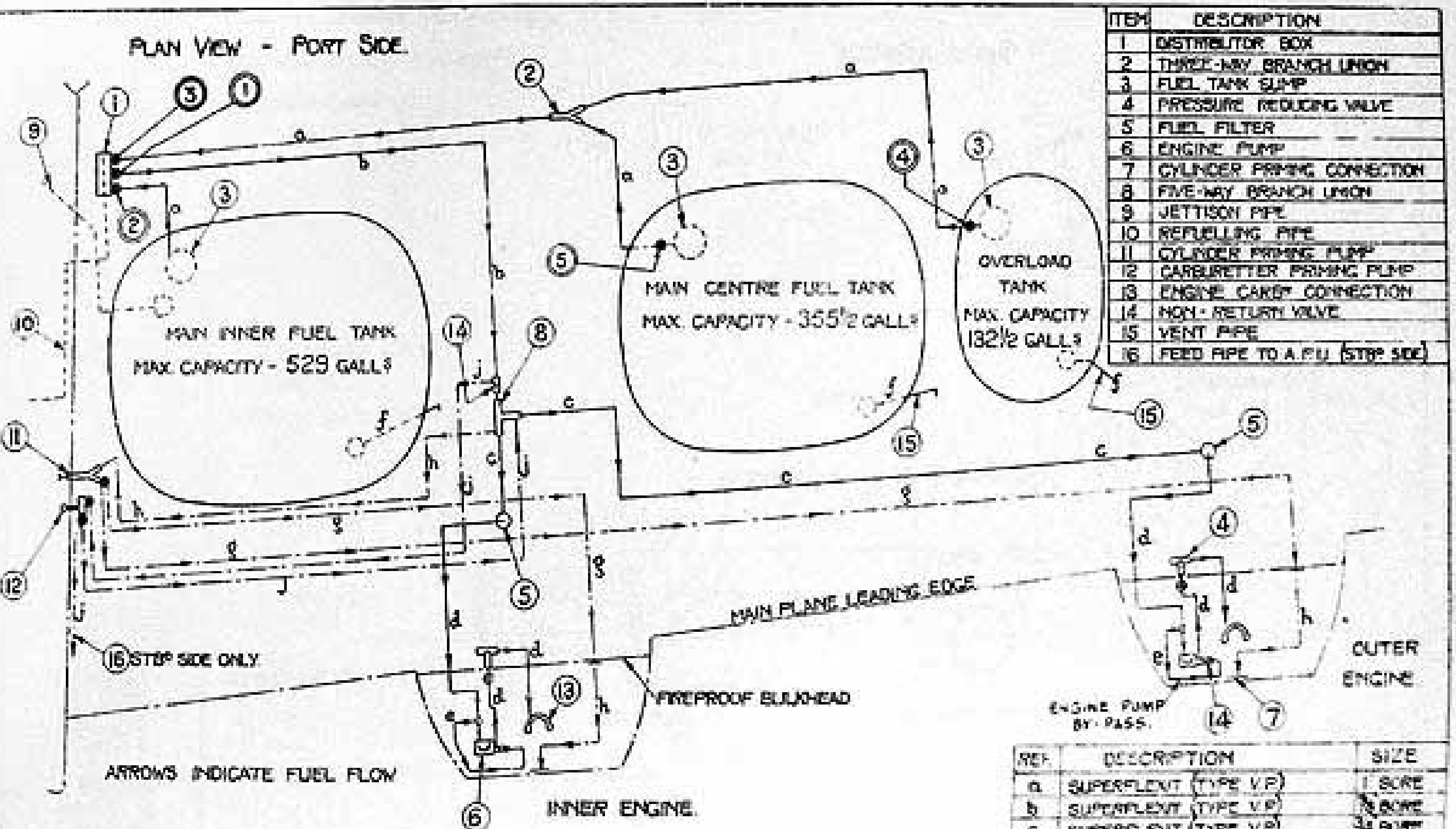
AUTOMATIC CONTROLS.
(SERVO MOTOR CLUTCH ASSEMBLY.)

FIG Nº 12.



AUTOMATIC CONTROLS
(CONNECTION OF SERVO MOTORS TO MAIN FLYING CONTROLS)

FIG Nº 13.



ITEM	DESCRIPTION
1	DISTRIBUTOR BOX
2	THREE-WAY BRANCH UNION
3	FUEL TANK SUMP
4	PRESSURE REDUCING VALVE
5	FUEL FILTER
6	ENGINE PUMP
7	CYLINDER PRIMING CONNECTION
8	FIVE-WAY BRANCH UNION
9	JETTISON PIPE
10	REFUELLING PIPE
11	CYLINDER PRIMING PUMP
12	CARBURETTER PRIMING PUMP
13	ENGINE CARB.R CONNECTION
14	NON-RETURN VALVE
15	VENT PIPE
16	FEED PIPE TO A.P.U. (STBD SIDE)

REF.	DESCRIPTION		SIZE
a	SUPERFLEXIT (TYPE V.P.)		1" BORE
b	SUPERFLEXIT (TYPE V.P.)		[illegible] BORE
c	SUPERFLEXIT (TYPE V.P.)		¾ BORE
d	SUPERFLEXIT (TYPE V.P.)		[illegible] BORE
e	SUPERFLEXIT (TYPE V.P.)		½ BORE
f	TUBE ALUMINIUM 20G	T.9	[illegible]
g	TUBE COPPER 20G	T.7	[illegible]
h	SUPERFLEXIT (TYPE V.P.)		[illegible] BORE
j	SUPERFLEXIT (TYPE V.P.)		[illegible] BORE

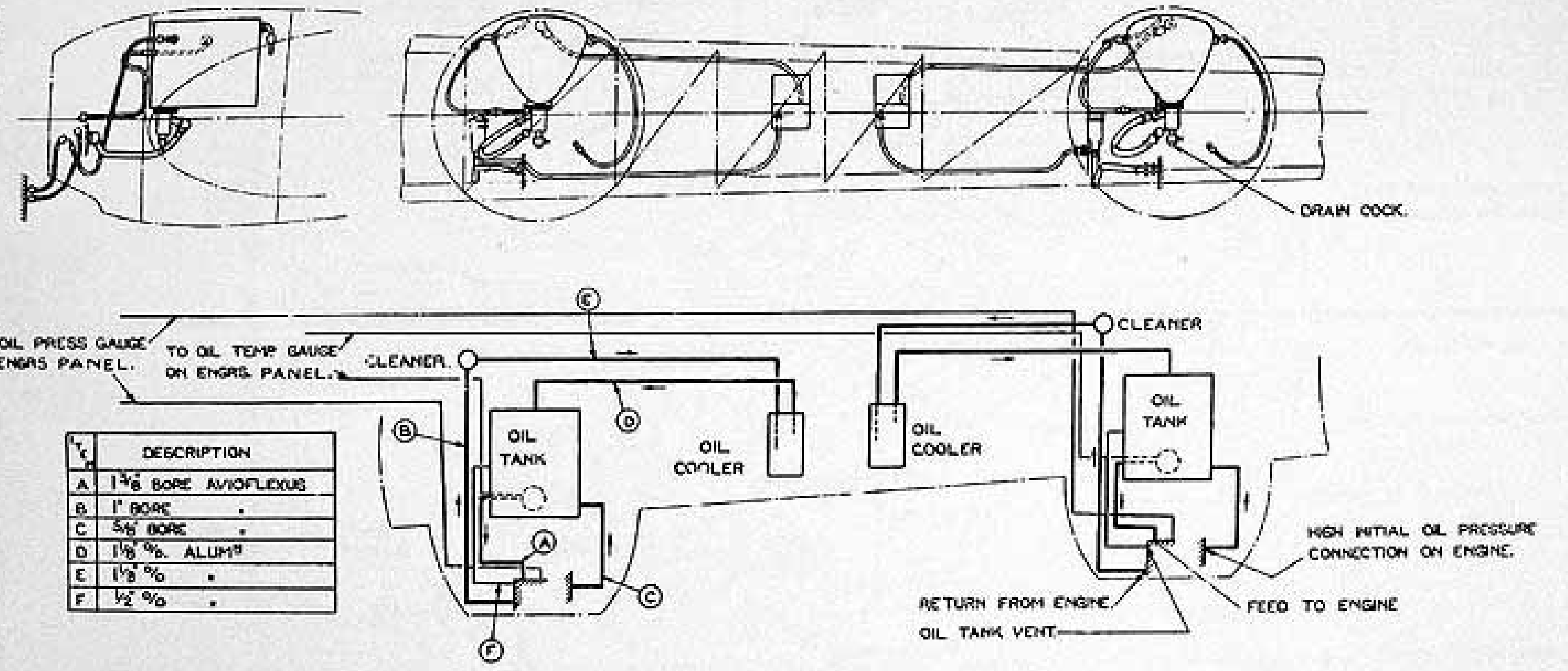
○ ● INDICATES FUEL COCK, ENGINEER CONTROLLED.
⊙ INDICATES FUEL COCK PILOT CONTROLLED.
——— INDICATES MAIN FUEL SYSTEM.
— · — INDICATES ENGINE PRIMING SYSTEM.

MAXIMUM FUEL CAPACITY 2,034 GALLONS.

FUEL SYSTEM.

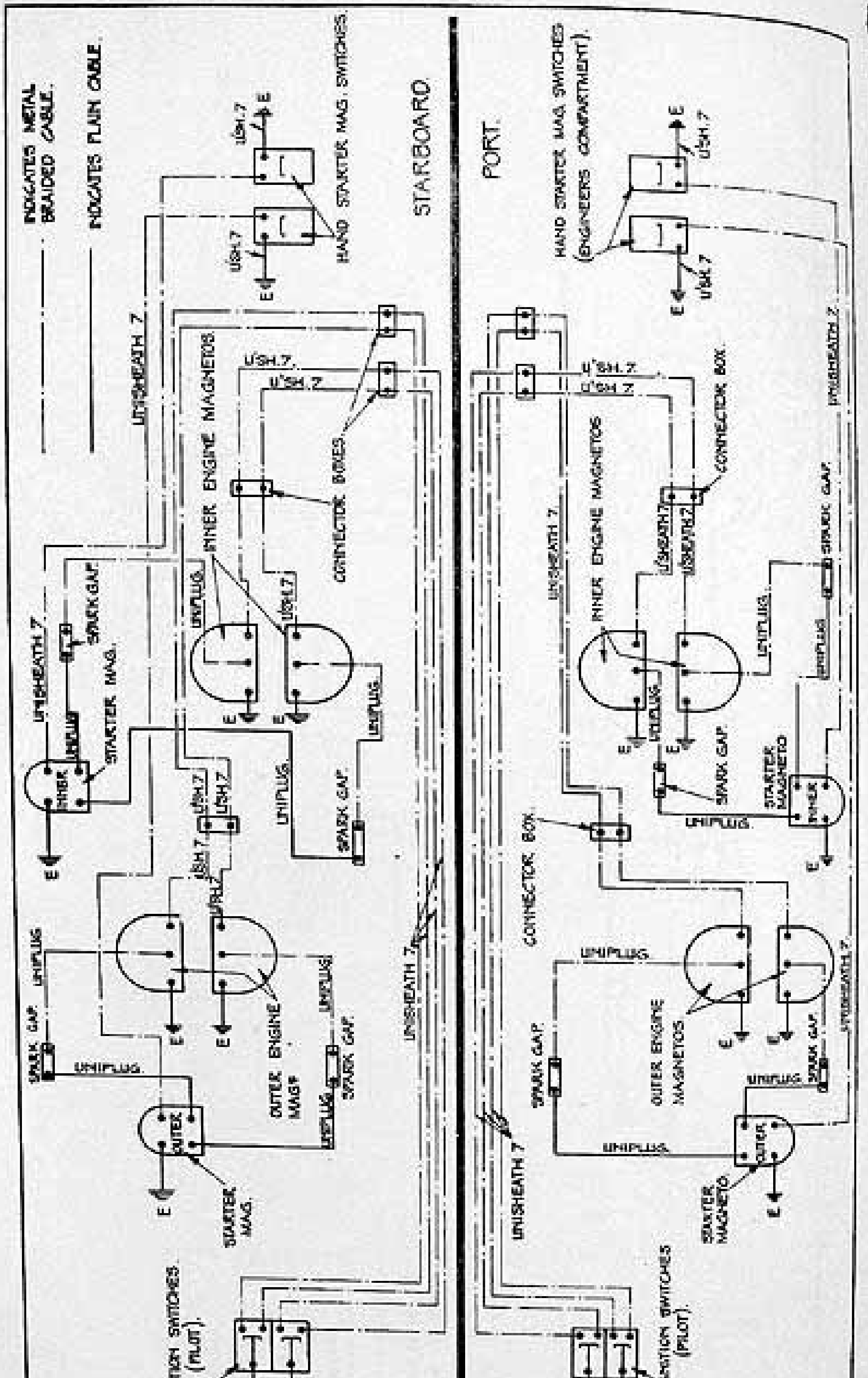
FIG. No 14.

OIL SYSTEM.

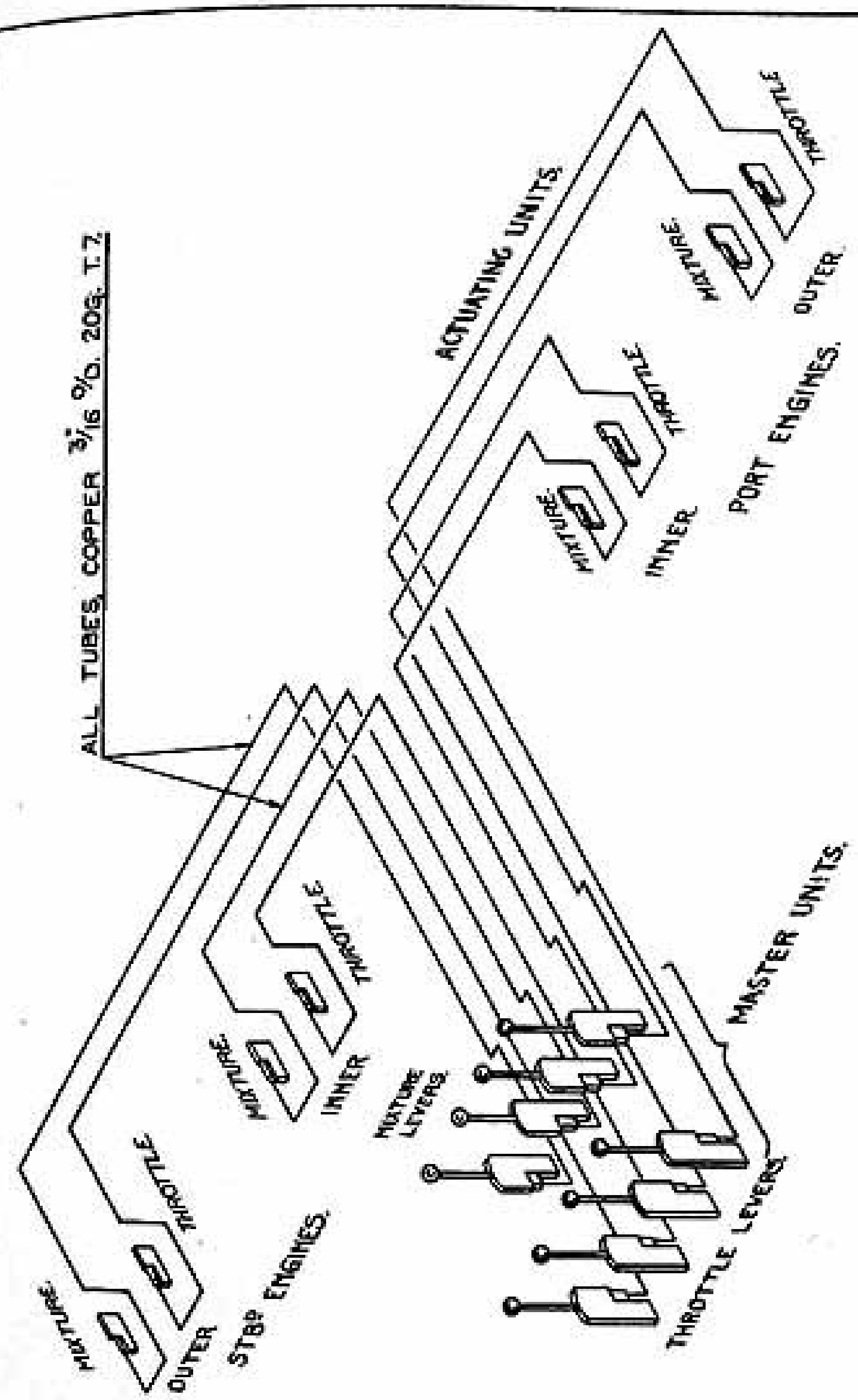


	DESCRIPTION
A	1 3/8" BORE AVIOFLEXUS
B	1" BORE "
C	5/16" BORE "
D	1 1/8" O/D. ALUM^m
E	1 1/8" O/D "
F	1/2" O/D "

FIG. No 15.



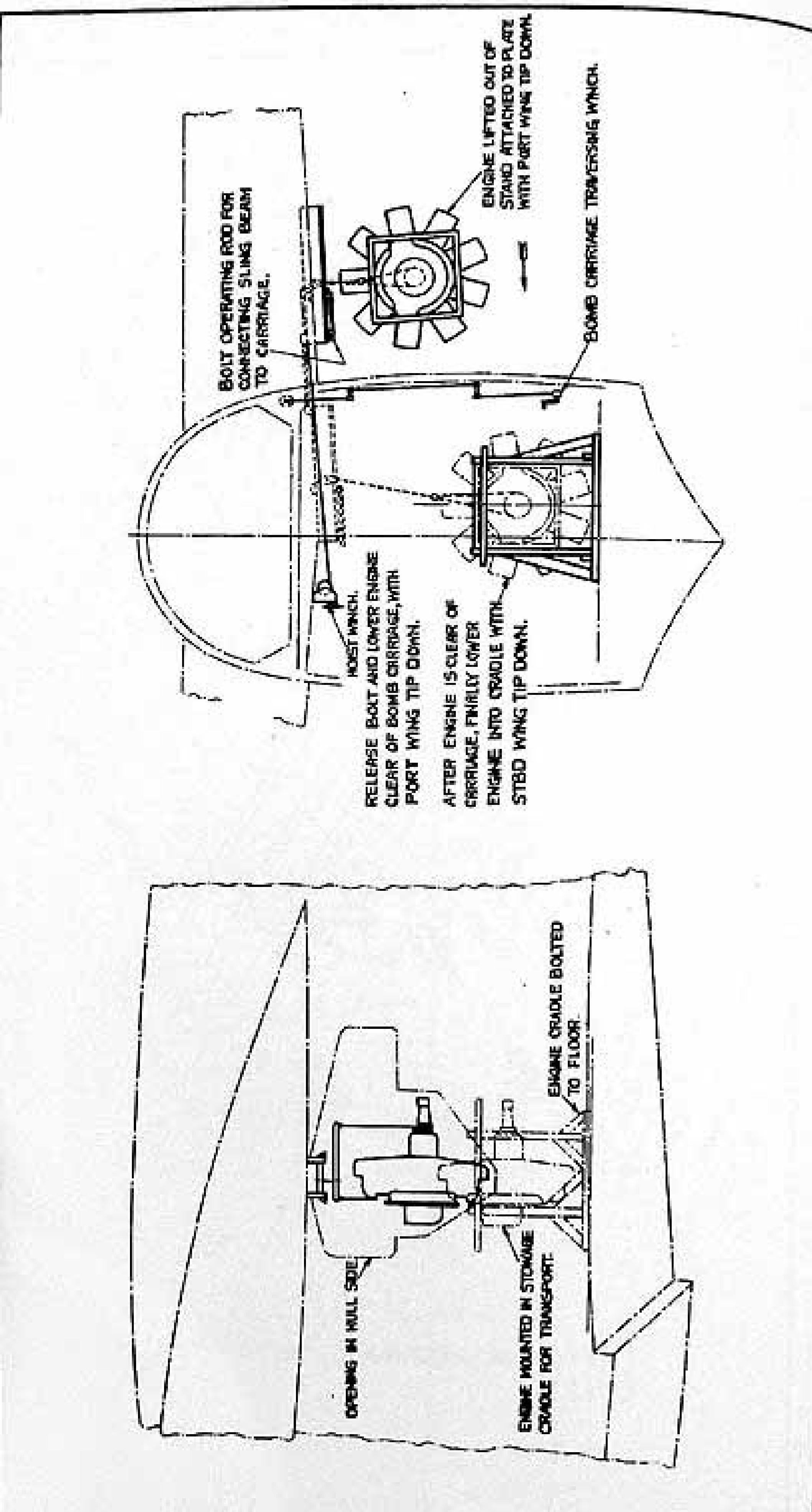
IGNITION WIRING. FIG. Nº 16.



EXACTOR HYDRAULIC OIL SYSTEM.

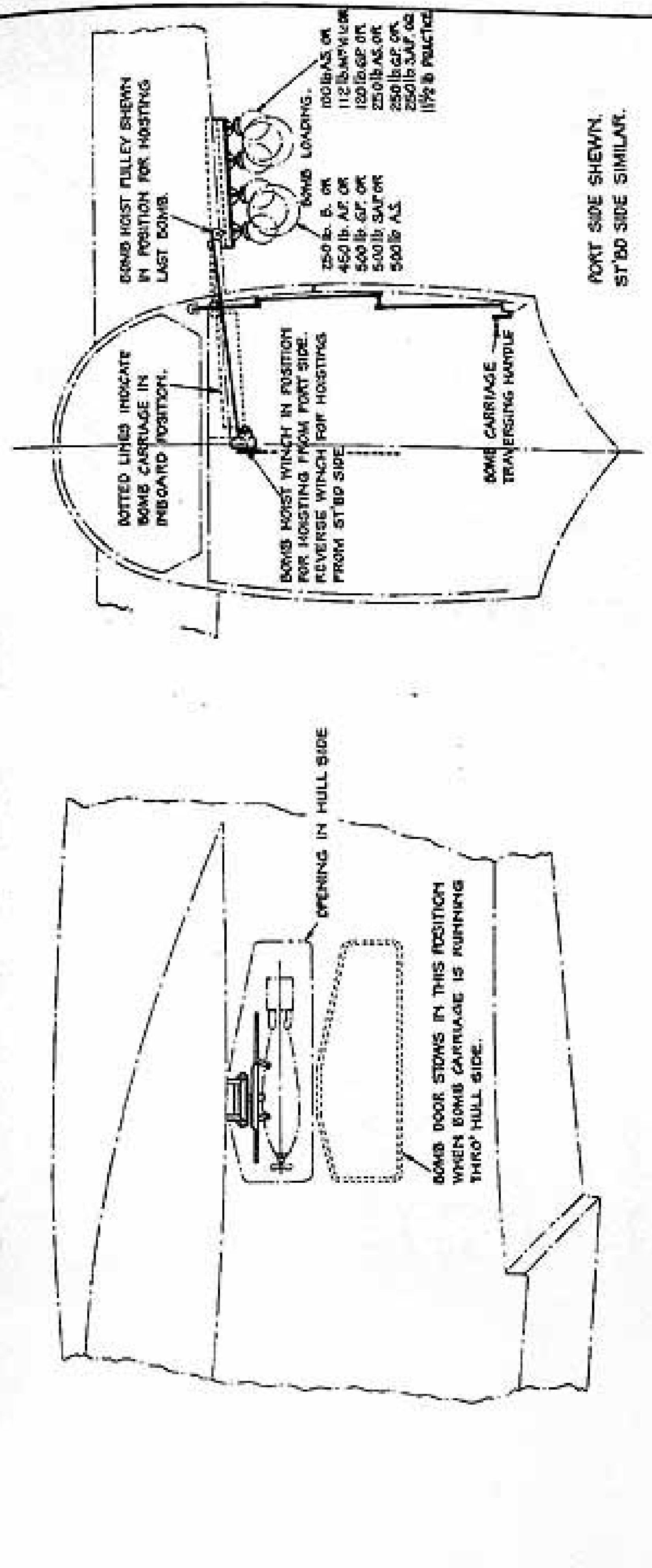
ENGINE CONTROLS

FIG. No. 17.



SPARE ENGINE HANDLING.

FIG: Nº 18.

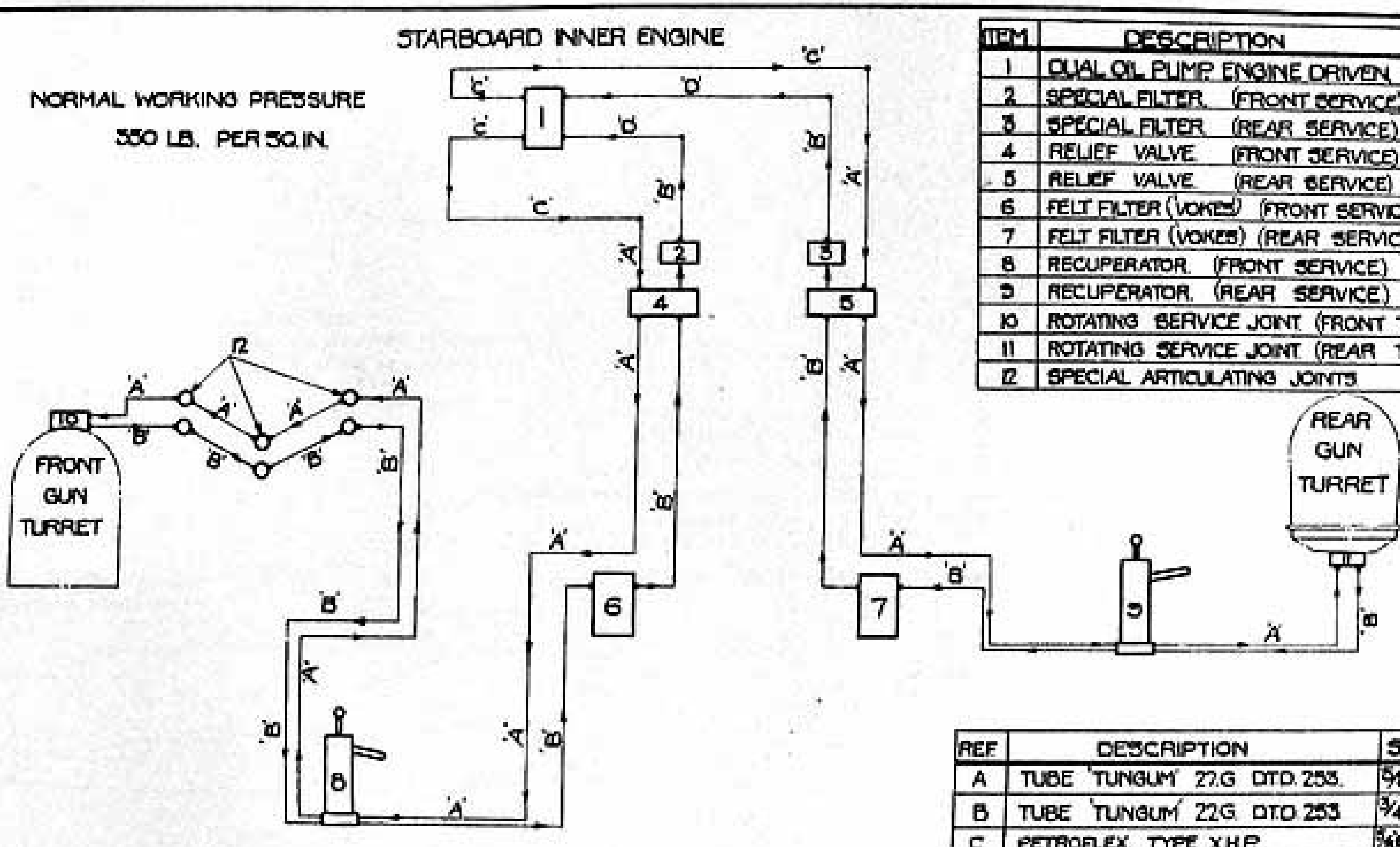


BOMB LOADING.

FIG Nº 19.

GUN CONTROL PIPING

NORMAL WORKING PRESSURE
350 LB. PER SQ. IN.

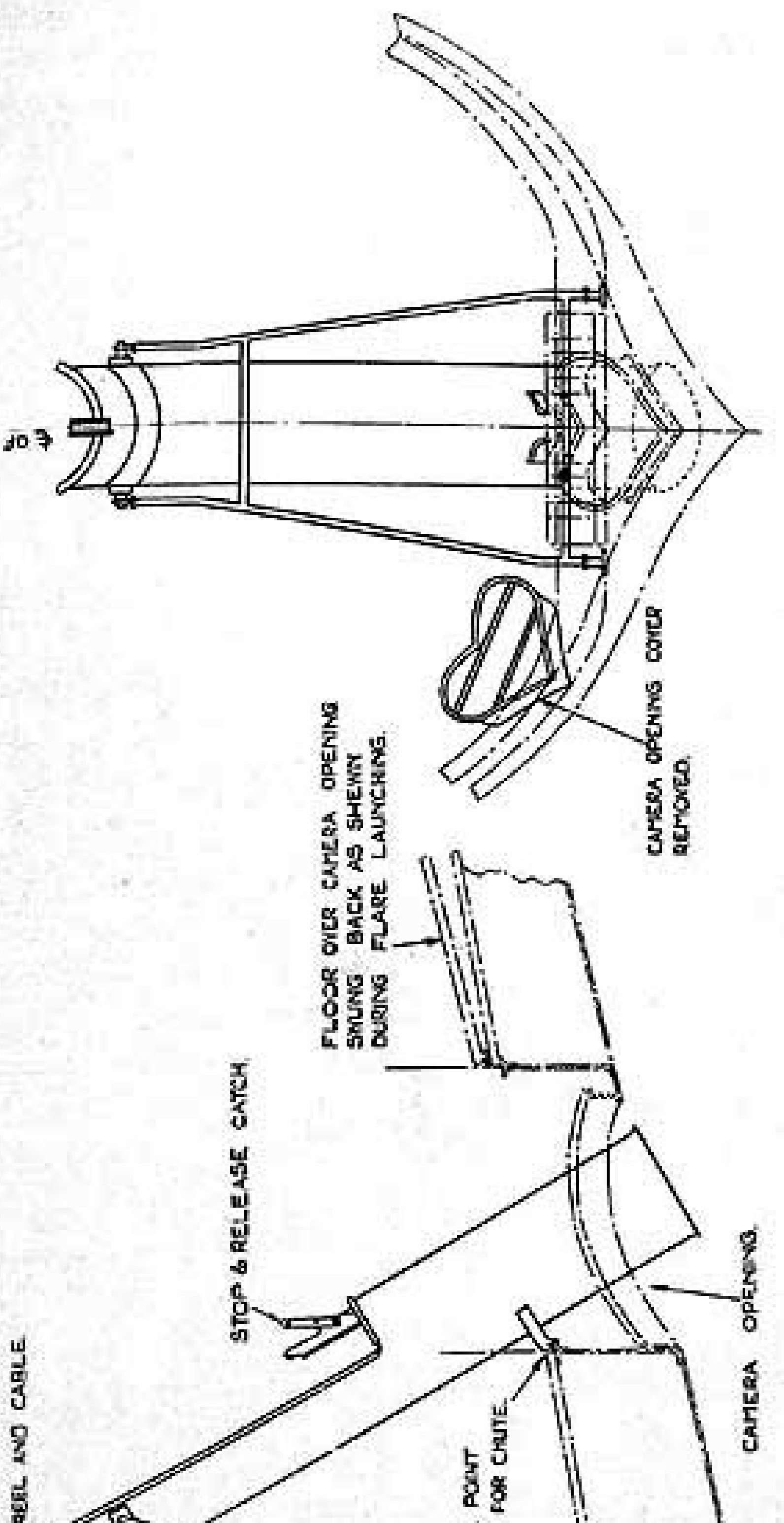


ARROWS INDICATE OIL FLOW

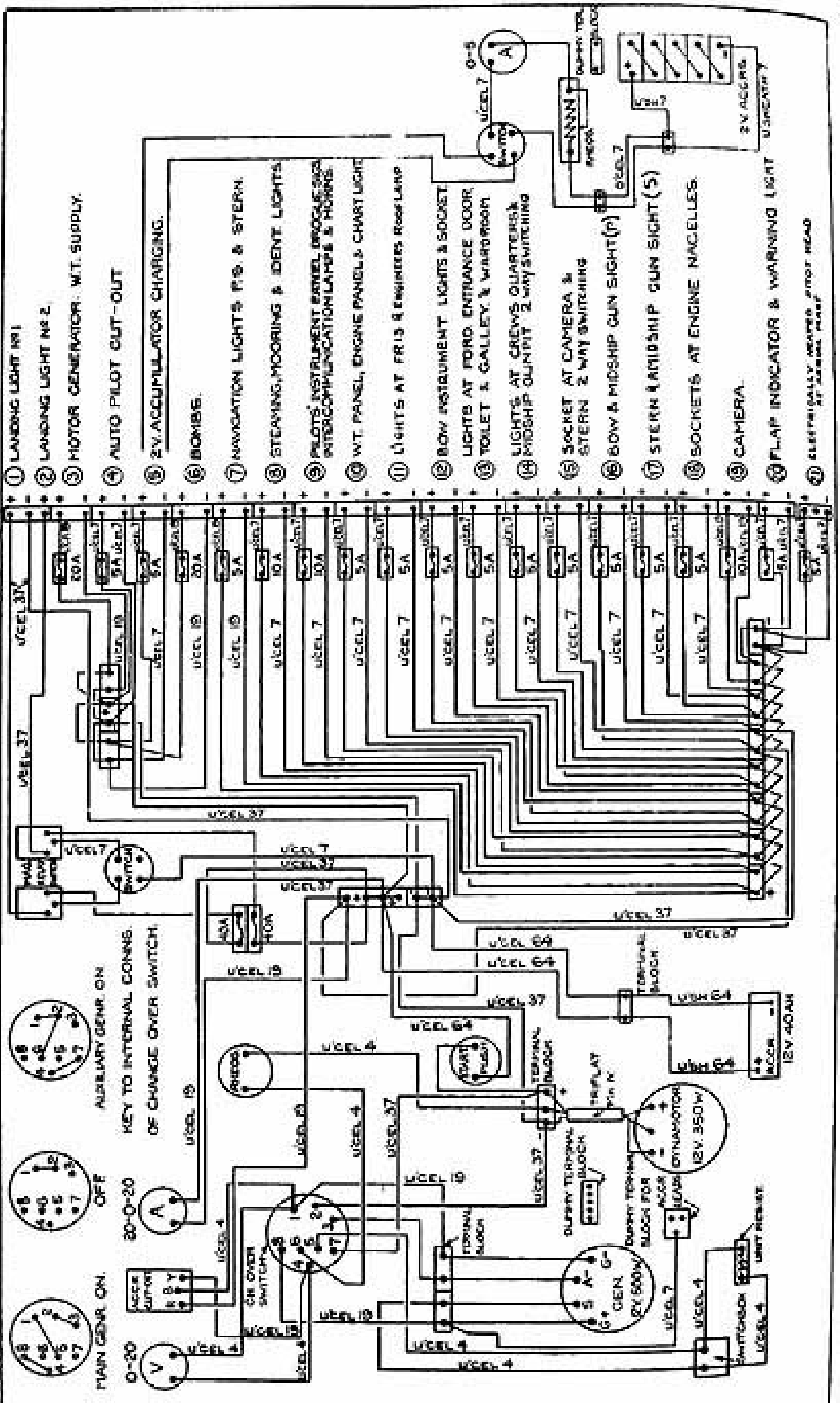
ITEM.	DESCRIPTION
1	DUAL OIL PUMP ENGINE DRIVEN.
2	SPECIAL FILTER. (FRONT SERVICE)
3	SPECIAL FILTER. (REAR SERVICE)
4	RELIEF VALVE. (FRONT SERVICE)
5	RELIEF VALVE. (REAR SERVICE)
6	FELT FILTER (VOKES) (FRONT SERVICE)
7	FELT FILTER (VOKES) (REAR SERVICE)
8	RECUPERATOR. (FRONT SERVICE)
9	RECUPERATOR. (REAR SERVICE)
10	ROTATING SERVICE JOINT. (FRONT TURRET)
11	ROTATING SERVICE JOINT. (REAR TURRET)
12	SPECIAL ARTICULATING JOINTS

REF.	DESCRIPTION	SIZE
A	TUBE 'TUNGUM' 22G. D.T.D. 253.	5/8" O/D
B	TUBE 'TUNGUM' 22G. D.T.D. 253	3/4" O/D
C	PETROFLEX. TYPE X.H.P.	5/8" BORE
D	PETROFLEX. TYPE X.H.P.	3/4" BORE

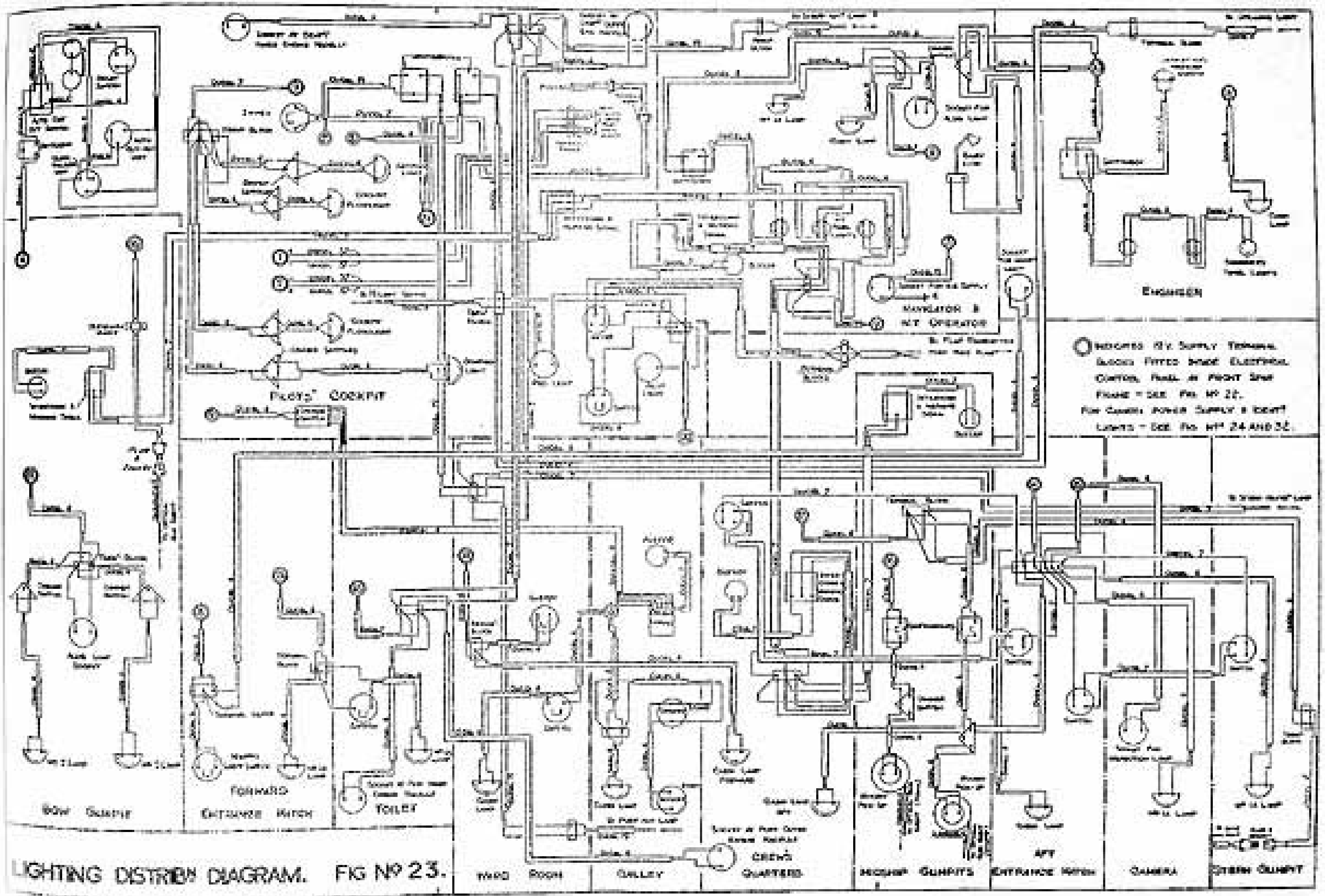
FIG. No 20.



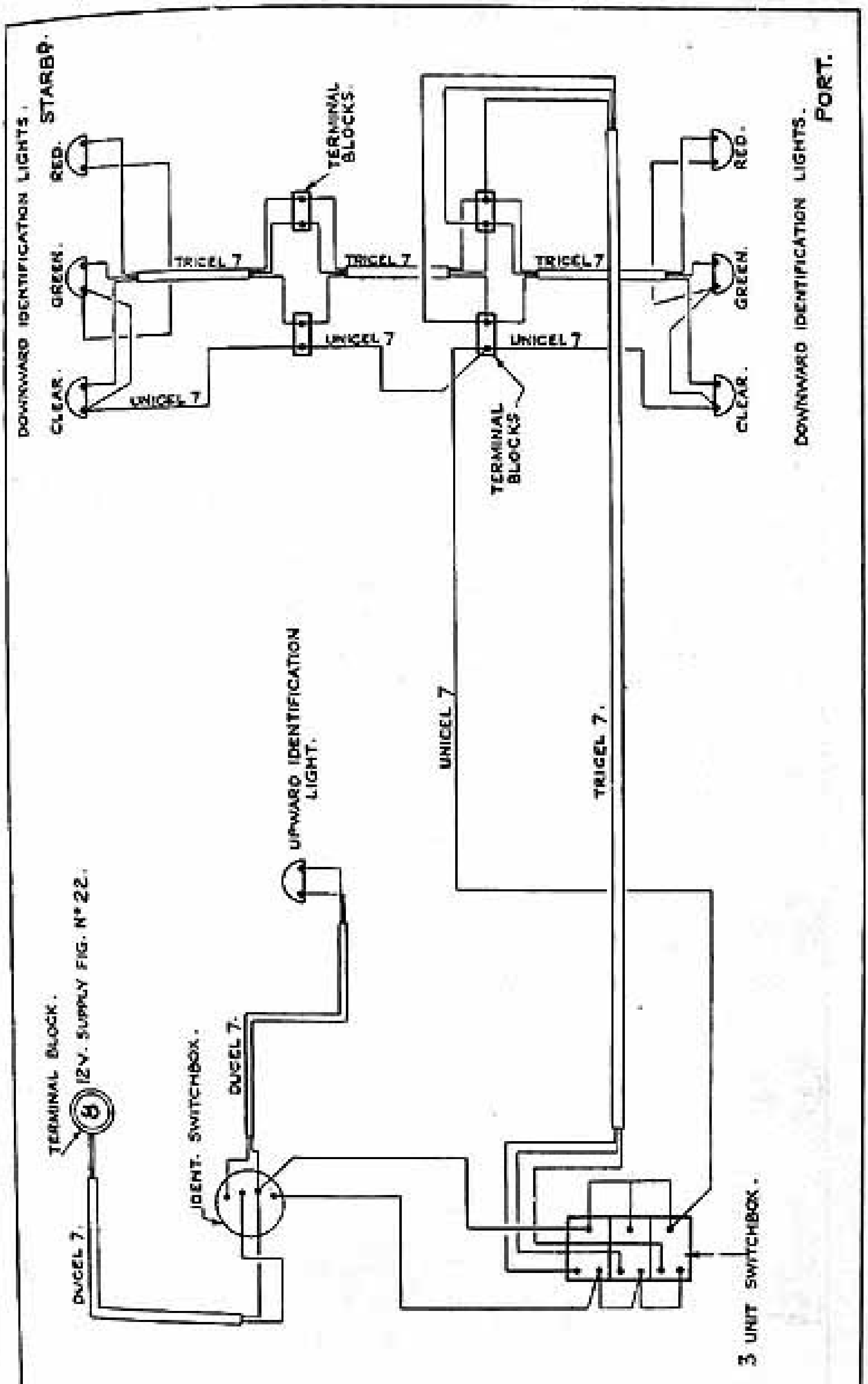
FLARE LAUNCHING. FIG No 21.



12V. GENERATOR CONTROL & ACCUMULATOR CHARGING. FIG. No 22.

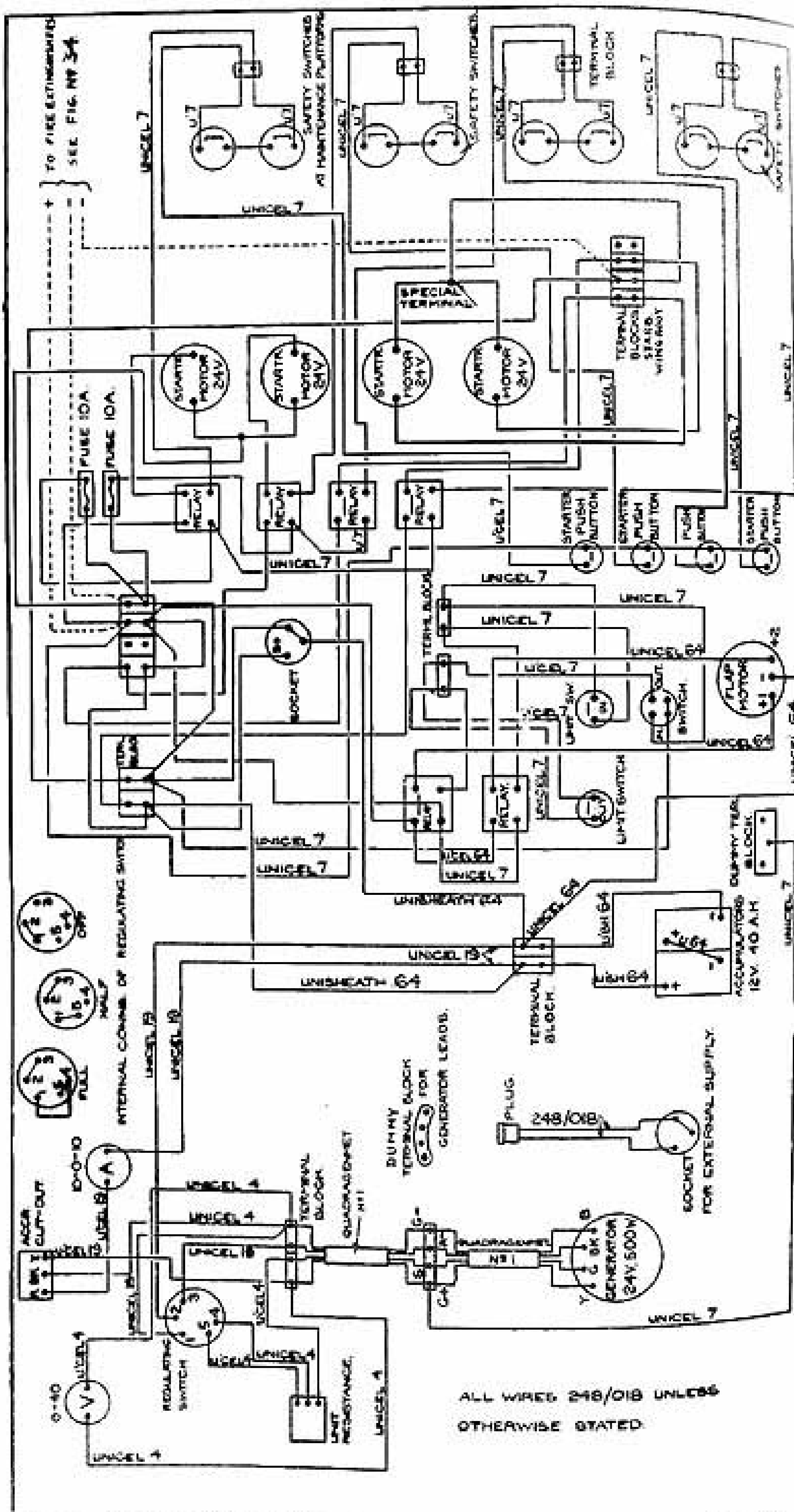


LIGHTING DISTRIBN DIAGRAM. FIG Nº 23.

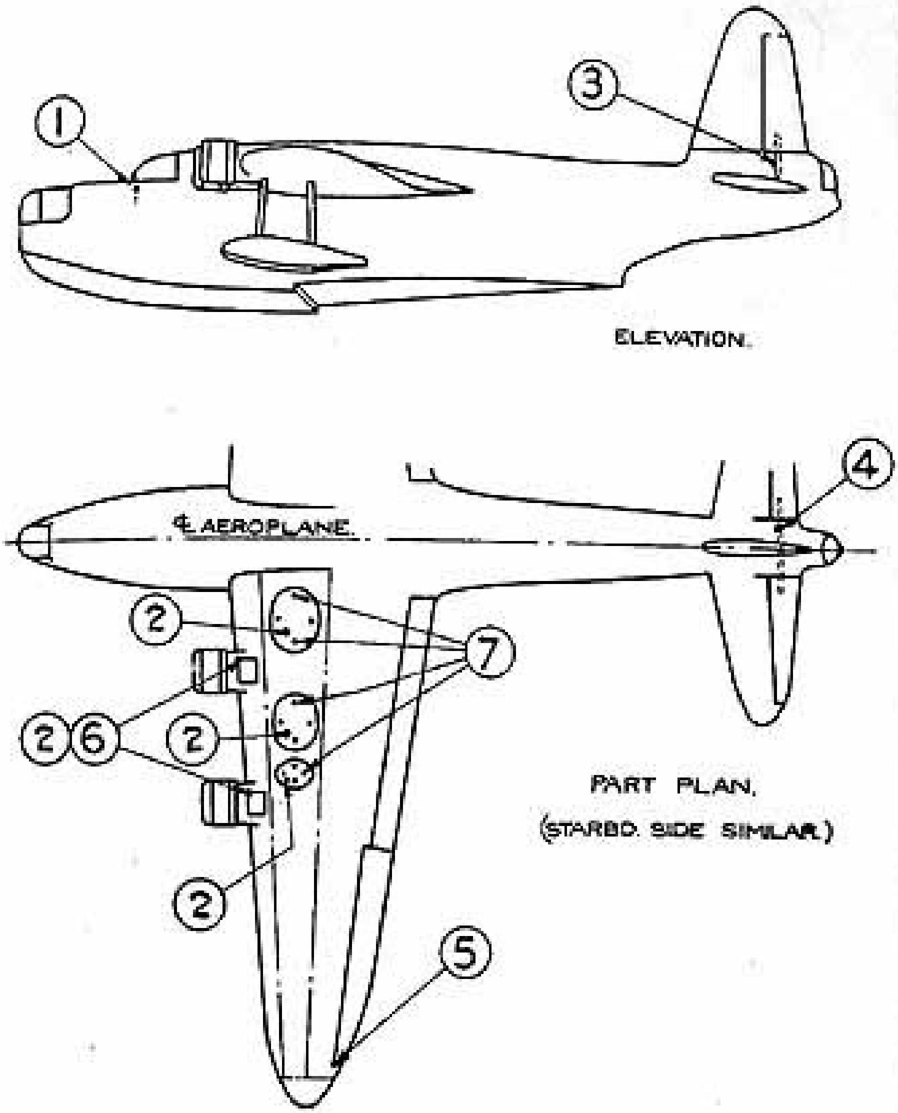


IDENTIFICATION LIGHTING SYSTEM.

FIG. No. 24.



24V. ACCUMULATOR CHARGING, ENGINE STARTING & FLAP OPERATING MOTOR SYSTEM. Fig. Nº 25.



(1) PILOTS' PANEL.- VIBRATIONLESS PANELS BONDED TO MAIN PANEL AT ONE SHOCK ABSORBER IN EACH CASE.

(2) BONDING SOCKETS ON FUEL AND OIL TANKS FOR REFILLING HOSES.

(3) RUDDER.- BONDED TO HULL AT TORQUE TUBE SLEEVE.

(4) ELEVATOR.- BONDED TO HULL AT TORQUE TUBE SLEEVE STARBD.

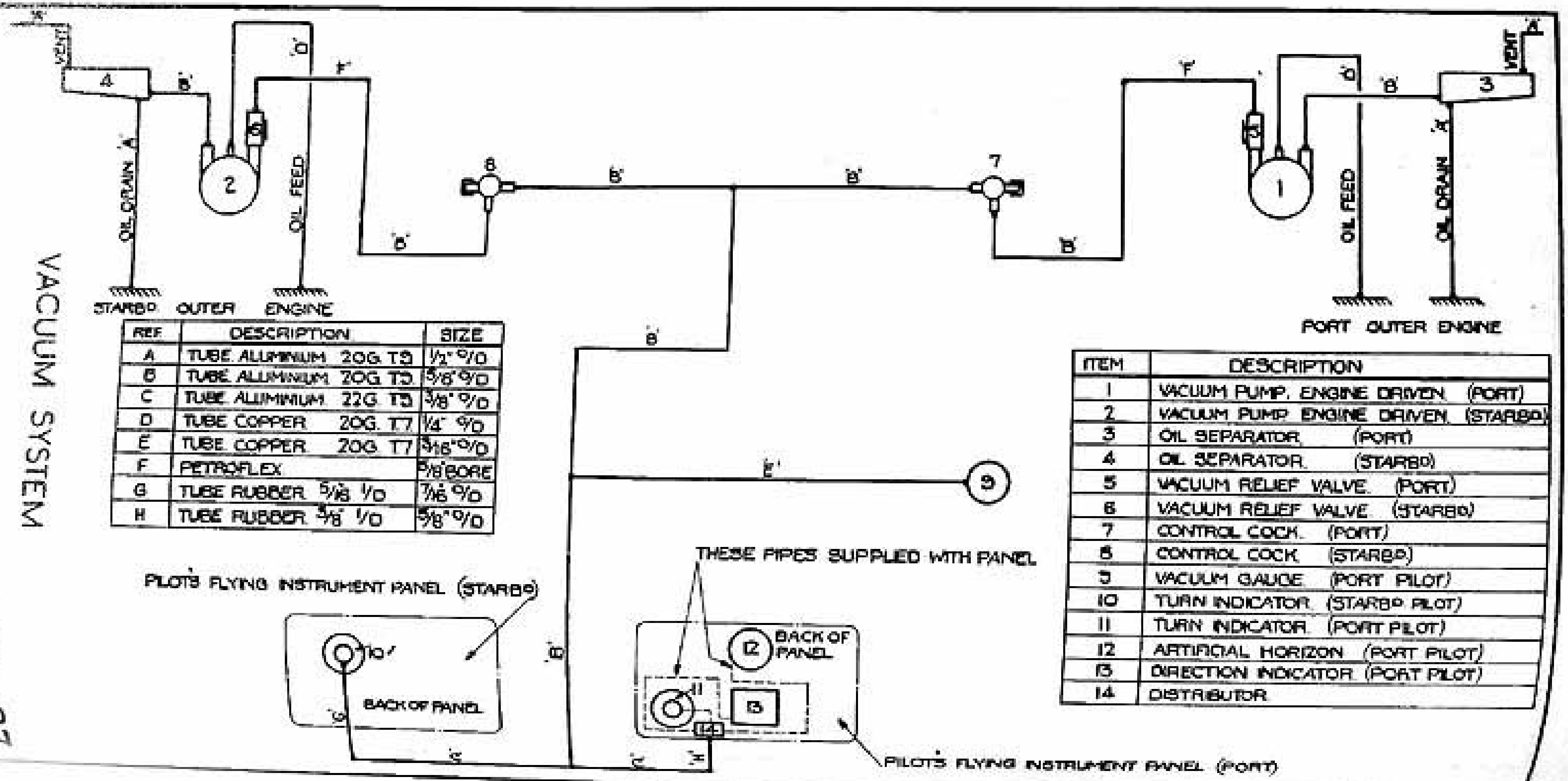
(5) AILERONS.- BONDED TO MAIN PLANE RIB AT TIP.

(6) OIL TANKS.- BONDED TO NACELLE FRAME AT ONE POINT IN EACH CASE

(7) FUEL TANKS.- BONDED TO MAIN PLANE AT FOUR POINTS IN EACH CASE

BONDING OF PIPE JOINTS ETC. CONFORMS TO G.E. SPECIFICATION No. 125 (LATEST ISSUE)

BONDING DIAGRAM. FIG. No. 26.

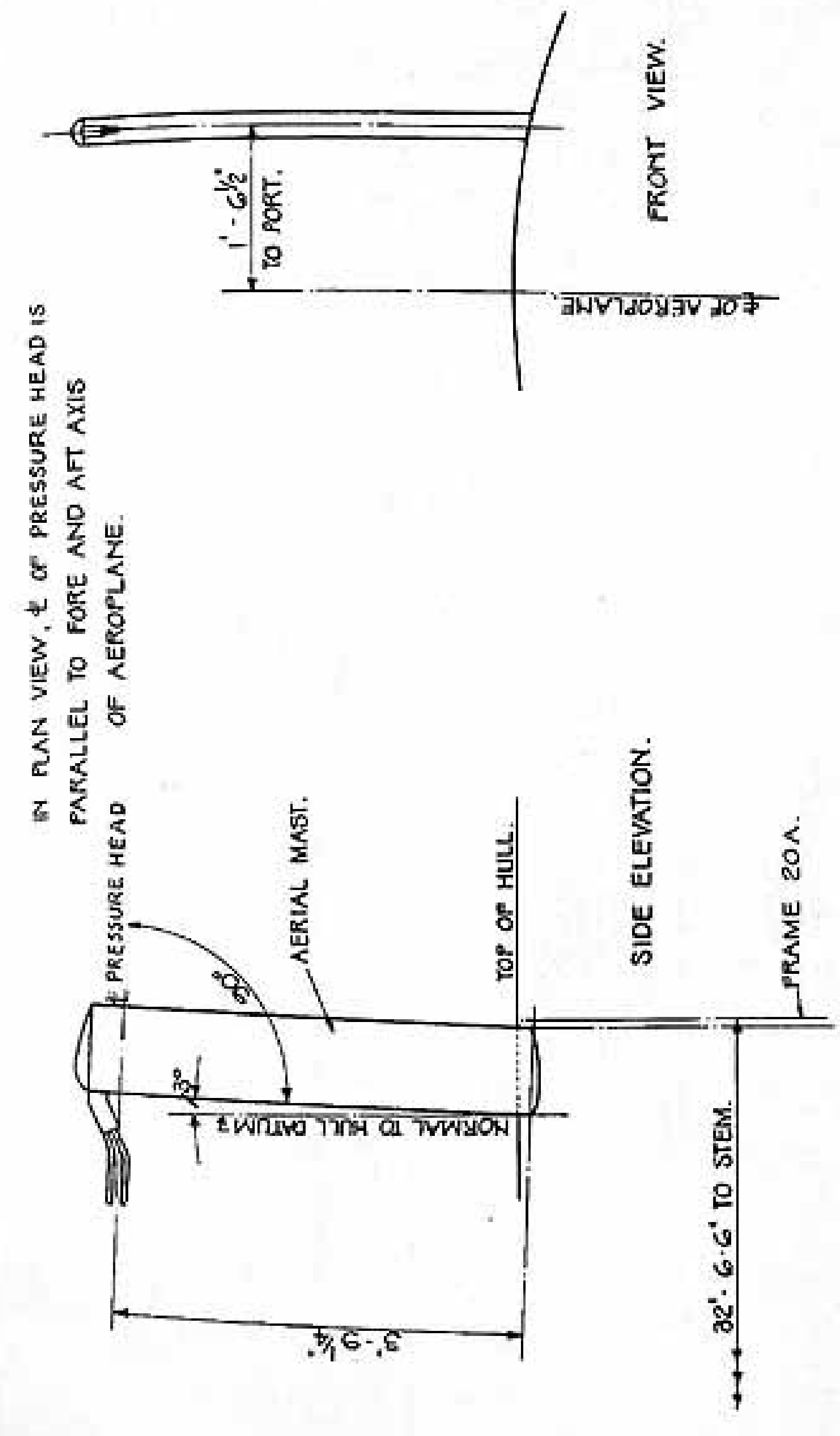


REF.	DESCRIPTION	SIZE
A	TUBE ALUMINIUM 20G. T5	1/2" O/D
B	TUBE ALUMINIUM 20G. T5	5/8" O/D
C	TUBE ALUMINIUM 22G. T5	3/8" O/D
D	TUBE COPPER 20G. T7	1/4" O/D
E	TUBE COPPER 20G. T7	3/16" O/D
F	PETROFLEX	5/8" BORE
G	TUBE RUBBER 5/16 I/D	7/16" O/D
H	TUBE RUBBER 3/8 I/D	5/8" O/D

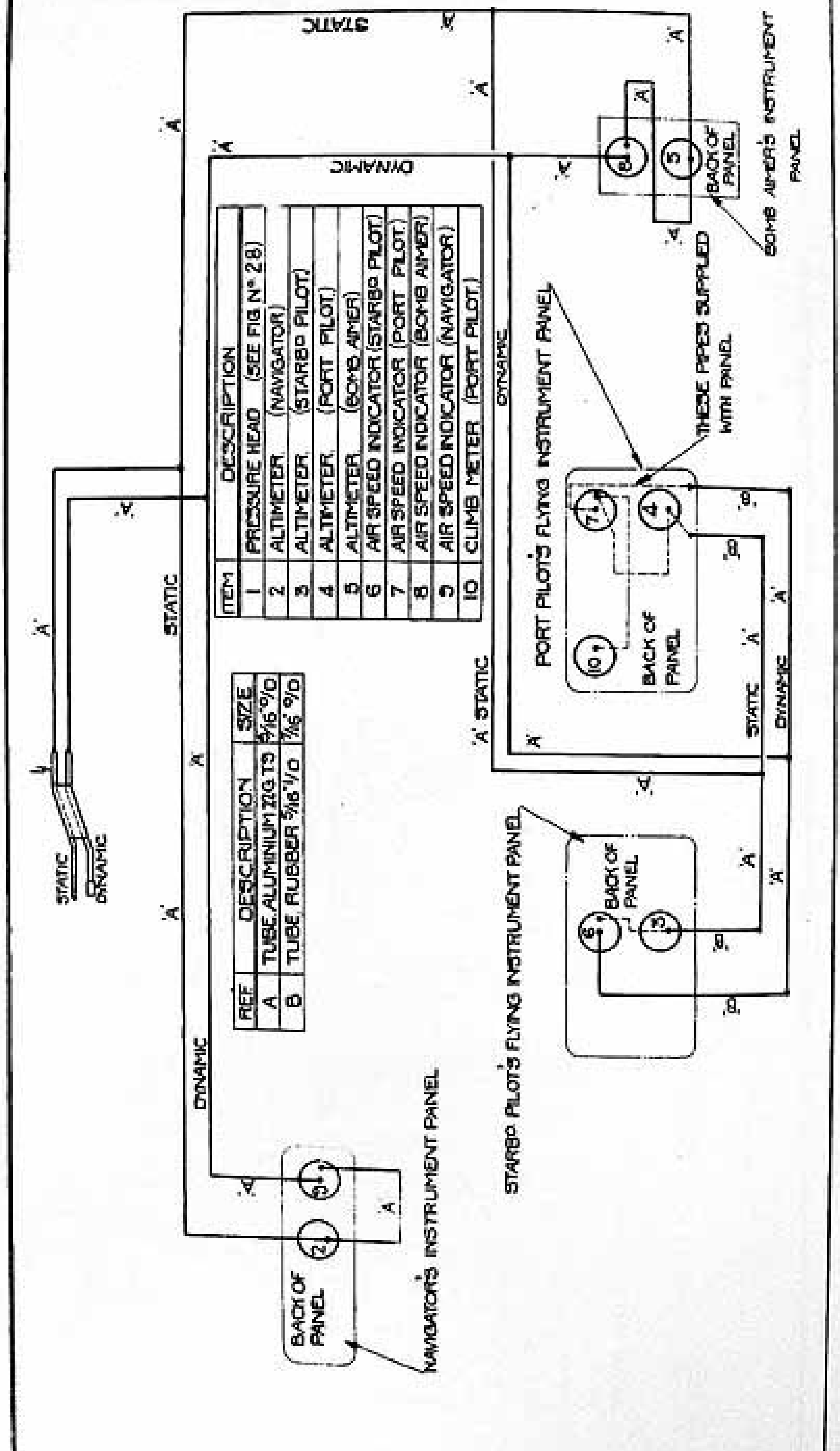
ITEM	DESCRIPTION
1	VACUUM PUMP, ENGINE DRIVEN (PORT)
2	VACUUM PUMP ENGINE DRIVEN (STARB°)
3	OIL SEPARATOR (PORT)
4	OIL SEPARATOR (STARB°)
5	VACUUM RELIEF VALVE (PORT)
6	VACUUM RELIEF VALVE (STARB°)
7	CONTROL COCK (PORT)
8	CONTROL COCK (STARB°)
9	VACUUM GAUGE (PORT PILOT)
10	TURN INDICATOR (STARB° PILOT)
11	TURN INDICATOR (PORT PILOT)
12	ARTIFICIAL HORIZON (PORT PILOT)
13	DIRECTION INDICATOR (PORT PILOT)
14	DISTRIBUTOR

VACUUM SYSTEM

FIG. No. 27.



POSITION AND ANGULAR SETTING
OF PRESSURE HEAD. FIG No 28

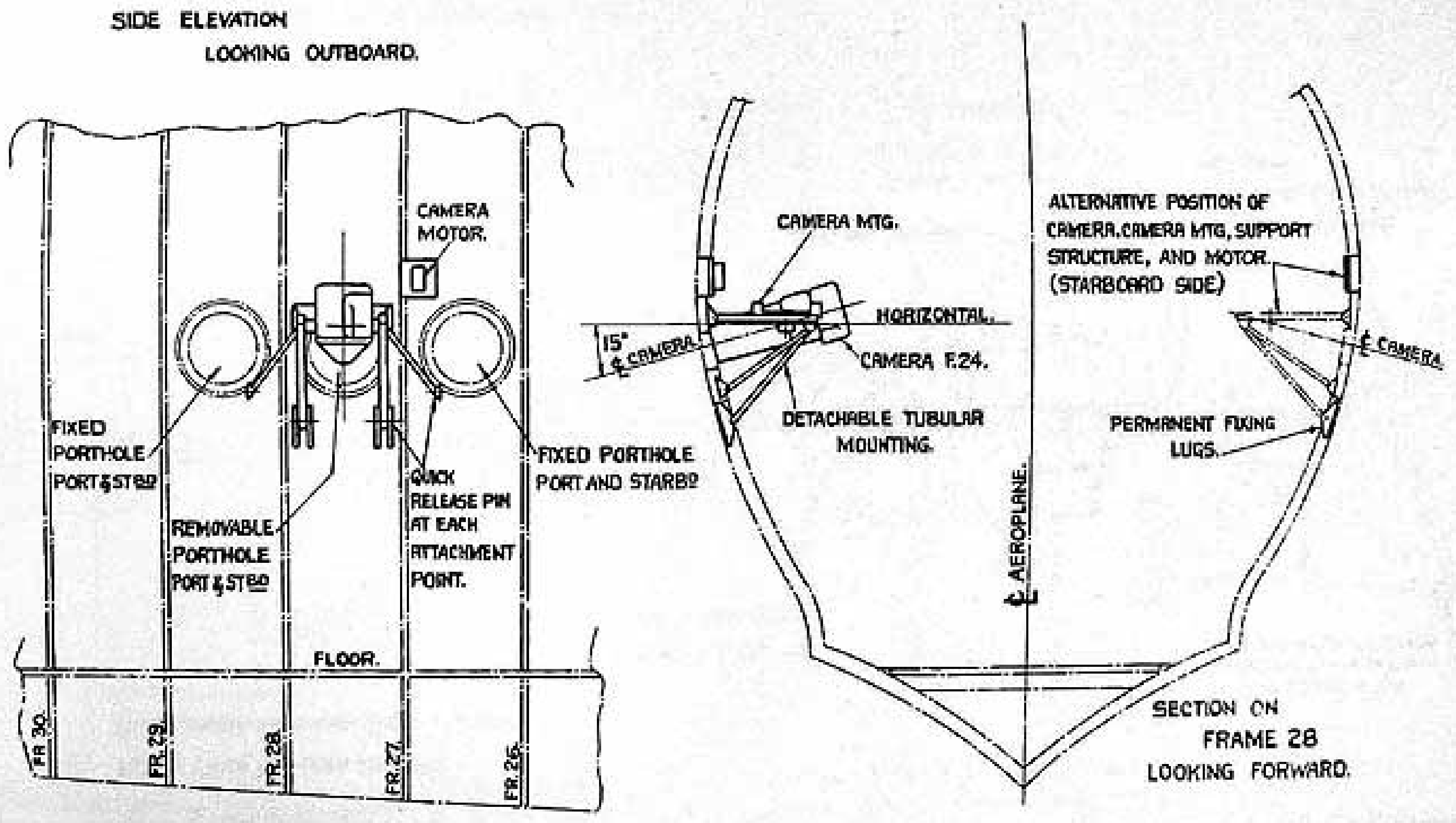


ITEM	DESCRIPTION
1	PRESSURE HEAD (SEE FIG No 28)
2	ALTIMETER (NAVIGATOR)
3	ALTIMETER (STARBD PILOT)
4	ALTIMETER (PORT PILOT)
5	ALTIMETER (BOMB AIMER)
6	AIR SPEED INDICATOR (STARBD PILOT)
7	AIR SPEED INDICATOR (PORT PILOT)
8	AIR SPEED INDICATOR (BOMB AIMER)
9	AIR SPEED INDICATOR (NAVIGATOR)
10	CLIMB METER (PORT PILOT)

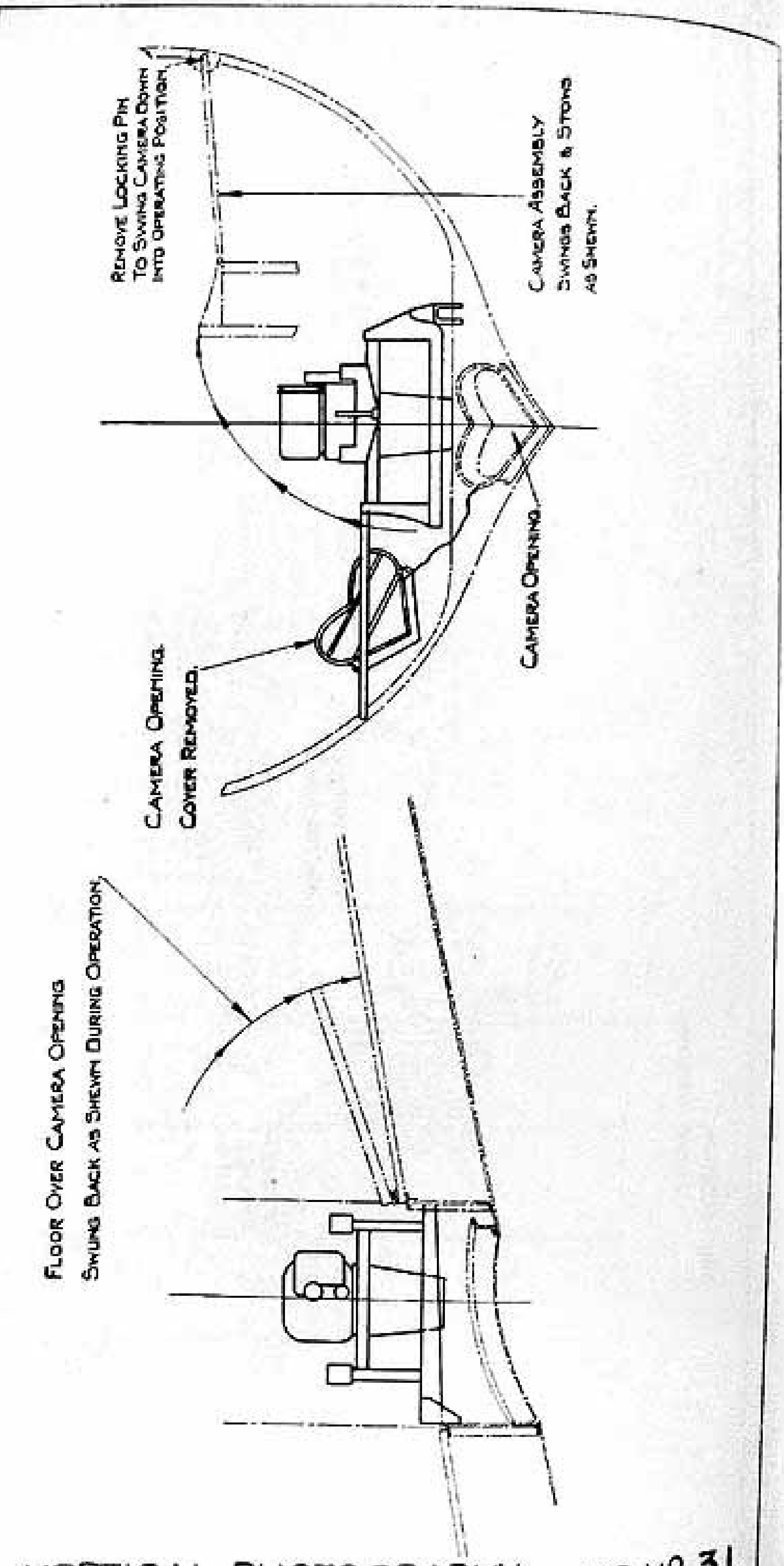
REF	DESCRIPTION	SIZE
A	TUBE, ALUMINIUM 22G T3	5/16" O/D
B	TUBE, RUBBER 5/16" I/D	7/16" O/D

PRESSURE HEAD PIPING

FIG No 29.

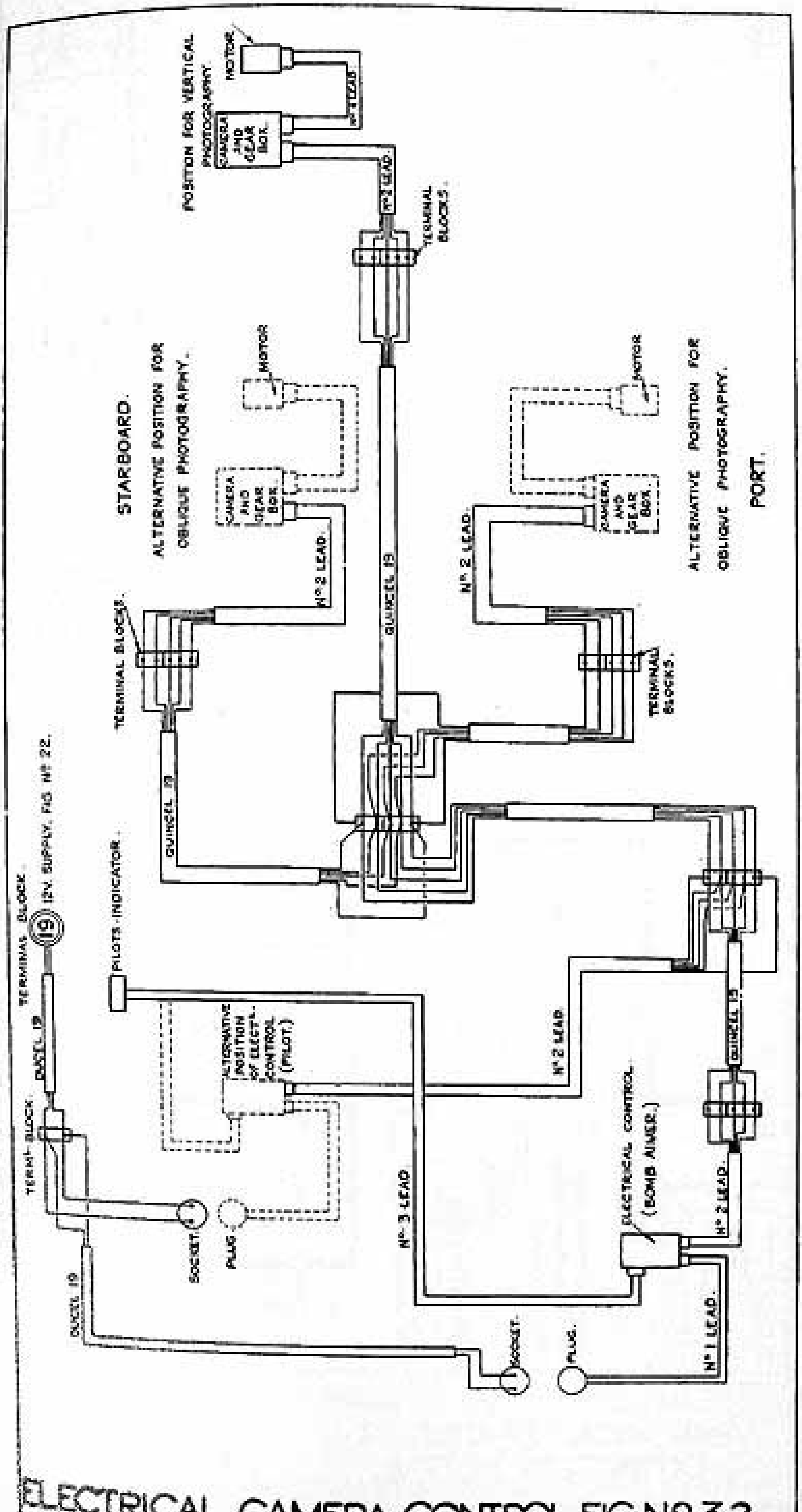


OBLIQUE PHOTOGRAPHY. FIG: Nº 30.

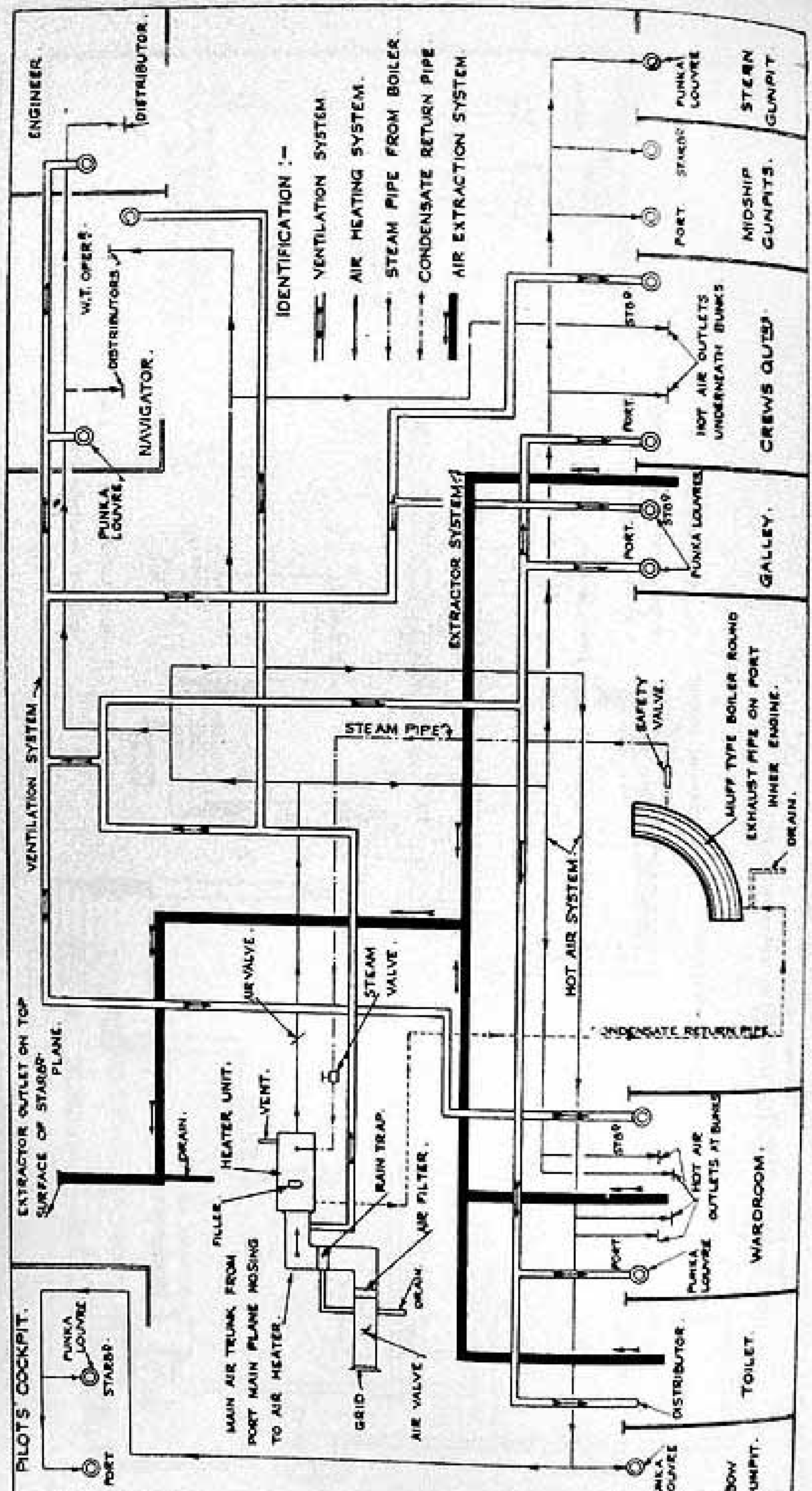


VERTICAL PHOTOGRAPHY. FIG No 31.

A.T.P. 4488/41

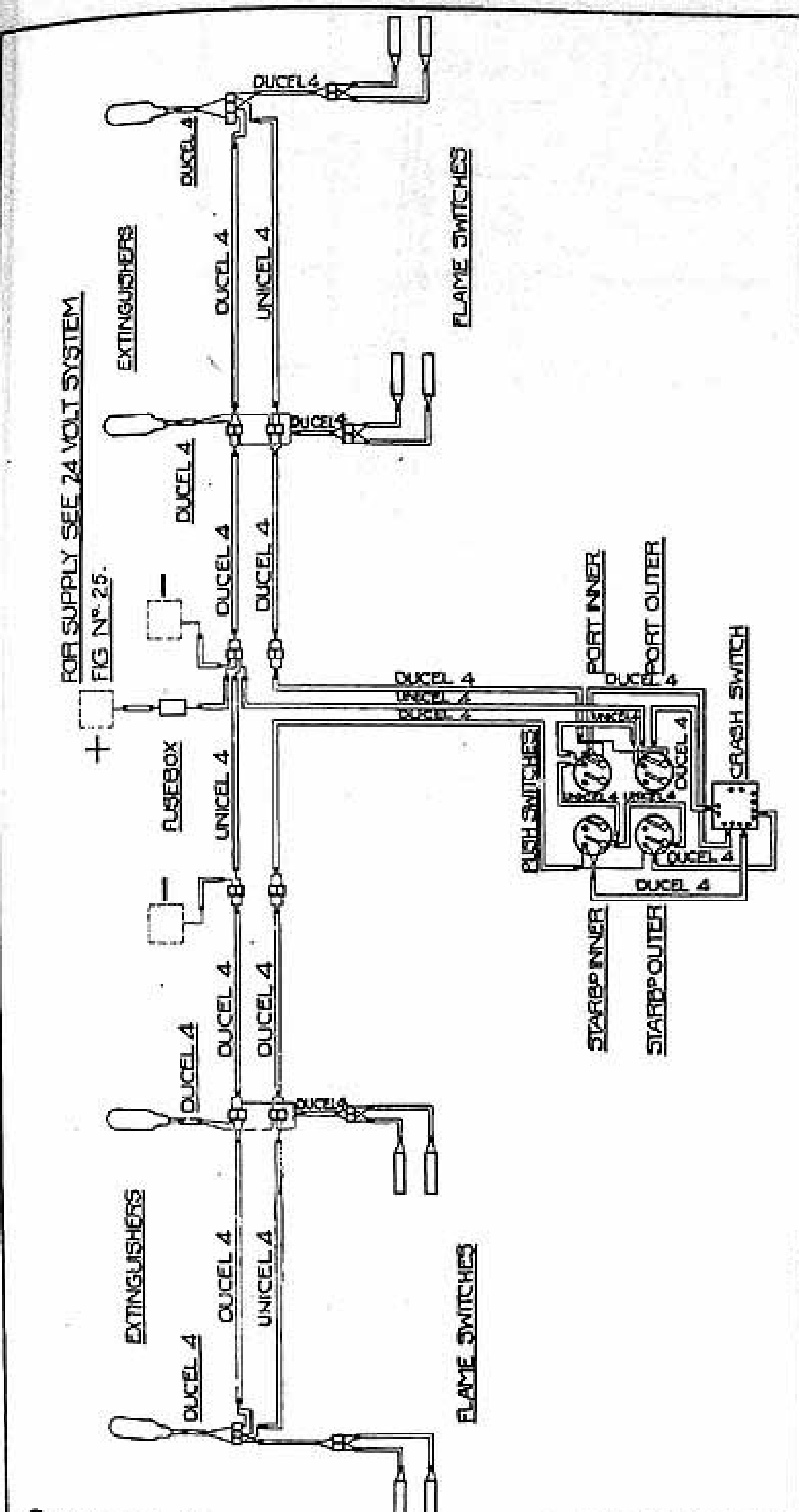


ELECTRICAL CAMERA CONTROL. FIG. Nº 32.



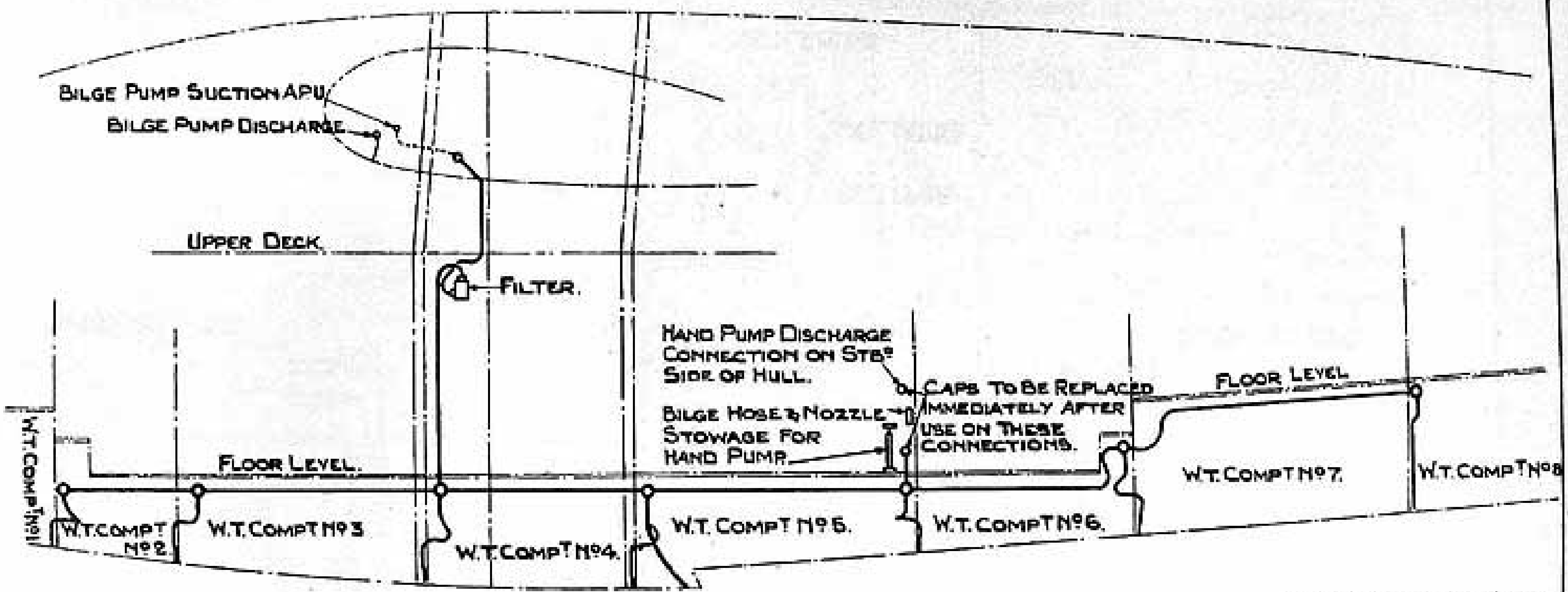
VENTILATION, HEATING & EXTRACTION SYSTEM.

FIG. No. 33.



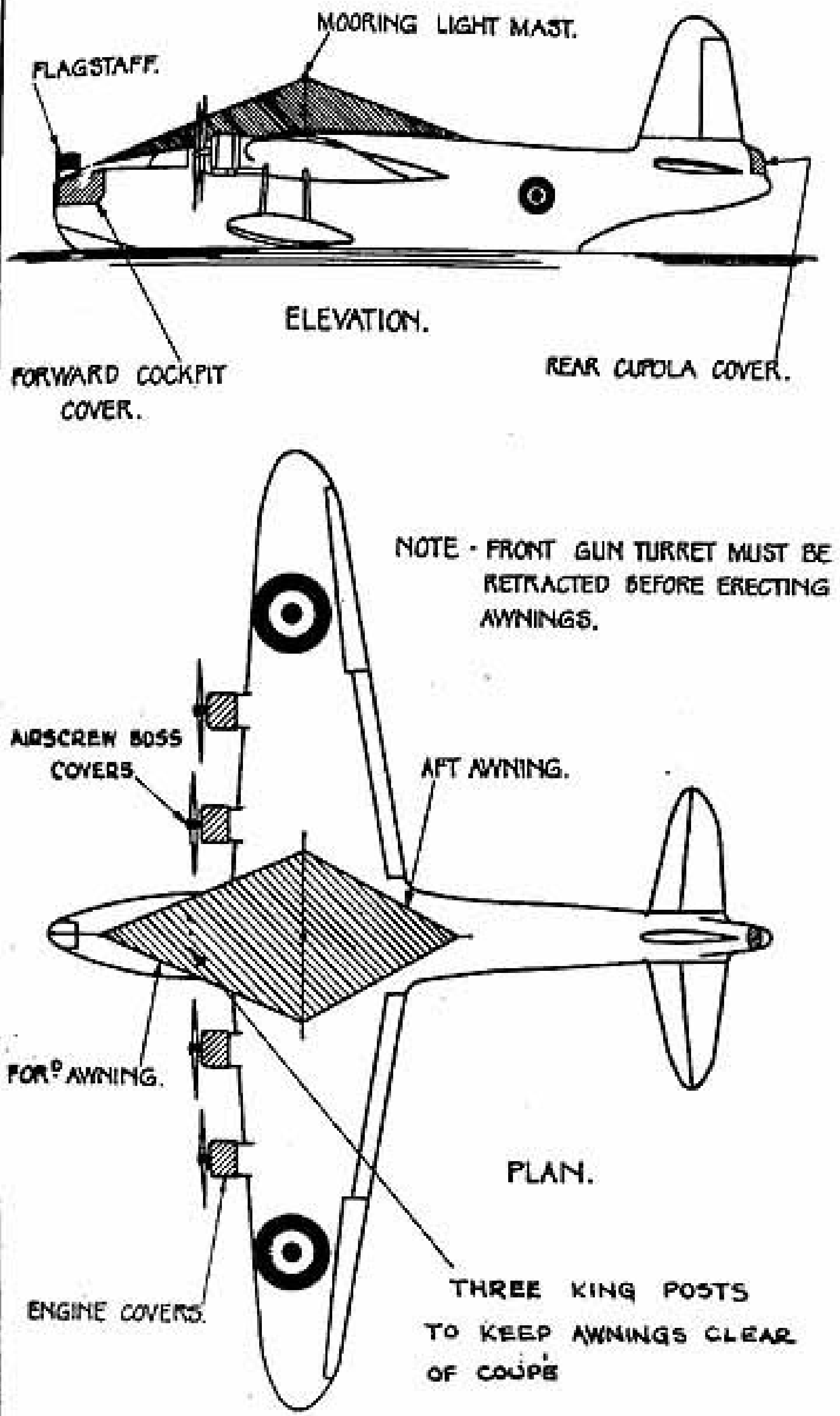
GRAVINER ELECTRICAL FIRE EXTINGUISHER SYSTEM

FIG No 34



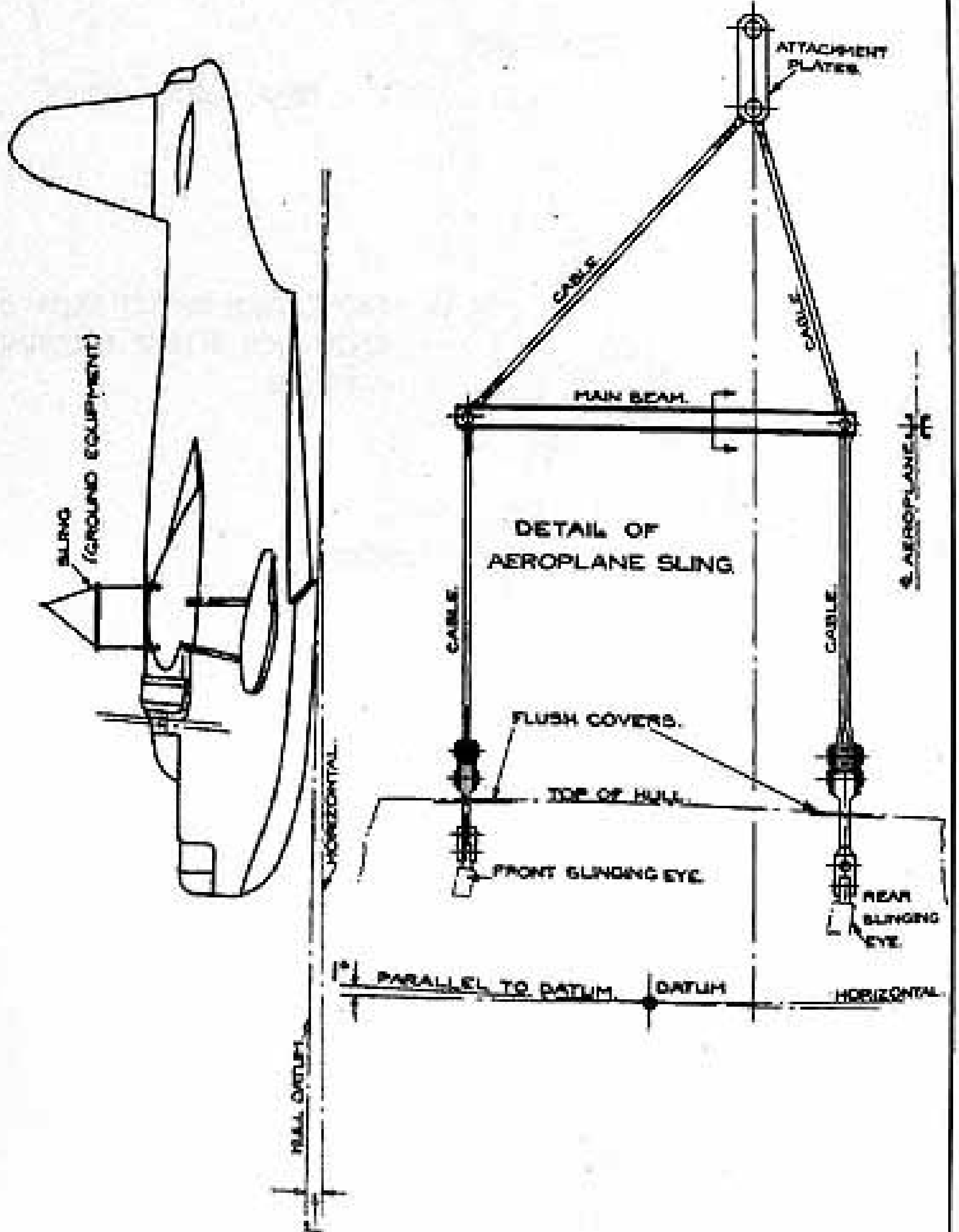
BILGE SYSTEM (ELEVATION.)

FIG. No 35.

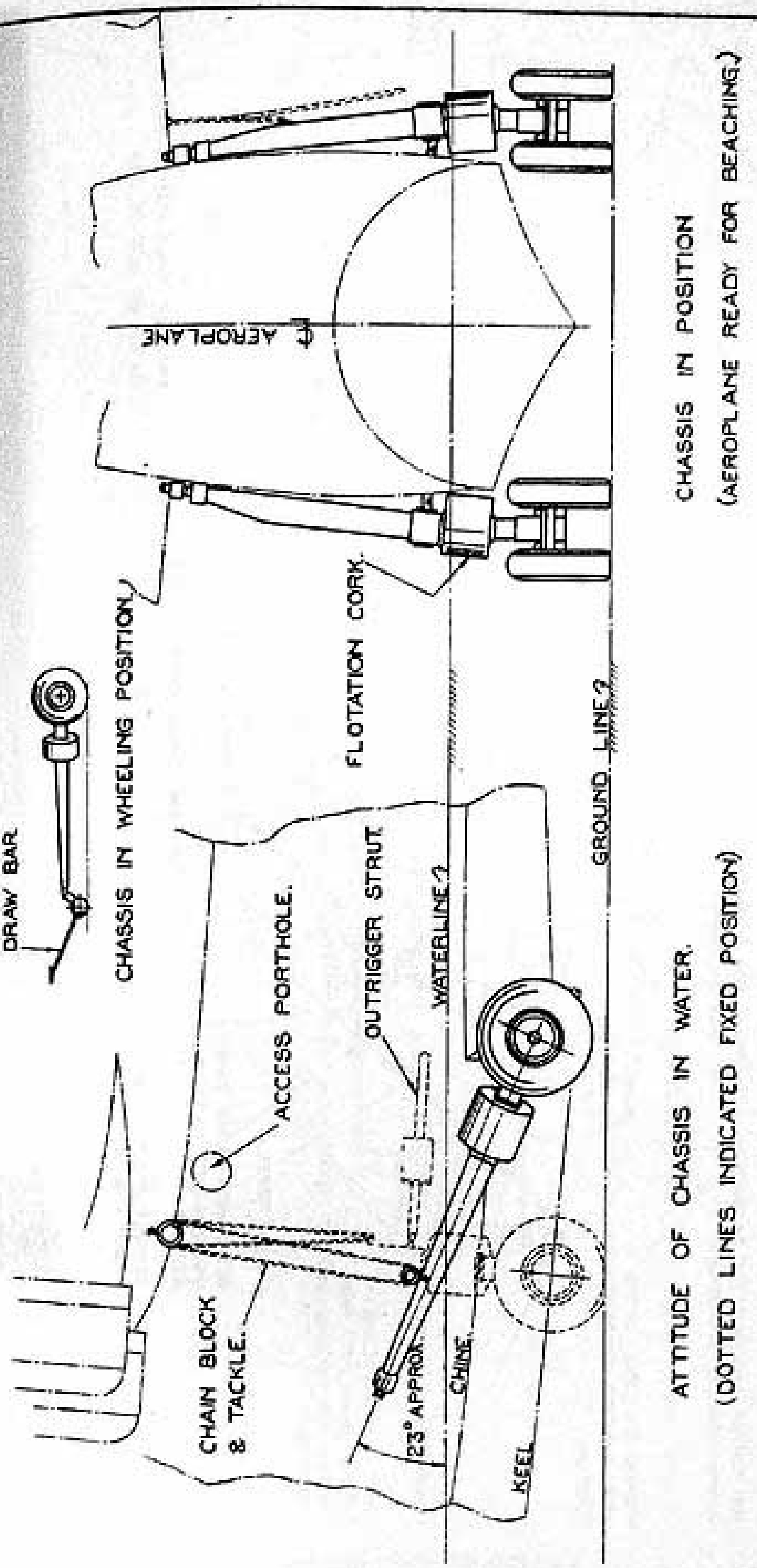


AWNINGS AND COVERS. FIG No 38.

ACCESS TO FRONT & REAR SLINGING FITTINGS ON AEROPLANE IS OBTAINED BY REMOVAL OF FLUSH FITTING COVERS POSITIONED ABOVE SLINGING POINTS ON THE CENTRE LINE OF HULL

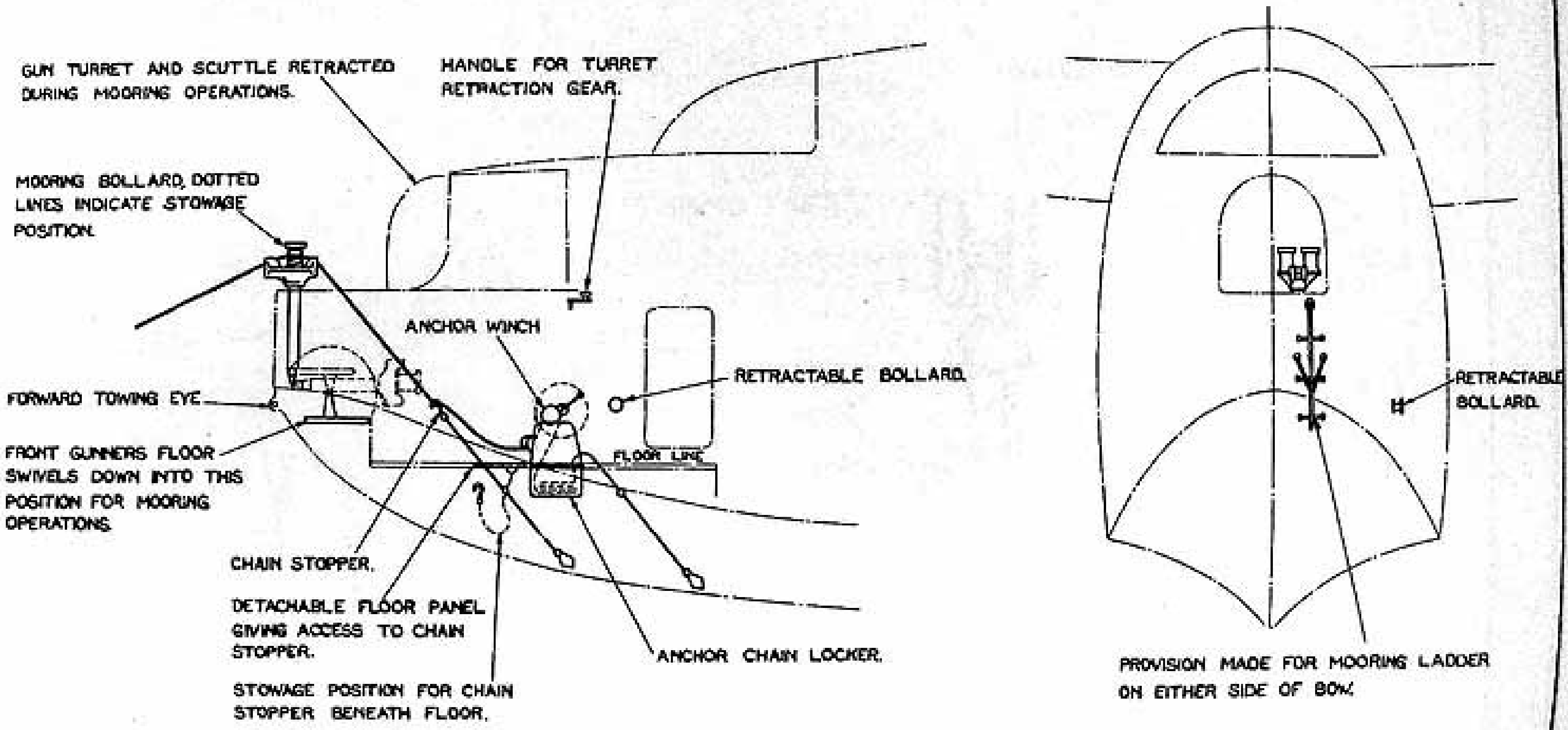


AEROPLANE SLING. FIG. Nº 39.

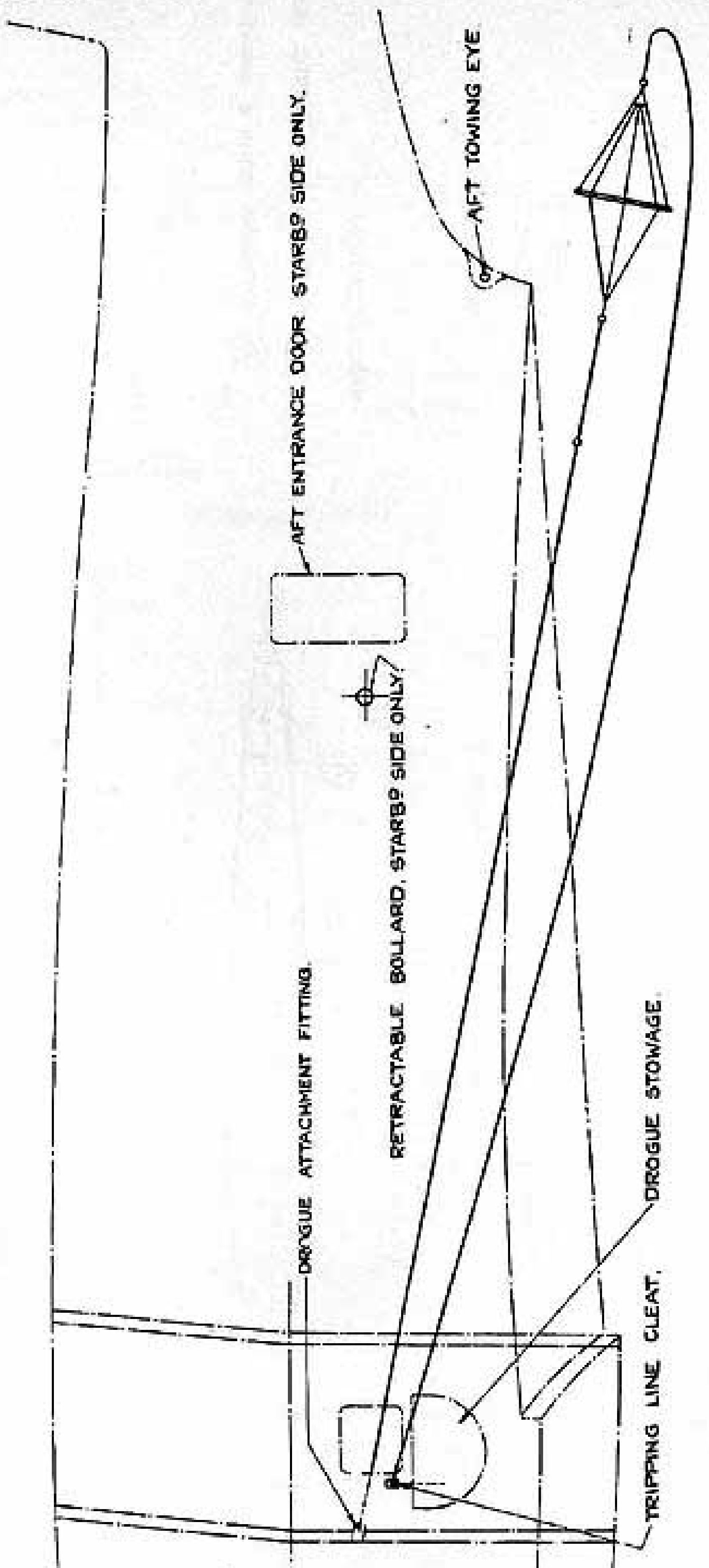


BEACHING CHASSIS

FIG. No. 40.



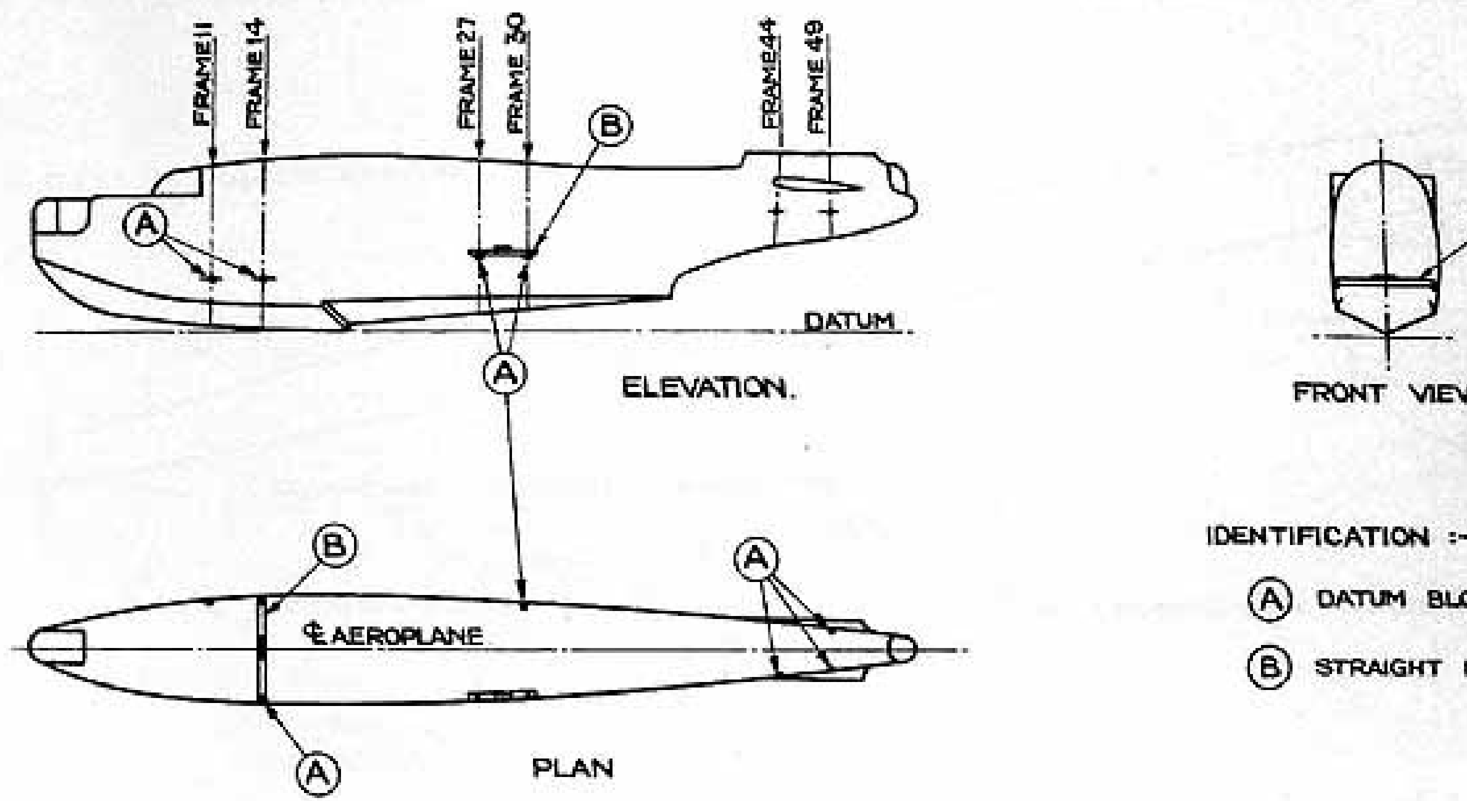
MARINE EQUIPMENT.
MOORING GEAR. FIG. No 41.



MARINE EQUIPMENT – DROGUES.

(PORT & STARB^D)

FIG. Nº 42.



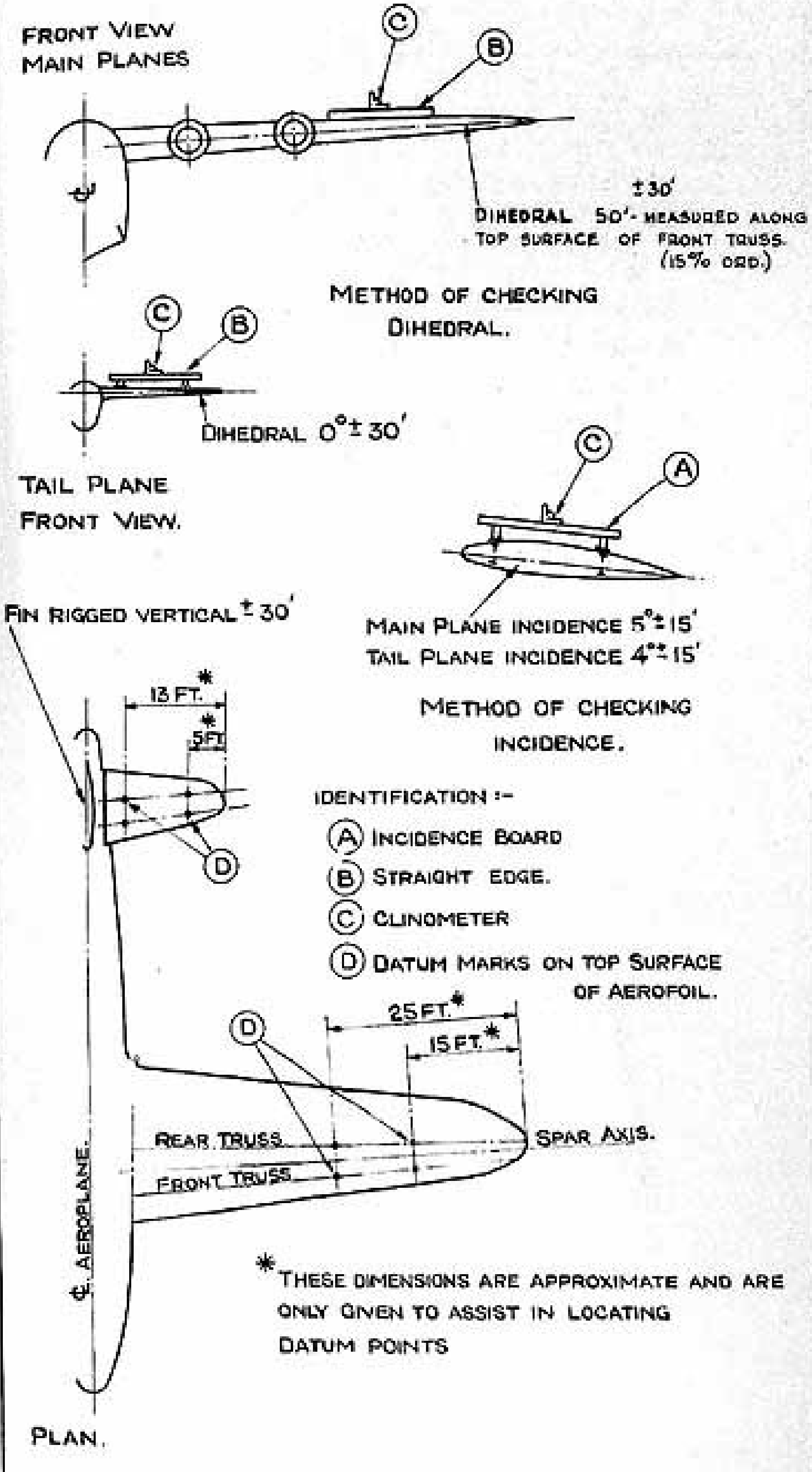
IDENTIFICATION :-

(A) DATUM BLOCKS INSIDE HULL

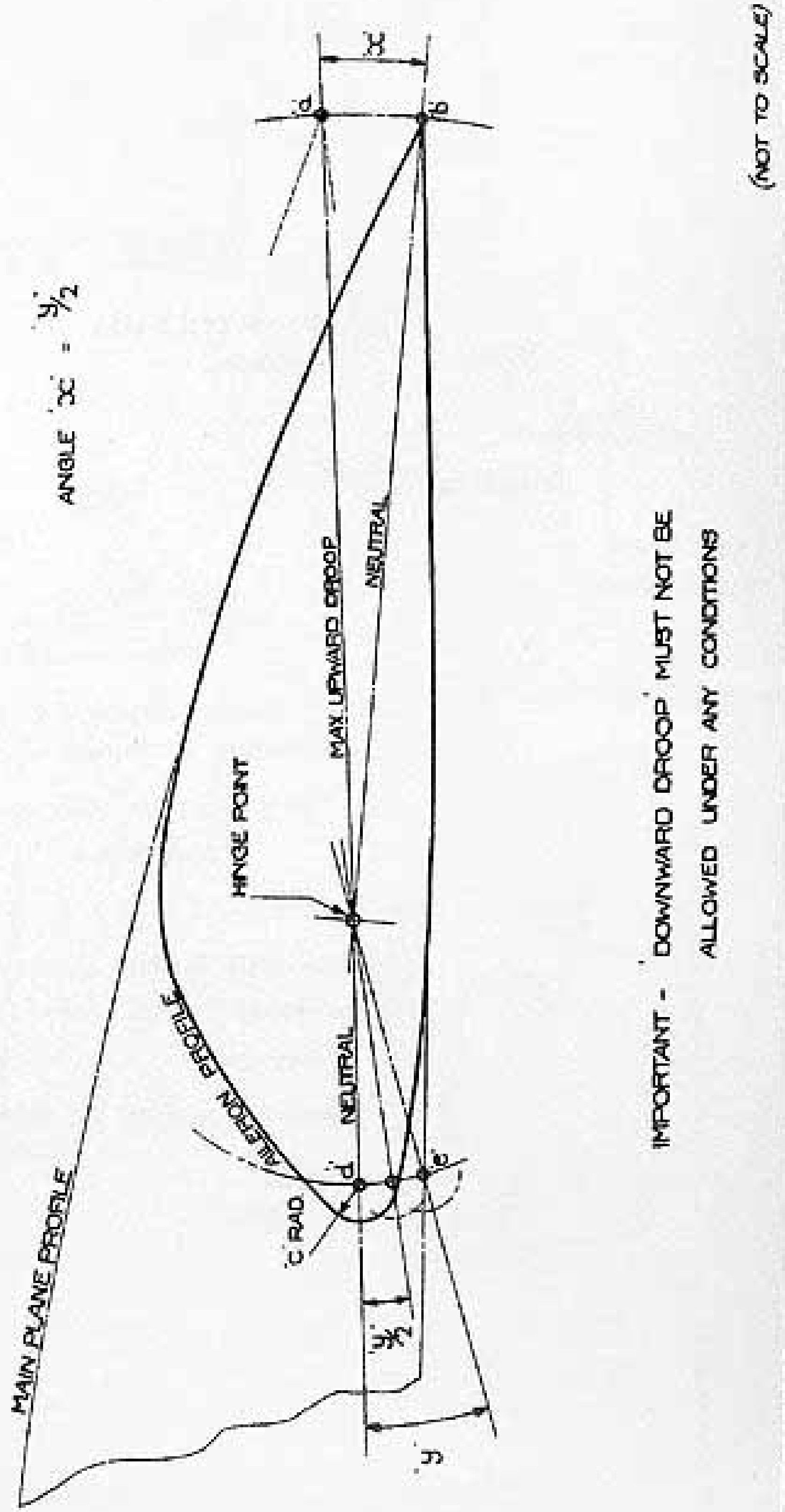
(B) STRAIGHT EDGE & SPIRIT LEVEL

THE HULL IS IN RIGGING POSITION WHEN
STRAIGHT EDGES ARE HORIZONTAL.

RIGGING DIAGRAM (HULL) FIG. Nº 43.



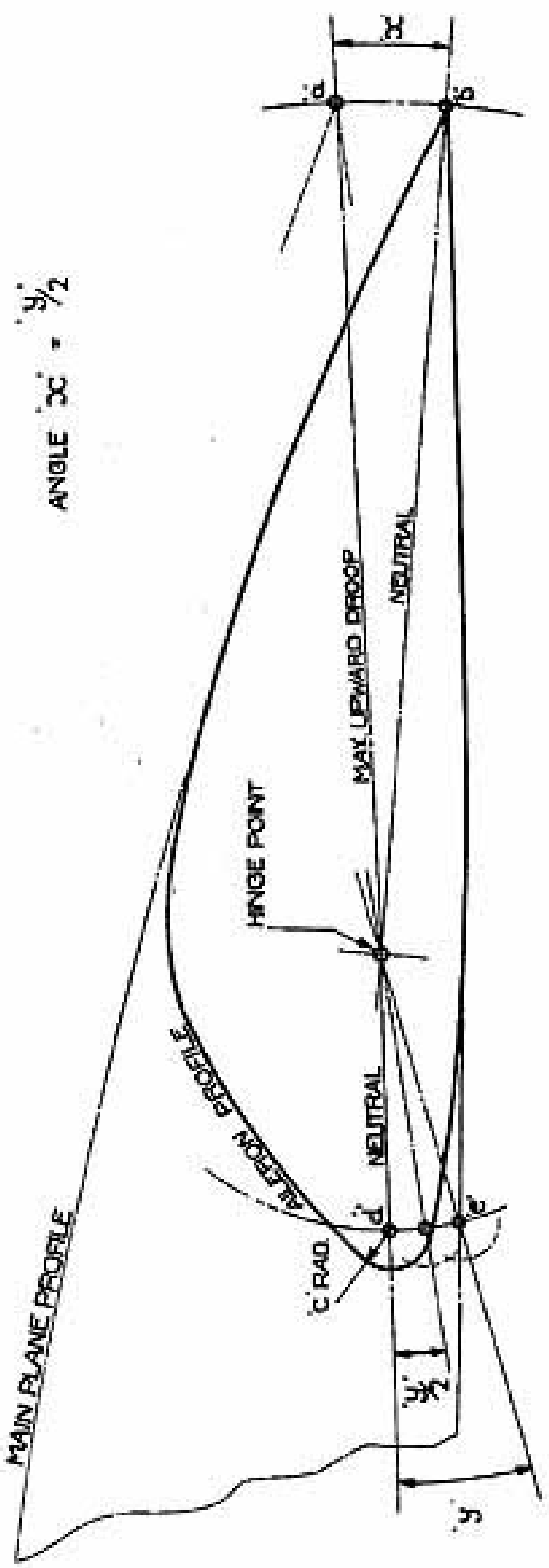
RIGGING DIAGRAM.(AEROFOILS) FIG. Nº 44.



RIGGING DIAGRAM

(AILERON DROOP)

FIG. No. 45.



IMPORTANT - 'DOWNWARD DROOP' MUST NOT BE ALLOWED UNDER ANY CONDITIONS

(NOT TO SCALE)

RIGGING DIAGRAM

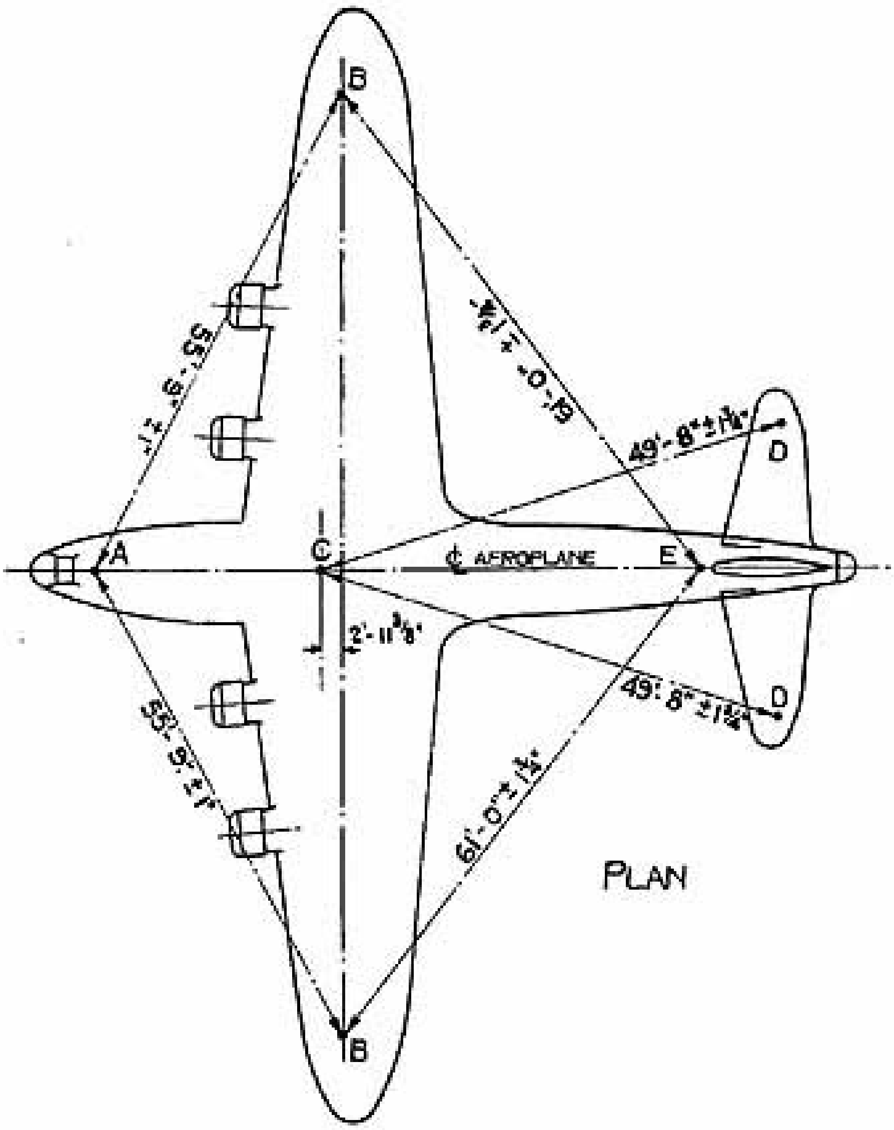
(AILERON DROOP)

FIG. No. 45.

R.T.P. 6464/61

DATUM POINT LOCATION			
POINT	DISTANCE FROM STEM	DISTANCE FROM ℄ AEROPLANE	IDENTIFICATION
A	5' - 2⅝"	NIL	ON ℄ IN FRONT OF PILOT'S COUPE
B	31' - 3⅜"	49' - 2"	UPPER SURFACE OF MAIN PLANE
C	28' - 4"	NIL	ON ℄ HULL MID - SECTION
D	75' - 3"	14' - 3"	UPPER SURFACE OF TAIL PLANE
E	67' - 6"	NIL	ON ℄ HULL TAIL SECTION

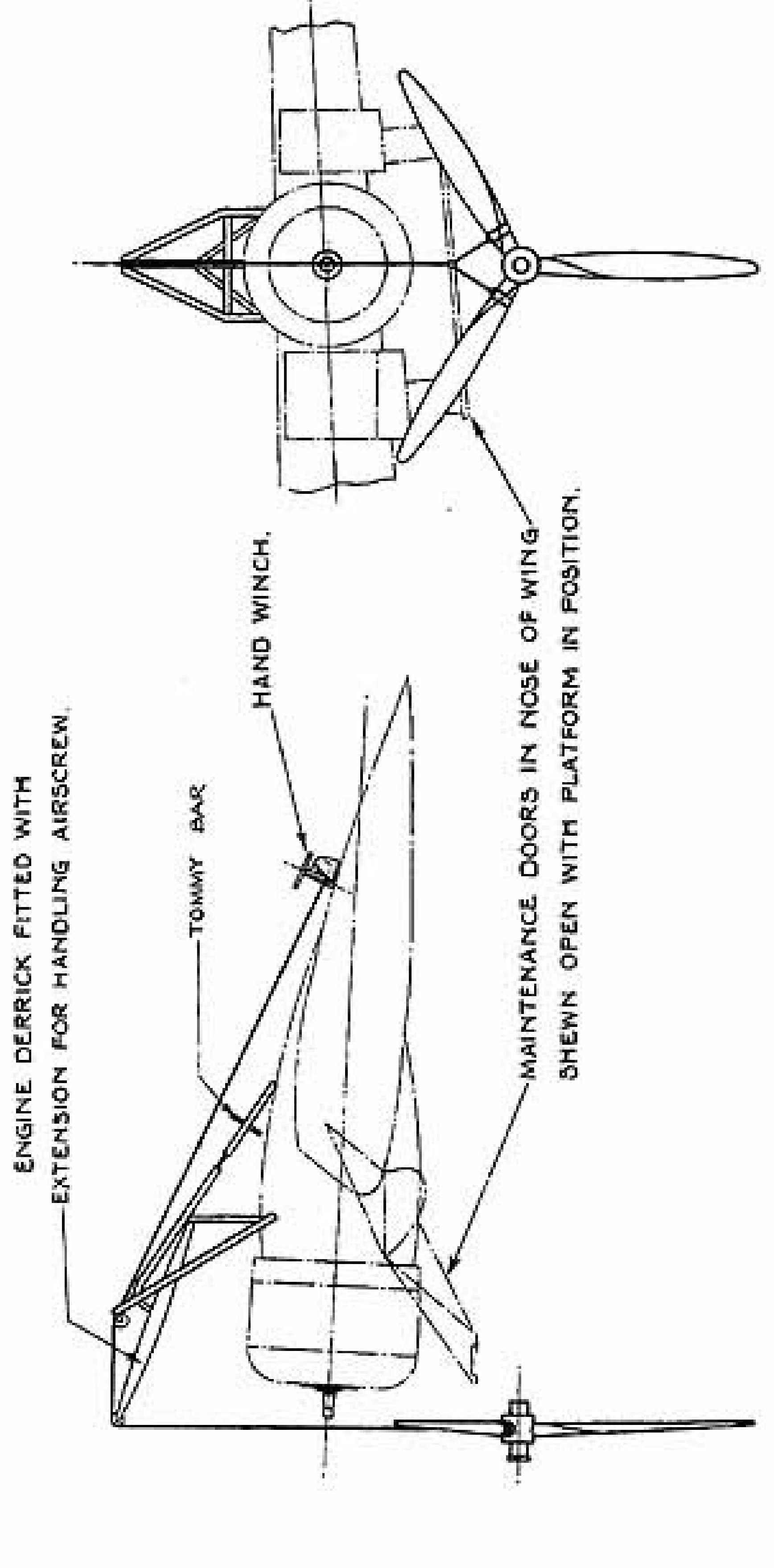
NOTE! THE DIMENSIONS GIVEN ARE APPROXIMATE AND ARE ONLY INTENDED AS A GUIDE IN LOCATING DATUM POINTS.



RIGGING DIAGRAM. FIG. Nº 46.

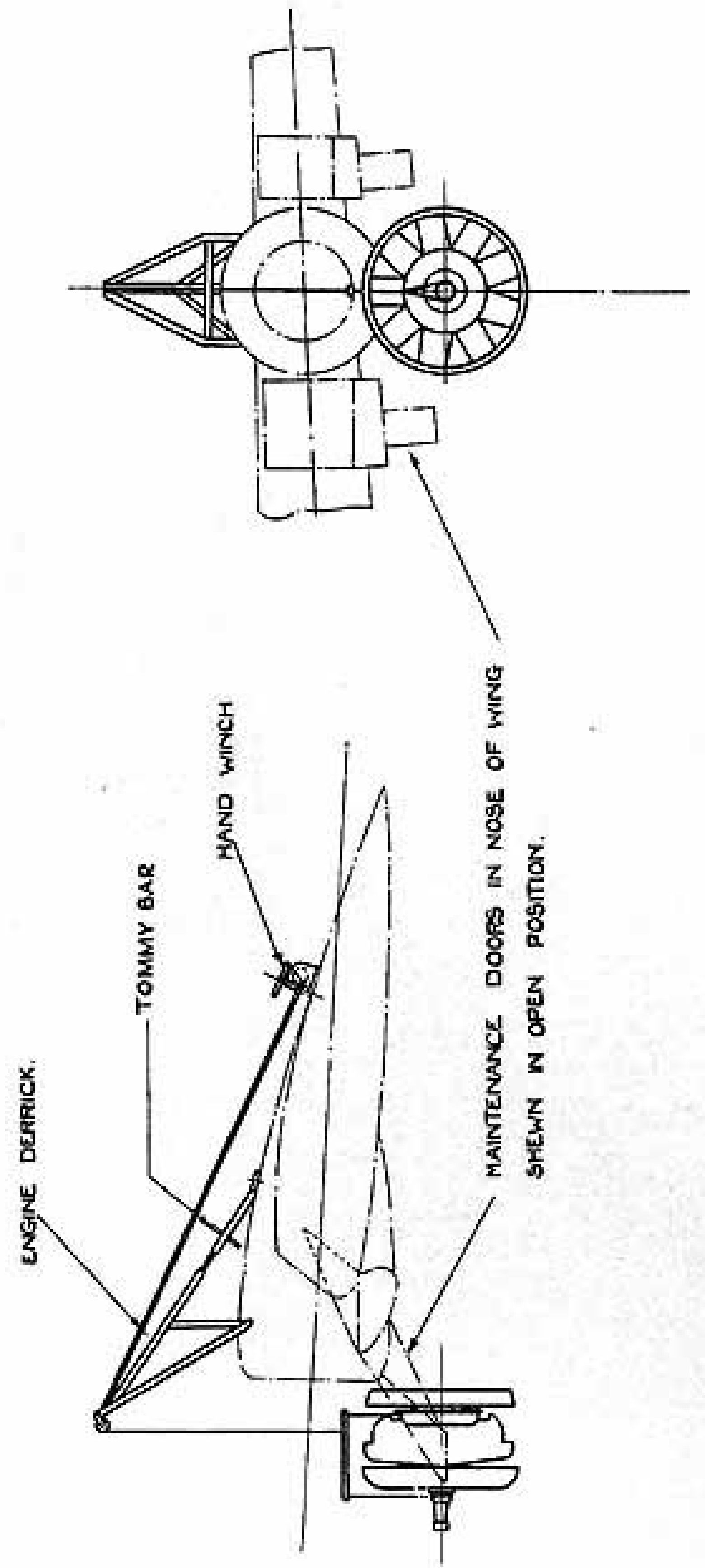
(DIAGONAL MEASUREMENTS)

A.T.R. 6258/61



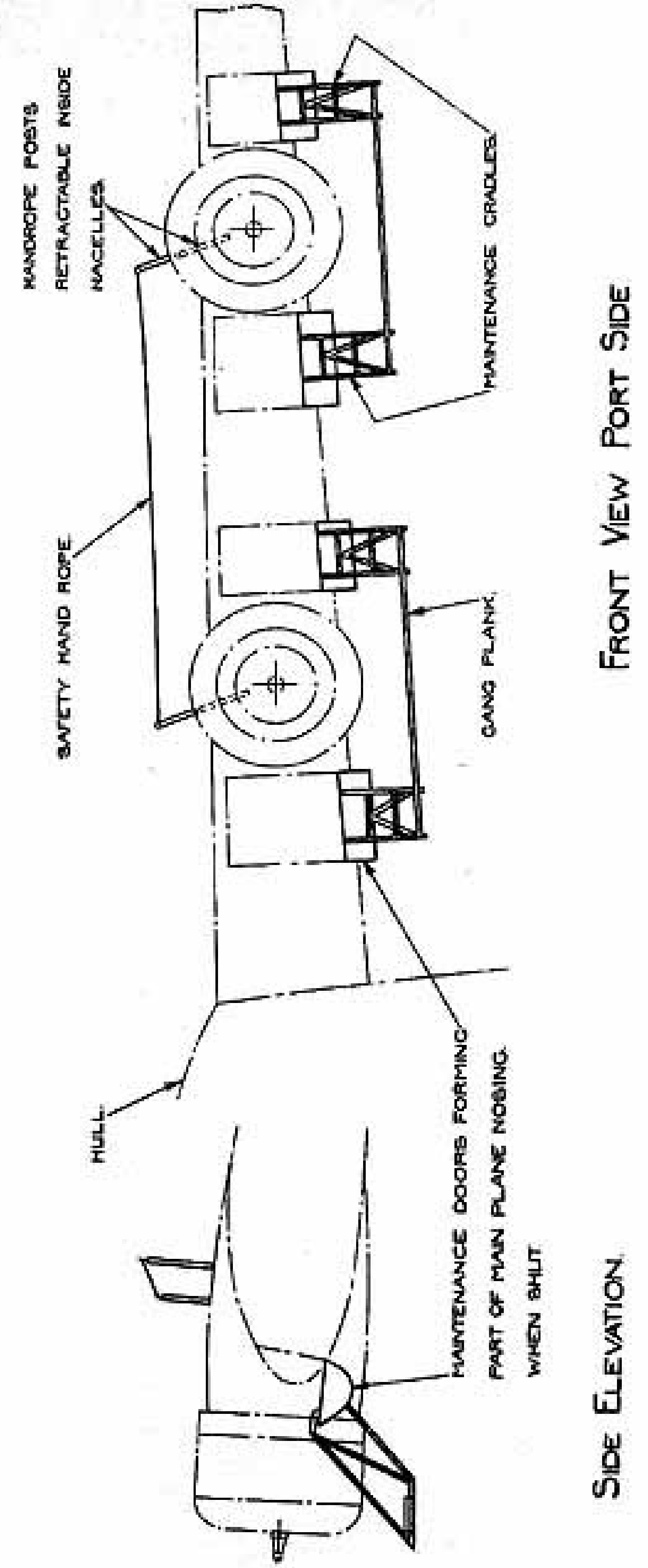
AIRSCREW HANDLING. FIG. Nº 47.

A.T.P. 685 9/61



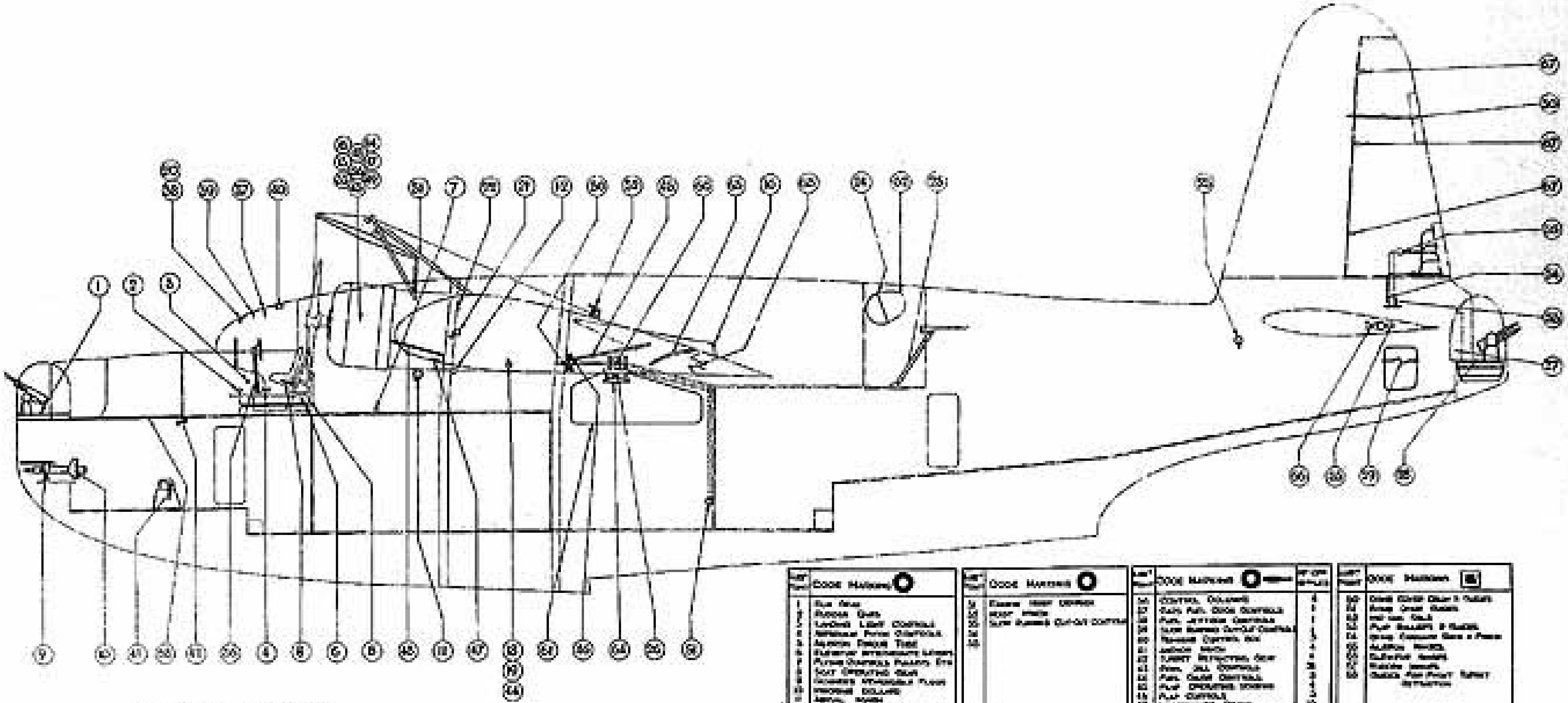
ENGINE HANDLING FIG Nº 48.

R.T.P. 6258/61



MAINTENANCE DOORS & CRADLES. FIG. No 49.

R.T.P. 62 C4/61



KEY TO CODE MARKINGS.

● Oil Lubricating, Anti-Freezing Type B (Stores Ref. 34A/36 and 56).

▣ Grease, Anti-Freezing (Stores Ref. 34A/49).

Gun Lubrication

Item No.	Code Marking ○
1	Gun Ring
2	Rudder Quad
3	Landing Light Controls
4	Airscrew Pitch Controls
5	Aileron Torque Tube
6	Elevator Intermediate Levers
7	Flying Controls Pulleys Etc
8	Boat Operating Gear
9	[illegible]
10	[illegible] Bollard
11	Aerial Winch
12	Cowl Gill Gear Boxes
13	[illegible] Air Shutter Controls
14	Fuel Cock Controls
15	Slow Running Cut-Out Controls
16	Aileron Controls
17	Airscrew Pitch Controls
18	Carb. Air Shutter Controls
19	Fuel Cock Controls
20	Fuel Jettison Controls
21	[illegible] Operating Gear
22	Landing Light Controls
23	[illegible]
24	[illegible]
25	Aerial Lowering Winch
26	Bomb Hoist Winch
27	Cupola Doors
28	Tail Gun Gear
29	Tail Escape Door
30	[illegible] Flap Gear

Item No.	Code Marking ○
[illegible]	Engine [illegible]
[illegible]	Boat Winch
[illegible]	Slow Running Cut-Out Controls

MISCELLANEOUS ITEMS

Bulkhead Cocks(?)
All Flying Controls Pulleys Etc.
Hinged Doors, Seats & [illegible]
Opening Portlights
Tail Trolley
All Guns

Item No.	Code Marking ○	No. of Nipples
[illegible]	Control Column	[illegible]
[illegible]	Carb. Fuel Cock Controls	[illegible]
[illegible]	Fuel Jettison Controls	[illegible]
[illegible]	Slow Running Cut-Out Controls	[illegible]
[illegible]	Throttle Control Box	[illegible]
[illegible]	Anchor Winch	[illegible]
[illegible]	Turret Retracting Gear	[illegible]
[illegible]	[illegible] Controls	[illegible]
[illegible]	Fuel Gauge Controls	[illegible]
[illegible]	Flap Operating Screws	[illegible]
[illegible]	Flap Controls	[illegible]
[illegible]	Maintenance Doors	[illegible]
[illegible]	Airscrew Pitch Controls	[illegible]
[illegible]	[illegible] Starting Gear	[illegible]
[illegible]	Aileron [illegible] Drive	[illegible]
[illegible]	Bomb Carrier Traversing Gear	[illegible]
[illegible]	Elevator [illegible]	[illegible]
[illegible]	Lower Rudder Hinge	[illegible]
[illegible]	Trailing Flap Hinges (Grouped Nipple Lubrication)	[illegible]
[illegible]	[illegible] Flap Gear Boxes	[illegible]
[illegible]	Carb. Fuel Cock Controls	[illegible]
	Tail Trolley Attachments	[illegible]

Item No.	Code Marking ▣
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	Flap Rollers & Rails
[illegible]	[illegible]
[illegible]	Aileron Hinges
[illegible]	Elevator Hinges
[illegible]	Rudder Hinges
[illegible]	Guides for Pilot's Turret Retraction

FIG. No 50. LUBRICATION DIAGRAM.

FIG. 50

APPENDIX

APPENDIX

CONTENTS

	Para.
Wireless installation –	
General	1
Fixed aerials	2
Trailing aerial	3
Intercommunication system	4
Electrical bomb gear	7

LIST OF ILLUSTRATIONS

	Fig.
Wireless installation	A1
Intercommunication system	A2
Bomb fuzing and release	A3

APPENDIX

WIRELESS INSTALLATION

General

1. The wireless equipment comprises a transmitter T.1083, a receiver R.1082, a motor generator, a hand generator, a smoothing unit, an H.T. battery and five L.T. accumulators. A wiring diagram of the installation is given in fig.A1. The accumulators supply the low tension current for both the transmitter and the receiver, the H.T. battery supplies the receiver only, and the H.T. current for the transmitter is generated either by the motor generator or by the hand-driven generator. The transmitter and the receiver are mounted on the wireless panel and the accumulators, the H.T. battery, and the motor generator complete with switch and hand generator, are all located in an accessible position behind the panel. Drawers and stowages are also provided for spare valves and coils, and the calibration plate is stowed in a vertical slot near the centre of the front of the operator's table.

2. Fixed aerials.- The two fixed aerials are arranged in series and run from the fin to the aerial mast and then to the small lead-in mast. A change-over switch, built into the top of the mast and remotely controlled from a handle adjacent to the wireless operator, enables either one aerial or both to be used. When a short aerial is required, the switch at the top of the mast should be moved to the open position and when a long aerial is required, the switch should be closed thus extending the effective aerial length from the mast to the fin. A winch and a halyard are provided at the fin to facilitate maintenance of the aerial. The winch is mounted inside the hull on a frame below the fin and the halyard runs up inside the fin nosing and over a pulley mounted inside the nosing.

3. Trailing aerial.- A trailing aerial is also fitted and is operated by a winch mounted on a wedge plate near the wireless operator's seat. The aerial wire passes through an insulated fairlead tube to the planing bottom of the hull. The lower part of the fairlead tube is split on the diameter and is hinged parallel to the axis of the tube as well as being hinged normal to the axis of the tube at its top end. This enables the lower portion of the tube to be swung back against the bulkhead for stowage and leaves the short portion of fairlead mounted on the planing bottom free to receive its watertight cap. It is absolutely essential that this cap be fitted before the aeroplane lands: failure to observe this precaution will result in the compartment becoming flooded. The change-over from either overhead aerial to the trailing aerial is effected by a switch mounted on the wireless panel.

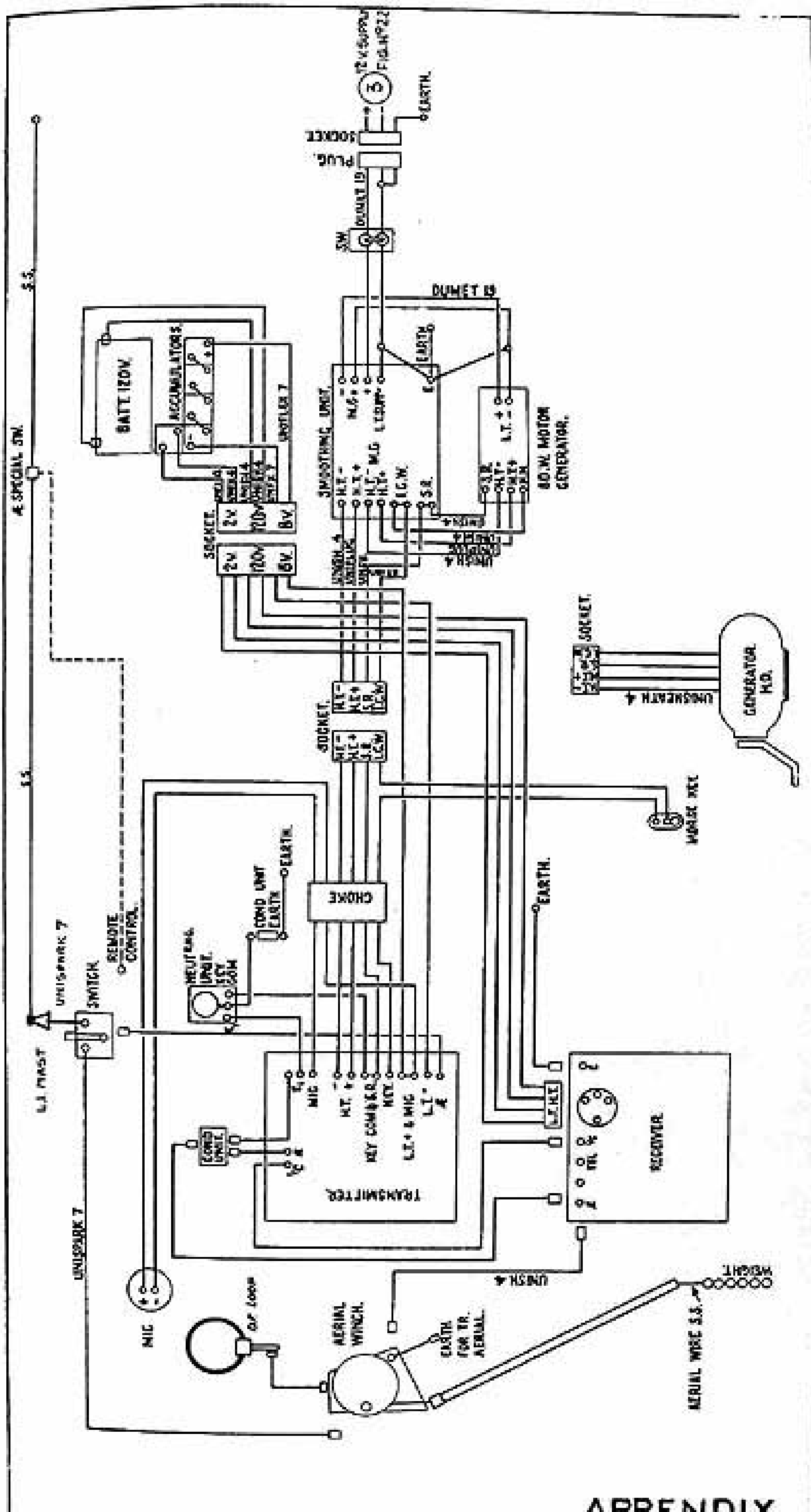
4. Intercommunication system.- The intercommunication system comprises an amplifier, five 2-volt accumulators, and a 120-volt H.T. battery and appropriate plugs, sockets and terminal blocks. The amplifier and the selector switches are mounted on the wireless panel and the battery and accumulators for the H.T. and L.T. supply are located behind the panel.

5. A combined microphone and telephone jack socket is provided at 10 stations between the bow and the stern (see fig.A2). The wiring for the rear gunner's jack is led into the rear turret by means of a plug and socket and flexible cable adjacent to the optical gun-sight supply.

6. The first pilot and the wireless operator have each an additional jack socket on a circuit separate from the remainder of the crew. This circuit via the transmitter gives external communication.

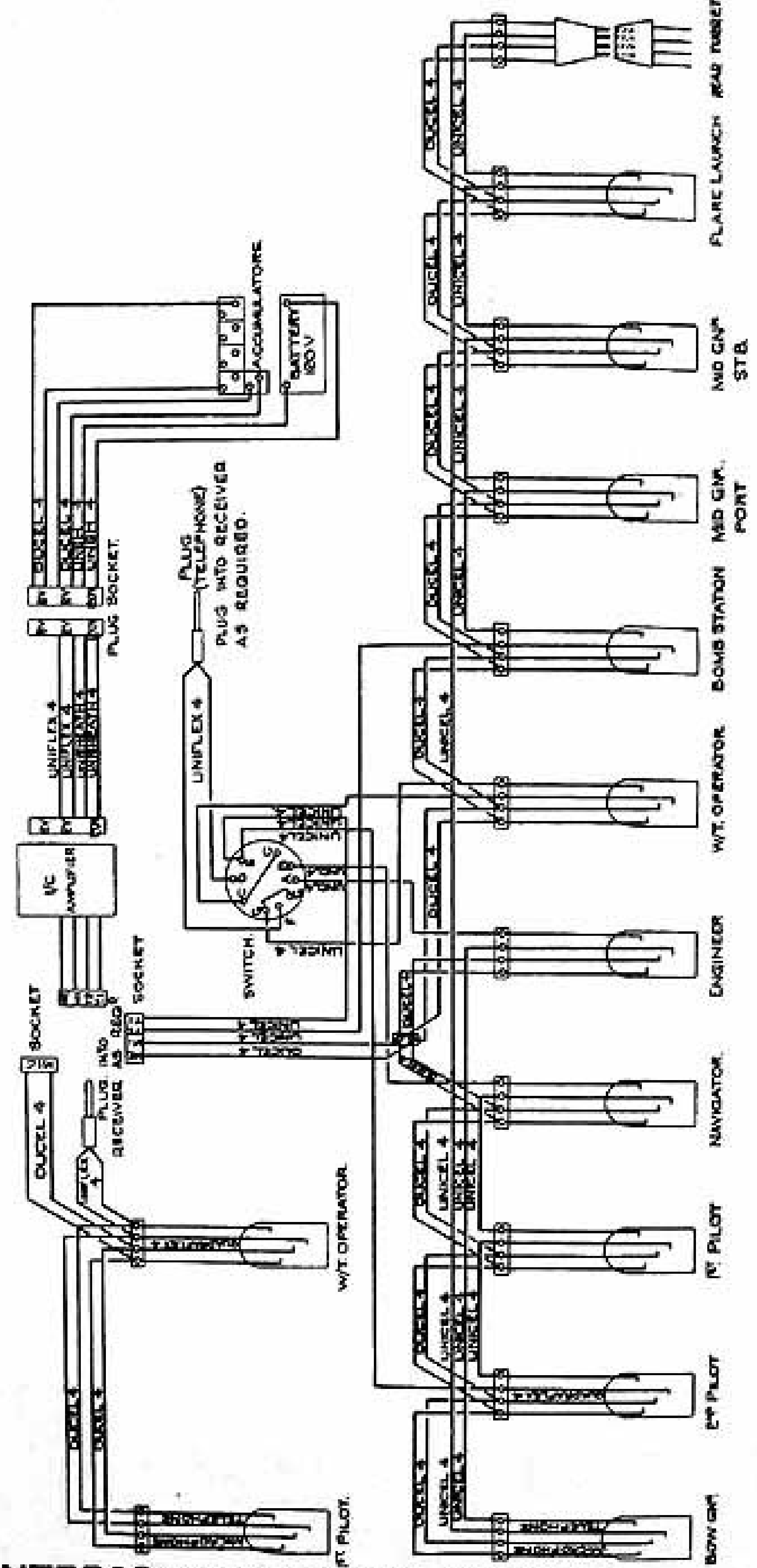
ELECTRICAL BOMB GEAR

7. The current supply for the electrical bomb gear is taken from the 12-volt control box (see para.145) on the front spar frame. A wiring diagram of the bomb fuzing and release system is given in fig.A3. Fixed to the port side of the hull close to the pilot is a panel on which are mounted eight selector switches in two units of four and numbered to correspond to the associated sockets on the bomb carriages. An instruction label adjacent indicates the relationship between the switches and the various bombs on the carriages. On the same panel aft of the selector switches are two nose-and-tail fuzing switches in one unit. The firing switch is located further aft and its associated jettison switch is mounted on the pilots' instrument panel. Mounted beside this switch is the H type jettison switch for the small bomb containers. It is essential, when a mixed load of bombs is carried, that all the containers should be jettisoned first by operating the H type jettison switch; then the operation of either the pilot's or the bomb-aimer's jettison switches will jettison all the remaining bombs. The bomb-aimer's jettison switch complete with lead, socket and firing switch, is mounted in a box in the bow of the hull on the starboard side. The press button for the bomb-aimer's jettison switch is a small filament lamp that has two functions. Normally it acts as a warning to the bomb-aimer by becoming illuminated and indicating that the pilot has selected a bomb; telephonic communication between the pilot and the bomb-aimer is necessary to warn the aimer that the bomb has been fuzed. The second function of the lamp is a mechanical one, as it is used as a press button for jettison purposes.



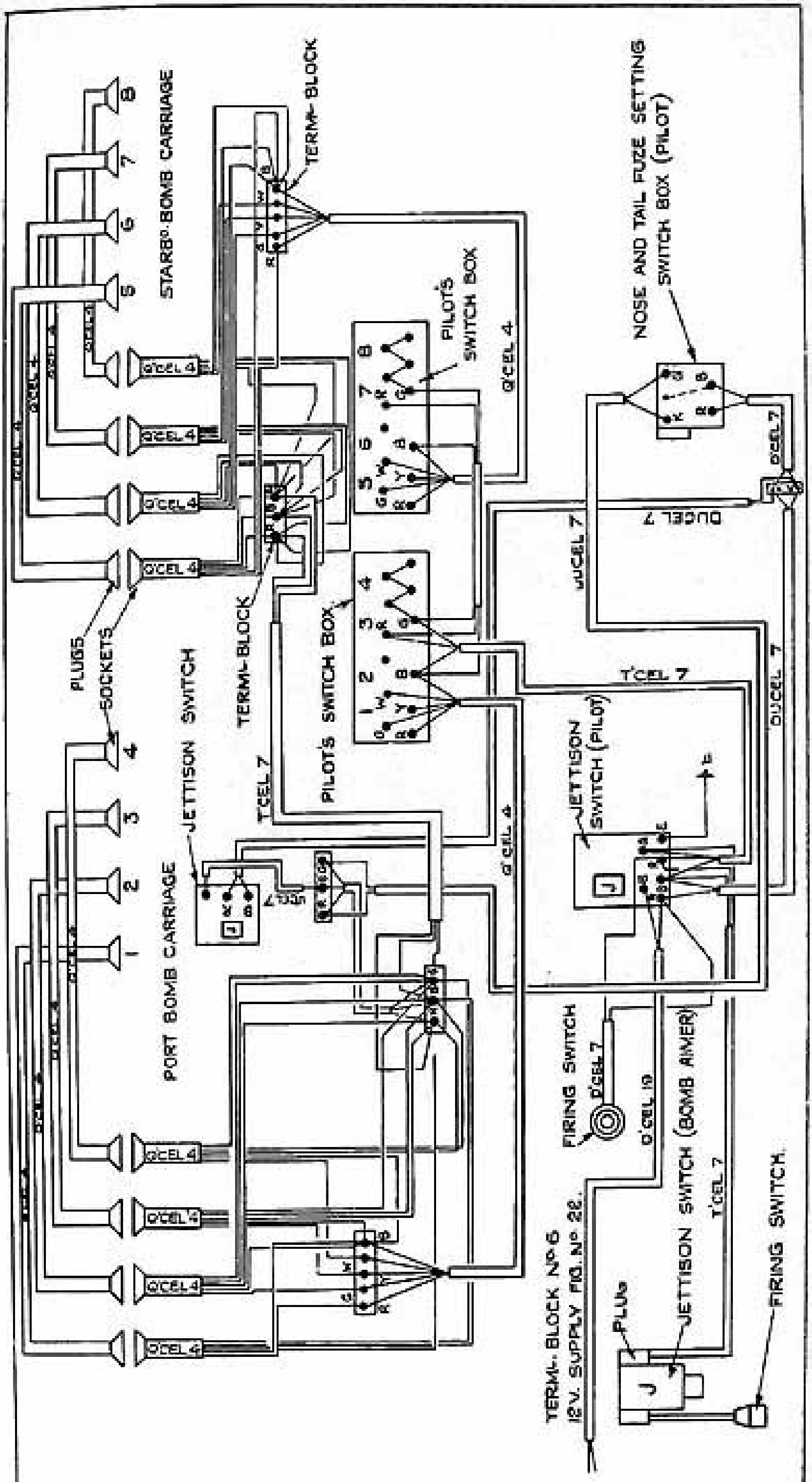
APPENDIX
FIG. No. A1.

WIRELESS INSTALLATION.



INTERCOMMUNICATION SYSTEM

APPENDIX FIG No A2.



BOMB FUZING & RELEASE

APPENDIX FIG. No A3.

R.T.P. 625 8/61