SHORT BROS.

"C" CLASS AIRCRAFT

When referring to this

Handbook please quote

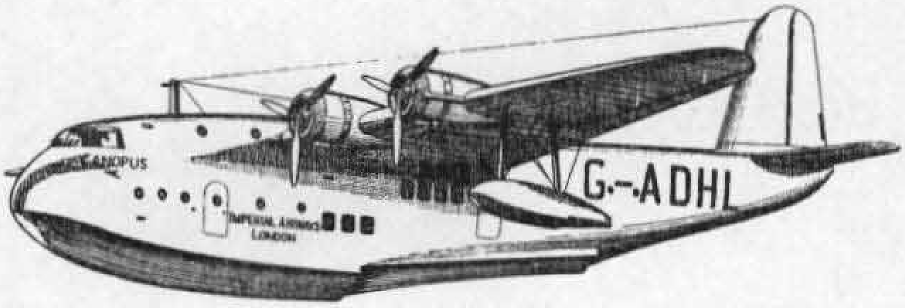
Ref.No. 3-1-37.

The contents of this book have been prepared and arranged with the main object of giving a maximum of help and information to the engineer responsible for the maintenance of the aircraft.

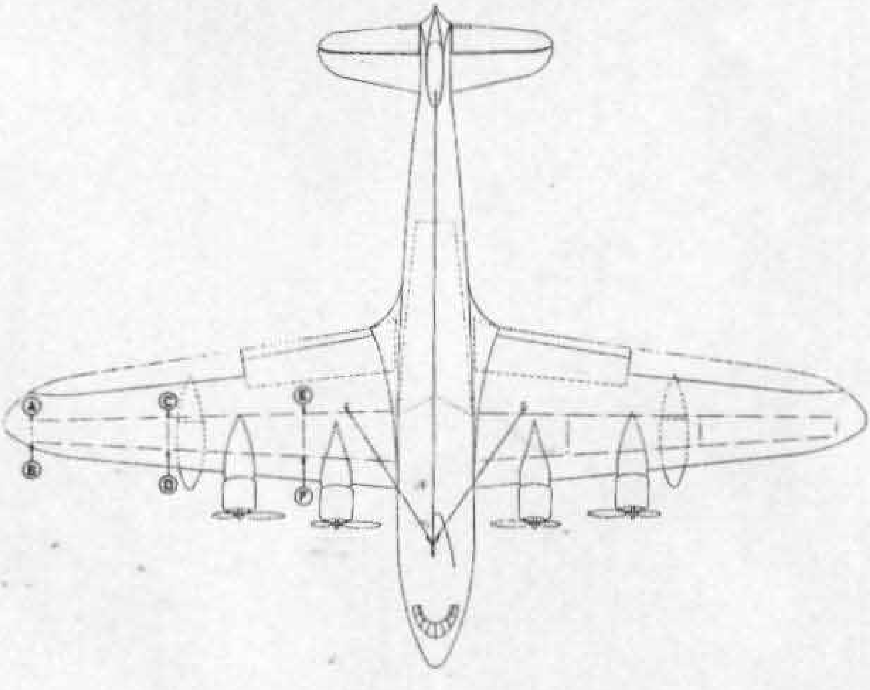
Certain plates, chosen for their value in a detached form, have been duplicated on a toughened paper and placed in the pocket in front of the book.

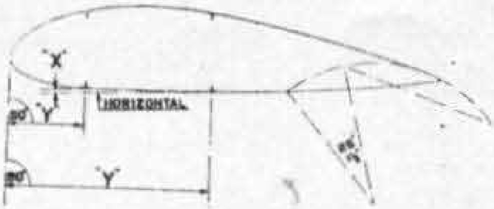
While every precaution has been taken to ensure accuracy, it must be realised that owing to the speed at which it was necessary to prepare this handbook, minor discrepancies may have occurred due to change of design during the course of publication and where these are of major importance they will be corrected by amendment at the earliest possible moment, accommodation having been made in the index to include these.

In order that the scope of the handbook may be as comprehensive as possible, verbatim extracts from the maintenance instructions issued by the firms supplying the various propriotory components have been included and due acknowledgment is made for them to those concerned.



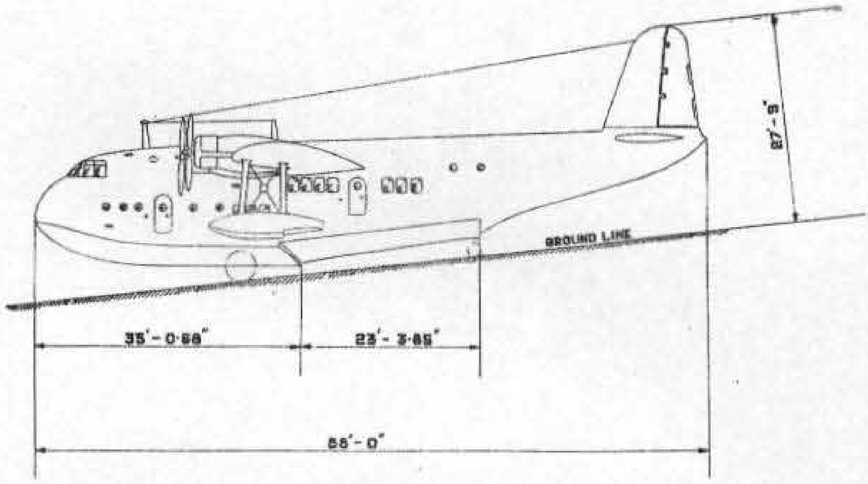
"C" CLASS AIRCRAFT

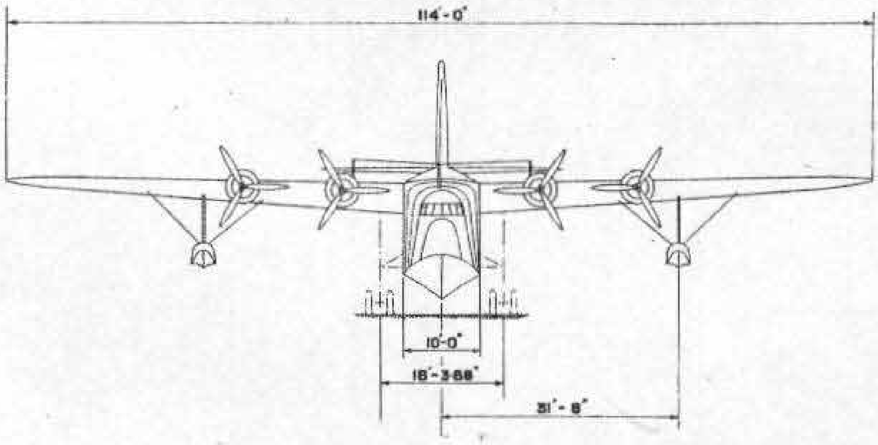




STATION	DISTANCE FROM HULL SIDE ON UNDERSIDE OF PLANE	DIM. "Y"	DIM "X"
A	48'-0"	45·2"	—
B	48'-0"	8·3"	1·26"
C	30'-0"	78·2"	—
D	30'-0"	24·4"	1·72"
E	12'-7"	102·0"	—
F	12'-7"	31·8"	2·20"

DIAGRAM SHOWING METHOD OF CHECKING INCIDENCE OF MAIN PLANE





ENGINES
TYPE BRISTOL PEGASUS X-C

AIRSCREWS
TYPE DE HAVILLAND VARIABLE PITCH 3 BLADE TRACTOR 12'- 8" DIA.

MAIN PLANE
INCIDENCE TO HULL DATUM 3° 0'
INCIDENCE TO THRUST LINE 1° 52'
SPAN 114'-0"

TAIL PLANE
SPAN 32'-1·3"

CONTROL SURFACE MOVEMENTS
AILERONS ABOUT NEUTRAL ±19¼°
ELEVATORS ABOUT NEUTRAL ±18°
RUDDER ABOUT NEUTRAL EACH WAY 22½°

TANKAGE
FUEL 650 [redacted] GALLONS
OIL 54 GALLONS

WEIGHT OF AIRCRAFT
TARE 27845 LBS.
MAX. LOAD 12865 LBS.

DRAFT
AT MAX. LOAD 4'- 2·175"

"C" CLASS AIRCRAFT
PROTOTYPE

NUMERICAL INDEX OF PLATES.

All plate numbers in this book without a suffix, refer to aircraft exactly similar to the prototype.

New plates with a suffix, refer to aircraft differing from the prototype, eg. Fig. 1 - Prototype; Fig. 1A, 1B, etc. subsequent aircraft. The index should have the new plate numbers added under the appropriate aircraft column as and when received.

HULL & PLANE TIP FLOATS.

HULL SHELL.

The hull shell is an all metal light alloy structure divided into separate compartments which are water tight up to floor level; these are marked by an asterisk on Fig. 35 (Hull Plating).

PLATING. FIG. 35.

The light alloy plating is arranged in strakes across the frames which are suitably joggled where laps and seams occur; by this method and also by countersinking all external riveting an entirely flush outer surface of the hull is produced. Fig. 36 illustrates the various methods of attaching the plating to frames while Fig. 35 gives gauges and disposition of plating. For information regarding methods of riveting Fig. 37 should be consulted.

STIFFENERS AND KEELSON.

The main keelson is the only continuous longitudinal member in the hull, all stiffeners terminating at the frames which are slotted to fit over the keelson.

COUPÉ.

A refinement has been introduced in the coupé design which is completely faired into the hull thus reducing drag to a minimum, but without detracting in any way from the pilots' view.

MAIN PLANE SPAR FRAMES.

Double frames braced to receive the wing roots are introduced amidships and house the stub joints protruding from the hull sides to which the main planes are attached. (See Fig. 42

"Plane attachment to Hull").

TAIL PLANE AND FIN ATTACHMENT TO HULL.

The cleanliness of the tail unit has been preserved by building stub sections on to the hull to take both the fin and tail plane; these aerofoils are attached to the hull through double spar frames in the same way as the main plane.

FRAMES.

The majority of the frames are made up of a single channel section 2" deep but for strength considerations certain frames are reinforced with a similar section by placing it back to back with the former thus making an "][" shaped section. On frames numbered 10, 11, 12, 13, 14, 17, 18 and 19, this additional channel extends from the chine line to a few inches above the upper deck, while from frames 22 to 34 it commences at 6" above a tangential line to the radius at the bottom corner of the hull frame down to the chine line.

The planing bottom portion of the frames consists of a "L" shaped section with 3/4" flanges together with cross members to form floor bearers, suitably braced. To support the extra load to be carried by the upper deck, certain frames have various additional members fitted, while pillars placed at intervals along the hull each side of the gangway provide additional support to the deck. (For "Hull Construction" see Fig. 36).

HATCHES PASSENGER AND LOADING.

The passenger entrance, bow mooring and buffet loading hatches open inwards, while the mail and baggage loading hatches open outwards.

All passenger entrance hatches can be locked and the clamps forced home from the outside; it is essential when mooring that the hatches are properly and tightly shut as they are not water tight until clamped right home on the sealing rubber.

HATCHES ESCAPE.

Working from the nose backwards, the the first escape hatch is just aft the starboard pilot and because it is also used for observation purposes it has been designed to open inwards which is accomplished by turning the clamp and pulling.

The second escape hatch is situated immediately above the two ladders leading from the buffet to the roof of the hull. To undo the fastening of this hatch all that is necessary is to turn the two clamps and push outwards.

Thirdly, the last escape hatch is placed in the aft end of the luggage hold which is situated just forward and immediately above the after passenger compartment.

Access to this hatch is obtained by pulling a folding ladder down from the luggage hold, the method of opening being the same as for the hatch above the buffet.

PORT HOLES.

All port holes are sealed and are not designed to open, ventilation being supplied from air ducts. (See Fig. 33 "Heating and Ventilating").

DATUM BRACKETS.

To enable the hull to be set for rigging, datum brackets are provided inside the centre cabin between the front and rear spar frames and aft the rear spar frame in the promenade cabin for both transverse and forward and aft levelling.

PLANE TIP FLOATS. CONSTRUCTION.

FIG. 48.

These floats are of all metal construction in light alloy, countersunk riveted externally with skin laps joggled giving a flush finish to the float in the same manner as the hull. Quick release flush type manholes and inspection covers are fitted and secured in position by spring fasteners which are operated by inserting a coin or screw driver into the screw slot and giving a half turn in either direction. Indication lines are stamped on the manhole and inspection covers showing the position of the screw slot on fasteners when in the locked position.

Bilge pump connections, drain plugs and trough cover plates are also fitted flush with the external sheeting, the latter being secured in position by anchor nuts and screws for quick detachability.

On the top cover between frame 1 and front trough, where it is impracticable to fit a standard manhole, a detachable panel has been fitted and secured by countersunk screws to a tapping strip under the skin, but this panel is only for use in case of internal repairs being necessary, a quick release cover having been fitted for inspection purposes.

A steadying eye has been fitted to the sternpost for use in handling the aircraft when on the beaching legs.

PLANE TIP FLOATS CHASSIS.

FIG. 48.

The floats are suspended on two tubular struts slung from the underside of the spar booms and are braced by streamline diagonal wires from the float, outboard and inboard, to attachment points on the spar.

The bracing forward and aft is provided with a shock absorbing device at a point where the cross bracing normally intersects, eliminating any torsional vibration that may be transmitted to the plane from the floats and also giving flexibility to the chassis when the machine is taxying and the floats are subjected to impact with the water. The shock absorber consists of two enclosed units containing compressed rubbers connected together by links.

Access for inspection is made by removing the "Rhodoid" fairing and the link fixing bolts.

BILGE SYSTEM. HULL.

FIG. 49.

The whole of the bottom of the hull is divided up into water-tight compartments into which is inserted one fixed suction pipe leading from the hull bottom to the floor level and accessible by removing a screw-in plug attached to the end of each pipe. Bilging is carried out by a "Saunders" portable bilge pump fitted with adaptor for the floor connection and its stowage is at the forward end of the baggage compartment.

Owing to the bottom of the hull being practically airtight it is essential that the inspection holes provided in the floors be opened at least once per week for ventilation purposes.

BILGE SYSTEM PLANE TIP FLOATS.

Bilging is carried out by an "Enots" portable pump fitted with adaptor for the screw in socket connections on top of the float. This bilge pump is also stowed at the aft end of the baggage compartment.

MAIN PLANE.

GENERAL DESCRIPTION OF CONSTRUCTION. The main planes are built entirely of metal including the covering which is of thin gauge plates. Each plane has one spar which is a braced box girder extending the full depth of the aerofoil section. This spar has two trusses, i.e. front and rear, connected at approximately three feet intervals by built up drag members with incidence bracing at these positions by streamlined wires.

The nose shape is formed by diaphragms attached to the spar at approximately one foot apart, while the metal covering is stiffened by stringers of "V" section.

The rear portion is composed of braced ribs which follow on from the drag member to the trailing edge, the metal covering being stiffened by stringers of "Ꞁ" section.

Circular inspection covers are provided in the plane tip and at all control pulley positions along the leading edge. The removal of these covers is very simply accomplished by unscrewing the central screw connecting the cover to a bridge piece inside the hole, which can be pushed aside when free. To prevent loss, the cover is permanently attached to the coaming by a short length of wire.

A large square inspection cover secured with countersunk screws in the lower surface of the plane and about eight feet from the tip gives access to the bracing wires in the outer portion of the spar.

PLATFORMS. To facilitate engine maintenance a portion of the plane nosing on each side of the nacelles is made to hinge forward, forming, when fully extended, platforms on which to stand.

These platforms are opened in the following manner.

i. Remove the circular inspection covers as previously described.

ii. Unscrew the handwheels disclosed by the covers, and push them towards the spar, which frees the retaining hooks.

iii. Pull on the handwheel to clear surface plating as the door opens.

When closing, the hooks should be pushed into the slots provided in the plane, after which the door can be shut, the handwheels screwed down and the covers replaced. (See also "Engines & Airscrews" Page 25).

To maintain a well ventilated interior to the plane, an air extractor has been incorporated in the leading edge on the outboard side of the outer engine, while in order to prevent moisture collecting, drain holes are provided at the maintenance doors.

REMOVAL OF MAIN PLANE.

FIG. 42.

The removal of a main plane is obviously an operation of major importance and the manner in which it is performed will depend largely on the facilities at hand; for instance, with plenty of available lifting tackle it may be unnecessary to remove the engines. On the other hand to reduce the weight on a less robust sling the removal of the engines, tanks, flaps and ailerons, will obviously ease the tension.

These are matters that can only be decided at the time but the following points should in any case be followed.

i. Remove airscrews.

ii. Drain all tanks.

iii. Remove plane tip floats and struts.

iv. Unscrew leading edge fairing at the juncture of the plane and hull.

v. Remove the fabric strip at the leading edge.

vi. Remove the fabric strip at upper and lower surfaces of the trailing edge.

vii. Take out the ¼" bolts securing the upper and lower 2" x 2" angle drag members to the hull side.

viii. Remove the countersunk screws from the outer surface at the upper and lower spar boom wing roots and the bolts securing the spar webs to the wing root forgings.

<u>Note!</u> To facilitate the removal of these bolts the inboard nose diaphragms are made detachable.

ix. Disconnect all control and electric cables, fuel, oil and heating pipes and torque shafts.

MAIN PLANE FLAPS.

CONSTRUCTION OF FLAPS. These are metal covered structures each consisting of three braced longitudinal members, interspersed with transverse ribs, the plating being supported by "ʅ" shaped stiffeners which are tied on their free edges with strips of channel section.

Each flap has four troughs, on each of which are fitted metal channel runners which follow the shape of the top side of the flap contour. Four arms having ball races attached, fixed to the main plane spars, support the flap at these runners in which the ball races engage, and to ensure that no lateral binding can take place a further set of ball races is fixed at right angles to engage on the sides of the runners.

These runners will need occasional greasing. Drain holes in the trailing edge prevent the accumulation of moisture.

OPERATING GEAR. DESCRIPTION. FIG. 27. An electric motor near the centre of the aircraft and just aft the rear spar is coupled to a gear box and drives a torque shaft extending outboard to the port and starboard flaps. This torque shaft is composed of a number of short lengths of tube coupled together by universal joints and supported at each joint by ball races housed in cast brackets which are variously anchored to the hull sides and spar lift struts. Each end of the torque shaft is coupled to the flap operating jack through a worm and worm wheel which is attached to the spar. The jack consists of a square threaded spindle contained in a tubular casing in the end of which is riveted two square threaded nuts to take the spindle. The torque shaft rotates the casing through a worm and worm wheel box anchored to the spar, causing the spindle to extend or retract depending on the direction of rotation.

The outer end of the spindle is attached to a special fitting in the flap.

<u>OPERATING GEAR. ELECTRICAL.</u>

<u>FIG. 12.</u>

The electric motor is a "Rotax" half horse power split field type, and is controlled by two solenoids which are actuated by a two-way switch in the pilots' cabin.

The wiring to the switch includes limit switches in each respective line which are closed automatically. A short length of teleflex control, actuating a worm driven gearbox, is coupled to the port side jack and forces open the limit switches when the jack has reached its full travel, thus breaking the circuit.

<u>OPERATING GEAR. HAND.</u>

<u>FIG. 27.</u>

For hand operation a detachable handle is made to fit a square shaft projecting from the gear box to which the electric motor is coupled, the transmission from the handle to the main drive being by bevel gears.

A clutch which throws the motor out of engagement with the gear box must be disengaged before the hand winding gear can be operated; when not in use the handle is stowed in a bag which is fixed to the bulkhead on the forward side of the gear box.

<u>POSITION INDICATOR.</u>

A "Smith" electrical indicator situated in the roof of the pilots' cabin close to the flap motor switch shows the exact position of the flaps.

The potentiometer of this indicator is actuated by the same teleflex control gear that operates the limit switches, while a push-pull switch enables the meter to be switched off when not required.

A further switch, also operated by the teleflex gear, controls a red warning light in the pilots' cabin which is illuminated when the flap is out one third of its travel, and remains "on" for the remainder of the travel outwards and until it has completed two thirds of its travel inwards.

The object of this device is to ensure that the pilot does not attempt to take off with the flap out more than one third of its travel.

A warning notice to this effect is placed adjacent to the light.

REMOVAL OF FLAP.

The following is the order of operations for removing a flap from the main plane.

i. From inside the wing, disconnect the jack at its attachment to the flap.

ii. Remove the square plate from the underside of flap at the jack attachment fitting.

iii. From inside the flap, take out one of the bolts in the jack attachment fitting. This fitting can now be pushed through the wing slot into the flap.

iv. Remove the cover plates from the underside of flap at the leading edge of the support troughs and unscrew the stopping block connecting the upper flanges of the channels. The flap can now be rolled off the ball races.

REMOVAL OF RUNNERS.

To enable the runners in the flap to be removed the following order of operations should be observed.

i. Remove the flap from the main plane. (See "Removal of flap" Page 12).

ii. Unscrew and take out the countersunk screws holding the circular covers each side of the trough and remove covers.

iii. Unscrew and take out the countersunk screws along each edge of the runner.

iv. Take out the bolts inside the flap, which fix the runner to the trough, using the hand holes each side for access. The runner can now be removed.

<u>ASSEMBLING TELEFLEX CONTROLS. TO INDICATOR.</u>

Assemble the Teleflex control so that the nut has equal clearance at top and bottom of its travel, i.e. when the flaps are fully "in" and fully "out" respectively. Check that these conditions are obtained by winding the flaps in and out manually, prior to coupling up the potentiometer, stop and indicator switches. If any adjustment is necessary it can easily be effected by disconnecting the fork end from the jack and rotating the teleflex cable. Couple up the potentiometer and check to give the arm its full travel. Adjustment may be made by using the slotted holes provided in the mounting.

The stop switches are operated by set screws with locknuts fitted to the indicator which are adjustable to give the correct cut out. It will be necessary to determine by test the allowance to be made for "lag". This should be such that when the switch has cut out, two full turns can be obtained on the handle (this is approximately equal to 1/8" linear travel on the jack).

The indicator switch operating ramp should now be bolted to the mounting provided on the indicator nut and a check should be made that **the** indicator switch cuts in when the flap is one third out.

AILERON.

DESCRIPTION OF CONSTRUCTION.

The framework of the aileron is of metal construction, being composed of a built up box spar with nose diaphragms and trailing edge ribs attached. The nose and tip are metal covered while the rest of the aerofoil from the spar to the trailing edge is covered in fabric.

A square inspection cover is fitted in the tip plating, which can be removed by unscrewing the retaining screws.

The hinge point, which is on the aft side of the spar, has ball races fitted which have been greased and sealed by the makers. These races will need no further attention.

REMOVAL OF AILERON.

The aileron can be removed in either of the following ways.

A. i. Disconnect all controls at their attachment to the levers.

ii. Unbolt the supporting arms at their attachment to the main plane. The aileron can then be lifted off.

or

B. i. Disconnect all controls at their attachment to the levers.

ii. Remove the tear-off patches at the hinge positions.

iii. Remove the covers over the hinges.

iv. Take out hinge bolts. The aileron can then be lifted off.

AILERON CONTROLS. For aileron controls description see

FIG. 3. Pages 34 & 38 .

TAIL UNIT.

TAIL PLANE. The tail plane, built in two units (Port and Starboard) is of metal construction similar to that used on the main plane, with the exception that the nose portion only is metal covered, the rest being fabric, supported by ribs.

Sheet metal diaphragms spaced at intervals along the spar act as formers for the metal covered leading edge.

The spar booms are of light alloy cruciform section as also are the front and rear trusses, but the upper and lower drag bracing members are tubular, while steel tie rods form the bracing for the panels.

The attachment of the tail plane to the specially formed stub section on the hull is at the four ends of the spar booms, which are fixed to the mating fittings on the hull by four bolts and expanding bushes. These ensure that there can be no chatter in the joints, giving the rigidity of a built on tail plane, with the flexibility of easy removal.

ELEVATOR. The elevator is, like the tail plane, of all metal construction with the exception of the rear portion which is fabric covered supported by metal ribs extending from the spar to the trailing edge. The leading edge from the spar to the nose is built up with metal formers and covered with metal.

The spar is formed by two light alloy channels placed back to back and spaced with diaphragms set at intervals along their length.

The elevator hinges are mounted on the

forward side of the spar and are attached to arms projecting from the tail plane. The hinge ball races are packed with grease and sealed by the makers, and will need no further attention.

ELEVATOR REMOVAL. The removal of an elevator is accomplished as follows:-

i. Disconnect the trimming tab control at the chain drive inside the stub section of the hull (for Tab controls see Fig. 7).

ii. Uncouple the torque shaft connection immediately inside the hull stub section. (See Elevator controls Fig. 5).

iii. Remove the bolts at the attachments of the hinge support arms to the tail plane.

iv. The Elevator can then be lifted out.

ELEVATOR TRIMMING TAB. A trimming tab of wooden construction is fitted on the inboard end of the elevator. The hinges of brass with steel bearing pins will need occasional oiling.

FIN. Except for size and shape, the fin is identical to the tail plane, both in construction and its attachment to the stub section on the hull.

RUDDER. The rudder is very similar in design to the elevator with the exception that while three of the four hinges are attached to the fin in the same manner as the elevator is to the tail plane, the fourth, mounted inside the hull, acts as a thrust bearing taking the weight of the rudder.

This hinge will require greasing (see Rudder Controls Fig. 4).

<u>RUDDER TRIMMING AND SERVO TABS.</u> These trimming tabs are similar in all respects to the elevator trimming tabs. (See Rudder Tab Controls Fig. 6).

<u>REMOVAL OF RUDDER.</u> The operations for removing the rudder should be carried out in the following order.

i. Disconnect the trimming tab control at the chain drive inside the hull.

ii. Uncouple the torque shaft connection immediately inside the hull at the bottom hinge position.

iii. Remove the bolts at the attachments of the hinge support arms to the fin post.

iv. The rudder can then be lifted out.

ENGINES & AIRSCREWS.

ENGINES. Four "Bristol Pegasus X-C" engines supply the power to the aircraft. (For details see "Bristol" engine handbook).

ENGINE MOUNTING. These engines are mounted in monocoque nacelles of streamline form, built on to the wing section. To obviate the necessity of removing the carburettor when changing the engine, the lower portion of the nacelle has been cut away.

FIREPROOF BULKHEAD. The fireproof bulkhead has three detachable panels which give access to the back of the engine.

EXHAUST. Each engine is fitted with an exhaust collector ring, a single outlet pipe from each being carried back through the wing and turned up to exhaust through the top of the plane just forward of the front spar. An air space 1" wide all round is arranged by building a steel duct into the wing.

Compensation has been arranged to allow for movement of the pipe caused by heat expansion and the flexible rubber engine mounting, while the inner starboard exhaust pipe is adapted for heating the interior of the aircraft. (See "Cabin Heating" Fig. 33 and Page 44).

CARBURETTOR HEATER PIPES. Carburettor heater pipes are fitted to each exhaust system and are controlled by a hand operated valve fitted into each inlet pipe. (See "Carburettor air shutter controls"

Fig. 51 and next paragraph).

CARBURETTOR AIR SHUTTER CONTROLS. FIG. 51.

Each air intake is fitted with a controllable shutter permitting the use of hot or cold air as required to suit atmospheric conditions. These shutters are controlled by two handwheels, coloured red and green, mounted on the front spar frame bulkhead, starboard side. Each wheel operates two shutters, i.e. the "Red" wheel controls the two port and the "Green" wheel the two starboard shutters.

A locking device, in the form of a press button, is fitted to each wheel to hold the control against springs which return the shutters to the "cold air" position. Care should be taken to see that the springs are effectively returning the shutters to normal position. For removal of pulley brackets see "Engine fuel cut-out Controls" in next paragraph.

ENGINE FUEL CUT-OUT CONTROLS.

Each engine is provided with a valve which cuts off the fuel supply to the slow running jet. These valves are controlled by the pilot by two levers mounted on the sides of the engine control box between the pilots' seats, the connections being so arranged that the left hand lever controls the two inner engines together, and the right hand lever the two outer engines together.

Single 5 cwt. wires run to each of these valves which are spring loaded and self returning. It is most important to make sure that these springs are effectively returning the valves, as failure to do so will cause starting to be difficult or impossible. Stop links are provided to prevent damage in operation.

Certain of the pulley brackets provided

in the nacelles for these controls are fitted at points behind the front spar booms, where direct access is impossible,and their positions are distinguished by circular covers held in position by countersunk screws.

These brackets may be removed in the following manner:-

i. Detach the circular covers.

ii. Slacken off the control cables.

iii. Uncouple and withdraw the bracket.

iv. Disconnect the cable from the pulleys.

AIRSCREW CONTROLS.

The "Hamilton" airscrews (for details see the special handbook) are controlled by the pilot by four levers mounted at the bottom of the engine control box between the pilots. Red and green knobs, together with an instruction plate, identify each control and show the position of levers for "Coarse Pitch" (levers up) and "Fine Pitch" (levers down).

Each control is connected by twin 5 cwt. cables to a bell crank lever in each nacelle, this lever being connected to a length of "Arens" control conveying the motion to the operating valve on the engine at the front of the reduction gear.

An adjustable stop is provided in each nacelle to remove the operating load from the valve in the engine and prevent damage thereto.

For the removal of pulley brackets see "Engine fuel cut-out Controls" Page 19.

For slinging see Fig. 30 and Page 26.

ENGINE TEMPERATURE.

A "Weston" type pyrometer model No. 602 H.1509 mounted on the engineers' panel and controlled by a four-way "Weston" type rotary switch, gives temperature readings for each engine. In each case the actual couple is to number one cylinder only, while to facilitate calibration of the pyrometer, junction boxes are fitted in each nacelle.

It is important to note that the connecting cables between pyrometers and junction boxes are not interchangeable due to the resistance of each circuit being balanced to suit the calibrations on each instrument.

COWL GILL CONTROLS.

FIG. 47.

The cowl gills, which are situated at the rear of the N.A.C.A. cowlings, are hand operated from two gear boxes located in the port and starboard sides of the hull forward of the front lower spar boom. These gear boxes operate flexible drives to the tubular torque shafts which run along the spar to the outboard nacelles.

The torque shafts operate worm gears, which are situated at the inboard sides of the inner nacelles and the outboard sides of the outer nacelles. From these worm gears torque shafts run forward to the rear of the cowlings, terminating in sprocket wheels. These sprockets drive chains running round the circumferences of the cowlings, operating the cowl gills by way of further sprockets. The cowl gills, are hinged to the rear edges of the cowlings.

TEL-TACHOMETER.

Each engine is fitted with a tel-tachometer ("Hasler" type) mounted in the nacelle on the front spar of the plane. These instruments are accessible through the engineer's platform openings, and are driven via the same gear box that serves the revolution indicators, by a 6 m/m flexible drive from the engine.

<u>REVOLUTION INDICATORS.</u>

<u>FIG. 13.</u>

The generators for these instruments are mounted just behind the fireproof bulkhead and are driven through the same gear box that serves the tel-tachometers, by a 6 m/m flexible drive from the engine.

The indicators ("Record" type), situated on the pilots' dashboard, are connected to the generators by 14/.0076 electric cable, connected by junction boxes at the wing roots.

<u>THROTTLE AND MIXTURE CONTROLS.</u>

These controls are operated by the "Exactor" hydraulic system. (See "Exactor" notes Page 26A). The operating levers in the pilots' control cabin are mounted in a control box located between, and just in front of, the pilots' ~~seats, with the~~ throttle levers placed forward and mixture levers aft.

Red and green knobs are employed to indicate the various engines.

Links are employed between each pair of levers to ensure correct return of mixture lever to "Normal" position when throttling back.

A gate is also provided to prevent the mixture lever from moving into the "Fully rich" position except when specially required at take off, etc. This gate is fitted with adjustable stops to allow individual setting of each mixture lever.

Pipe runs between control cabin units and engine nacelle units are 3/16" o/d.

Levers in the engine end units are

connected to the engine levers by adjustable push rods, the throttle motion being operated differentially to ensure smooth running when opening up.

FAILURE TO START. If the starter motor fails to turn it may be due to one of the following causes and should be checked before the component parts are suspected.

i. Are the maintenance doors closed and locked? If not the switches at those points are not making contact.

ii. If using the external battery i.e. from lighter or shore, is the plug securely connected?

iii. If using the aircraft battery, is the "Desiderio" master battery switch screwed right down?

iv. Has the fuse blown on the electric control panel?

v. If the motor turns too slowly, try stopping up on the battery (see note on Fig. 14 "Engine starting system").

ENGINE STARTING. The engines are started electrically by "Eclipse E.160" starter motors mounted direct on to the back of the engine, the motors being controlled by push buttons in the control cabin at the top of the dashboard.

Over each push button spring loaded safety caps are fitted which must be lifted before the button can be operated; on the faces of these caps warning notices have been engraved to prevent premature starting by the operator. These push buttons besides controlling the motor solenoids allow no current to pass through the booster coils, which supply the high tension current necessary for starting, until they have been depressed.

The current required for starting is

normally supplied by a separate battery on shore or lighter, in which case use is made of a socket on the starboard side of the hull near the front spar frame. The main lighting battery may be used for starting in emergency and a "Desiderio" switch situated on the electrical control panel is provided for this purpose.

A safety switch is incorporated in each leading edge door to break the connection between engine starter motors and push buttons in the control cabin, to prevent accidental starting while work is in progress on the engines.

The engines may also be turned over, or started, by the hand turning gear provided on the starboard side of each nacelle. When starting by this means the starting switches on the electrical control panel must be moved into the positions indicated by the instruction plates attached to the panel.

MAGNETOS.
FIG. 9.

The magnetos (two per engine) are controlled from the pilots' cabin by "Lundberg" type two-unit, twinob, flush mounting switches with master control attached.

These switches are mounted on the front face of a separate unit at the top of the dashboard, which also houses on its upper face the four starter buttons, each of which is immediately above its appropriate switch. To facilitate the wiring of this unit, it has been made quickly detachable by the removal of its four attachment bolts, after which it can be hinged back on the cables.

Connector boxes are fitted at the wing roots and at each nacelle for the electric cables.

ENGINE PRIMING.

See "Fuel System" Page 28.

TRANSPORT GEAR. (Spare Engine).
FIG. 40.

This comprises a horizontal lifting beam, pulley block and trolley, with support struts and modified "Bristol" type cradle.

SPARE ENGINE LIFTING BEAM.

The beam which is of "H" section steel, can be attached to the roof of the baggage compartment of the hull by wing-headed bolts and protrudes a sufficient distance to enable the engine to be slung well clear of the side.

SPARE ENGINE STRUTS.

A vertical support strut is attached by bolts through eye plates to the inner end of the beam and the floor, while on the opposite side of the hull diagonal struts, connected in a similar manner at the beam, run outwards to each side of the hatchway and are coupled to screwed socket bolts permanently fixed to the vertical coamings.

SPARE ENGINE LIFTING TACKLE.

The lifting tackle consisting of a "Buck & Hickman" epicycloidal pulley block and a trolley can be run out to the end of the beam to pick up the engine which, after it has been raised a sufficient distance to clear the opening, can then be carried back to its stowed position in the hull.

SPARE ENGINE STOWAGE.

The spare engine is stowed in a modified "Bristol" type cradle (see Fig. 40 spare engine transport gear) which is bolted to the floor of the baggage compartment.

MAINTENANCE PLATFORMS.
FIG. 30.

These have been described under "Main Planes" Page 8 but the following further particulars will be of use in this section.

Owing to the difference in the depth of the wing between the inboard and outboard platforms, the former have special link plates attached to the top boom of the front spar truss to which the support wires may be connected in either the bottom or top position, thus raising or lowering the platform as required.

MAINTENANCE PLATFORM EXTENSION.

FIG. 30.

In order to get at the airscrews and lower cylinders, extension ladders have been provided which can be fitted to the castings set in the front edge of the platforms.

The extension plank is laid across the lower ends of the ladders forming a platform on which the operator can stand. The extension ladders are completely interchangeable.

MAINTENANCE PLATFORM SAFETY BELTS.

FIG. 30.

When changing an airscrew the safety belt which attaches to a conveniently placed eyebolt on the nacelles should always be used.

EXACTOR CONTROLS.

FILLING. The system should be filled through the reservoir by working the transmitter unit as a pump. The pipe should be disconnected from the receiver cylinder until such a time as oil, free from air bubbles, begins to flow. It should then be reconnected and the control operated a number of times. "Sponginess" at the end of the stroke indicates the presence of air in the system, probably situated in the receiver, and may be removed by raising the receiver piston (i.e., "closed throttle position") and slacking back the receiver union. The contents of the cylinder are then expelled by the force of the spring.

Care should be taken that the pipelines are perfectly clean as foreign matter finding its way to the valve may cause leakage from the system into the reservoir which is indicated by the operating lever creeping. Should this occur, the valve may be cleaned by removing the plug in the underside of the reservoir.

OPERATION AND MAINTENANCE. The control should be synchronised daily before flight and at any time when any variation due to temperature is suspected. It must be borne in mind that the synchronisation immediately and automatically resets the control. The synchronising position on throttle control is "full throttle" and on mixture control "extra rich mixture." Thus the control incorporates the safety device that any pipeline failure will ensure full throttle and rich mixture respectively. The Control being filled with and operating in oil, no maintenance beyond periodical inspection of the level in the reservoir is required. Owing to the inherent tendency of any hydraulic system to form an adhesive film if loft at rest, it must be remembered that the initial movement may be somewhat stiffer than is experienced in normal operation. ~~Air Ministry standard "Oil non-freezing" or "Vacuum Flowrex E" oil is recommended.~~ A filling mixture of one part of "Flowrex E" or one part of anti-freezing oil and 2 parts of paraffin is recommended

FUEL SYSTEM.

MAIN FUEL SUPPLY. The fuel is supplied from two light alloy tanks, each of 325 gallons capacity, mounted one in each plane and connected by a balance pipe marked "A" on Fig. 1 (Fuel system).

MAIN FUEL SUPPLY CONTROL. The main supply is controlled by three cocks marked "C" & "G" on Fig. 1 (Fuel system) and operated by levers coloured red, black and green respectively, mounted in the roof of the hull, on the starboard side, just forward of the front spar frame.

ENGINE FUEL PUMP FEED. Each engine having its own pump (see Bristol Engine Handbook) all feed lines are interconnected by pipe 'B' on Fig. 1. to ensure adequate supply of fuel in the event of a pump failure.

TEST COCKS TO ENGINE FUEL PUMPS. Three test cocks marked "D" & "H" on Fig. 1 (Fuel system) are provided in the fuel pump delivery lines, which, when closed, isolate the pumps so that they can be tested individually. The two wing cocks are controlled by hand-wheels mounted on the front spar frame bulkhead, coloured red and green and suitably labelled. The third and central cock "H" on Fig. 1 (Fuel system) is accessible from the hull through a door in the starboard side adjacent to the two handwheels.

BEFORE TAKE-OFF THESE COCKS MUST BE OPENED.

TEST COCKS TO CARBURETTOR.

These are controlled by levers, coloured red and green and labelled to identify each, mounted in the step behind the pilots' seats on the centre line of the aircraft.

CARBURETTOR PRIMING.

The two inboard engines' carburettors can be primed from the engineer's platform. Two spring loaded cocks, marked "K" on Fig. 1 (Fuel system) keep a short by-pass feed pipe permanently closed, but when priming is required these can be held open by hand for as long as is necessary to fill the carburettors. Emergency cock for shutting off fuel to carburettors shown at F.

ENGINE PRIMING.

Engines are primed by "Ki-gas" primers controlled by three-way cocks marked "F" on Fig. 1 (Fuel system). These primers are mounted in the port and starboard wing roots and are operated from inside the hull.

FUEL FILTER.

The fuel filter is mounted on the forward side of the main plane spar front truss, just behind the engine, and can be got at for cleaning purposes through the engineer's platform opening on the leading edge. It is placed in the main feed line to engine pump.

FUEL TANK SUMP.

Access to the fuel tank sump is gained by removing the circular cover on the underside of the plane on the aft side of the tank.

FUEL CONTENTS GAUGES. FIG. 28.

The fuel contents gauges, which are the "Televel" mechanical type, are situated on the forward and starboard side of the front spar frame. To read the contents of the tanks, the wing nut on the gauge dial must first be rotated in a clockwise direction to free the float, then slowly reversed in an anticlockwise direction until it locks, when the dial will give the correct reading. See also page 30B.

IMPORTANT. Whilst warming up the engines, all engine pumps should be tested by shutting off the test cocks, but it is important to remember that before taking off these cocks must be opened to obviate the danger of engine failure through fuel starvation at a critical time.

REMOVAL OF FUEL TANK. The sequence of operations for removing the fuel tank is as follows:-

i. Remove the tank cover plate in the top surface of the plane. This can be done as follows:-

(a) Remove the two small covers i.e. the square one in the centre and the round one at the front edge.

(b) Unscrew the nut and remove the distance piece on the centre spindle.

(c) Take out all screws from the outer edge and lift the complete cover plate off.

ii. Drain tank empty of fuel. (See Refuelling Page 31 and FIG. 1 Fuel system).

Note! Unless a certain weight of fuel is left in the tank it will be impossible to unscrew the screws in the cover plate due to the natural spring in the tank itself forcing against it.

iii. Disconnect all bonding wires and pipes. To disconnect the "Televol" control, unscrew the nut at the point where the cable casing enters the tank.

iv. Unscrew the nut and remove the distance piece and rubber ring from the centre spindle at the bottom of the tank. A small hole in the under surface provides access for this to be done.

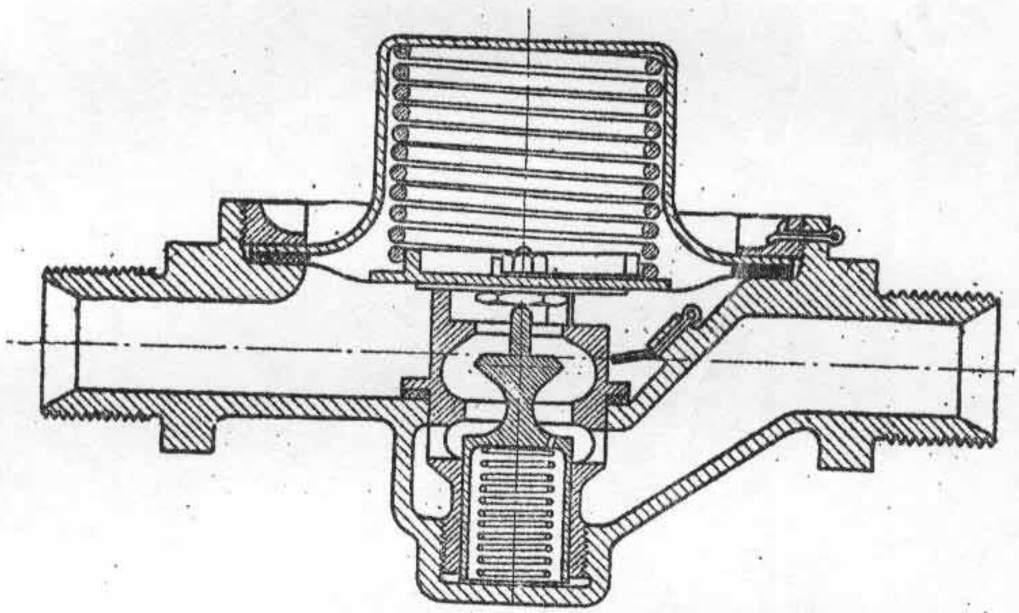
v. The tank is now free of the plane and can be removed. Slings are provided on the tank for this purpose.

REPLACING FUEL TANK. When replacing the fuel tank, sufficient fuel should be put in to make the tank bed down, otherwise it will be impossible to close the cover plate.

FUEL PRESSURE VALVE.

This valve has been inserted in the feed line to the carburettor in order to relieve the pressure from the pumps when this becomes excessive,the flow being then **by-passed into** the main inter-pump feed line.

The diagram below indicates its main features.



FUEL PRESSURE VALVE.

MAIN FUEL SUPPLY.

FIG. 1B.

The fuel is supplied from eight light alloy tanks, three being mounted in each plane and two in the centre section of the hull.

The respective capacities are 175 gallons for each of the outboard tanks, 326 gallons for each of the centre tanks, 380 gallons for each of the inboard tanks and 280 gallons for each of the hull tanks. All these tanks are connected by a balance pipe, marked "A", on Fig. 1B. (Fuel system).

MAIN FUEL SUPPLY CONTROL.

FIG. 26B.

The main supply is controlled by nine cocks, (see Fig. 1B.) four of which control the supply from the centre and outboard plane tanks, and are situated between the centre and inboard tanks in each plane; two control the inboard tank supply, and are situated at the connections to the five-way distributors in each plane. These cocks with the exception of those controlling the inboard port tank, are operated by levers mounted in the starboard side of the hull roof, just forward of the front spar frame. Two cocks control the supply from the hull tanks, and are situated at the connections to the balance pipe "A", while a levelling cock is placed in the balance pipe near the main cock of the port hull tank. These cocks, together with those controlling the inboard port tank, are operated by levers mounted on the port side of the front spar frame bulkhead. The levers are coloured, those referring to the port tank cocks being red, the starboard tanks green, and the levelling cock black. (See Fig. 26B).

FUEL CONTENTS GAUGES.

FIG.28 & FIG.28A.

The Televel gauge is a manually operated instrument in which the position of a float on a guide rod in the fuel tank is registered on the dial. A flexible cable attached to the dial, has, at its further end, a small plunger (in the form of a conical pin) which, when it contacts with the float resting on the surface of the fuel, locks the float and the moveable index dial at the same moment.

TO SECURE A READING, the flynut on the dial is moved SLOWLY & GENTLY in the "DOWN" direction until the locking action is felt. The position of the index dial registers the fuel content. Before moving the flynut in the "DOWN" direction it is advisable always to give it a slight turn to the "UP". This releases the float in the event of it being still in the locked position of the last reading.

CAUTION. GREAT CARE must be exercised to ensure that the stuffing gland connected to the tank unit is filled with a very high grade non-freezing grease and that copious applications of a very high grade of thin non-freezing oil be made at each oiling point in the transmission.

THESE ITEMS MUST BE ATTENDED TO PERIODICALLY.

REFUELLING.

<u>REFUELLING COCK.</u> The refuelling cock is in a petrol tight box, recessed into the starboard side of the hull, just below the leading edge of the plane. Two pipe lines run from this cock, one to the port and one to the starboard fuel tank, where each connects to the "Relunits" valve fitted in the top of the tank (see Fig. 1 Fuel system) which automatically closes when the tank is full. The refuelling cock can be turned on to feed either the port or starboard wing tank, or both tanks simultaneously. When not in use, the cock must be turned to the "All off" position.

<u>DRAIN COCK.</u> A drain pipe in the port wing root connects the refuelling pipe to the balance pipe, for drawing off fuel at the refuelling cock.

The cock (marked "E" on Fig. 1, Fuel system) on the drain pipe must be kept closed during re-fuelling.

<u>ALTERNATIVE REFUELLING.</u> An alternative method of refuelling may be employed using the filler cap provided in the top of each tank, access to which is obtained by removing the small circular cover from the front edge of the tank lid, in the upper surface of the main plane.

OIL SYSTEM.

MAIN OIL SUPPLY.

Each engine is supplied with oil by a self contained circuit from a light alloy tank of 13½ gallons capacity, mounted in the top of the nacelle.

The two inboard engines have the oil tank to each mounted on the inner side of the nacelle and vice versa for the outboard engines, making the port inner and starboard outer interchangeable with each other and conversely the starboard inner and port outer.

FILLER CAP.

Access to the filler cap of each oil tank is by a door in the top of the nacelle at the tank position, and marked "Filler Cap". A similar door, marked "Circulating Chamber and Dipstick" gives access to these components. For information regarding this circulating chamber see the "Bristol" engine handbook.

FILTER.

The filter in the oil tank sump can be withdrawn through the circulating chamber after removing the cap.

OIL CLEANER AND COOLER.

A "Tecalemit" type oil cleaner, in the pressure side of the scavenge pump of each system, is mounted on the front truss of the spar, and the oil must pass through this before entering the "Robertson" cooler (see notes on Page 33A), which is built into the leading edge of the plane.

The four coolers are mounted midway between the engines, two on the port and two on the starboard side; they are placed well away from the nacelles, to ensure a free flow of air through the cooling surfaces.

REMOVAL OF COOLER.

To remove a cooler from the plane the following order of operations should be observed:-

i. Remove the strut in the nose diaphragm adjacent to the engineers' maintenance platform opening. This has been specially designed to facilitate easy removal.

ii. Withdraw the four skewer retaining pins by pulling on the specially shaped handles made for this purpose.

iii. Take out the eight bolts which are accessible from outside the leading edge.

The cooler can now be removed through the gap left by the diaphragm strut.

ROBERTSON COOLERS.

TYPE R.H.5.-29.

DETAILS OF COOLER.

Before delivery each cooler is pressure tested for five minutes as a complete assembly with air at 70 lbs. per square inch and immersed in a bath of hot water (approximately 40°C).

Average weight including relief valve	16 lbs.
Average capacity including relief valve	5½ pints.
Cooling surface area	22 square feet.
Average rate of flow through the cooler using D.T.D.109 oil at 50°C, and with a pressure head at the inlet of six feet.	357 gallons per hour.
Average rate of flow with paraffin at six feet pressure head	960 gallons per hour.

CONSTRUCTION.

The oil cooler comprises a single tube block assembly arranged for a series oil flow through four tube groups. The oil enters at the front of the cooler and after rising in the first tube group is deflected by the centre joint dividing the top collector cover into the second group. The oil flow is in a downward direction in the second and fourth group and upward in the first and third. The bottom cover is divided into three compartments by the two transverse bolted joints and the centre compartment of this cover acts as a transfer chamber between the second and third tube groups.

The tube block is built up from oval section aluminium tubes assembled into aluminium end plates. The tubes are swaged to round section at the ends and each tube is secured by a patented form of joint of an entirely mechanical nature. The tube block is anodised as an assembly and treated with lanoline.

The side protection covers the top and bottom collector covers, the end frames and the reinforcing angle and channel pieces are constructed from either aluminium or its alloys and all these parts are anodised.

The support brackets are made from steel cadmium coated with a rubber bush insert.

THE RELIEF VALVE. TYPE R.V.2. The relief valve parts made from either aluminium alloy bar or light alloy die castings are anodised. The valve plunger is steel. The relief valve is secured to the lower collector cover of the cooler and it can be removed as a unit by unscrewing the union for each of the two banjo type connections.

The rubber connecting hose on the valve can be replaced by removing one union and banjo. The relief valve is supplied with a spring to open at a nominal oil pressure of 35 lbs. per square inch and there is no provision for adjustment on this spring.

FLYING CONTROLS.

GENERAL. The units of control in the control cabin are connected to their respective surfaces by swaged tie rods, which are supported at frequent intervals by fibre fairleads. Where the controls change direction the tie rods are interspaced by roller chains which are run over chain pulleys or sprockets fitted with ball bearing races. These races are factory greased and sealed and should require no further attention.

The control rods in the cabin are collected together and run under the port pilot's seat from whence the opposite sides of the three circuits are guided into two banks, one connecting to the automatic servo units while the other passes by.

Immediately after this all controls are collected into one bank and run up the aft side of the W/T ~~water tight~~ bulkhead to connect up to the fittings which form the locks and stops. They then follow on from the other side of these fittings to the top of the ~~water tight~~ W/T bulkhead, and thence aft to their respective levers.

LOCKING. All controls should be locked when rigging or adjusting and for this purpose a control locking device is incorporated in the system. This is situated on the aft side of the W/T ~~water tight~~ bulkhead, but for the convenience of operation there is a hinged door on the forward side of this bulkhead. When the locking handle (which is complete with all locking pins) is in the locked position the door can be fixed to it by screwing in the knurled screw. This is a safety device to ensure that the locking handle cannot be removed accidentally while controls are being adjusted. A canvas bag marked "Stowage - Flying Control Locking Handle", attached to the forward side of the ~~water tight~~ W/T bulkhead, is provided for the stowage of the locking handle during flight.

CONTROLS - LOCKING - AIRCRAFT MOORED. Controls must be locked when the aircraft is moored, with aileron and rudder normal and elevator with control column in most forward position (i.e. elevator down).

STOPS. All controls - aileron, elevator and rudder,are fitted with limit stops which are incorporated in the locking device.

ELEVATOR CONTROLS.

SYSTEM. FIG. 5.

The control column is of orthodox design in that the movement forward and aft controls the elevator. The transmission is operated by push-pull rod attached to a lever fixed to the base of the port control column, which operates a bell-crank lever under the port pilot's seat.

From this lever, chain and rod carry the control aft to the lever via dashpots on the elevator lay-shaft.

The starboard control column movement is transferred to the port column by a torque tube which has triangular flanged plug ends, while the castings at the base of the control columns have similar triangular fittings. These triangular flanges are offset to one another and are coupled together by a number of spring steel plates of thin gauge which give a universal joint action to accommodate any slight misalignment.

DASHPOTS.

The same type of spring loaded dashpots are fitted to the elevator levers as are used on the aileron. (See Aileron Controls Page 38 and illustration on Fig. 5).

CONTROL MOVEMENTS.

For control and surface movement see Fig. 5 "Elevator Control".

RUDDER CONTROLS.

SYSTEM.
FIG. 4.

The control rods and chains are connected to a lever on the underside of the port rudder bar and are collected together by two horizontal sprockets situated just aft of the control column. They are then carried aft, under the port pilot's seat, to the levers attached to the rudder torque tube at the tail of the aircraft.

The rudder system is operated by the starboard pilot through a transverse connecting tube which is coupled up to levers on the underside of each rudder bar.

The rudder bars are independently adjustable for leg length, forward and aft, and manipulated by rotating the toothed wheel, forward for a greater, and the reverse for a shorter length.

DASHPOTS.

The same type of spring loaded dashpots are fitted to the rudder lever as are used on the aileron. (See Aileron Control Page 38 and illustration on Fig. 5).

CONTROL MOVEMENTS.

For control movements see Fig. 4 "Rudder Control".

AILERON CONTROLS.

SYSTEM.
FIG. 3.

The aileron control system is split into three separate circuits.

i. Port control column to front spar frame sprocket battery.

ii. Front spar frame sprocket battery to port aileron.

iii. Front spar frame sprocket battery to starboard aileron.

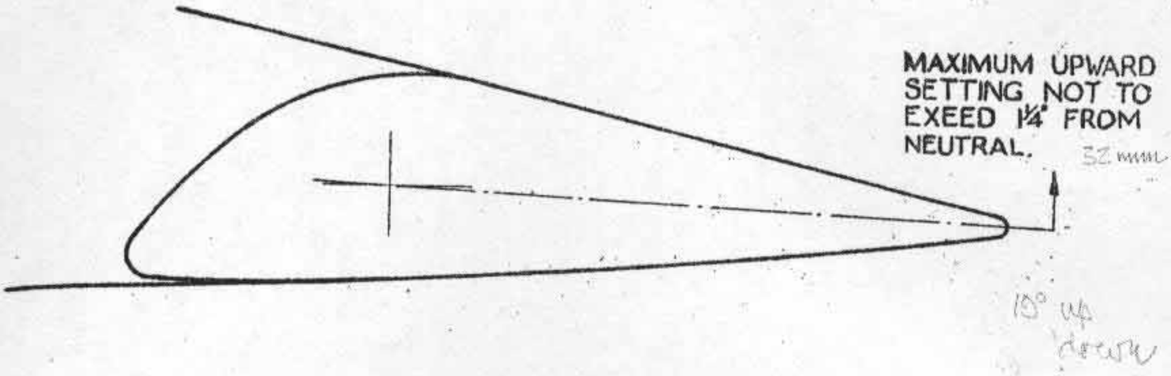
The starboard control column is coupled to the port column by chains and tie rods.

DASHPOTS.

A spring loaded dashpot (see illustration on Fig. 5) is fitted to the aileron levers, to compensate for any slackness which may occur in the control runs. These dashpots are filled with non-freezing oil ("Mobiloil arctic") to relieve snatch. ~~To refill with oil, remove the two screws on the top side and pour into one hole allowing the air to exude from the other.~~ To refill with oil, controls should be slackened off to allow piston rod to enter cylinder to fullest extent. Remove the two screws on the top side and refill with oil through one hole, allowing the air to exude through the other. Replace screws, lock and re-set dashpot on controls.

CONTROL MOVEMENTS.

For control movement see Fig.3 "Aileron Control".



AILERON SETTING

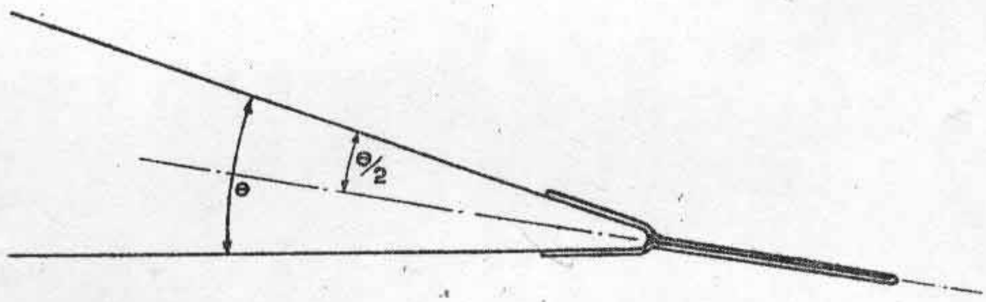


DIAGRAM SHOWS MAXIMUM DOWNWARD SETTING OF AILERON TRIM TAB.

AILERON TRIM TAB SETTING

AILERON RIGGING INSTRUCTIONS

Cont'd

ELEVATOR TAB CONTROLS.

SYSTEM.
FIG. 7.

The elevators are fitted with tabs which are used for trimming the aircraft for flying angle, the control of which is operated from the control cabin. Fixed to the roof within convenient reach of each pilot is a small handle, clearly marked "Elevator Tab" which, through a reduction gear box, operates the control runs.

These control runs, of extra flexible steel cable, are carried aft along the inside of the roof to a battery of small pulleys in the tail of the machine. From these pulleys the control is taken down to the floor of the aircraft and up again to a chain sprocket on the aft side of a two to one increase ratio countershaft. This completes the first circuit. Chains are then run from two chain sprockets on the forward side of the countershaft; one to a self locking worm box in the port elevator and the other to a similar box in the starboard elevator, each of these circuits being independent of the other. The elevator tab is operated through a push rod connected to the lever arm fixed to the worm segment. An adjuster is fitted in each of the final chain circuits, while four adjusters are fitted in the main circuit.

CONTROL
MOVEMENTS.

For control movements see Fig. 7 "Elevator Tab Control".

RUDDER TAB CONTROLS.

SYSTEM.
FIG. 6.

The rudder is fitted with two tabs, the upper being actually a rudder control assister and operated automatically with a relative movement of the main rudder, while the lower is operated from the control cabin and is designed to balance out engine torque or drift tendencies. Fixed to the roof within convenient reach of both pilots is a handle clearly marked "Rudder Tab", which, through a reduction gear box, turns a chain sprocket operating the control runs of extra flexible steel cables. These control runs are carried aft along the inside of the roof to a battery of pulleys in the tail of the aircraft, from whence they are taken down to the floor of the aircraft and up again, through the rudder support casting, to a chain sprocket on the aft side of a two to one increase ratio countershaft fitted inside the bottom of the rudder itself. This completes the first circuit. A continuous length of chain is then used to connect the sprocket on the forward side of the countershaft to a self locking worm box which is positioned higher up in the rudder. The tab is operated through a push rod connected to the lever arm fixed to the worm segment, the chain between the worm wheel box and the countershaft being adjusted by increasing or decreasing the number of packings under the countershaft casting. Four turnbuckles are incorporated in the first circuit for adjustment.

CONTROL
MOVEMENTS.

For control movements see Fig. 6 "Rudder Tab Control".

AUTOMATIC PILOT.

INSTALLATION.

GENERAL. For information regarding the details and upkeep of the "Sperry" Automatic pilot reference should be made to the "Sperry" handbooks No. 15/710 and 15/711 and 15/726 but on pages 42A to 42T sufficient running hints and instructions are printed for ordinary uses. The layout of the various units in the aircraft is as follows:-

VACUUM SYSTEM. One "Romeo" vacuum pump and relief valve is mounted in each starboard nacelle and is connected to the vacuum distributor by a 5/8" o/d x 20G. aluminium pipe. This distributor is mounted on the engineer's panel on which is also mounted the vacuum gauge. The two pipe lines of 3/8" o/d x 20G. aluminium from the distributor to the "Smith" turn indicators have a test cock inserted, while two other pipes of the same size go to the artificial horizon and the gyro respectively.

The remaining pipe of 1/2" o/d x 20G. aluminium is connected via the vacuum relief valve to the "Sperry" unit. The auto turn control on the port dashboard is connected to the "Sperry" unit by rubber hose 1/4" i/d. A vacuum adjuster is mounted on the top of the distributor.

OIL SYSTEM. A "Northern" oil pump, which supplies pressure to the oil system, is mounted on the inner port' engine and is connected to the oil supply tank and pressure gauge attached to the front spar by two 3/8" o/d x 20G. pipes.

The feed pipe is connected to the speed control valve unit through a "Parker" four-way plug valve, both of these being mounted alongside the port pilot's seat.

Three pipes $\frac{3}{8}$" o/d x 20G. connect each of the three control valves to the elevator, aileron and rudder control units respectively. The return or exhaust pipes lead from the control units to an exhaust manifold, from thence being connected by a single $\frac{1}{2}$" o/d x 20G. pipe through the "Parker" four-way valve to the base of the oil supply tank.

Three $\frac{1}{4}$" o/d drain pipes from the control units connect to another manifold, the oil being drained from this through a single $\frac{3}{8}$" o/d x 20G. pipe to a drain trap and thence to the drain tank. The three servo units which are separately connected into one side of each of the control systems (see Fig. 3, 4 and 5), are mounted on the floor to the rear of the pilots' seats.

Each of these are connected by two $\frac{3}{8}$" o/d x 20G. pipes to the control units.

FOLLOW-UP CABLES. The follow-up cables are anchored to drums attached to sprockets operated by chains in the main control runs. The return is arranged by springs in the "Sperry" control units.

ENGAGING LEVER. The engaging lever, mounted on the forward side of the throttle control box, is connected to the operating lever on the valves in the servo units by "Bowden" cable.

AUTOMATIC PILOT.

MAINTENANCE.

USING THE GYROPILOT. It is assumed in this section that the operator of the equipment is already familiar with its principles of operation and its component parts and that the equipment is in good working order. The section, therefore, deals only with the operation of the Gyropilot by the human pilot.

GROUND CHECK. Prior to take-off the Gyropilot should be given a ground check by the ground engineer responsible for releasing the aircraft as ready for service, using the following procedure:

i. Check for Air in Servos. Before starting engines set the aircraft controls approximately neutral and set Gyropilot engaging lever "ON". Apply light pressure each way to each control. Controls should act as though locked. If there is a resilient action it is an indication of air in the servo cylinder which should be worked out during the engine run-up by working controls back and forth with the Gyropilot off. While working out air, hold each control at each extreme position for about 30 seconds to allow time for air to be carried from the servo to the sump tank. Do not mistake springing of the control cable system with the resilient action of air in a servo cylinder. Servo piston movement is indicated by movement of follow-up indices on control unit dials.

ii. Check Vacuum. Should not be less than 3" of mercury at 1000 r.p.m. or more than 5" of mercury with engines at maximum ground r.p.m.

iii. Check Oil Pressure. Close speed control valves when checking oil pressure. Should be within 10 lbs. of recommended operating pressure for the aircraft.

iv. Uncage Bank and Climb Gyro. If aircraft is not level, gyro should move slowly toward correct indication of the attitude of the aircraft on the water when uncaged.

v. Set and Uncage Directional Gyro.

vi. Open Speed Control Valves. A control will not operate unless its speed control valve is open.

vii. Set Turn Control OFF. (if Turn Control is installed).

viii. Set Level Control OFF.

ix. Set Follow-up Indices to match gyro indications using the Rudder, Aileron and Elevator knobs when manual controls are approximately neutral.

x. Engage Gyropilot.

xi. Test Operation of Gyropilot by turning Rudder, Aileron and Elevator knobs, noting that controls move both ways, in the correct direction and at approximately equal speed each way. (Up elevator will probably be slower than down elevator due to the weight of the surface.) Slow aileron or rudder one way and fast action the opposite way, or control in one direction only is indicative of maladjustment which should be corrected in accordance with service instructions on Trouble Spotting. Set Turn Control successively RIGHT AND LEFT to check operation of rudder follow-up knob and card.

As soon as ground engineer or pilot has become familiar with the above routine he will be able to run a complete ground check in two to three minutes during the run up of engines. A Gyropilot which does not check out properly on the water cannot be expected to perform satisfactorily in the air, and, therefore, any malfunctioning of the apparatus should be corrected before any attempt is made to use it.

ENGAGING THE GYROPILOT. Several details should be checked or performed prior to engaging the Gyropilot. These are listed for convenience of the pilot. Familiarity with the Gyropilot will soon reduce this procedure to a simple routine.

i. Check vacuum. — Desired vacuum is four inches of mercury. 0.53 kPa It should not be less than three inches or more than [illegible] five inches. 0.66 kPa

ii. Check oil pressure. — Best operating pressure will have been determined during original tests.

iii. Open Speed valves. — A closed speed valve locks its control in position when the Gyropilot is ON. It is, therefore, important that the valves be open prior to engaging the Gyropilot.

iv. Set level control to OFF.

v. Check Directional Gyro setting and be sure both gyros are uncaged.

vi. Trim the aircraft for "Hands off" condition.

vii. Set follow-up indices to coincide with gyro indi- — Rudder follow - up card should match Directional

Gyro, Bank index should match mark at top of Bank and Climb Gyro dial and Climb index should match mark at right end of the miniature aircraft bar.

viii. Set Turn Control to OFF.

ix. Engage Gyropilot slowly. By holding on to the controls as the Gyropilot is engaged the pilot can feel when the Gyropilot is taking over and functioning properly.

SPEED CONTROL VALVE SETTING. When the Gyropilot is engaged there may be an oscillation of one or more of the controls with the speed control valves wide open. The valve corresponding to the oscillating control should be slowly turned toward closed position until the oscillation ceases. A valve should not be completely closed, as this stops oil flow to the servo and locks the control. After the speed valve has been closed enough to stop oscillation in a control, the setting knob for that control should be moved back and forth a small amount to be sure that control operation has not been stopped by closing the speed valve too far. Speed valve settings should not have to be changed unless it is desired to materially increase the speed of control in rough air. The numbers on the valve dials represent turns of the valve and may be used as a reference for bringing the valve back to a desired setting. When there is no oscillation present Speed Control Valves should be left wide open, unless reduced speed of control is desired.

<u>DIRECTIONAL CONTROL.</u>

Directional Control in the Gyropilot is based on the Directional Gyro which must be set with the magnetic compass and re-checked at periodic intervals. The average drift of a Directional Gyro should not be more than 3° in 15 minutes. A drift of 5° in 15 minutes is permissible on one heading providing the average on the four cardinal headings does not exceed the 3° in 15 minutes. Since the Gyropilot controls to a set heading on the Directional Gyro, the drift will cause a corresponding change in the magnetic heading of the aircraft. When the aircraft is only two or three degrees off the desired heading by magnetic compass a small adjustment of the rudder knob will suffice to correct the heading. When there is an appreciable difference in reading between the compass and Directional Gyro, the Gyropilot should be disengaged for a moment while the Directional Gyro is being reset. An alternative method is to leave the Gyropilot engaged, close the rudder speed valve for a few moments (which locks the rudder at centre) while the Directional Gyro and follow-up are being reset. Rudder control is restored when the speed valve is re-opened.

<u>LATERAL CONTROL.</u>

Lateral control in the Gyropilot is taken from the Bank and Climb Gyro. The aileron knob can be set for either level flight or to any angle of bank up to 30° for use in either an automatic turn (using turn control) or in a turn where the turning is controlled by continued manual operation of the rudder knob.

<u>LONGITUDINAL CONTROL.</u>

Basic longitudinal control is taken from the Bank and Climb Gyro. The desired longitudinal attitude is set by means of the elevator knob. Use of the level knob permits automatic control of altitude. When the level knob is in the OFF position, control is purely to an attitude which is controlled by the elevator knob. To use the level control, first set the elevator knob to bring the aircraft's Climb Indicator to zero; then turn the level knob slowly from OFF to LEVEL. This may cause some rotation of the elevator knob and a slight change in altitude but when this ceases the aircraft will be stabilized at a practically constant pressure altitude within normal operating limits.

Turn the level knob to OFF position when it is desired to change altitude, then to ON when desired to stabilize at the new altitude.

MANOEUVRES. Outside of straight flight which may be either level or climbing or descending, the only manoeuvres that it should be necessary to perform with a Gyropilot are turns and spirals. Course changes of a few degrees may be made as flat turns in which case it is only necessary to rotate the rudder knob slowly until the aircraft reaches the new heading. When Automatic Turn Control is used, the Turn Control handle is moved to right or left (depending on the direction of turn desired) causing a small air motor in the Directional Gyro Control Unit to drive the rudder knob and follow-up card in the proper direction to produce the turn. As the turn starts, the aileron knob should be turned to produce the proper bank for the turn. As the desired new heading is approached, the Turn Control should be returned to zero and the aircraft levelled out by means of the Aileron knob. After the Turn Control has been set to OFF it will be noticed that the aircraft will continue to turn at a decreasing rate and the Directional Gyro and Rudder Follow-up cards will continue to travel together. This is necessary to accomplish removal of the rudder control which was applied to create the turn. If the cards are still moving at a noticeable rate as the aircraft approaches the desired Directional Gyro heading for straight flight, set Turn Control for opposite turn which will speed up neutralization of rudder. For control in a spiral the required climb or descent setting is made in conjunction with the turn setting in the same manner as in straight flight.

USE OF THE AIRCRAFT TRIMMING CONTROL.

Changes in flight attitude, power, altitude and load shifts will effect the fore and aft trim of the aircraft and cause the Gyropilot to hold the elevator against the out of trim condition so as to hold the aircraft to the set-in attitude. This may result in an oscillation of the elevator control. The trim of the aircraft can be checked by disengaging or re-engaging the Gyropilot for a few seconds and noting whether the aircraft tends to nose up or down. A trim correction should then be made with the elevator trimming tab or stabilizer.

On aircraft equipped with individual by-pass valves for each servo, only the elevator control need be turned off to check trim. When by-passing a single servo cylinder, close the speed control valve to that control so that oil pressure to the other two controls will not be by-passed. In rare cases better control may result with a slight loading of the elevator control in one direction. In order that the human pilot will not have to suddenly apply a large force to the elevator to hold the aircraft when the Gyropilot is disengaged, the aircraft should be kept approximately in trim during Gyropilot operation.

MANUAL CONTROL.

When it is desired to resume manual control it is only necessary to move the engaging lever to the OFF position and take over the controls. As an added safety measure, servo relief valves are provided which allow for immediate emergency overpowering of the Gyropilot by applying about twice normal force on the controls.

PERIODIC INSPECTION AND MAINTENANCE.

The purpose of any inspection and maintenance is to forestall trouble or failure by detecting maladjustment, wear or weakness before it becomes serious and to make the necessary correction to prevent a failure of the apparatus. The inspection periods mentioned can only be suggestive since thoir actual required frequency will depend largely on the service to which the apparatus is subjected. It is suggested that the minimum periods be used, until the user becomes thoroughly familiar with the apparatus. Airlines will undoubtedly assign portions of the work to men or crews specializing in some particular phase of the installation, such as cable and control men, instrument men, motor accessory and piping installation men. Here Gyropilot inspection and maintenance will be co-ordinated with other inspection and maintenance programmes.

PRIOR TO FLIGHT.

The mechanic, inspector or test pilot who is responsible for releasing the aircraft as satisfactory for service should perform a ground check as outlined in the instructions for using the Gyropilot. A check of the quantity of servo oil in the tank should be made at this time. Check lights and spare bulbs also.

50-100 Hour Check.

i. Inspect all piping and fittings including flexible hoses. Tighten or replace fittings or pipes where necessary to stop leaks. Replace any flexible hoses showing signs of seepage at connections or pimples on surface of hose. Tighten servo packing nuts if there is any leakage.

ii. Inspect all cables, cable connections and pulleys. Main cables, follow-up cables and servo ON-OFF cables should be free working, positive and free from any signs of fraying or wear.

iii. Check follow-up pulleys on Mounting Unit with Gyro Control Units removed and oil springs if dry. A few drops of engine oil is sufficient.

iv. Inspect and replace air intake screens if necessary on the air relays, vacuum relief valve and gyro control unit intakes.

v. Check oil in sump tank. Should be $3/4$ full.

vi. Ground test as previously noted.

300-400 Hour (Engine Overhaul) Period.

i. Perform all operations called for in 50-100 hour check.

ii. Remove gyro control units and have bench check made in instrument shop. Overhaul if performance is not satisfactory. Replace rubber grommets if necessary.

iii. Drain oil sump and remove strainer. Clean strainer in petrol and replace.

iv. Remove oil and vacuum pumps. Wash in petrol and inspect driving end for wear. Check freedom of rotation. Do not disassemble the pumps unless absolutely necessary. If facilities are available, have pumps checked for performance.

v. Inspect shock-absorbing bushings on Mounting Unit and replace if necessary.

vi. Check servo relief valves for blow-off pressure. This is done by connecting a pair of oil pressure gauges of 200 or 300 lb. range to the servo cylinder at the point where the tubings from the balanced oil valves are normally attached and applying manual pressure to the control until the relief valve opens. The main valve should be in the ON (closed) position during the test. The servo relief valve should be set to open at a pressure 25 lbs. per square inch higher than the normal Gyropilot operating pressure for the aircraft.

vii. Check freedom of balanced oil valves and air relays and centralization of balanced oil valves. The location of the balanced oil valves on the Mounting Unit is positively fixed. The air relays can be shifted slightly by the amount of clearance between the mounting holes and the mounting screws. After the balanced oil valve and air relay are both individually checked for free working, the air relay may be mounted loosely and shifted about on the screws until the two units together operate freely. Freedom of the two units can best be checked with the rear cover of the balanced oil valve removed. If the balanced oil valves are centralized properly there should be no movement of a control with the Gyropilot turned ON (oil pump operating) and the gyro control units removed. If there is control movement in either direction remove the rear cover of the balanced oil valve and adjust to centre. Connect a rubber tubo to one of the air relay connections.

With oil pressure ON and Gyropilot engaging lever ON, light suction and pressure should produce movement of the controls in each direction, which movement should cease when pressure or suction is removed.

viii. Ground test as previously noted.

600-800 Hour Period.

NOTE: Operations recommended at this time should only be performed by organizations trained in the overhaul of Gyropilot equipment and having the necessary special tools and fixtures required.

i. The following units should be removed and overhauled to put them in first class operating condition.

   a. Directional Gyro Control Unit.
   b. Bank and Climb Gyro Unit.
   c. Balanced Oil Valves.
   d. Oil Sump and Pressure Regulator.
   e. Oil Pump.
   f. Vacuum Pump.

ii. The following units should be removed and tested but not disassembled for overhaul unless their performance is not satisfactory.

   a. Air Relays.
   b. Speed Control Valves.
   c. Vacuum Relief Valve.
   d. Servo Unit.

   The construction of these units is such that there is little chance of internal wear.

iii. Re-instal all units and make all checks recommended for the more frequent periods.

iv. Ground test as previously noted.

TROUBLE SPOTTING.

It is assumed under this heading that the initial installation was basically correct. The possible troubles listed below with their causes and remedies all refer to service difficulties which are not connected with a faulty installation. In order to obtain ground test at all, it is necessary to have the proper vacuum, oil in the sump and oil pressure. Possible causes of vacuum and oil troubles are listed below and followed by other troubles which might occur when vacuum and oil pressure are sufficient.

Low or No Vacuum (under 3" Hg.)

Causes.	Remedies.
a. Vacuum Relief valve not properly adjusted.	Screw in adjusting screw. If this fails to increase vacuum the trouble lies elsewhere.
b. Pump failure.	Repair or replace pump.
c. Leak or break in vacuum line.	Locate and repair.
d. Obstruction in vacuum line (may be collapsed inner wall of flexible hose).	Locate and repair.

Excessive Vacuum (Over 5" Hg.)

. Air intake filters clogged.	Replace with new filters.
b. Vacuum relief valve set too high.	Reset.
c. Vacuum relief valve stuck closed.	Remove screen and push valve free with finger. Replace screen. If sticking persists replace or repair.

Low or No Oil Pressure.

a. Broken line or leak.	Locate and repair.
b. Pressure regulator out of adjustment.	Adjust with speed valves closed.

c.	Pressure regulator defective.	Repair.
d.	Clogged strainer.	Remove, clean, re-instal.
e.	Defective oil pump.	Bench test and repair if necessary.
f.	No oil in system.	Fill sump $\frac{3}{4}$ full. After running engine 5 minutes refill to make up for oil fed into the system.

No Control

Failure to operate all three controls in either direction can be attributed to the following causes.

a.	Low or no oil pressure.	See "insufficient oil pressure".
b.	Low or no vacuum.	See "low or no vacuum".
c.	Engaging lever OFF.	Set to "ON".
d.	Broken connection between engaging lever and servo.	Repair.

Failure of one of the controls to operate in either direction may be attributed to one or more of the following causes:

a.	Oil valve stuck.	Remove rear cap and work valve back and forth by hand.
b.	Air relay filter clogged.	Replace filter.
c.	Defective control unit (NOTE: If light sucking and blowing on the air relay produces control operation the trouble is probably in the control unit - otherwise not).	Replace - examine control unit for condition of rubber grommets at rear.
d.	Speed valve closed.	Open speed valve.

e.	Clogged oil line to servo unit.	Check lines.

Controls Hunting.

a.	Air in oil system. Special attention must be given on a first ground test in expelling all the air in the oil system. Air in the system can be determined in operating the aircraft's controls with the Gyropilot lever engaged. The reaction of the manual control stick or pedals in over-powering the pilot will definitely indicate the presence of air locks. If a control does not move to manual pressure until considerable force has been applied, it proves the absence of air. If, however,, it moves easily a short distance before resistance is felt, it is a positive indication of air in the system. This control, therefore, will hunt, due to the kickback of the compressed air expanding when the control load is removed. If there is any	Move controls back and forth manually with engine running and Gyropilot OFF. Hold each control at one and then the other extreme position for one minute. This permits continuous flow of oil down one servo line, through the by-pass and into the other line thus carrying any air back to the sump via the exhaust line. The follow-up indices should be set neutral at the start with the controls at neutral.

e.	Backlash in oil valve. If the oil valve cannot be set to neutral so as to produce no control movement there is probably backlash or lost motion between the centralizing springs and the valve stem. Before deciding that backlash exists, recheck with the air relay removed so that any sticking of the air relay is not the basic cause. The neutral setting is limited to a fraction of a turn of the adjusting screw.	Shim washers .005" thick or less may be installed at the end of the two centralizing springs to take up any shortening of the centralizing spring due to permanent set. Do not shim enough to produce any compression of the springs as this will cut down sensitivity of control.
f.	Gyros caged. A caged gyro will precess back and forth against the caging stops causing the controls to follow.	Uncage gyros.

Jerky Control.

	Causes.	Remedies.
a.	Sticking in follow-up pulleys.	Remove control boxes and check for lubrication and rust in spring and bearing.
b.	Excess friction or sticking in follow-up cable between servo and follow-up pulleys.	Examine follow-up cable system and pulleys and free up.
c.	Air in oil system.	Work controls with engines

		running to expel air.
d.	Sticky balanced oil valve (may not stick enough to render control inoperative but will cause jerky operation).	Free valve - clean if necessary. Valve will have to be rebalanced if removed for cleaning.

Lagging Control in One Direction Only.

a.	Follow-up pulley not wound sufficiently.	Shorten follow-up cable so that when control is hard over in the direction to wind the spring, the spring will be within ¼ turn of being wound tight.
b.	Dirt in balanced oil valve restricting travel in one direction.	Free valve. Clean if necessary. Rebalance after reassembly.
c.	Oil valve not properly balanced. When the valve is not too far out of balance the air relay can hold it on centre. Further movement in the direction which the air relay has to pull is restricted thus slowing the control.	Balance oil valve with control units removed. Replace control unit and recheck.
d.	Unbalanced air cut-off in control unit. Due to plugged air passage or unequal clearance between cut-off plates and air nozzles.	Remove control unit and determine if control speed is equal in both directions when same pressure is applied to either side of air relay which would indicate trouble in the control unit. Check

		operation with a control unit known to be good. Repair or replace defective control unit.

Lagging Control in Both Directions.

a.	Speed valves closed too much.	Open valves and note if control speed increases.
b.	Oil pressure too low.	Reset pressure regulator to amount previously known to be satisfactory.
c.	Oil supply choked.	Examine interior of flexible hose, especially suction line to pump. Check oil supply lines and oil strainer and clean if necessary.
d.	Vacuum too low to give full travel of air relay and balanced oil valve.	Adjust regulator to 4" Hg. Check vacuum system if adjusting regulator does not give higher vacuum.
e.	Clogged filters in air relays.	Make temporary test with filters removed. If operation is satisfactory instal new filters.
f.	Servo relief valve set too low.	Install gauge on servo and operate control to overpower. Set relief to 25 lbs. higher than Gyro-pilot operating pressure (read with speed valves closed).

Control in One Direction Only.

a.	Balanced oil valve restricted by dirt.	Operate manually to check. Free and clean valve if

		cause of trouble.
b.	One filter clogged on air relay.	Check with both filters removed.
c.	Follow-up or piping reversed. Would not take place on an installation which was previously satisfactory unless cables or piping had been removed and reconnected incorrectly.	Connect according to correct diagram.

Reversed Control.

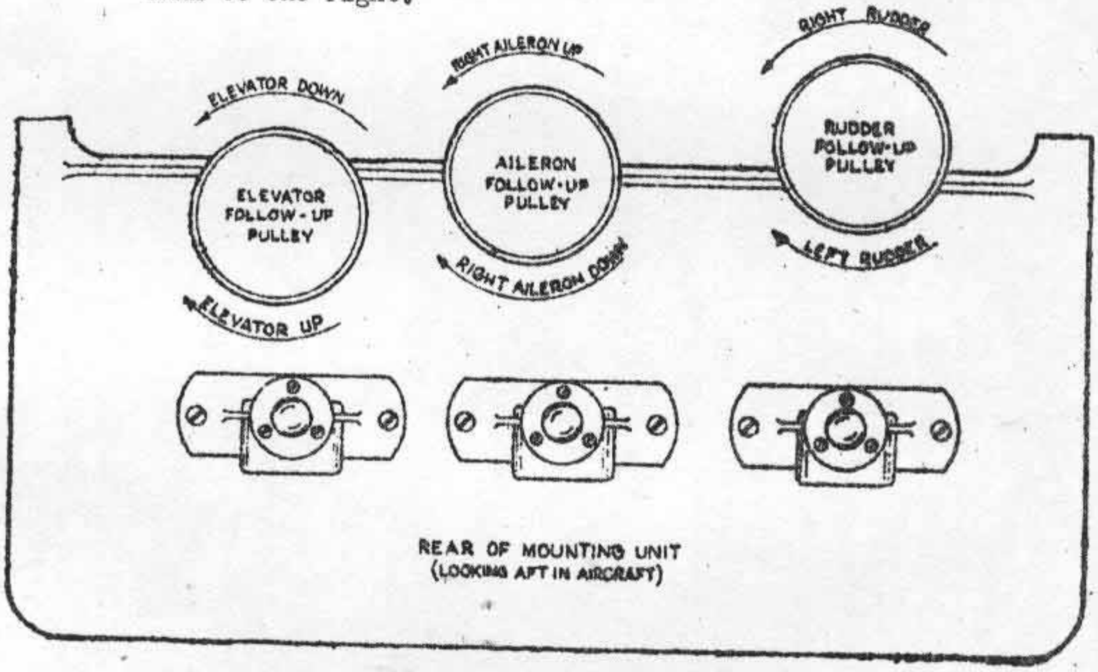
Should the follow-up cables or the oil lines between the balanced oil valves and the servo unit be disconnected and then incorrectly reconnected, reverse control will result. Check in accordance with the instructions on the following page.

FOLLOW-UP CABLES. A reversed follow-up cable will cause a control to move in the wrong direction to one or the other extreme positions when the Gyropilot is turned on. The follow-up pointer will move away from coincidence with the gyro indication instead of toward it. The connections should be checked first at the follow-up pulleys, using the diagram shown in Fig. A, and re-checked in the cockpit as follows:

Right Rudder should move the follow-up card to the left.

Down Elevator should move the follow-up pointer for climb and glide up.

Right Aileron should move the follow-up pointer for bank to the right.



CABLES MAY BE INSTALLED TO PULL FOLLOW-UP CLOCKWISE OR COUNTERCLOCKWISE DEPENDING ON HOOK-UP TO SERVO AND HOOK-UP OR SERVO TO CONTROLS. IN ALL CASES, HOWEVER, THE RELATION BETWEEN CONTROL SURFACE MOVEMENT AND DIRECTION OF FOLLOW-UP PULLEY ROTATION MUST BE AS ABOVE.

Figure A.

DIAGRAMMATIC DRAWING SHOWING METHOD OF MAKING FOLLOW-UP PULLEY CONNECTIONS.

SERVO
OIL LINES.

If the connections between a balanced oil valve and a servo cylinder are reversed, opposite control will result continuing to the end of the control travel. The accompanying diagram and table (Fig. 21) should be used to check this portion of the system.

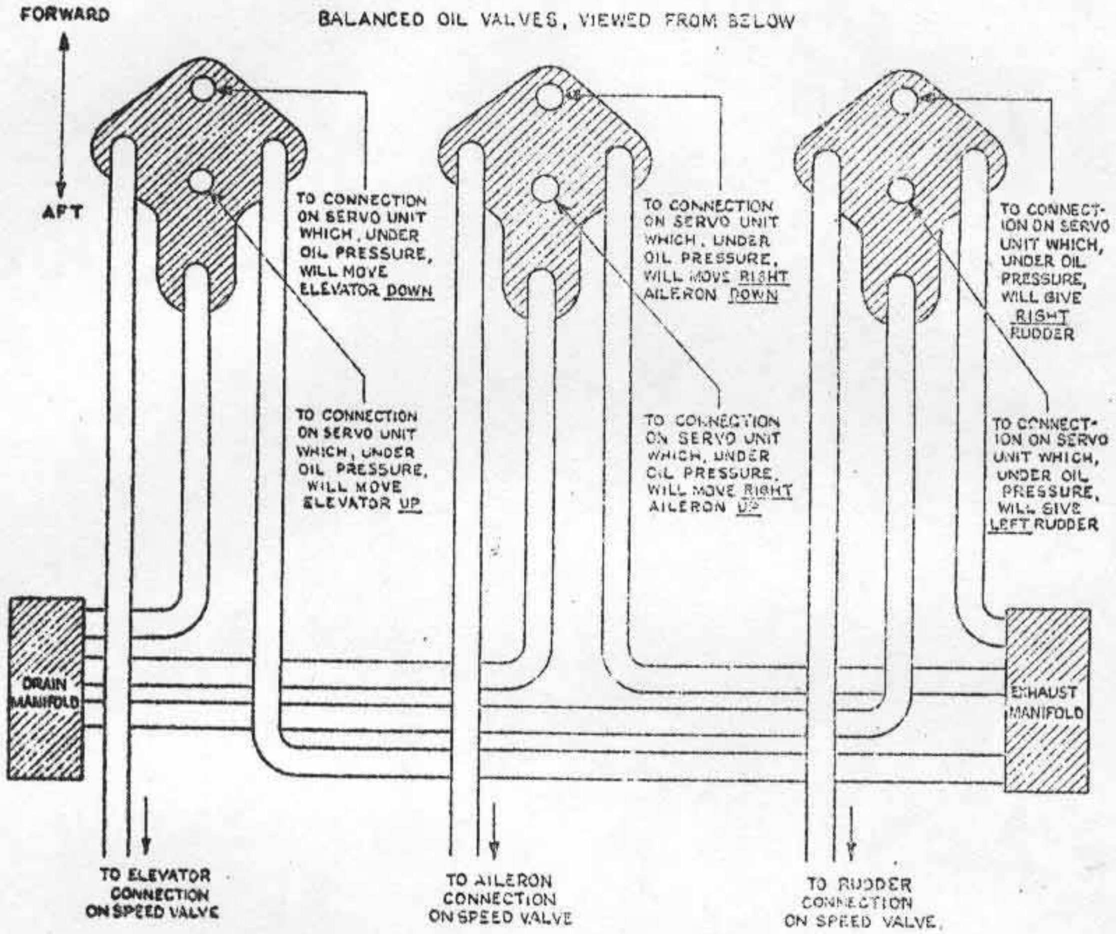


Figure B.
DIAGRAMMATIC DRAWING SHOWING METHOD OF MAKING OIL LINE CONNECTIONS TO BALANCED OIL VALVES.

In general, remember that trouble must be due to some changes in the condition of the apparatus or its installation. Normal wear incident to service is not likely to be the cause of trouble, especially trouble which becomes suddenly apparent. Therefore, look for dirt, loose connections, incorrect adjustments or settings and the like. Along with using the foregoing information as a guide, check over the equipment and its installation completely and carefully to be sure that all possible sources of trouble have been attended to. Be sure that the equipment is in good operation condition before re-

PILOTS SEATS.

The pilots' seats are adjustable in two planes, vertical and horizontal. The horizontal or forward and aft movement has four positions 2" apart giving a total adjustment of 6", which is operated by lifting the cross tube just below the front edge of the seat and pushing the seat backwards or forwards as required. 50 mm 150 mm

50 mm The vertical movement has five positions 2" apart giving a total travel of 8", 200 mm which is operated by a lever mounted on the outboard side of each seat. The knob at the forward end of the lever has to be pressed in thus freeing the seat to be raised or lowered as required.

CONTENTS.

Delete Pages 44, 45 and 46 and add the following pages 44, 45, 46 and 46A.

HEATING & VENTILATING.

The system as shown in Fig.33 (Heating & Ventilating) consists of a muff type boiler around the exhaust pipe of the starboard inner engine, and a 'Gallay' type air heater and water tank through which the air required for ventilation passes.

A $1\frac{1}{2}$" dia. steam pipe runs from the top of the boiler to the bottom of the heater and a $\frac{3}{4}$" dia return pipe conveys the condensate from the tank at the bottom of the heater back to the boiler. The returm pipe is tapped by a $\frac{3}{8}$" dia. filler pipe leading to the filler on the front spar frame bulkhead in the hull. A drain cock is provided at the lowest part of the system, that is at the bottom of the boiler, while a vent in the top of the heater prevents the possibility of an air lock. A safety valve is fitted in the steampipe and this is set to blow off at 4 lbs per. square inch. The normal working pressure is about 1 lb. per square inch.

An extractor system, entirely automatic in its operation, is fitted on both port and starboard sides, taking air from the lavatory and buffet compartments respectively, the extractor discharge being at the point of low pressure on the wing surface.

Fresh air is admitted at the leading edge of both port and starboard wings at a point outside the airscrew disc. A grille is fitted to the inlet to prevent large objects being blown into it.

Removable filters fitted in the air ducts, may be readily removed for cleaning through the doors on the upper deck.

A butterfly valve is provided just in front of each filter, so that the air flow may be cut off while the filters are being changed.

Rain traps are fitted to the bottom of each filter box and also in the trunking just behind, so that any water entering these traps is let out through the underside of the wing, the apertures being closed by small hinged doors.

On the port side the air trunk enters the hull at a point just forward of the rear spar, and thence to all the 'punka louvre' ventilators throughout the boat.

The whole of the air admitted through the starboard trunking passes through the air heater and is discharged through a system of ditributors which are filted throughout the boat and are situated mainly at or about floor level.

Immediately aft of the heater a butterfly valve is fitted which is used for regulating the volume of hot air required. This valve is fitted with a remote control situated on the front spar frame.

A magnetic valve is situated in the steam pipe near the heater, a thermostat switch on the bulkhead in the centre cabin and a velostat switch in the starboard trunking at the rear spar frames in the hull.

These three units are wired together in series. The velostat is a switch consisting of a light metal vane suspended in the trunking and pivoted about its upper edge, the flow of air impinging upon the vane causes it to be deflected thus closing the electric circuit. The valve which consists of a plunger actuated by a solenoid is now controlled by the thermostat switch which can be set to any required cabin temperature.

When the aircraft is not in flight the vane returns to its normal position thus breaking the electric circuit. The valve then closes by gravity. Thus when the aircraft is not in flight the valve being closed the heating is shut off.

FILLING INSTRUCTIONS. · Remove the cap of the filler attached to the front spar frame bulkhead, and fill with distilled or softened water up to the red ine (approx. 1 gallon). Replace the cap.

NOTE. The red line indicates the correct quanitity of water when the aircraft is afloat.

DRAINING. Connect a hose to the drain tap at the bottom of the boiler, open the tap and syphon out the water through the nacelle door. Close the tap.

FLYING. See that the system is filled as above before take - off, and that the air supply valves, in the port and starboard wings, are open (the handles in line with the ducts.)

In extremely cold weather it may be necessary to cut down the quantity of air slightly, this should be done by partially closing the air regulating valve, the remote control being on the front spar frame bulkhead; otherwise this valve must always be open.

If a filter requires cleaning in flight, close the air supply valve and close also the magnetic steam valve by setting the thermostat control knob to "off", when the filter can be removed and cleaned. Replace filter and open valves.

<u>NON-FUNCTIONING OF SYSTEM.</u>

If the system is not functioning properly the following questions should be answered.

i Are the control valves in the port and starboard wings open? The handles should be in line with the centre of the duct.

ii Is the regulating valve set correctly?

iii Is the system charged with water?

iv Is the thermostat in the cabin set correctly?

ELECTRICAL INSTALLATION.

GENERATORS. The electric power supply is obtained from two direct engine driven generators, (Rotax) one on the port inner engine, and one on the starboard inner engine.

These generators each give an output of 1,000 watts at 24 volts, and are controlled by a combined cut-out and automatic voltage regulator situated on the main electrical panel in the upper deck of the hull.

(For operating instructions of generators see "Rotax" handbook).

ACCUMULATOR. The accumulator is an 18 cell N.I.F.E. battery of 55 ampere hours capacity and is connected to the generator for charging via the cut-outs.

This battery supplies the following services:-

24 Volts.

Navigation Lights.

Landing Searchlight.

Power Supply to W/T.

Internal Lighting.

Stewards Call Signals.

Power for Flap Motor.

12 Volts.

Instrument Lighting.

Engine Starting. (For emergency use when the ground battery is not available).

TERMINAL BOARD. At the distribution point just above the battery a terminal board has been introduced, in order to simplify the connections thereto.

The major part of the electrical services are controlled by a "Rotax" combined switch and fuse box.

NAVIGATION AND ANCHOR LIGHTS.

The navigation lights fulfil the latest Air Ministry and internationsl requirements. A combined light fitting in the W/T masthead carries the steaming light and anchor light. The port and starboard lights are housed into the leading edge of the plane, whilst to facilitate replacement of a bulb or glass, a door has been provided on the upper surface of the nosing through which the lamp complete with its special mounting may be readily withdrawn.

The anchor light is controlled by a special push switch outside the hull near the main bollard. (Port side).

LANDING LIGHTS.

Two landing searchlights are provided, one in the bow (240 watts) which may be adjusted in two planes by the pilot, and is housed in a retractable mounting, the other (500 watts) in a fixed mounting in the nose of the starboard plane just outboard of the outer engine. The searchlights are electrically controlled by a "Rotax" two-way switch on the port side of pilots' cabin.

INSTRUMENT LIGHTING.

The instrument lighting is arranged in special boxes behind the dashboard and is controlled by a bank of dimmer switches on the port side of the pilots' cabin.

INSTRUMENTS.

AIR SPEED INDICATORS.

Two air speed indicators are provided, one in front of each pilot, and each with its respective pressure head mounted on top of the telescopic aerial mast.

STATIC PRESSURE HEAD. (Common).

A separate static pressure head is mounted just outside the hull on the starboard side and is coupled to the "Kollsman" altimeter, "Smith" altimeter and the rate-of-climb indicator.

SHOCK ABSORBERS.

The pilots' instrument panel is mounted on "Lord" shock absorbers.

TURN INDICATORS.

Two "Smith" turn indicators are fitted, for information on these see Page 41 "Vacuum system".

BEACHING CHASSIS.

MAIN CHASSIS.

FIG. 31 & 32.

The main or front chassis is made in two separate units each consisting of a central strut, with two outriggers about half way along its length and mounted on two "Dunlop" 6" x 20" wheels fitted with pneumatic tyres which should be inflated to a pressure of 90 lbs. per square inch, the axle of which pivots about the strut in a vertical direction to counteract any uneven ground surface.

Two cylindrical flotation corks are built onto the strut each side of the outriggers which both have an air ball attached; these, aided by ballast, maintain the unit floating at an angle of 60° to water-line. CAUTION:- The all-up weight of the machine MUST NOT EXCEED 39000 lbs when using the beaching chassis.

STOWAGE AND MANHANDLING.

FIG. 31.

For stowage and manhandling on the ground or slipway, the main units are arranged to take a horizontal attitude and are steerable through the castor wheel and draw-bar provided. (See Fig. 31 (i) Beaching equipment operations). By withdrawing the pin "A" Fig. 31, the top of the main strut will pivot through an angle of 90°, and in this position is locked by the strut "B" Fig. 31 and pin "C" Fig. 31.

The castor wheel is then inserted into its socket and locked by the pin "D" Fig. 31. In this attitude the gear is let down the slipway and into the water axle first, the castor removed and a rope hitched round the top of the main post for towing to the aircraft.

ATTACHMENT OF MAIN CHASSIS TO AIRCRAFT.

FIG. 31 & 32.

The main chassis supports the aircraft amidship under the front truss of the spar and is braced by the outriggers to two points each side of the hull on the front and rear spar frames above the chine.

In order to preserve the clean lines of the hull the attachment pins "R" Fig. 32 are made part of the chassis and are pushed into holes in the hull side made to receive them.

The water-tight plungers "K" Fig. 32, which close the holes when the chassis pins are removed, have been designed to act in a dual capacity in that by withdrawing and reversing them inside the hull they lock the pins in position by the screw thread "C" Fig. 32 and are themselves locked by a device "[illegible]" Fig. 32 permanently attached inside the hull.

By hinging the plunger halfway along its length it can be thrown over at right angles and used as a lever for drawing the chassis pin right home, but this should not be done until the chassis has been attached.

The following is the order in which the chassis has been arranged to be attached:-

i. Insert attachment pins "R" Fig. 32 into the hull.

   Note: It may be found expedient to arrange the insertion of these pins to coincide with the withdrawal of the water-tight plungers in order to avoid shipping water.

ii. Connect the short front outrigger strut to front spar frame at "E" Fig. 31.

iii. Connect the rear outrigger strut to the rear spar frame at "F" Fig. 31.

iv. Insert and screw home the ring bolt at "J" Fig. 31 and attach a 10 cwt. differential chain block and tackle, the other end being connected to the top of the beaching leg at "N" Fig. 31. Take up the load lightly on the chain.

v. Using the top cork as a platform, insert the main plane fitting "L" Fig. 31 and with the aid of the lifting tackle draw the leg into position and fix with pin at "O" Fig. 31.

The main plane fitting "L" Fig. 31 is held in position by the use of two hinged stub pins, which when inserted and turned through an angle of 90° automatically lock themselves in position. The small stub pin is provided with a hinge and is inserted first with the body of the fitting hanging vertically downwards and the wooden fitting pointing forwards, and then locked by turning the whole fitting through the required angle and hinged up to its fixed position. The fixed stub is then entered and locked by turning the lever at the base of the pin through the required angle and hooking over the catch provided.

Repeat the process on the opposite side and remove lifting tackle. A small variable adjustment of .3" in a horizontal direction is provided in the slotted flanges of the top piece of the beaching leg "M" Fig. 31; a serrated plate is held between these flanges and locked in position by bolts and nuts.

REMOVING MAIN CHASSIS FROM HULL.

When these units are removed from the hull the reverse procedure should be adopted, but it is very important to remember that the front outrigger tube must be the last to be disconnected, otherwise undue torsional stresses will be placed on the rear fittings.

TAIL TROLLEY.

FIG. 31.

The tail trolley is made of wood in its main body and is mounted on two swivelling solid rubber tyred wheels steered by a long wooden handle.

Due to its innate bouyancy it floats high in the water and is manœuvred into position under the keel by hand pressure.

ATTACHMENT OF TAIL TROLLEY.

FIG. 31.

The tail trolley having been forced into position by hand is attached to the hull as follows:-

i. Enter the adjustable stub fittings into their receiving eyes on the hull, and secure the trolley to the planing bottom by the hand screws "Q" Fig. 31 located on each side.

ii. Insert the ring bolt "P" Fig. 31 and to it lash the steering arm.

WHEEL CHOCKS.

Under no circumstances are chocks to be placed under the beaching chassis wheels when running up engines. For this purpose the slip release hook at the rear of hull must be used.

CAUTION. Make sure that the slip release hook is LOCKED before running up engines, see Fig. 44 slip release hook.

MARINE EQUIPMENT.

DROGUES.

Two complete drogues are supplied with the aircraft which may be used either singly or in tandem.

DROGUE STOWAGE.

The following is the order in which the drogues should be stowed:-

i. Feed the trip line into the bottom of the drogue container; the end of this line is always attached to the cleat inside the hull.

ii. Place the drogue folded into the container and feed the pennant line down into the box with the spring hook fixed to the edge of the container.

SINGLE DROGUE.

FIG. 41.

The following sequence of operations should be observed when throwing out a single drogue.

i. Wind out the drogue swivel using the wheel attached to the cleat to which the trip line is attached.

ii. After attaching the spring hook on the pennant line to the drogue swivel, pay out down the outside of the hull.

iii. Remove the drogue from the container and open out, then drop it into the water when it will drop away aft automatically paying out the trip line.

TANDEM DROGUES.

FIG. 41.

To operate the drogues in tandem the following is the sequence of operations.

i. Wind out the drogue swivel using the wheel attached to the cleat to which the trip line is attached.

ii. Attach the spring hook on the pennant line of the starboard drogue to the drogue swivel and pay out the pennant line down the outside of the hull, placing the starboard drogue fully opened on to the top of the hull.

iii. Remove the trip line attached to the starboard drogue by unclasping the spring hook and stow the line as this will not be needed.

iv. Remove the pennant line attached to the port drogue in the same manner and stow, as this will also not be required.

v. Attach the forward end of the port drogue to the aft end of the starboard drogue by the spring hook on the former.

vi. Drop the fully opened port drogue into the water first, letting the starboard one follow.

MOORING BOLLARD.

A patent retractable mooring bollard is fitted into the nose of the hull which is quite simply operated as follows:-

A. To place in position for mooring.

i. Grip both handles inside the hull and push inwards to release the catch.

ii. Still holding both handles, thrust outwards and release grip, when the handles will spring back and lock the bollard.

B. To retract, the operations are reversed.

SLIP RELEASE HOOK.

At the aft end of the hull a special slip release hook has been incorporated which enables the pilot to run the engines up on the buoy and to cast off without external assistance, thereby obtaining a much shorter take-off run.

A lever in the roof of the control cabin must be pulled down to release the aircraft from the buoy, whilst to return the lever to its position a spring is attached at the aft end of the cable run.

SAFETY SCREW.

Owing to the fact that the aircraft is pulled up the slipway by this hook it has been necessary to provide some means of locking it to prevent the lever in the control cabin being operated while in this position.

This has been provided for by a knurled screw from which hangs a red pennant so that it is clearly visible hanging from the hook. When not required this screw is stowed forward.

REPAIR SECTION.

EXAMINATION OF DAMAGE.

The main point to aim at when carrying out a repair is to restore the damaged portion as nearly as possible to its original shape and strength, and in the case of floats and hulls to make them water-tight.

A careful examination of the structure must be made over a large area in the vicinity of the damage. In the case of plane tip floats this will entail the opening of inspection covers.

TESTS FOR WATER-TIGHTNESS.

The method usually adopted to discover whether or not the structure is water-tight is to force a small jet of water on to all seams and laps that are to be tested from the inside, whilst watching for leaks on the outside.

An alternative test, but one which requires that the structure should be properly supported owing to the weight added, is to fill the compartment to be tested with water and watch for leaks as before. This test is only recommended in the case of the plane tip float, which must, on no account, be moved whilst in the loaded state.

Where conditions permit, the hull can be tested by floating it and loading it down if necessary, watching for leaks inside.

Any rivets found leaking should be removed and replaced and the test repeated. Should it be found that the seam is leaking along the whole or greater part of its length, it indicates very surely that the plate was not closed down properly and will necessitate the removal of all the rivets along that seam, a fresh quantity of jointing compound inserted and re-riveting. No amount of tightening up on the old rivets will improve a bad seam, but will be more likely to increase the leakage.

CARE OF ANODIC FILM. As it is practically impossible to apply the anodic treatment a second time with any degree of a satisfactory result, it is most important to preserve, with as little damage as possible, the film deposited by the process. This film is so thin that corrosion will quickly start in any scratches or abrasions that have removed it.

MARKING. An indelible pencil is the only instrument that should be used to mark on light alloys after they have been anodically treated, and it must be remembered that it is impossible to remove the dye from the anodic film so care should be taken to ensure that the marks are correct.

Under no circumstances must a scriber be used for the reasons explained in the previous paragraph.

ANNEALING AND NORMALISING. The longest time allowed for working light alloys between the process of normalising is one hour, and under no circumstances should this be exceeded. After this period of time these metals age-harden, and if they are worked in the hard state internal stresses are set up which eventually crack the material and lead to corrosion and failure.

A method of determining whether the metal is hardening or not is to strike it, when, if it is hardening, it will ring like steel.

If the material is to be worked for more than two hours, it should be annealed which renders it permanently soft, and on the completion of the work, heat-treated to restore it to its normal state.

TREATMENT OF SURFACES WHEN ASSEMBLING. All faying surfaces, i.e., surfaces in contact, must be given a coating of jointing compound. This not only resists corrosion, but ensures a good water-tight joint. Likewise when replacing steel fittings, stainless or otherwise, the same procedure should be adopted to reduce the possibility of corrosion.

Where, owing to the difficult nature of the job, bad joints are made, such as on a step repair, with the consequent danger of leakage, the surfaces in contact should be liberally smeared with a composition known as "Dombo" before riveting. This consists of Rylard's undercoating and whitening, mixed into a putty.

PAINTING. Where the original surface of the repaired part was coated with paint, treat again with the same paint after the repair and water test, if any. Make sure before so doing, especially after the water test, to thoroughly remove any moisture that may be left on the surface.

In order to ensure that the paint will find its way to all joints, it should be sprayed on, always remembering that if this is done indiscriminately it will defeat its own object, the tendency being to block up all drain holes, thus preventing the draining of any water that may accumulate inside. Apropos the foregoing, paint must never be applied on the top of the old paint, as successive coats form a hard crust under which corrosion takes place unobserved. As the main object in applying paint is to prevent moisture and air touching the surface of the metal, only the thinnest coat of paint is necessary. Paint containing lead must never be used on light alloys. When replacing inspection covers, see that all screws etc., are well greased before being inserted.

REMOVING PAINT. Owing to the presence of the anodic film (see "Care of Anodic Film" page 62) abrasives are never to be used for removing paint. Clean round the damaged parts with a suitable solvent.

CLEANING AFTER REPAIR. After a repair has been effected it is most important that all chips, filings, etc., should be removed from any enclosed part such as the hull or nacelle or inside any bracket, as, if they are left, corrosion sets up and will damage the parts on which they lay. All cleaning etc., should obviously be carried out before painting.

TEMPORARY BOLTS. When holding patches temporarily in place by means of bolts prior to riveting up, washers must always be placed under the nuts to prevent damage being done to the anodic film by the nut being turned.

REMOVING RIVETS.

The heads of all solid rivets should never be chiselled or filed off. The correct method is to make a centre pop mark in the centre of the head and drill it off by using a drill approximately twice the diameter of the rivet. Only drill sufficiently deep to remove the head, or the hole may get damaged. Where possible the original head should be removed, as this is more likely to be symmetrical than the head formed in position. If any difficulty is experienced in removing a rivet, do not use excessive force but drill it out with a drill the same diameter as the rivet. For further details see Fig. 37.

SPACING OF RIVETS. (METHOD OF).

The size and spacing of rivets can best be settled by adopting those found in similar parts of the structure. Thus a new piece of shell plating would be riveted in a similar manner to the plate removed, or a patch would be riveted round the edges with rivets of a similar size and pitch to those used at the laps and seams of the plates being patched. Where it is impossible or difficult to obtain this information, Fig. No. 36 will cover all the requirements needed on this aircraft.

SPACING OF RIVETS. (IMPORTANCE OF REGULARITY).

To ensure that each rivet takes an equal amount of strain, particular care should be taken to see that rivet holes are spaced and drilled regularly and equally. This is most essential in the case of water-tight riveting.

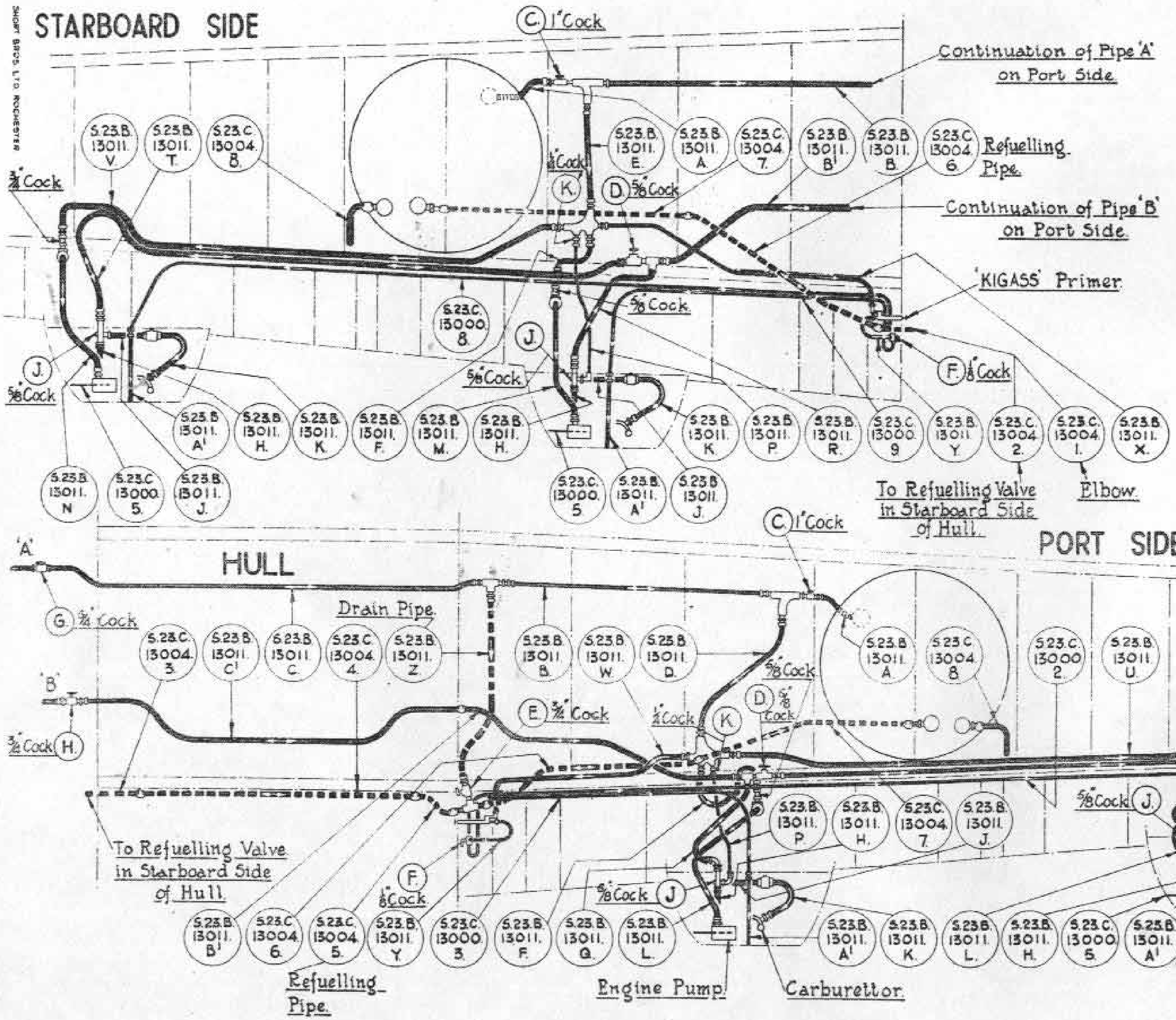
UNFAIR HOLES. If a hole is munfair from any reason whatsoever, whether it has been badly drilled or has been damaged during the removal of a rivet, it must never be drifted, but re-drilled or reamered $\frac{1}{32}$" larger in diameter.

RIVET HOLES. Owing to the damage caused to the metal round a punched hole by the use of punches this method of making rivet holes is prohibited, and all holes must be drilled.

ANODIC TREATMENT AND NORMALISING FOR RIVETS. Light alloy rivets are always anodically treated before normalising, the reverse procedure it will be noticed to that for light alloy plates and fittings. The reason for this reversal of processes is due to the fact that while the anodic treatment can be the last operation performed on a fitting or plate before assembly, it obviously cannot be done to a rivet when it is in place. Normalising has no deleterious effect on the anodic film and can be done several times without harm to the rivets. All rivets should be used within one hour of normalising and it cannot be too strongly stressed that this time limit is vitally important. The light alloy rivets used in this aircraft are so small and the metal so naturally soft that it takes but a very little extra strength to knock down a "hard" rivet. The effect of this is that instead of having a head moulded when the metal is ductile and still retaining its full natural strength it has become crystallised by the hammering and will snap off at the slightest pressure.

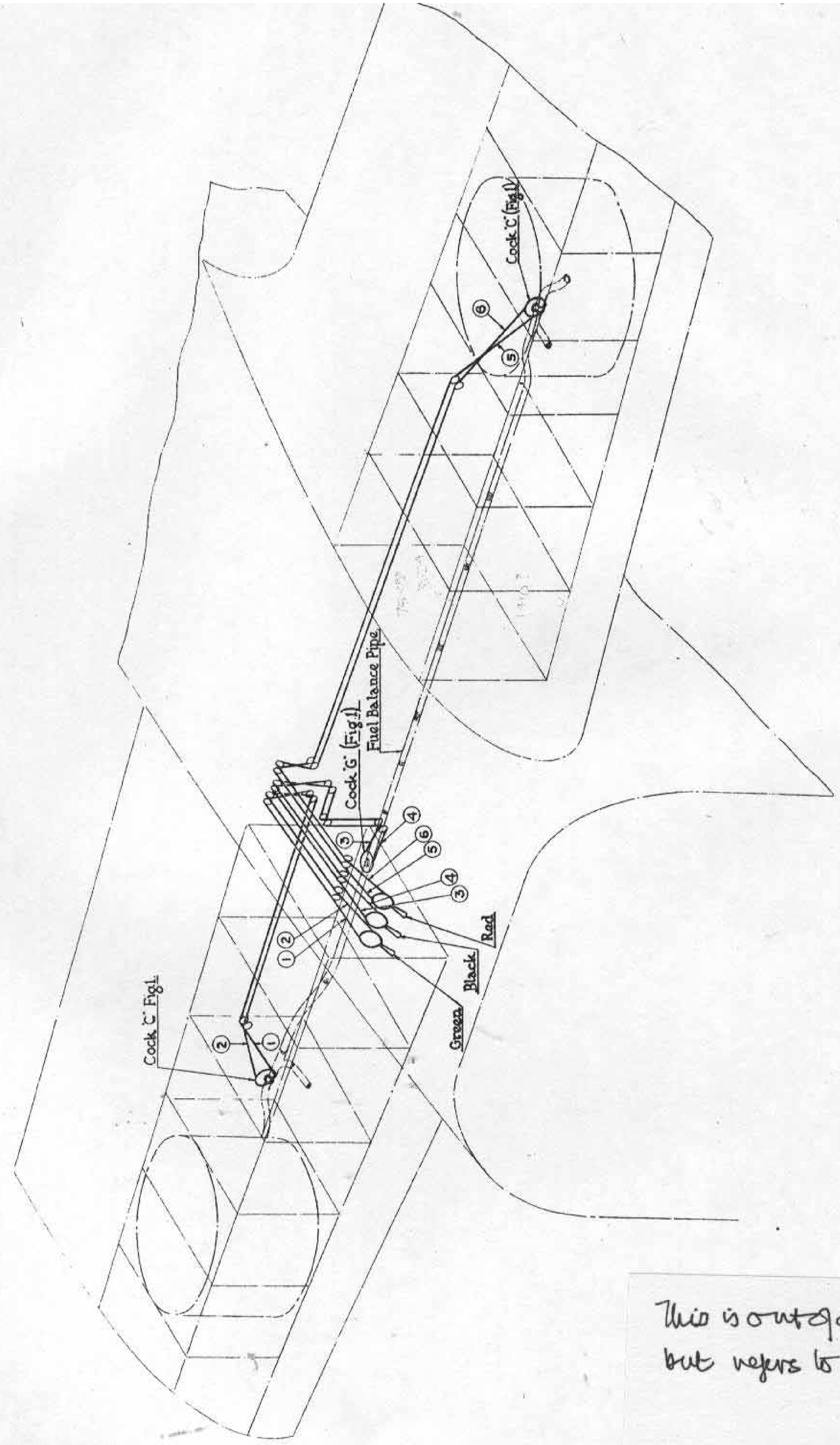
<u>ORDER OF RIVETING.</u>

Trouble is often experienced by rivet holes not "picking up" even although they have been drilled together. This is nearly always caused by the wrong order of inserting the rivets. If rivets are put in consecutively and riveted over a stretching action takes place in the metal with the consequent result that at the end of the row the holes do not match. The correct procedure is to insert rivets at wide intervals until the whole length of the row is secured and then to gradually reduce these intervals until the whole row is finished, remembering not to complete one section of the row on its own or the consequent stretching of the plate will buckle it.



FUEL COCKS	
Nº	Size
A.255.	1" B.S.P.
A.251.	5/8" B.S.P.
A.254.	3/4" B.S.P.
A.271.	1/8" B.S.P.
A.254.	3/4" B.S.P.
A.254.	3/4" B.S.P.
A.251.	5/8" B.S.P.
A.253.	1/4" B.S.P.

DRG. Nº	DESCRIPTION.		LENGTH.
S.23.B.13011/A.	Superflexit.	1" bore.	2'-3"
S.23.B.13011/B.	Superflexit.	3/4" bore.	7'-3"
S.23.B.13011/C.	Superflexit	3/4" bore	12'-3"
S.23.B.13011/D.	Superflexit	1" bore	4'-6"
S.23.B.13011/E.	Superflexit	1" bore	4'-3"
S.23.B.13011/F.	Superflexit	5/8" bore	1'-6"
S.23.B.13011/H	Superflexit	5/8" bore.	1'-3"
S.23.B.13011/J	Superflexit	5/8" bore	7½"
S.23.B.13011/K	Superflexit	5/8" bore	2'-0"
S.23.B.13011/L.	Superflexit	5/8" bore	5'-8"
S.23.B.13011/M.	Superflexit	5/8" bore	6'-3"
S.23.B.13011/N.	Superflexit	5/8" bore.	5'-3"
S.23.B.13011/P.	Superflexit	1/4" bore	3'-9"
S.23.B.13011/Q	Superflexit	5/8" bore	3'-6"
S.23.B.13011/R	Superflexit	5/8" bore	4'-6"
S.23.B.13011/S.	Superflexit	5/8" bore	15'-3"
S.23.B.13011/T	Superflexit	5/8" bore	17'-0"
S.23.B.13011/U	Superflexit	3/4" bore	14'-6"
S.23.B.13011/V.	Superflexit	3/4" bore	13'-3"
S.23.B.13011/W.	Superflexit	1/4" bore	7'-3"
S.23.B.13011/X.	Superflexit	1/4" bore	9'-3"
S.23.B.13011/Y	Superflexit	5/32" bore	1'-6"
S.23.B.13011/Z.	Superflexit	3/4" bore	6'-0"
S.23.B.13011/A'	Superflexit	5/32" bore	2'-9"
S.23.B.13011/B'	Superflexit	3/4" bore	8'-0"
S.23.B.13011/C'	Superflexit	3/4" bore	11'-0"
S.23.C.13004/1.	Tube. Dural.	1¼" % x 20G.	1'-3"
S.23.C.13004/2	Tube. Dural.	1¼" % x 20G.	2'-6"
S.23.C.13004/3	Tube. Dural.	1¼" % x 20G.	2'-4"
S.23.C.13004/4	Tube. Dural	1¼" % x 20G	7'-6"
S.23.C.13004/5	Tube. Dural.	1¼" % x 20G	2'-4"
S.23.C.13004/6	Tube. Dural	1¼" % x 20G	6'-6"
S.23.C.13004/7	Tube. Dural	1¼" % x 20G	6'-3"
S.23.C.13004/8	Tube. Alumⁿ	1¼" % x 20G	5'-0"
S.23.C.13000/2	Tube. Copper.	1/8" % x 22G.	25'-0"
S.23.C.13000/3	Tube. Copper.	1/8" % x 22G.	13'-6"
S.23.C.13000/5	Tube. Copper.	3/16" % x 22G.	2'-0"
S.23.C.13000/8	Tube. Copper.	1/8" % x 22G.	30'-0"
S.23.C.13000/9	Tube. Copper.	1/8" % x 22G.	16'-0"



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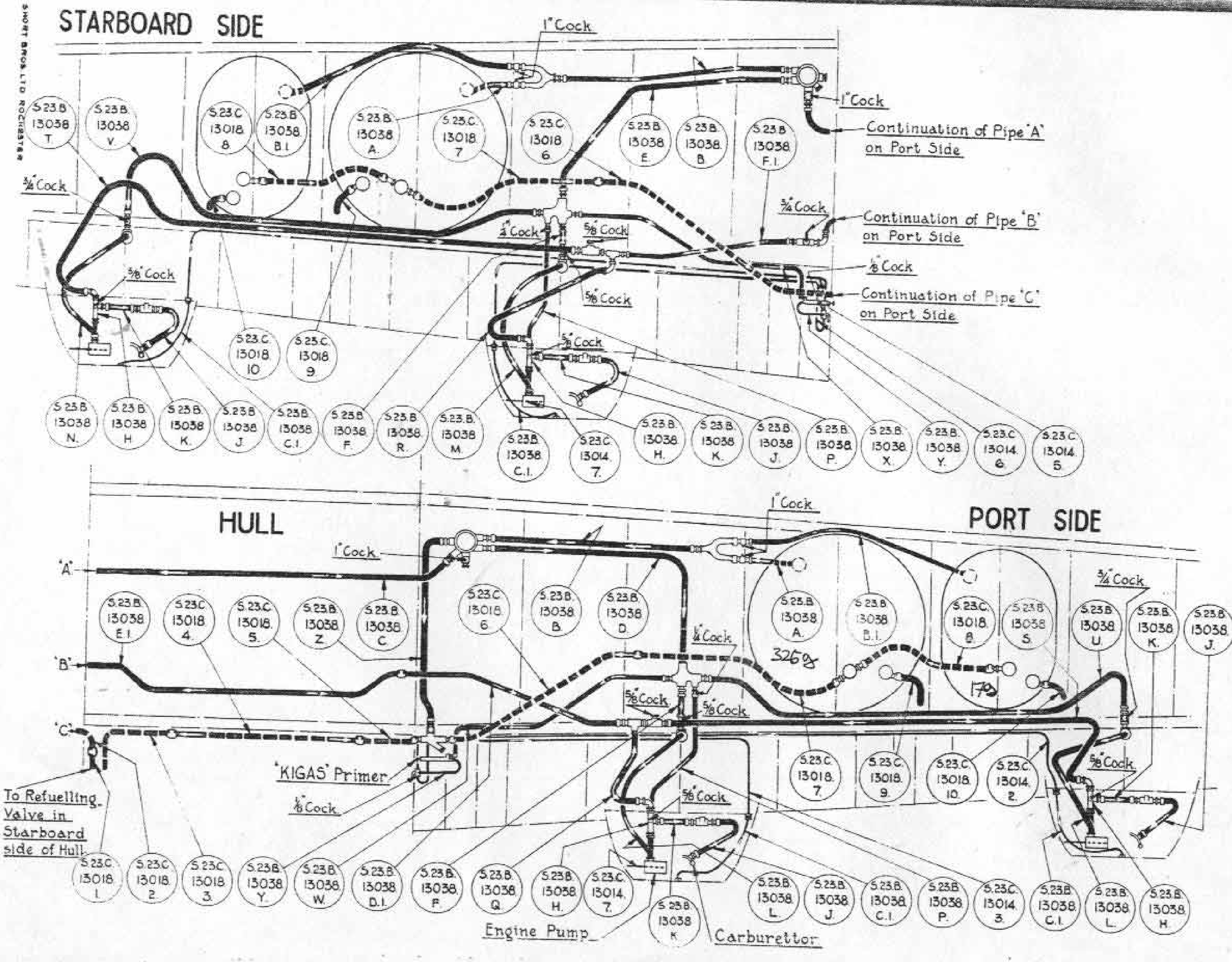
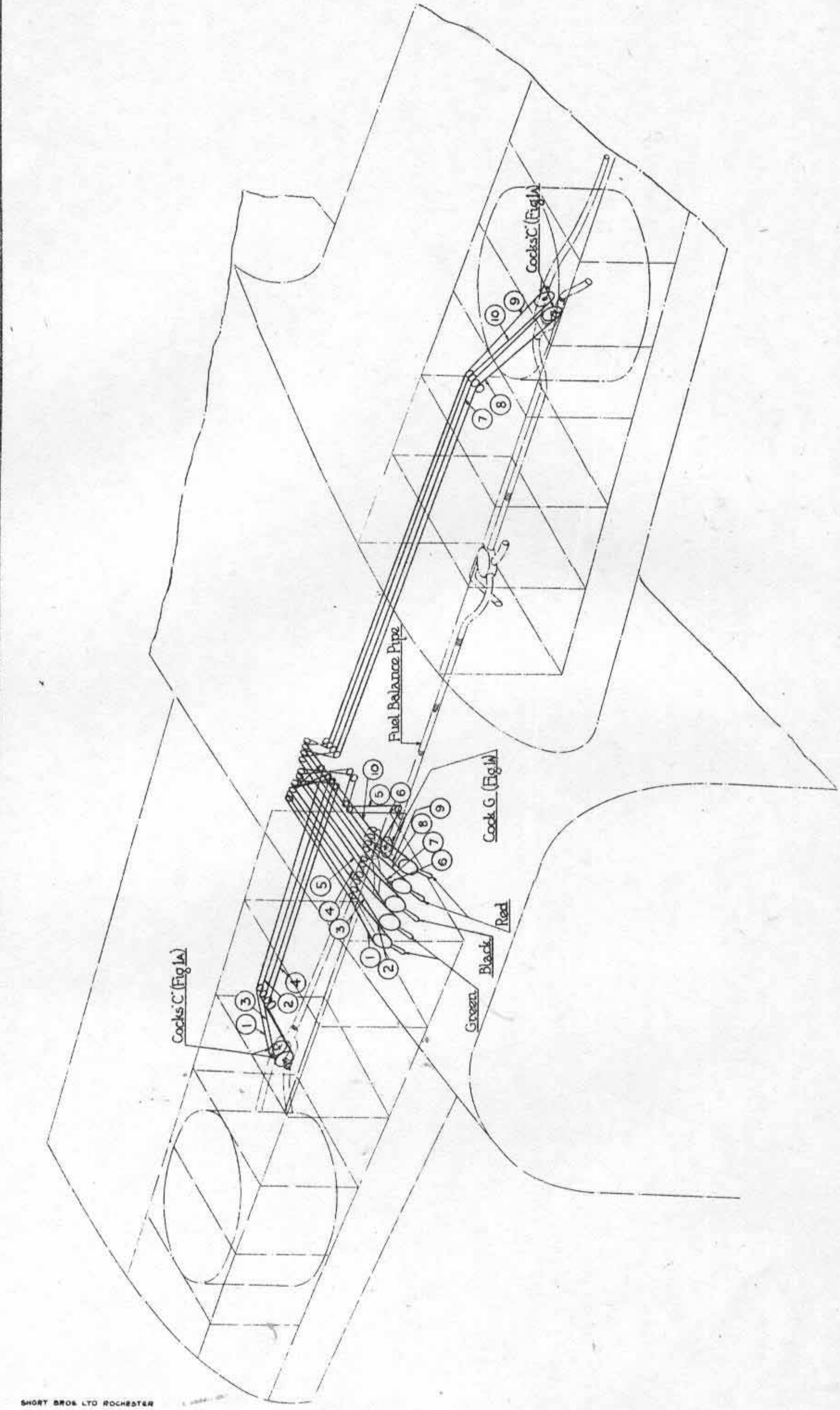
SHORT BROS LTD. ROCHESTER

TANK COCK CONTROLS

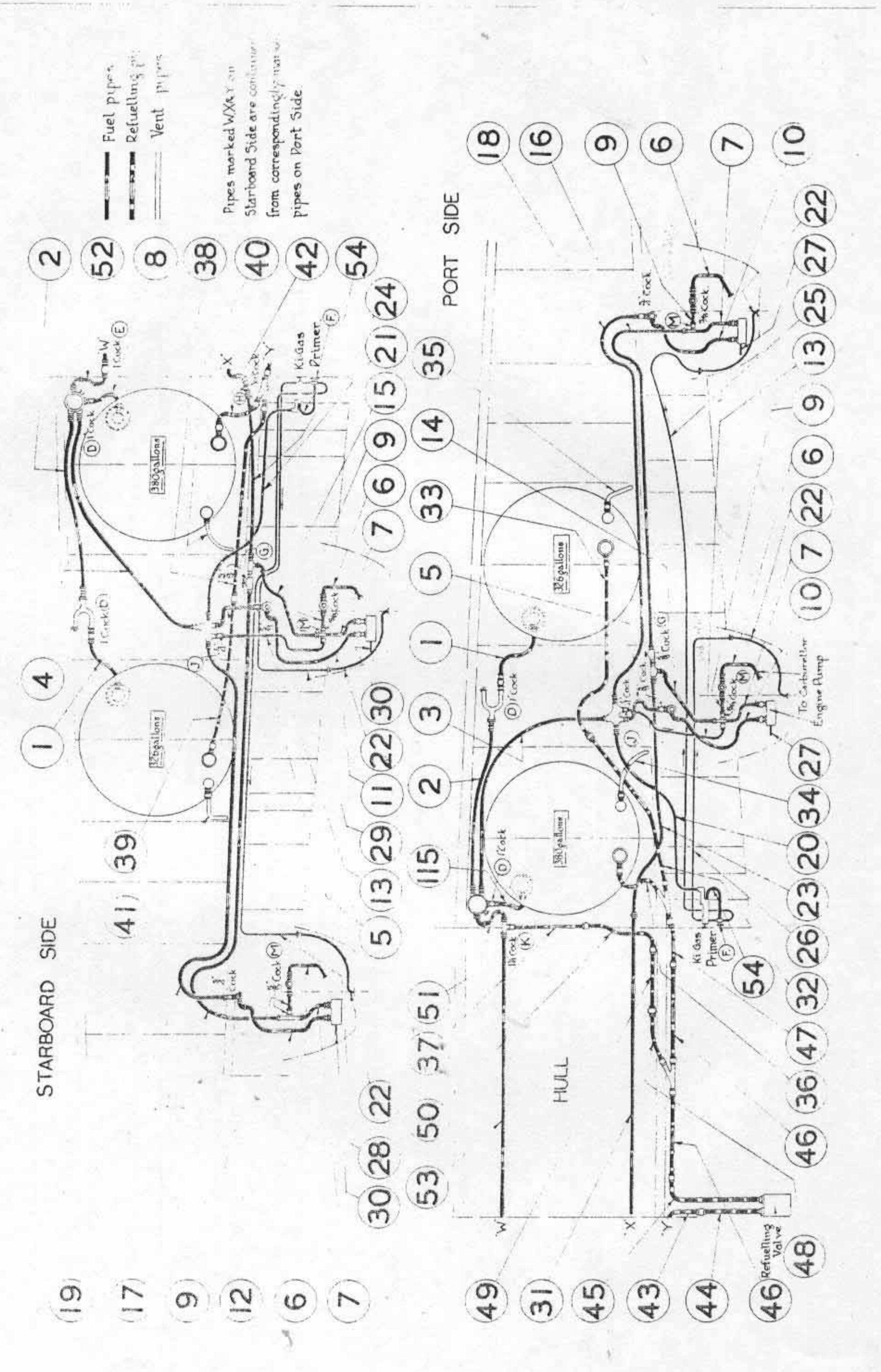


DRAWING Nº	DESCRIPTION		LENGT
5.23.B. 13038/A	Superflexit	1" bore	2'-3
5.23.B. 13038/B	Superflexit	1" bore	6'-4
5.23.B. 13038/C	Superflexit	3/4" bore	13'-0
5.23.B. 13038/D	Superflexit	1" bore	10'-0
5.23.B. 13038/E	Superflexit	1" bore	10'-6
5.23.B. 13038/F	Superflexit	5/8" bore	1'-6
5.23.B. 13038/H	Superflexit	5/8" bore	1'-6
5.23.B. 13038/J	Superflexit	5/8" bore	2'-0
5.23.B. 13038/K	Superflexit	5/8" bore	7
5.23.B. 13038/L	Superflexit	5/8" bore	5'-8
5.23.B. 13038/M	Superflexit	5/8" bore	6'-3
5.23.B. 13038/N	Superflexit	5/8" bore	5'-3
5.23.B. 13038/P	Superflexit	1/4" bore	3'-9
5.23.B. 13038/Q	Superflexit	5/8" bore	3'-6
5.23.B. 13038/R	Superflexit	5/8" bore	4'-6
5.23.B. 13038/S	Superflexit	5/8" bore	15'-3"
5.23.B. 13038/T	Superflexit	5/8" bore	17'-0"
5.23.B. 13038/U	Superflexit	5/8" bore	14'-6"
5.23.B. 13038/V	Superflexit	3/4" bore	13'-3"
5.23.B. 13038/W	Superflexit	1/4" bore	7'-3"
5.23.B. 13038/X	Superflexit	1/4" bore	9'-3"
5.23.B. 13038/Y	Superflexit	5/32" bore	1'-6"
5.23.B. 13038/Z	Superflexit	3/4" bore	7'-3"
5.23.B. 13038/B1	Superflexit	1" bore	8'-0"
5.23.B. 13038/C1	Superflexit	5/32" bore	4'-0"
5.23.B. 13038/D1	Superflexit	3/4" bore	9'-6"
5.23.B. 13038/E1	Superflexit	3/4" bore	13'-0"
5.23.B. 13038/F1	Superflexit	3/4" bore	7'-6"
5.23.C. 13018/1	Tube Dural 1¼" o/d X 20G		1'-3"
5.23.C. 13018/2	Tube Dural 1¼" o/d X 20G		1'-9"
5.23.C. 13018/3	Tube Dural 1¼" o/d X 20G		2'-4"
5.23.C. 13018/4	Tube Dural 1¼" o/d X 20G		7'-6"
5.23.C. 13018/5	Tube Dural 1¼" o/d X 20G		2'-6"
5.23.C. 13018/6	Tube Dural 1¼" o/d X 20G		6'-3"
5.23.C. 13018/7	Tube Dural 1¼" o/d X 20G		6'-3"
5.23.C. 13018/8	Tube Dural 1¼" o/d X 20G		4'-0"
5.23.C. 13018/9	Tube Alumⁿ 1¼" o/d X 20G		4'-0"
5.23.C. 13018/10	Tube Alumⁿ 1¼" o/d X 20G		3'-6"
5.23.C. 13014/2	Tube Copper 1/8" o/d X 22G		25'-0"
5.23.C. 13014/3	Tube Copper 1/8" o/d X 22G		13'-6"
5.23.C. 13014/5	Tube Copper 1/8" o/d X 22G		30'-0"
5.23.C. 13014/6	Tube Copper 1/8" o/d X 22G		16'-0"
5.23.C. 13014/7	Tube Copper 3/16" o/d X 22G		2'-0"

FUEL SYSTEM

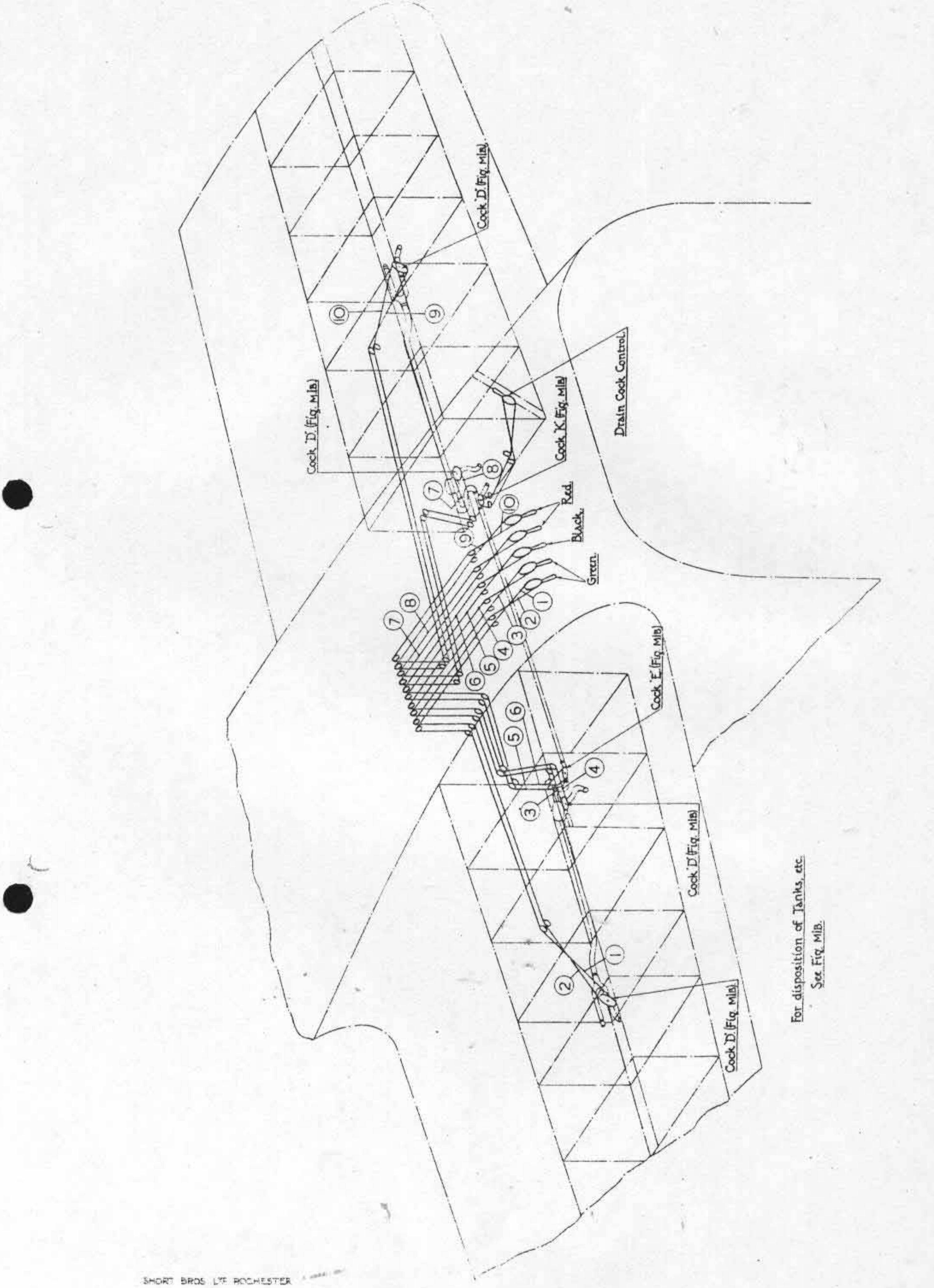


TANK COCK CONTROLS



FOR IDENTIFICATION OF PIPES SEE KEY SCHEDULE FOLLOWING FIG. M.1D

FUEL SYSTEM



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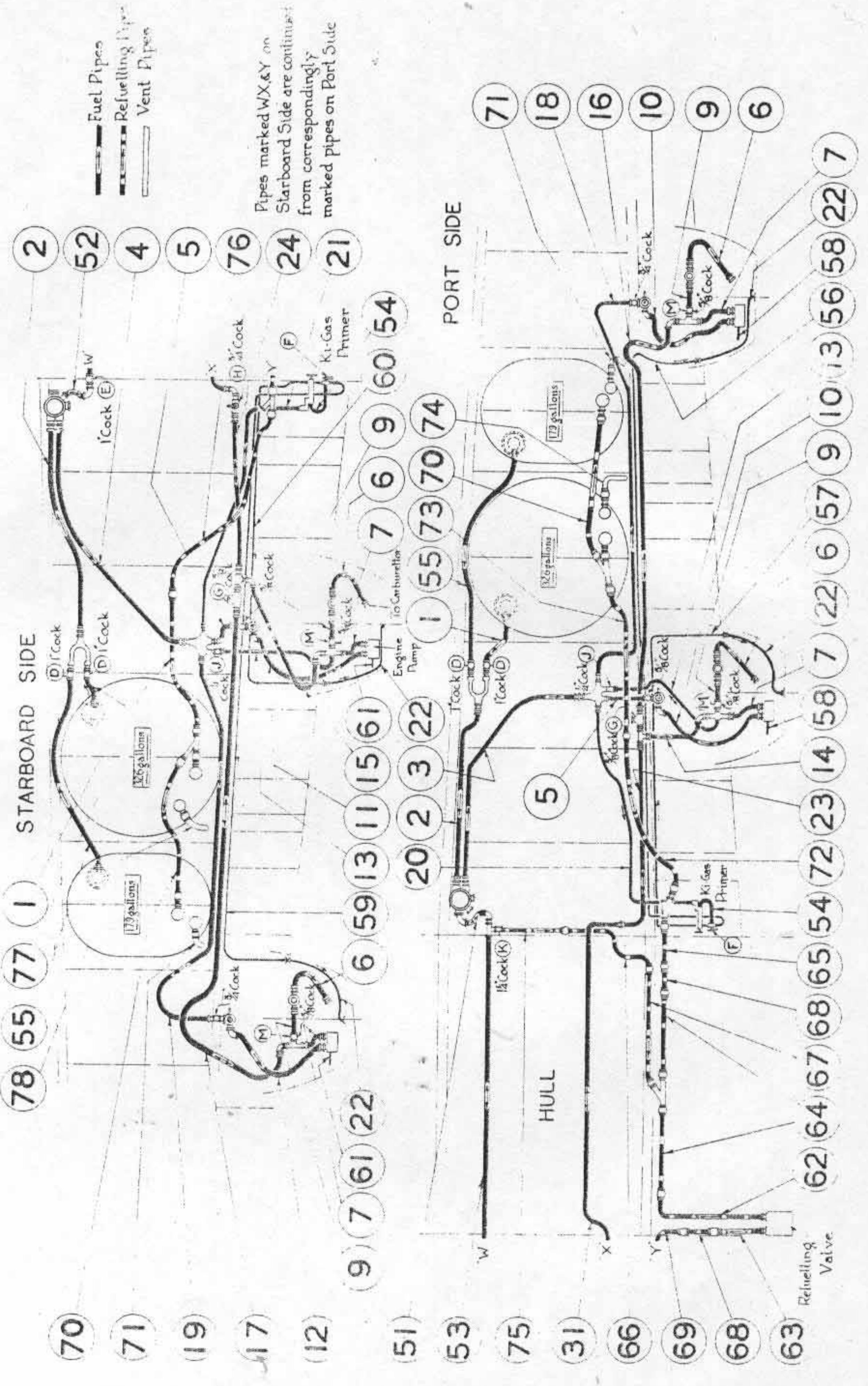
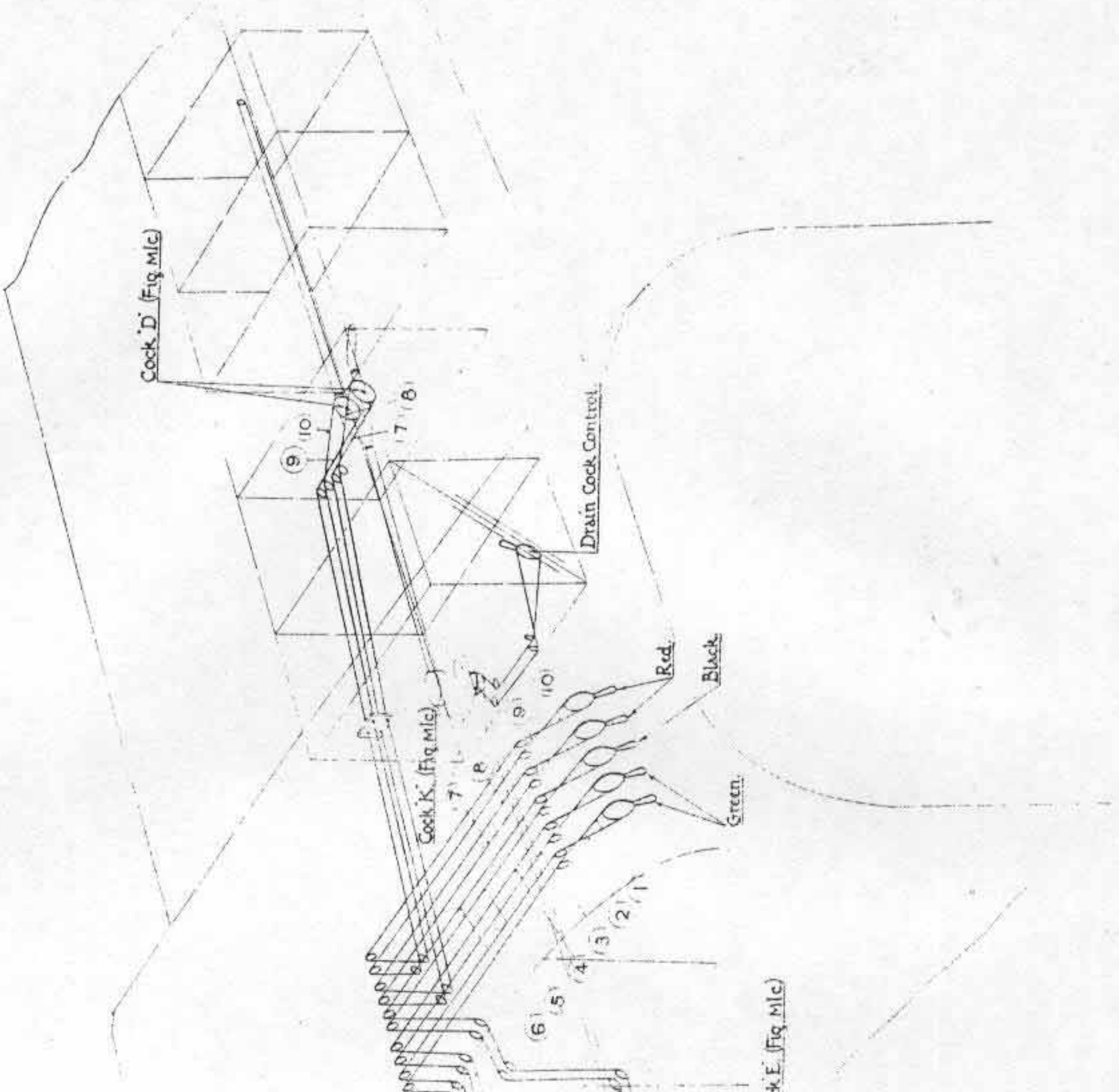
TANK COCK CONTROLS

M1C



FOR IDENTIFICATION OF PIPES SEE KEY SCHEDULE FOLLOWING FIG M.I.D

FUEL SYSTEM



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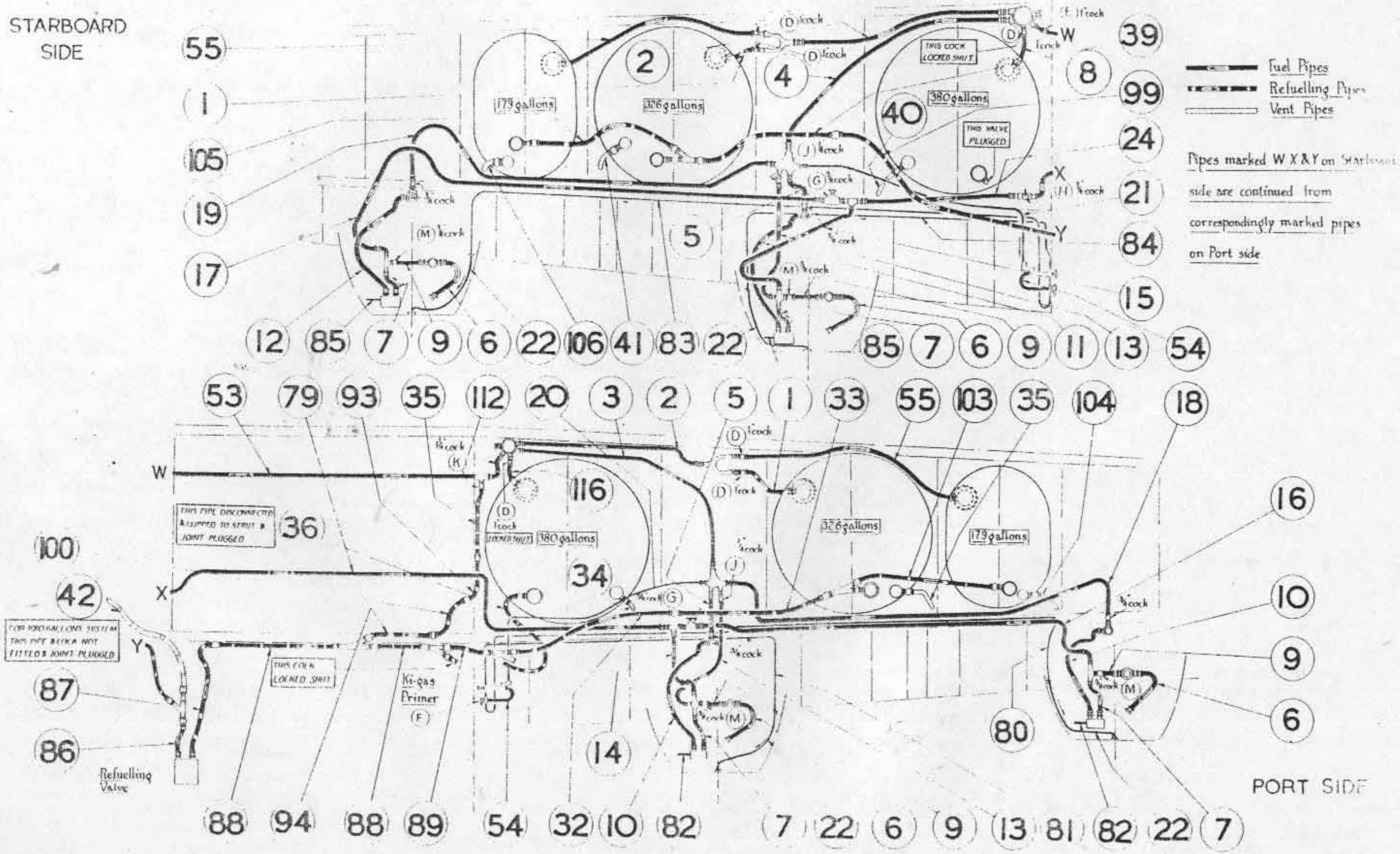
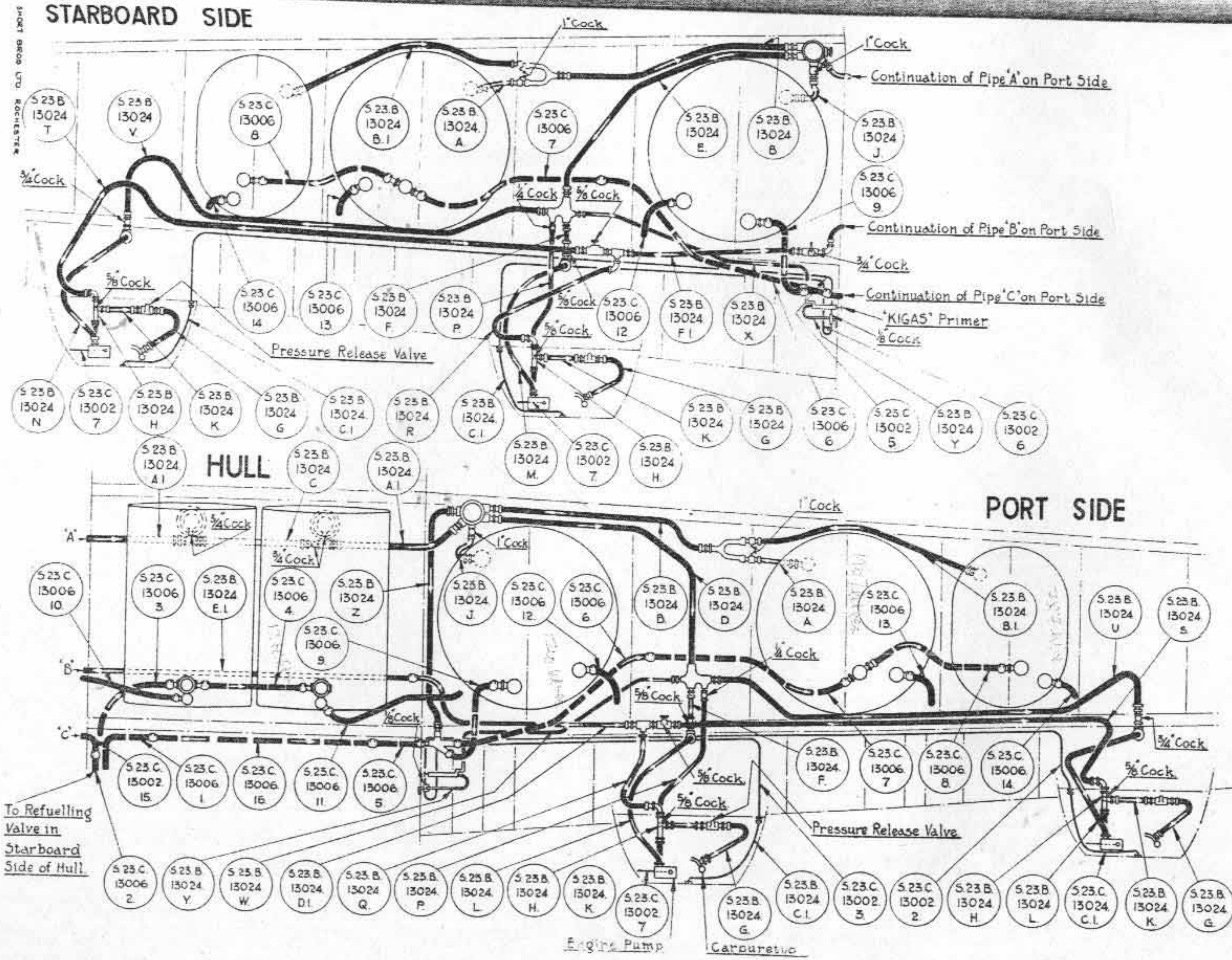
TANK COCK CONTROLS



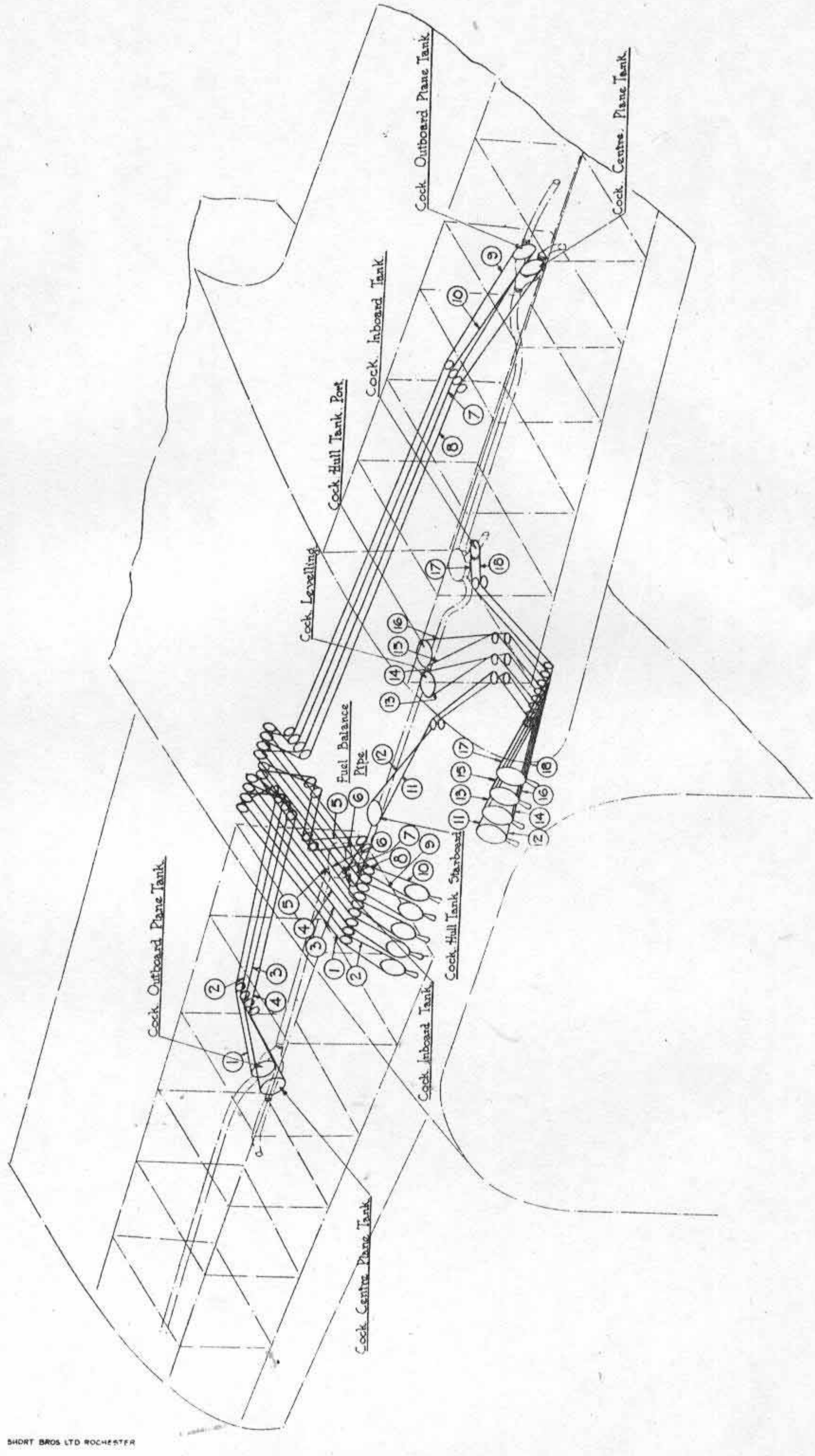
FOR IDENTIFICATION OF PIPES SEE KEY SCHEDULE FOLLOWING THIS FIG

FUEL SYSTEM

FUEL SYSTEM

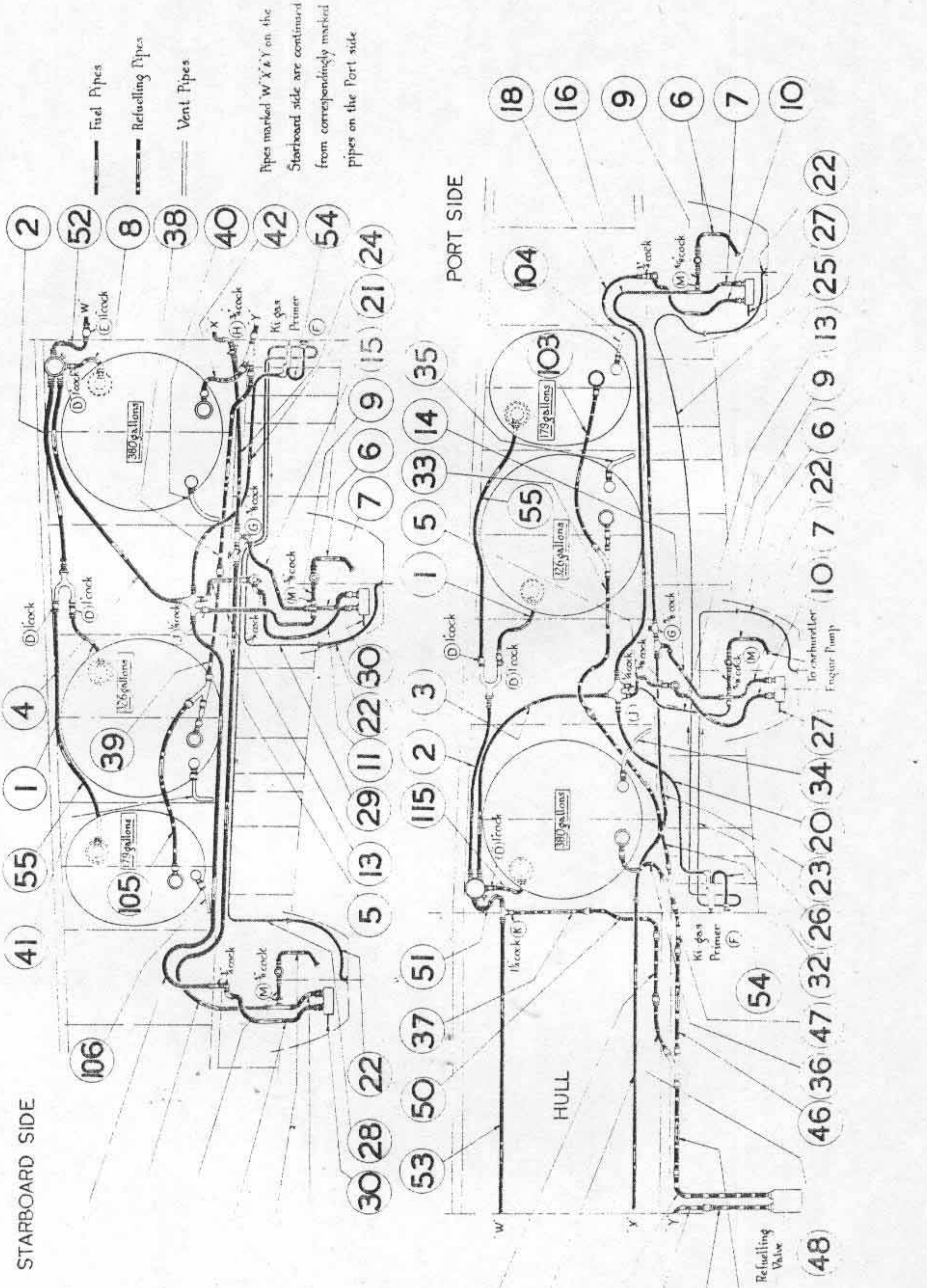


DRAWING Nº	DESCRIPTION		LENGTH
S.23.B.13024/A	Superflexit	1" bore	2' - 3"
S.23.B.13024/B	Superflexit	1" bore	6' - 4"
S.23.B.13024/C	Superflexit	¾" bore	3' - 9"
S.23.B.13024/D	Superflexit	1" bore	10' - 0"
S.23.B.13024/E	Superflexit	1" bore	10' - 6"
S.23.B.13024/F	Superflexit	⅝" bore	1' - 6"
S.23.B.13024/G	Superflexit	⅝" bore	2' - 0"
S.23.B.13024/H	Superflexit	⅝" bore	1' - 3"
S.23.B.13024/J	Superflexit	1" bore	1' - 3"
S.23.B.13024/K	Superflexit	⅝" bore	7½"
S.23.B.13024/L	Superflexit	⅝" bore	5' - 8"
S.23.B.13024/M	Superflexit	⅝" bore	6' - 3"
S.23.B.13024/N	Superflexit	⅝" bore	5' - 3"
S.23.B.13024/P	Superflexit	¼" bore	3' - 9"
S.23.B.13024/Q	Superflexit	⅝" bore	3' - 6"
S.23.B.13024/R	Superflexit	⅝" bore	4' - 6"
S.23.B.13024/S	Superflexit	⅝" bore	15' - 3"
S.23.B.13024/T	Superflexit	⅝" bore	17' - 0"
S.23.B.13024/U	Superflexit	¾" bore	14' - 6"
S.23.B.13024/V	Superflexit	¾" bore	13' - 3"
S.23.B.13024/W	Superflexit	¼" bore	7' - 3"
S.23.B.13024/X	Superflexit	¼" bore	9' - 3"
S.23.B.13024/Y	Superflexit	5/32" bore	1' - 6"
S.23.B.13024/Z	Superflexit	¾" bore	7' - 3"
S.23.B.13024/A1	Superflexit	¾" bore	3' - 10"
S.23.B.13024/B1	Superflexit	1" bore	8' - 0"
S.23.B.13024/C1	Superflexit	5/32" bore	4' - 0"
S.23.B.13024/D1	Superflexit	¾" bore	9' - 6"
S.23.B.13024/E1	Superflexit	¾" bore	10' - 0"
S.23.B.13024/F1	Superflexit	¾" bore	7' - 3"
S.23.C.13006/1	Tube Dural	1¼" %D X 20G	2' - 4"
S.23.C.13006/2	Tube Dural	1¼" %D X 20G	1' - 9"
S.23.C.13006/3	Tube Dural	1¼" %D X 20G	6' - 6"
S.23.C.13006/4	Tube Dural	1¼" %D X 20G	3' - 3"
S.23.C.13006/5	Tube Dural	1¼" %D X 20G	2' - 6"
S.23.C.13006/6	Tube Dural	1¼" %D X 20G	6' - 6"
S.23.C.13006/7	Tube Dural	1¼" %D X 20G	6' - 3"
S.23.C.13006/8	Tube Dural	1¼" %D X 20G	4' - 0"
S.23.C.13006/9	Tube Dural	1¼" %D X 20G	3' - 6"
S.23.C.13006/10	Tube Dural	1¼" %D X 20G	6' - 6"
S.23.C.13006/11	Tube Dural	1¼" %D X 20G	6' - 9"
S.23.C.13006/12	Tube Dural	1¼" %D X 20G	5' - 6"
S.23.C.13006/13	Tube Dural	1¼" %D X 20G	4' - 0"
S.23.C.13006/14	Tube Dural	1¼" %D X 20G	3' - 6"
S.23.C.13006/15	Tube Dural	1¼" %D X 20G	1' - 3"
S.23.C.13006/16	Tube Dural	1¼" %D X 20G	7' - 6"
S.23.C.13002/2	Tube Copper	⅛" %D X 22G	25' - 0"
S.23.C.13002/3	Tube Copper	⅛" %D X 22G	13' - 6"
S.23.C.13002/5	Tube Copper	⅛" %D X 22G	30' - 0"
S.23.C.13002/6	Tube Copper	⅛" %D X 22G	16' - 0"
S.23.C.13002/7	Tube Copper	3/16" %D X 22G	2' - 0"



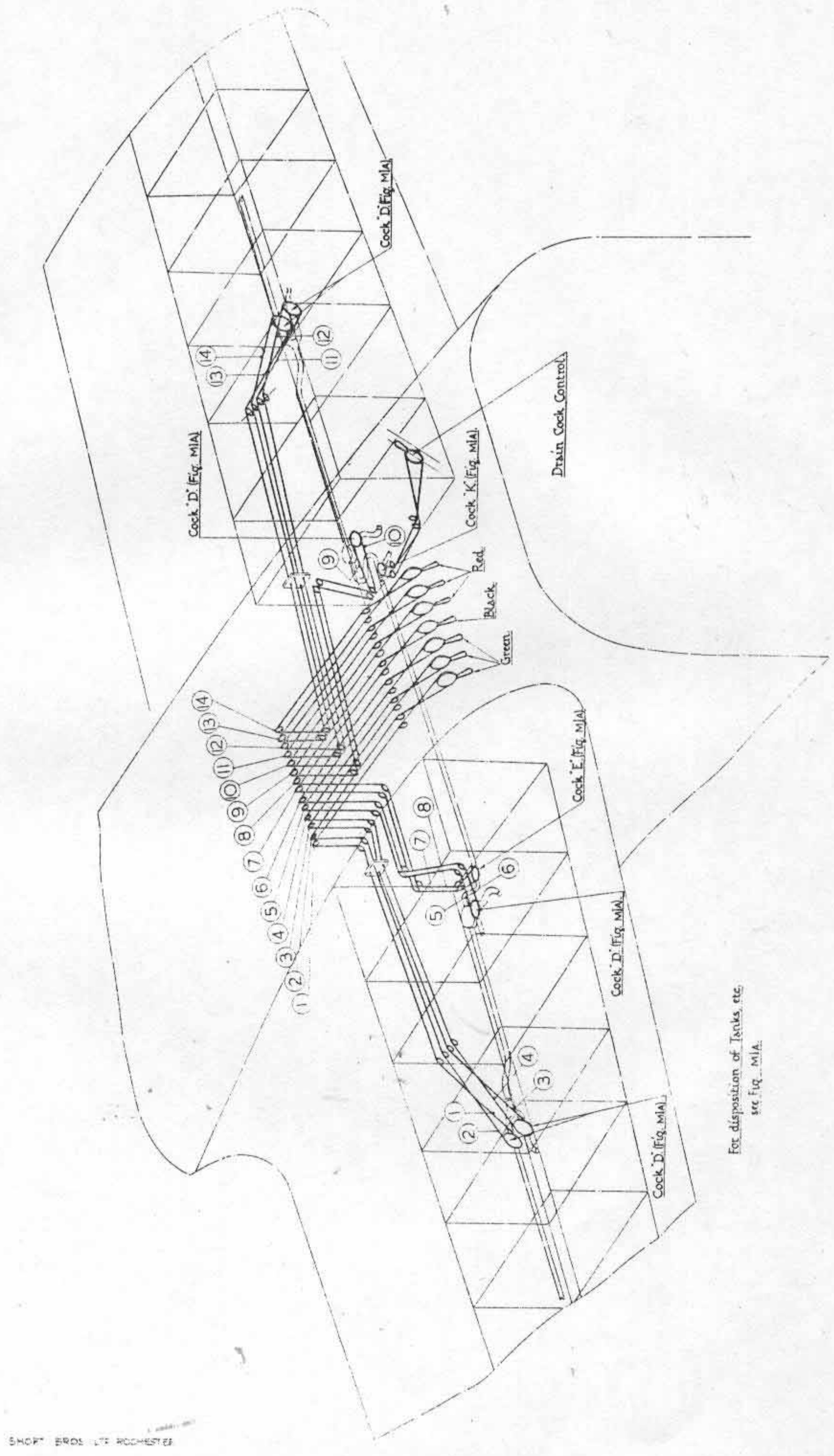
SHORT BROS LTD ROCHESTER

TANK COCK CONTROLS



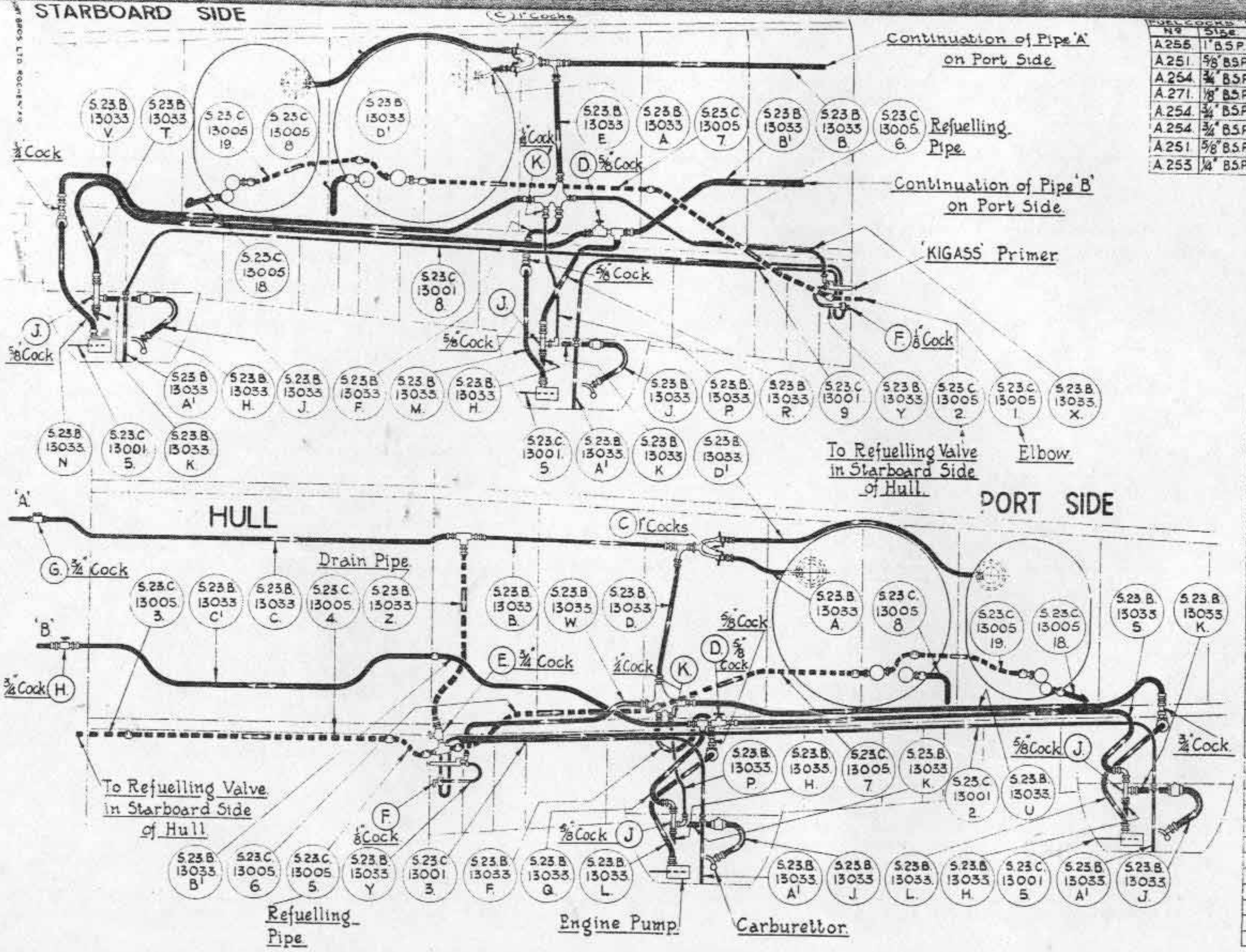
FOR IDENTIFICATION OF PIPES SEE KEY SCHEDULE FOLLOWING FIG M1D

FUEL SYSTEM



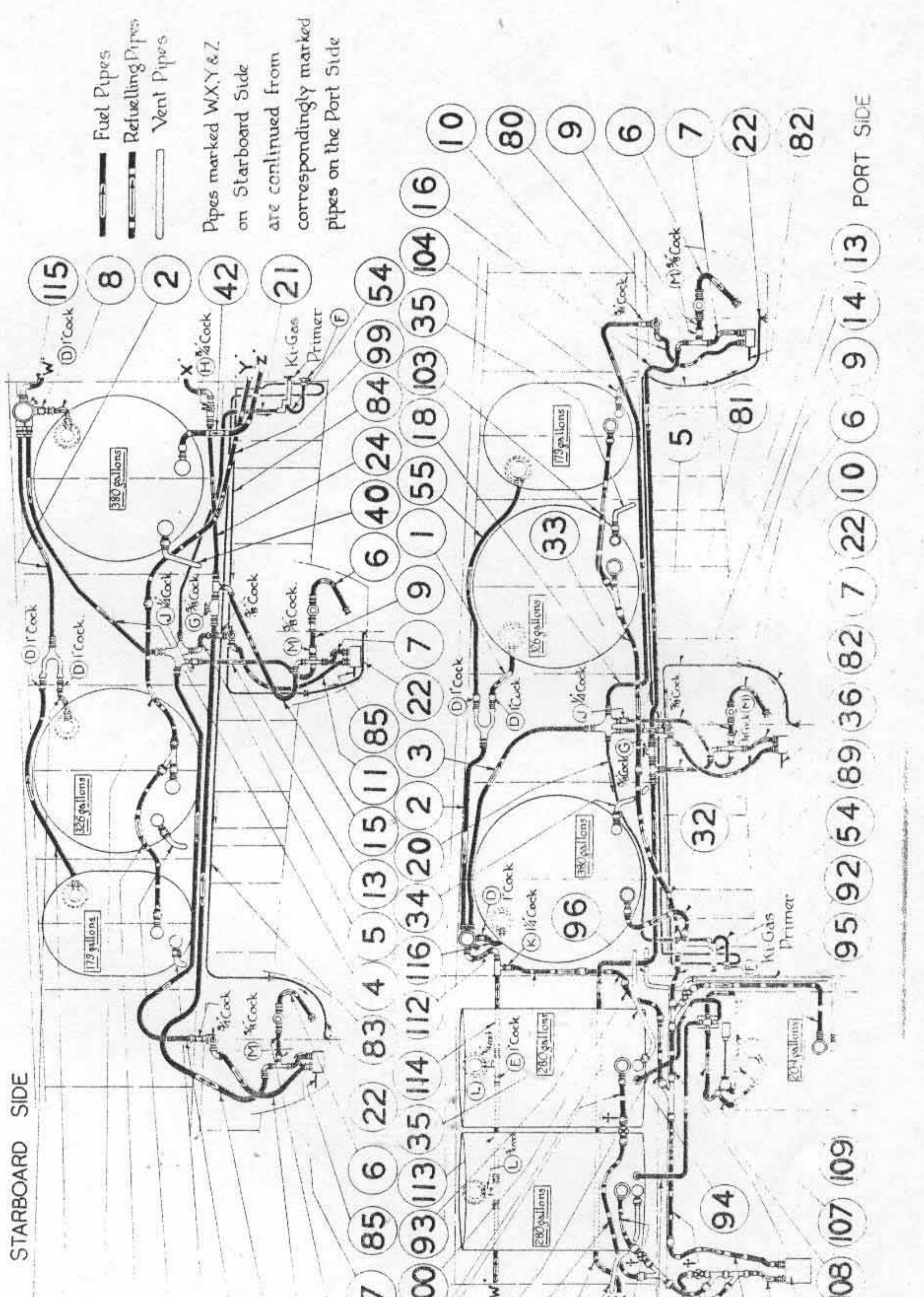
TANK COCK CONTROLS

FUEL SYSTEM



Fuel Cocks Nº	Size
A 255	1" B.S.P.
A 251	5/8" B.S.P.
A 254	3/4" B.S.P.
A 271	1/8" B.S.P.
A 254	3/4" B.S.P.
A 254	3/4" B.S.P.
A 251	5/8" B.S.P.
A 253	1/4" B.S.P.

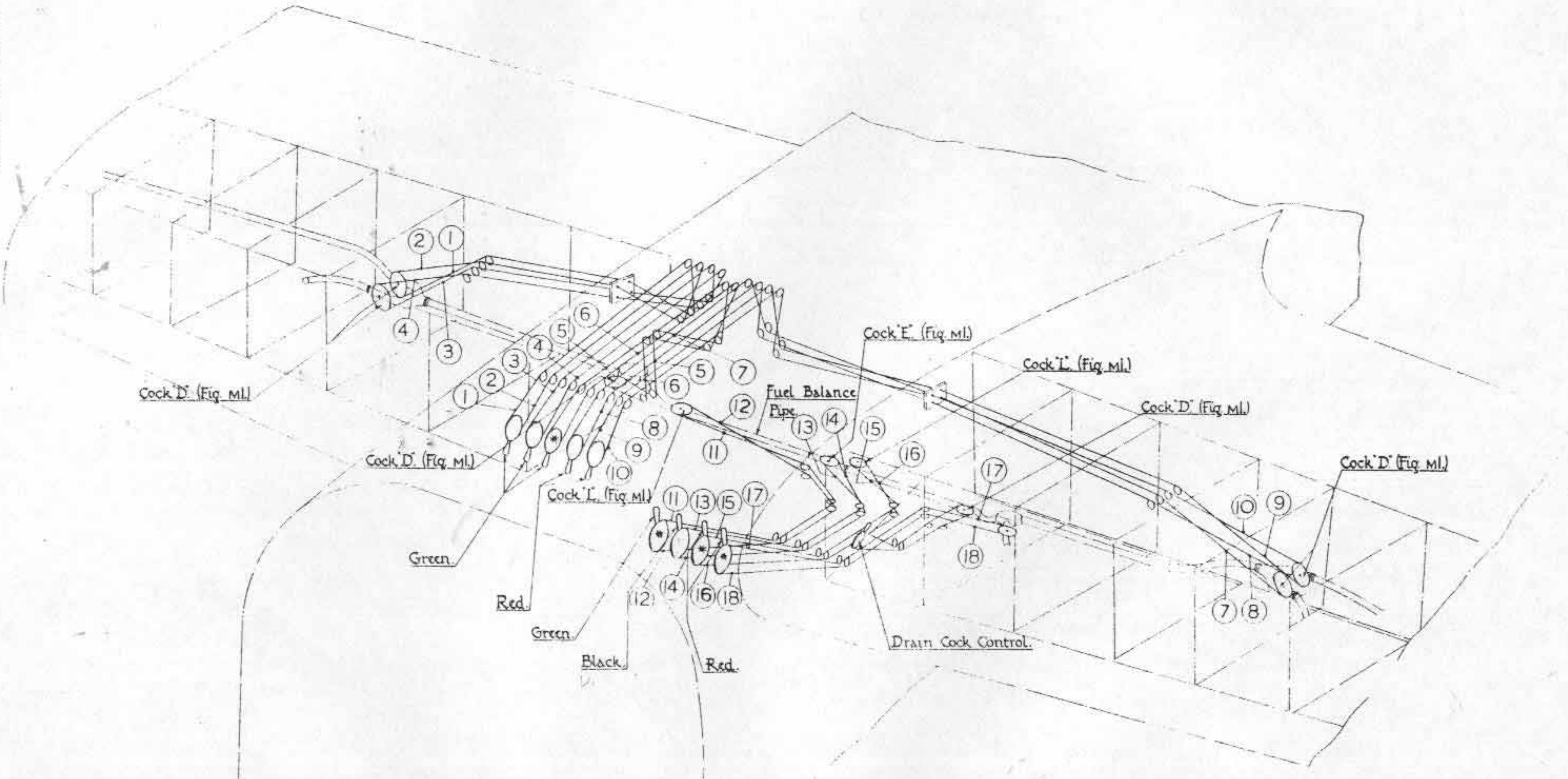
Drg Nº	Description		Length
S.23.B.13033/A	Superflexit	1" bore	2'-3"
S.23.B.13033/B	Superflexit	3/4" bore	6'-6"
S.23.B.13033/C	Superflexit	3/4" bore	12'-3"
S.23.B.13033/D	Superflexit	1" bore	4'-6"
S.23.B.13033/E	Superflexit	1" bore	4'-9"
S.23.B.13033/F	Superflexit	5/8" bore	1'-6"
S.23.B.13033/H	Superflexit	5/8" bore	1'-6"
S.23.B.13033/J	Superflexit	5/8" bore	2'-0"
S.23.B.13033/K	Superflexit	5/8" bore	7½"
S.23.B.13033/L	Superflexit	5/8" bore	5'-8"
S.23.B.13033/M	Superflexit	5/8" bore	6'-3"
S.23.B.13033/N	Superflexit	5/8" bore	5'-3"
S.23.B.13033/P	Superflexit	1/4" bore	3'-9"
S.23.B.13033/Q	Superflexit	5/8" bore	3'-6"
S.23.B.13033/R	Superflexit	5/8" bore	4'-6"
S.23.B.13033/S	Superflexit	5/8" bore	15'-3"
S.23.B.13033/T	Superflexit	5/8" bore	17'-0"
S.23.B.13033/U	Superflexit	3/4" bore	14'-6"
S.23.B.13033/V	Superflexit	3/4" bore	13'-3"
S.23.B.13033/W	Superflexit	1/4" bore	7'-5"
S.23.B.13033/X	Superflexit	1/4" bore	9'-3"
S.23.B.13033/Y	Superflexit	5/32" bore	1'-6"
S.23.B.13033/Z	Superflexit	3/4" bore	6'-0"
S.23.B.13033/A'	Superflexit	5/32" bore	4'-0"
S.23.B.13033/B'	Superflexit	3/4" bore	8'-0"
S.23.B.13033/C'	Superflexit	3/4" bore	11'-0"
S.23.B.13033/D'	Superflexit	1" bore	8'-0"
S.23.C.13005/1	Tube Dural	1¼" o/D x 20G	1'-3"
S.23.C.13005/2	Tube Dural	1¼" o/D x 20G	2'-6"
S.23.C.13005/3	Tube Dural	1¼" o/D x 20G	2'-4"
S.23.C.13005/4	Tube Dural	1¼" o/D x 20G	7'-6"
S.23.C.13005/5	Tube Dural	1¼" o/D x 20G	2'-4"
S.23.C.13005/6	Tube Dural	1¼" o/D x 20G	6'-6"
S.23.C.13005/7	Tube Dural	1¼" o/D x 20G	6'-3"
S.23.C.13005/8	Tube Alumⁿ	1¼" o/D x 20G	5'-0"
S.23.C.13005/18	Tube Alumⁿ	1¼" o/D x 20G	3'-6"
S.23.C.13005/19	Tube Dural	1½" o/D x 20G	4'-0"
S.23.C.13001/2	Tube Copper	1/8" o/D x 22G	25'-0"
S.23.C.13001/3	Tube Copper	1/8" o/D x 22G	13'-6"
S.23.C.13001/5	Tube Copper	3/16" o/D x 22G	2'-0"
S.23.C.13001/8	Tube Copper	1/8" o/D x 22G	30'-0"
S.23.C.13001/9	Tube Copper	1/8" o/D x 22G	16'-0"



FOR IDENTIFICATION OF PIPES SEE KEY SCHEDULE FOLLOWING FIG. M1.E

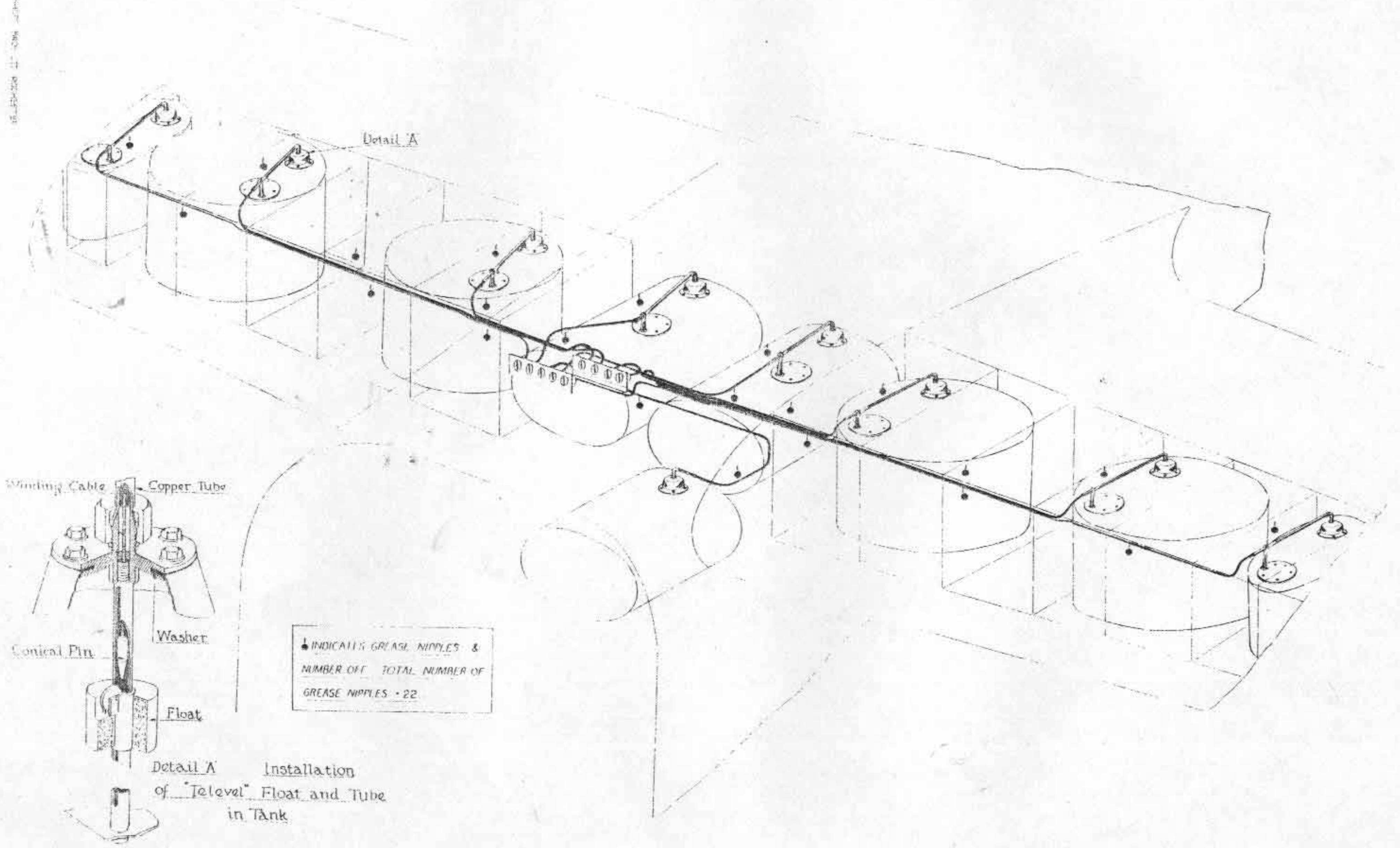
FUEL SYSTEM

TANK COCK CONTROLS

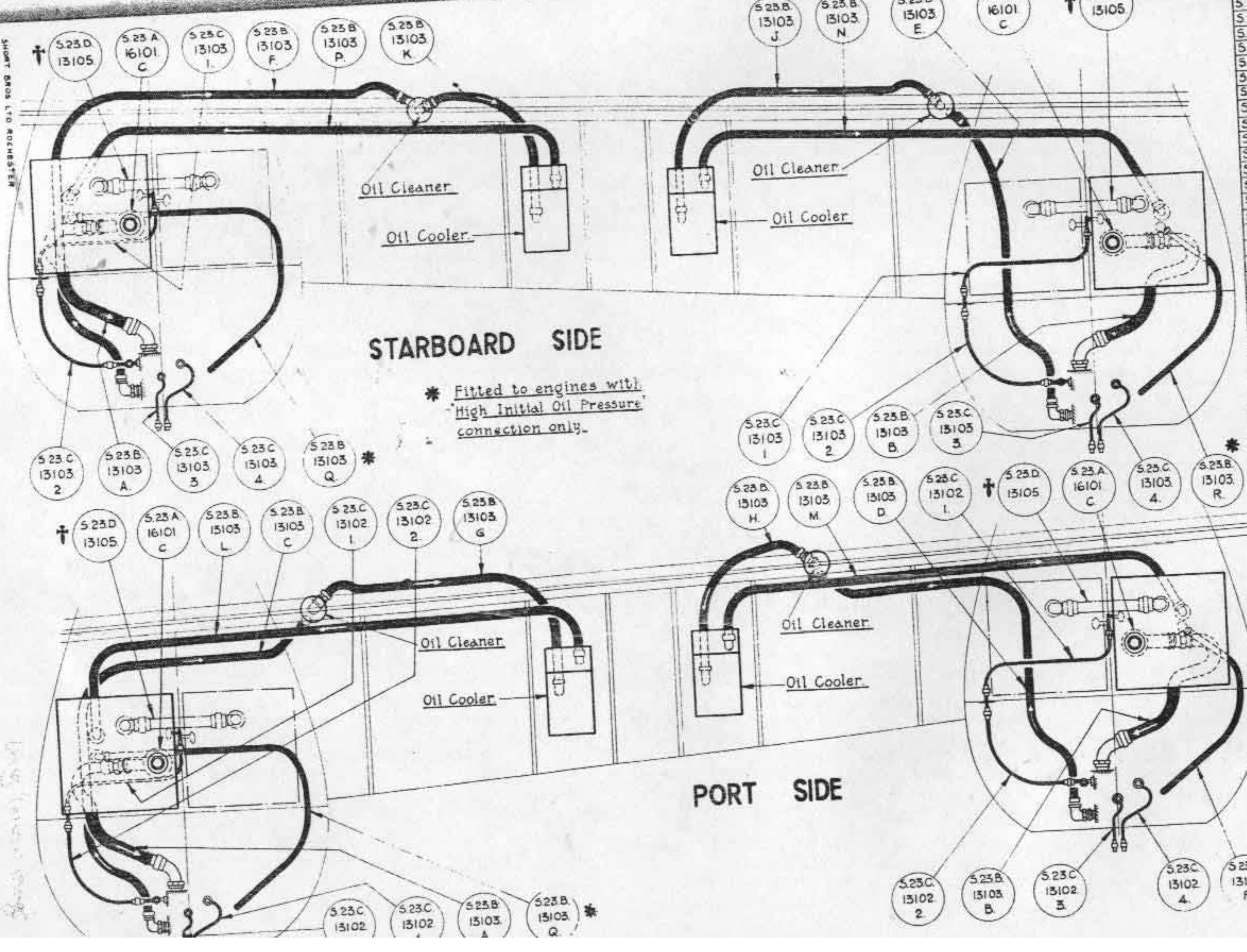


For Disposition of Tanks, etc.
See Fig. M1.

SHORT BROS LTD ROCHESTER



Installation of "Televel" Float and Tube in Tank

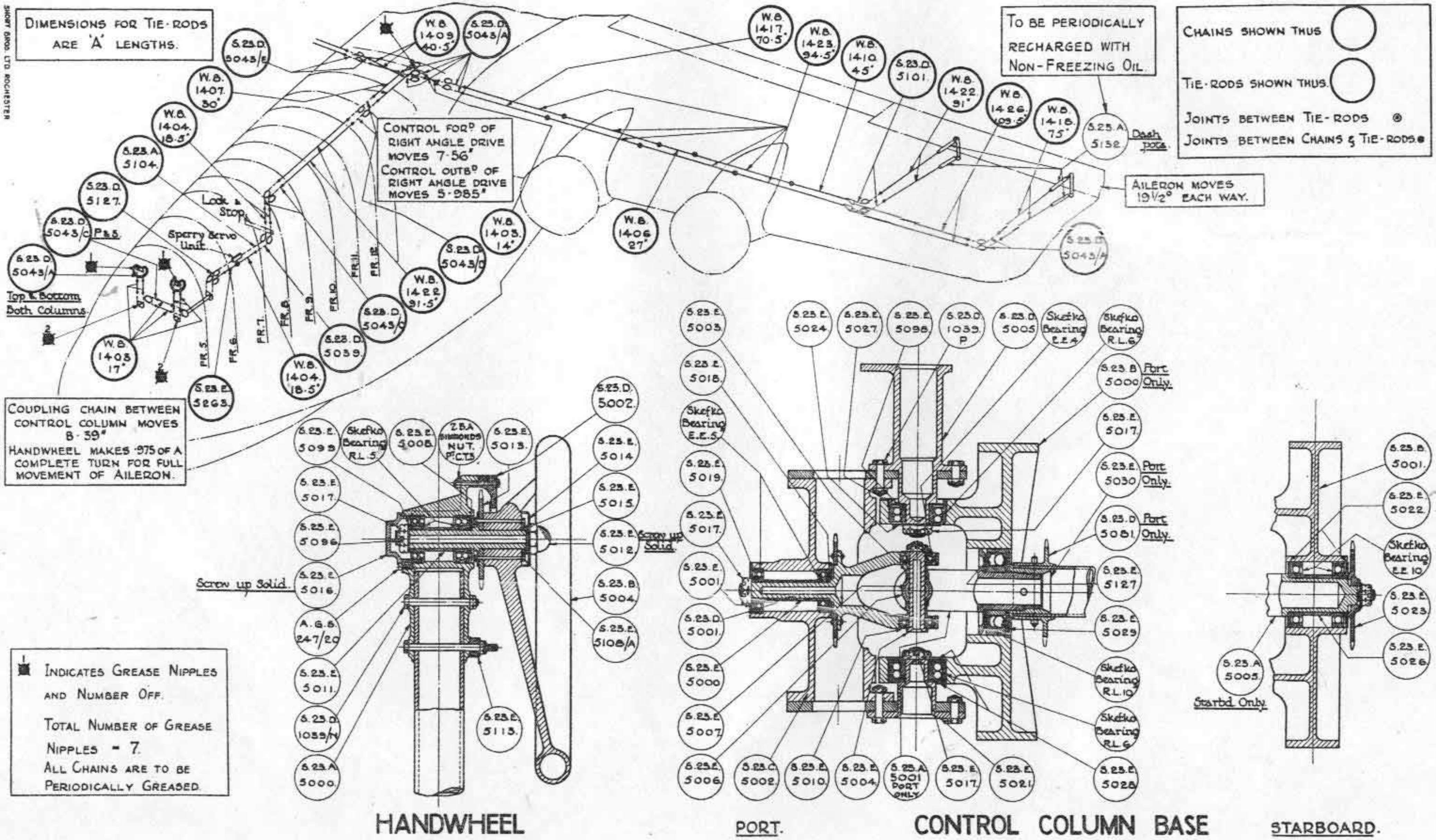


DRAWING Nº	DESCRIPTION		LENGTH
5.23.B.13103/A	Superflexit	½" bore	3' 3"
5.23.B.13103/B	Superflexit	½" bore	3' 3"
5.23.B.13103/C	Superflexit	1" bore	8' 0"
5.23.B.13103/D	Superflexit	1" bore	7' 6"
5.23.B.13103/E	Superflexit	1" bore	6' 0"
5.23.B.13103/F	Superflexit	1" bore	10' 0"
5.23.B.13103/G	Superflexit	1" bore	5' 6"
5.23.B.13103/H	Superflexit	1" bore	3' 2"
5.23.B.13103/J	Superflexit	1" bore	5' 6"
5.23.B.13103/K	Superflexit	1" bore	3' 3"
5.23.B.13103/L	Superflexit	1" bore	8' 9"
5.23.B.13103/M	Superflexit	1" bore	8' 6"
5.23.B.13103/N	Superflexit	1" bore	8' 9"
5.23.B.13103/P	Superflexit	1" bore	9' 0"
5.23.B.13103/Q	Superflexit	⅝" bore	6' 6"
5.23.B.13103/R	Superflexit	⅝" bore	4' 0"
5.23.C.13102/1	Tube Alumᴹ	½" o/d X 20G	3' 0"
5.23.C.13102/2	Tube Alumᴹ	½" o/d X 20G	3' 0"
5.23.C.13102/3	Tube Copper	⅝" o/d X 20G	3' 0"
5.23.C.13102/4	Tube Copper	¾" o/d X 20G	3' 6"
5.23.C.13103/1	Tube Alumᴹ	½" o/d X 20G	3' 0"
5.23.C.13103/2	Tube Alumᴹ	½" o/d X 20G	3' 0"
5.23.C.13103/3	Tube Copper	⅝" o/d X 20G	3' 0"
5.23.C.13103/4	Tube Copper	¾" o/d X 20G	3' 0"
5.23.D.13105	Tube Copper	2" o/d X 20G	1' 3½"
5.23.A.16101/C	Assembly of Filter		

Note:- Diagram shows Oil System for 'BERMUDA' and 'LONG RANGE' classes. Oil Tanks for 'BERMUDA' Boat are shown in full.
When using diagram for 'LONG RANGE' boats Tanks shown in chain dot are also used.
Parts marked thus † are used on 'LONG RANGE' boats only.

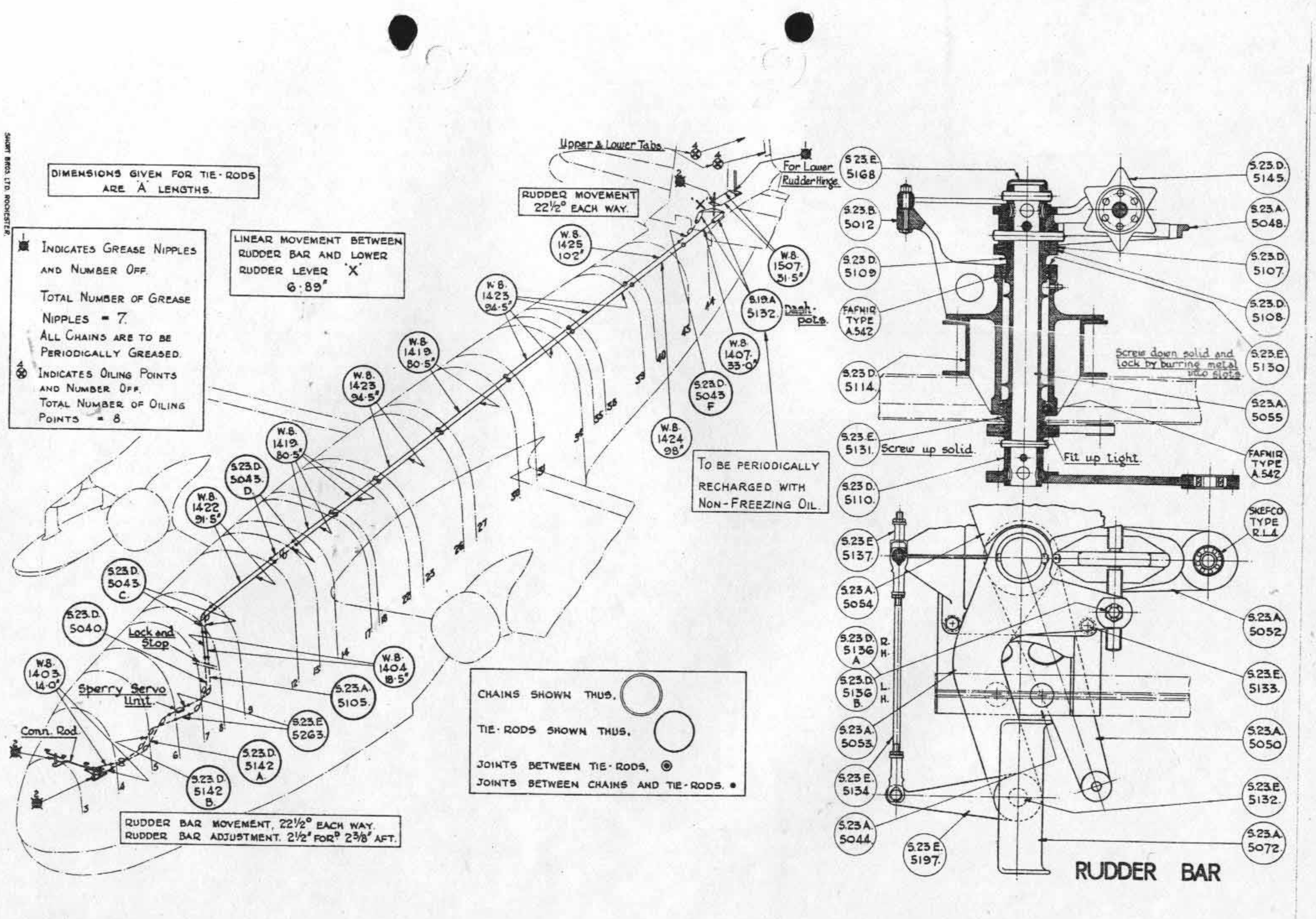
OIL SYSTEM

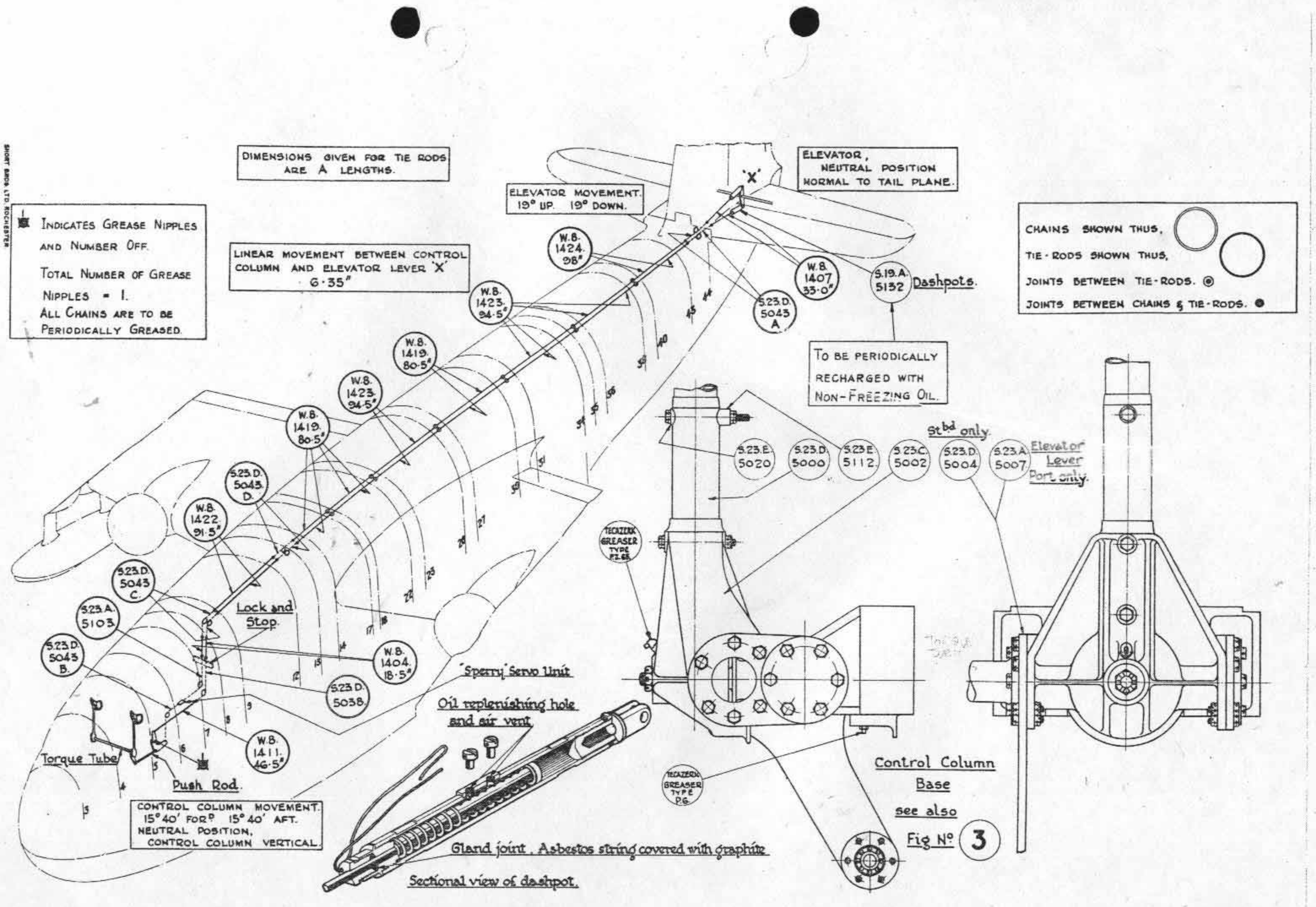
2/



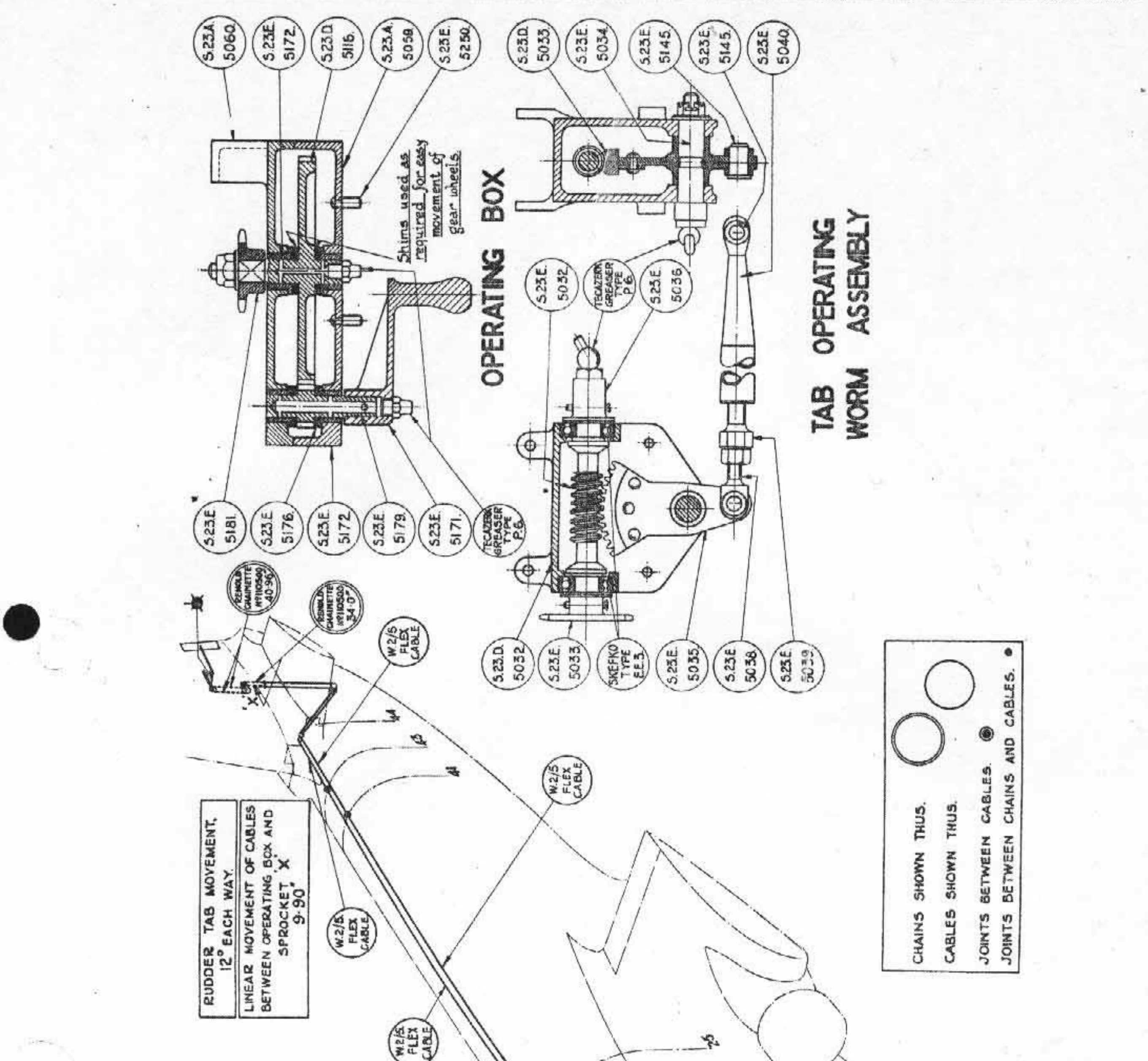
AILERON CONTROLS

RUDDER CONTROLS

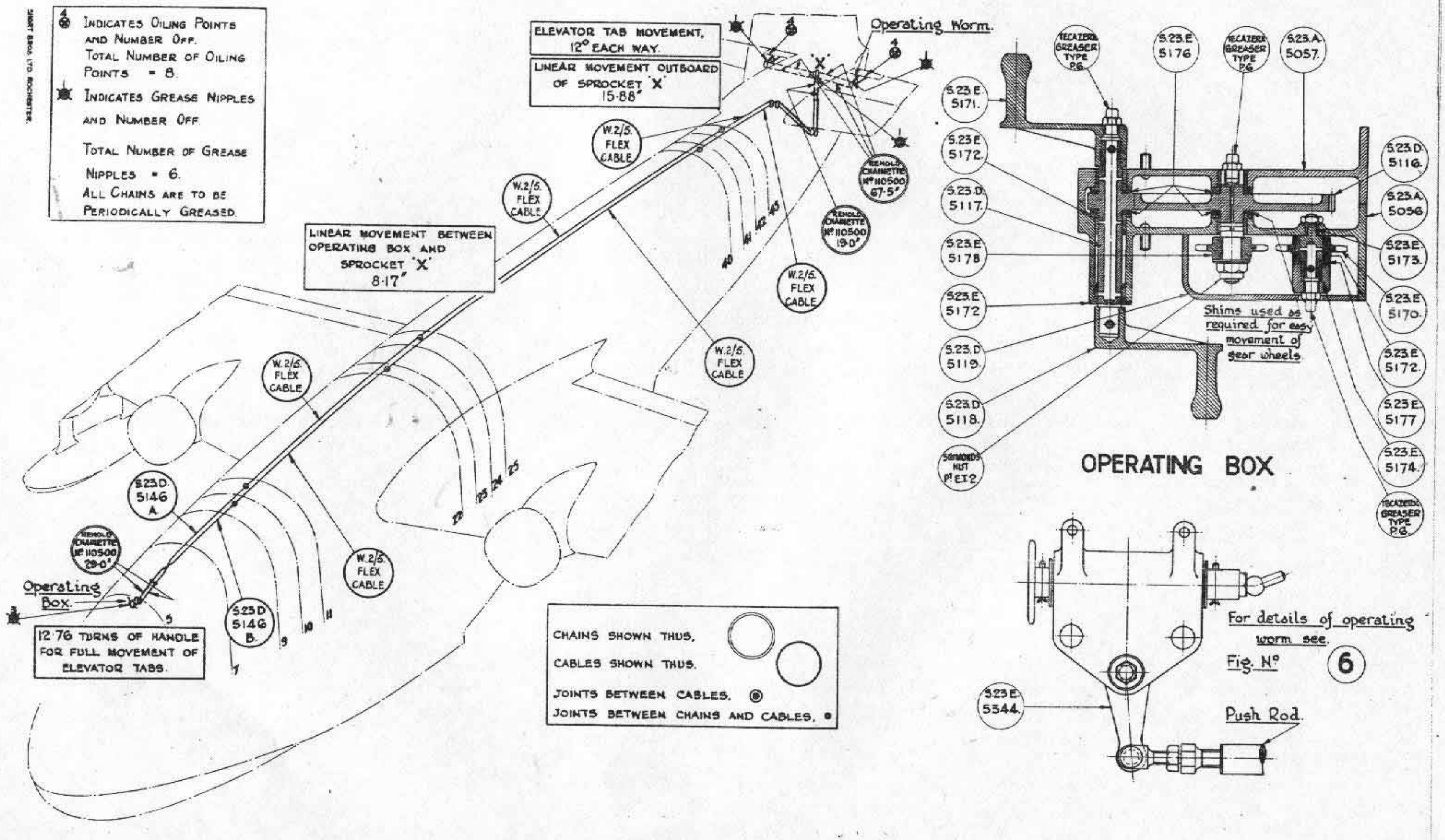




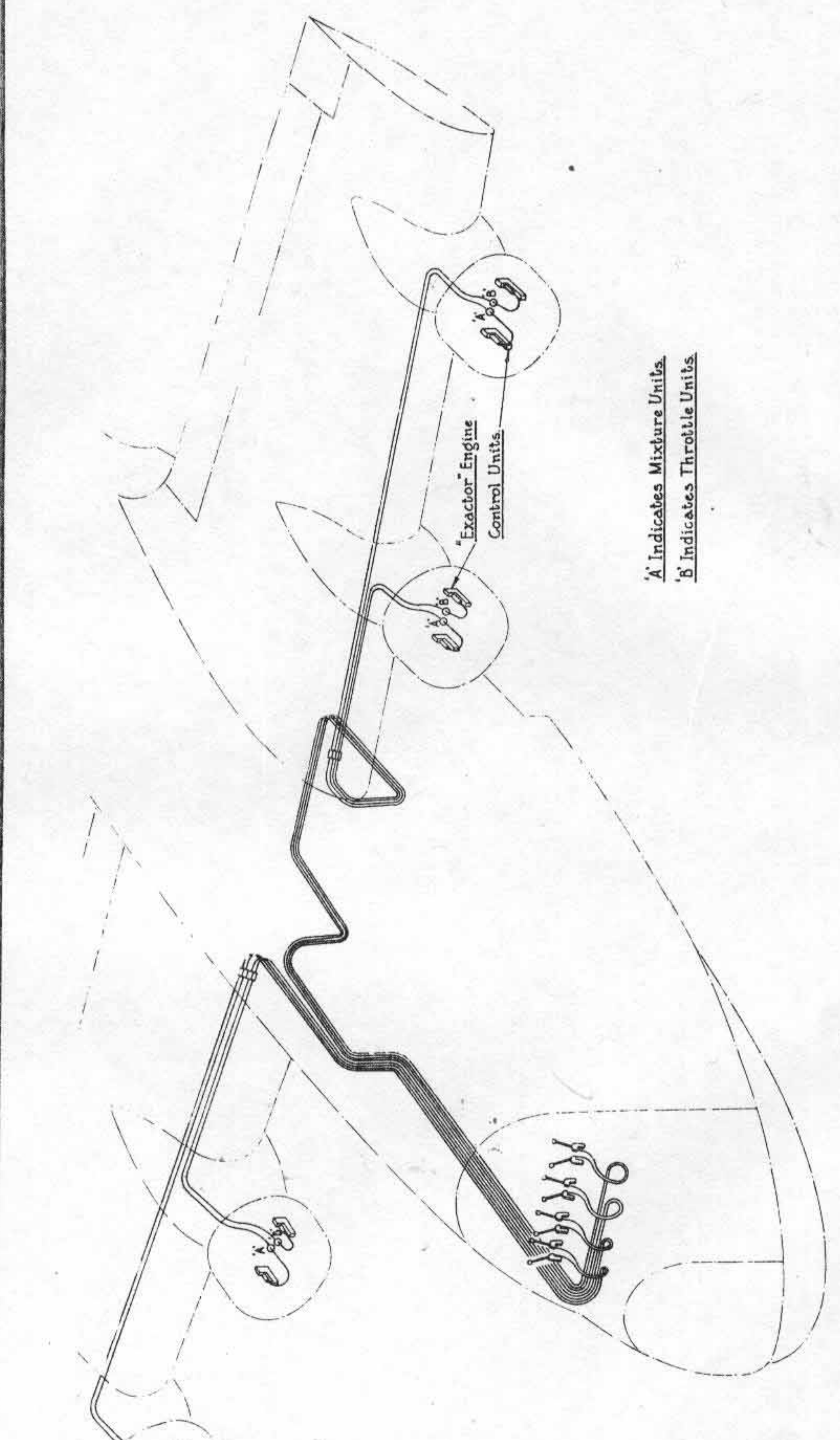
ELEVATOR CONTROLS



RUDDER TAB CONTROLS

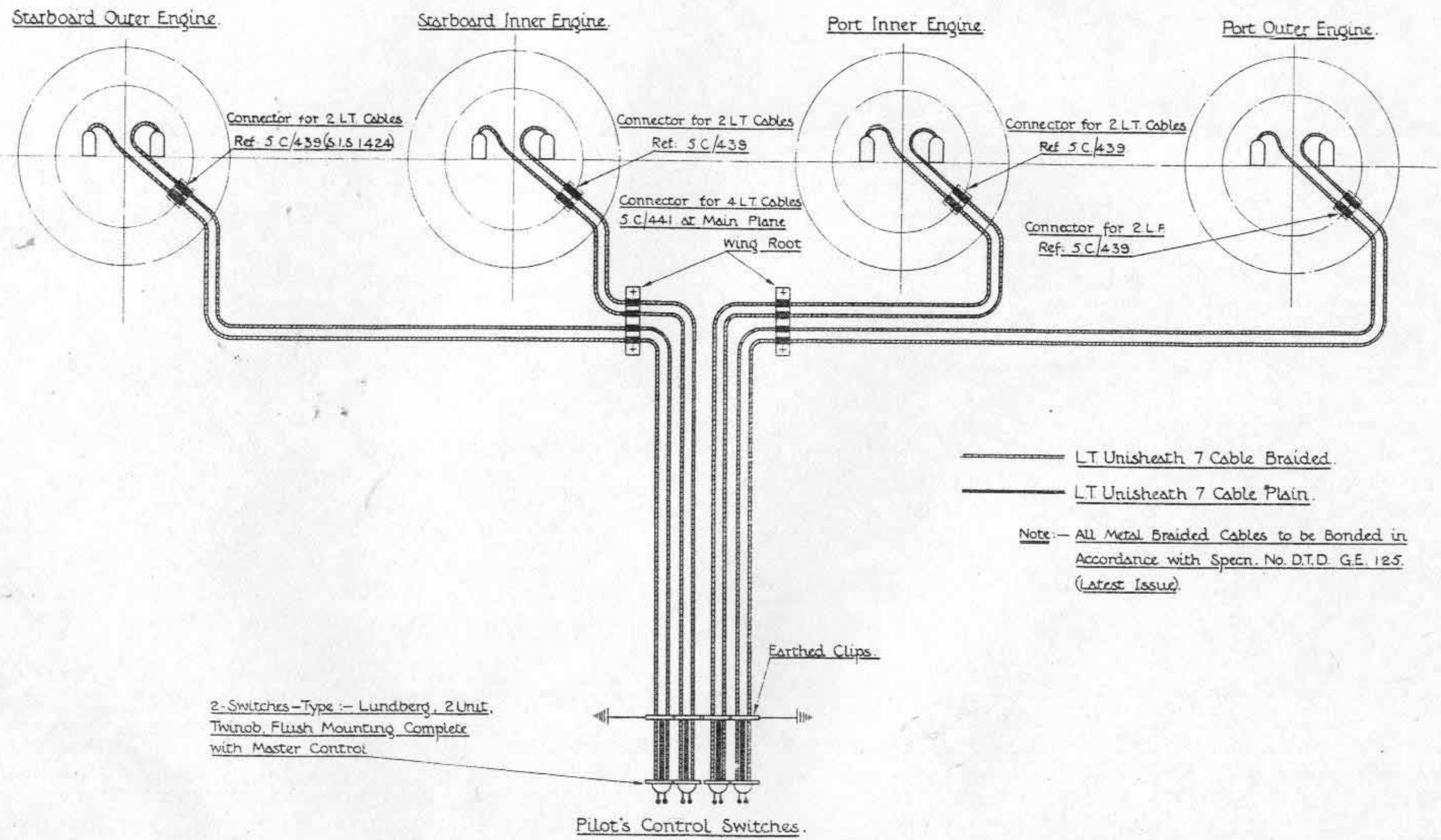


SHORT BROS. LTD. ROCHESTER.



ENGINE CONTROLS

IGNITION SYSTEM

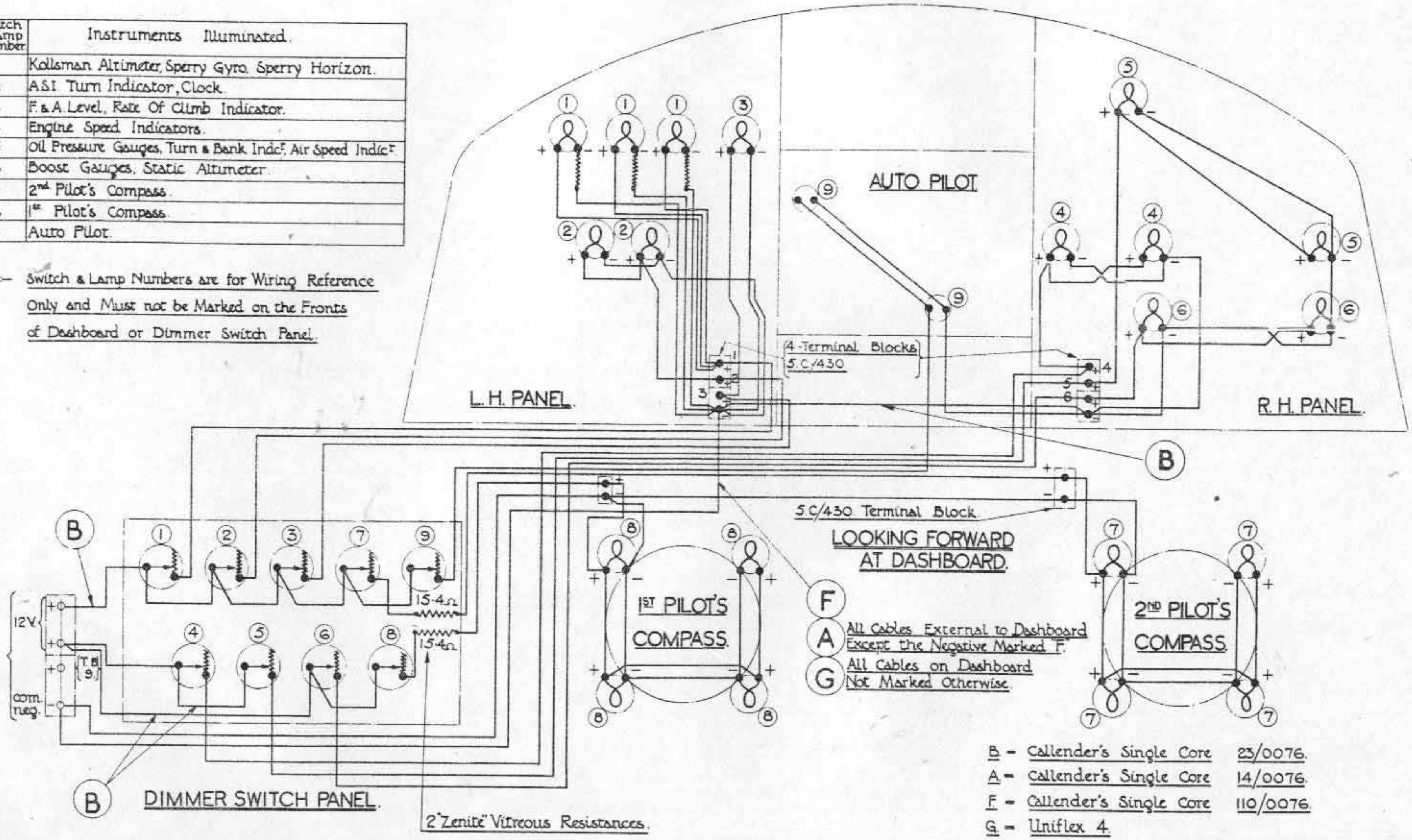


SHORT BROS LTD ROCHESTER

INSTRUMENT LIGHTING CIRCUITS

Switch & Lamp Number	Instruments Illuminated.
1.	Kollsman Altimeter, Sperry Gyro, Sperry Horizon.
2	A.S.I. Turn Indicator, Clock.
3	F. & A. Level, Rate Of Climb Indicator.
4	Engine Speed Indicators.
5	Oil Pressure Gauges, Turn & Bank Indc^r. Air Speed Indic^r.
6	Boost Gauges, Static Altimeter.
7	2^nd Pilot's Compass.
8	1^st Pilot's Compass.
9	Auto Pilot.

Note:– Switch & Lamp Numbers are for Wiring Reference Only and Must not be Marked on the Fronts of Dashboard or Dimmer Switch Panel.



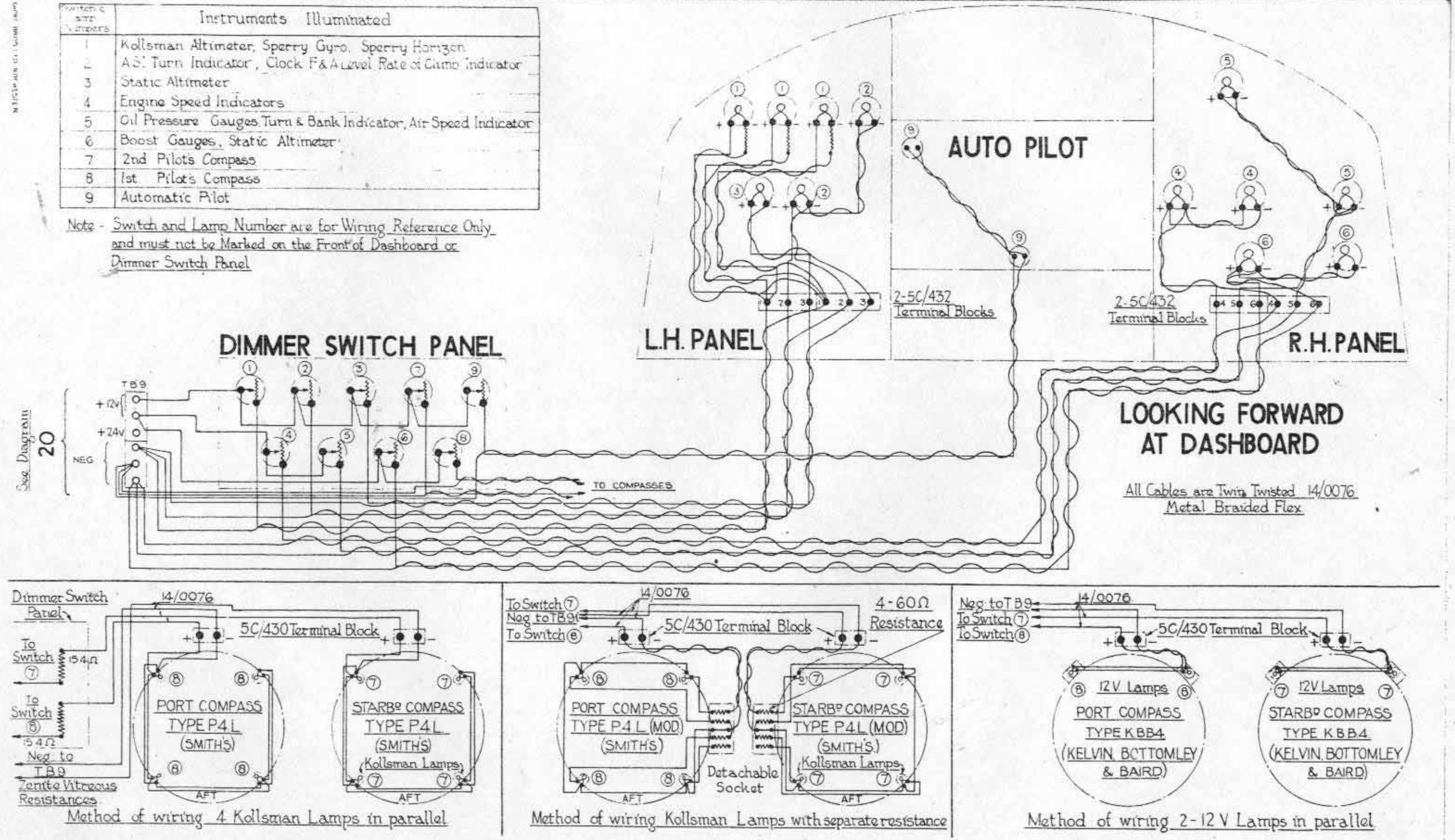
SHORT BROS LTD ROCHESTER

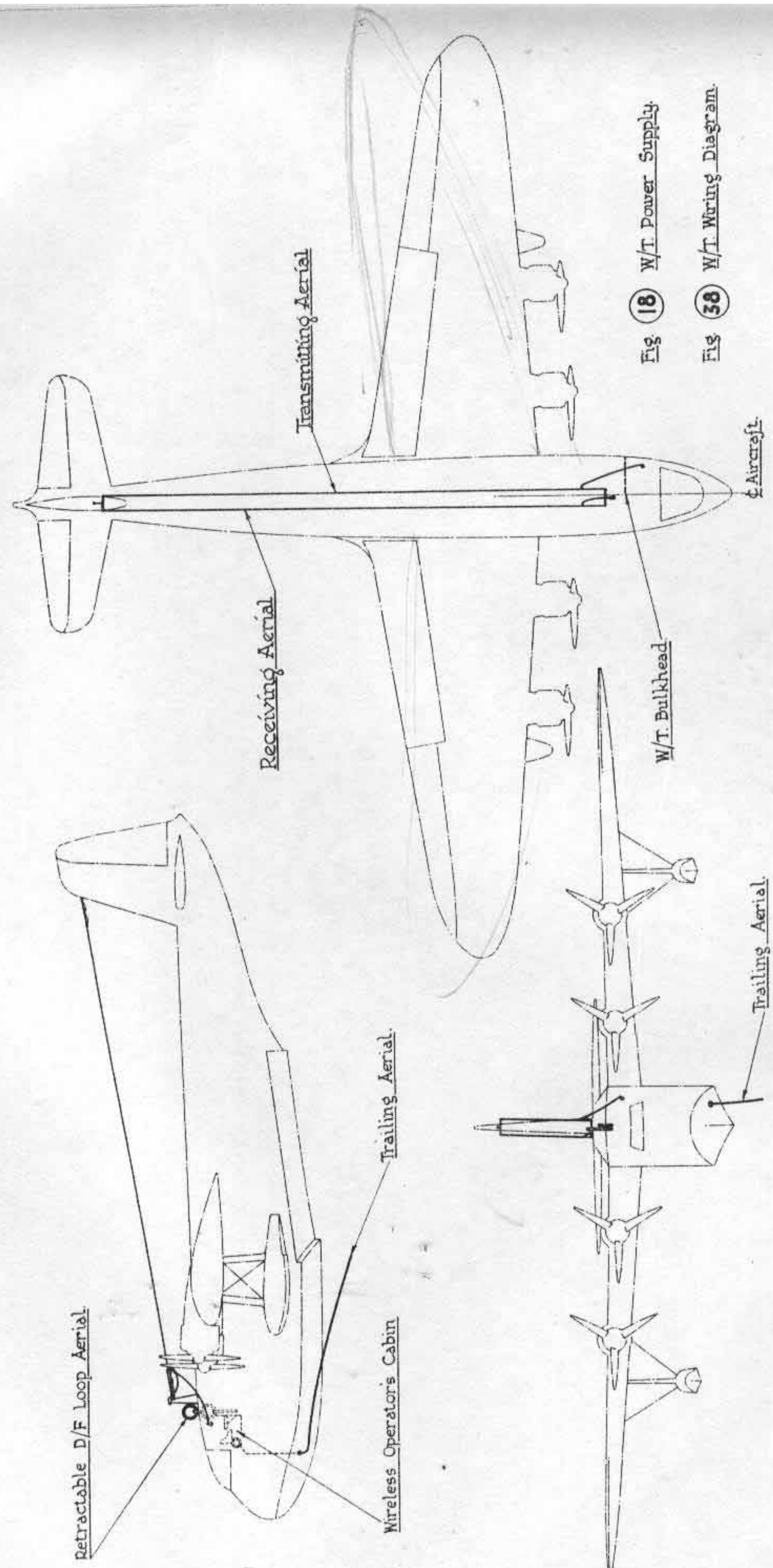
INSTRUMENT LIGHTING CIRCUITS

ISSUE 3

Switches and Jumpers	Instruments Illuminated
1	Kollsman Altimeter, Sperry Gyro, Sperry Horizon
2	A.S.I. Turn Indicator, Clock F&A Level, Rate of Climb Indicator
3	Static Altimeter
4	Engine Speed Indicators
5	Oil Pressure Gauges, Turn & Bank Indicator, Air Speed Indicator
6	Boost Gauges, Static Altimeter
7	2nd Pilot's Compass
8	1st Pilot's Compass
9	Automatic Pilot

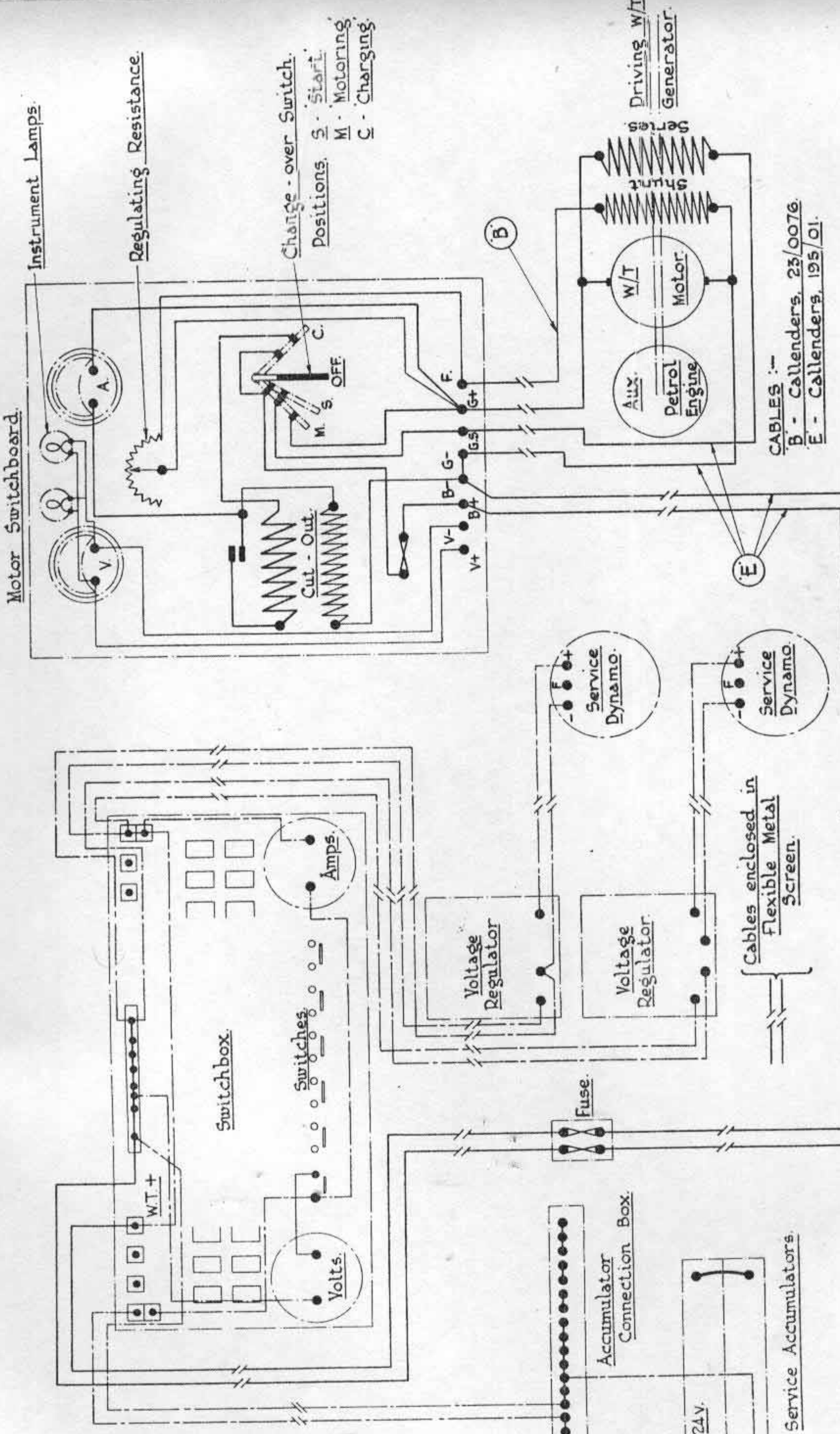
Note - Switch and Lamp Number are for Wiring Reference Only and must not be Marked on the Front of Dashboard or Dimmer Switch Panel





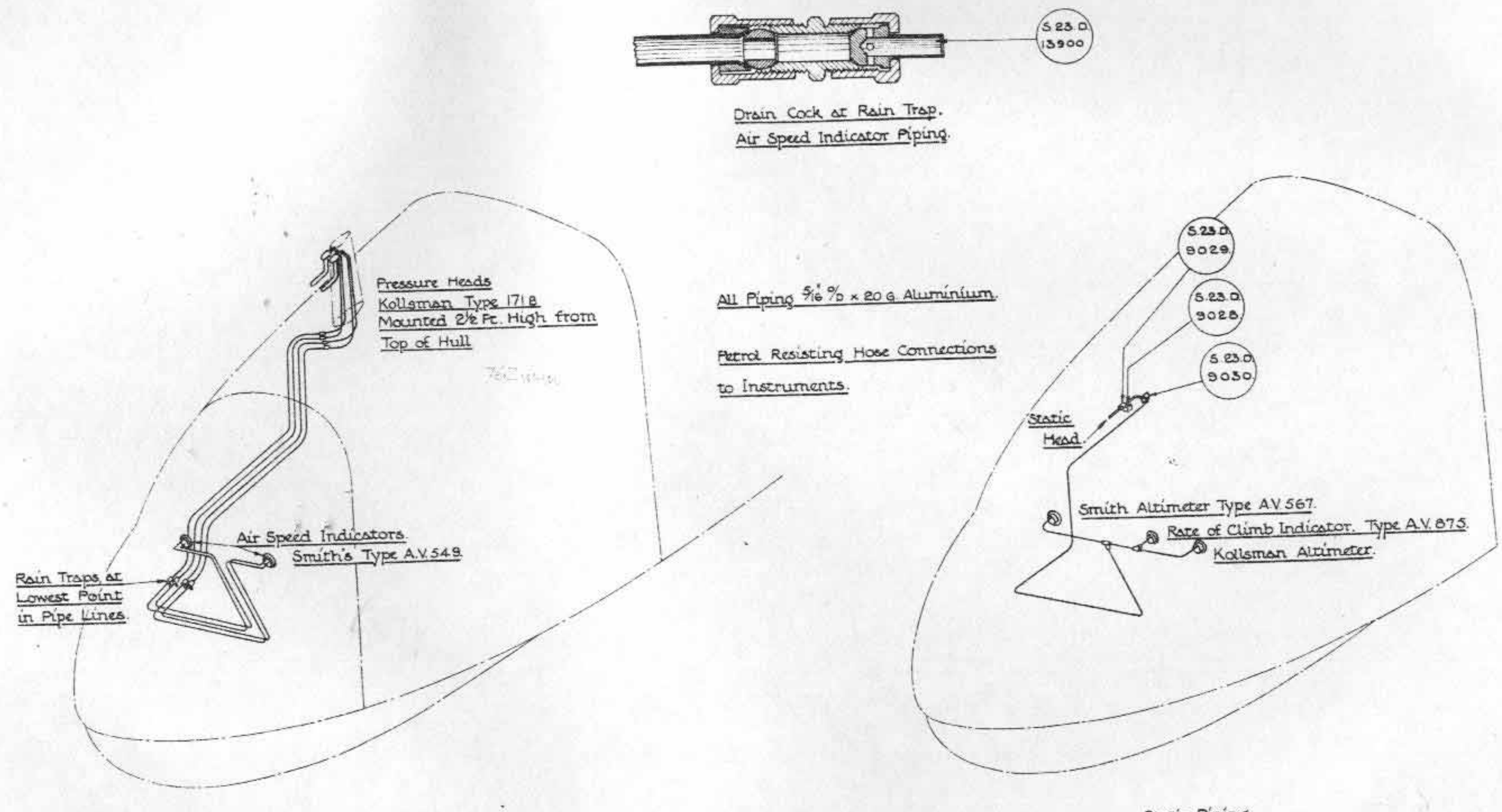
SHORT BROS. LTD. ROCHESTER

WIRELESS EQUIPMENT



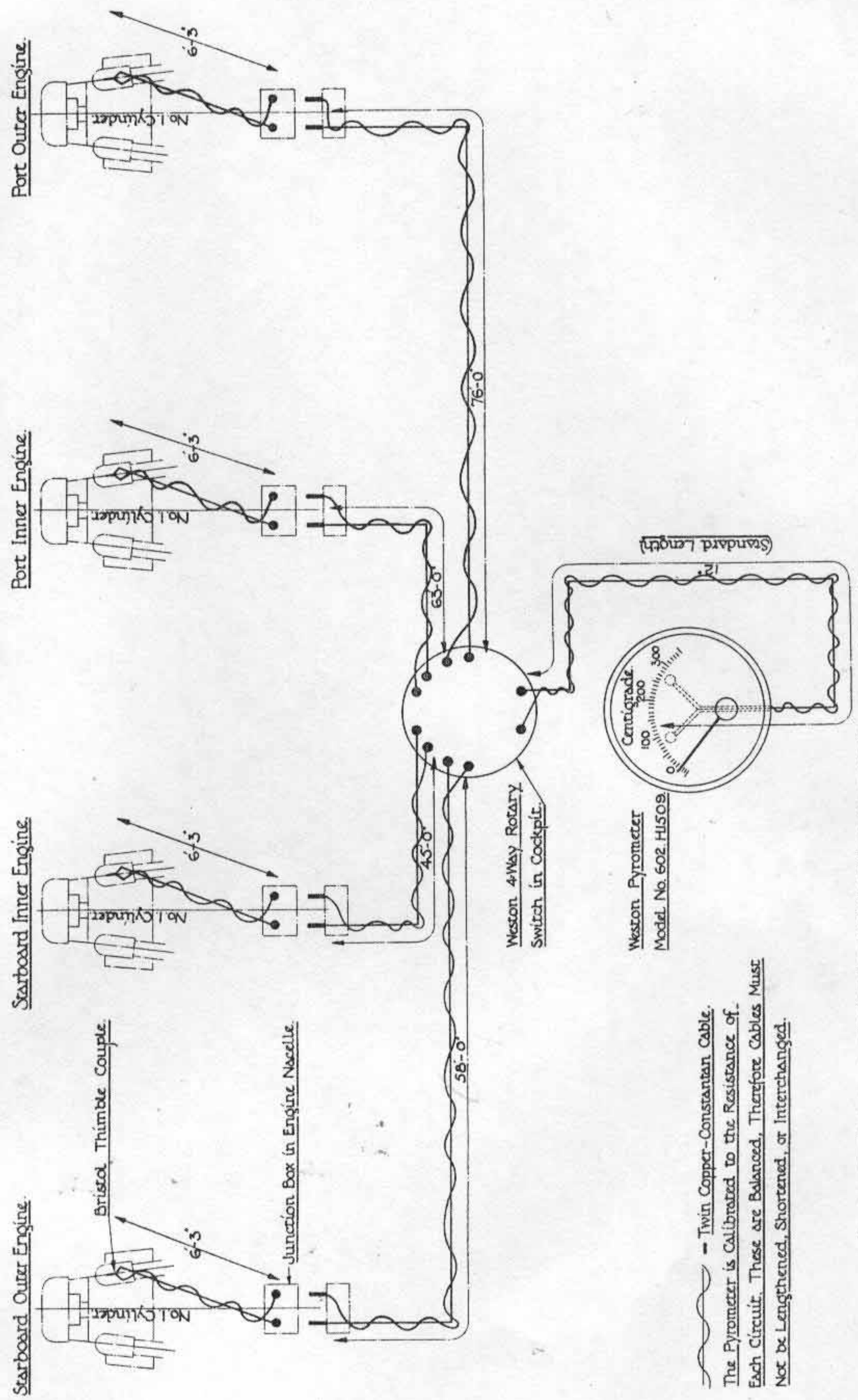
WIRELESS POWER SUPPLY

AIR SPEED INDICATOR PIPE LINES



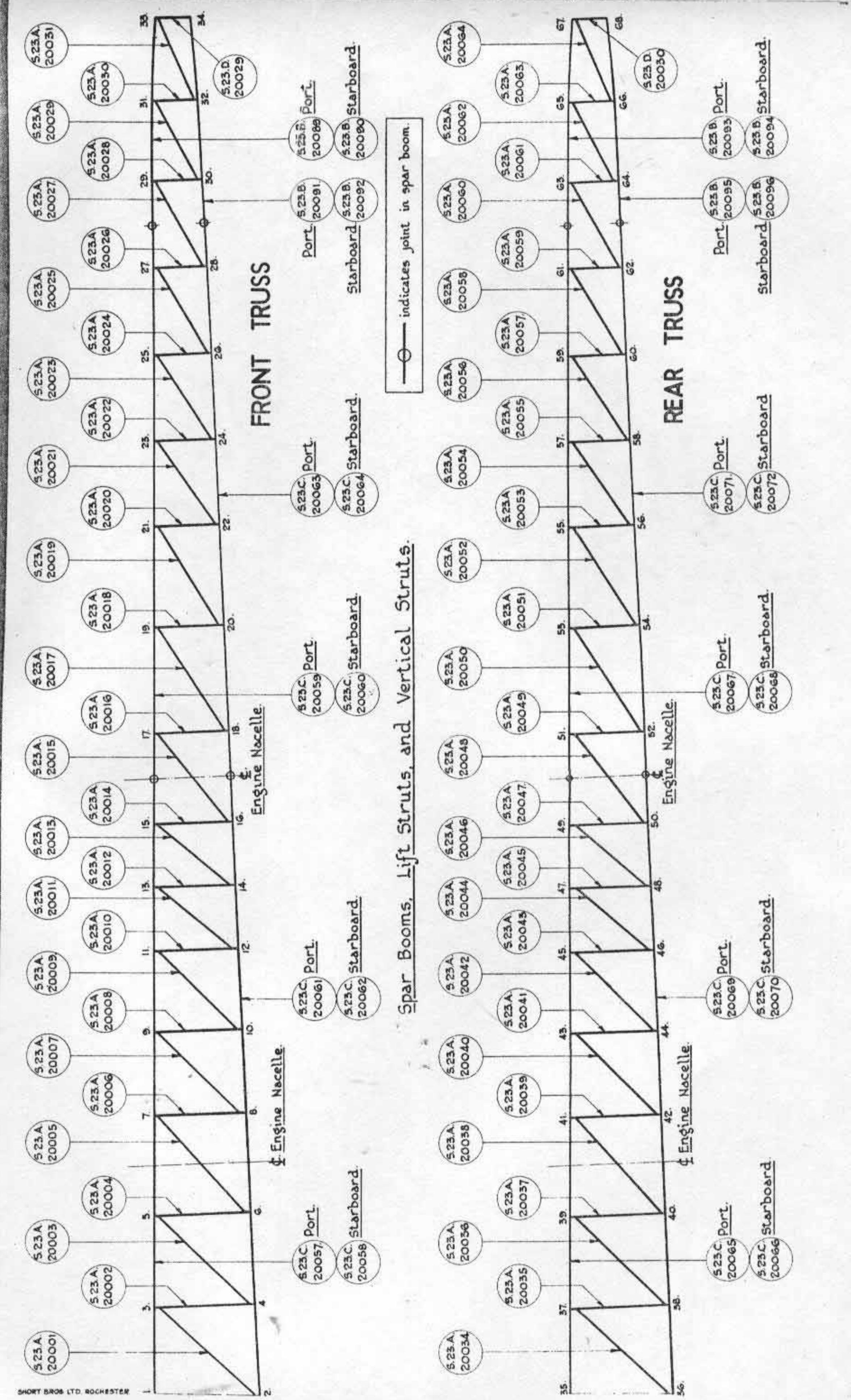
Air Speed Indicator Piping.

Static Piping.



SHORT BROS LTD ROCHESTER

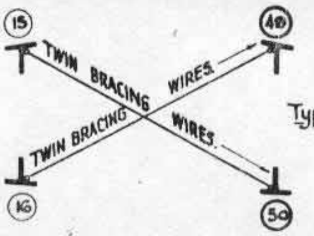
ENGINE PYROMETER WIRING



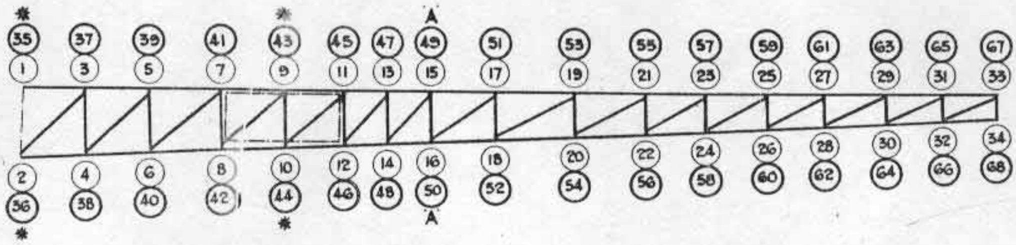
SPAR SIDE PANELS MAIN PLANE

◯ indicates FRONT TRUSS.

◯ indicates REAR TRUSS.



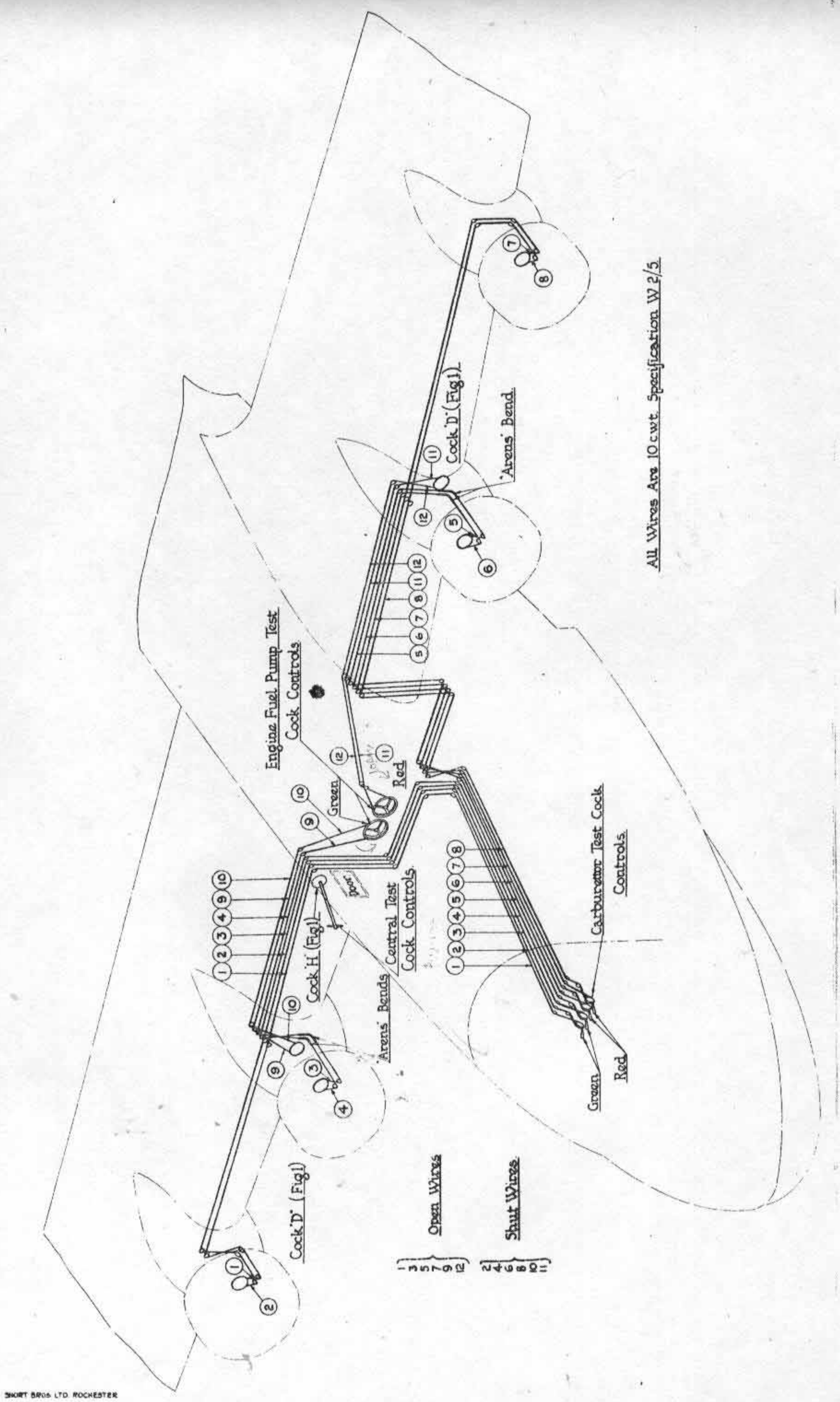
Typical Panel, Section 'A'-'A'



PANEL	SIZE OF WIRE	STREAMLINE WIRES SPECN.	PART NO.	'A' LENGTH.	FORK ENDS H.T.S.2. SPECN.	PINS SPECN.	LOCK NUTS PART NO.	SPLIT PINS PART NO.
3 – 37, 4 – 38	5/16" B.S.F.	W.3.	519.	83·5"	S.P.7.G. S.P.7.G.L.	S.P.4. G-7	A.G.S. 672/C. A.G.S.672/C.L.	A.G.S.784/10.
5 – 39, 6 – 40	9/32" B.S.F.	W.3.	419.	80·5"	S.P.7.F. S.P.7.F.L.	S.P.4. E. G.	A.G.S.672/B. A.G.S.672/B.L.	A.G.S.784/10
7 – 41, 8 – 42	9/32" B.S.F.	W.3.	418.	76·5"	S.P.7.F. S.P.7.F.L.	S.P.4. E. 6.	A.G.S.672/B. A.G.S.672/B.L.	A.G.S.784/10.
11 – 45, 12 – 46	9/32" B.S.F.	W.3.	416.	70·5"	S.P.7.F. S.P.7.F.L.	S.P.4. E. 6.	A.G.S.672/B. A.G.S.672/B.L.	A.G.S.784/10.
13 – 47, 14 – 48	9/32" B.S.F.	W.3.	416.	68·0"	S.P.7.F. S.P.7.F.L.	S.P.4. E. 6.	A.G.S.672/B. A.G.S.672/B.L.	A.G.S.784/10.
15 – 49, 16 – 50	9/32" B.S.F.	W.3.	415.	66·0"	S.P.7.F. S.P.7.F.L.	S.P.4. E. 6.	A.G.S.672/B. A.G.S.672/B.L.	A.G.S.784/10.
17 – 51, 18 – 52	9/32" B.S.F.	W.3.	414.	62·5"	S.P.7.F. S.P.7.F.L.	S.P.4. E. 6.	A.G.S.672/B. A.G.S.672/B.L.	A.G.S.784/10.
19 – 53, 20 – 54	11/32" B.S.F.	W.3.	613.	58·0"	S.P.7.H. S.P.7.H.L.	S.P.4.G.8.	A.G.S.672/D. A.G.S.672/D.L.	A.G.S.784/10.
21 – 55, 22 – 56	4.B.A.	W.3.	13.	55·5"	S.P.7.B. S.P.7.B.L.	S.P.4. A. 2.	A.G.S.673/C. A.G.S.673/C.L.	A.G.S.784/1.
23 – 57, 24 – 58	4.B.A.	W.3.	12.	52·5"	S.P.7.B. S.P.7.B.L.	S.P.4. A. 2.	A.G.S.673/C. A.G.S.673/C.L.	A.G.S.784/1.
25 – 59, 26 – 60	4.B.A.	W.3.	11.	49·0"	S.P.7.B. S.P.7.B.L.	S.P.4. A. 2.	A.G.S.673/C. A.G.S.673/C.L.	A.G.S.784/1.
27 – 61, 28 – 62	4.B.A.	W.3.	10.	46·0"	S.P.7.B. S.P.7.B.L.	S.P.4. A. 2.	A.G.S.673/C. A.G.S.673/C.L.	A.G.S.784/1.
29 – 63, 30 – 64	4.B.A.	W.3.	10.	43·0"	S.P.7.B. S.P.7.B.L.	S.P.4. A. 2.	A.G.S.673/C. A.G.S.673/C.L.	A.G.S.784/1.
31 – 65, 32 – 66	4.B.A.	W.3.	9.	39·5"	S.P.7.B. S.P.7.B.L.	S.P.4. A. 2.	A.G.S.673/C. A.G.S.673/C.L.	A.G.S.784/1.
33 – 67, 34 – 68	4.B.A.	W.3.	8.	36·0"	S.P.7.B. S.P.7.B.L.	S.P.4. A. 2.	A.G.S.673/C. A.G.S.673/C.L.	A.G.S.784/1.

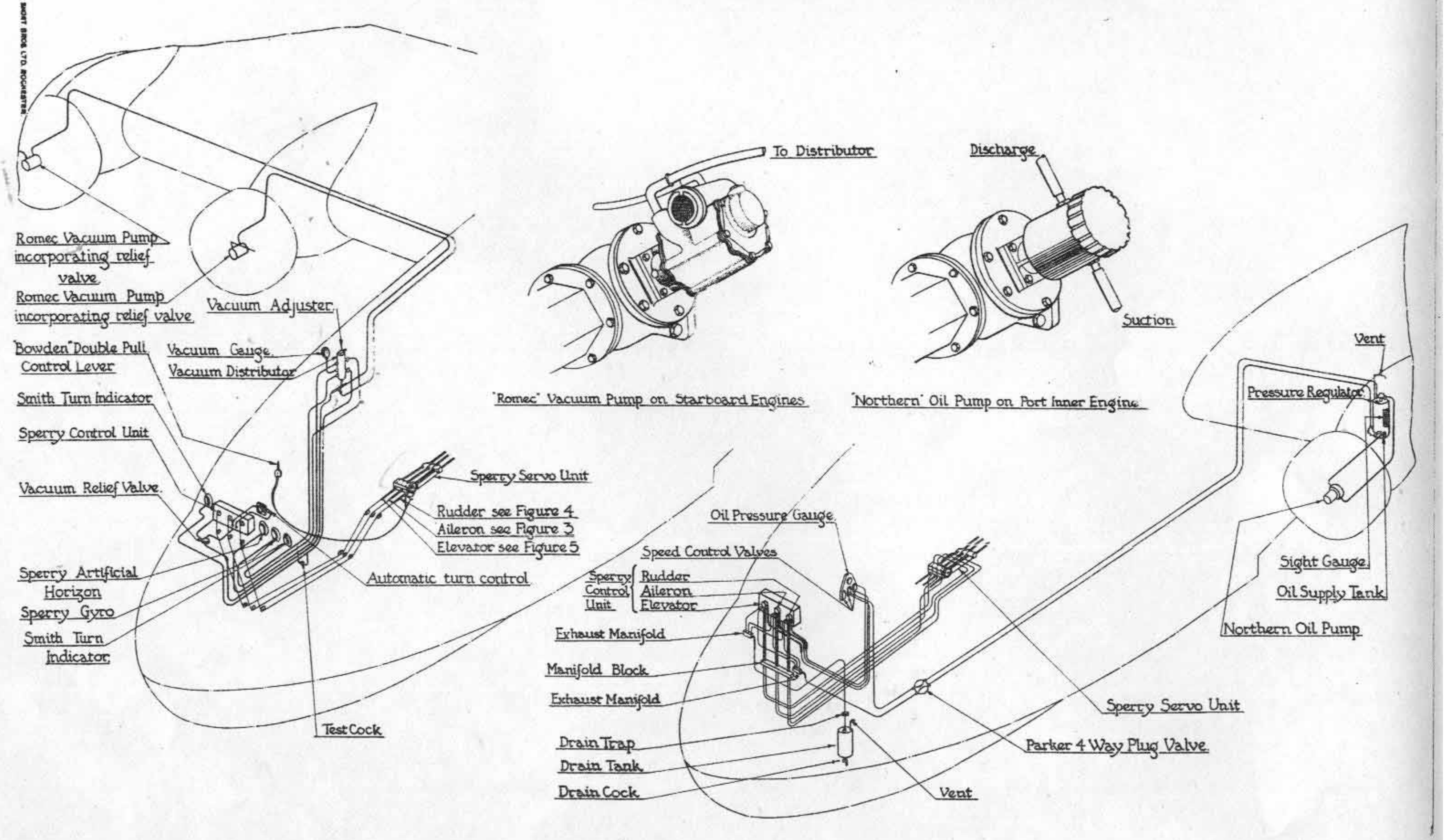
No Bracing Wires at positions marked thus ✱.

SPAR INCIDENCE BRACING MAIN PLANE

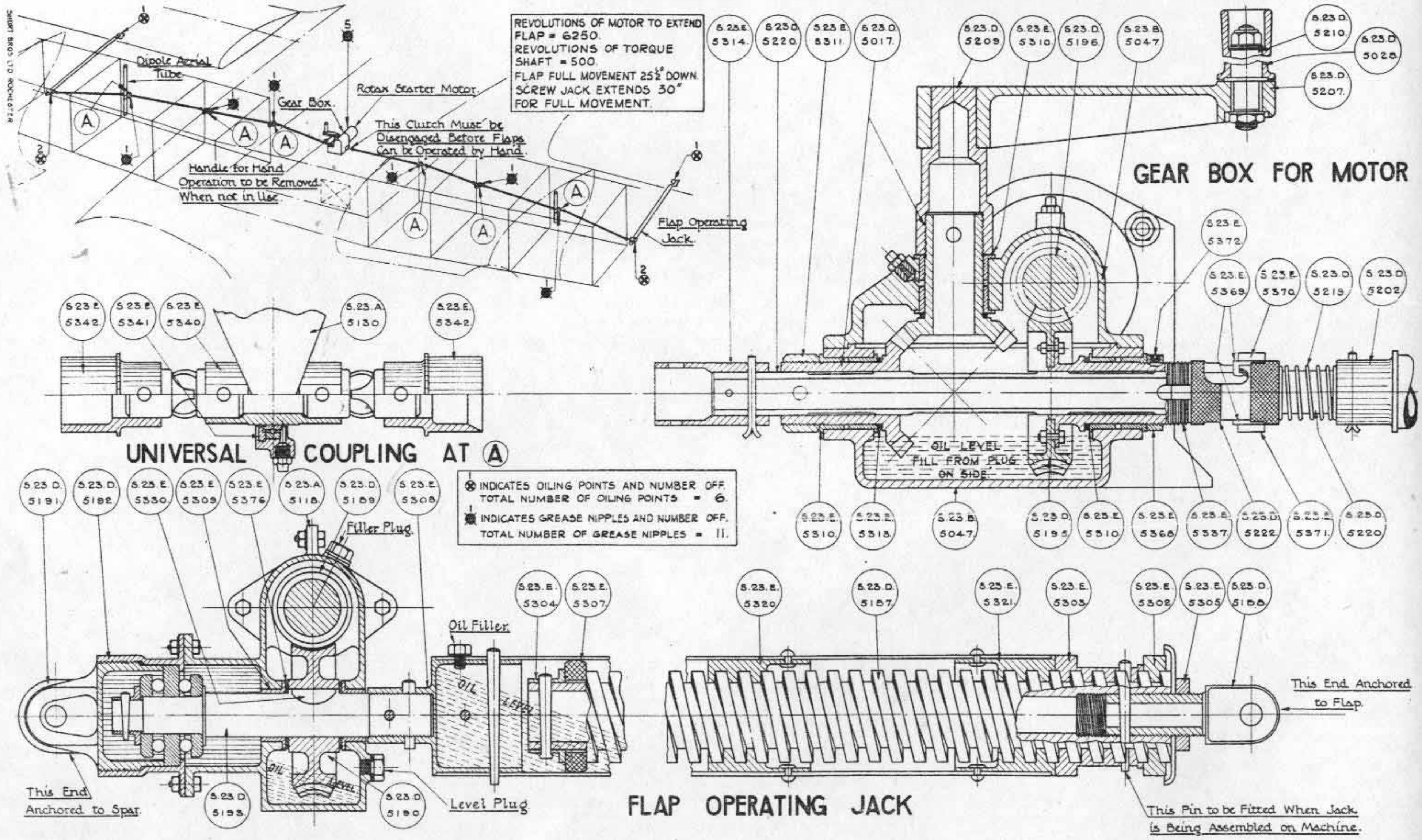


SHORT BROS LTD ROCHESTER

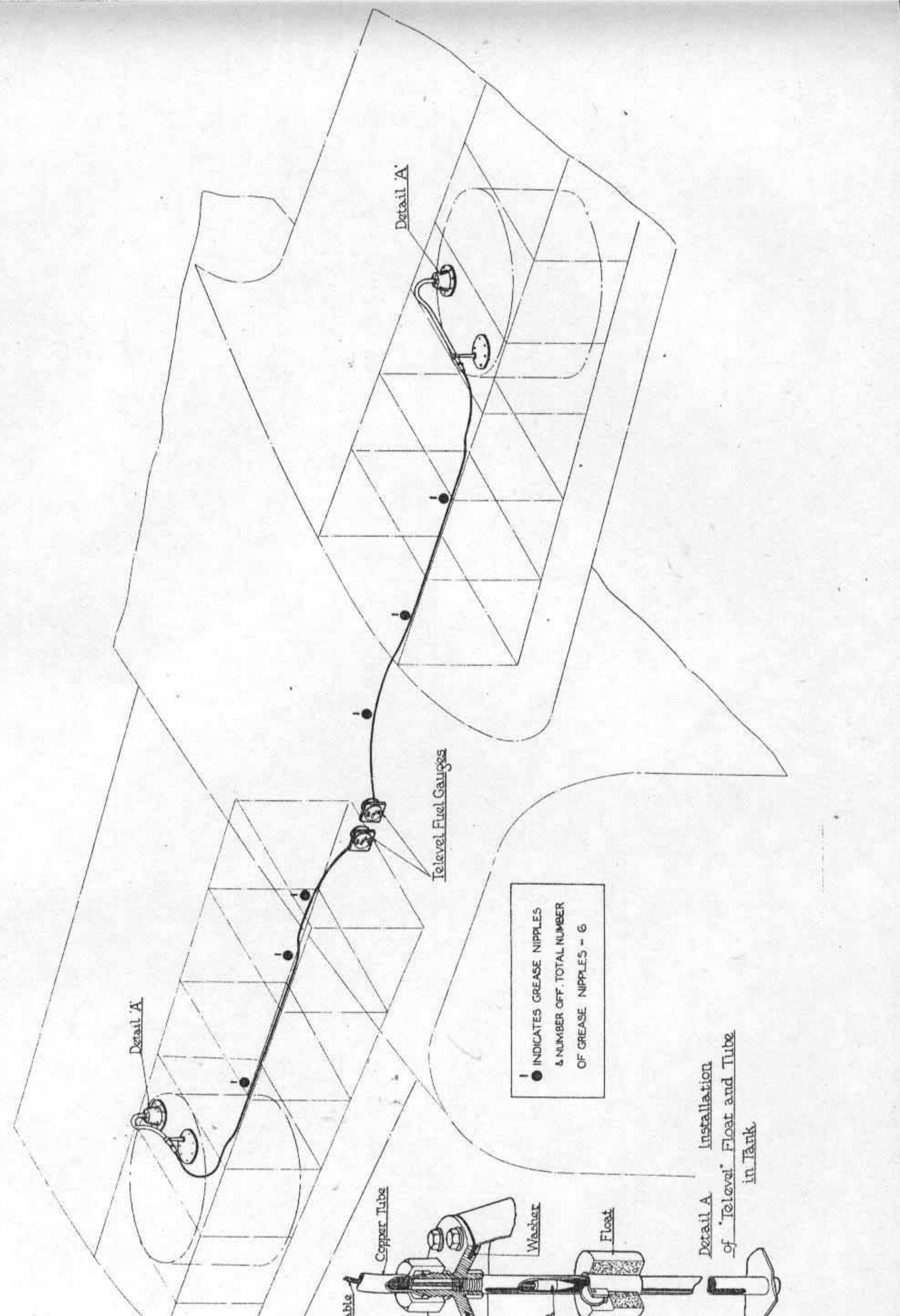
CARBURETTOR & TEST COCK CONTROLS



SPERRY AUTOMATIC PILOT PIPING



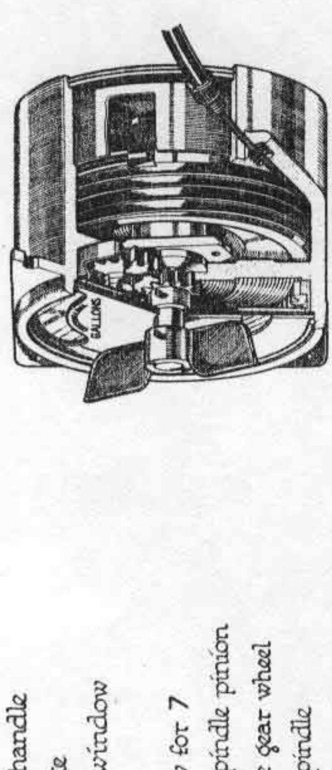
MECHANICAL FLAP CONTROL

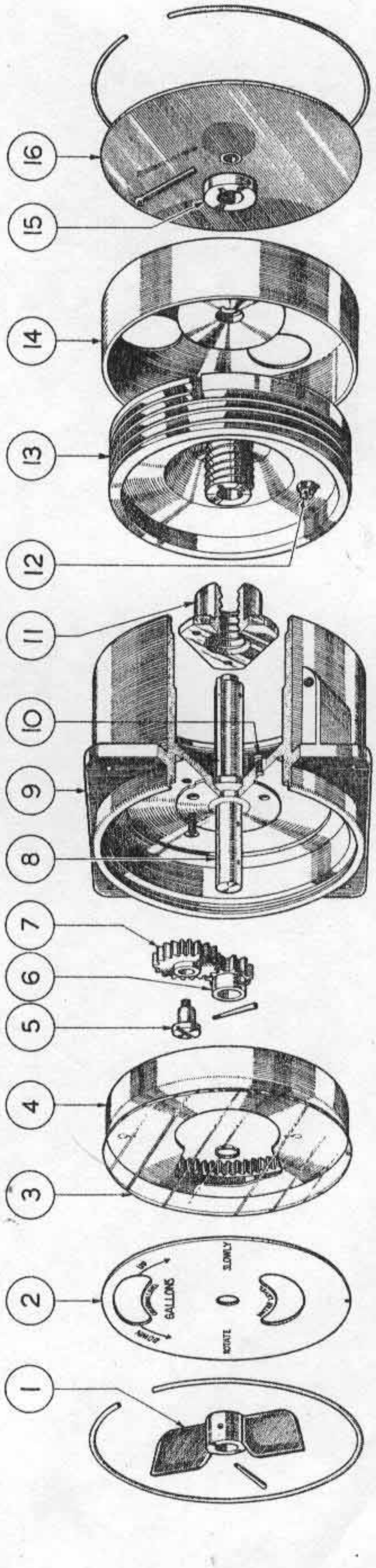


SHORT BROS LTD ROCHESTER

"TELEVEL" FUEL GAUGES

1. Winding handle
2. Front plate
3. Celluloid window
4. Dial
5. Pivot screw for 7
6. Winding spindle pinion
7. Intermediate gear wheel
8. Winding spindle

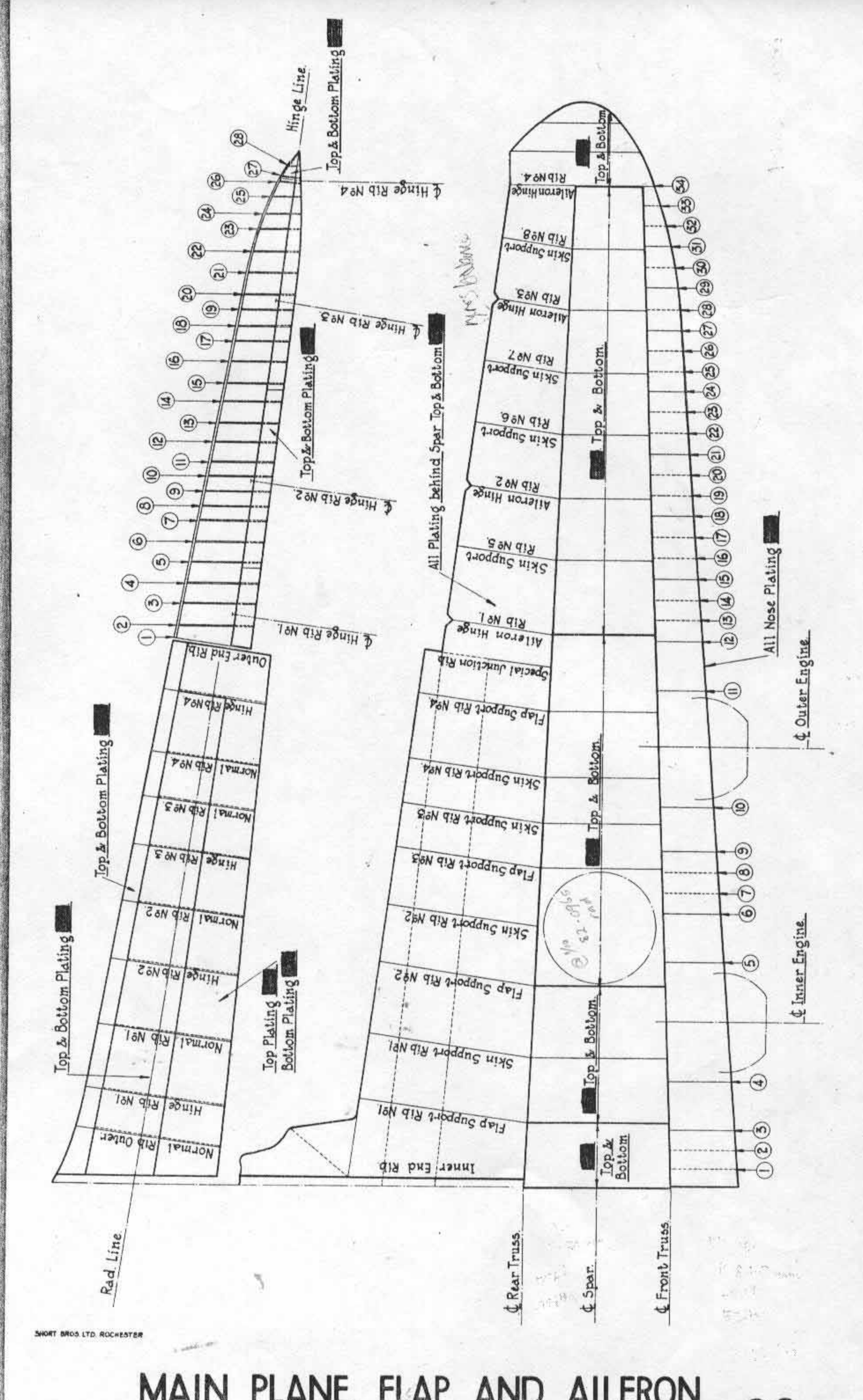




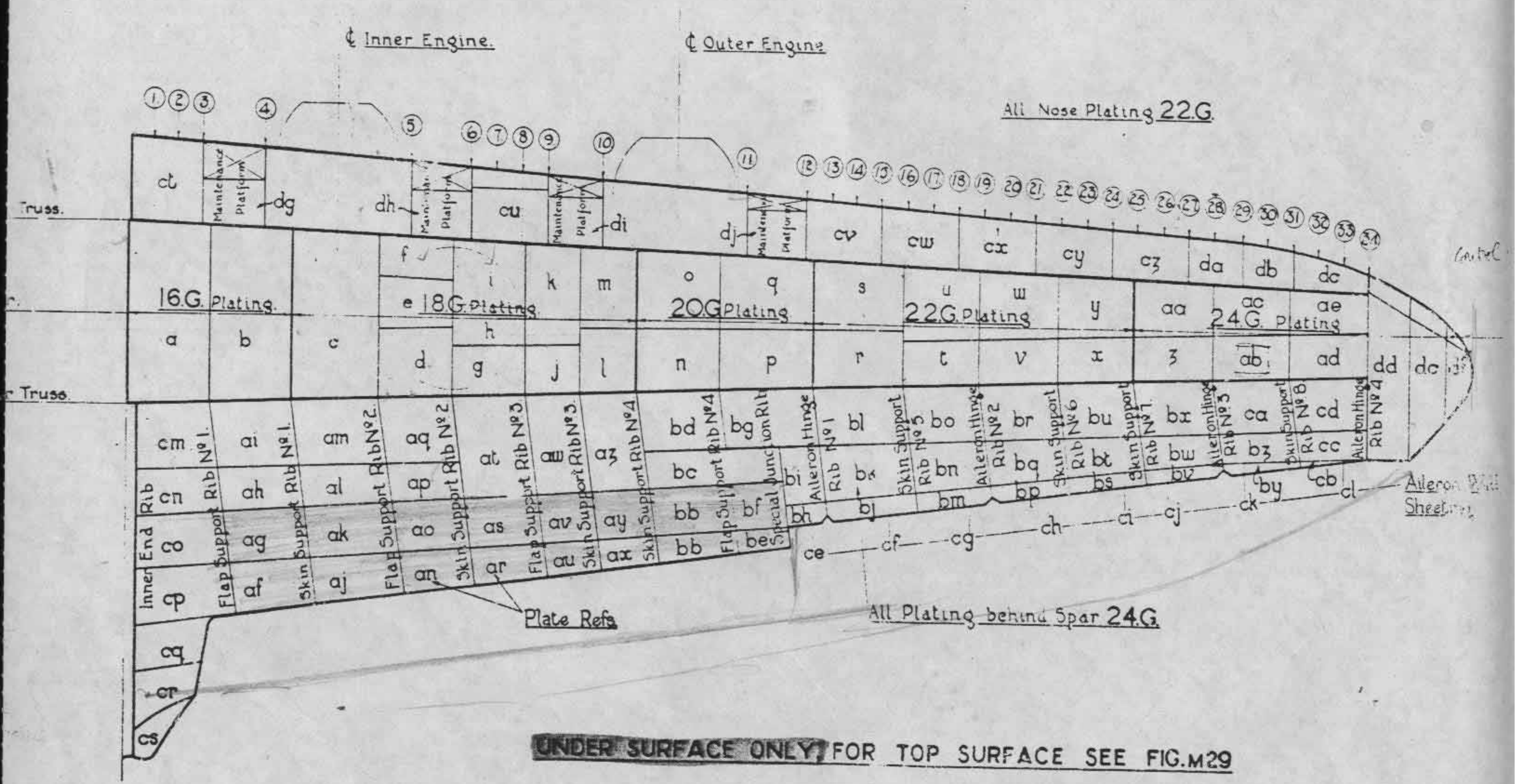
9. Indicator casing
10. Stop screw in indicator casing
11. Nut for winding drum
12. Winding drum stop screw
13. Winding drum
14. Guide drum
15. Locating collar
16. Back plate

SHORT BROS. LTD. ROCHESTER

"TELEVEL" FUEL GAUGE DETAILS

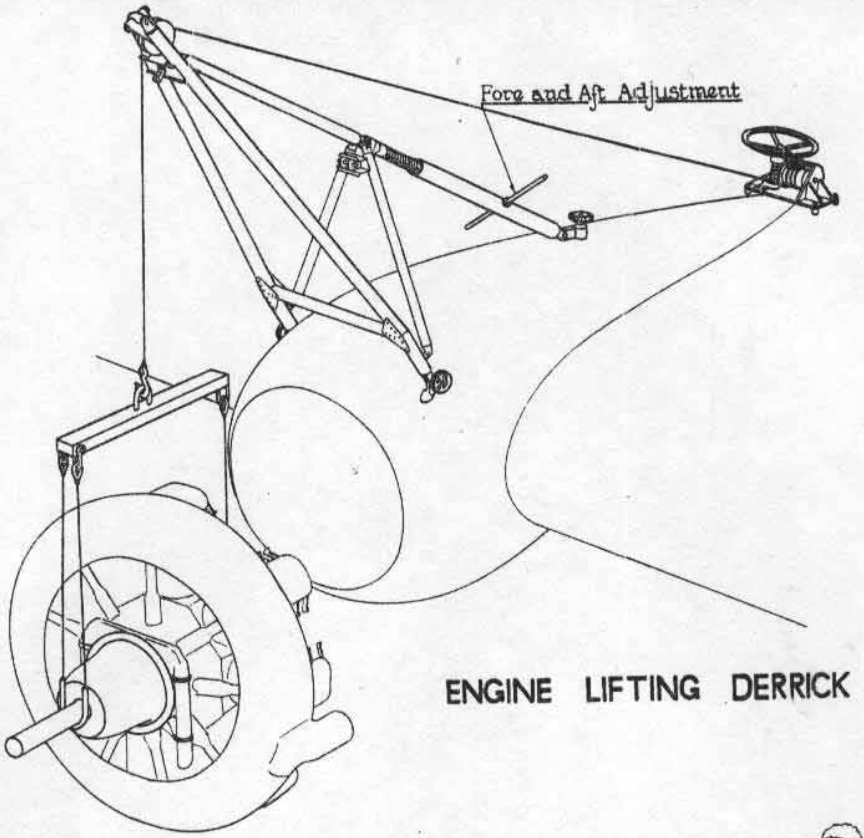


MAIN PLANE, FLAP AND AILERON

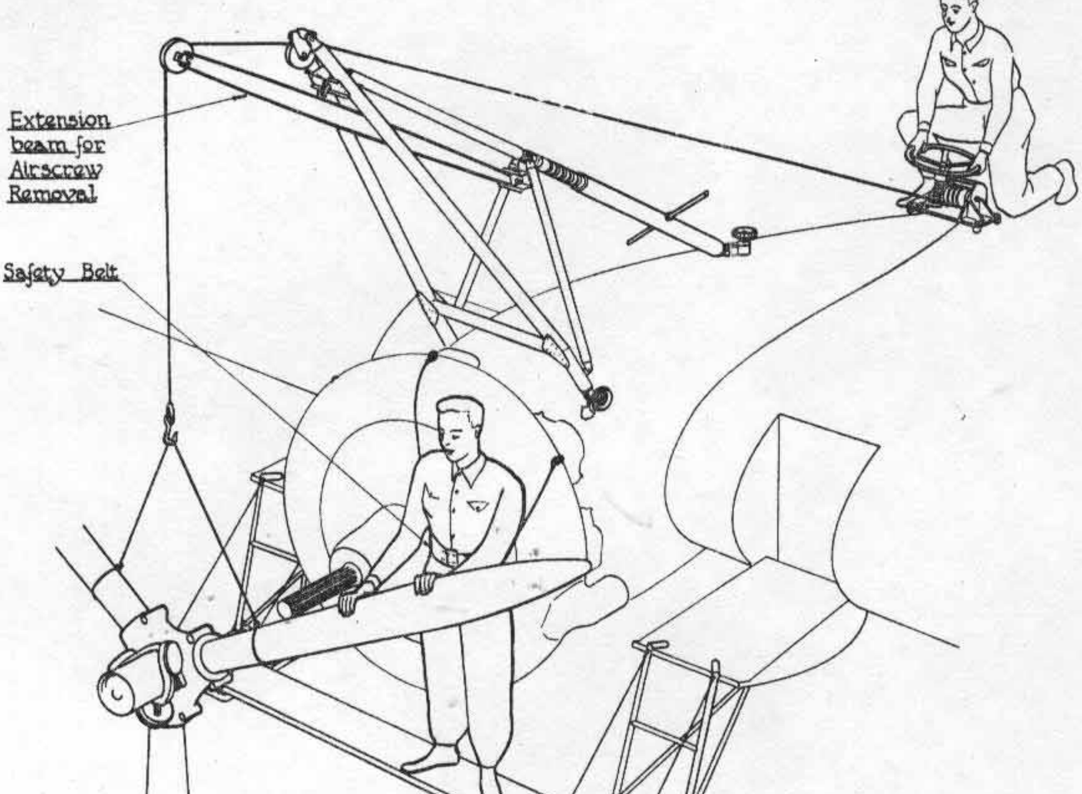


UNDER SURFACE ONLY, FOR TOP SURFACE SEE FIG.M29

1 - 51 - 45



ENGINE LIFTING DERRICK



REMOVAL OF AIRSCREW

SHORT BROS LTD. ROCHESTER.

AIRSCREW AND ENGINE REMOVAL

BEACHING EQUIPMENT

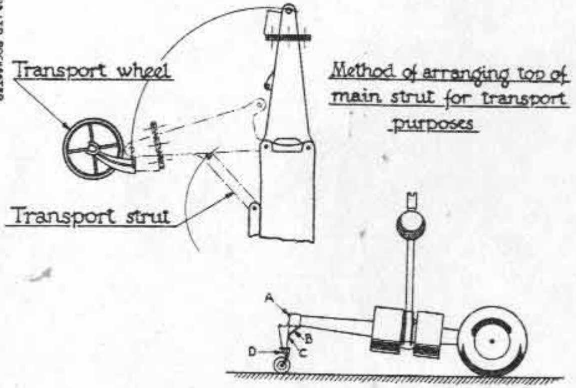


Fig. i. View of gear in wheeling position

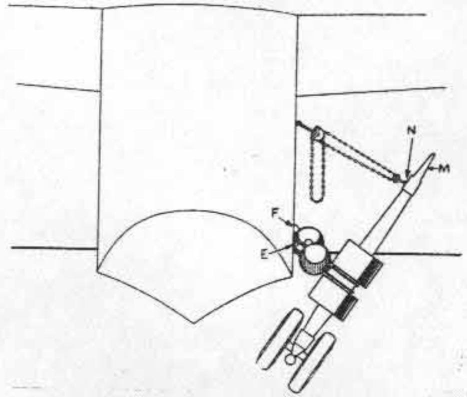


Fig ii Attitude of gear in water, showing method of approaching aircraft. Lower struts first made fast, and then the main leg hauled into an upright position by block and tackle.

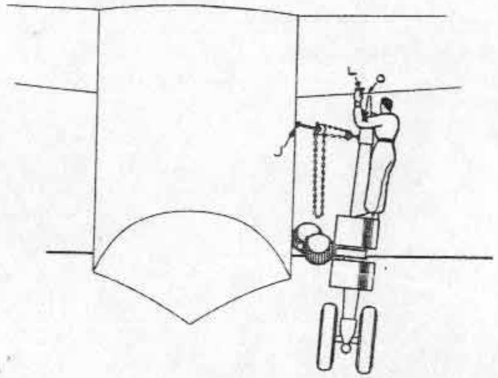


Fig iii Method of securing fitting to plane.

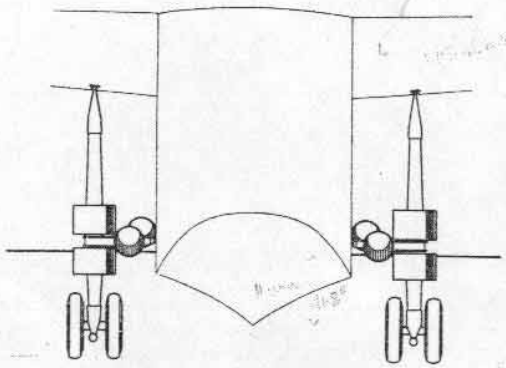


Fig iv Both legs in position in water.

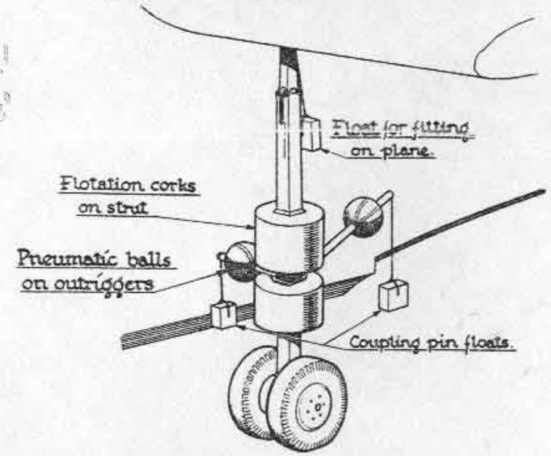


Fig. v. View of leg on land.

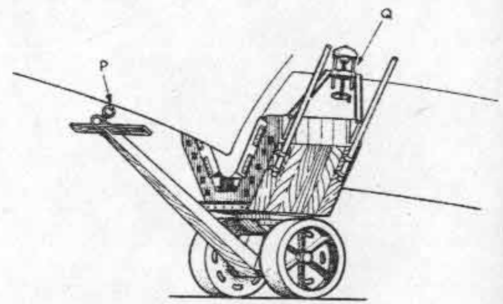
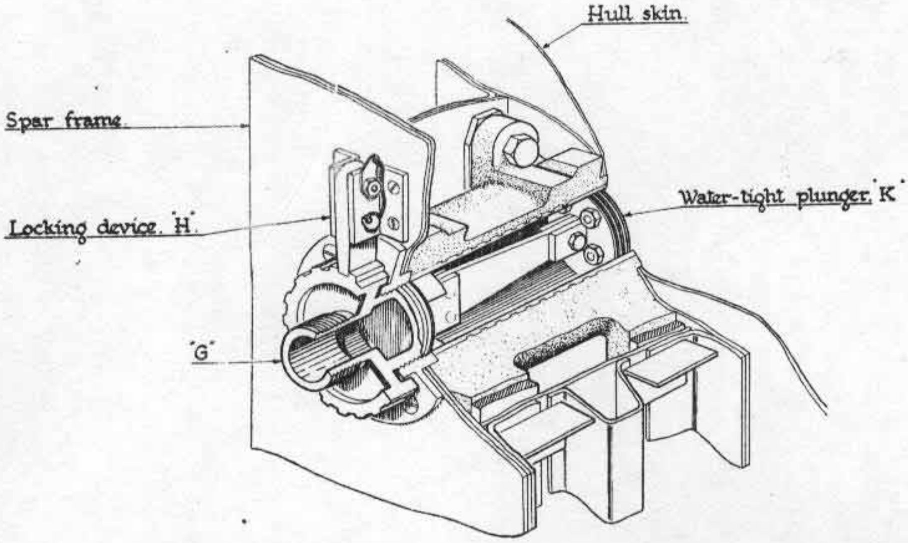
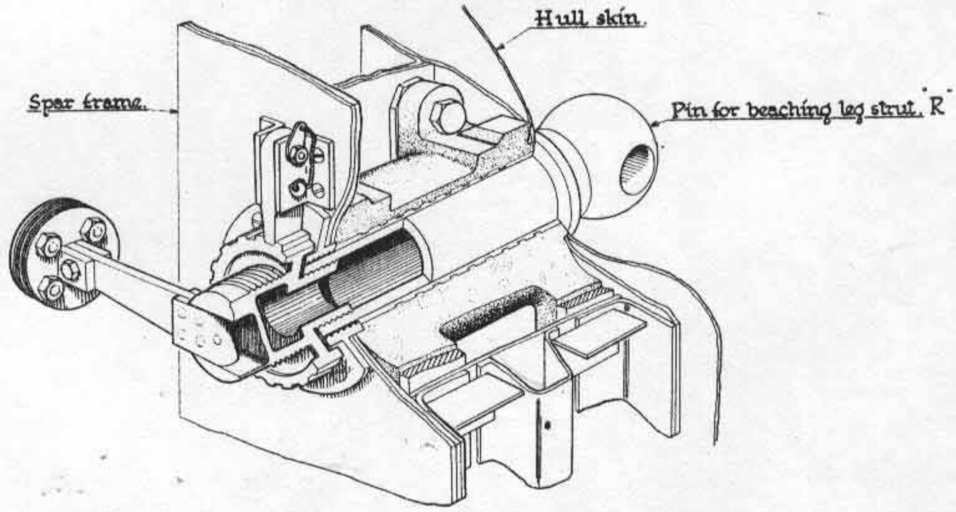


Fig vi View of tail trolley on land.

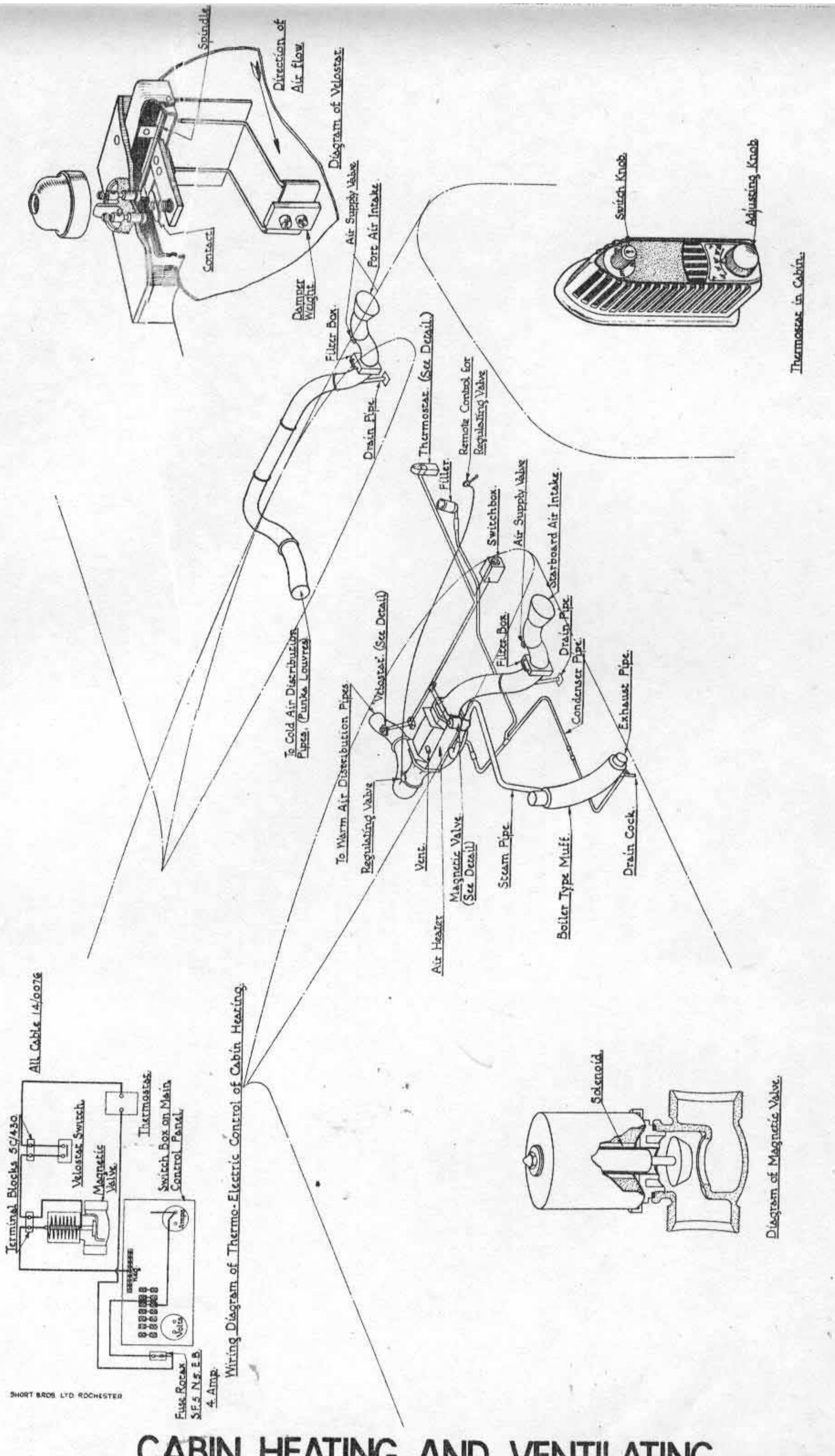
SHORT BROS LTD ROCHESTER



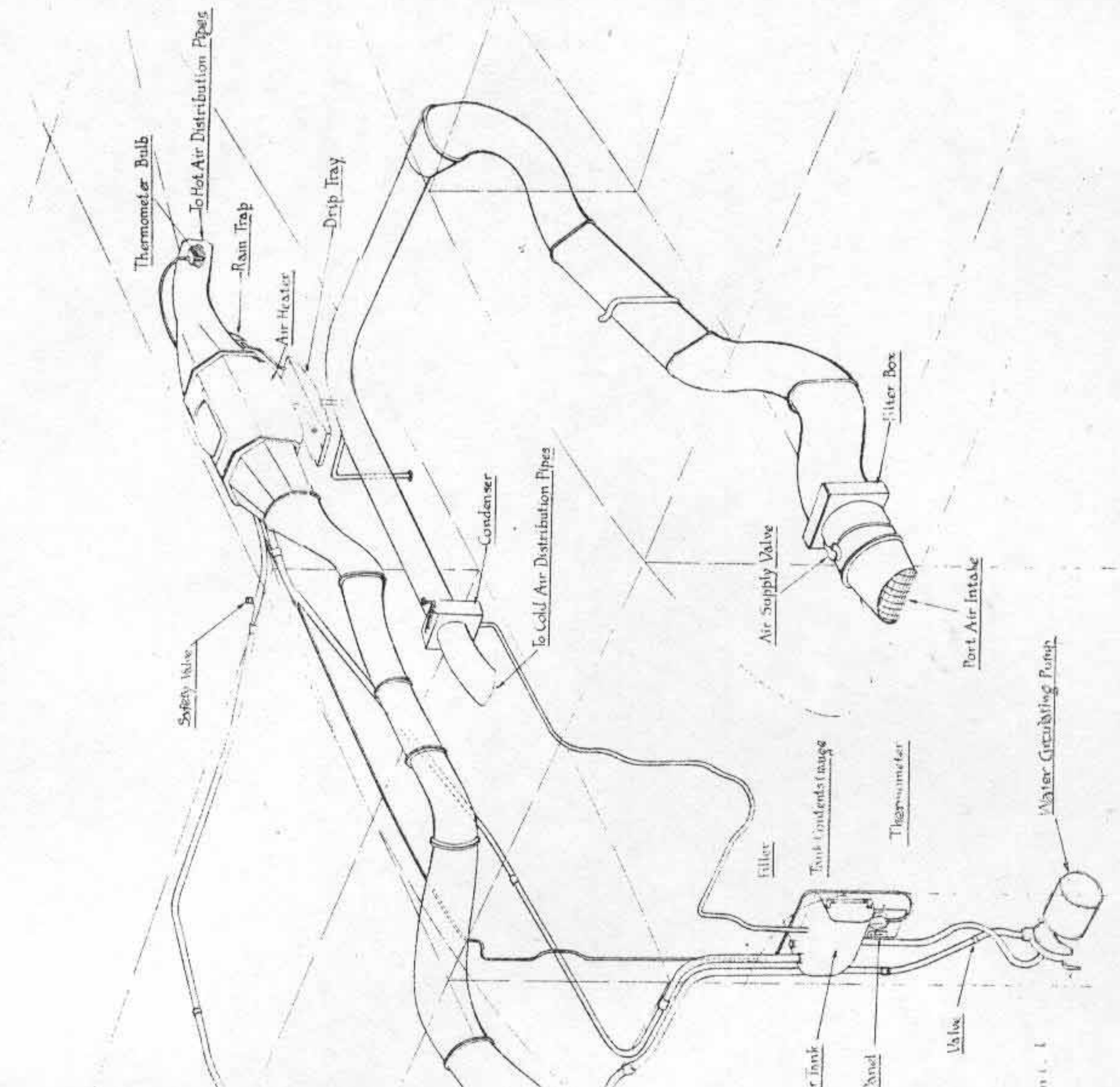
Sectional view of fitting in hull, showing position of water-tight plunger.



View showing plunger extracted, reversed and used as a lever for screwing in pin.



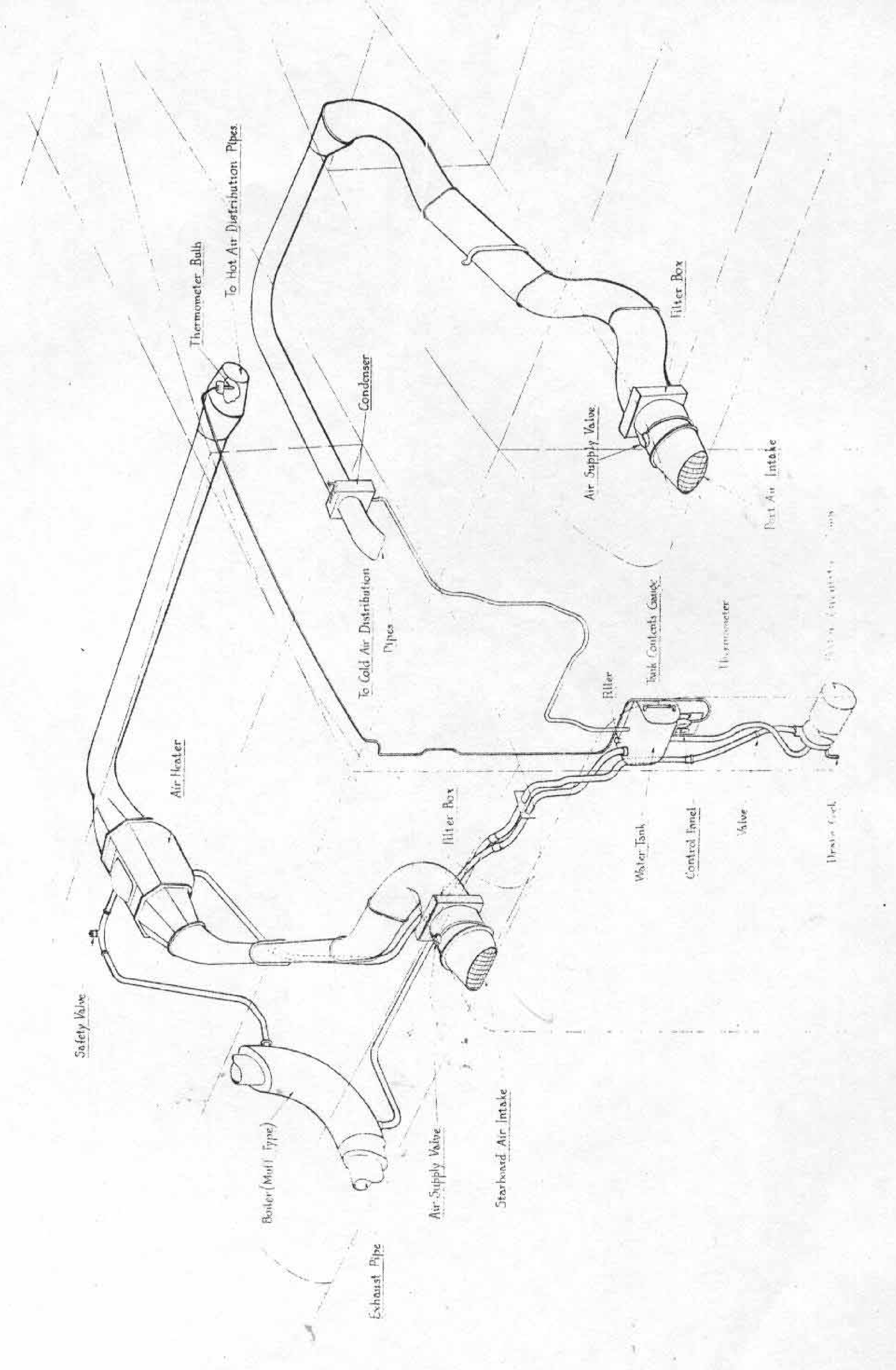
CABIN HEATING AND VENTILATING



HEATING & VENTILATING

PASSENGER AIRCRAFT

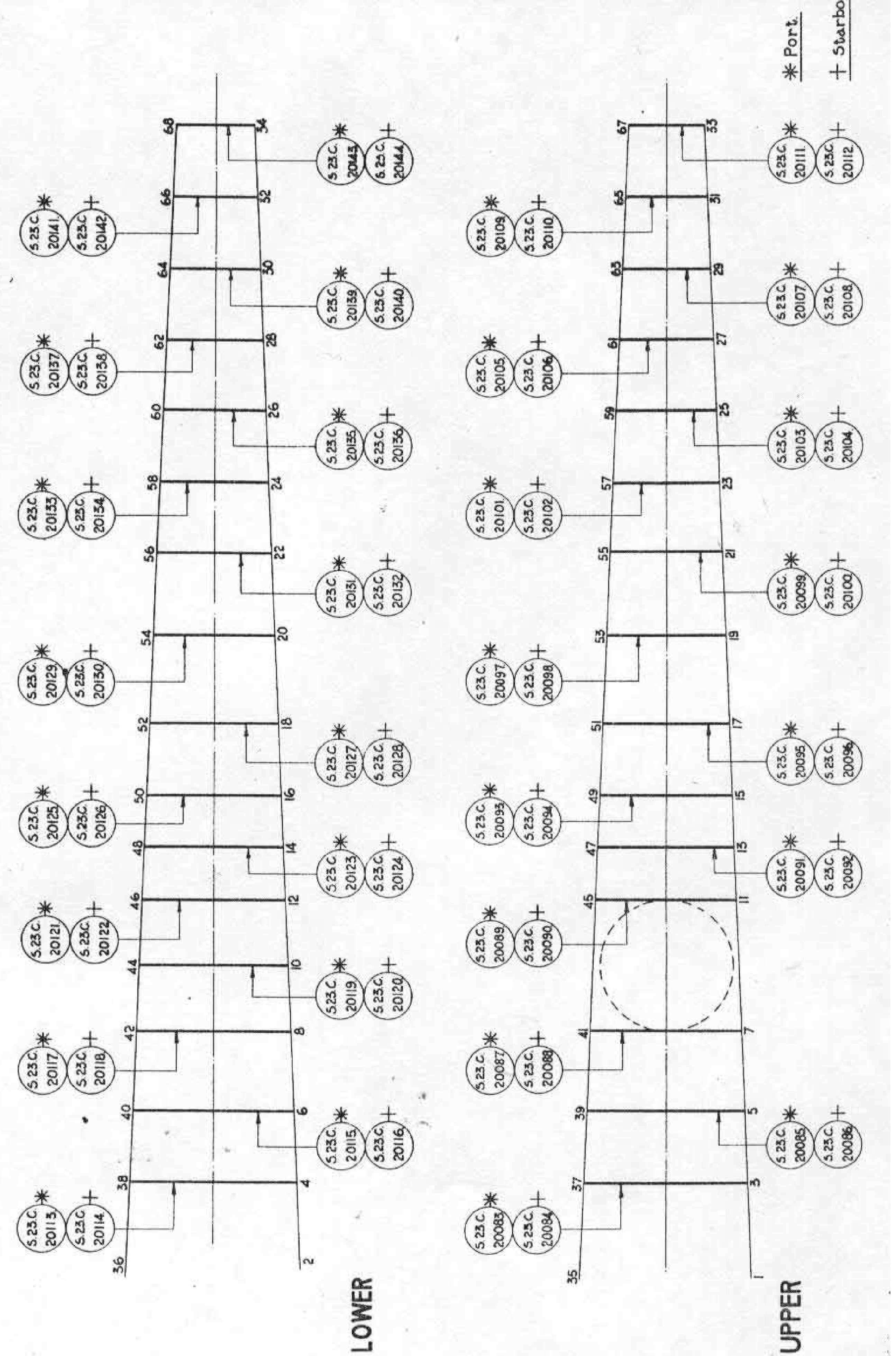
M33



HEATING & VENTILATING.

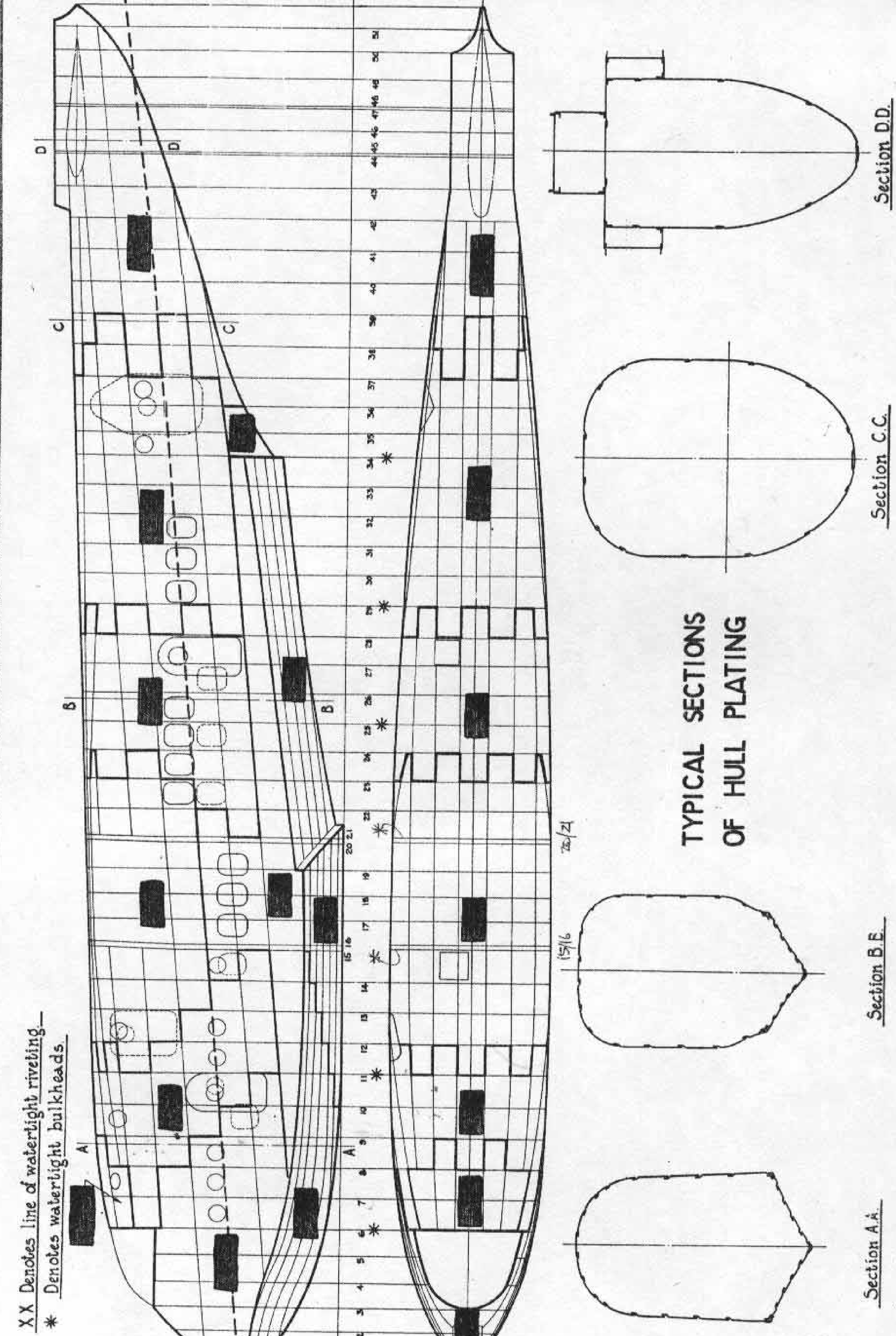
MAIL AIRCRAFT

M33A

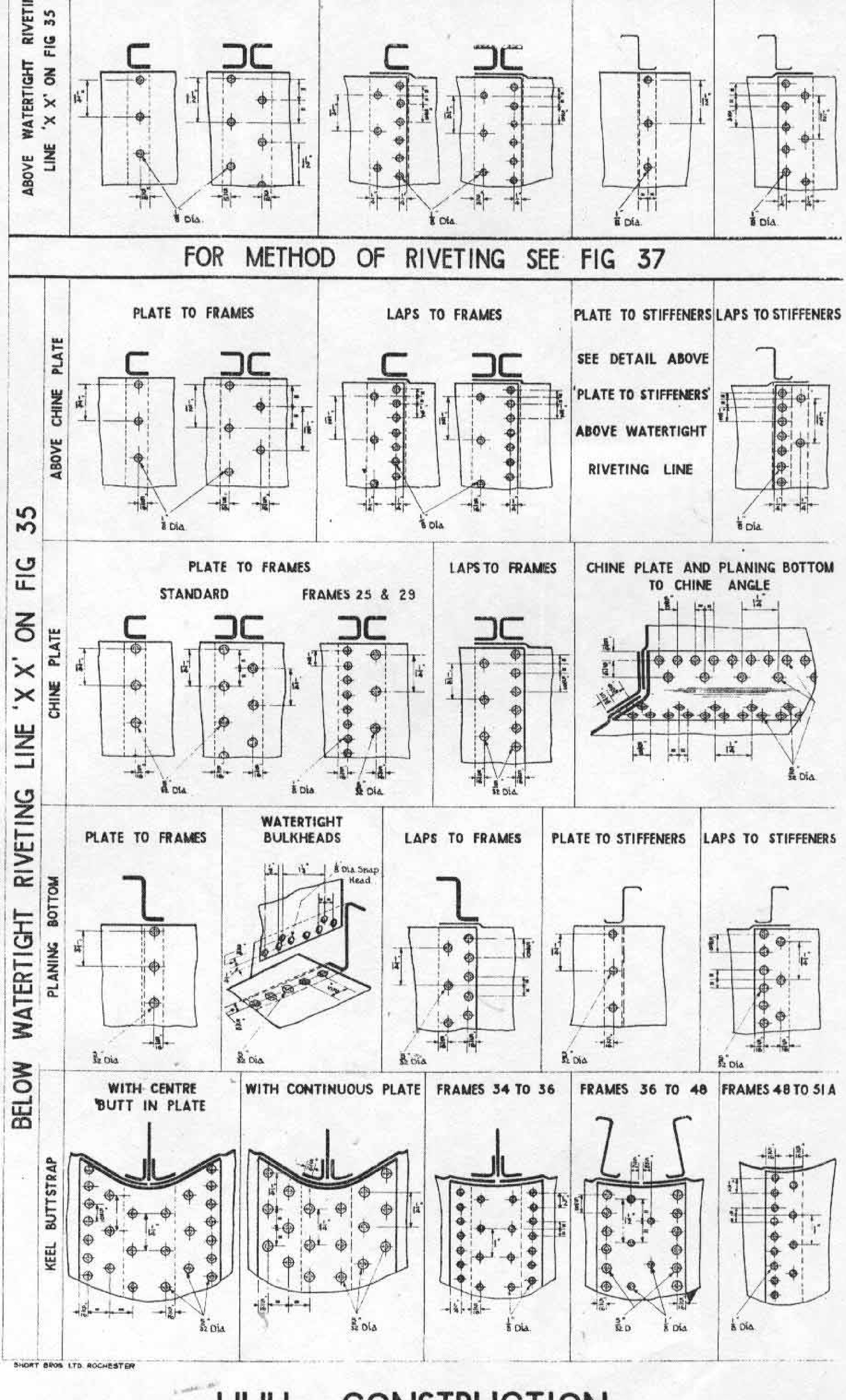


SHORT BROS LTD ROCHESTER

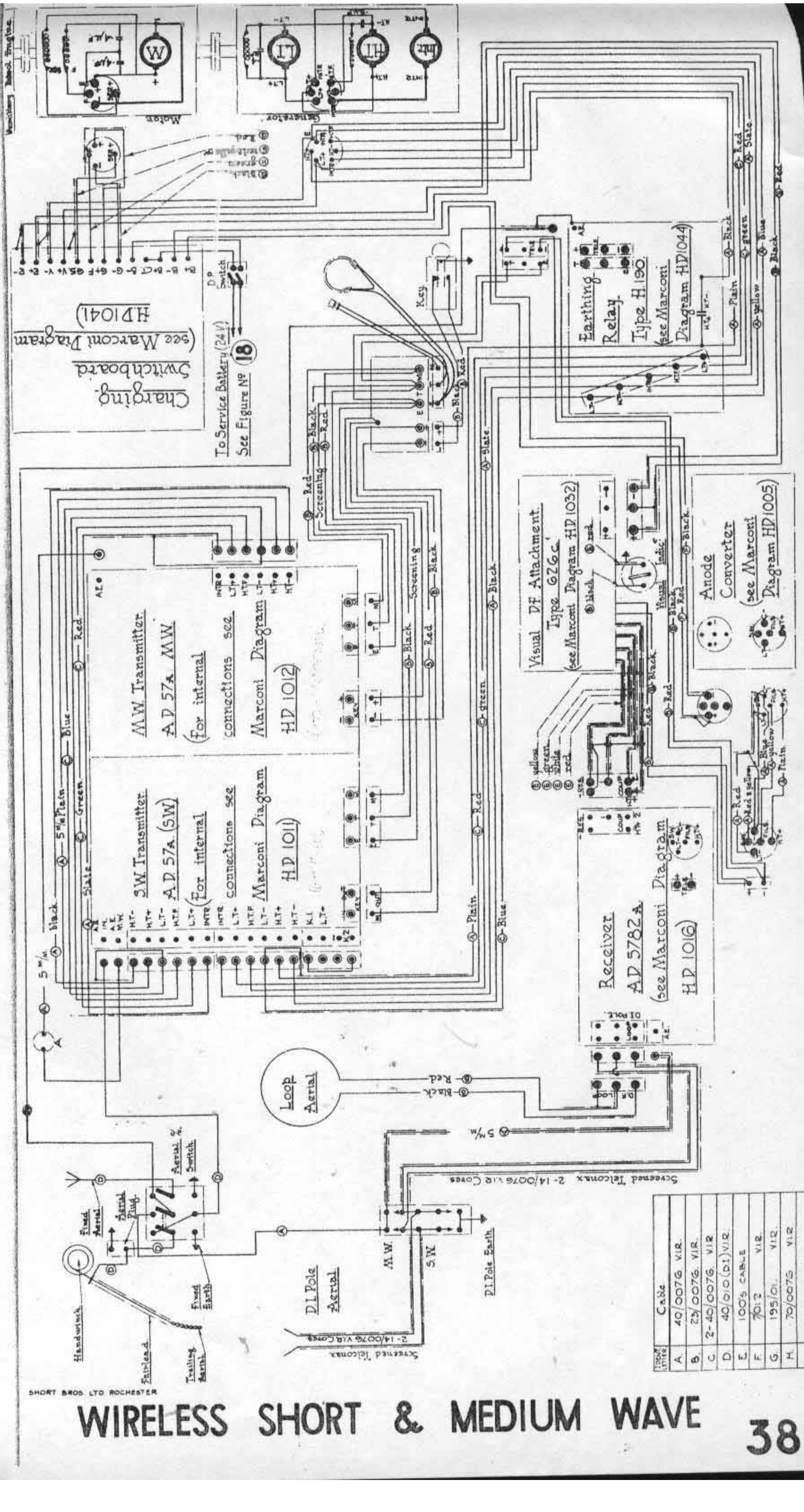
MAIN PLANE SPAR DRAG MEMBERS



HULL PLATING



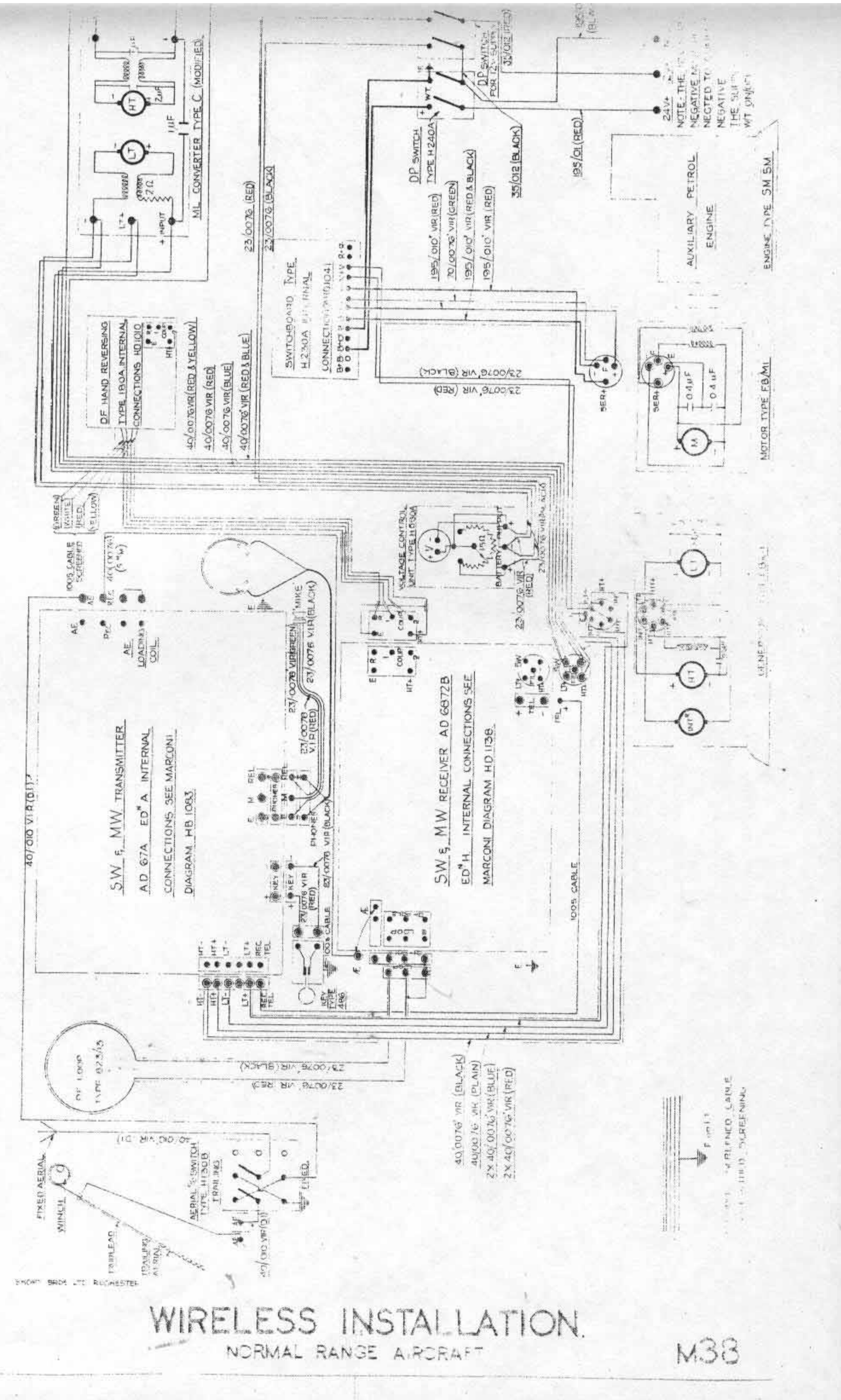
HULL CONSTRUCTION



Ident Letter	Cable
A	40/007G V.I.R.
B	23/007G V.I.R.
C	2-40/007G V.I.R.
D	40/010 (D.I.) V.I.R.
E	100's CABLE
F	70/.12 V.I.R.
G	195/.01 V.I.R.
H	70/007G V.I.R.

SHORT BROS LTD ROCHESTER

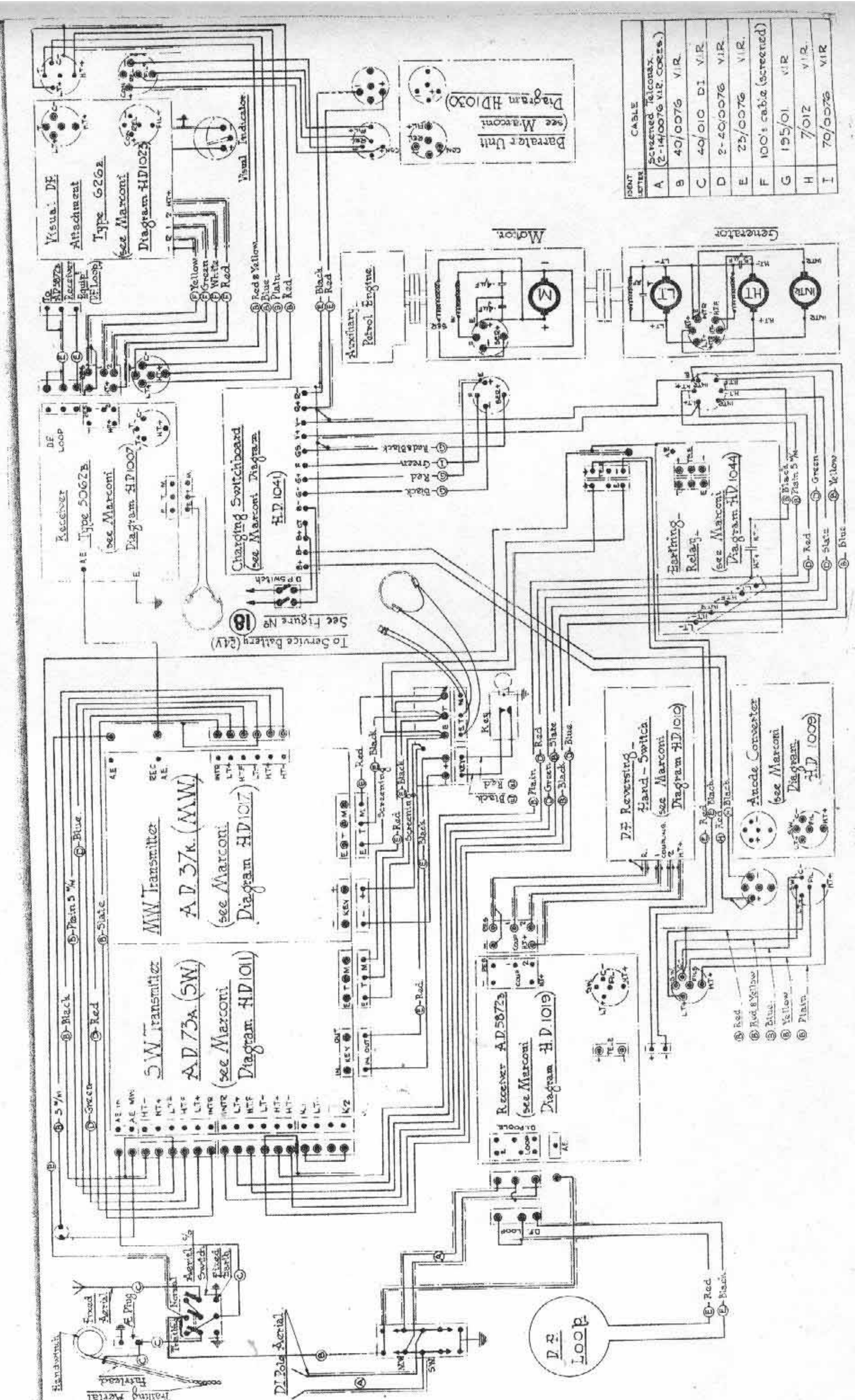
WIRELESS SHORT & MEDIUM WAVE



WIRELESS INSTALLATION.

NORMAL RANGE AIRCRAFT

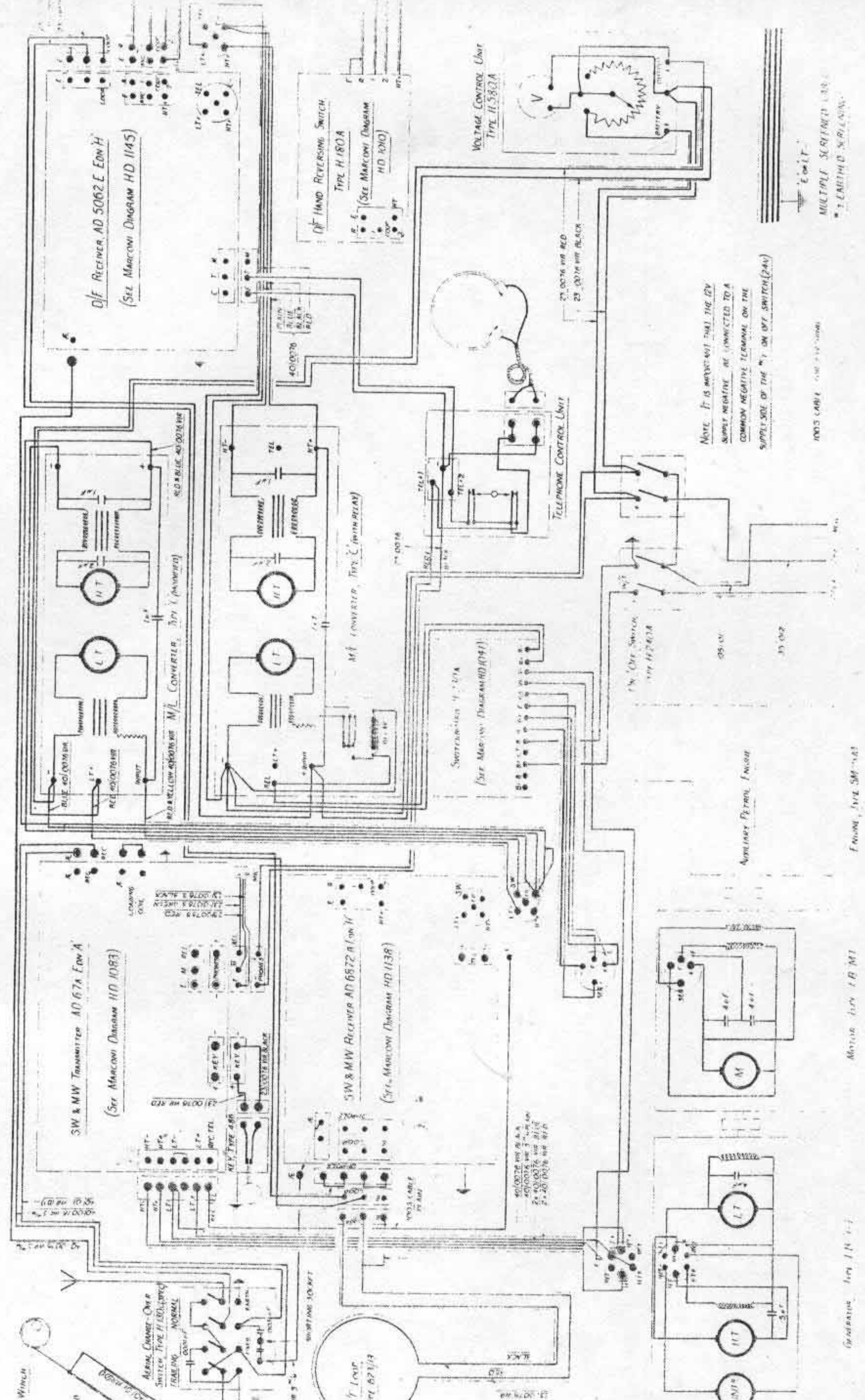
M38



WIRELESS SHORT & MEDIUM WAVE

Caverdien

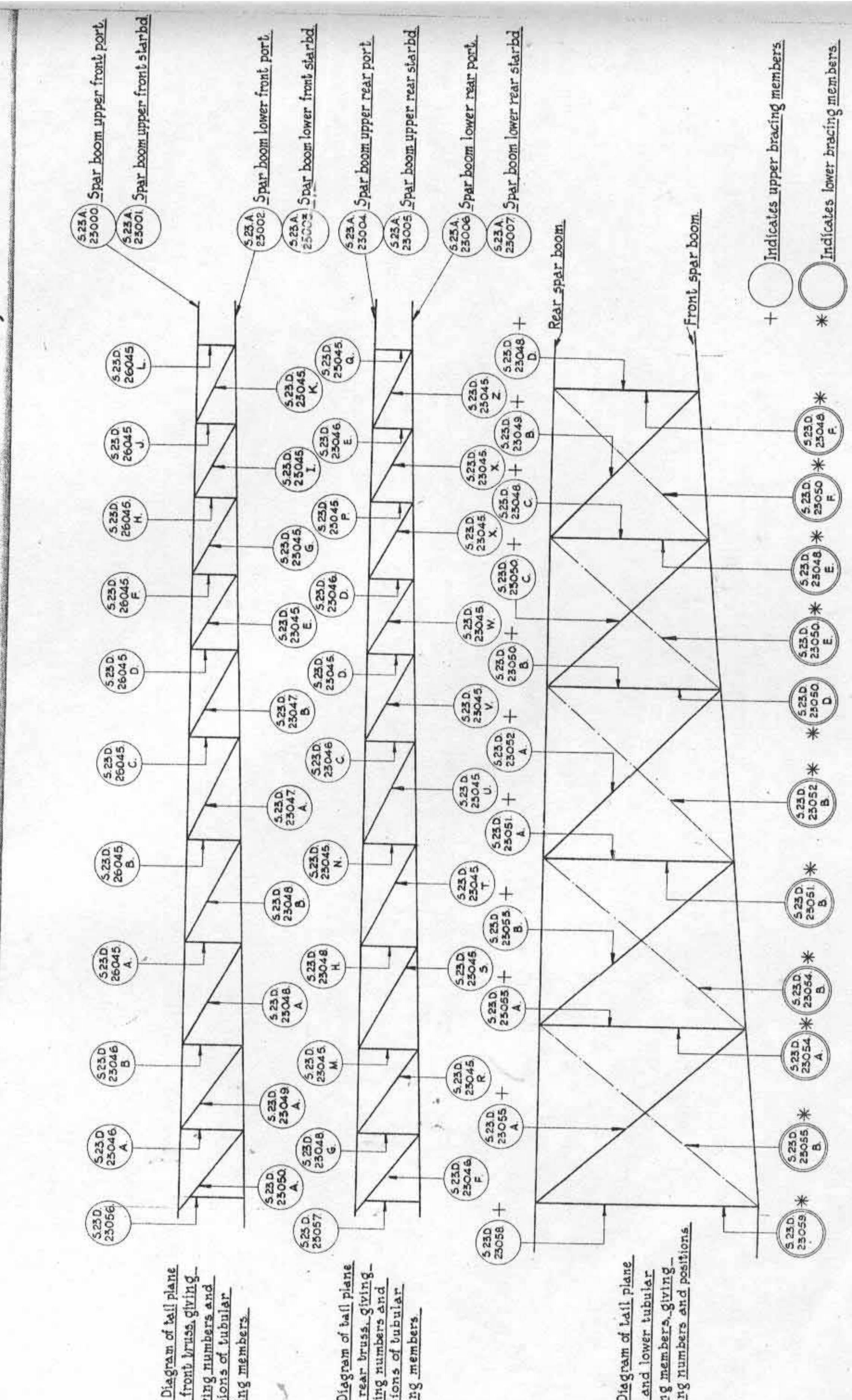
38A



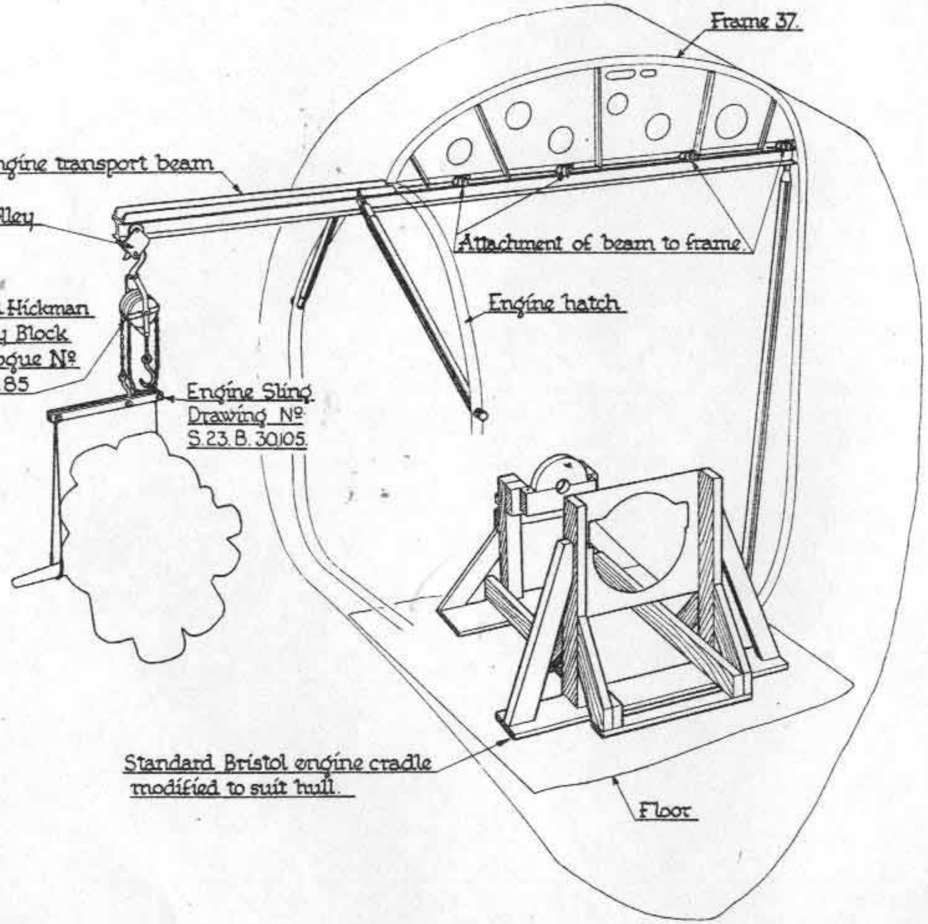
WIRELESS INSTALLATION.

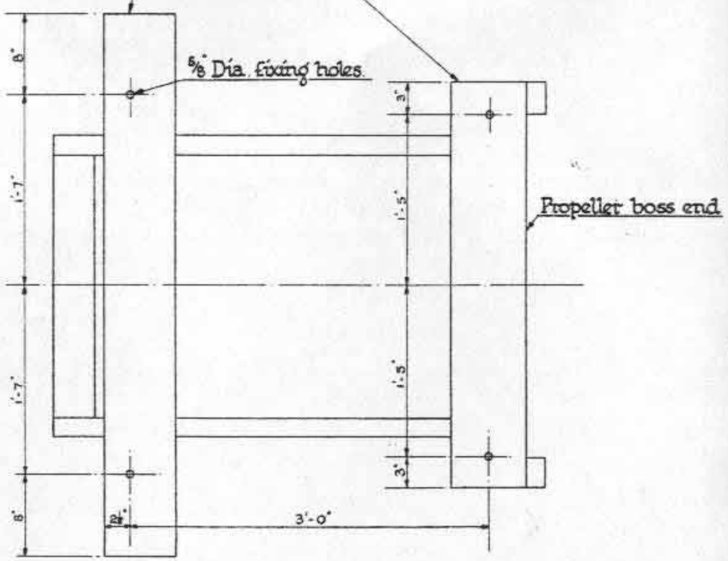
LONG RANGE AIRCRAFT.

M38A



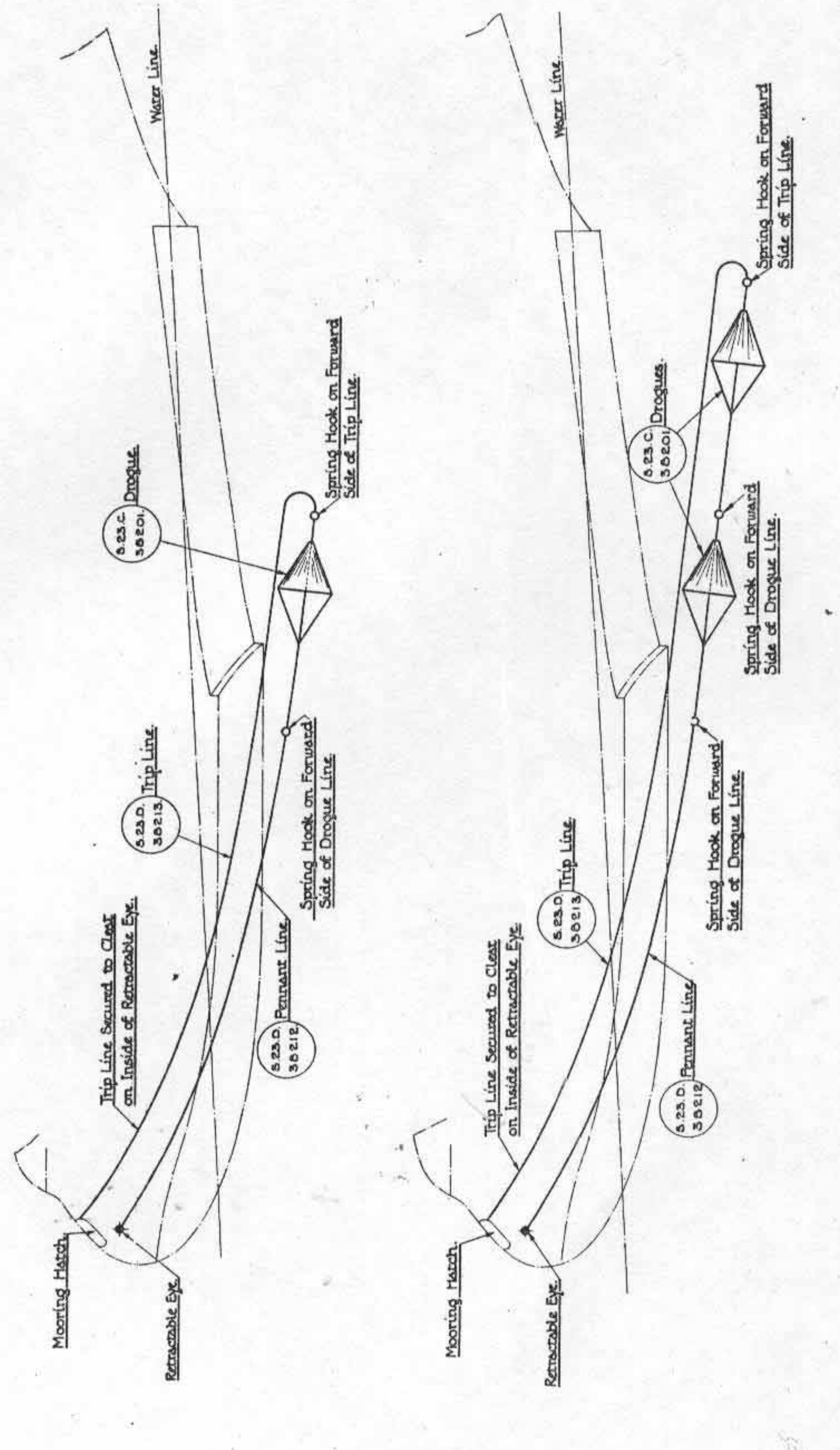
TAIL PLANE SPAR MEMBERS





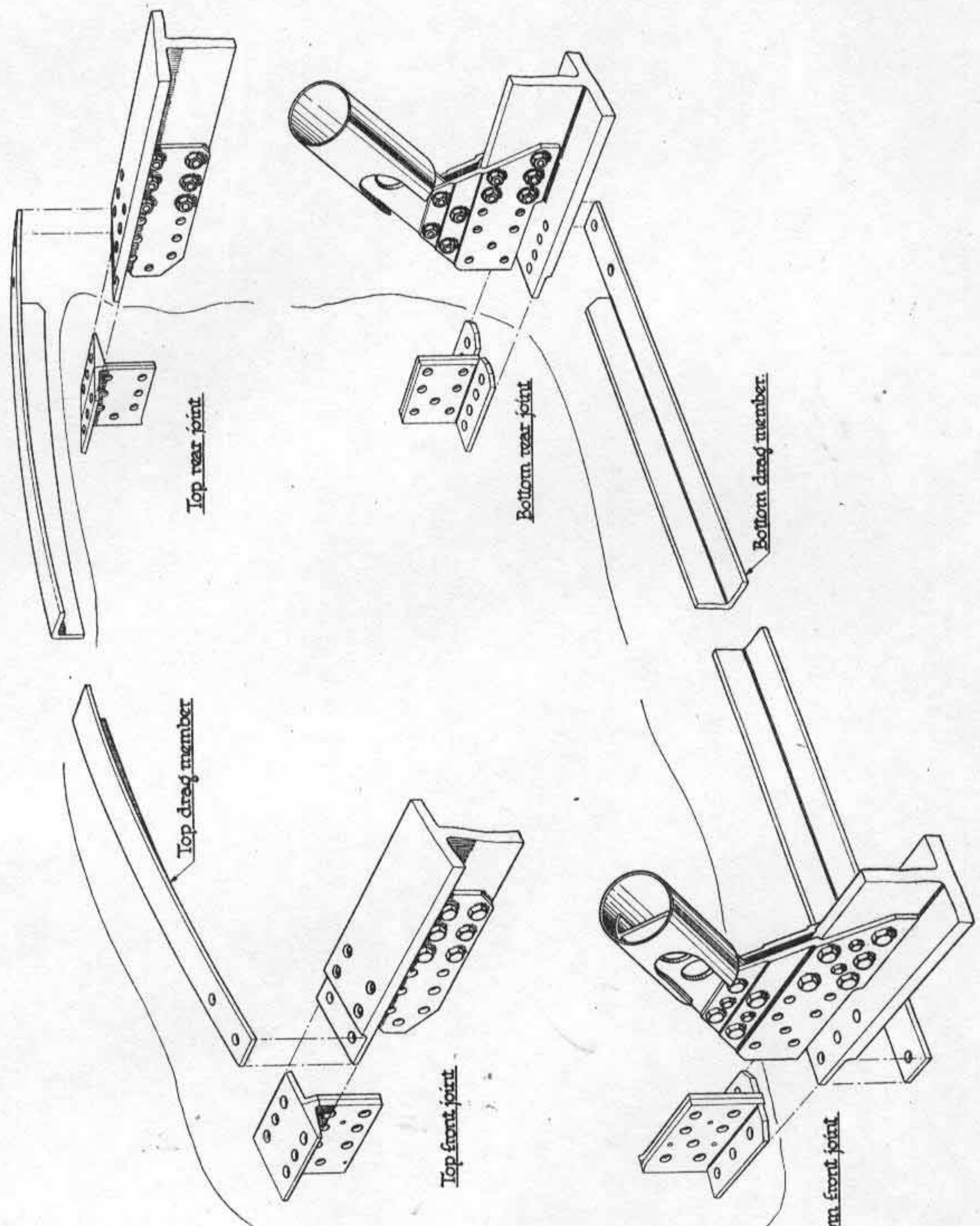
Modification to standard Bristol cradle

SPARE ENGINE TRANSPORT



SHORT BROS. LTD. ROCHESTER.

OPERATION OF DROGUES

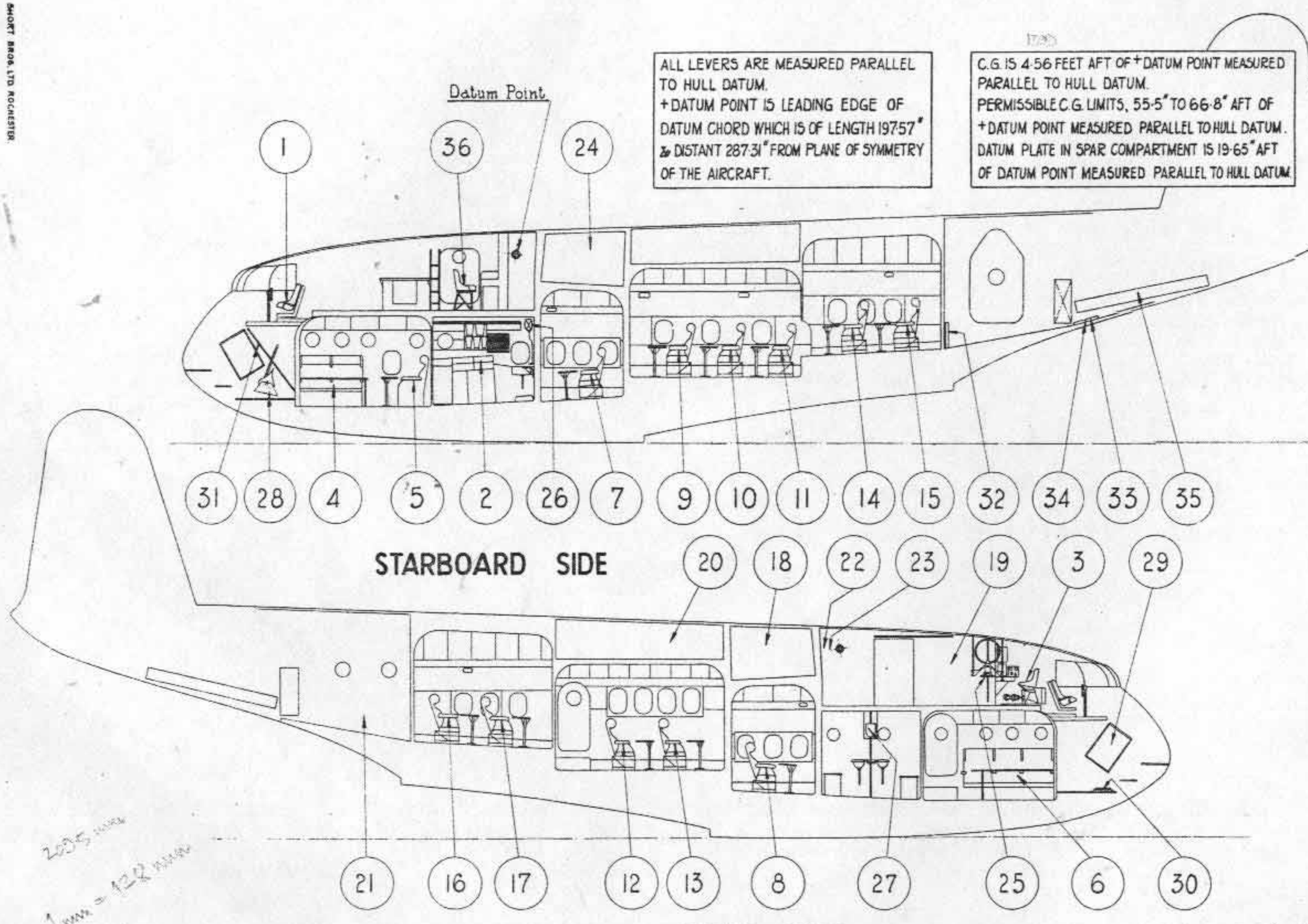


SHORT BROS LTD. ROCHESTER

PLANE ATTACHMENT TO HULL

LOAD DISTRIBUTION. DAY

SHORT BROS. LTD. ROCHESTER.



INDEX NUMBER	DESCRIPTION	WEIGHT IN LBS	LEVER FROM DATUM IN FEET FORWARD	AFT.
1	2 Pilots	340	17.42	
2	2 Stewards	340	2.5	
3	1 W/T Operator	170	14.92	
4	2 Passengers in Forward Cabin	340	14.0	
5	2 Passengers in Forward Cabin	340	7.8	
6	3 Passengers in Forward Cabin	510	12.8	
7	2 Passengers in Spar Compartment	340		5.75
8	1 Passenger in Spar Compartment	170		5.75
9	2 Passengers in Promenade Cabin	340		12.3
10	2 Passengers in Promenade Cabin	340		16.15
11	2 Passengers in Promenade Cabin	340		20.0
12	1 Passenger in Promenade Cabin	170		16.25
13	1 Passenger in Promenade Cabin	170		12.4
14	2 Passengers in Rear Cabin	340		25.0
15	2 Passengers in Rear Cabin	340		28.8
16	1 Passenger in Rear Cabin	170		28.8
17	1 Passenger in Rear Cabin	170		25.0
18	Spar Mail Compartment			5.1
19	Forward Mail Compartment		5.21	
20	Bunk Stowage			15.0
21	Rear Freight Compartment			37.1
22	Oil 22 Gallons at 9lbs/Gall.	198		0.16
23	Oil 22 Gallons at 9lbs/Gall	198		1.14
24	Petrol 600 Gallons at 7.6lbs/Gall	4560		5.10

Items below ARE included in the Tare Weight.

25	Wireless Equipment	317	13	
26	Domestic Water 5 Gallons	50		1.0
27	Washing Water 5 Gallons	50	2.3	
28	Anchor & Rope	84	18.5	
29	Drogue & Tripline	41	20.6	
30	Cables Towing & Mooring, Heaving & Slip Lines	51	19.5	
31	Boat Hook	12	18.3	
32	Bilge Pump & Hose	19		32.5
33	Plane Tip Float Pump	4		43.25

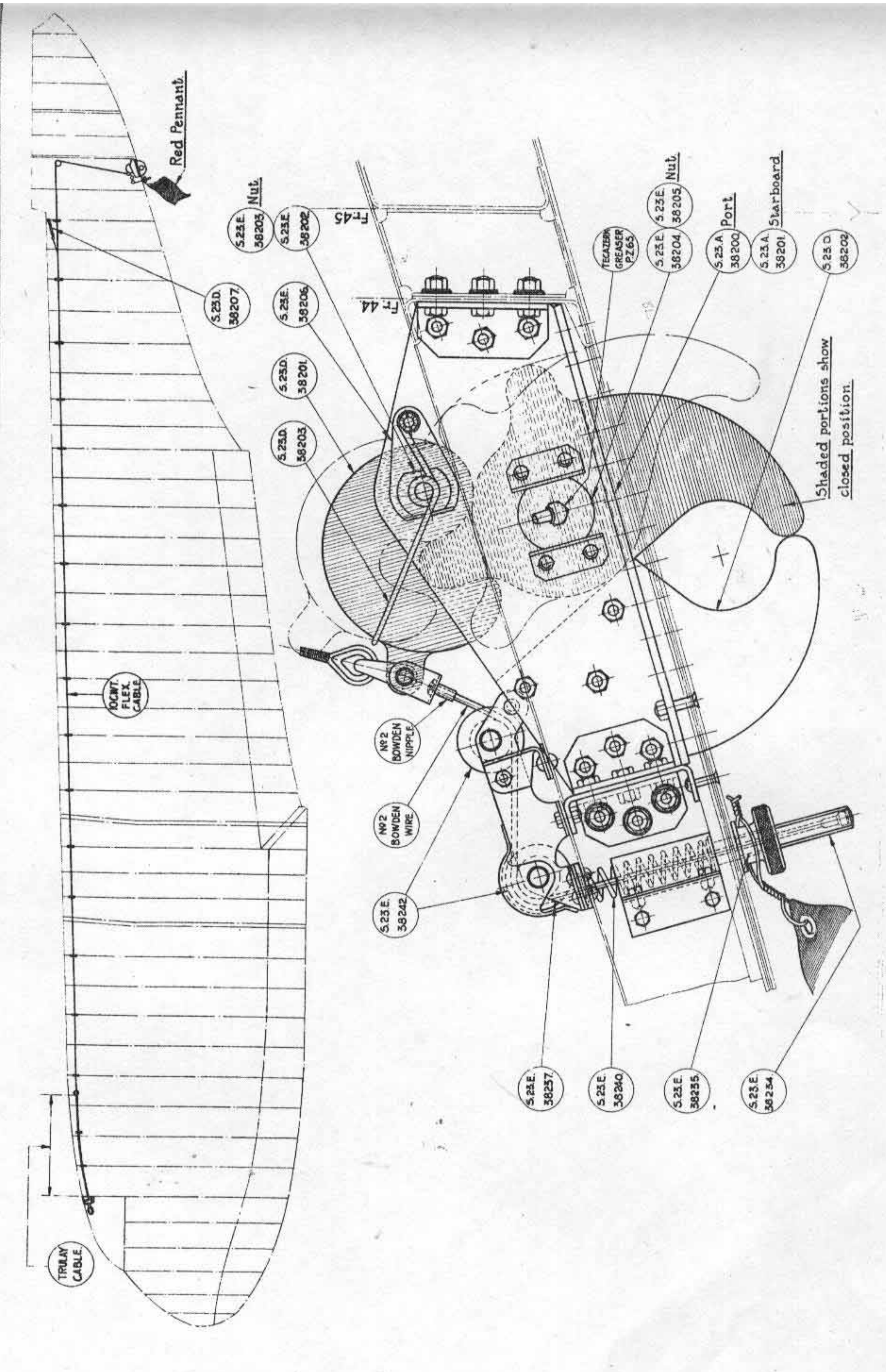
Items below are NOT included in the Tare Weight.

34	Engine, Airscrew & Seat Covers	53		43.25
35	Engineer's Platforms & Cradles	113		44.5
*36	Purser	170	3.75	

* Maximum Number of crew to be FIVE. See Items 1, 2 & 3.

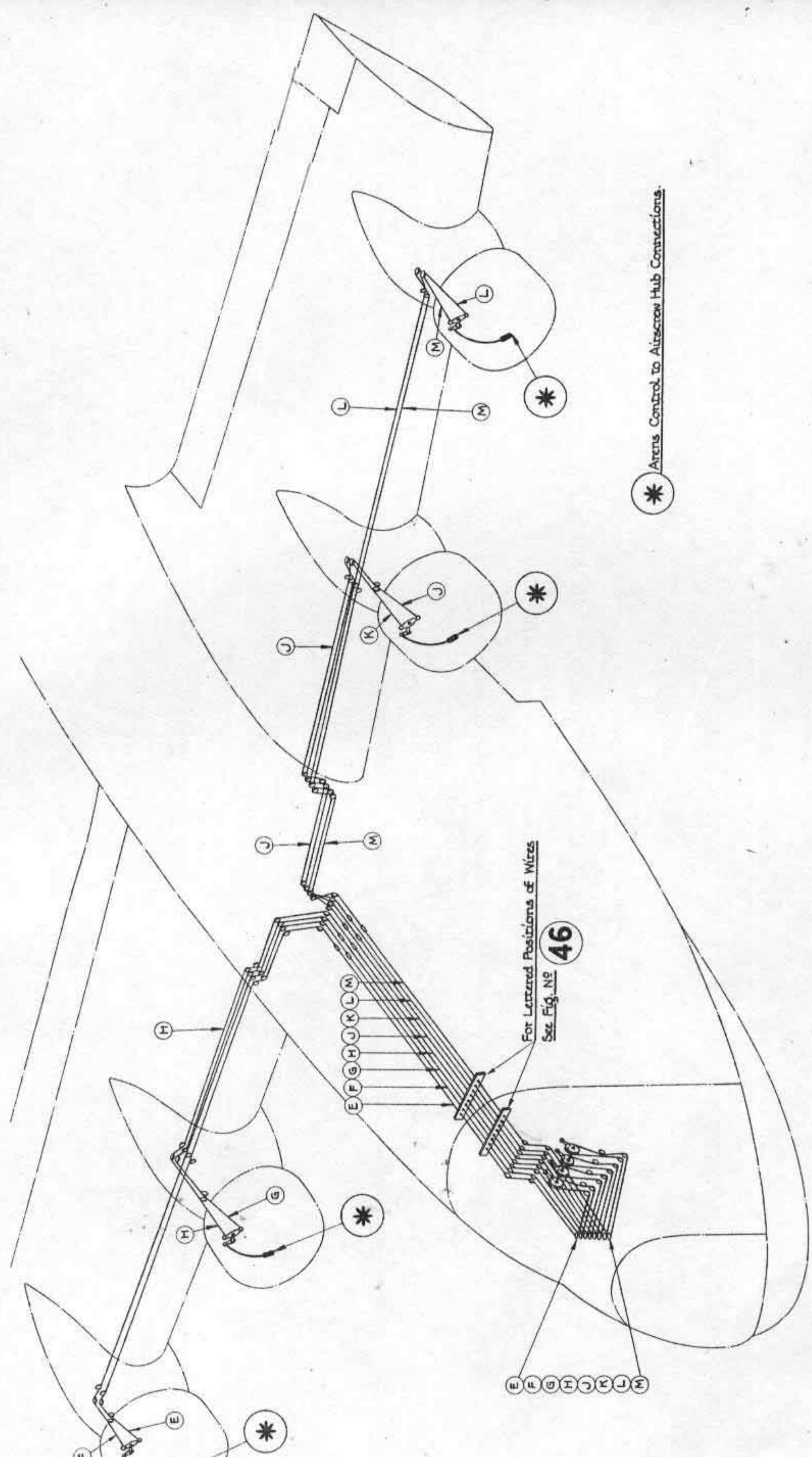
TARE WEIGHT = 27845 LBS.

MAX. AUTHORIZED WEIGHT = 40500 LBS.



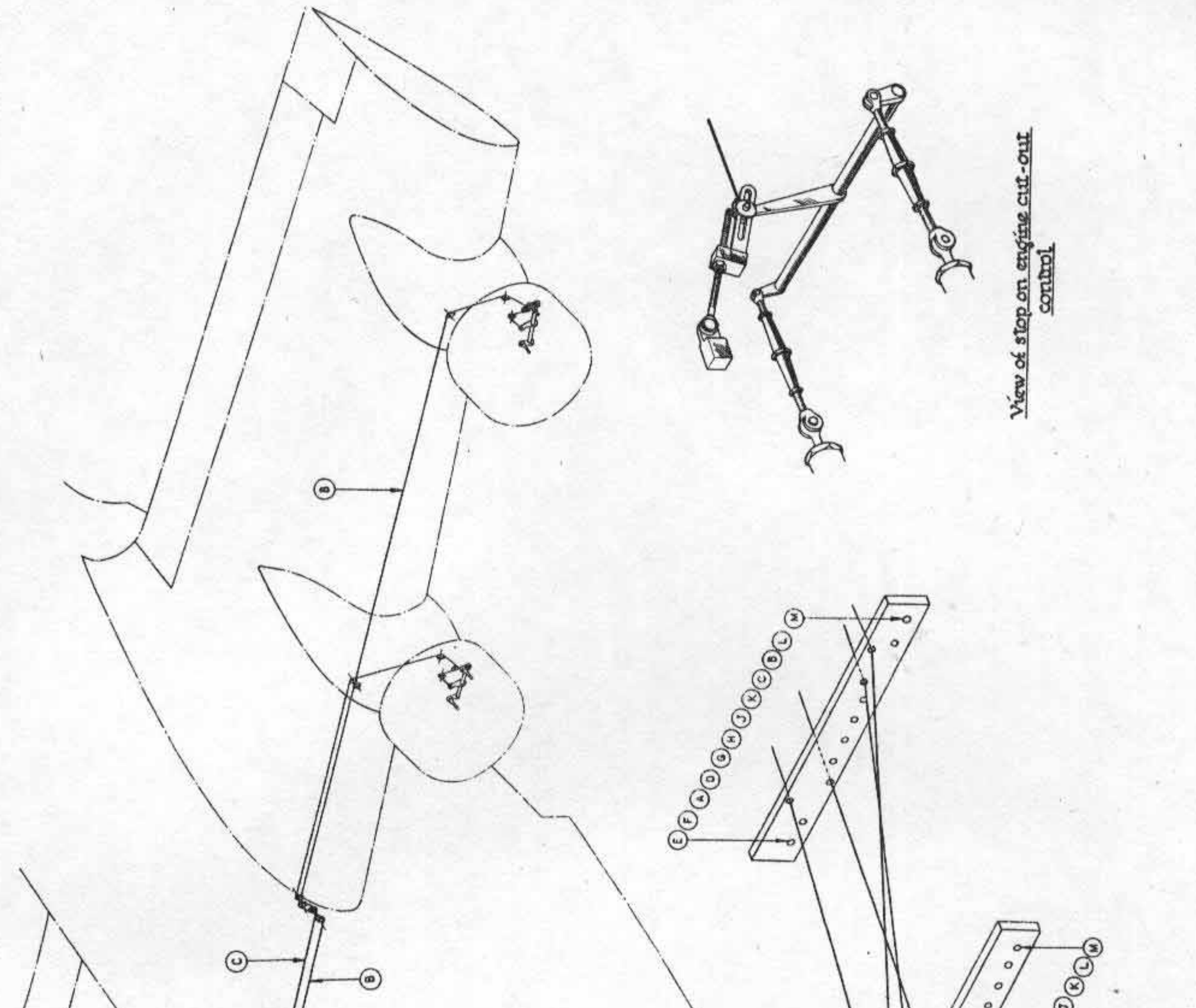
SHORT BROS LTD ROCHESTER

SLIP RELEASE HOOK



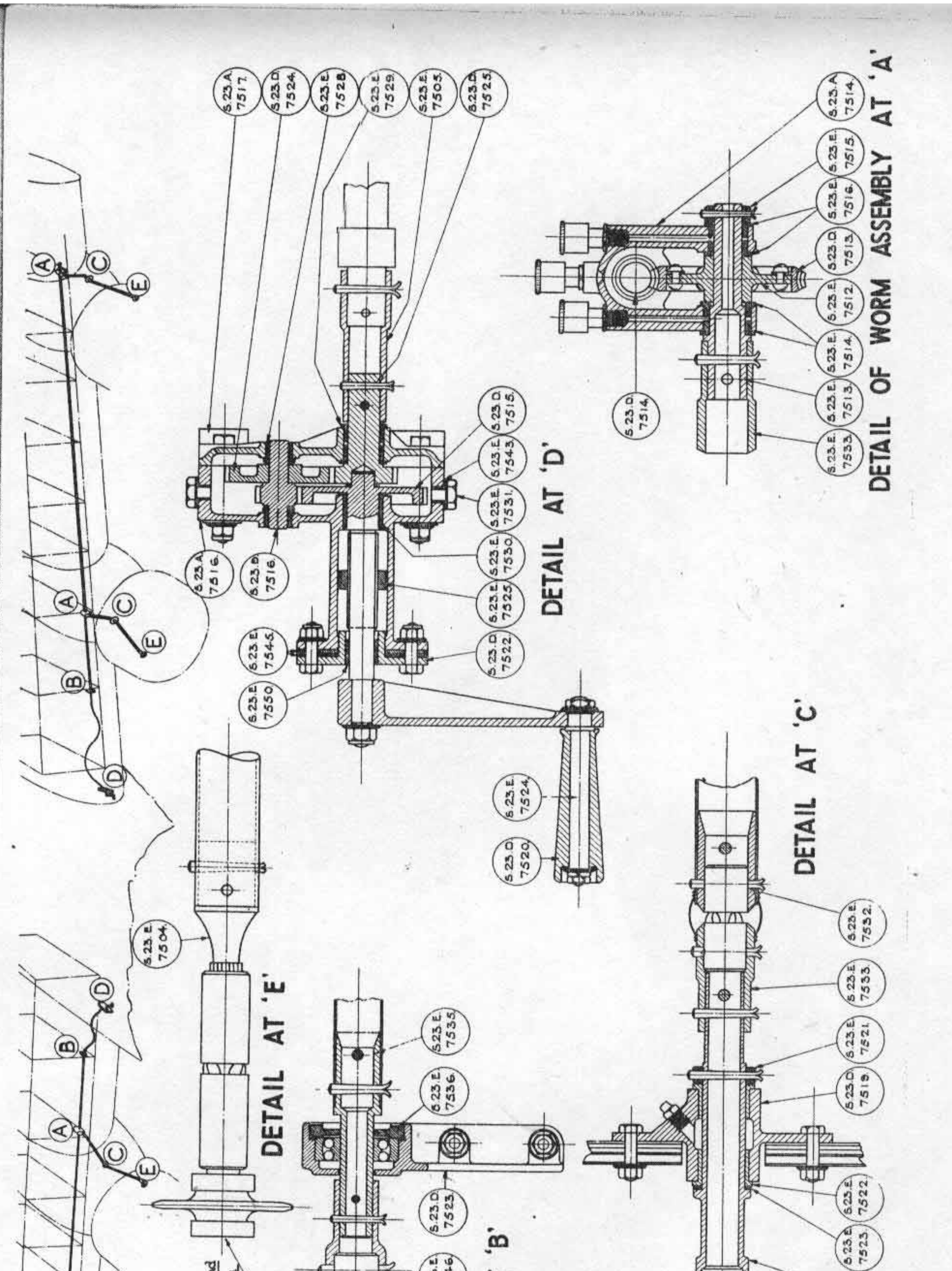
SHORT BROS LTD ROCHESTER.

AIRSCREW PITCH CONTROLS



SHORT BROS. LTD. ROCHESTER.

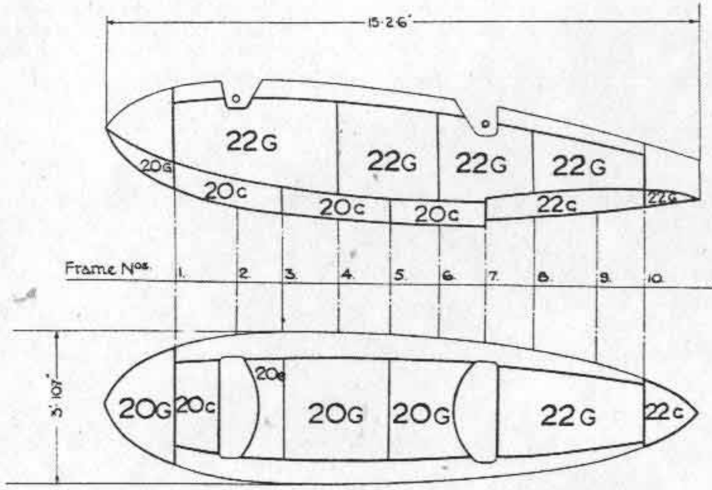
ENGINE CUT-OUT CONTROLS



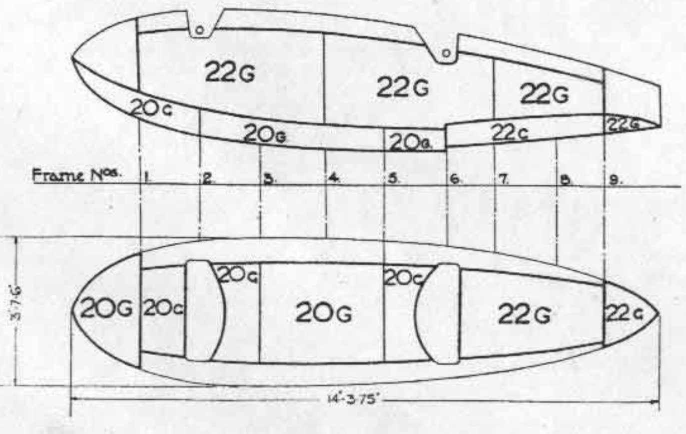
COWL GILL CONTROLS

PLANE TIP FLOAT AND CHASSIS

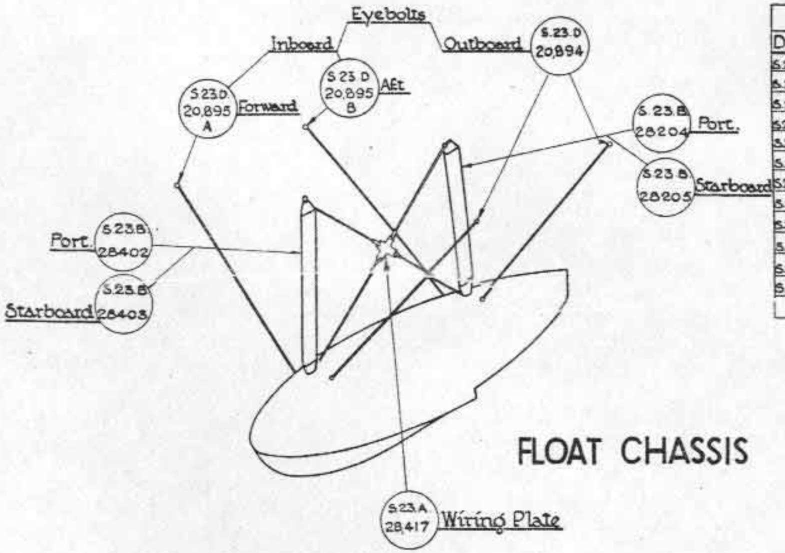
SHORT BROS LTD ROCHESTER



FLOAT TYPE I

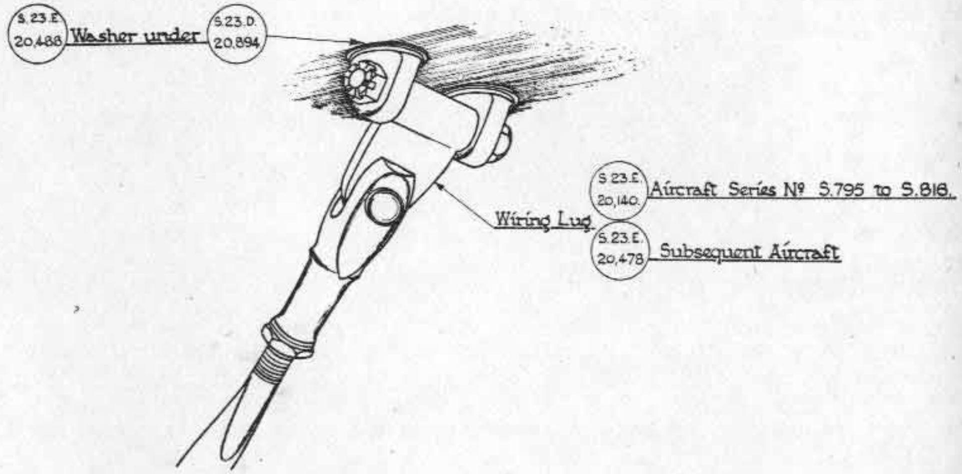


FLOAT TYPE 2



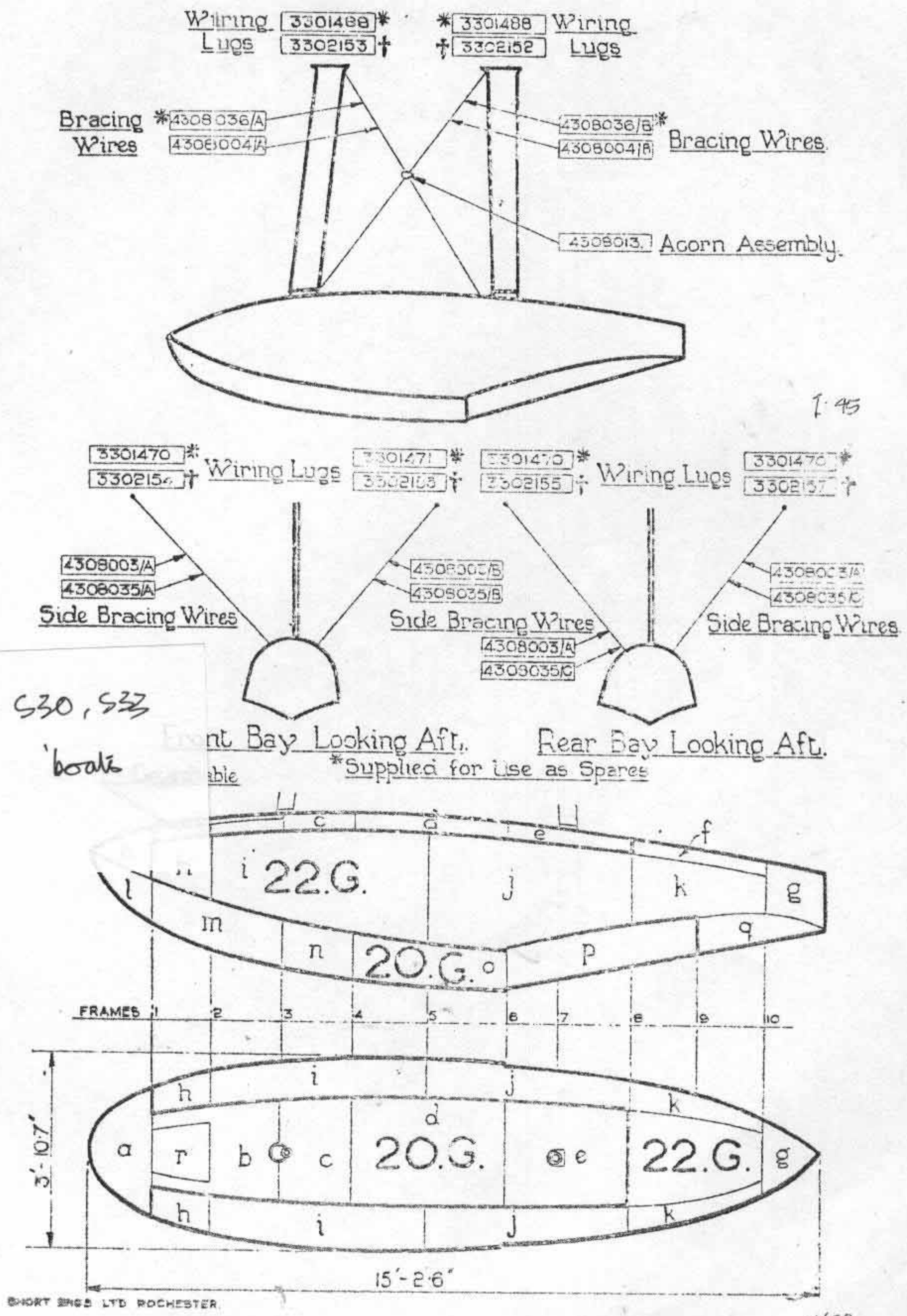
	Bracing Wires.
Drg. Number	Location of Wires.
S.23.D.28409/3	Front Bay. Inboard. Port.
S.23.D.28409/3	Front Bay. Inboard. Starboard.
S.23.D.28409/1	Front Bay. Outboard. Port.
S.23.D.28409/1	Front Bay. Outboard. Starboard.
S.23.D.28409/7	Rear Bay. Inboard. Port.
S.23.D.28409/7	Rear Bay. Inboard. Starboard.
S.23.D.28409/5	Rear Bay. Outboard. Port.
S.23.D.28409/5	Rear Bay. Outboard. Starboard.
S.23.D.28408/1	Panel Bracing Upper Forward.
S.23.D.28408/2	Panel Bracing Upper Rear.
S.23.D.28408/3	Panel Bracing Lower Forward.
S.23.D.28408/4	Panel Bracing Lower Rear.

FLOAT CHASSIS



Attachment of Bracing Wires to Planes.

Important Note - When fitting spare wires marked thus * check whether the lugs are long type marked thus †. If this is so replace with short lugs marked thus * in each case before attempting to assemble wire

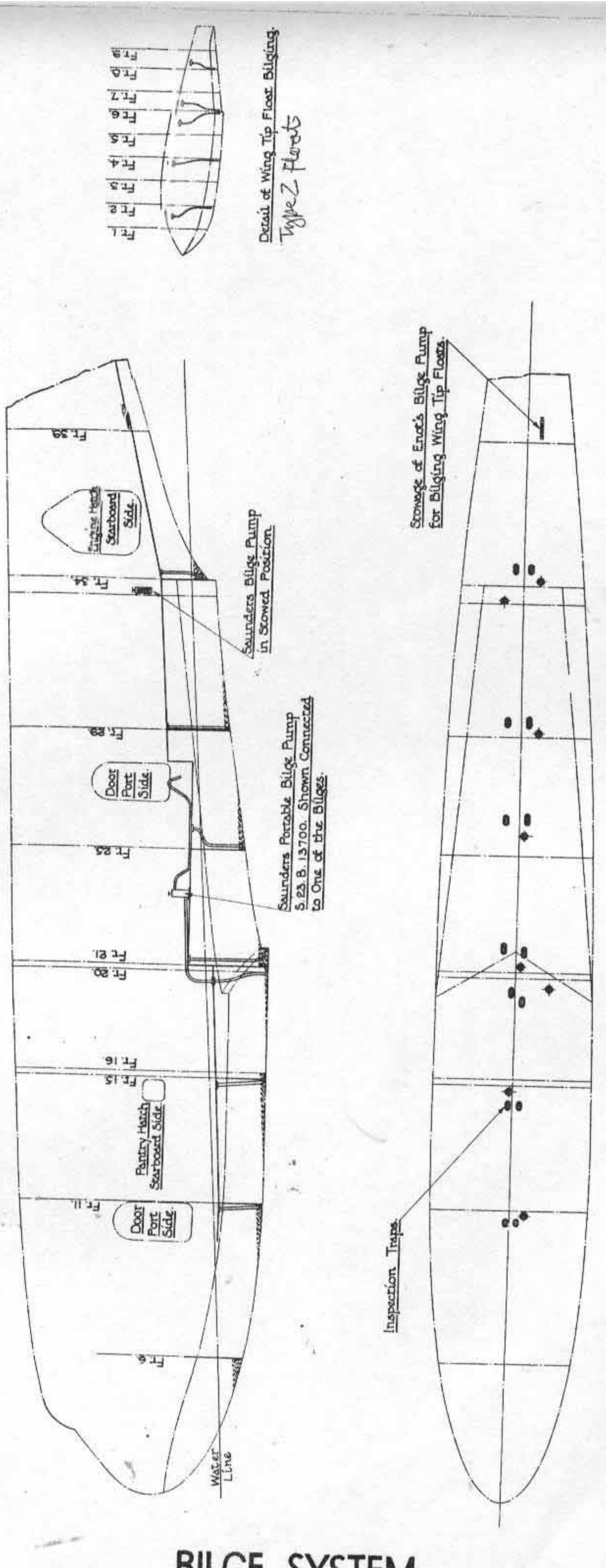


4638

PLANE TIP FLOAT & CHASSIS.

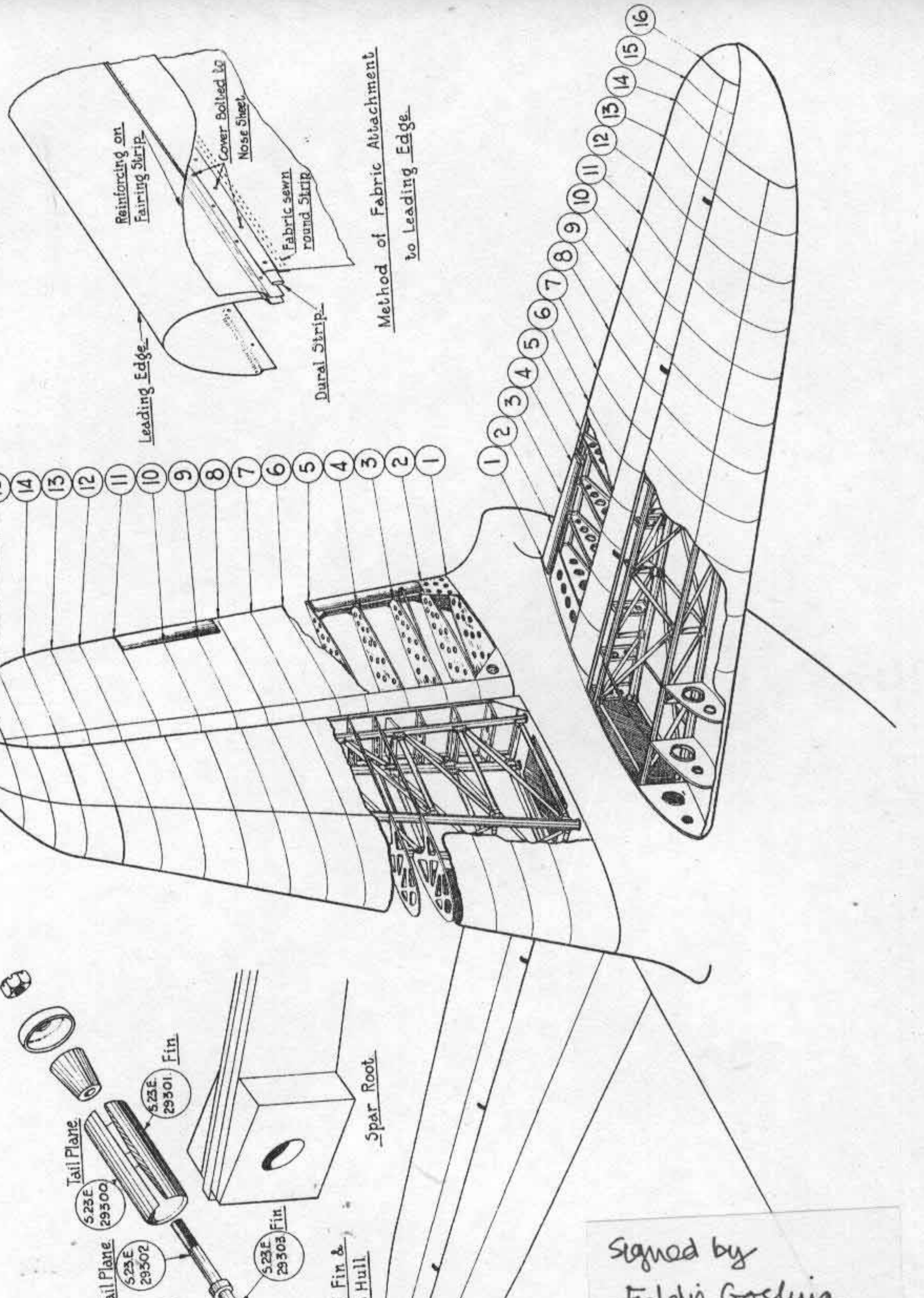
M.48.

1.31.7674



SHORT BROS LTD ROCHESTER

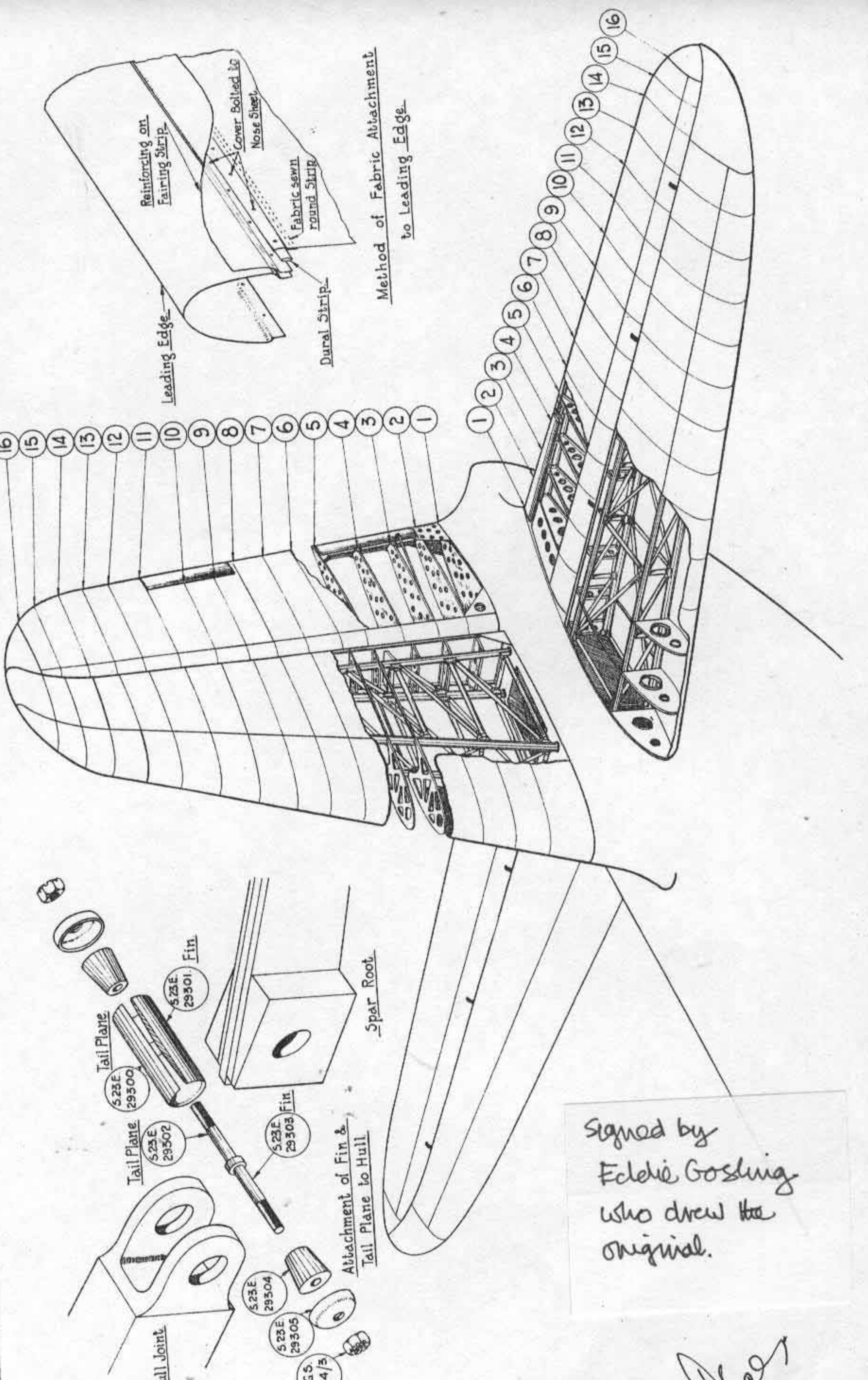
BILGE SYSTEM



SHORT BROS LTD ROCHESTER

TAIL UNIT

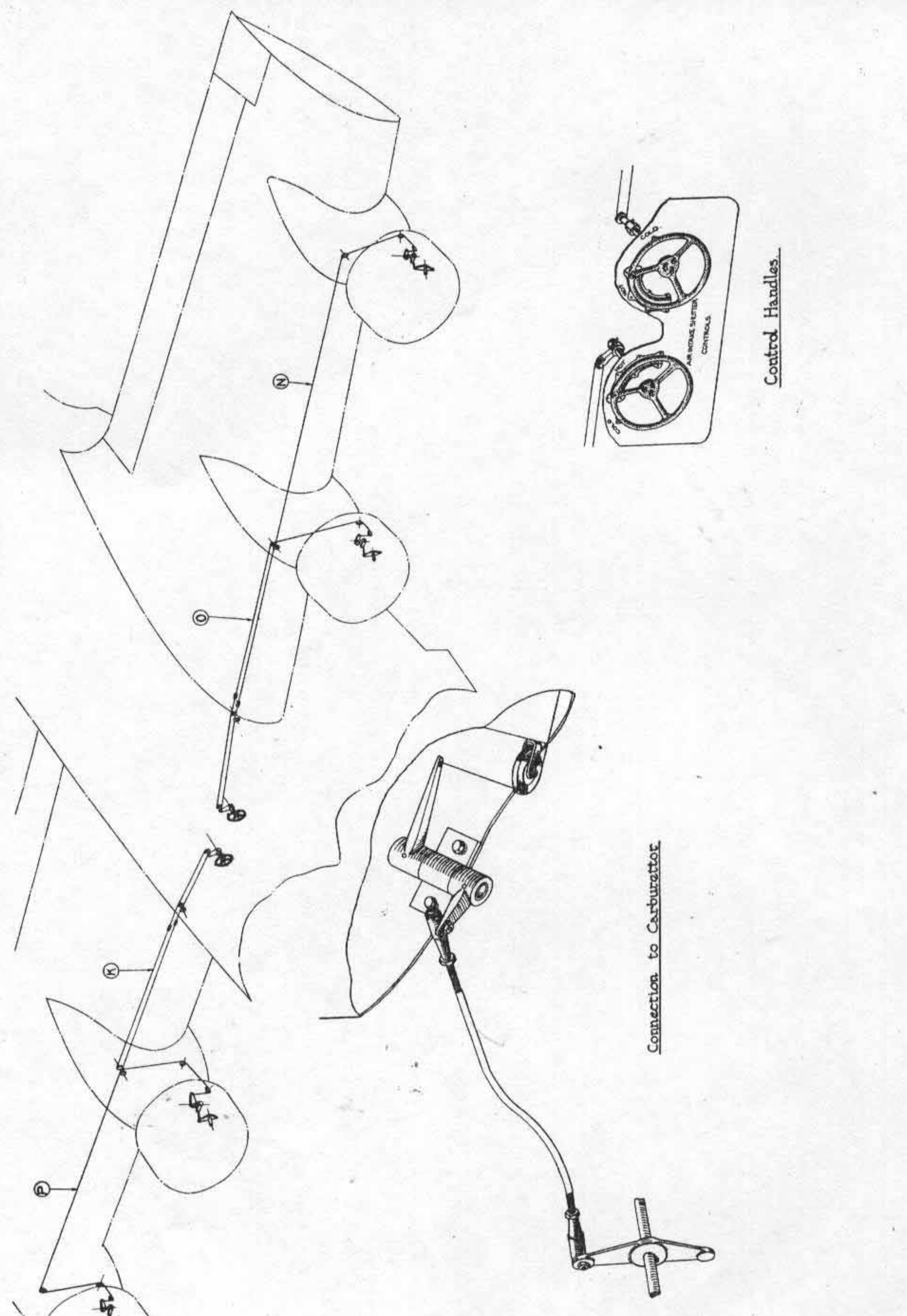
Signed by Eddie Gosling who drew the original.



Signed by Eddie Gosling who drew the original.

SHORT BROS LTD ROCHESTER

TAIL UNIT

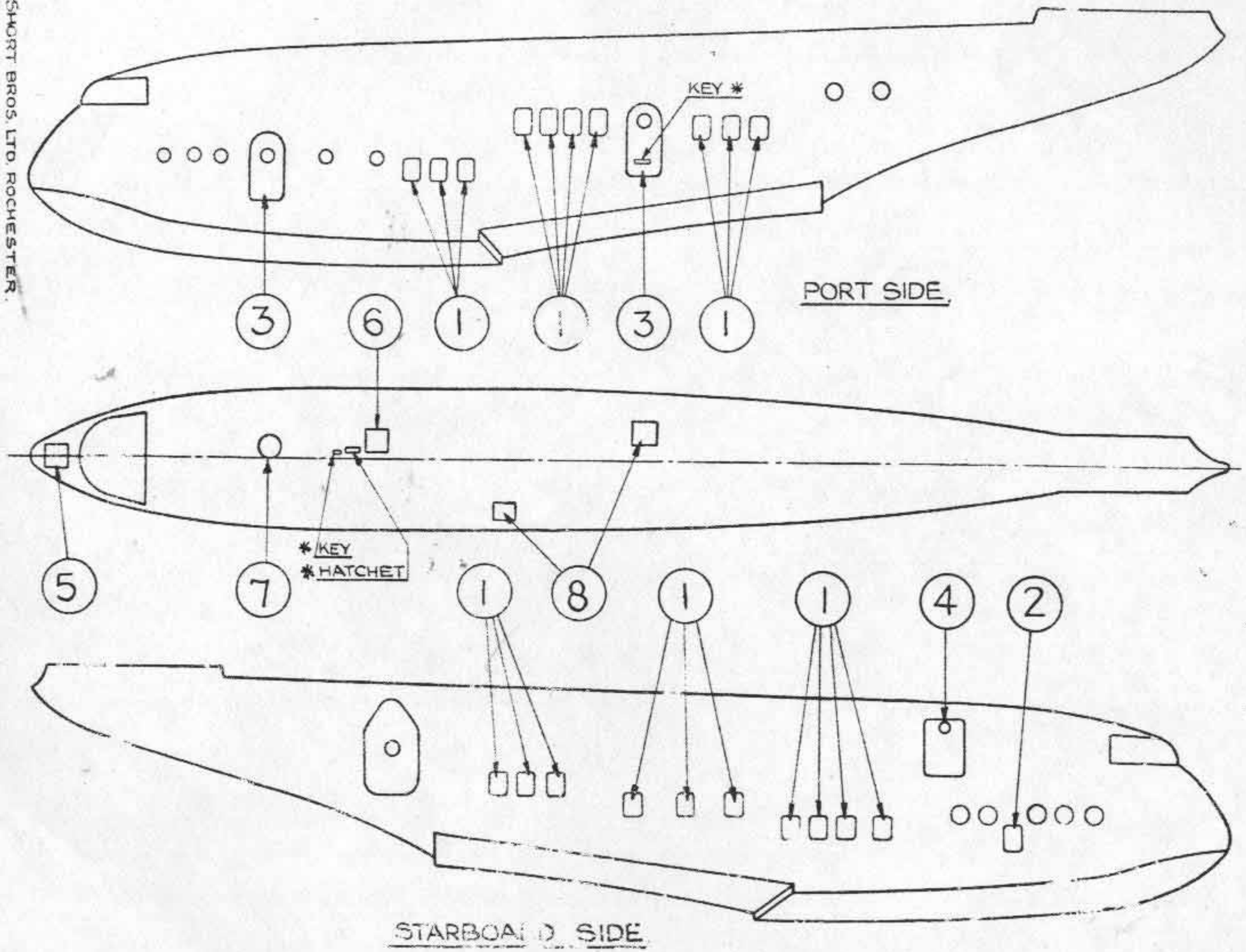


SHORT BROS. LTD. ROCHESTER.

CARBURETTOR AIR SHUTTER CONTROLS

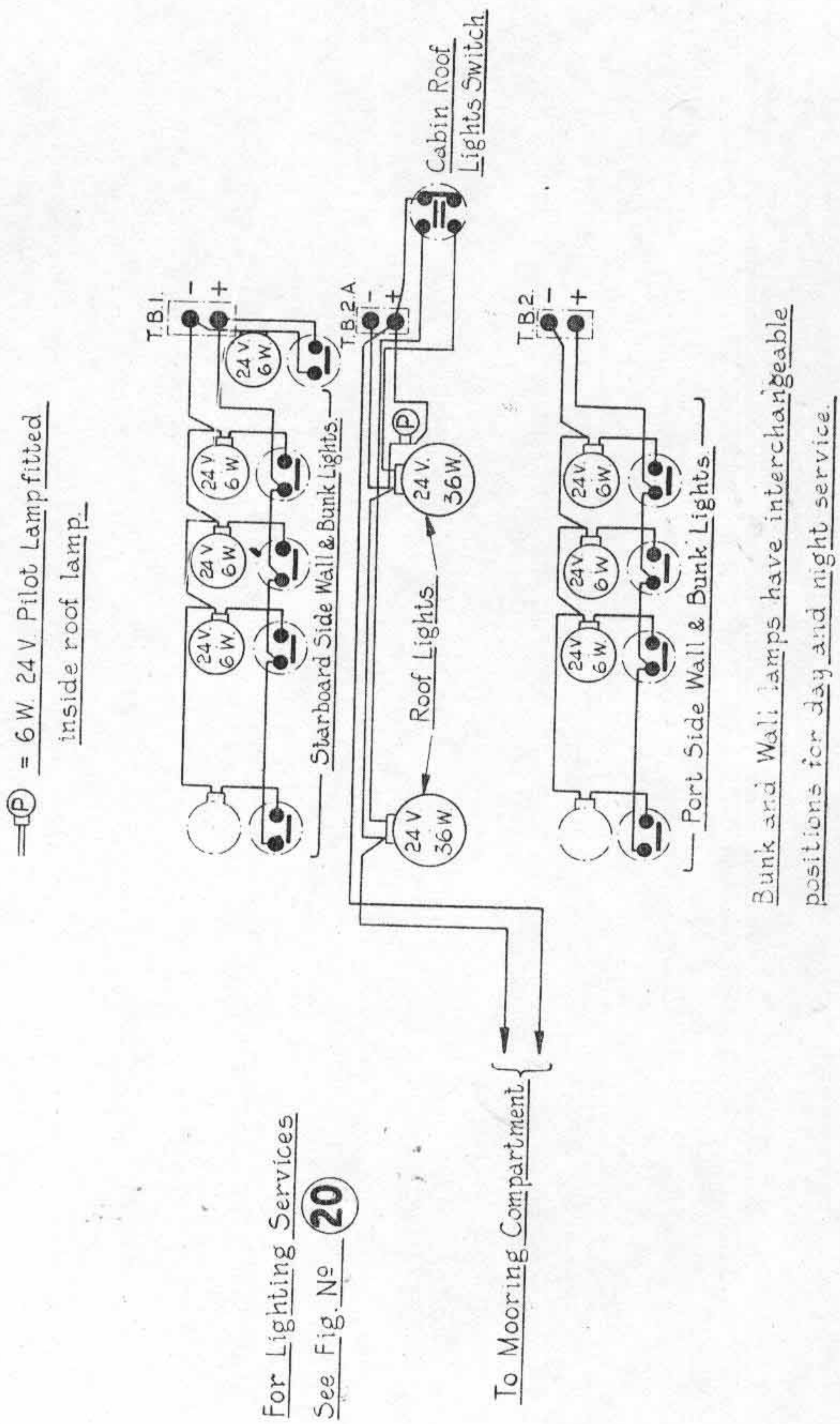
EMERGENCY ESCAPE MEASURES

SHORT BROS. LTD. ROCHESTER.



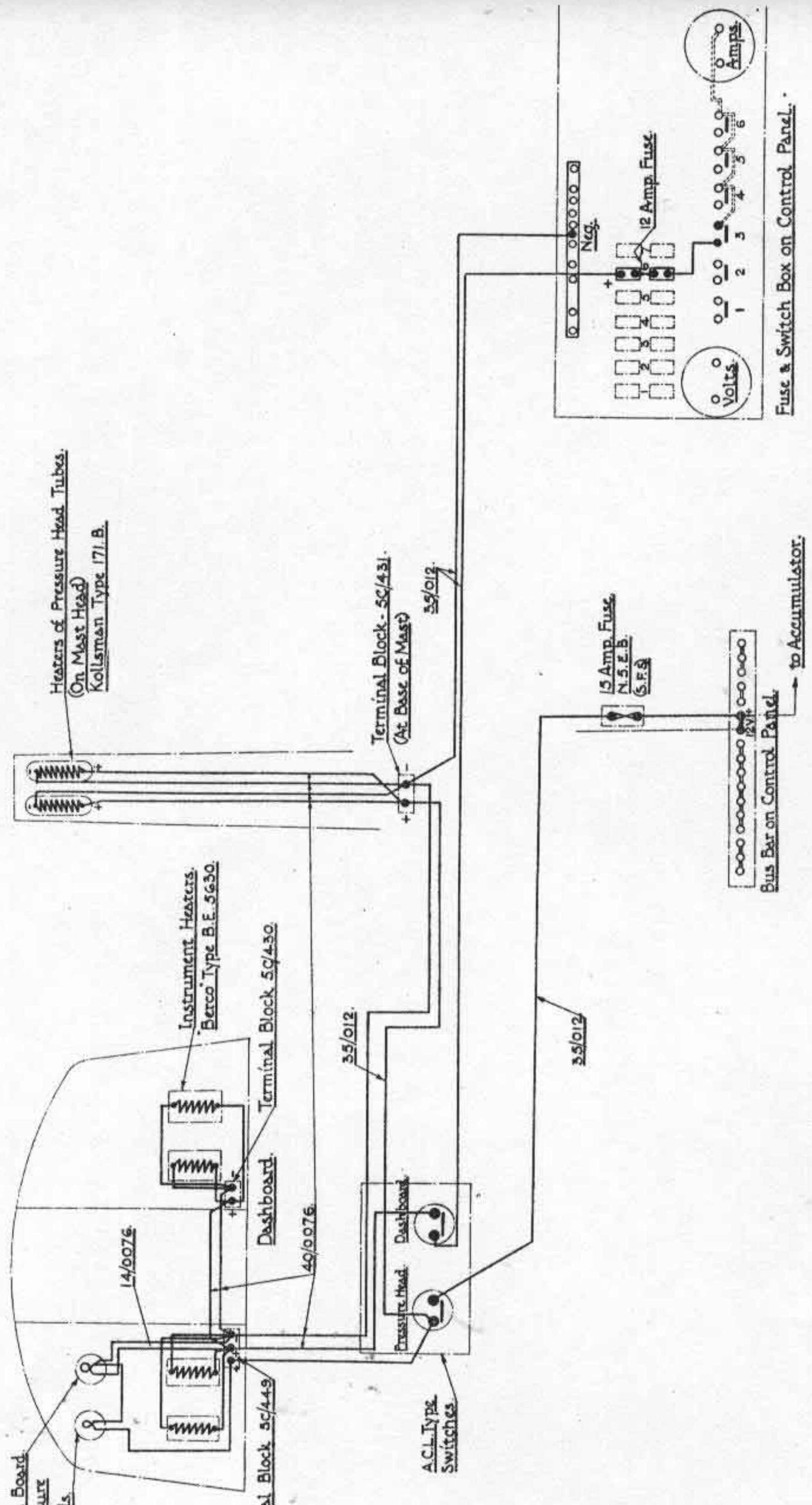
OPERATION.

1. CABIN WINDOWS (PUSH OUT TYPE) – SHARP BLOW ON ONE EDGE.
2. PANTRY WINDOW – RELEASE CATCH FRC INSIDE.
3. PASSENGER DOORS – CATCHES ON INSI CAN BE OPENED FRC OUTSIDE WITH EMERGE KEY *
4. MAIL LOADING DOOR – RELEASE CATCHES INSIDE.
5. MOORING HATCH – RELEASE CATCHES O INSIDE.
6. ESCAPE HATCH – RELEASE CATCH AND PUSH OUT. EMERGEN KEY AND HATCHET OUTSIDE.
7. ESCAPE HATCH – RELEASE CATCHES INSIDE.
   $2'3\frac{1}{2}$ 1 4/70
8. ESCAPE HATCHES – PUSH OUT – BY OF INSIDE LEVER HANDLES PROVI OUTSIDE TO HATCH.
   $10\frac{1}{2}'' \times 16''$



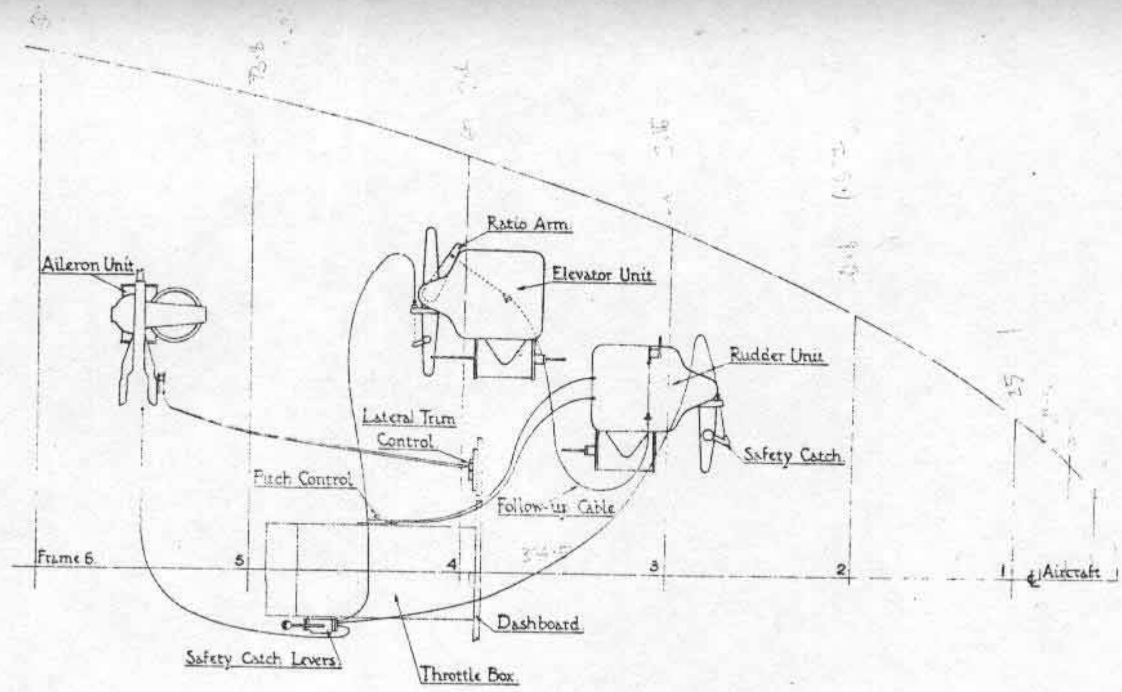
SHORT BROS LTD ROCHESTER

WIRING FOR FORWARD CABIN

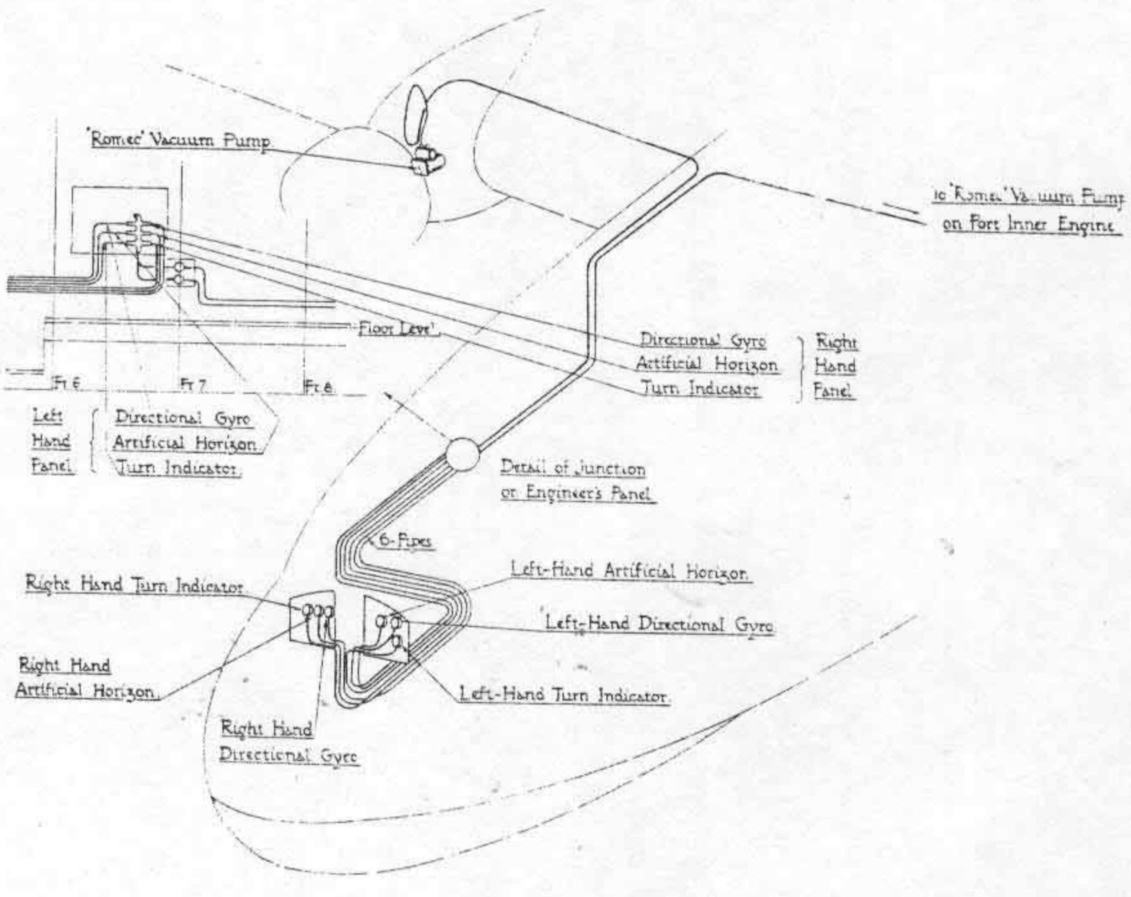


SHORT BROS LTD ROCHESTER.

WIRING OF INSTRUMENT HEATING



BOWDEN CONTROLS.



VACUUM PIPING.

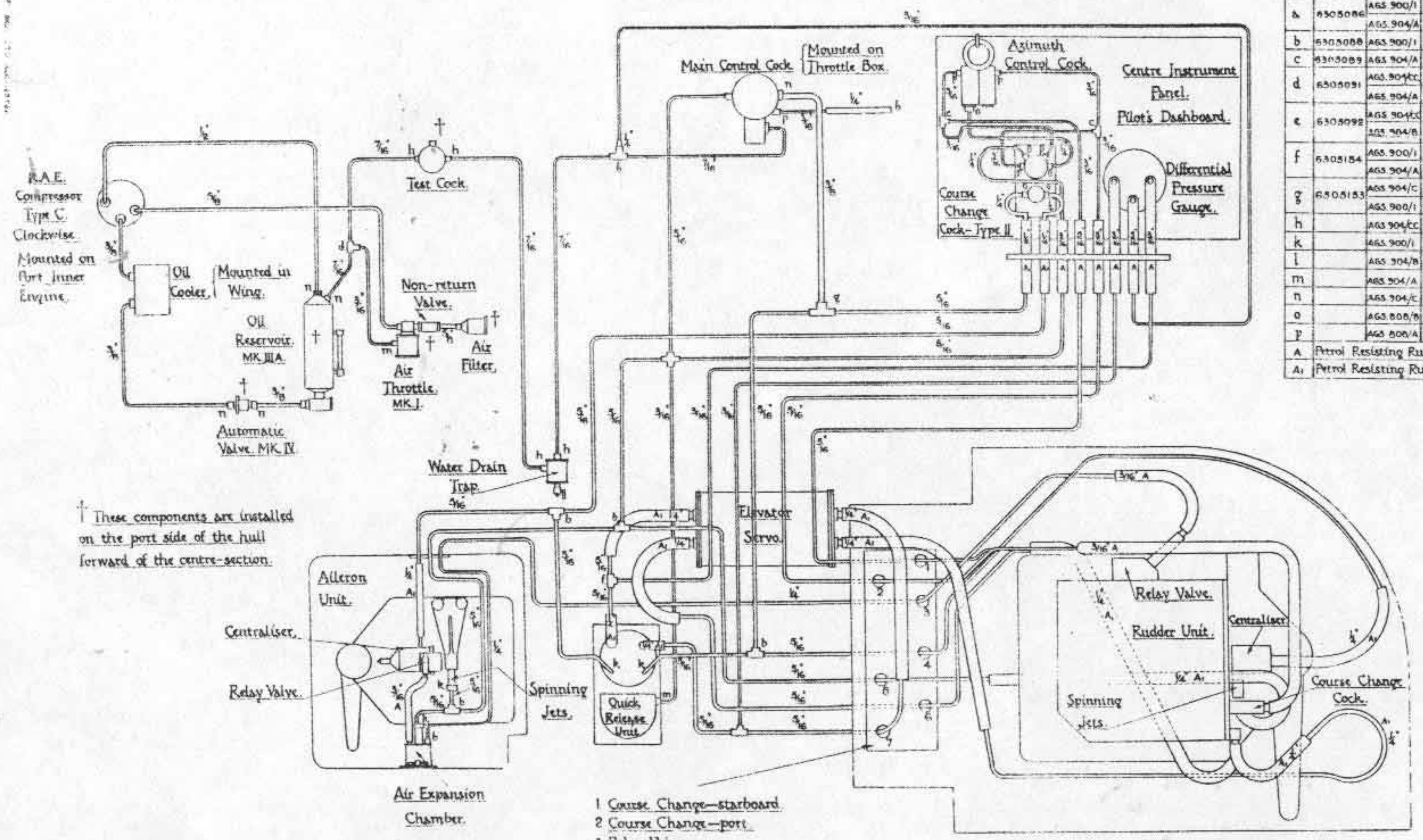
SHORT BROS LTD ROCHESTER

SMITH MK IA AUTOMATIC PILOT.

M60.

SMITH MK IA AUTOMATIC PILOT PIPING

Ref.	Union.	Outer Sleeve.	Inner Sleeve.	Nipple.	Adaptor Nipple.	Pipe Collar.	Pipe Size	[illegible]
a	6305086	AGS. 900/1			AGS. 891/5	AGS. 891/2	5/16"	1
		AGS. 904/A			AGS. 713/A	AGS. 709/A	3/16"	
b	6305088	AGS. 900/1			AGS. 891/5	AGS. 891/2	5/16"	1
c	6305089	AGS. 904/A			AGS. 713/A	AGS. 709/A	3/16"	1
d	6305091	AGS. 904/CC			AGS/ 713/CC	AGS. 709/CC	7/16"	2
		AGS. 904/A			AGS. 713/A	AGS. 709/A	3/16"	1
e	6305092	AGS. 904/CC			AGS. 713/CC	AGS. 709/CC	7/16"	2
		AGS. 904/B			AGS. 713/B	AGS. 709/B	1/4"	1
f	6305154	AGS. 900/1			AGS. 891/5	AGS. 891/2	5/16"	2
		AGS. 904/A			AGS. 713/A	AGS. 709/A	3/16"	1
g	6505153	AGS. 904/C			AGS. 713/C	AGS. 709/C	3/8"	1
		AGS. 900/1			AGS. 891/5	AGS. 891/2	5/16"	2
h		AGS. 904/CC			AGS. 713/CC	AGS. 709/CC	7/16"	1
k		AGS. 900/1			AGS. 891/5	AGS. 891/2	5/16"	1
l		AGS. 904/B			AGS. 713/B	AGS. 709/B	1/4"	1
m		AGS. 904/A			AGS. 713/A	AGS. 709/A	5/16"	1
n		AGS. 904/C			AGS. 713/C	AGS. 709/C	3/8"	1
o		AGS. 808/B		AGS. 209/B			1/4"	1
p		AGS. 808/A		AGS. 209/A			3/16"	1
A	Petrol Resisting Rubber Tubing, 3/16" I/D. approx. 7/16" O/D.							
A1	Petrol Resisting Rubber Tubing, 1/4" I/D. approx. 1/2" O/D.							

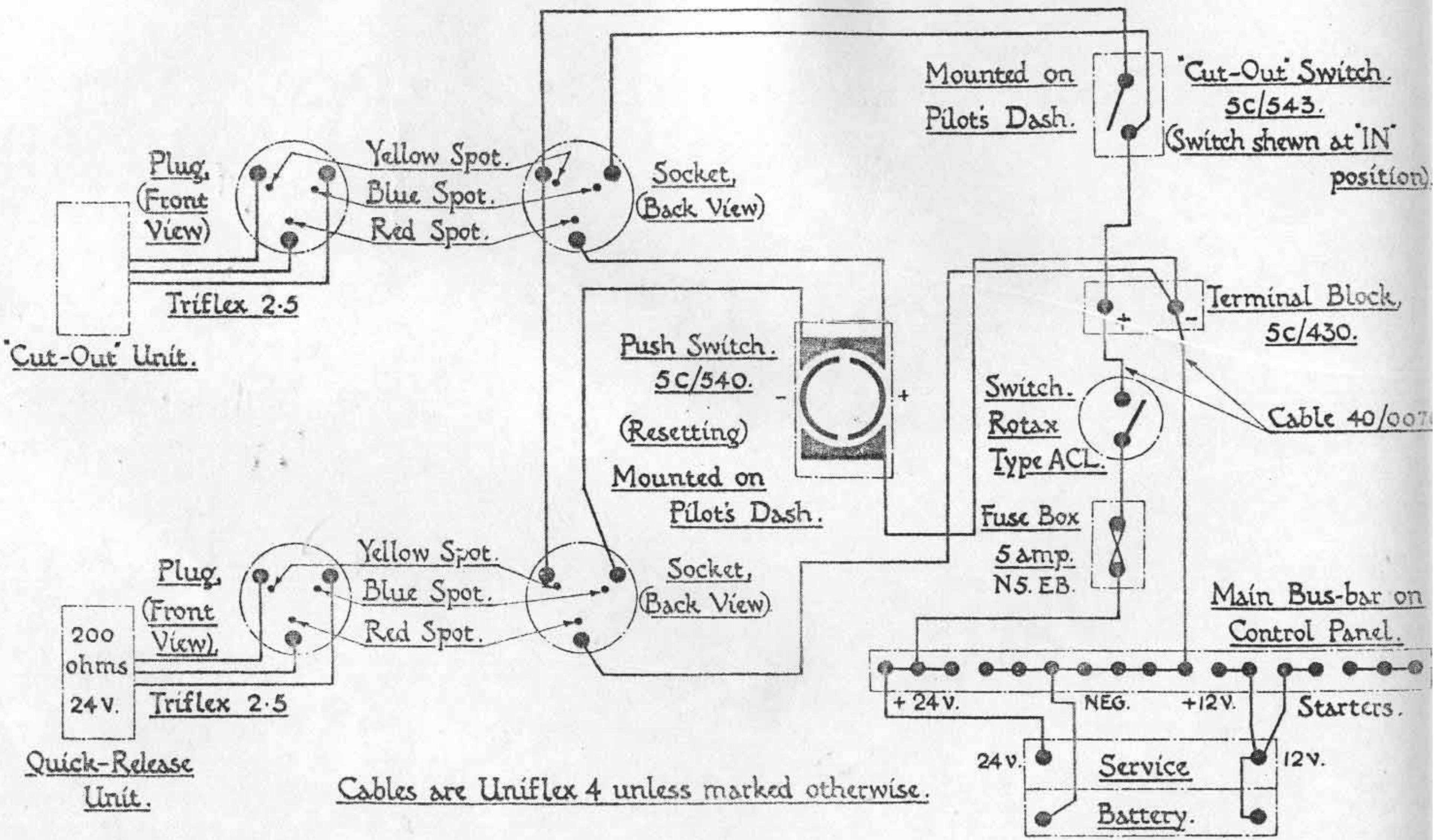


† These components are installed on the port side of the hull forward of the centre-section.

1 Course Change—starboard.
2 Course Change—port.
3 Relay Valve.
4 Centraliser.
5 Spun Gyro.
6 Elevator Unit.
7 Quick Release Unit.

The Aileron, Elevator & Rudder Units & the Quick Release Unit, are mounted under the floor of the Pilot's cockpit.

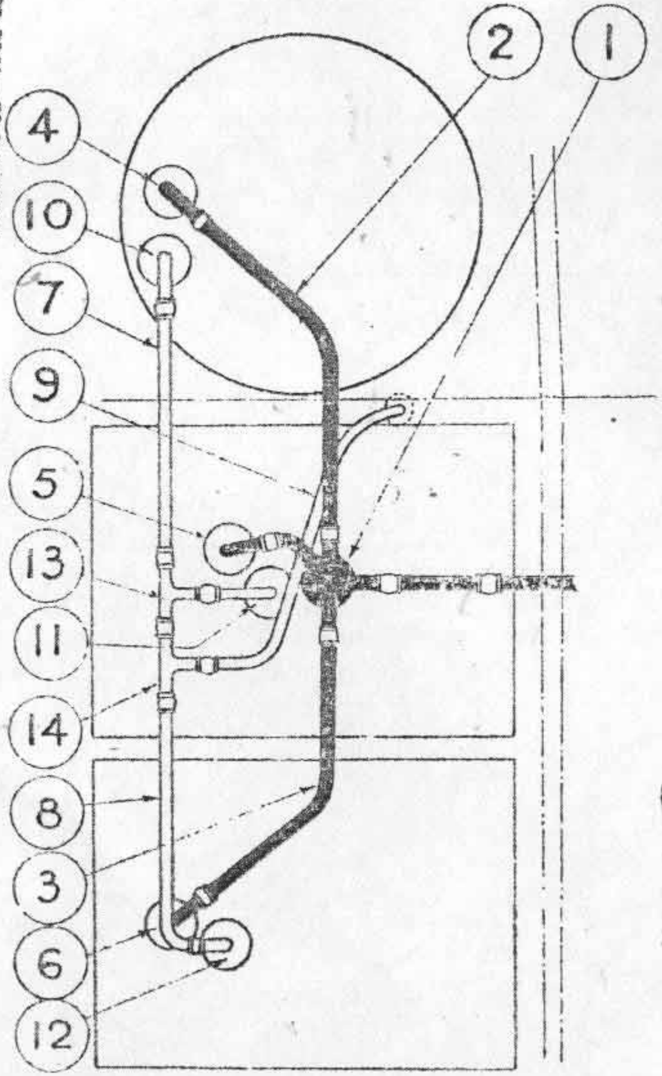
SMITH AUTOMATIC PILOT WIRING.



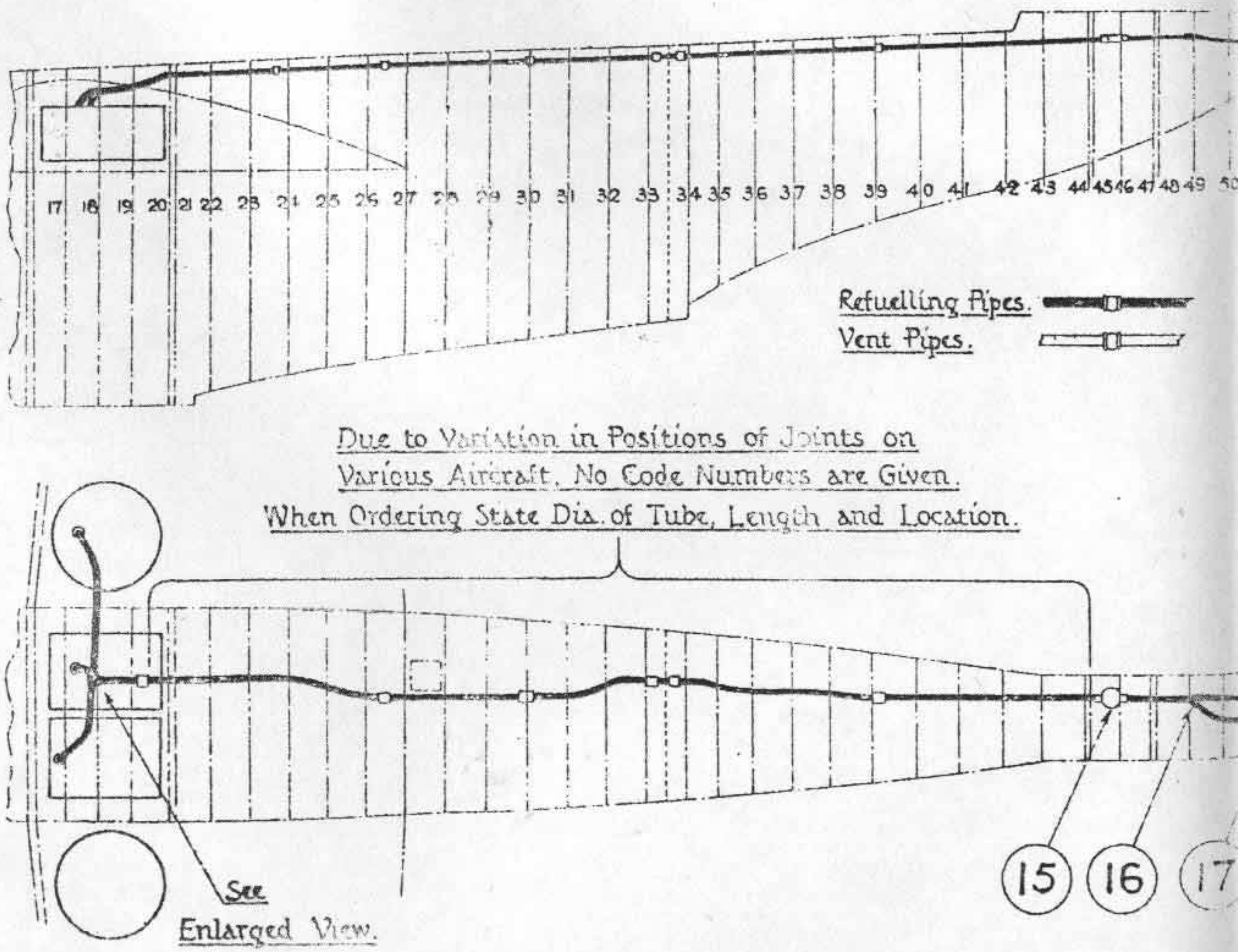
SHORT BROS. LTD. ROCHESTER

FLIGHT REFUELLING

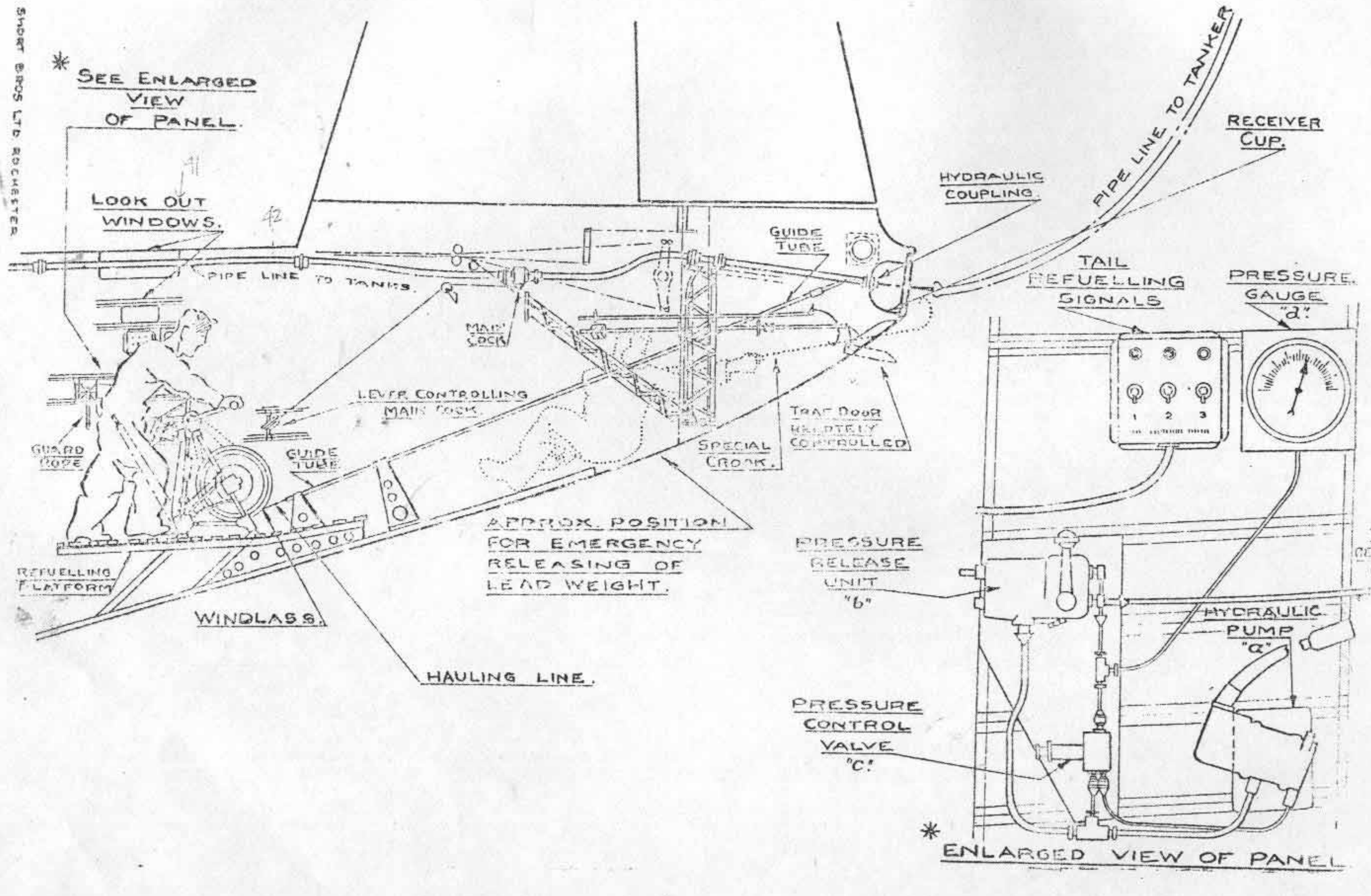
SHORT BROS LTD ROCHESTER



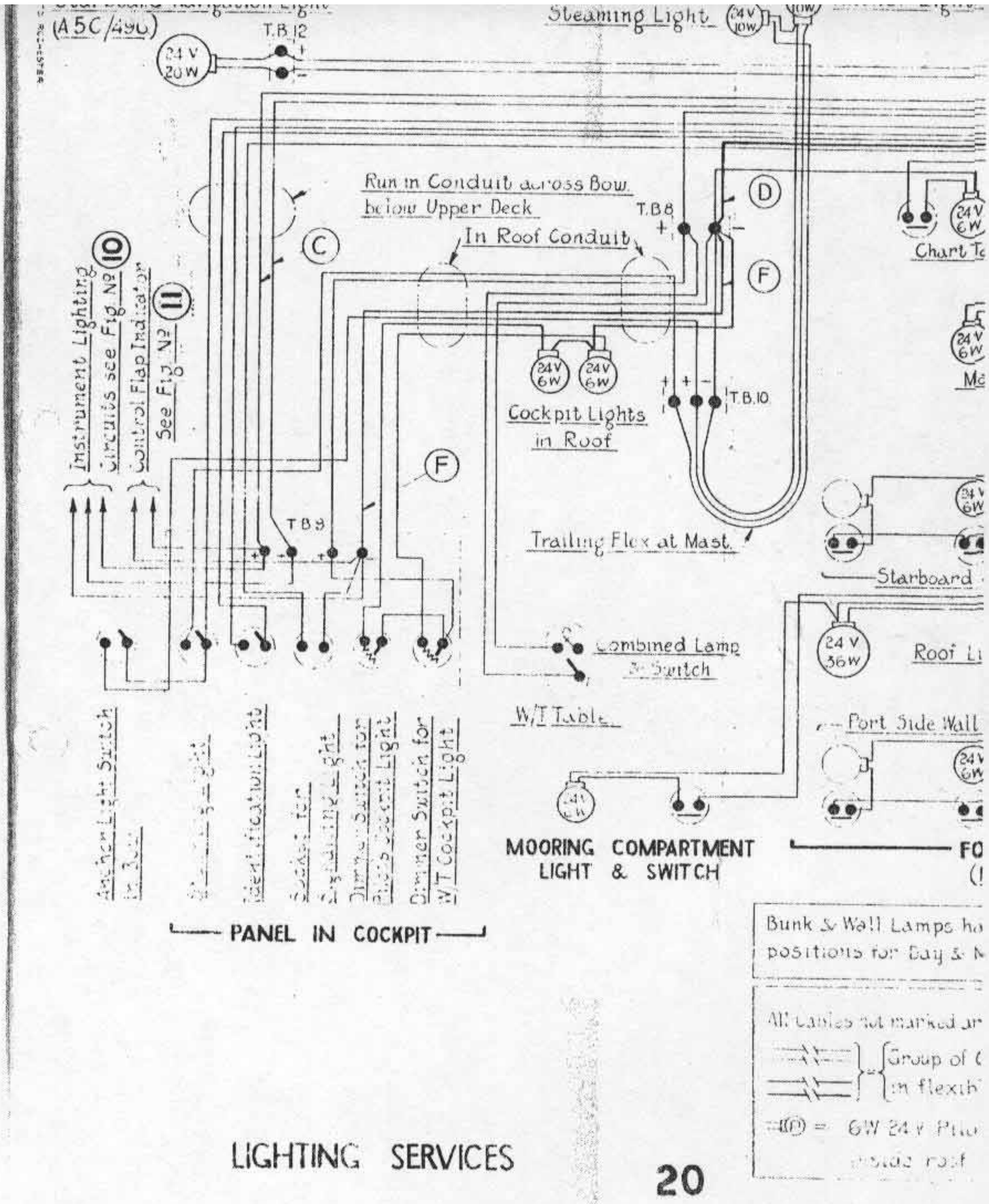
Enlarged View of Distribution Pipes.



M 43

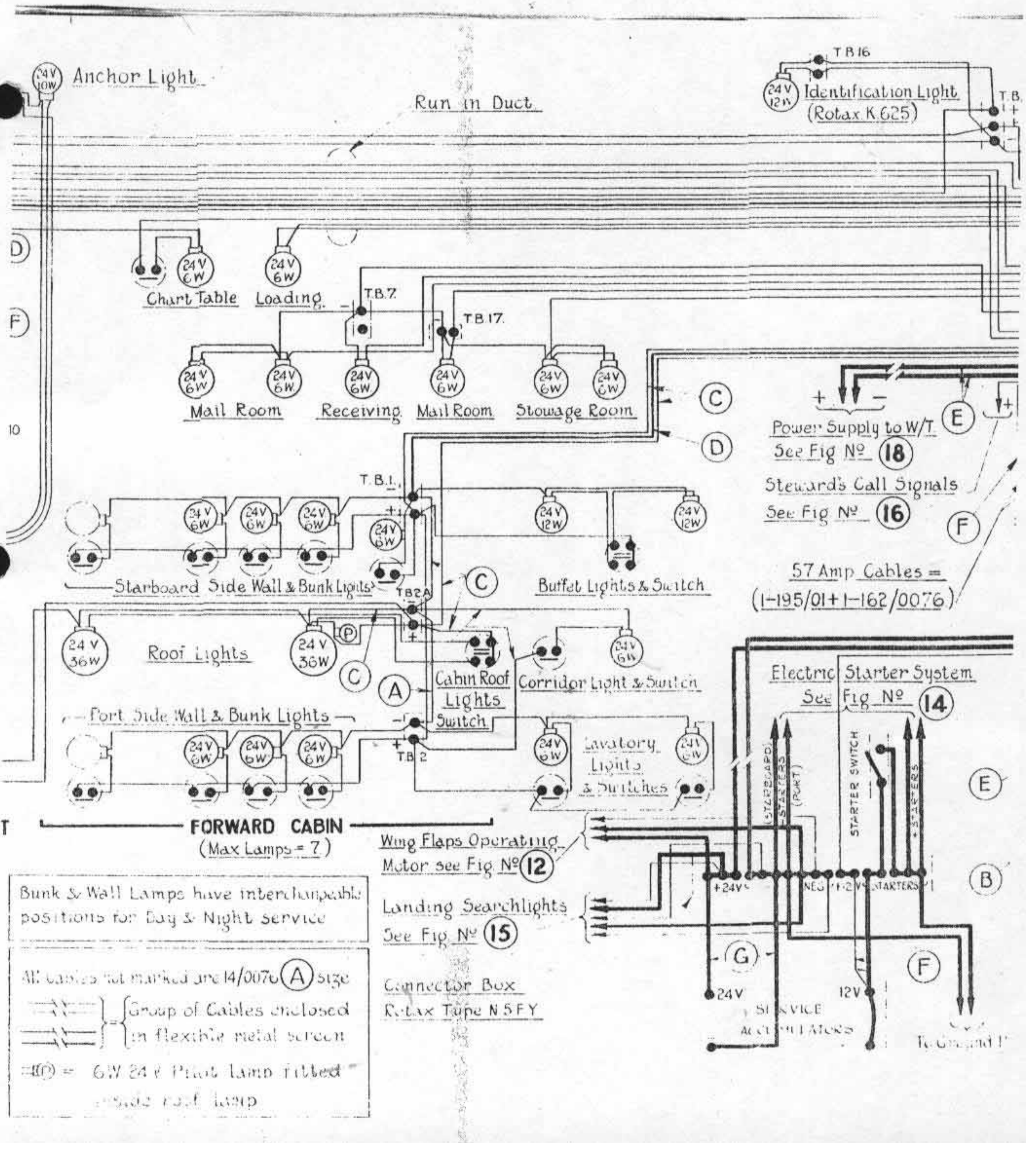


FLIGHT REFUELLING.

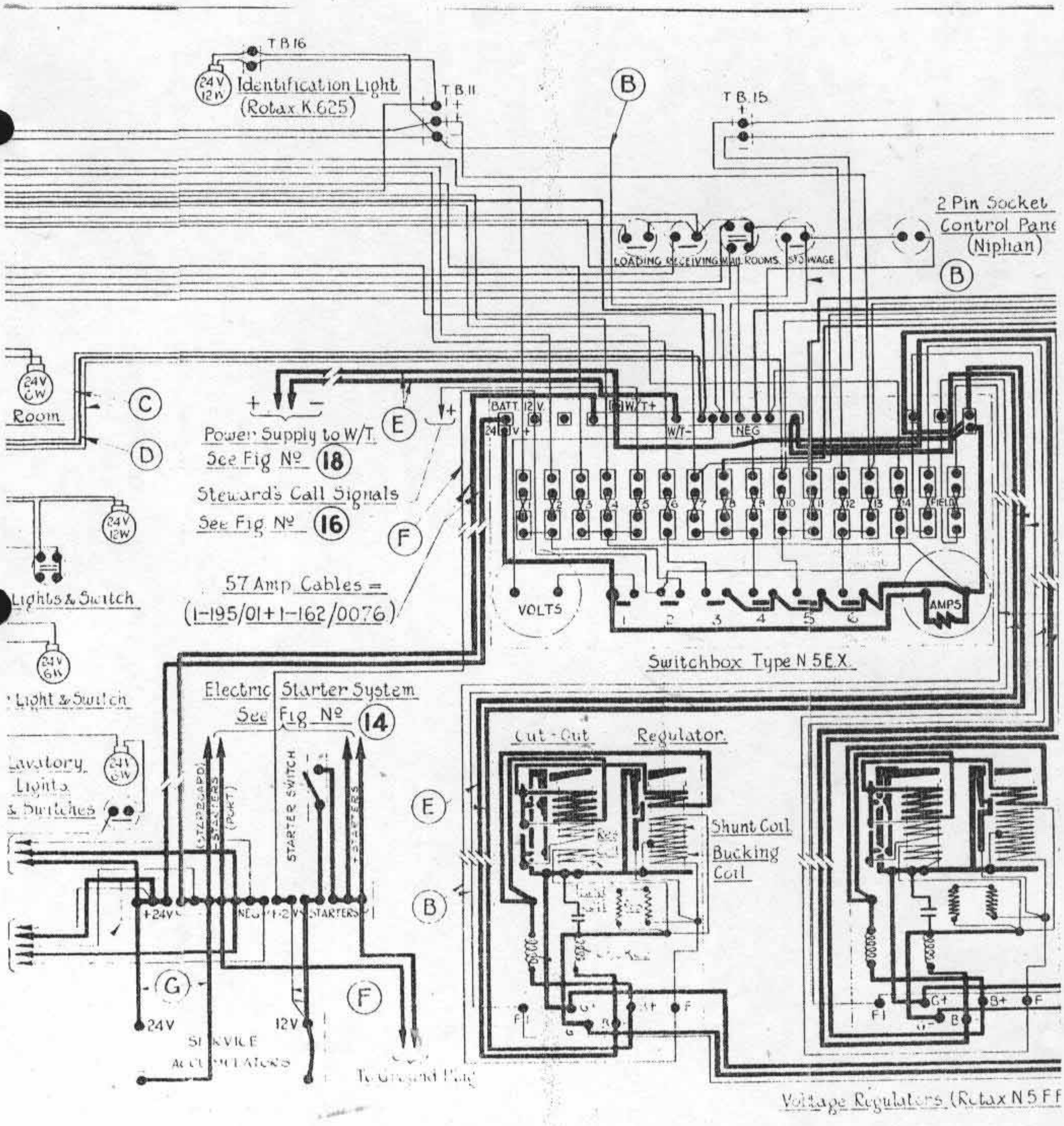


LIGHTING SERVICES

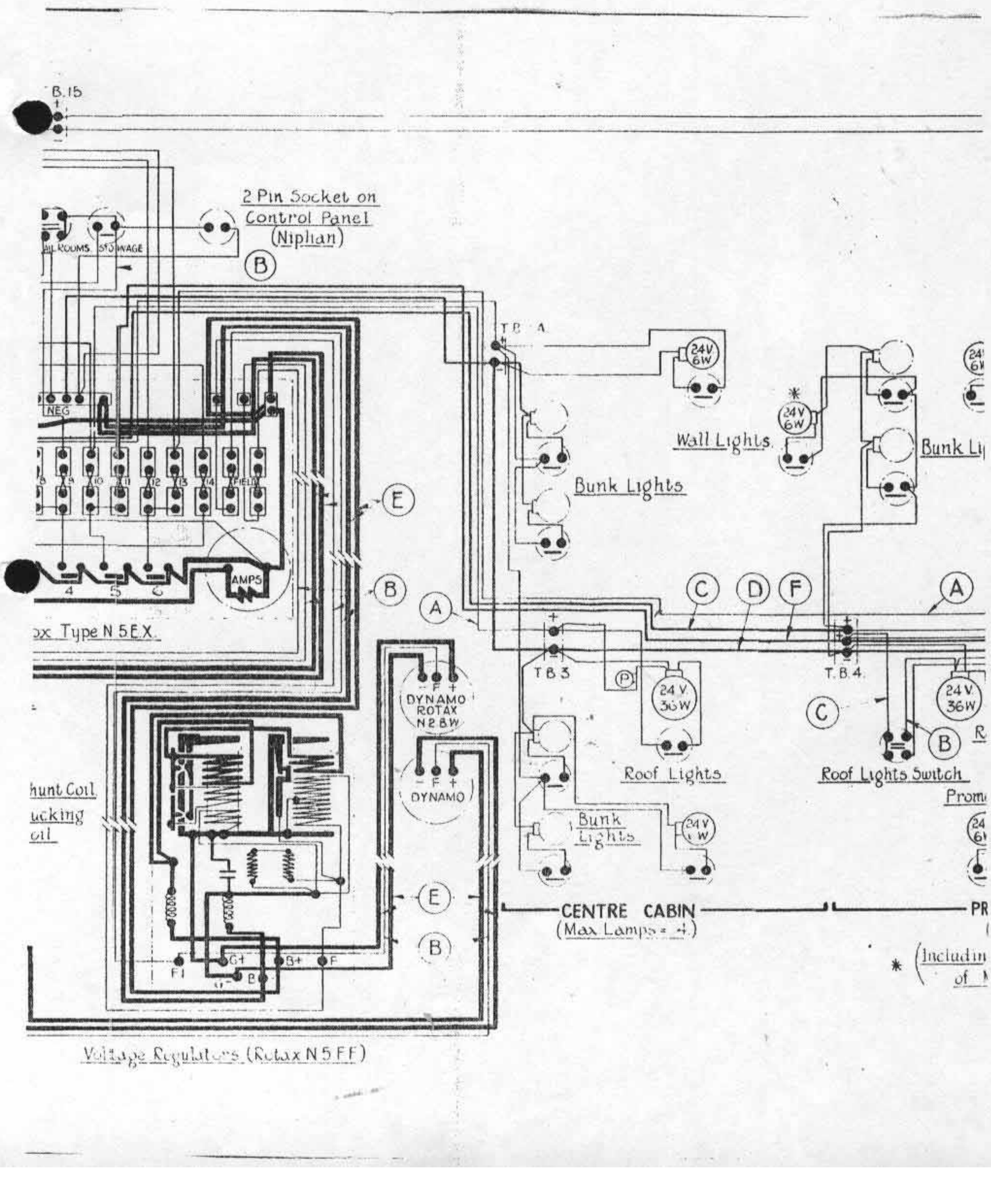
10



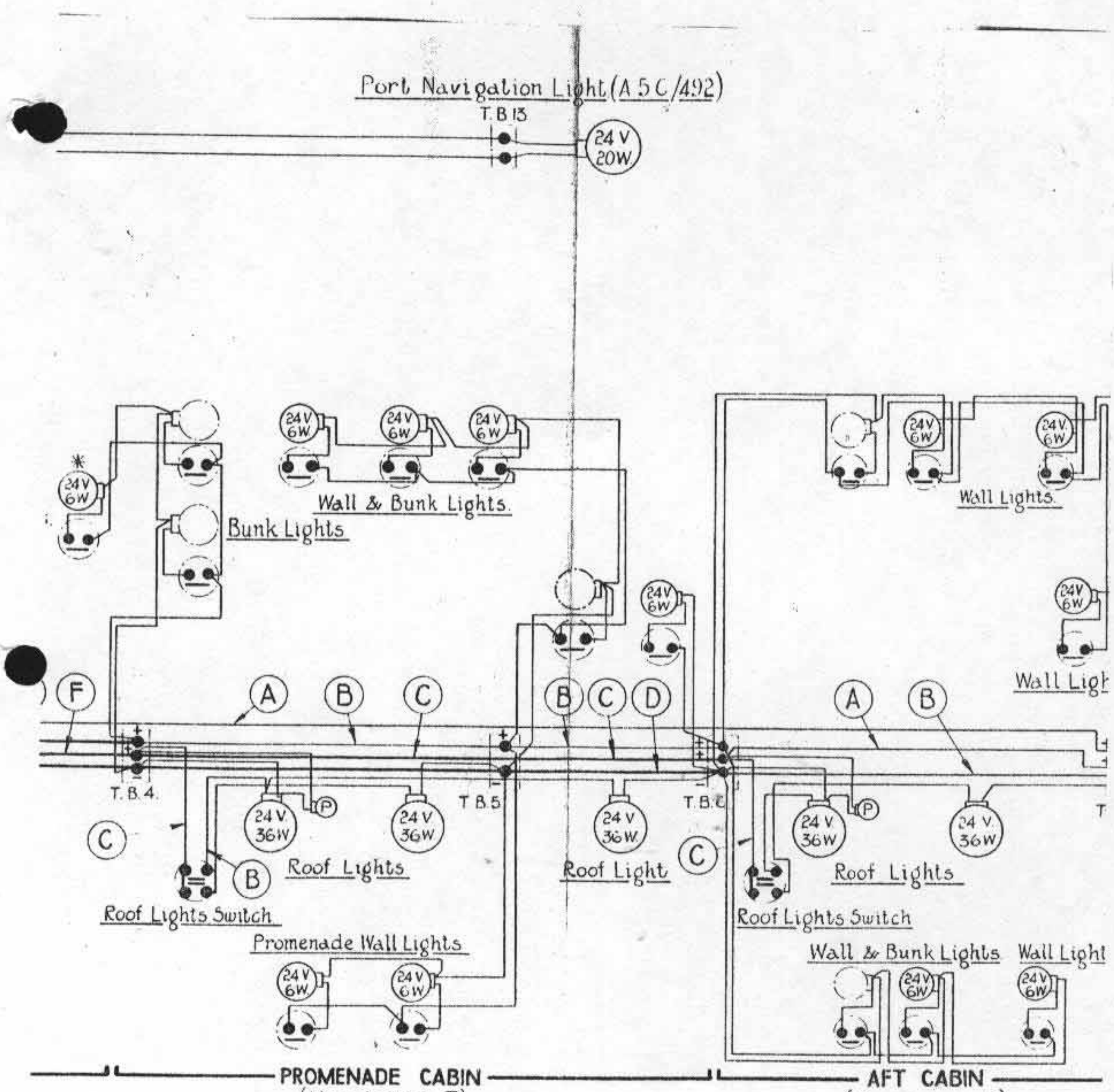
24V 10W
Anchor Light
Run in Duct
T.B.16
24V 12W
Identification Light
(Rotax K.625)
T.B.
D
F
24V 6W
Chart Table
24V 6W
Loading
T.B.7
T.B.17.
24V 6W
24V 6W
Mail Room
24V 6W
Receiving
24V 6W
Mail Room
24V 6W
24V 6W
Stowage Room
C
D
+ −
Power Supply to W/T
See Fig Nº 18
E
Steward's Call Signals
See Fig Nº 16
F
T.B.1.
24V 6W
24V 6W
24V 6W
24V 6W
24V 12W
24V 12W
Starboard Side Wall & Bunk Lights
Buffet Lights & Switch
57 Amp Cables =
(1-195/01 + 1-162/0076)
T.B.2A
C
24V 36W
Roof Lights
24V 36W
P
C
A
Cabin Roof Lights Switch
Corridor Light & Switch
24V 6W
Electric Starter System
See Fig Nº 14
Port Side Wall & Bunk Lights
24V 6W
24V 6W
24V 6W
T.B.2
24V 6W
Lavatory Lights & Switches
24V 6W
(STARBOARD) STARTERS
(PORT)
STARTER SWITCH
+ STARTERS
E
FORWARD CABIN
(Max Lamps = 7)
Wing Flaps Operating Motor see Fig Nº 12
+24V'S
NEG
F-2V'S
STARTERS
B
Bunk & Wall Lamps have interchangeable positions for Day & Night service
Landing Searchlights See Fig Nº 15
All cables not marked are 14/0076 (A) size
Group of Cables enclosed in flexible metal screen
(P) = 6W 24V Pilot lamp fitted inside roof lamp
G
F
Connector Box
Rotax Type N.5.F.Y.
24V
12V
SERVICE ACCUMULATORS



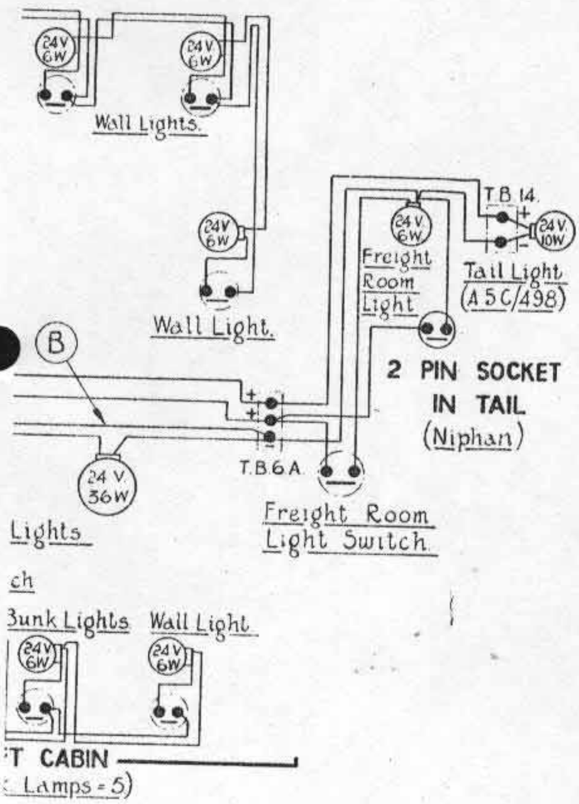
T.B.16
24V 12W
Identification Light
(Rotax K.625)
T.B.11
T.B.15
B
2 Pin Socket
Control Pane
(Niphan)
LOADING
RECEIVING
MAIL ROOMS
STOWAGE
Room
24V 6W
C
D
Power Supply to W/T.
See Fig Nº 18
E
Steward's Call Signals
See Fig Nº 16
F
57 Amp Cables =
(1-195/01+1-162/0076)
Lights & Switch
24V 12W
24V 6W
Light & Switch
Lavatory
Lights
& Switches
BATT.
12V
24V
W/T+
W/T-
NEG
FIELD
VOLTS
AMPS
Switchbox Type N 5 E.X.
Electric Starter System
See Fig Nº 14
STARTER SWITCH
STARTERS
Cut-Out
Regulator
Shunt Coil
Bucking
Coil
+24V
NEG
+12V
STARTERS
G
24V
12V
SERVICE
ACCUMULATORS
To Ground Plug
Voltage Regulators (Rotax N 5 FF



B.15
2 Pin Socket on Control Panel (Niphan)
ROOMS
STOWAGE
NEG
FIELD
AMPS
4
5
6
ox Type N 5 E X.
E
B
A
T.B. A.
24V 6W
Wall Lights.
Bunk Lights
Bunk Li
C
D
F
TB 3
T.B.4.
P
24 V. 36 W
Roof Lights
Roof Lights Switch
Prom
DYNAMO ROTAX N 2 BW
DYNAMO
hunt Coil
ucking oil
F1
G+
G-
B
B+
F
CENTRE CABIN
(Max Lamps = 4)
PR
Includin
of
Voltage Regulators (Rotax N 5 FF)



* (Including One on Aft Bulkhead of Midship Cabin)



CONNECTION BLOCKS.		
Nº	DESCRIPTION.	POSITION.
T.B.1.	5C/431. 2 Way. Nº 2	Buffet Roof Forward
T.B.2	5C/430 2 Way. Nº 1.	Corridor Forward in Centre
T.B.2A	5C/430. 2 Way Nº 1	Corridor Forward in Centre
T.B.3	5C/431. 2 Way. Nº 2	Front Spar Frame on Bulkhead Upper Deck to Starboard
T.B.3A	5.C/431. 2 Way. Nº 2	Front Spar Frame on Bulkhead Upper Deck Centre
T.B.4	5C/449. 3 Way. Nº 2	Rear Spar Frame on Bulkhead Upper Deck Centre
T.B.5	5.C/431. 2 Way. Nº 2	Promenade Cabin Roof Light Mounting in Centre
T.B.6	5.C/449. 3 Way. Nº 2	Promenade Cabin Rear Bulkhead Centre
T.B.6A	5.C/432. 3 Way. Nº 1	Aft Cabin Rear Bulkhead on Aft Side
T.B.7	5.C/430. 2 Way Nº 1.	Upper Deck Mail Compartment Mid
T.B.8	5.C/431. 2 Way Nº 2	Upper Deck Gangway Starbd
T.B.9	5C/430. {2 Way+ / 2 Way} Nº 1	Cockpit Panel.
T.B.10	5C/432. 3 Way Nº 1.	Bulkhead near Mast
T.B.11	5C/432. 3 Way Nº 1.	Wing Root Starbd.
T.B.12	5.C/430. 2 Way Nº 1	Wing Tip. Starboard
T.B.13	5.C/430. 2 Way. Nº 1	Wing Tip. Port.
T.B.14	5.C/430. 2 Way Nº 1	Tail.
T.B.15	5.C/430. 2 Way Nº 1.	Wing Root Port
T.B.16	5.C/430. 2 Way Nº 1	Wing. Starboard
T.B.17.	5.C/430 2 Way Nº 1	Centre Section Upper Deck

SWITCH Nº ON CONTROL PANEL.	FUSE Nº	FUSE CIRCUITS.	WATTS.	CIRCUIT AMPS	FUSE.
1	–	Voltmeter			
2	1	Instrument Lighting (12V)	48	4	8 Amp
	2	Instrument Lighting (12V)	48	4	8 Amp
	3	Anchor & Steaming Lights	20	·83	4 Amp
	4	Identification Light.	12	·5	4 Amp
	5	Steward's Call Signals.	24	1	4 Amp
3	6	Cockpit & Wireless Lights.	18	·75	4 Amp
	7	Corridor, Ford. & Centre Cabin Bunks, Lavatory & Buffet Lights	108	4·5	8 Amp
4	8	Prom. & Aft. Cabin Bunk & Wall Lights	72	3	8 Amp
	9	Chart Table, Mail Rooms, Receiving Table, Loading & Stowage Lights	48	2	4 Amp
5	10	Forward & Centre Cabins (Roof) & Mooring Compartment Lights	126	5·25	12 Amp
	11	Prom. & Aft Cabins & Freight Room Roof Lights	204	8·5	12 Amp
6	12	Port Navigation Light	20	·83	4 Amp
	13	Tail & Starbd Navigation Lights	30	1·25	4 Amp
	14	Signalling Light	30	2·5	4 Amp
	F	Dynamo Fields			4 Amp

	CABLE SIZES.	MAX. AMPS
A	Single Core 14/0076.	2
B	Single Core 23/0076	3
C	Single Core 40/0076	5
D	Single Core 162/0076	20
E	Single Core 195/01	37
F	Single Core 110/0076.	10
G	Single Core 61/044	100