56. Dept.

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AIR PUBLICATION 1515A & B
Volume I
2nd Edition, December, 1937

No. 1. (4)

THE WALRUS I and II AEROPLANES

(AMPHIBIAN)

PEGASUS II.M.2 ENGINE
OR
PEGASUS VI ENGINE

Promulgated for the information and guidance of all concerned
By Command of the Air Council

Donald Banks

AIR MINISTRY
Issued February, 1938

Frontispiece.—The Walrus I aeroplane.—Side view.

(42) Front cover, title page, amendment certificate and page 138. *Amend* the Air Publication number "1515A" to read "1515A & B".

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18 Sept 40

AIR PUBLICATION 1515A, 7B
Volume I
2nd Edition

The amendments promulgated in the undermentioned amendment lists have been made in this publication.

Amendment List		*Amendment made by*	*Date*
Number	*Date*		
(1-4) 1	March '38	1-4 G.D.F.	5/8/38
(5) 2	March 39.	E Bagot.	25-5-39.
~~(6-44) 3~~	~~Mar. 42.~~	~~M.R. Campbell~~	~~9. 7. 42.~~
(6-33) 3.		M.R. Campbell	9. 7. 42.
(34-41) 4.	Dec. 41.	M.R. Campbell	9. 7. 42.
(42-57) 5	June 1942.	L.M. English	18-8-42.
(58-63) 6.	July '42.	P. Richards.	28.9.42
64-165 7	Feb '43	J Wallace	4-3-43
(122-234) 8	~~April 44~~ Dec. '43	R.M. Fay	22.4.44

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1-4

Posted 5/8/38. RST.

AIR MINISTRY

Amendment List No. 1
to
AIR PUBLICATION 1515A
Volume I
2nd Edition, December, 1937
March, 1938

THE WALRUS I AEROPLANE PEGASUS II.M.2 OR PEGASUS VI AERO-ENGINE

Sent 25/5/39.

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AIR MINISTRY

Amendment List No. 2
to
AIR PUBLICATION 1515A
Volume I
(2nd Edition, December, 1937)
March, 1939

THE WALRUS I AEROPLANE
PEGASUS II.M.2 or PEGASUS VI ENGINE

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June 1942

AIR MINISTRY (42-51)

Posted. 18-8-42.

Amendment List No. 5
to
AIR PUBLICATION 1515A
Volume I
2nd Edition, December 1937

THE WALRUS I AND II AEROPLANES
(AMPHIBIAN)
PEGASUS II.M.2 OR PEGASUS VI ENGINE

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July, 1942

AIR MINISTRY

Amendment List No. 6
to
AIR PUBLICATION 1515A and B
Volume I
(2nd Edition, *December, 1937*)

THE WALRUS I AND II AEROPLANE
PEGASUS II M.2 OR PEGASUS VI ENGINE

FOR OFFICIAL USE ONLY

February, 1943

AIR MINISTRY

Amendment List No. 7
to
AIR PUBLICATION 1515A and B
Volume I
(2nd Edition, *December, 1937*)

THE WALRUS I AND II AIRCRAFT
PEGASUS II M.2 OR PEGASUS VI ENGINE

RESTRICTED

(For official use only)

AIR MINISTRY
December, 1943

A.L. No. 8 to A.P. 1515A and B
Volume I
2nd Edition, December, 1937

WALRUS I AND II AIRCRAFT

(59) Para. 102, line 4. *Amend* "wheel" to read "which".

(60) Fig. 61. *Remove* this illustration and *substitute* new fig. 61 supplied herewith.

(61) Para. 111, line 1. *Amend* "tyre" to read "type".

(62) Para. 287. After this paragraph, *insert* paras. 287A–287G supplied herewith.

(63) Fig. 147 *Remove* this illustration and *substitute* new fig. 147 supplied herewith.

A single Vickers G.O. gun is mounted in the front cockpit (*see* fig. 122) and twin Vickers G.O. guns are mounted in the rear cockpit (*see* fig. 123B). (A.L.8)

The vertical support lug (S) is locked to the swivel pin (P1) by means of a quick-release pin (N), so that the gun can be instantly detached from the mounting. (A.L.8)

(vi) Locate the securing position on the catapult structure, and secure an eyebolt or other suitable fitting for the attachment of the cable.

(vii) Secure the shackle, Admiralty Part No. 2051, on the cable to the fitting on the catapult structure and adjust if necessary the length of the lower cable; finally tighten the turnbuckle.

(viii) Repeat operations (v), (vi) and (vii) on the port wing tip float.

CONTENTS

CONTENTS

(8) Contents, page v. After "Towing and mooring fittings . . 44" *insert* the following:—

CHAPTER III—Tail Unit

CHAPTER IV—Alighting Gear

LAND UNDERCARRIAGE

TAIL WHEEL UNIT

CHAPTER V—Flying Controls

CHAPTER III—Tail Unit

CHAPTER IV—Alighting Gear

LAND UNDERCARRIAGE

TAIL WHEEL UNIT

CHAPTER V—Flying Controls—*contd.*

CHAPTER VI—Engine Installation

CHAPTER VII—Equipment

ARMAMENT

A.L.8

A.L.8

ELECTRICAL

INSTRUMENTS

MISCELLANEOUS

CHAPTER V—Flying Controls—*contd.*

CHAPTER VI—Engine Installation

(9) Contents, page vii. After "Tanks . . . . . 192", *insert* "Tank drainage . . . . . 193A".

(43) Contents, page vii. *Delete* "Oil dilution system ... 197A". A.L.5

Contents, page vii. After "Oil tank . . . . . 196", *insert* "Oil dilution system . . . . . 197A". A.L.5

(11) Contents, page vii. After "Starting the engine . . . . . 205", *insert* "Carburettor de-icing . . . . . 205A".

A.L.8

ELECTRICAL

INSTRUMENTS

MISCELLANEOUS

CHAPTER VII—Equipment—*contd.*

CHAPTER VIII—Erection, Rigging and Maintenance

(12) Contents, page viii. After "Deck and catapult lashing gear . . . . . 297" *insert* "Covers for venting and inspection . . . . . 298".

CHAPTER VII—Equipment—*contd.*

CHAPTER VIII—Erection, Rigging and Maintenance

(58) Contents, page viii. After "To check oil level .....287" *insert* "Dismantling 287A
Assembly 287C
Testing 287D
Tools for dismantling and assembling... 287F
List of testing equipment ... ... 287G"

(12) Contents, page viii. After "Deck and catapult lashing gear . . . . . 297" *insert* "Covers for venting and inspection . . . . . 298".

LIST OF ILLUSTRATIONS

CHAPTER III—Tail unit

CHAPTER IV—~~Undercarriage~~ Alighting Gear

CHAPTER V—Flying ~~particulars~~ controls

CHAPTER III—Tail unit

CHAPTER IV—~~Undercarriage~~ Alighting Gear

CHAPTER V—Flying ~~particulars~~—*contd.*

CHAPTER VI—Engine installation

CHAPTER VII—Equipment

CHAPTER VIII—Erection, rigging and maintenance

controls

CHAPTER V—Flying ~~particulars~~—*contd.*

CHAPTER VI—Engine installation

(14) List of Illustrations, page xi. After "121 ignition diagram . . . . . 97", *insert* "121A Carburettor de-icing system . . . . . 98".

see slip attached

(34) List of Illustrations. After "127 Bomb carriers—under bottom plane (starboard) . . . . 104" *insert* "127A Bomb loading diagram . . . . 104".

(36) Page (xi), Chapter VII. After "123 Forward gun mounting 100" *insert*
"123A Vickers gun stowage in bow cockpit . . . 100"
"123B Twin gun mounting in aft cockpit . . . 100"
"123C Twin gun stowage in aft turret . . . 100"

(37) Page (xi), Chapter VII. After "127A Bomb loading diagram 104" *insert*
"127B Suspension lug attachments on universal bomb carrier, Mk. III . . . 104"

CHAPTER VIII—Erection, rigging and maintenance

(35) List of Illustrations. After "149 Bonding diagram . . . . 136" *insert* "149A Bonding diagram (wooden hull) . . . 136".

LEADING PARTICULARS

Duty	F.A.A.
Type	Amphibian boat seaplane

Main dimensions

Aeroplane in rigging position unless otherwise stated

Length overall	38 ft. 0 in.
Height to highest point of structure, undercarriage down (Tail down position)	15 ft. 2 in.
Height to tip of airscrew, undercarriage down	16 ft. 10½ in.
Span of main planes, top and bottom	45 ft. 10 in.
Chord of main planes, top and bottom	7 ft. 0 in.
Gap at centre section	8 ft. 0 in.
Gap at outer struts	7 ft. 6¾ in.
Aerofoil section	N.A.C.A. 2412.
Incidence of main planes, top and bottom	7° 0′ ± 15′.
Dihedral of main planes, top	1° 0′ ± 10′.
Dihedral of main planes, bottom	3° 0′ ± 10′.
Sweepback of main planes, top and bottom	7° 30′.
Stagger, nominal	Nil.
Stagger, actual; of bottom planes measured at the centre line of the interplane struts	0·38 in. ± 0·25 in.
Angle of fold of top and bottom outer planes	78° ± 1°.
Span of tail plane	17 ft. 6 in.
Chord of tail plane	5 ft. 6 in.
Tail plane incidence, normal setting	6°.

Areas

Main planes, including ailerons, top	315 sq. ft.
Main planes, including ailerons, bottom	287 sq. ft.
Total	602 sq. ft.
Ailerons, total: top	40 sq. ft.
Ailerons, total: bottom	40 sq. ft.
Total	80 sq. ft.
Tail plane, without elevators	48·3 sq. ft.
Elevators, total, including trimmer flaps	37·9 sq. ft.
Elevator trimmer flaps (total)	1·84 sq. ft.
Fin, without rudder	19·7 sq. ft.
Rudder, including servo-rudder	20·9 sq. ft.

Movement of control surfaces

(Measured on chord of arc)

Aileron range of movement	16½°	+1° / −1° or 4·6 in.	+0·25 in. / −0·25 in.	up.
	16½°	+1° / −1° or 4·6 in.	+0·25 in. / −0·25 in.	down.
Aileron droop	¾ in.			
Tail plane range of movement—ground trimming range from normal incidence	±2° +31′ −0			
Elevator range of movement	28½°	+¾° / −¾° or 13¼ in.	+0·25 in. / −0·25 in.	up.
	28½°	+¾° / −¾° or 13¼ in.	+0·25 in. / −0·25 in.	down.
Elevator trimmer flaps range of movement	9°	+3° / −0° or 0·75 in.	+0·25 in. / −0	up.
	9°	+3° / −0° or 0·75 in.	+0·25 in. / −0	down.
Air and water rudder range of movement	27°	+¾° / −¾° or 18 in.	+0·5 in. / −0·5 in.	port.
	27°	+¾° / −¾° or 18 in.	+0·5 in. / −0·5 in.	starboard.

Undercarriage (Retractable)

Type	Single-wheeled units.
Track	7 ft. 7 in.
Shock absorber compression legs	Oleo-pneumatic.
~~Compression leg pressure—before assembly—~~	
~~Port compression leg~~	~~420 lb./sq. in.~~
~~Starboard compression leg~~	~~365 lb./sq. in.~~
Main wheels—	
Type	Palmer No. 495/B *or* Dunlop A.H.2074.
Tyre pressure	60 lb./sq. in.

A.L.5.

Tail wheel

Type	Solid tyre (metal).
Shock absorber compression leg	Oleo-pneumatic.

h Catapult Spools.

Engine

Name	Pegasus II.M.2 or VI.
Type	9-cylinder, air-cooled radial, supercharged.
Engine thrust incidence	5° ± 5′.
Engine offset, in plan view, forward end to port	3° ± 5′.

Engine operational limitations

For these limitations reference should be made to the appropriate M leaflet in Volume II of the relevant engine handbook, Air Publications 1451C or 1451D.

Airscrew

Type	Wood (Supermarine's).
Blades	2-part, 4-bladed R.H. pusher.
Drawing No.	228,928.
Diameter	10·0 ft.
Pitch	8·0 ft.

Tank capacities

Fuel, two tanks each 75 gall.	Total 150 gall.
Oil, one tank	Oil 14½ gall. Air space 1½ gall.
Normally carried	Oil 10 gall. Air space 6 gall.

Optimum indicated climbing speeds

At sea level	70·7 knots.
At 1,000 ft.	70·0 ,,
At 2,000 ft.	69·6 ,,
At 3,000 ft.	69·0 ,,
At 5,000 ft.	67·8 ,,
At 6,500 ft.	66·9 ,,
At 10,000 ft.	64·8 ,,
At 13,000 ft.	62·9 ,,

Undercarriage (Retractable)

Type	Single-wheeled units.
Track	7 ft. 7 in.
Shock-absorber compression legs	Oleo-pneumatic.

(44) Leading Particulars, page xiii, lines 4, 5 and 6. *Delete* "Compression leg pressure . . . . 365 lb./sq. in." and *substitute*:—

Compression leg pressure (fully extended)—

Port leg	425 lb./sq. in.
Starboard leg	400 lb./sq. in.

Tail wheel

Solid tyre (metal).

(45) Leading Particulars, page xiii, Tail wheel. After "Shock-absorber compression leg . . . oleo pneumatic" *add*:—

Compression leg pressure (fully extended) ... 595 lb./sq. in.

or

Type	Dunlop pneumatic A.H.O./5519
	or
	W.K.19
Tyre	ECTA 6·0 in. × 4·0 in. extra heavy
Tyre pressure	35–38 lb./sq. in.
Shock-absorber strut ..	Vickers oleo pneumatic

Rear 3 ft. 4·94 in.

Airscrew

Type	Wood (Supermarine's).
Blades	2-part, 4-bladed R.H. pusher.
Drawing No.	228,928.
Diameter	10·0 ft.
Pitch	8·0 ft.

Tank capacities

Fuel, two tanks each 75 gall.	Total 150 gall.
Oil, one tank	Oil 14½ gall. Air space 1½ gall.
Normally carried	Oil 10 gall. Air space 6 gall.

Optimum indicated climbing speeds

At sea level	70·7 knots.
At 1,000 ft.	70·0 ,,
At 2,000 ft.	69·6 ,,
At 3,000 ft.	69·0 ,,
At 5,000 ft.	67·8 ,,
At 6,500 ft.	66·9 ,,
At 10,000 ft.	64·8 ,,
At 13,000 ft.	62·9 ,,

Undercarriage (Retractable)

Type	Single-wheeled units.
Track	7 ft. 7 in.
Shock absorber compression legs	Oleo-pneumatic.
~~Compression leg pressure—before assembly—~~	
~~Port compression leg~~	~~420 lb./sq. in.~~
~~Starboard compression leg~~	~~365 lb./sq. in.~~ A.L.5.
Main wheels—	
Type	Palmer No. 495/B *or* Dunlop A.H.2074.
Tyre pressure	60 lb./sq. in.

Tail wheel

Solid tyre (metal).

(45) Leading Particulars, page xiii, Tail wheel. After "Shock-absorber compression leg . . . oleo pneumatic" *add*:—

Compression leg pressure (fully extended)	595 lb./sq. in.
or	
Type	Pneumatic (Dunlop A.H.O.5519) A.L.5.
Shock-absorber compression leg	Oleo-pneumatic
Compression leg pressure (fully extended)	~~625~~ 575 lb./sq. in. A.L.8
Tyre pressure	35–38 lb./sq. in.

Distance athwartships between pairs of spools	Front	4 ft. 7·75 in.
	Rear	3 ft. 4·94 in.

~~Airscrew~~

Type	Wood (Supermarine's).
Blades	2-part, 4-bladed R.H. pusher.
Drawing No.	228,928.
Diameter	10·0 ft.
Pitch	8·0 ft.

Tank capacities

Fuel, two tanks each 75 gall.	Total 150 gall.
Oil, one tank	Oil 14½ gall. Air space 1½ gall.
Normally carried	Oil 10 gall. Air space 6 gall.

Optimum indicated climbing speeds

At sea level	70·7 knots.
At 1,000 ft.	70·0 ,,
At 2,000 ft.	69·6 ,,
At 3,000 ft.	69·0 ,,
At 5,000 ft.	67·8 ,,
At 6,500 ft.	66·9 ,,
At 10,000 ft.	64·8 ,,
At 13,000 ft.	62·9 ,,

Undercarriage (Retractable)

Type	Single-wheeled units.
Track	7 ft. 7 in.
Shock absorber compression legs	Oleo-pneumatic.
~~Compression leg pressure—before assembly—~~	
~~Port compression leg~~	~~420 lb./sq. in.~~
~~Starboard compression leg~~	~~365 lb./sq. in.~~
Main wheels—	
Type	Palmer No. 495/B *or* Dunlop A.H.2074.
Tyre pressure	60 lb./sq. in.

A.L.5.

Tail wheel

Solid tyre (metal).

(5) Leading Particulars, page xiii, Tail wheel. After "Shock absorber compression leg . . . . . oleo pneumatic" *insert* :—

Catapult spools

Distance between front and rear spools	Horizontal	9 ft. 7·2 in.
	Vertical	2 ft. 0·48 in.
Distance athwartships between pairs of spools	Front	4 ft. 7·75 in.
	Rear	3 ft. 4·94 in.

~~Airscrew~~

Type	Wood (Supermarine's).
Blades	2-part, 4-bladed R.H. pusher.
Drawing No.	228,928.
Diameter	10·0 ft.
Pitch	8·0 ft.

Tank capacities

Fuel, two tanks each 75 gall.	Total 150 gall.
Oil, one tank	Oil 14½ gall. Air space 1½ gall.
Normally carried	Oil 10 gall. Air space 6 gall.

Optimum indicated climbing speeds

At sea level	70·7 knots.
At 1,000 ft.	70·0 ,,
At 2,000 ft.	69·6 ,,
At 3,000 ft.	69·0 ,,
At 5,000 ft.	67·8 ,,
At 6,500 ft.	66·9 ,,
At 10,000 ft.	64·8 ,,
At 13,000 ft.	62·9 ,,

Correction for position error of airspeed indicator

At	50	knots	indicated	airspeed	*add* ..	..	3·5 knots.
At	60	,,	,,	,,	,, ..	..	2·0 ,,
At	70	,,	,,	,,	,, ..	..	1·4 ,,
At	80	,,	,,	,,	,, ..	..	1·0 knot.
At	90	,,	,,	,,	,, ..	..	1·0 ,,
At	100	,,	,,	,,	,, ..	..	1·0 ,,

The all-up weight of the aeroplane during the tests upon which the above climbing speeds and position errors are based was 7,350 lb.

Flying limitations

For these limitations reference should be made to the appropriate T leaflet of Air Publication 1515A, Vol. II.

Position of pressure head

Position—

On the port front outer interplane strut with the forward extremity of the static pressure tube located $8\frac{3}{4}$ in. in front of a line joining the leading edge of the top and bottom planes. The distance down the strut is 42 per cent. of the geometric gap, measured from the top plane chord. Allowable limits : plus or minus $\frac{1}{2}$ in.

Angular setting—

The centre line of the static pressure tube is inclined downwards at an angle of 7° relative to the main plane chord. Allowable limits : plus or minus 2°.

NOTE TO OFFICIAL USERS

Air Ministry Orders and Volume II leaflets as issued from time to time will affect the subject matter of this publication. It should be understood that amendment lists are not always issued to bring the publication into line with the orders or leaflets and it is for holders of this book to arrange the necessary linking-up.

Where an order or leaflet contradicts any portion of this publication, an amendment list will generally be issued, but when this is not done the order or leaflet must be taken as the overriding authority.

FIG. 1.—The Walrus I aeroplane.—Three-quarter front view.

INTRODUCTION

1. The Walrus I is a single-engined boat seaplane amphibian of biplane form and designed for catapulting. It is intended for duty with the Fleet Air Arm and normally carries a crew of three.

2. The hull is constructed of girder section frames interconnected by a keel and stringers, and is covered by a skin of alclad. At the forward end and on the aft portion of the hull deck gun turrets are provided.

3. The main planes have equal span and chord and the same aerofoil section, the spars and box ribs being constructed of stainless steel, the ordinary ribs being spruce. The upper and lower surfaces of the main planes are fabric covered whilst the nose portions of the main planes are covered with plywood. Hinged flaps are also provided on the bottom planes to permit folding of the planes. Floats are fitted to the outer portions of the bottom planes.

4. The aeroplane is rendered amphibious by the permanently attached undercarriage units which are retractable. When fully retracted the undercarriage wheels are stowed in special recesses in the bottom main planes. These units are hydraulically operated, their retracted or extended position being visually indicated in the pilot's cockpit. In conjunction with the engine throttle control hand lever, audible warning is also given when the undercarriage units are not locked in their fully extended position.

5. The cabin is totally enclosed, the roof and the upper portions of the sides of the pilot's cockpit being panelled with safety glass. In the cabin, aft of the pilot's seat, on the port side, are the navigator's seat and table, and aft of these are the wireless operator's seat and table. Access to the cabin is by the sliding panel in the roof of the pilot's cockpit.

6. The fin is built integral with the fuselage, the tail plane being a separate unit. The elevators are provided with trimming flaps, a servo-rudder being fitted aft of the air rudder trailing edge. The tail wheel unit is fitted with an oleo-pneumatic shock absorber leg, and (when freed from the rudder controls within the hull) is partially castored, the tail wheel being housed within the combined tail skid and water rudder.

7. The flying controls are of normal design, the first pilot's control column and rudder pedals being mounted on the port side of the pilot's cockpit. Dual control is provided for and, when fitted, the second pilot's control column

INTRODUCTION

1. The Walrus I is a single-engined boat seaplane amphibian of biplane form and designed for catapulting

(16) Para. 1. At the end of this paragraph *add* the following:—

"The hull of the Walrus I is of metal, and the hull of the Walrus II is of wood".

of girder section frames interconnected by a keel and stringers, and is covered by a skin

(18) Para. 2, line 3. After "alclad" *insert* "The wooden hull is constructed of a wooden centre keelson, wooden frames and stringers, and covered with a plywood skin".

same aerofoil section, the spars and box ribs being constructed of stainless steel, the ordinary ribs being spruce. The upper and lower surfaces of the main planes are fabric covered whilst the nose portions of the main planes are covered with plywood. Hinged flaps are also provided on the bottom planes to permit folding of the planes. Floats are fitted to the outer portions of the bottom planes.

4. The aeroplane is rendered amphibious by the permanently attached undercarriage units which are retractable. When fully retracted the undercarriage wheels are stowed in special recesses in the bottom main planes. These units are hydraulically operated, their retracted or extended position being visually indicated in the pilot's cockpit. In conjunction with the engine throttle control hand lever, audible warning is also given when the undercarriage units are not locked in their fully extended position.

5. The cabin is totally enclosed, the roof and the upper portions of the sides of the pilot's cockpit being panelled with safety glass. In the cabin, aft of the pilot's seat, on the port side, are the navigator's seat and table, and aft of these are the wireless operator's seat and table. Access to the cabin is by the sliding panel in the roof of the pilot's cockpit.

6. The fin is built integral with the fuselage, the tail plane being a separate unit. The elevators are provided with trimming flaps, a servo-rudder being fitted aft of the air rudder trailing edge. The tail wheel unit is fitted with an oleo-pneumatic shock absorber leg, and (when freed from the rudder controls within the hull) is partially castored, the tail wheel being housed within the combined tail skid and water rudder.

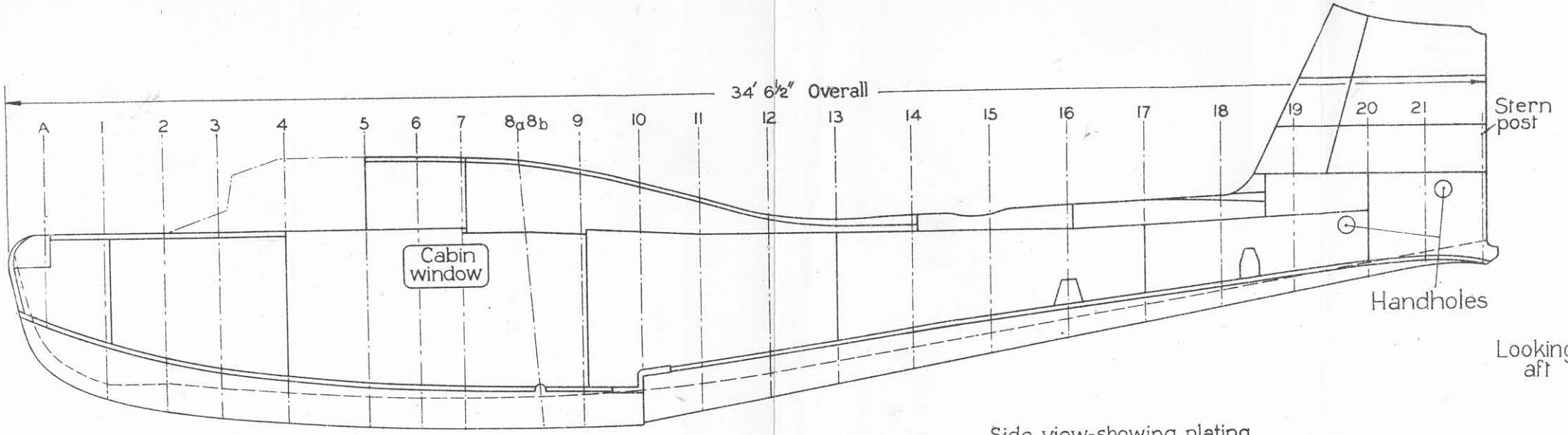
7. The flying controls are of normal design, the first pilot's control column and rudder pedals being mounted on the port side of the pilot's cockpit. Dual control is provided for and, when fitted, the second pilot's control column

and rudder pedals are mounted on the starboard side, in line transversely with those of the first pilot. The engine controls are mounted on the port side of the pilot's cockpit.

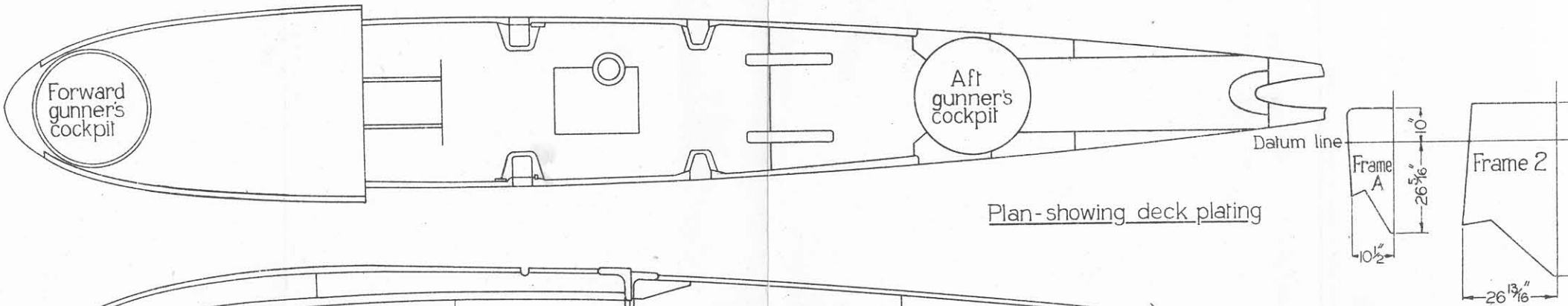
8. The engine, fitted with a pusher airscrew, is mounted on the aft end of the engine nacelle which is positioned over the hull centre line and structurally supported between the top centre plane and hull deck, the centre line of the engine being offset to port at the forward end. The fuel tanks are housed in the top outer planes, at the inboard ends, the oil tank forming the nose portion of the engine nacelle. Double-acting hand pumps are provided for filling the fuel tanks.

9. Bombs are carried under the port and starboard bottom planes, outboard of the undercarriage wheel recesses. The armament consists of two Lewis guns, one being mounted in the forward gun turret, the other in the aft gun turret. The wireless installation comprises transmitting and receiving units, two fixed aerials being provided.

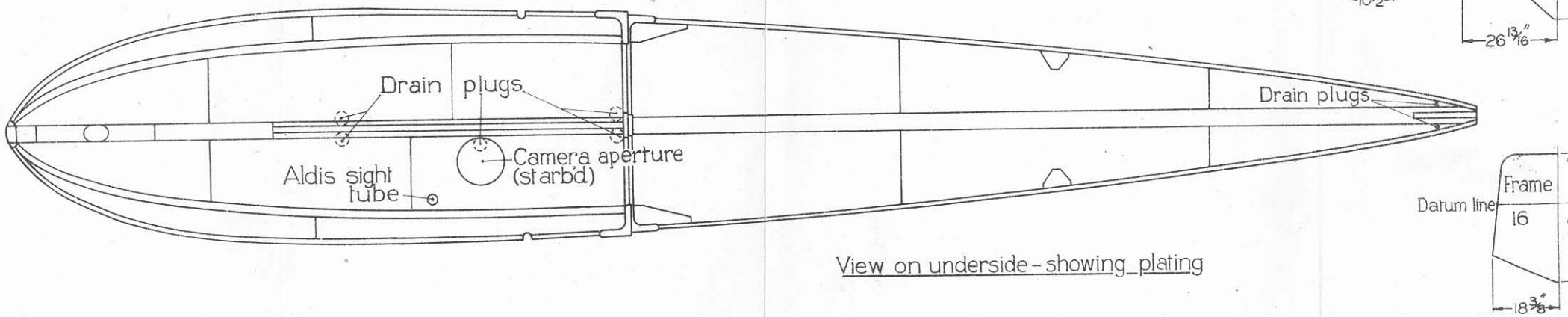
10. A dinghy, distress signals, anchors, boathooks, etc., are included in the marine equipment together with a double-acting hand pump for pumping the bilges.



Side view-showing plating



Plan-showing deck plating



View on underside-showing plating

FIG.2. HULL

(3981).

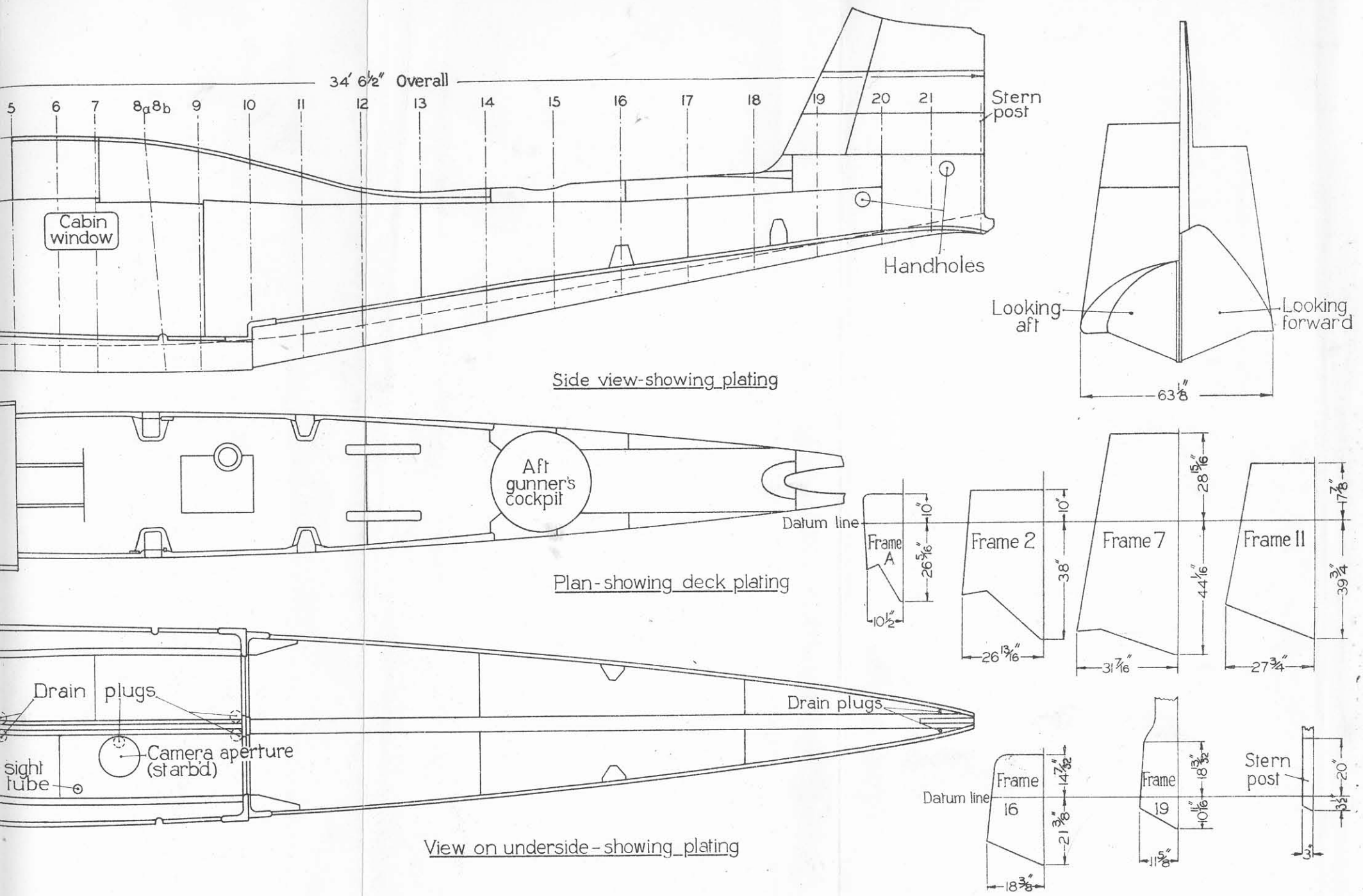

34' 6½" Overall
5
6
7
8a
8b
9
10
11
12
13
14
15
16
17
18
19
20
21
Stern post
Cabin window
Handholes
Looking aft
Looking forward
63 1/8"
Side view-showing plating
Aft gunner's cockpit
Datum line
Frame A
10"
26 5/16"
10 1/2"
Frame 2
10"
38"
26 13/16"
Frame 7
28 15/16"
44 1/16"
31 7/16"
Frame 11
7/8"
39 3/4"
27 3/4"
Plan-showing deck plating
Drain plugs
Drain plugs
Camera aperture (starb'd)
sight tube
Datum line
Frame 16
14 7/32"
21 3/8"
18 3/8"
Frame 19
13/32"
10 1/16"
11 5/8"
Stern post
20"
3/32"
3"
View on underside-showing plating

FIG.2. HULL

CHAPTER I

HULL

General Construction

11. The hull is a riveted alclad monocoque structure, the rivets and all extruded structural components being duralumin. The hull forms one continuous compartment, a semi-bulkhead on the portside, at frame 5, separating the pilot's cockpit and forward gun turret portion from the main cabin in which are housed the seats and tables for the navigator and wireless operator.

Note.—Items referred to in this chapter by reference letters are similarly indicated in the illustrations, the numbers of which are given *en bloc* early in the relevant paragraphs. These reference letters are not necessarily indicated in all these illustrations.

12. The construction of the hull is shown in fig. 2. In the deck are three openings, the forward gun turret, the pilot's cockpit and the aft gun turret, access to the hull being normally obtained through the pilot's cockpit. Covers which can be freed or secured either from inside or outside the hull are provided for the gun turrets. The pilot's cockpit is provided with a windscreen framework panelled with celestoid and safety glass, the roof and side windows being fitted with sliding panels.

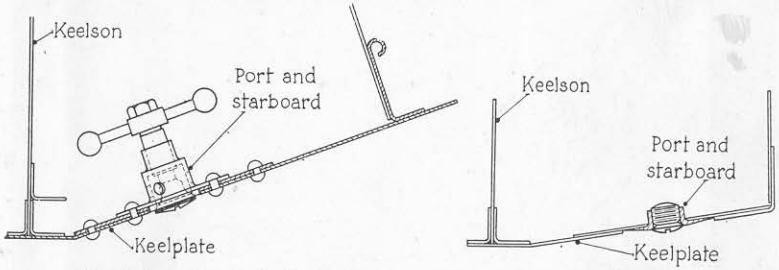


FIG. 3.—Drain plugs in hull.

13. At the bottom of the hull, adjacent to and on each side of the keel are six drain plugs (*see* figs. 2 and 3), two immediately forward of frame 5, two forward of the hull step, and two between frame No. 21 and the stern post. An aperture on the bottom of the hull, on the starboard side, is provided for photographic purposes, the drain plug in the camera recess bottom closing plate being positioned on the keel line of the hull aperture.

(19) Page 3. After CHAPTER I, *amend* "HULL" to read "HULL, METAL (WALRUS)".

General Construction

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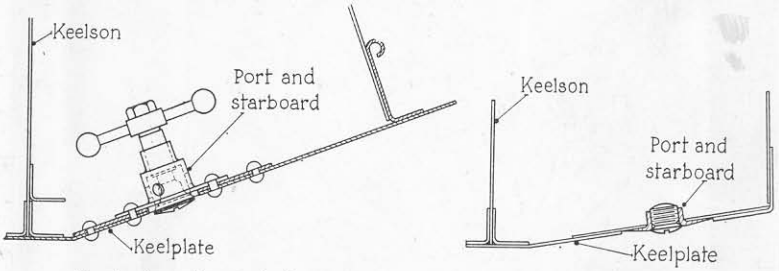

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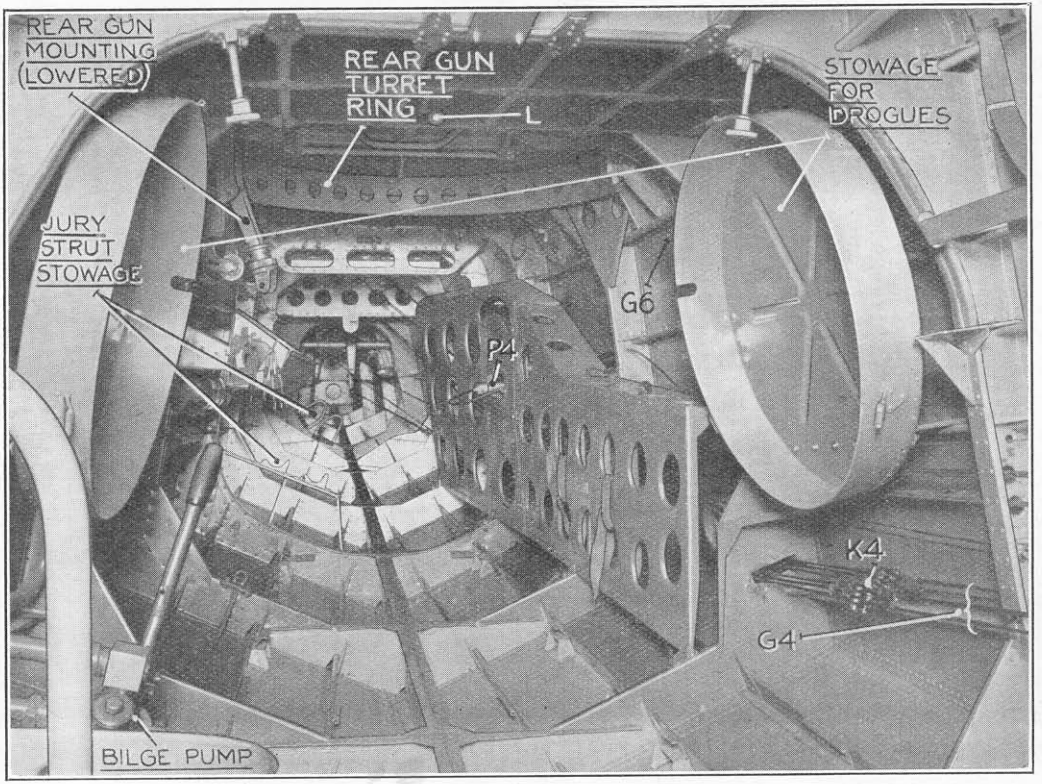

FIG. 4.—Hull interior (looking aft).

14. A walkway, consisting of corrugated alclad panels, runs from the forward gun position, down the starboard side and terminates immediately aft of the rear gun station. Firing steps are provided at the forward gun station, these steps also being constructed of corrugated alclad and positioned on the port and starboard sides and across the peak.

15. The hull is formed with a step beneath the main cabin, at frame 10, from which the hull contours converge smoothly to the stern post. The following lines define the contours of the hull :—the keelson running from bow to stern, the forward chine on either side running from the bow to the hull step, the after chine on either side running from the hull step to the stern post, and the gunwale on either side defining the limits of the hull roof. The hull roof is referred to as the forward, cabin, or rear deck according to its relative position in the hull length.

16. Trunnions are provided for mounting the aeroplane on a ship catapult, the two forward trunnions being fitted at the port and starboard ends of the hull step, at the chine, the two aft trunnions being secured to the port and starboard after chines at frame No. 16.

17. The protective treatment of the hull surfaces is in accordance with the official publications on the repair, maintenance and protection of metal hulls and floats. Reference should be made to Air Publication 1464, Vol. I, Leaflet D.60, and Aircraft Design Memorandum No. 324 (issue 2).

Construction

18. *Keelson.*—The chief longitudinal member of the hull is the keelson (*see* fig. 2) which is structurally continuous from the bow to the stern post. The keelson (A) is an H-sectioned lightened girder built up of alclad sheeting riveted to alclad angle pieces. Butt straps in the web and butt bars in the top and bottom keel bars occur at intervals along the keelson length, no two butts in the keelson web and bars being in the same transverse plane. The step in the keelson, at frame No. 10, forms the apex of the hull step.

19. *Stern post and stem.*—The stern post (B) is of box form and is constructed of two alclad sheets 18 s.w.g. spaced 2 in. apart. These transverse sheet members are secured to the hull and fin plating by riveted alclad angles, the forward and aft angles pointing forwards and aft respectively. The stern post provides attachment for the rudder hinge supports and tail plane rear strut fittings. The stem plate (C) of 18 s.w.g. alclad consists of a wide angle flat bottom U-sectioned profile rigidly secured to the forward end of the keelson. This stem plate is stiffened by a vertical alclad plate centrally positioned, the aft and forward edges of which are flanged on each side by riveted alclad angles, the forward flanges being also riveted to the stem plate.

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(20) Para. 16. *Delete* this paragraph and *insert* the following new paragraph:—

16. Spools are provided for mounting the aeroplane on a ship catapult, the two forward spools being fitted at the port and starboard ends of the hull step, at the chines, and the two aft spools being secured to the port and starboard after chines at frame No. 16.

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20. *Frames and skin.*—Transverse strength is contributed to the hull by the frames, (*see* figs. 4, 5, 6 and 87) and semi-bulkhead at frame No. 5, each frame being constructed with the whole (or part, as at frame 5) of the base divided at the centre, the edges of the divided base being riveted to the keelson web by means of angle lug plates (D). Small triangular openings (E) in the bottom edge of the frame bases provide passage for bilge water. The hull frames are constructed of

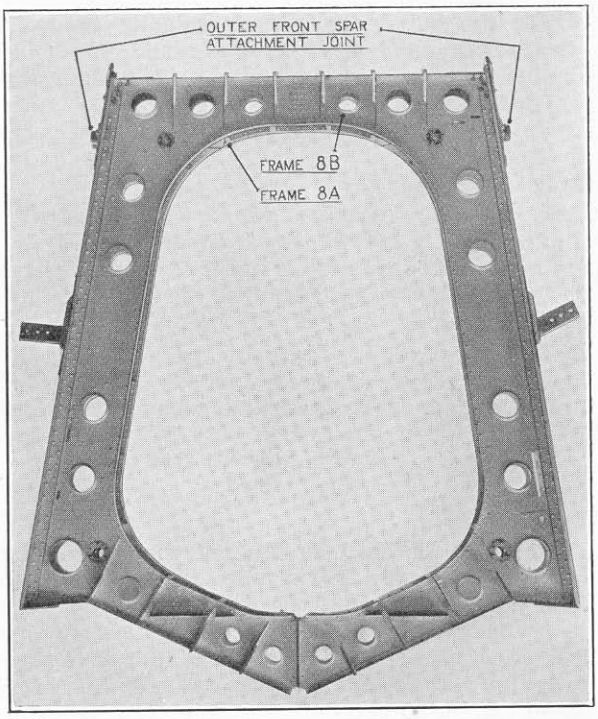


FIG. 5.—Hull frames Nos. 8A and 8B (looking forward).

alclad sheets, and are flanged at the outboard and inboard edges, the flanges being formed either by the bending of the frame edges or by separate light angle sections riveted on. The frames are stiffened longitudinally by stringer brackets (F).

21. Longitudinal stringers (G) running along the hull contribute some measure of interframe bracing, but in the main the frames depend for their bracing on the outer skin which is built up of alclad sheets riveted to the frames and keelson. Longitudinal compression members (H) of flanged U-section are fitted between frames Nos. 8B and 11, at No. 9 stringer

station, whilst diagonal bracing members (*J*) of similar section extend from the ends of the compression members, converging at frame No. 10 at a point approximately $2\frac{1}{4}$ in. above the chine. The greater portion of the hull skin is of 18 and 20 s.w.g. alclad sheet but a number of sheets of 16 s.w.g. are used for the bottom, the sides and the deck, where greater strength is required.

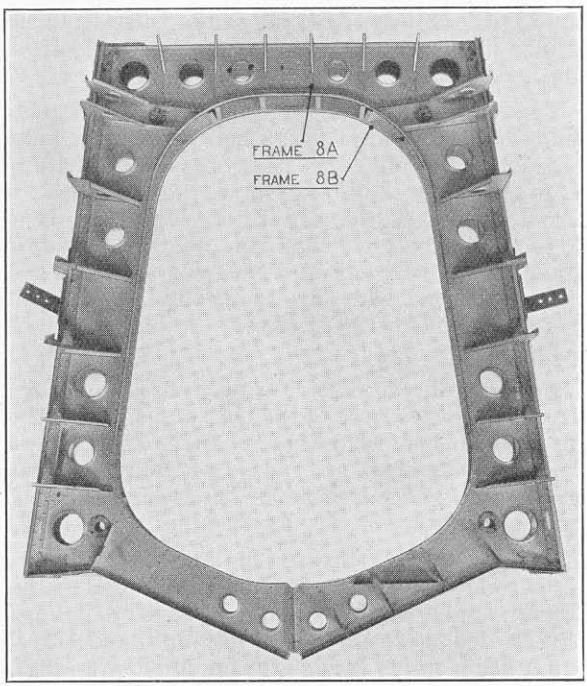


FIG. 6.—Hull frames Nos. 8A and 8B (looking aft).

22. Drain plugs (referred to in para. 13) are illustrated in fig. 3. The camera aperture (also referred to in paras. 13 and 233) consists of a vertical tube, approximately 13 in. dia., which is let into the hull bottom, on the starboard side, between frames No. 7 and 8A. This tube is rigidly secured to the hull by means of an angle-sectioned ring. The top end of the tube (*see* fig. 7) is provided with a coned ring with a rounded seating which, in conjunction with a corresponding cover, securing screw, bridge and securing links, provides a water-tight sealing. A spring-loaded catch mounted on the bridge locks the securing screw, a finger grip permitting, when desired, the freeing of the catch from engagement with the securing screw notched collar.

Deck structure

23. *Forward gun turret.*—At the extreme forward end of the deck (*see* figs. 2, 8 and 123) is mounted a gun turret which is described in para. 210. Support for this turret is provided by an angle-sectioned ring which is secured to the deck and stiffeners on the underside of the deck. These stiffeners run from the turret support ring to the deck beam at frame No. 2, and to the port and starboard gunwales forward of this deck beam. At the forward point of the turret ring support is given by a flanged gusset which is riveted to the aft side of the stem plate vertical stiffener.

24. *Forward turret cover.*—This cover is constructed of alclad and, as illustrated in figs. 9 and 10, is hinged along its transverse diameter, stiffeners being provided on its underside. It is secured in position by first registering the forward longitudinal bolt (A) on the forward portion (B) in its corresponding socket in the turret hull ring, then pulling down the aft portion (C) of the cover and engaging the hand-operated levers (D) in the inclined slots in the hull ring. Normally the cover is secured to the inside of the hull by the check cable (E) and snap hook (F).

25. *Aft gun turret.*—This turret consists of an outer complete alclad ring secured to the hull, and an inner partially complete Z-sectioned alclad ring secured to the outer ring. The outer and inner rings are rigidly secured to the hull by common stiffeners. Within the inner Z-sectioned ring is secured a lightened gun track which is described in para. 211.

26. *Aft turret cover.*—This cover is a permanent fitting and is made to slide to its stowed position immediately forward of the turret. Like the forward turret cover it is hinged on its transverse diameter as shown in figs. 9, 10 and 125, the aft portion (G) being spring loaded, thus occupying a semi-raised position when freed from the hand locking levers positioned in the deck immediately aft of the turret. This spring loading mechanism consists of two cables (H) which pass over guide pulleys (O1) housed on the inner sides of the slide arms (J), the ends of the cables being attached to the forward ends of the tension springs (K). The flat bottomed U-channel slide arms (J), ~~operating in the bight of U-channels (I,)~~ are provided with roller bearings (M) and horizontal guide rollers which are fitted to the pins (N).

27. Centrally positioned on the underside of the deck, immediately forward of the aft gun turret, is a spring-loaded bolt (item (L) of fig. 4) which operates a vertical pin centrally mounted on the underside of, and protruding through the deck, forward of the gun turret. When in engagement with the socket (O) this vertical pin locks the aft turret cover in

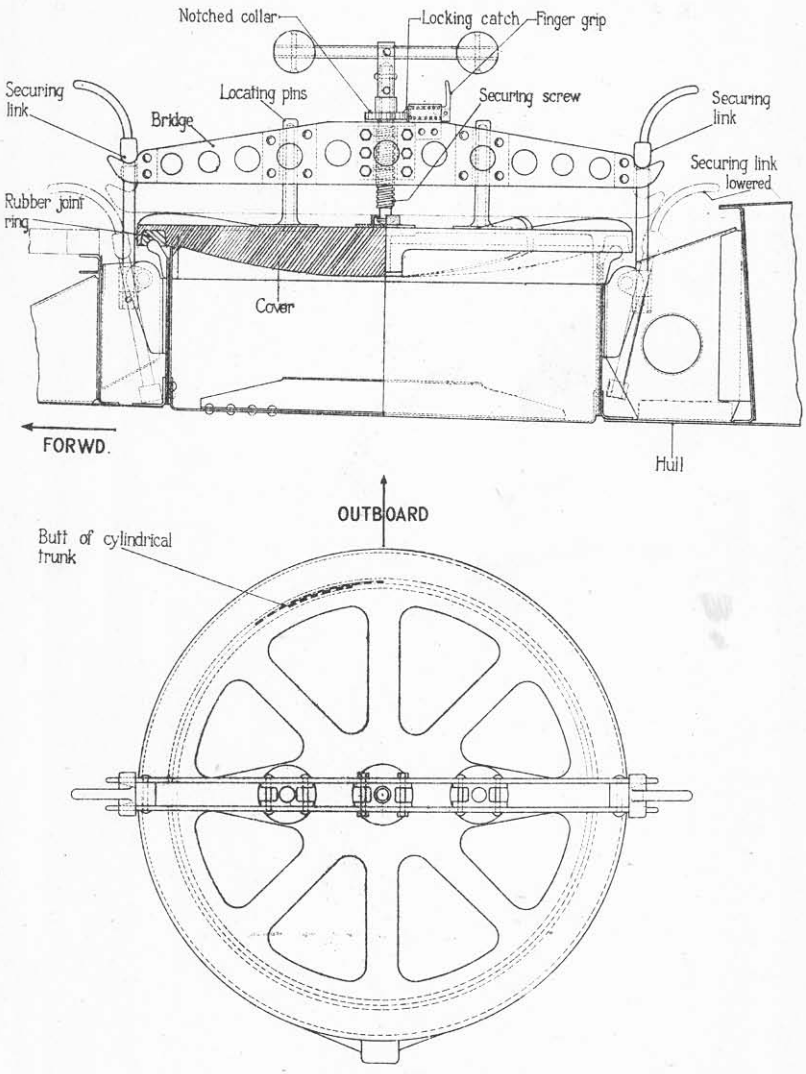


FIG. 7. CAMERA MOUNTING IN HULL

its forward position. When in the forward position the aft portion of the turret cover is supported by the hinged panel strut (P), the bottom ends of which are sprung into the deck clips (Q), spring-loaded pins being provided at the ends of the panel strut bottom member. When raised thus the aft portion of the cover forms a windscreen. When the panel strut is not in use it is swung forward and secured by the spring clip (P1). Fig. 9 shows the sliding arms with their inverted flat-bottomed U-channel covers removed. Levers (Q1), operated from either inside or outside the hull, secure the turret cover in its closed position.

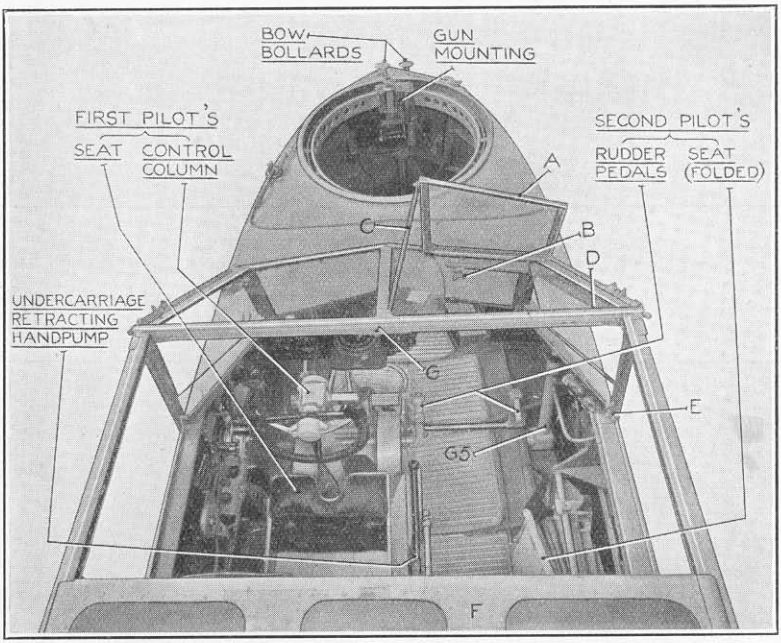


FIG. 8.—Hull forward portion (from above).

Windscreen over pilot's cockpit

28. The windscreen structure is shown in figs. 8 and 11, and consists of a light alloy framework and a sliding roof (F), both panelled with safety glass. The forward portion of the windscreen is composed of two panels in its upper sloping portion, and of four panels in its lower vertical portion.

29. The centre of the upper sloping portion starboard panel is open, a movable panel (A) hinged at its forward side serving the double purpose of windscreen, in its raised position when the compass mounting is in position, or cover when

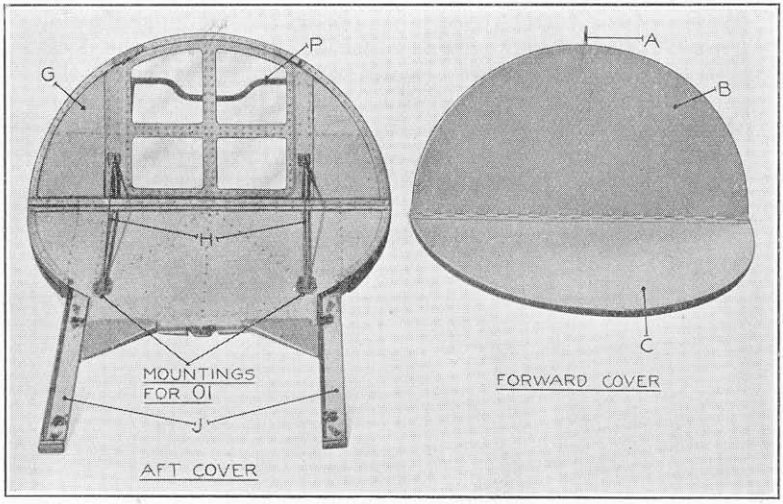


FIG. 9.—Gun turret covers (from above).

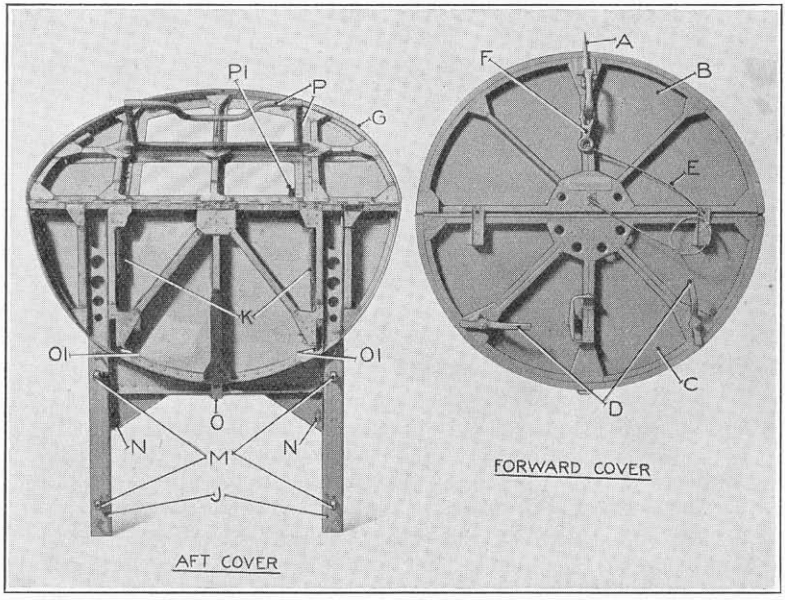


FIG. 10.—Gun turret covers (from below).

lowered to the open portion of the starboard panel. This movable panel is operated by a four-winged knob (B) and a quadrant (*see* fig. 11), the panel being swung through 66° from its closed to its fully open position. To relieve the operating quadrant and worm from undue load, a stay (C) is provided which can be swung into position as shown in fig. 8, the stay when not in use being swung to port and horizontally clipped in front of the rear edge of the upper sloping port panel.

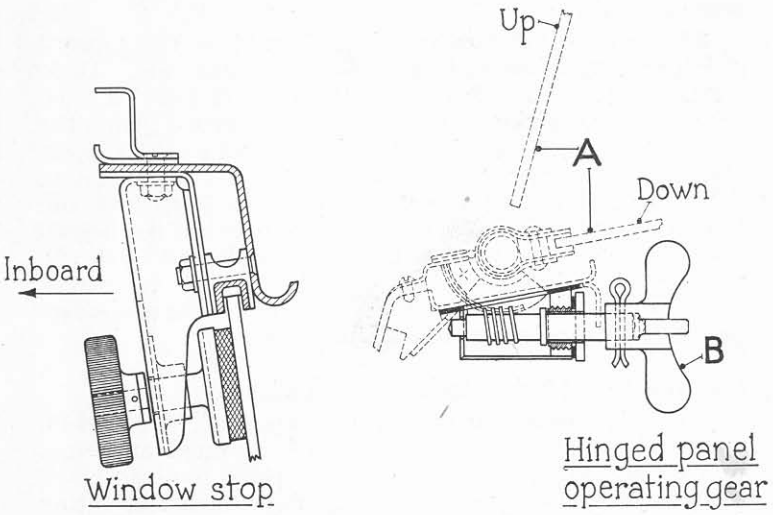


FIG. 11.—Windscreen sliding window stop and upper starboard panel operating gear.

30. The two centre panels of the lower vertical portion are fixed, a windscreen wiper being fitted to each. The two side panels of this lower vertical portion are movable and swing outward on hinges at the top of the panels. These panels are operated by a knurled knob (D) secured to the end of a worm shaft, the fully open position of the panels being approximately horizontal.

31. The panels on the port and starboard sides of the cockpit slide in runways. In the closed position these panels are secured by hand-controlled lever catches (E). The panels can be secured in any position by means of the window stops mounted at mid-length of the top runways and illustrated in fig. 11, a rubber friction disc being pressed against the panel, when desired, by means of the knurled operating knob.

32. The cockpit roof (F) operates in grooved runways and is secured in its closed position by a hand-operated lever catch (G) centrally positioned. The sliding roof is held secure in the fully open position by a spring-loaded catch, centrally positioned on the underside of the fixed portion of the roof, engaging with the forward edge of the sliding roof.

33. Over the wireless operator's position, on the starboard side of the cabin roof, is a circular skylight protected on the outside by duralumin bars.

Bow bollards

34. Two bollards are mounted forward of the forward gun turret, $2\frac{1}{4}$ in. on each side ~~from~~ of the centre line. These bollards, shown in figs. 8, 12 and 123, can be dismantled when desired to give greater clearance for the forward gun. The bollard housing (L) is bolted at its lower end to the support plate (M) and supported at its upper end by the hull mounting (N). The bollard housing is screwed at its lower end and fitted internally with a sleeve (O) at its top end, the bollard (Q) being secured in position by the spring-loaded catch (P), after being screwed into its housing. The bollard is removed by first withdrawing the catch (P), and then unscrewing ~~the bollard (by the top) and lifting clear when unscrewed~~.

Hull attachment fittings for the bottom planes

35. Attachment fittings are provided (*see* figs. 13, 14 and 15) for the bottom outer planes, and are mounted at frames Nos. 8A and 8B for the bottom outer plane front spar and at frame No. 11 for the rear spar. The attachment fitting (A) for the front spar consists of a centrally recessed boss integral with a base plate which is bolted to the frames Nos. 8A and 8B, near the gunwale. On this recessed boss is an interrupted double thread, the engagement and release of which is similar to that described in paras. 50 and 64 for the top centre and top outer main planes. The locating pegs (not shown in fig. 15) for the bottom plane front spar hull attachment fittings are similar to those (item (F) of fig. 22) shown for the top centre section front spar attachment fittings for the top outer planes. The attachment fitting (B) for the bottom plane rear spar consists of a double-lugged casting bolted to frame No. 11, near the gunwale, and provides means of vertical hinge attachment for the bottom plane rear spar.

Seats

36. Four seats are provided, the first and second pilot's seats positioned in line transversely in the cockpit, and the navigator's and wireless operator's seats positioned in the cabin, on the port side. The seats are shown in fig. 16.

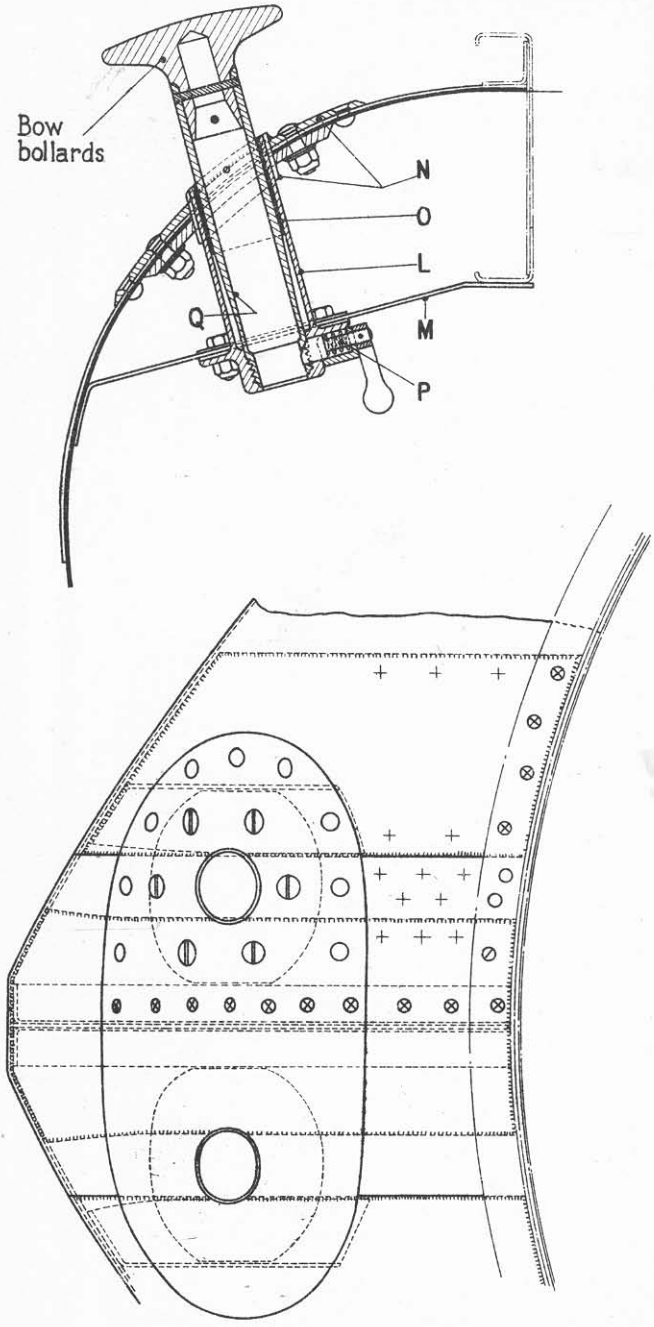


FIG.12. BOW BOLLARDS

37. *First pilot's seat.*—The seat position and back rest of this seat form one piece, the head rest being independently mounted on the bulkhead at frame No. 5. The seat (A) is supported by two pin-jointed lugs on its underside engaging the ends of a transverse duralumin tube rigidly interconnecting the forward ends of two height-adjusting levers (B). These levers are supported at their fulcrum interconnecting transverse shaft by two brackets mounted on the lower end of two vertical channel guides (C) the bottom ends of which are supported by two brackets mounted on the chassis, the top ends being pin jointed to two brackets secured to the forward

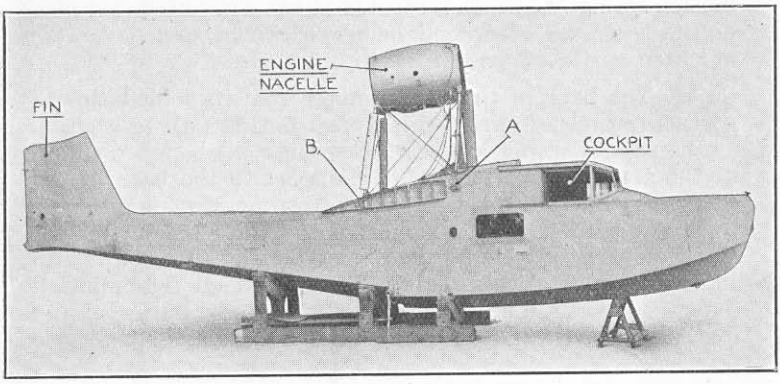


FIG. 13.—Hull with engine nacelle.

face of the bulkhead. The channel guides are transversely interconnected by tubes positioned near their top and bottom ends, the top transverse tube projecting through the guides, thus providing means of pin-jointed attachment for the top ends of the compression spring units (D), the bottom ends of which are pinjointed to the aft ends of levers (B).

38. The transverse interconnecting shaft at the forward ends of levers (B) extends beyond the port side of the seat and provides means of securing the hand operating lever (E). At the end of this lever is a press button (F) by which means a pawl is locked with or freed from the notched quadrant (G) thus allowing the seat freedom to respond to the movement of the hand lever. The seat is kept in its correct relative position by means of slotted brackets, secured to the back of the seat, engaging the vertical guide interconnecting top transverse tube. The compression spring units serve as a counterbalance to the weight of the seat and its occupant thus allowing ease in the raising and lowering of the loaded seat.

39. *Second pilot's seat.*—This seat (*see* figs. 16, 100 and 108) is hinged to two brackets (H) mounted in line longitudinally on the starboard side of the cockpit. When in its stowed position the seat is swung downwards and secured by the aft pinned double lever mounted on a spring-loaded torque shaft below the port edge of the seat, engaging an open lugged bracket secured to the starboard side of the cockpit, immediately above the floor. When in its raised position the seat is secured by ~~both~~ fore and aft pinned double levers ~~(J)~~ on the spring-loaded torque shaft engaging with corresponding open lugs mounted on the starboard side of the first pilot's seat. The spring-loaded torque shaft is energized by a tension spring ~~(K)~~ which is secured at one end to the rear edge of the seat, the other end being connected to a lever ~~(L)~~ mounted on the aft end of the torque shaft.

40. The back of the seat is freed from its folded stowed position by releasing the spring press button (M). The back of the seat is spring loaded, the springs (N) being mounted at the aft corners of the seat. Support to the back of the seat, with the head rest (G8) in the down position, is provided by a pin-jointed stay which is swung into its supporting transverse position, its free end being pressed downwards into an ~~the~~ open wedge socket fitting ~~(O)~~ mounted on the bulkhead central support. The spring-loaded cone press button at the free end of the stay automatically secures the stay in its service position.

41. The second pilot's head rest is hinged at its top end to the inner edge of the frame under the deck. When stowed it is swung backwards (*see* fig. 109) and clipped in a horizontal position. When in the service vertical position the head rest downward projecting bars are held between the spring-loaded back of the seat and the back rest transverse support tube (T8).

42. *Navigator's seat.*—This seat is of bucket form and is hinged below its forward edge, thus permitting access to the stowage beneath (*see* fig. 86). It is secured in its service position by a double-lugged bracket and a bolt centrally positioned at the top of the back rest.

43. *Wireless operator's seat.*—This seat (see fig 16) is a light tubular rigid type and is secured to brackets mounted on the keel and stringer at hull frame No. 10. The head rest vertical supports ~~(P)~~ are adjustable for length and are pin-jointed to the seat back rest top member and to the frame on the underside of the deck. Diagonal longitudinal adjustable stays are fitted between the bottom of the head rest vertical supports and the frame immediately aft, under the deck. A metal case secured to the rear of the wireless operator's seat provides stowage for Bigsworth charts and chartboard.

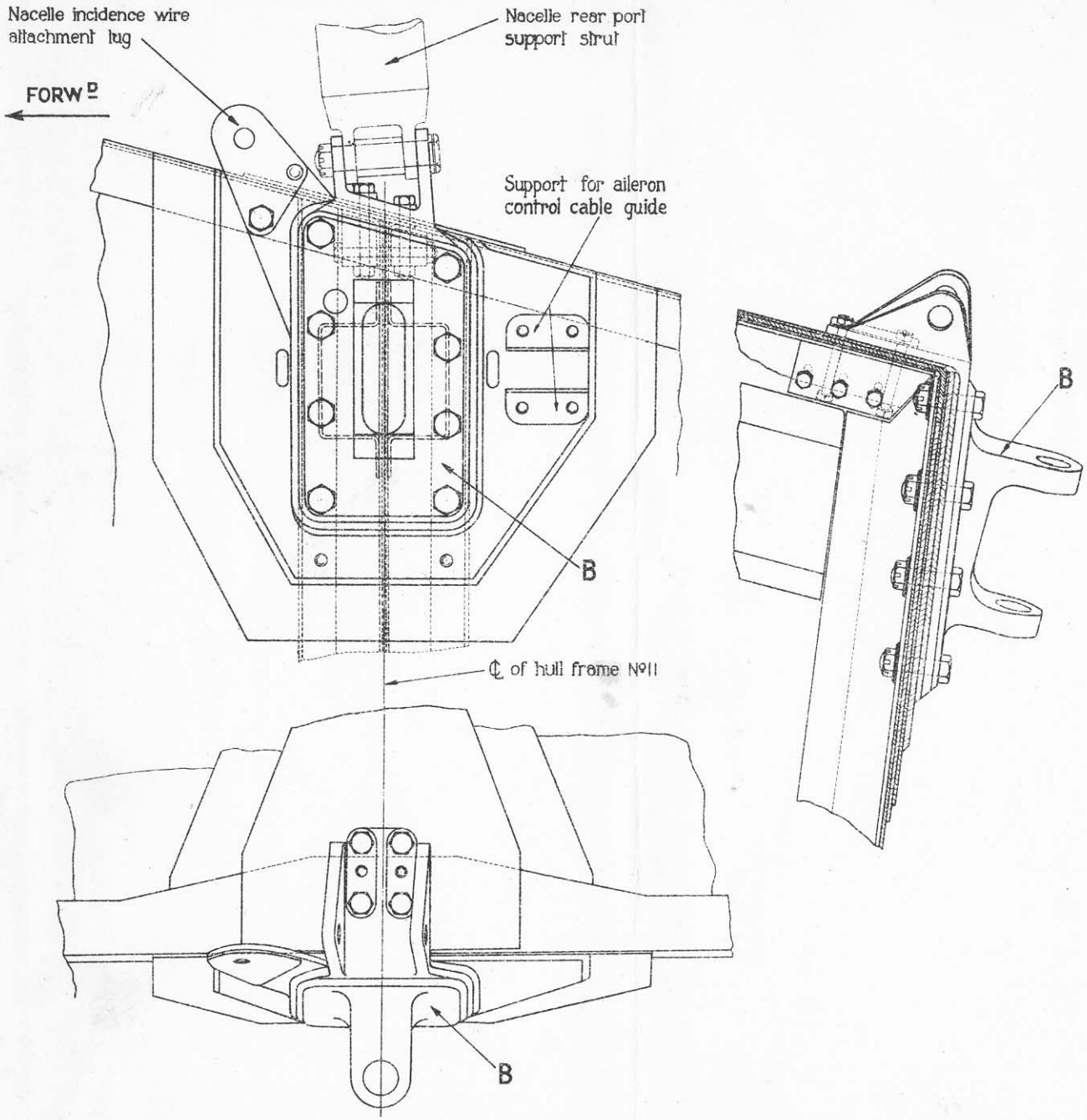


FIG. 14. REAR SPAR ATTACHMENT JOINT ON HULL (PORT)

(3481)

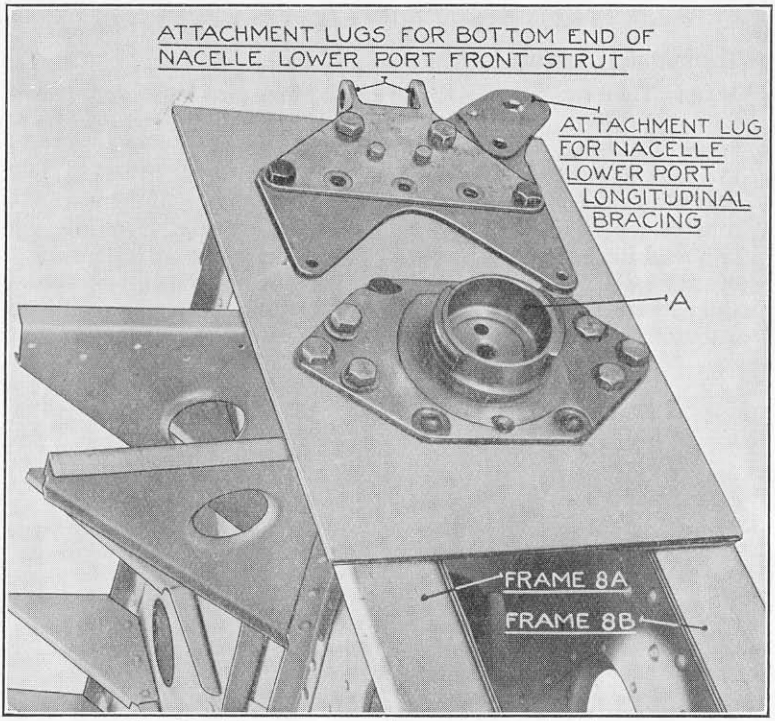


FIG. 15.—Front spar attachment joint on hull (port).

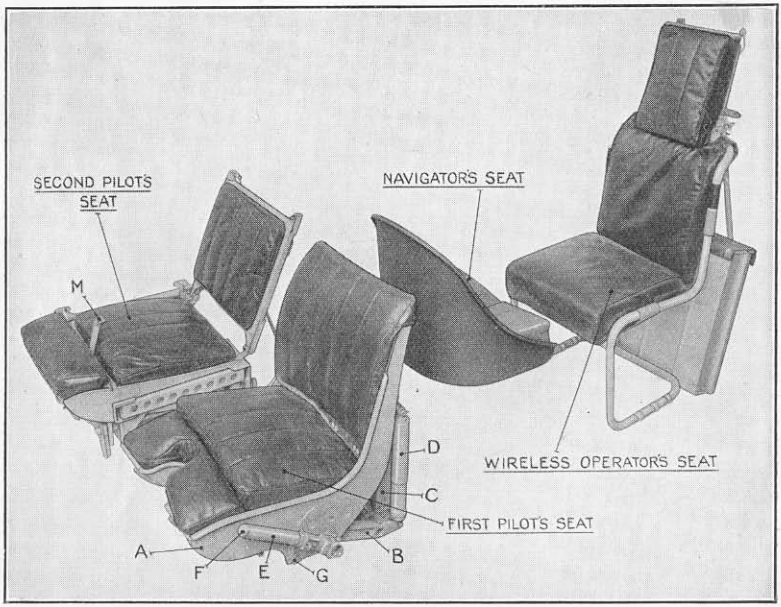


FIG. 16.—Seats.

Towing and mooring fittings

44. Two towing and mooring fittings are provided (*see* fig. 17), one mounted approximately at mid-height of the stem, the other on the keel plate at frame No. 1. Each fitting consists of four shaped pieces of steel (to D.T.D. Specification 166) bolted to place, the forward portions of the four pieces in each fitting being riveted together forming a laminated eyed lug. Doublers are fitted locally on the inside of the hull plating, zinc plates being sandwiched between the fittings and the hull to prevent detrimental local galvanic interaction.

(22) Para. 44. After this paragraph *insert* the following:—

CHAPTER IA

HULL, WOOD (WALRUS II)

General construction

44A. This hull is a wooden monocoque structure, glued, screwed and nailed, the screws being of brass and the nails of copper with roves. In various places, such as at plywood gussets, brass brads are used. The hull forms one continuous compartment, a semi-bulkhead on the port side, at frame No. 5, separating the pilot's cockpit and forward gun turret portion from the main cabin in which are housed seats and tables for the navigator and wireless operator.

44B. The general appearance of the hull is similar to that shown in fig. 2. In the deck are three openings, the forward gun turret, the pilot's cockpit and the aft gun turret, access to the hull being normally obtained through the pilot's cockpit. Covers which can be freed or secured either from inside or outside the hull, are provided for the gun turrets. The pilot's cockpit is provided with a windscreen framework panelled with celestoid and safety glass, the roof and side windows being fitted with sliding panels. Forward of the hull main step, the edges of the planking, namely the gunwale, chine, knuckle and keel are covered with brass rubbing strips.

44C. At the bottom of the hull, adjacent to and on each side of the keel, are four drain plugs (similar to those shown in figs. 2 and 3), two forward of the main step at frame No. 10 and two forward of the stern post. An aperture in the bottom of the hull, on the starboard side, is provided for photographic purposes.

44D. A walkway, consisting of three-ply panels, runs from the forward gun position, down the starboard side and terminates immediately aft of the rear gun station. Firing steps are provided at the forward gun station, these steps also being constructed of three-ply panels with mahogany battens.

44E. The hull is formed with a step beneath the main cabin, at frame 10, from which the hull contours converge smoothly to the stern post. The following lines define the contours of the hull:—the keelson running from stem to stern; the forward chine on either side running from the stem to the hull step; the after chime on either side running from the hull step to the stern post, and the gunwale on either side defining the limits of the hull roof. The roof is referred to as the forward cabin, or rear deck according to its relative position in the hull.

44F. Spools are provided for mounting the aeroplane on a ship catapult, the two forward spools being fitted at the port and starboard ends of the hull step, at the chines and the two aft spools being secured to the port and starboard after chines at frame No. 16.

44G. The hull surfaces are given protective treatment in accordance with A.D.M. No. 325 (Issue 1).

Construction

44H. *Keelson.*—The chief longitudinal member of the hull is the keelson which is structurally continuous from the bow to the stern post. The keelson is an H-section girder built up of a birch plywood web, a mahogany keel piece and mahogany top capping piece. The step in the keelson at frame 10 forms the apex of the hull step and also at this position the joint is made between the forward and aft parts of the keelson. The upswept portion of the keelson, at the bow, is scarfed into the bottom part of the keelson at frame 2.

44J. *Stern post and stem.*—The stern post is of box form and is constructed of two plywood panels, spaced 2 in. apart. These panels are secured at their outboard edges to vertical posts with horizontal stiffening blocks fitted between at intervals. The stern post provides attachment for the rudder hinge supports and the tail plane rear strut fittings.

44K. The stem post is a continuation of the keelson, extending forward and upward and terminating at the deck line at the forward face of the forward gun turret ring.

44L. *Frames and skin.*—Transverse strength of the hull is provided by the frames and semi-bulkhead at frame No. 5. Some frames each have a three-ply web with single stiffening strips at the edge, and others have double stiffening strips one on each side of the web. The frames forward of frame 8 have webs of spruce or mahogany $\frac{1}{2}$ in. thick. All the webs are slotted to take the keelson and are secured to it by means of vertical blocks glued and nailed to the keelson and to the frames. Small triangular openings in the bottom edge of the lighter frame bases provide passage for bilge water.

44M. Longitudinal stringers contribute some measure of interframe bracing, but in the main the frames depend for their bracing on the outer skin which is of plywood glued, nailed, and screwed to the frames, chines and keelson. The greater portion of the hull skin or planking is $\frac{3}{16}$ in. thick or less, but that of the fore bottom and immediately forward of the aft gun turret is $\frac{1}{4}$ in. thick.

44N. The camera aperture (*see* para. 44C) consists of a vertical tube, approximately 13 in. dia. which is let into the bottom, on the starboard side between frames Nos. 7 and 8A. This tube is rigidly secured to the hull by means of a mahogany ring. The top end of the tube (*see* fig. 7) is provided with a coned ring with a rounded seating which in conjunction with a corresponding cover, securing screw bridge and securing links, provides a water-tight sealing. A spring-loaded catch mounted on the bridge locks the securing screw, a finger grip permitting the freeing of the catch from engagement with the securing screw notched collar.

Deck structure

44P. *Forward gun turret.*—At the extreme forward end of the deck (*see* figs. 2, 8 and 123) is mounted a gun turret which is described in para. 210. Support for this is provided by a deep ring of elm which is secured on the underside of the deck by means of a square-section spruce ring and stiffeners. These stiffeners run from the turret support ring to the deck beam at frame No. 2 and to the port and starboard gunwales forward of this deck beam. The forward point of the turret ring is supported by the upper end of the stem post and mahogany chocks secured to the inboard side of the stem-head decking and to the stem post. An alclad capping ring is fitted over the upper edge of the elm ring and the circular gun track is secured within the elm ring.

44Q. *Forward turret cover.*—(*See* para. 24).

44R. *Aft gun turret.*—This turret consists of a deep elm ring secured to the deck through the medium of a square-section spruce ring. Both rings are rigidly secured to the decking and stabilized by the deck stringers which are increased in depth locally. Within the elm ring is secured the gun track (*see* para. 211).

44S. *Aft turret cover.*—(*See* paras. 26 and 27).

Windscreen over pilot's cockpit

44T. (*See* paras. 28 to 33).

Bow bollards

44U. Two bollards (*see* figs. 8, 12, and 123) are mounted forward of the forward gun turret. These bollards can be dismantled when desired to give greater clearance for the forward gun. The bollards pass through mahogany chocks (*see* para. 44P) and are supported at their upper ends within a metal bush which is welded to a deck plate. The bollards are threaded at their lower ends and screw into sleeves which are fitted to the inboard part of the chocks. After being screwed into its housing each bollard

is secured by a spring-loaded catch (P) (*see* fig. 12). The bollard is removed by first withdrawing the catch (P) then unscrewing.

Hull attachment fittings for the bottom planes

44V. (*See* para. 35).

Seats

44W. (*See* paras. 36 to 43).

Towing or mooring fitting

44X. A towing or mooring fitting is mounted on the stem post at chine height. The fitting is of stainless steel and in the form of a four-pointed star, the longer arms embracing the chines and the shorter arms fitting over the stem post. The bolts securing the fitting pass through blocks fitted locally inside the hull. The splayed ends of the fitting are secured by woodscrews.

CHAPTER II

MAIN PLANES

General

45. The main planes comprise a top centre plane and top and bottom outer main planes, the outer main planes being constructed to fold back through an angle of 78 degrees (*see* figs. 17 and 18), folding flaps being fitted to the inner ends of the trailing edges of the bottom planes. The ailerons are of the Frise type and are mass balanced.

Note.—Items referred to in the text by reference letters are similarly indicated in the illustrations, the numbers of which are given *en bloc* early in the relevant paragraphs. These reference letters are not necessarily indicated in all these illustrations.

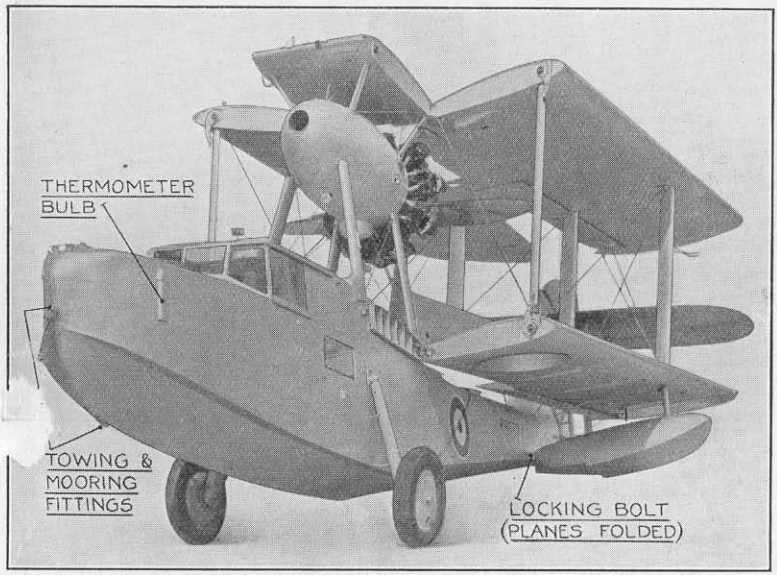


FIG. 17.—The Walrus I aeroplane with main planes folded.

Top centre plane

46. The top centre plane (*see* figs. 19 and 20) is a ply-covered seven-ribbed single-panelled structure, the spars and box ribs being of stainless steel construction, and the ribs wood. This plane is wire braced from both the top and bottom booms of its end box ribs, and is mounted above the engine nacelle structure (*see* paras. 255 and 275) by two front and two rear struts. These struts, 1·25 in. o/d × 20 s.w.g., are pin jointed

at their upper ends to the end fittings of the corresponding spars and at their lower ends to lug fittings on the upper portion of the engine nacelle, the supporting structure being transversely and longitudinally wire braced. Lifting gear stowage is provided just to starboard of the centre line, and approximately eighteen inches aft of the front spar, marine distress signal stowage being provided centrally immediately forward of the rear spar.

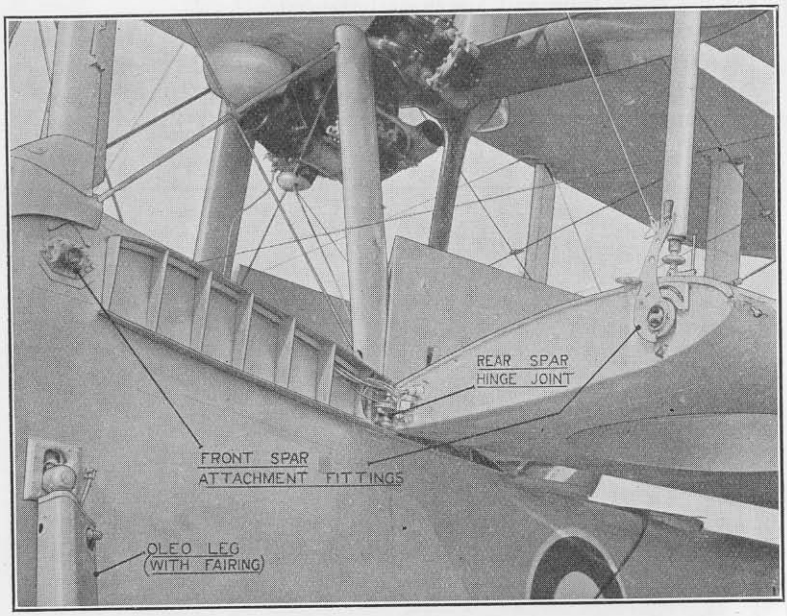


FIG. 18.—Main planes folded (close up).

Spars

47. The front and rear spars are shown in fig. 20 and their sections illustrated in fig. 21, the booms and webs of both the front and rear spars being 24 s.w.g. and ·015 in. thick, respectively.

Spar end fittings

48. These fittings embody the attachment points for the upper ends of the nacelle upper struts, the outer main plane spars, the transverse and longitudinal bracing wires and the box ribs and the lifting cable shackles. The assemblies of these fittings for the front and rear spars are shown in fig. 20.

49. *Front spar fittings.*—These are constructed of stainless steel sheet, means of attachment for the transverse bracing and support strut pin joints being provided by shaped plates (C) bolted on each side of the spar ; doublers, supports and stiffeners are provided where necessary. Lightened U-channels (D), with shaped limbs, bolted to the rear face provide means of securing the box ribs and lifting shackles.

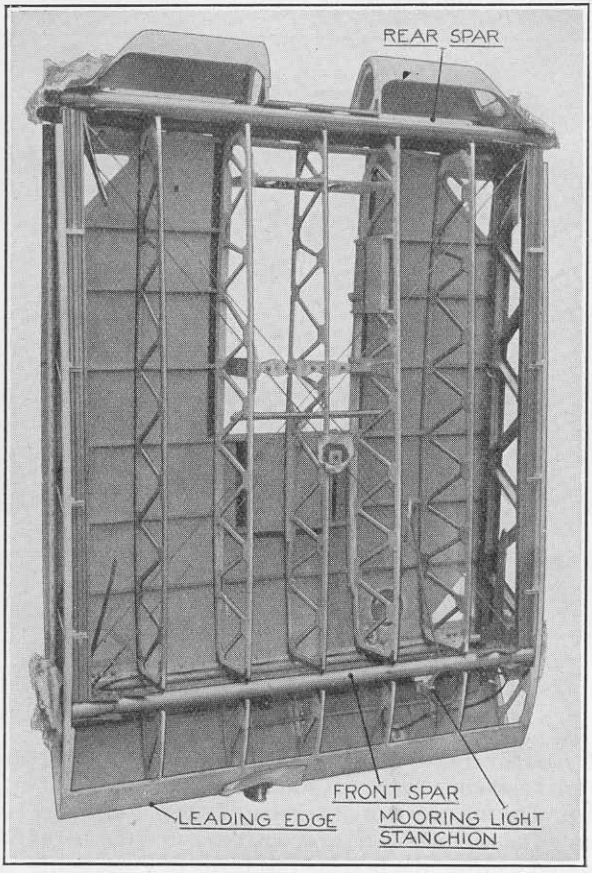


FIG. 19.—Top centre plane—showing construction (looking on underside).

50. Between the side plates (C) at the ends of the spar (*see* figs. 22 and 23), is bolted an interrupted double-threaded fitting (E) in the end recess of which is secured a wedge-shaped locating peg (F) which registers with the corresponding fitting on the inboard ends of the top outer plane front spars.

A riding light stanchion and hand grip (G), protruding above the plane, is mounted on the forward face of the front spar, on the starboard side.

51. *Rear spar fittings.*—These spar fittings are similar in construction to those of the front spar (*see* para. 49) except that eyed lug fittings (H) socketed and secured by bolts into the ends of the top and bottom booms, provide means of hinged attachment for the top outer plane rear spars.

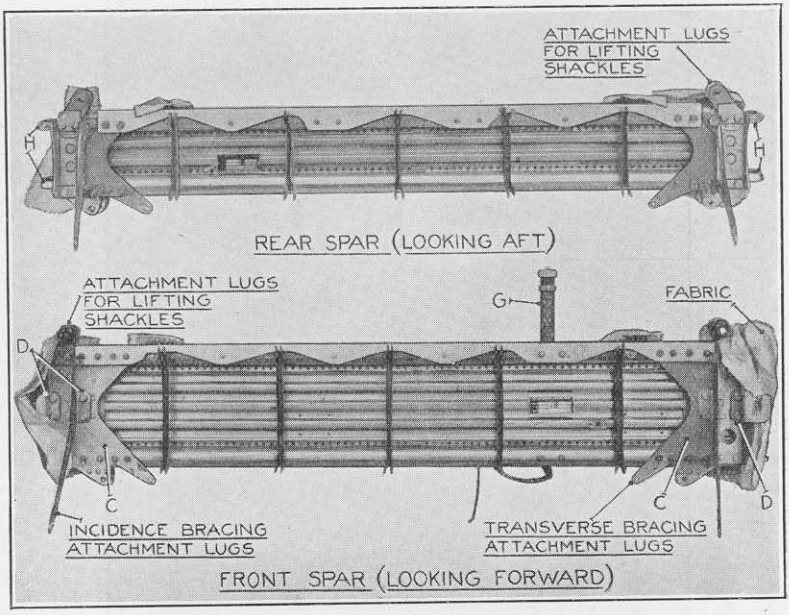


FIG. 20.—Top centre plane spars.

Ribs

52. *End box ribs.*—These ribs (J), shown in figs. 19, 24 and 25, are braced and constructed of stainless steel booms and bracing. Wood profile formers are also secured to the top and bottom booms. The top boom (K) and bottom boom (L) are of flanged corrugated section, the bracing (M) being of U-section. Above the top and below the bottom booms are screwed wood auxiliary booms (N) to which profiled plywood longitudinals (O) are secured, the profile edges of these longitudinals being reinforced by lengths of rectangular section spruce (P). These ribs are secured by transverse bolts to their corresponding spar end fittings described in paras. 49 and 51. The nose portions of these end ribs are secured to the forward edge of the spar end plates (item (A) of figs. 22 and 28).

53. *Intermediate ribs.*—These ribs are constructed of wood and are braced. The booms and bracing (*see* fig. 19) are of spruce to Specification D.T.D. 36A, the five ribs, in general, being of similar construction. The ends of the ribs are secured by transverse bolts to the lugs of the stainless steel vertical U-channels secured to the front and rear spar booms.

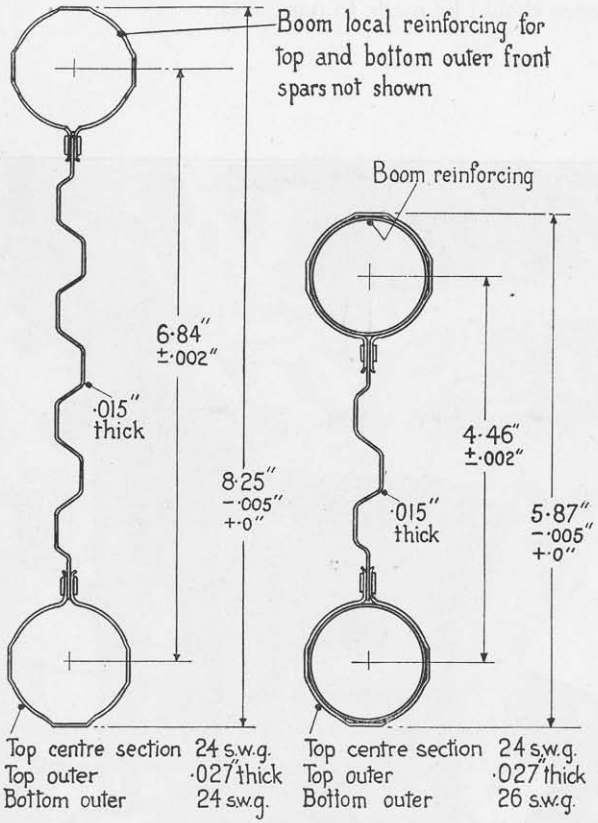


FIG. 21.—Main plane spar sections.

Struts and bracing

54. The front and rear upper supporting struts are constructed of $1\frac{1}{4}$ in. o/d × 20 s.w.g. stainless steel tube with pinned and riveted plug end fittings. The top end fittings are lugged and provide means of pin joint attachment for the top centre plane spar end fittings, as described in para. 48. Each bottom plug end is internally screwed and takes a double lugged eyed fitting provided with a locknut, thus permitting

adjustment in length. These bottom end fittings are pin jointed to the attachment mountings on the engine nacelle. Due to the engine nacelle being offset 3° to port, at its forward end, the front struts are of unequal pin centre lengths, the port front strut being 16·31 in., the starboard strut being 18·46 in. The pin centre length of both port and starboard rear struts is 16·6 in. For the engine nacelle supporting struts, reference should be made to para. 185.

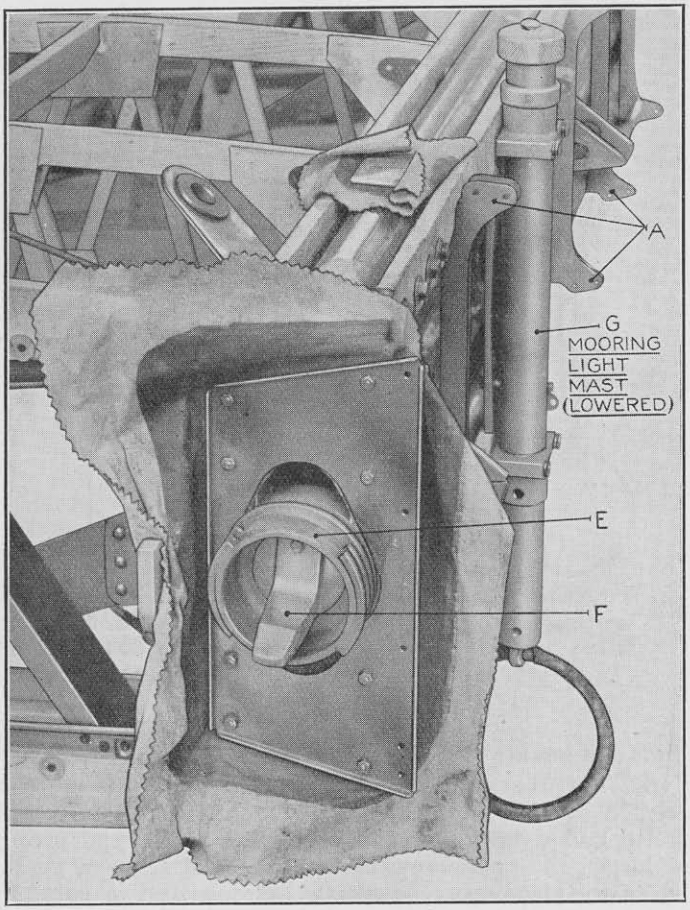
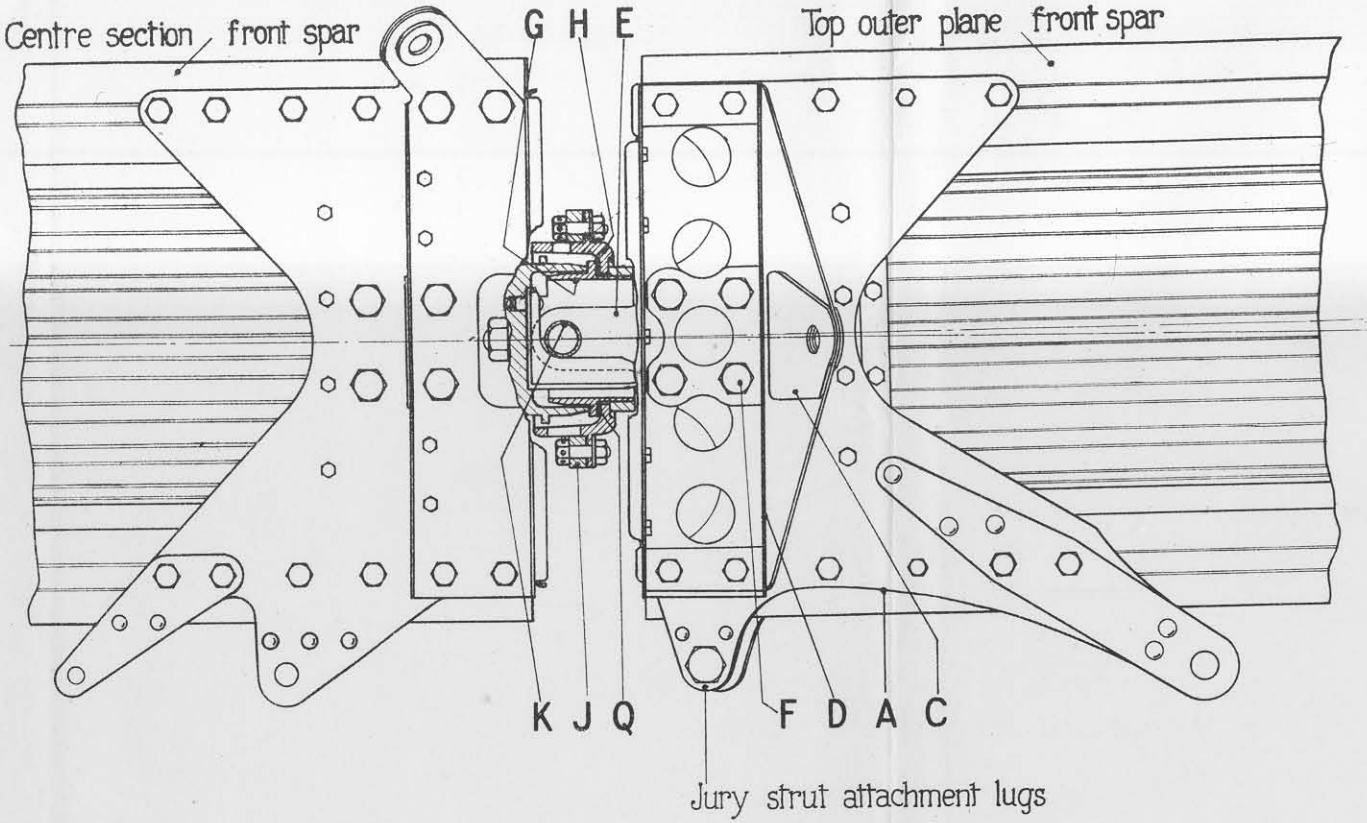
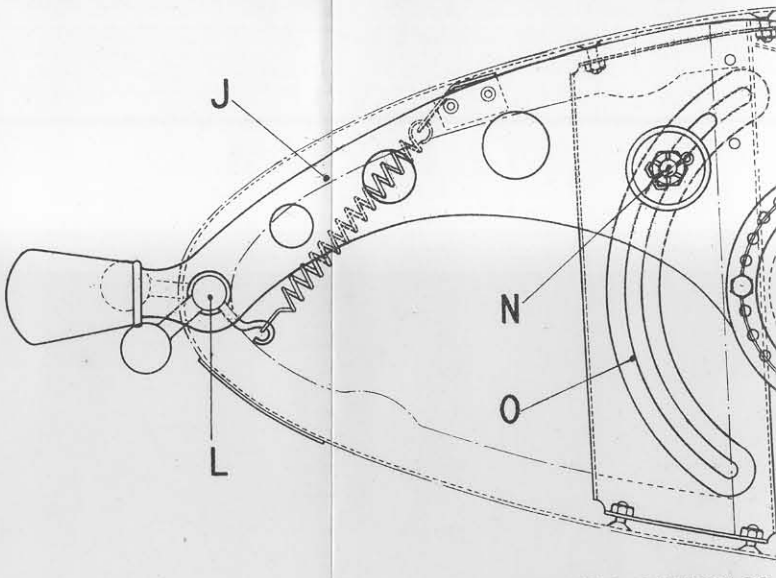


FIG. 22.—Top centre plane front spar end fitting (starboard).



LOOKING FORWARD



LOOKING OUTBOARD
(on inner end of top outer

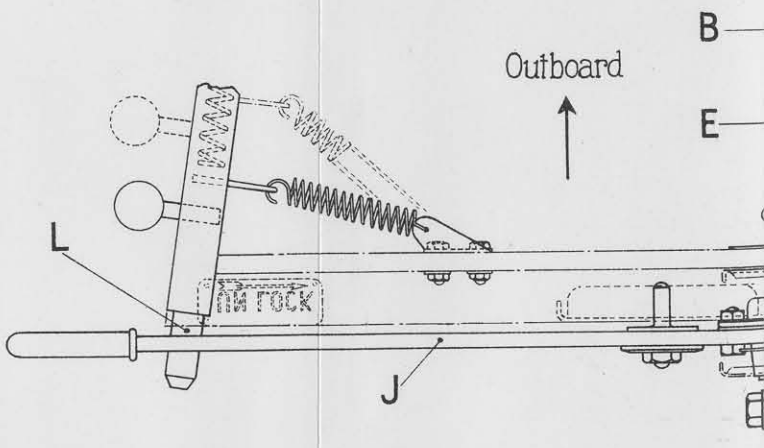
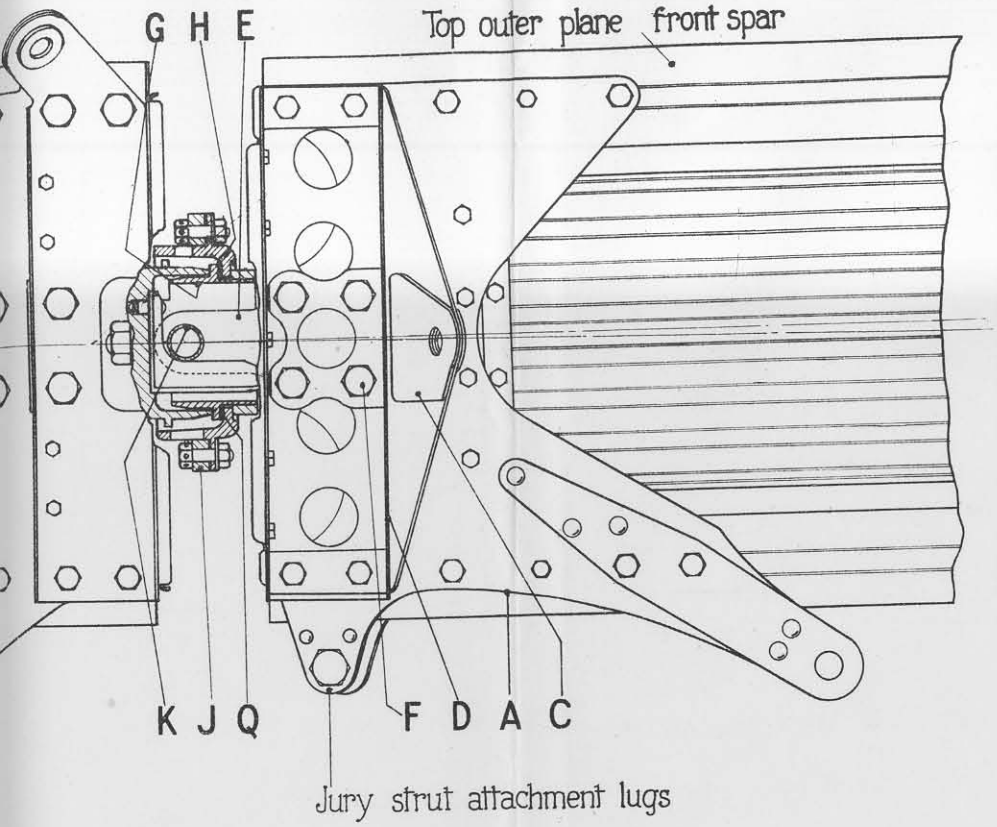


FIG. 23. TOP OUTER PLANE FRONT SPAR ATTACHMENT FITTINGS (STARBD.)



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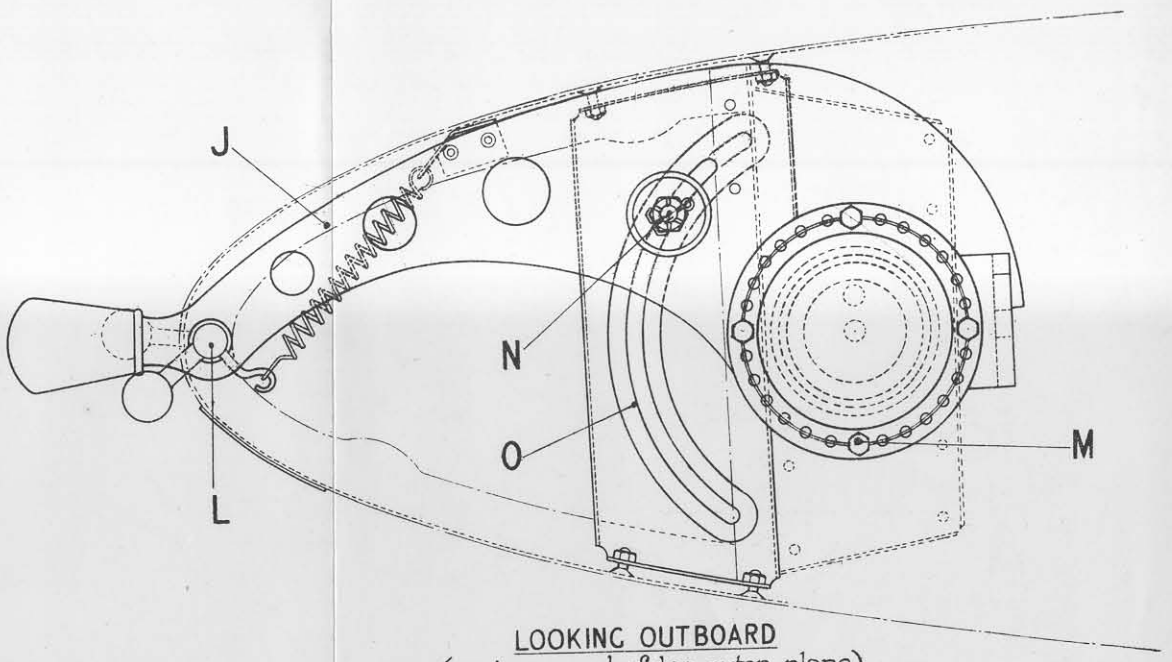
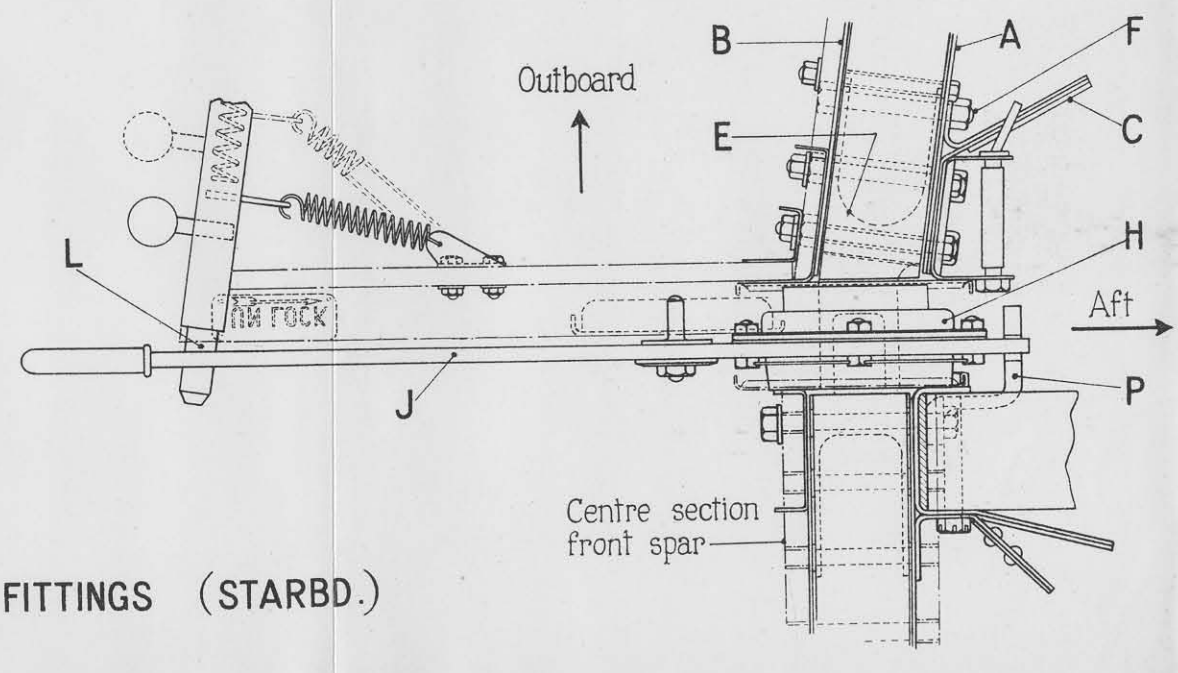


LOOKING OUTBOARD
(on inner end of top outer plane)



G.23. TOP OUTER PLANE FRONT SPAR ATTACHMENT FITTINGS (STARBD.)

55. The incidence and transverse panels formed by the port and starboard front and rear top centre plane support struts are wire braced. The incidence panel stainless steel bracing wires from the front spar end fittings to the rear of the engine nacelle are $\frac{9}{32}$ in., the starboard incidence wire being 42·55 in. pin centre length, that of the port incidence wire being 41·35 in. The incidence panel bracing wires from the rear spar end fittings to the front of the engine nacelle are $\frac{11}{32}$ in., the starboard incidence wire being 35·6 in. pin centre length, that of the port incidence wire being 36·6 in. The transverse panels are V-braced, the stainless steel wire bracing extending from the top centre plane front and rear spar end fittings to the front and rear top centres, respectively,

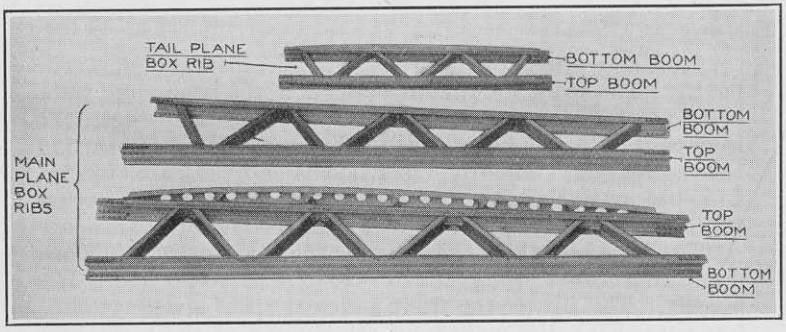


FIG. 24.—Typical ribs.

of the engine nacelle. The front transverse panel bracing wires are $\frac{1}{4}$ in., the pin centre length of the starboard wire being 20·55 in., that of the port wire being 17·05 in. The rear transverse panel bracing wires are also $\frac{1}{4}$ in., both their pin centre lengths being 18·55 in. For the engine nacelle lower incidence and transverse panel bracing wires, reference should be made to para. 185.

Top outer main planes

56. In construction each top outer main plane (*see* figs. 26 and 27) consists of five panels, the four outer panels being wire braced, the inner panel housing a fuel tank which provides in its construction the necessary cross bracing (*see* para. 193). Each plane consists of two stainless steel spars, six stainless steel drag struts (or box ribs) and thirteen wood intermediate ribs, and is fabric covered except for the nose portion which is plywood covered.

57. The spars permit replacement of the plane tips in the event of these being damaged. On the outer trailing edge portions of these planes ailerons are fitted. The nose portion and the portion of the planes aft of the rear spars and immediately forward of the ailerons are ply covered, the remaining upper and lower surfaces being fabric covered.

58. Attachment to the top centre plane is effected by means of eyed fittings mounted on the inboard ends of the rear spars, being pin jointed to corresponding fittings on the outer ends of the top centre plane rear spar, and by quickly detachable joints of interrupted double-thread construction and mounted on the inboard ends of the front spars, engaging the corresponding fittings mounted on the outboard ends of the top centre plane front spar.

Spars

59. The sections of the front and rear spars are shown in fig. 21. The spars are of built-up section, the booms and webs being of stainless steel. Along portions of their length the front and rear spar booms are reinforced by internally fitting tubes, as shown. The front spar booms and webs are ·027 in. and ·015 in. thick respectively, the inner and outer reinforcing tubes being 23 s.w.g. The rear spar booms and webs are ·027 and ·015 in. thick respectively, the outboard and inboard reinforcing tubes being 23 and 26 s.w.g. respectively (*see* fig. 21). The tips of the front and rear spars are detachable (*see* para. 57) ; the manner of attachment of the front spar tips is shown in fig. 28, the rear spar tips being similarly attached.

Spar fittings

60. Stainless steel plate fittings (*see* figs. 26 and 29) bolted to the spars provide attachment points for the drag struts, intermediate ribs, wire bracing, outer and jury inner struts and fuel tanks, special end fittings providing points of attachment of the top outer planes to the top centre plane. Hinge support brackets are also provided on the aft face of the rear spar for the ailerons.

Front spar fittings

61. *Outer interplane strut fittings.*—The spar fittings, shown in fig. 29, consist of two stainless steel lightened plates (A) bolted to the spar booms and supported by Z-section bars at the spar web, one on each face of the spar. The reinforced extension fingers interconnected below the bottom boom by a shaped U-fitting, provide for the attachment of the lift wires, whilst the downward pointing lugs provide for the

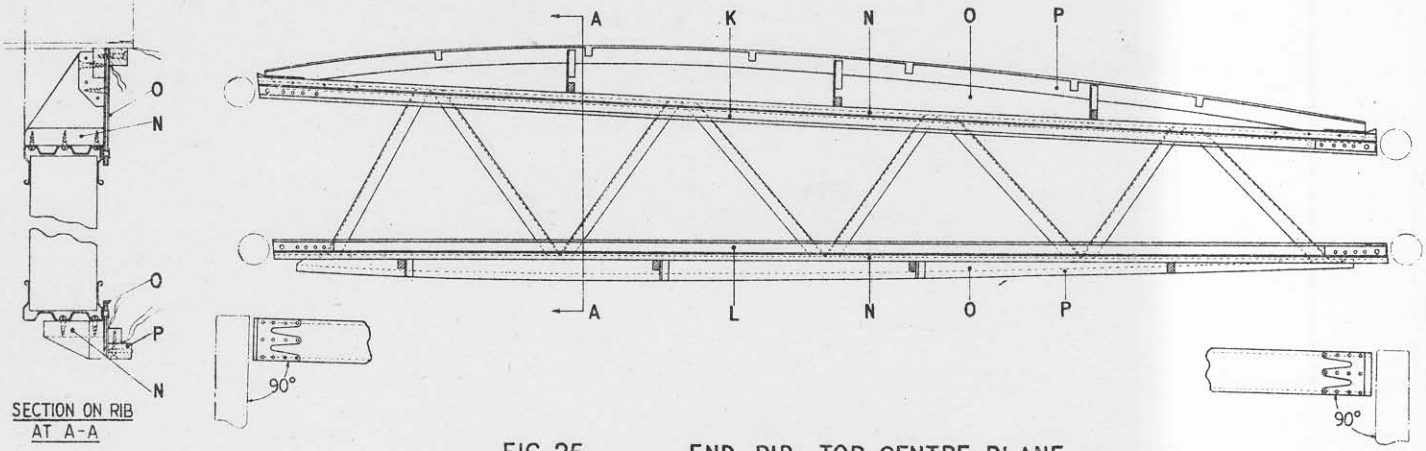


FIG. 25. END RIB - TOP CENTRE PLANE

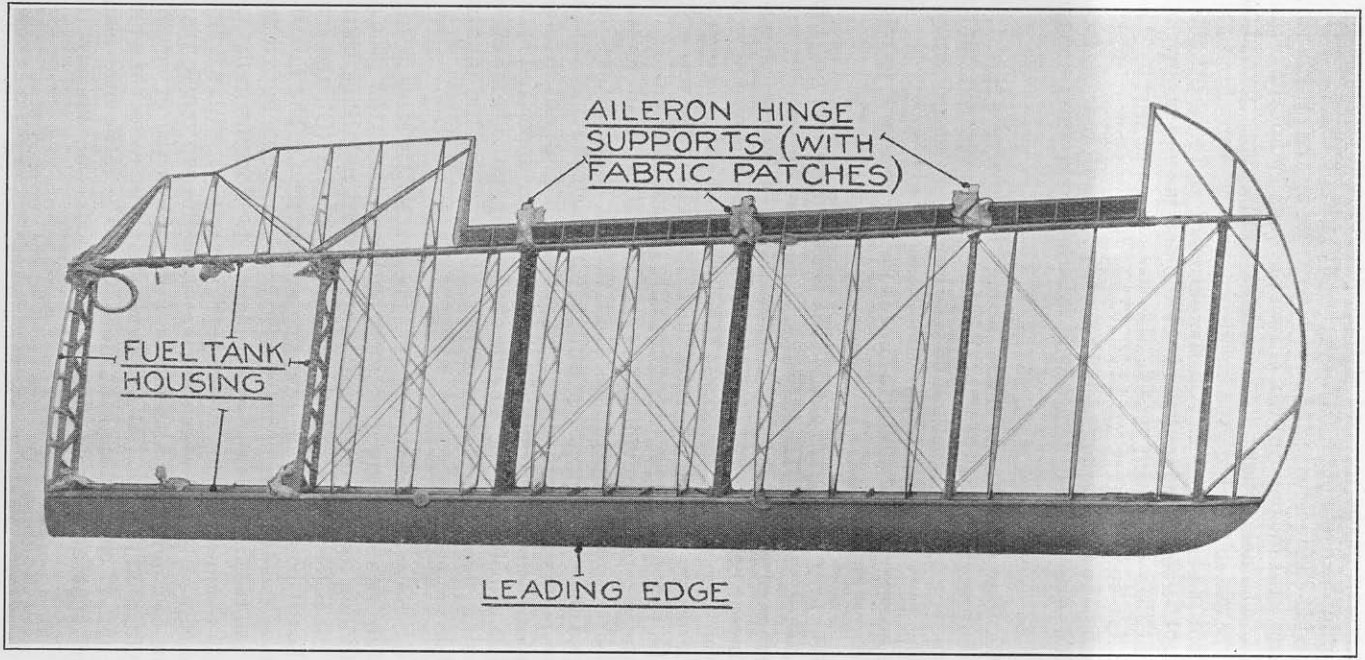


FIG. 26.—Top outer main plane (port)—showing construction.

attachment of the top end of the outer front interplane strut. Superimposed on plate (A), on the aft side of the spar, is a shaped U-channel fitting (B) which provides for the attachment of drag strut (or box rib) No. 4 from the inner end of the plane, the U-channel fitting downward extending lugs providing for the attachment of the incidence bracing wire from the bottom plane rear spar. On the outboard and inboard sides of the U-channel fitting (B), at the top and bottom booms, are lug fittings (C) which receive the cross bracing wires. The stainless steel light U-channel fitting (D) is typical of the attachment fittings bolted both to the forward and aft faces of the spar for the attachment of the wood intermediate ribs.

62. *Box rib fittings.*—These fittings for box ribs Nos. 1, 2 and 3 from the inboard end of the plane are, in general, similar in construction and method of attachment to those described in the previous paragraph, the fittings for box rib No. 2 also providing means of attachment for the fuel tank forward outer pin joint fitting.

63. *Jury inner interplane strut bracing wire and fuel tank attachment fittings.*—The jury interplane strut and anti-lift wire attachment points (*see* fig. 23) are provided by two shaped stainless steel plates (A) and (B) bolted to the booms and web, one on each side of the spar. The downward pointing lugs of these plates provide the attachment points for the top ends of the jury inner strut, the diagonally downward pointing lug of the aft plate providing the point of attachment for the anti-lift wires. Superimposed on the aft plate fittings are angled plate reinforced lug fittings (C) which provide attachment points for the fuel tank forward inner pin joint fittings. Shaped U-channel fittings (D), lugged at their upper and lower ends and bolted on the aft side of the spar, provide means of securing the forward ends of box rib No. 1 at the inboard end of the plane.

64. *Spar attachment fittings.*—These stainless steel fittings (E) are double pronged at their outboard ends, the prongs, straddling the web of the spar at its inboard end, being bolted by six bolts (F) to the plate fittings (A) and (B), the four outboard bolts passing through the spar web. The inboard ends of the attachment fitting (E), which is double lugged and pin jointed, receives the swivel block (G). Concentrically and freely mounted on this swivel block is a nut (H) with a double interrupted thread which engages with the top centre plane front spar outboard attachment fitting (item (E) of fig. 22). Mounted on this nut (H) is a handlever (J) by means of which the nut is engaged with or freed from the top centre plane front spar attachment fitting. The axis pin, uniting the

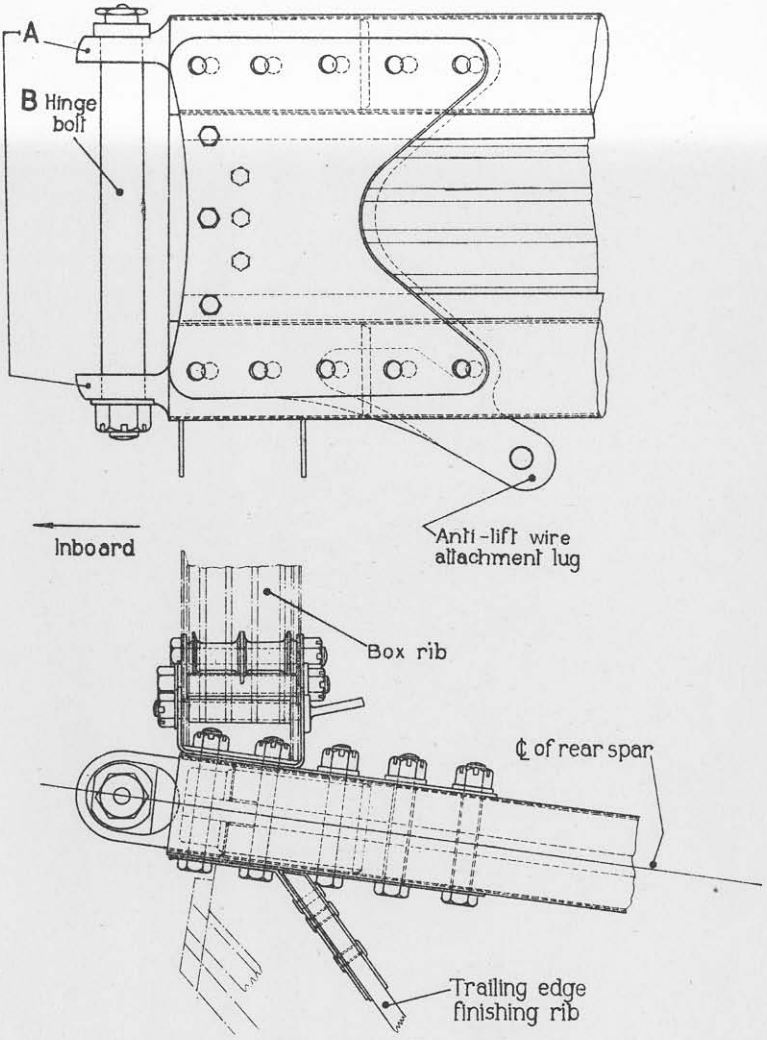


FIG.27 REAR SPAR HINGE ATTACHMENT-TOP ~~CENTRE~~ OUTER PLANE-(STARBOARD)

AL7

attachment fitting (E) and the swivel block (G) is provided with a stainless steel rotating bush (K) by means of which, in conjunction with the locating peg (item (F) of fig. 22), the

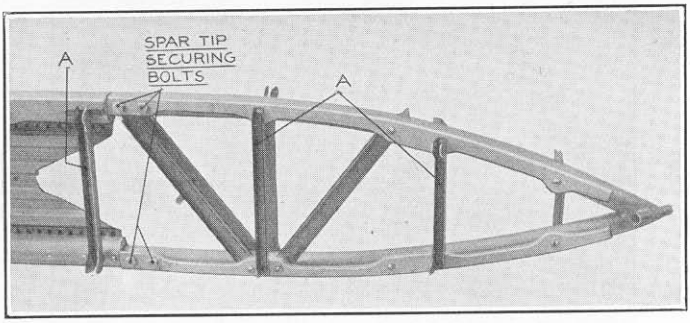


FIG. 28.—Front spar detachable tip—top main plane (port).

nut (H) is aligned with its corresponding fitting (item (E) of fig. 22) mounted on the outboard end of the top centre plane front spar. The hand lever (J) is locked in its joint-securing position by means of the spring-loaded draw-bolt (L).

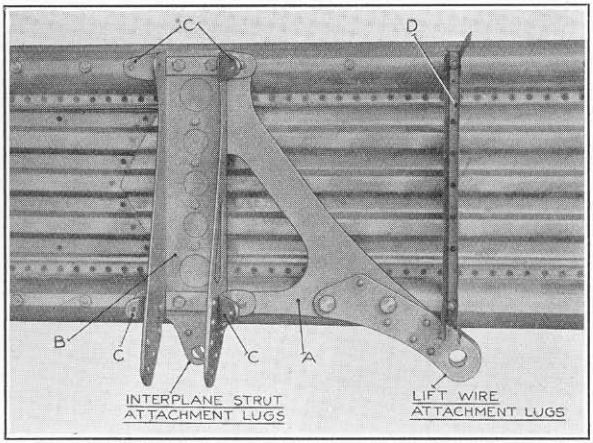


FIG. 29.—Top outer main plane front spar interplane strut and box rib attachment fitting (port).

Rear spar fittings

65. The fittings for the box ribs, ordinary ribs, and the outer interplane struts and bracing wires are similar in their general construction to those of the front spar. On the aft faces of these spars (*see also* figs. 30 and 31 for the bottom outer

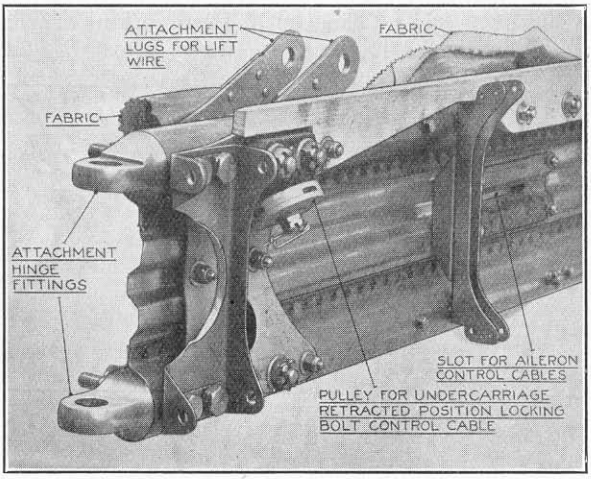


FIG. 30.—Bottom main plane rear spar inboard end fitting (port).

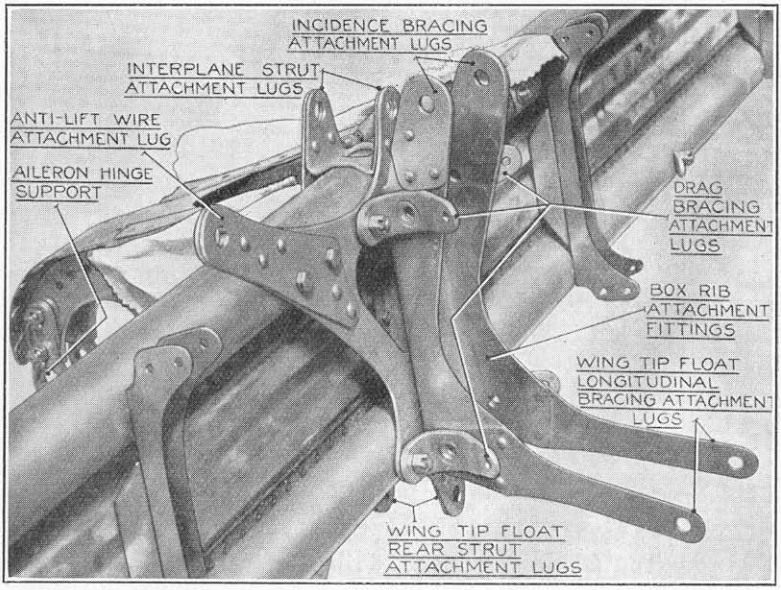


FIG. 31.—Bottom main plane rear spar interplane strut, box rib and wing tip float strut attachment fittings (port).

main plane rear spars) are mounted the aileron hinge support brackets, whilst at the rear spar inboard ends are the hinge attachment end fittings.

66. *Aileron hinge support brackets.*—These support brackets are mounted, as described in para. 65, on the aft faces of the rear spars (*see* figs. 31 and 32) three on each port and starboard plane, one in line longitudinally with each of the box ribs

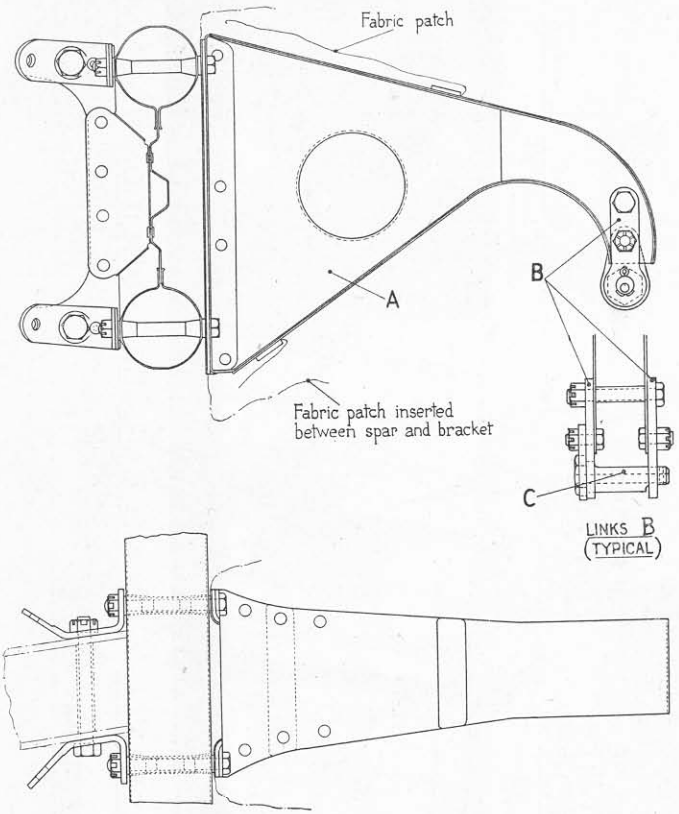


FIG. 32.—Aileron support bracket (typical).

Nos. 3, 4 and 5 from the inboard end. In construction these aileron hinge support brackets are of plate and boxed in section. In transverse view these brackets taper from the full depth of the rear spar at their bases to necks at their aft ends, the necks curving downwards. To these necks are secured hinge support links (B) which are provided with hinge pins (C), the shanks of which are 0·1 in. eccentric relative to their end supports,

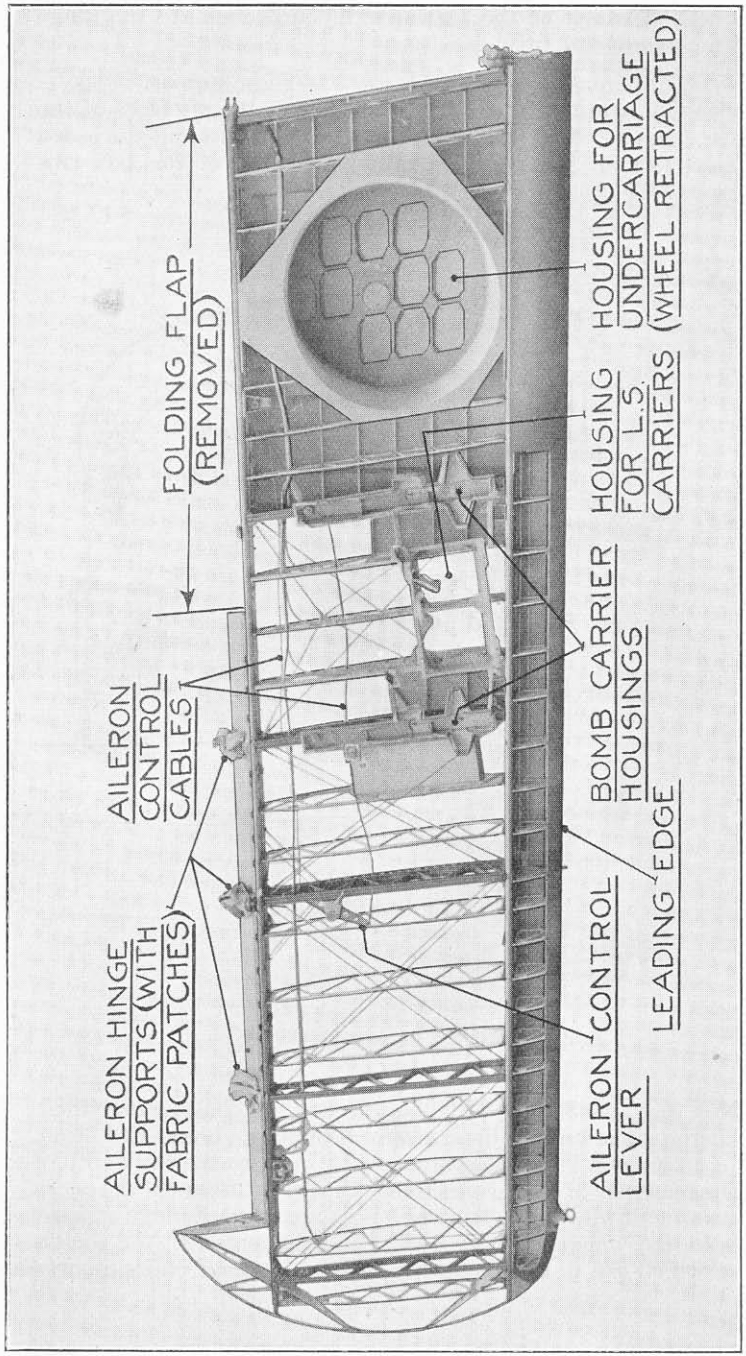


FIG. 33.—Bottom main plane (port)—showing construction.

for hinge alignment purposes. The brackets are secured to the spar booms, together with pieces of fabric for attachment of the plane covering, by longitudinal through-bolts.

67. *Inboard end hinge attachment fittings.*—These hinge attachment fittings (*see* fig. 27), similar to those for the bottom outer main plane rear spar (*see* fig. 30 and para. 71), consist of "eyed" plug ends (A) which are bolted in the inboard ends of the rear spar top and bottom booms, the eyed ends being fitted with hinge bolts (B) about which the top outer plane pivots when being folded.

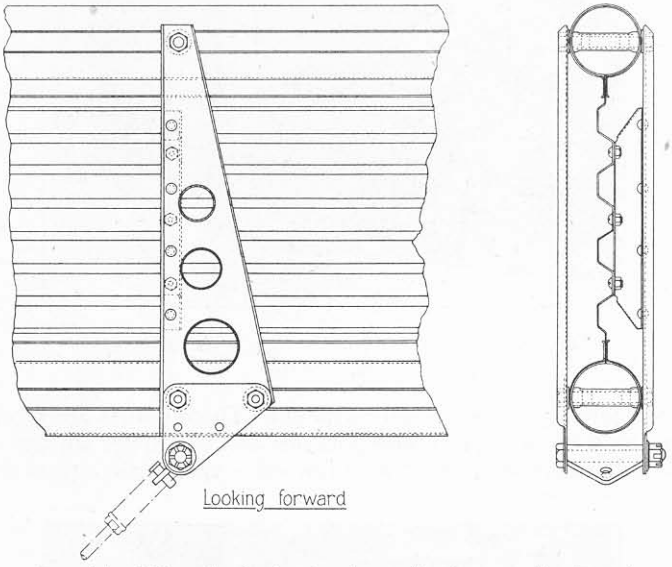


FIG. 34.—Wing tip float outer brace front spar attachment fitting (starboard).

Ribs

68. The box ribs and intermediate ribs of the top outer main planes are similar in their construction to those of the top centre plane and are described in paras. 52 and 53 respectively.

Bottom outer main planes

69. These planes (*see* fig. 33) are of the same span and chord as the top outer main planes and their general structural design is as described in paras. 56 to 59. The method of attachment of these planes to the hull (*see* item (A) of fig. 15 for front spar attachment) is in general the same as for the top outer planes as described in para. 64. At the inboard ends of these planes,

in the trailing edge portions, folding flaps are fitted to allow the folding of the planes. Also at the inboard ends, between the spars, provision is made on the underside for housing the

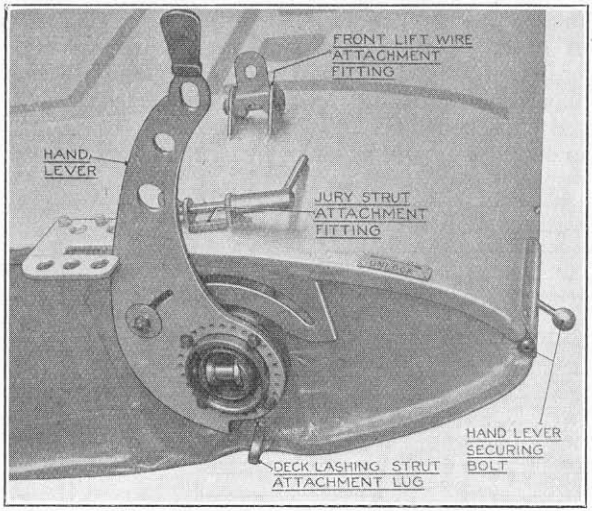


FIG. 35.—Bottom main plane front spar joint—lever open (port).

undercarriage wheels when retracted. These planes are fabric covered except for the nose portions and the upper surface of the inboard panels, which are plywood covered, portions of the

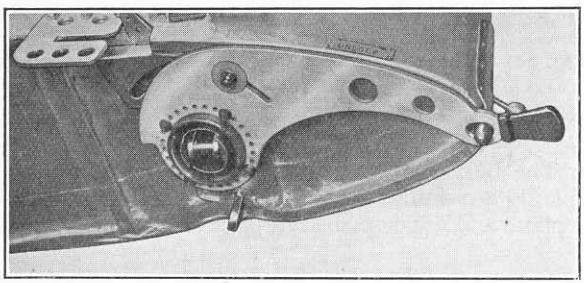


FIG. 36.—Bottom main plane front spar joint—lever closed (port).

upper surface of the panels, No. 2 from inboard, also being plywood covered. On the underside of the bottom planes, at box ribs Nos. 2 and 3 from the inboard ends provision is made for mounting universal and light series bomb carriers, whilst

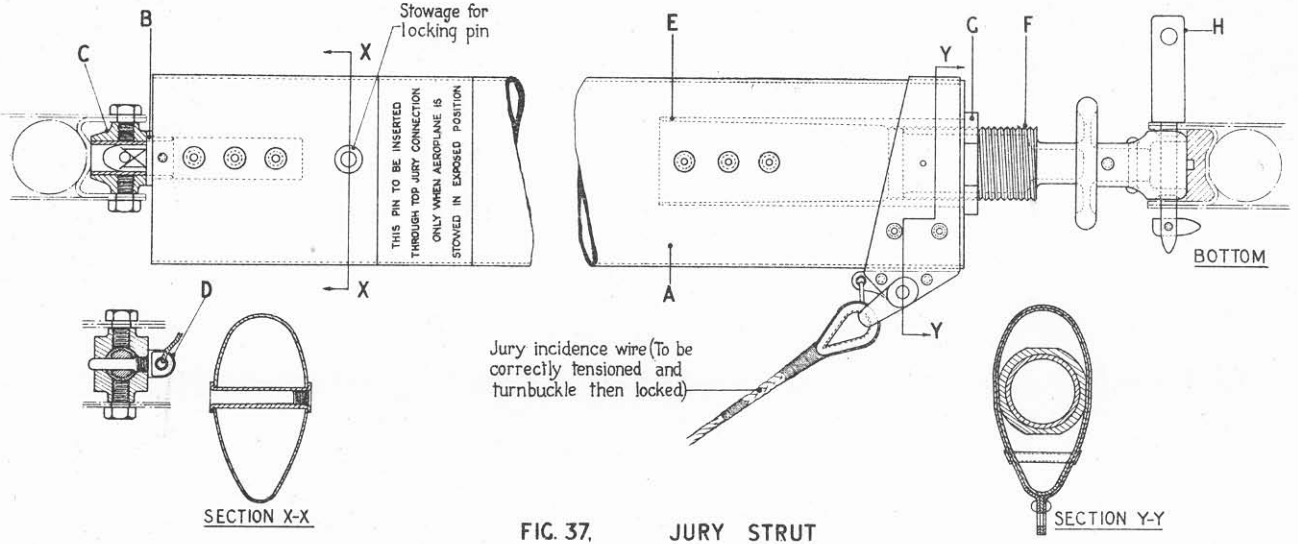


FIG. 37. JURY STRUT

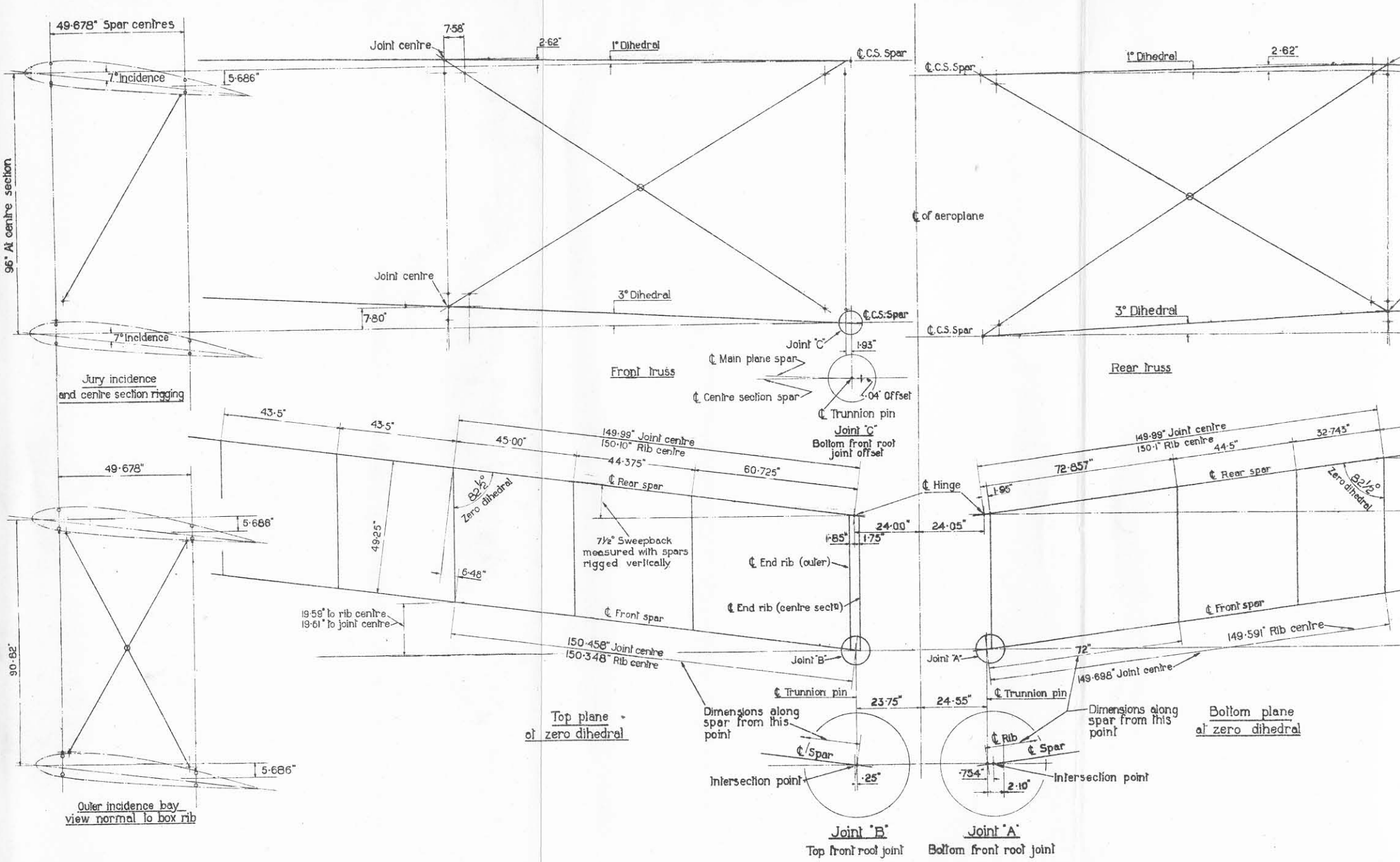


FIG. 38. MAIN PLANE BRACING

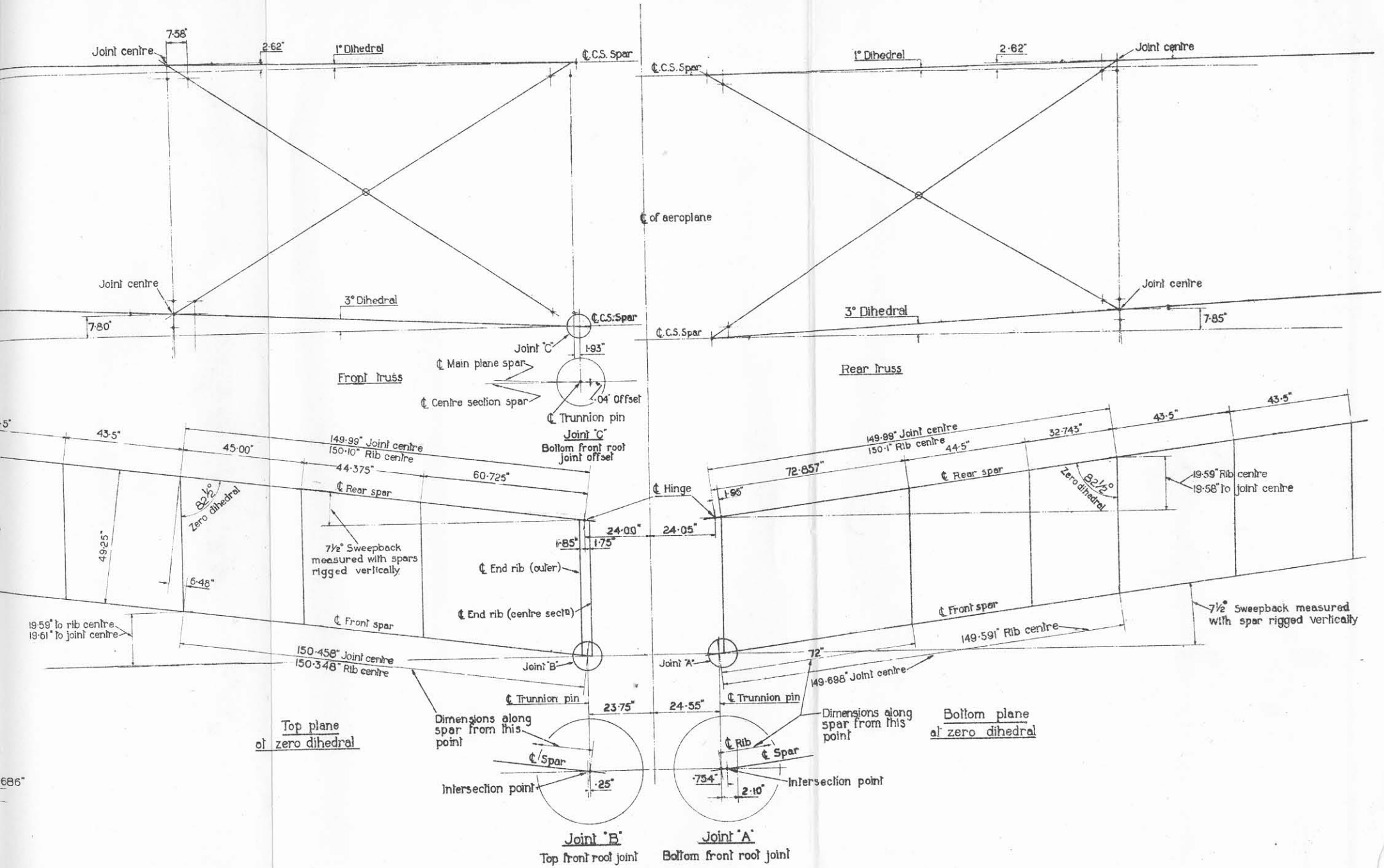


FIG. 38. MAIN PLANE BRACING

at box ribs No. 4 from the inboard ends the wing tip floats are mounted, this last-named rib also providing means of attachment for the aileron control lever mountings (*see* fig. 89).

70. The recess for the undercarriage wheel in the bottom plane is circular, its circumferential wall being plywood $\frac{1}{16}$ in. thick. At the centre of the recess is mounted the undercarriage wheel spring-loaded locking bolt which retains the undercarriage wheel in its fully retracted position.

Spars and spar fittings

71. The spars and spar fittings are similar in general to the top outer main plane spars and spar fittings as described in paras. 60 to 62 and 64 to 66. The bottom outer main plane front spar booms and webs are 24 s.w.g. and ·015 in. thick respectively, whilst those of the rear spar are 26 s.w.g. and ·015 in. thick (*see* fig. 21). On both front and rear spars the outer interplane strut fittings also provide downward pointing transverse lugs for the attachment of the upper ends of the float struts. Attachment fittings for the float bracings are also provided on each front and rear spar, at 26·75 in. on each side of the float strut and outer interplane strut fittings. Fig. 34 illustrates the float outer brace front spar attachment fittings, this illustration being typical of the fittings for the float inner brace attachment. Fig. 30 shows the port rear spar inboard end box rib and hinge attachment fittings, whilst fig. 31 shows the port rear spar interplane strut, box rib and float strut attachment fittings. The bottom plane front spar attachment fittings are shown in the open and closed positions respectively in figs. 35 and 36.

Jury interplane struts

72. These struts, illustrated in fig. 37, are adjustable and fitted between the inner ends of the top and bottom outer plane front spars, and keep the complete outer plane structures rigid when the planes are being folded.

73. Each jury strut consists of a duralumin hollow streamlined section main member (A) and top and bottom end fittings, the bottom end of the main member providing means of pin joint attachment for the jury incidence wire. The top end fitting (B), internally secured to the main member by four rivets, is shouldered, its upper end terminating in a short rounded nose spindle. This upper end is engaged by the seating block (C) which is secured between the appropriate lugs of the top outer main plane front spar end fittings, the seating block and spindle end being locked by the screwed pin (D). The bottom end fittings consist of an internally screwed tubular fitting (E) secured to the main member by three

rivets, and an adjustable end piece (F) which is screwed into the tubular fitting (E), a locknut (G) being provided. This adjustable end piece is provided with a notched handwheel integral with and approximately at mid-length of its shank, the bottom end of this end piece being " eyed," thus providing for pin joint attachment to the bottom outer main plane front spar end fittings. The securing pin (H) is easily detachable and is self-locking.

Outer interplane struts and main plane bracing

74. The front and rear outer interplane struts are similar in construction, each consisting of a tubular main member into the ends of which are socketed and pinned plug end fittings which provide for pin joint attachment to the top and bottom front and rear spar corresponding fittings. The front outer interplane strut main members are $2\frac{1}{4}$ in. o/d $\times$ 20 s.w.g., the rear outer interplane strut main members being $2\frac{3}{8}$ in. o/d $\times$ 20 s.w.g. The main plane bracing is shown in fig. 38.

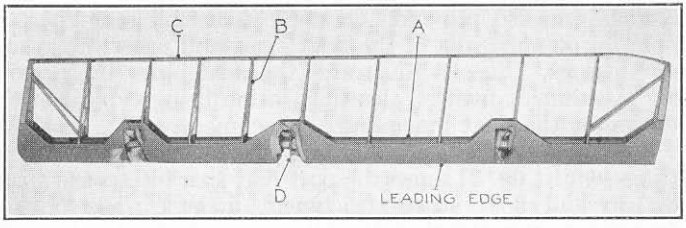


FIG. 39.—Aileron—top outer plane (port)—showing construction.

Ailerons

75. Ailerons (*see* figs. 39 and 92) are fitted to both top and bottom outer main planes, the ailerons being of the Frise type and mass balanced. Mass balance is effected by strips of lead which are secured to the inside of the leading edge. For aileron aerodynamic balance reference should be made to para. 279.

76. The top and bottom ailerons, interconnected by a tie rod running along and immediately aft of the outer rear interplane strut, within the strut fairing (*see* fig. 40), are similar in structure. Each aileron consists of a stainless steel tubular spar (A), eleven braced wood ribs (B), a tubular duralumin trailing edge (C) and a leading edge of spruce. The end ribs are diagonally braced. There are three aileron hinges, the inboard and outboard hinges consisting of eyed bolts which pass through the tubular spar, the centre hinge being embodied in the aileron interconnecting lever (D) riveted

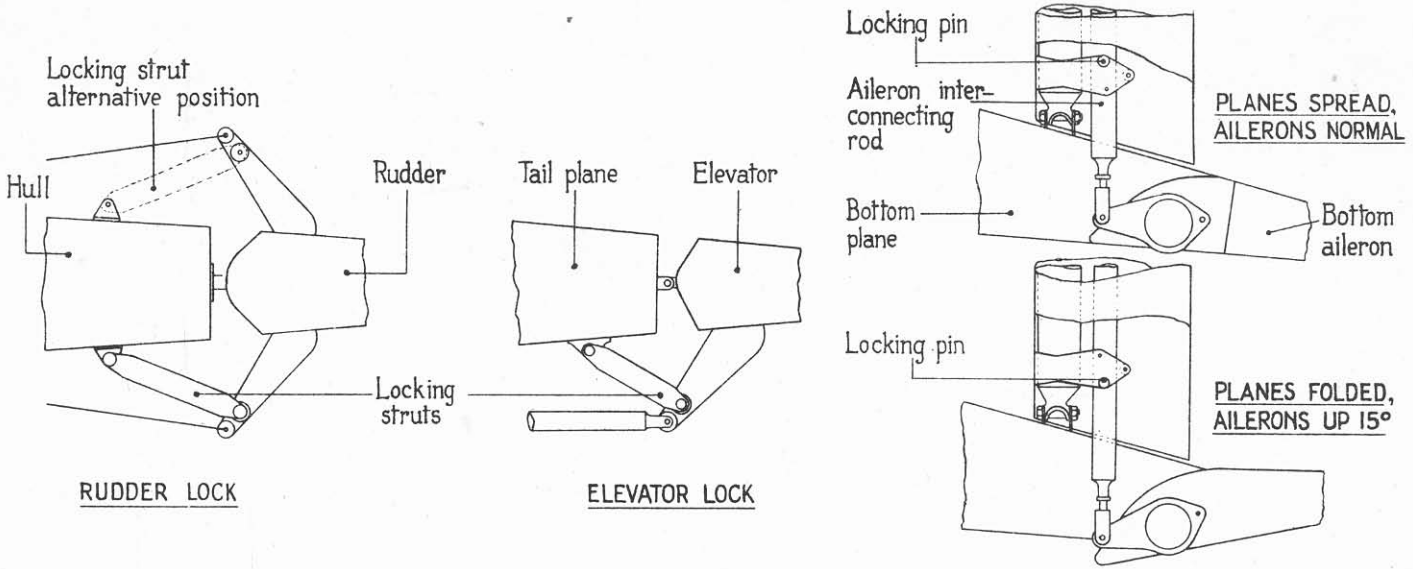


FIG. 40. AILERON, ELEVATOR AND RUDDER LOCKING GEAR

to the spar. The aileron operating lever (E) (item of fig 92) is secured to the aileron below the nose portion, immediately inboard of the interconnecting lever and centre hinge. For the locking of the ailerons reference should be made to para. 177 and fig. 40.

Folding Flaps

77. These flaps are fitted to the bottom main planes in the trailing edge portions, the flaps extending from the inboard ends of the planes to the inboard ends of the ailerons. Each flap is hinged at the top of its auxiliary forward spar and held in position by a transverse bolt engaging " eyed " lugs secured to the bottom edge of the bottom plane rear spar. When the planes are being folded the flaps are raised, in order to clear the hull, by disengaging the transverse bolts when the flaps, which are spring loaded, are raised automatically.

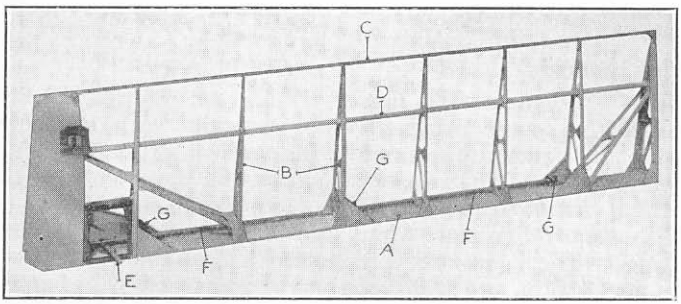


FIG. 41—Folding flap (port)—showing construction.

78. Each flap (*see* figs. 41 and 42) consists of a spruce auxiliary spar (A), eight braced wood ribs (B), a tubular brass trailing edge (C) and a spruce secondary spar (D) extending across the full span of the flap in the region of the trailing edge. At the inboard end of each flap is a pivoted handlever (E) by which the flap locking bar (F) is operated. The operating handlever is hinged so as to fold within the flap upper profile. This lever is held secure when in the locked position by a downwards projecting pin mounted on the undersurface of the hinged access door. Through the transverse locking bar (F) are three longitudinal bolts (G) in the " eyed " forward ends of which are secured the locking spindles (H), the spindles engaging the eyed fittings (J) bolted through the bottom boom of the rear spar.

79. Each of the three folding flap hinges is double spring loaded (*see* fig. 43 and para. 77) the flap hinge mounting engaging with a double-lugged eyed bolt (A) secured to the

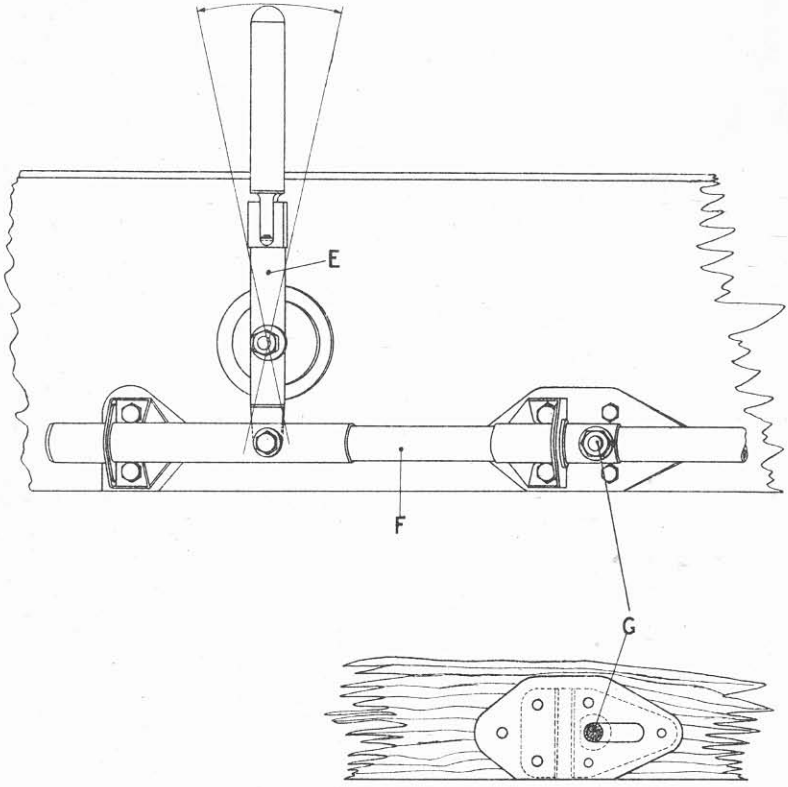
outer plane rear spar top boom. The hinge bolt (B) extends on both sides of the bolt (A) and is supported at its ends by single lugged eyed bolts (C) also secured to the outer plane rear spar top boom. The hinge springs (D) are mounted on the hinge bolt extensions and enclosed within a cylindrical cover (E), one of the straightened ends of the helical spring engaging the outer plane rear spar top boom, the other straightened end engaging the forward face of the flap auxiliary spar, on which a contact plate is conveniently mounted.

80. *Locking of folding flaps.*—To guard against buffetting by wind gusts, the folding flaps are rigidly locked in their folded position (*see* fig. 44) by means of a strut on each port and starboard side, the strut being connected at its forward end to an eyed plate lug in the bottom plane inboard rib, approximately 15 in. forward of the rear spar, and at its aft end to a similar lug approximately $5\frac{1}{2}$ in. outboard of the folding flap inner end.

Wing tip floats

81. These floats (*see* figs. 1, 17 and 45) positioned below the bottom outer planes in line vertically with the outer interplane struts, are secured by the vertical struts (A) rigidly mounted on the float upper structure, the upper ends of the vertical struts being pin jointed to the lugs provided on the bottom outer plane front and rear spar interplane strut fittings. The floats are wire braced longitudinally, between the float struts, and transversely, the transverse wire bracing being pin jointed to the lugs (B) mounted on the float upper surface, inboard and outboard of the vertical struts, and to the float bracing fittings (*see* fig. 34) mounted on the bottom outer plane front and rear spars.

82. The floats are constructed of alclad framing and skin, and of stainless steel nose and chine capping pieces. Four watertight bulkheads are provided at frames Nos. 3, 5, 7 and 9 from the forward end, these bulkheads being longitudinally strut interbraced at the float centre line. In the bottom of the floats, forward of bulkheads Nos. 3, 5, 7 and 8, and aft of bulkhead No. 9, drain plugs (C) are provided, whilst on the upper surface of the floats are five inspection doors (D) (*see* fig. 46) and an air vent (E). At frame No. 7 from the forward end, between the keelson and the chine the floats are stepped. Lashing " eye " plate fittings (G) of stainless steel are mounted on the stem and on the stern post. On the stern post of each float is also provided a swivel mushroom-headed spindle (F) which, when the planes are in their folded position, engage a spring-loaded catch (item (B) of fig. 47) fitted in a recess in the hull, at the chine.



View looking on rear face of flap spar

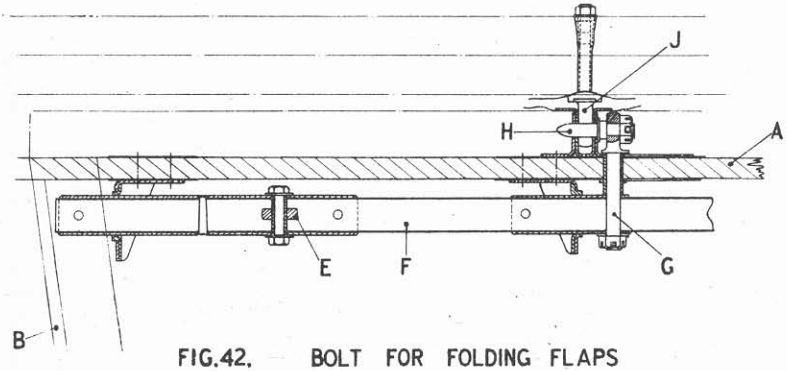


FIG.42. BOLT FOR FOLDING FLAPS

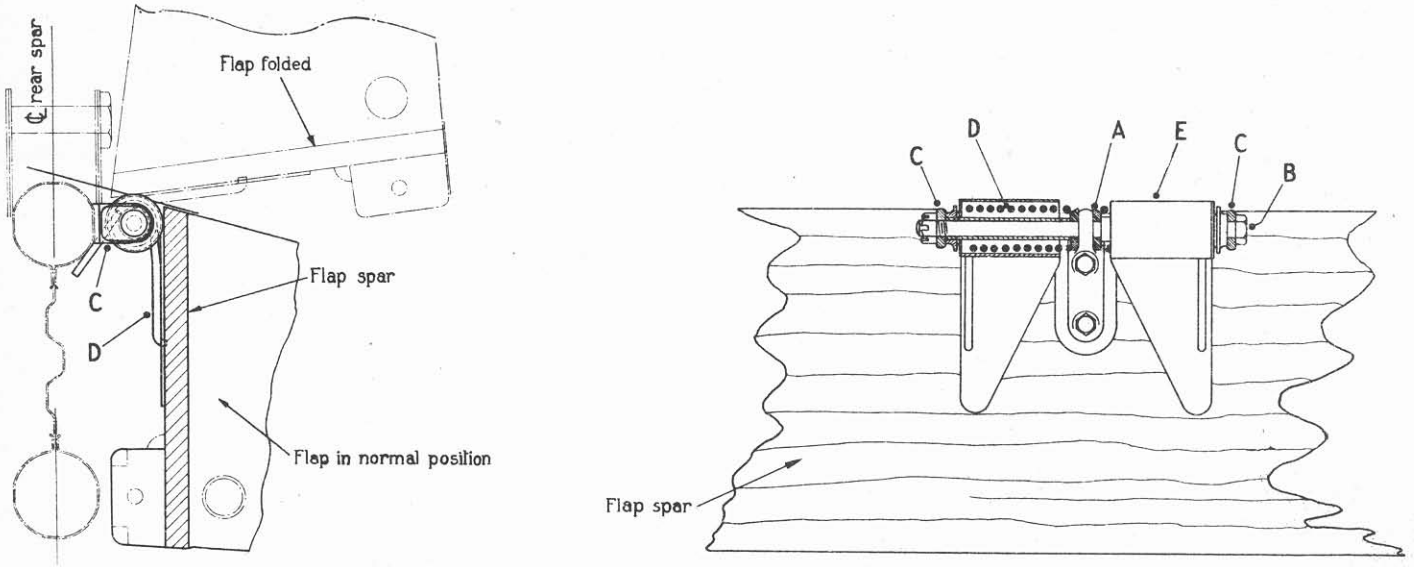


FIG. 43, HINGE FOR FOLDING FLAPS

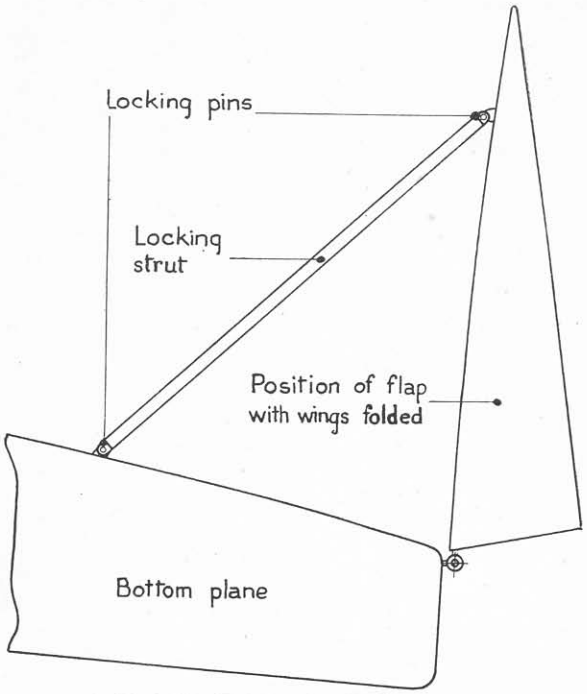


FIG. 44.—Folding flap locking gear.

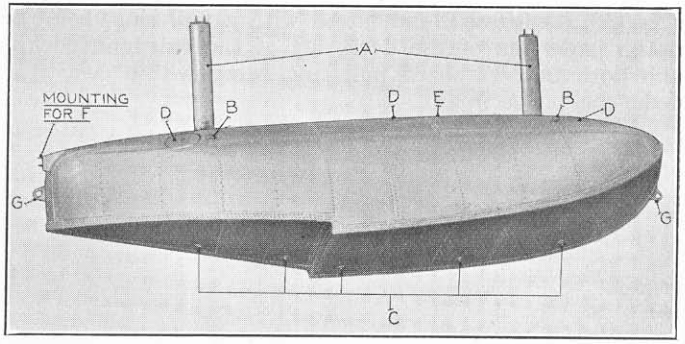


FIG. 45.—Wing tip float (starboard).

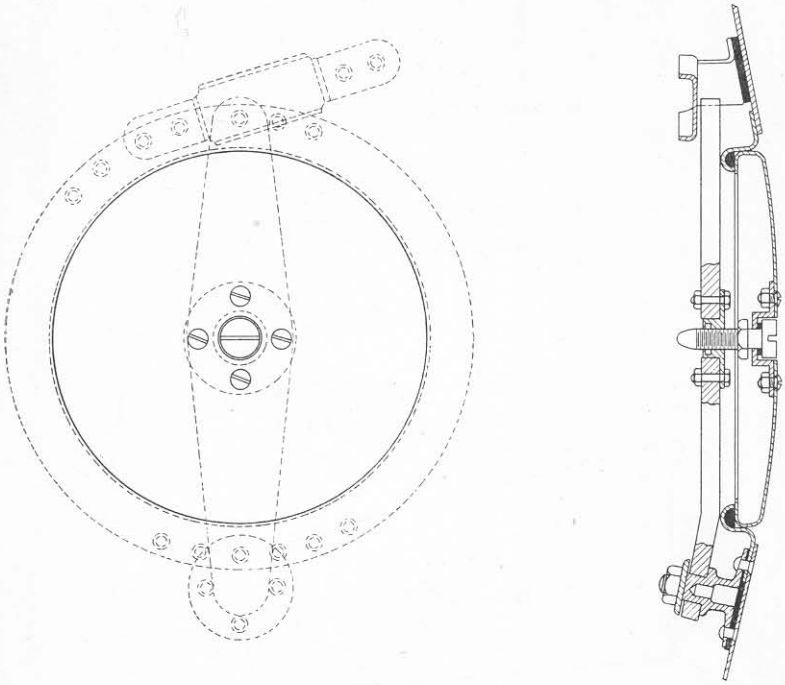


FIG. 46.—Wing tip float inspection door.

83. *Wing tip float locking mechanism.*—This mechanism on each port and starboard side, the port mechanism being shown in fig. 47, is operated by means of a cable, the aft end of which is connected to the inboard pointing end of the spring-loaded lever (A), its forward end, fitted with a pull ring, being led to the underside of the deck, aft of the rear gun cockpit, each port and starboard pull ring being within easy reach of the cockpit occupant.

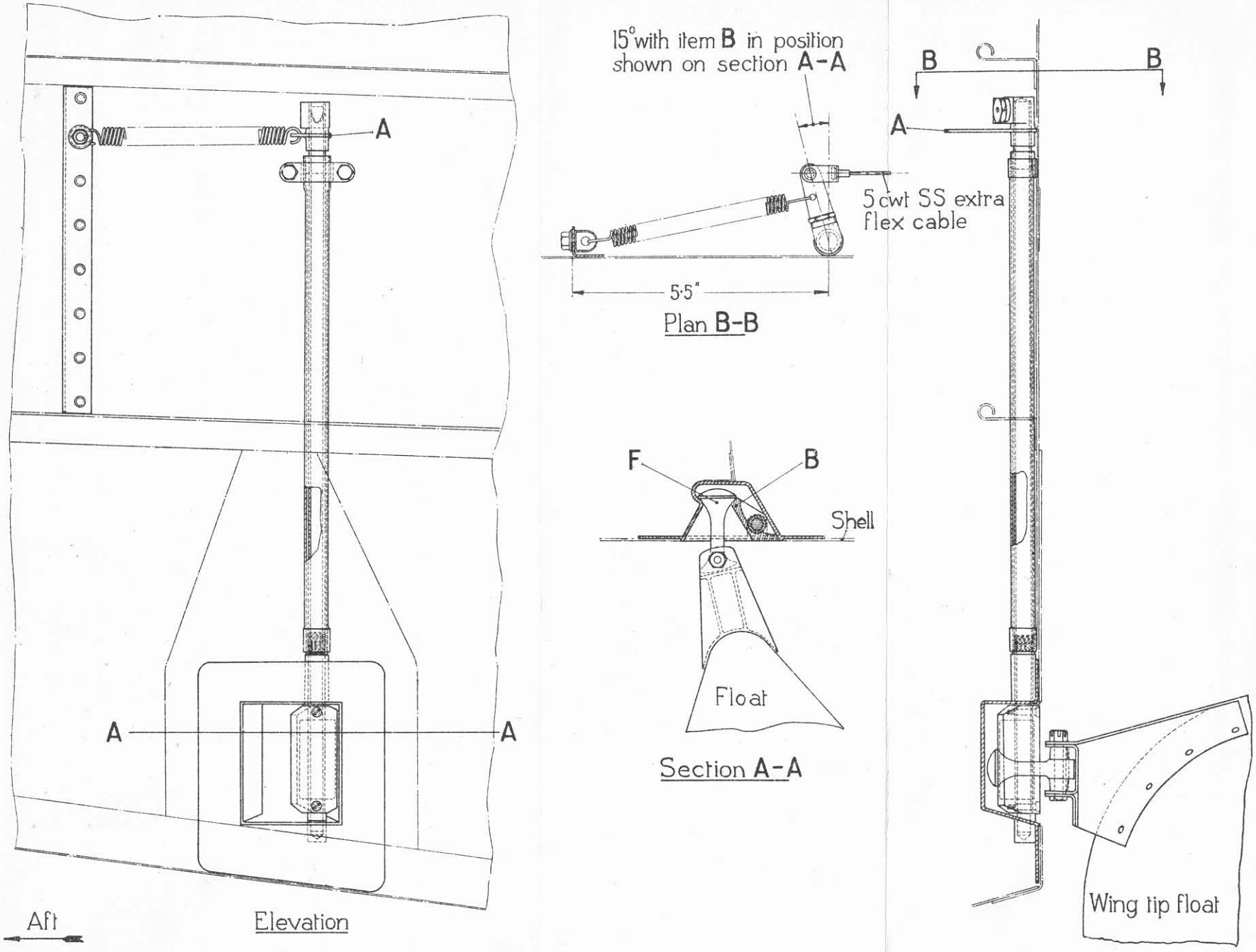


FIG. 47. WING TIP FLOAT LOCKING MECHANISM

CHAPTER III

TAIL UNIT

General

84. The tail unit (*see* figs. 48 and 95) consists of a fin, an air rudder with servo-rudder, a water rudder and a tail plane with port and starboard elevators, each elevator being fitted with a trimmer flap. The air rudder is mass balanced.

Note.—Items referred to in the text by reference letters are similarly indicated in the illustrations, the numbers of which are given *en bloc* early in the relevant paragraphs. These reference letters are not necessarily indicated in all these illustrations.

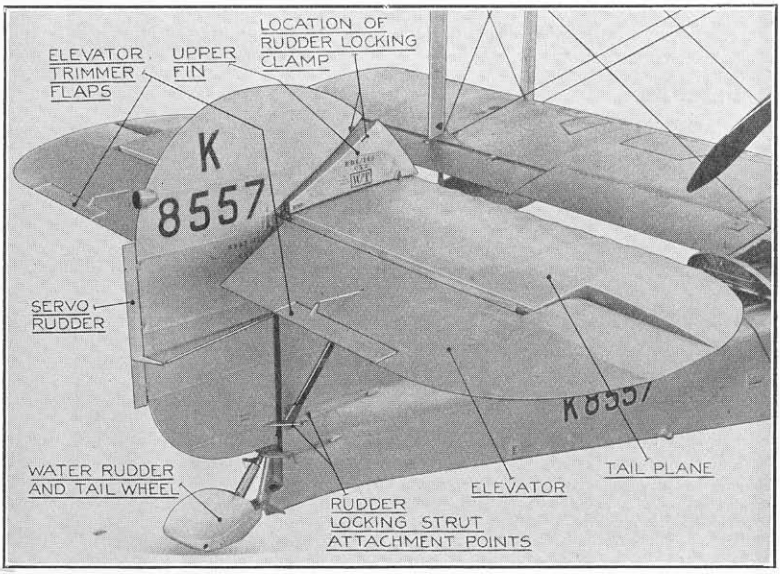


FIG. 48.—Tail unit.

Lower fin

85. The fin is alclad covered and is integral with the hull (*see* figs. 13 and 48), the fin main members being the hull frame No. 19, the stern post, which is described in para. 19, and the horizontal former ribs. The fin extension portion of the hull frame No. 19, above the hull, takes the form of a lightened webbed girder, the port and starboard sides of the fin extension portion being rigidly interconnected by a lightened transverse plate. The former ribs interconnecting

CHAPTER III

TAIL UNIT

General

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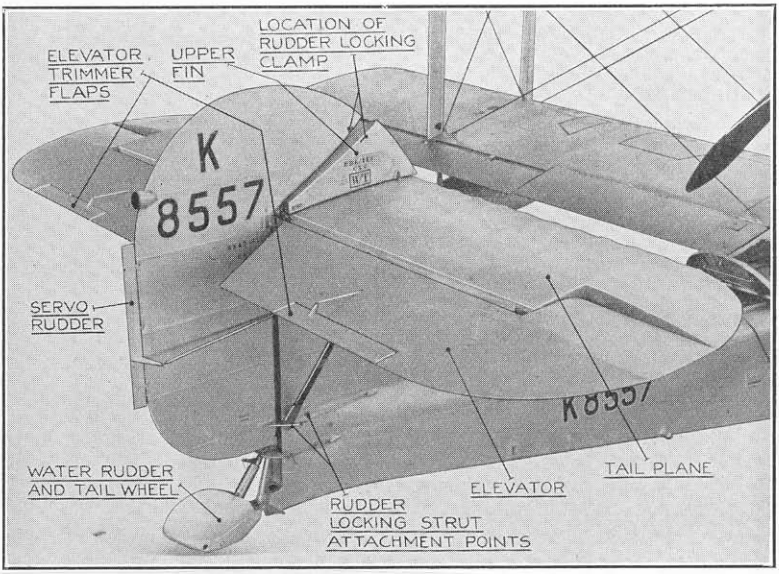

(23) Para. 85, line 1. After "covered" *insert* "in the metal hull, and plywood covered in the wooden hull".

Lower fin

85. The fin is alclad covered and is integral with the hull (*see* figs. 13 and 48), the fin main members being the hull frame No. 19, the stern post, which is described in para.

(24) Para. 85, line 4. After "19" *insert* "for the metal hull and para. 44J for the wooden hull".

lightened webbed girder, the port and starboard sides of the fin extension portion being rigidly interconnected by a lightened transverse plate. The former ribs interconnecting

(25) Para. 85, line 8. After "plate" *delete* the stop and *insert* "for the metal hull and a plywood web for the wooden hull".

the stern post and the fin extension of hull frame No. 19, A.L.B. together with the former rib nose portions, support the ~~aleled~~ covering of the fin. At the upper ends of the stern post and hull frame No. 19 provision is made for pin joint attachment of the tail plane.

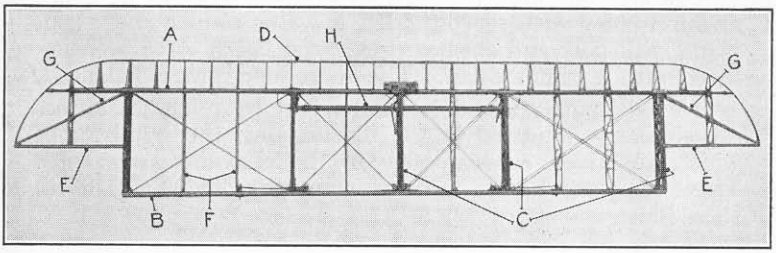

FIG. 49.—Tail plane—showing construction.

Upper fin

86. The upper fin (*see* fig. 48) is a streamlined fabric-covered wood structure mounted centrally above the tail plane, points of attachment being provided on the tail plane front and rear spars.

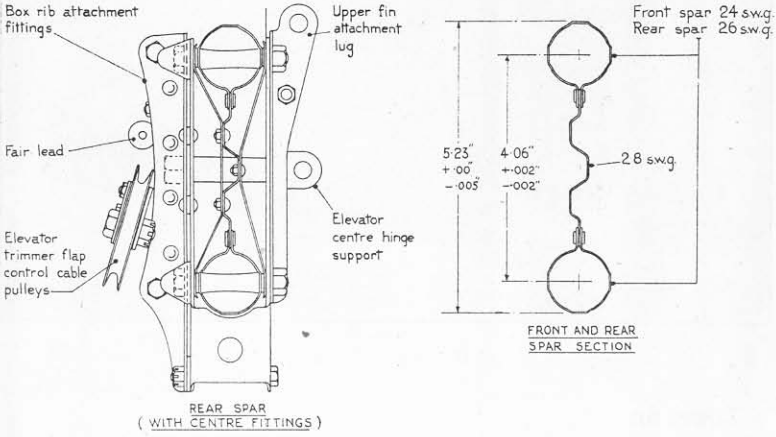

FIG. 50.—Tail plane spar sections.

Tail plane

87. This plane (*see* fig. 49) consists of stainless steel front and rear spars and box ribs (A), (B) and (C) respectively, a tubular duralumin leading edge (D), the tip rear spars (E) and ordinary ribs (F) being spruce and plywood to D.T.D.

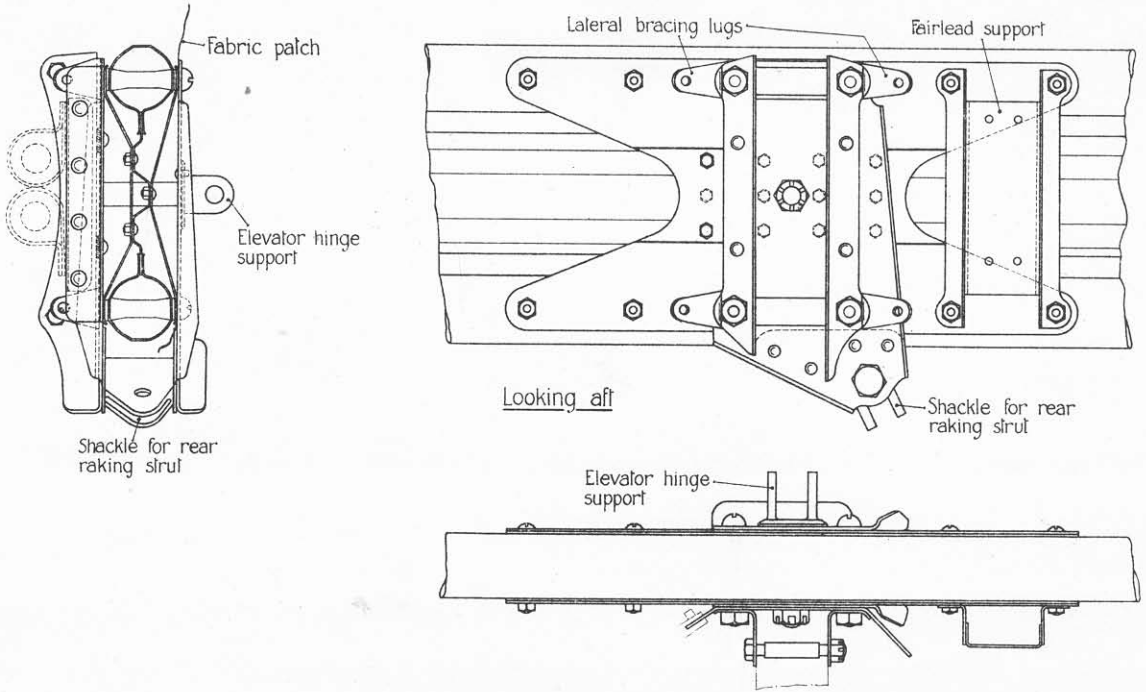

FIG. 51, TAIL PLANE REAR SPAR FITTINGS (STARBOARD)

Specification No. 36 and British Standard Specification V3. The two panels on each side of the centre line are wire braced whilst the tip panels are braced by a spruce and plywood diagonal rib (G). The centre box rib, together with the port and starboard adjacent box ribs, provide support for the elevator operating torque shaft (H).

88. The tail plane is secured to the top of the lower fin by double-lug attachment fittings and transversely set bolts mounted on the front and rear spars and at the upper extremities of hull frame No. 19 and the stern post. The incidence of the tail plane can be varied on the ground by adjustment of these attachment fittings, the range available being $\pm 2° \begin{cases} +31' \\ -\ 0' \end{cases}$. The normal incidence of the tail plane, in rigging position, is 6°. The tail plane is braced by stainless steel streamlined struts, the strut bracing pin joint attachment points being provided by the front and rear spar inner box rib fittings and on the hull at frame No. 19 and the stern post.

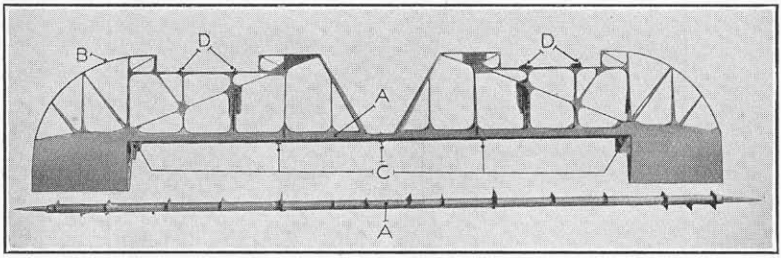

FIG. 52.—Elevators—showing construction.

89. *Tail plane spars and box ribs.*—The sections of front and rear spars are shown in fig. 50, each consisting of approximately circular booms and corrugated webs. The box ribs are as shown in fig. 24.

90. *Tail plane spar fittings.*—These fittings for the rear strut joint are illustrated in figs. 50, 51, and are of stainless steel. On the rear spar, on each side of the centre line, elevator hinge supports are provided, one at the rear strut joint fittings and one at the rear outer joint. The fittings for the front spar, at the strut joint and outer joint, are similar in construction to those of the rear spar.

Elevators

91. The port and starboard elevators (*see* fig. 52) are interconnected by a stainless steel tubular spar (A) $2\frac{1}{2}$ in.

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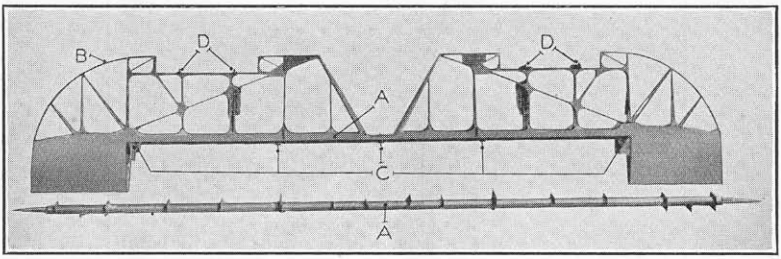

FIG. 52.—Elevators—showing construction.

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Elevators

91. The port and starboard elevators (*see* fig. 52) are interconnected by a stainless steel tubular spar (A) $2\frac{1}{2}$ in.

o/d. × 26 s.w.g., the elevators being of wood construction with a tubular duralumin trailing edge (B). Through the spar are bolted the five hinge pins (C) whilst on the underside of the elevator, on the port and starboard sides (*see* para. 156), are secured the elevator operating levers (item (G7) of figs. 85 & 95). The horned portions of the elevators are plywood covered, the remainder being fabric covered. Mass balance is effected by securing suitable lead weights both in the nose, at the inboard ends of the horned portions, and at the inboard ends of each port and starboard trailing edge.

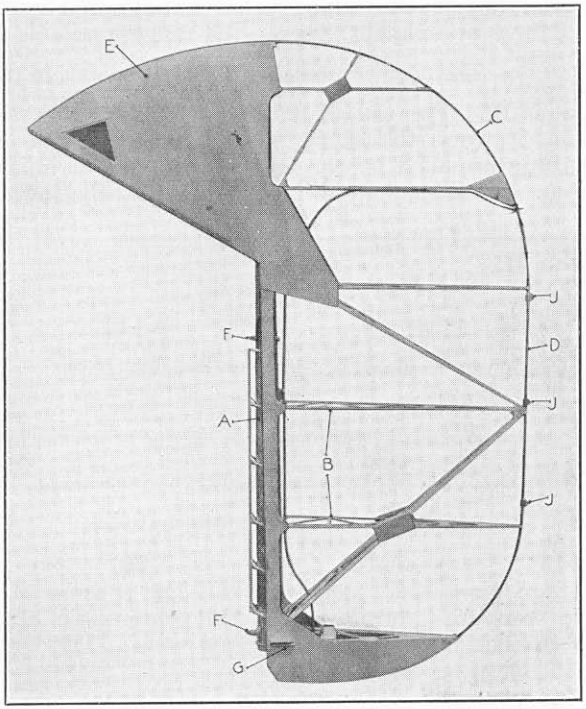

FIG. 53.—Rudder (air)—showing construction.

92. *Elevator flaps.*—On each port and starboard elevator, at the trailing edge and supported at two hinge points (D), is fitted a fabric covered trimmer flap of wood construction. For the locking of the elevators reference should be made to para. 178 and fig. 40.

Rudder

93. The rudder (*see* figs. 48, 53 and 54) consists of a stainless steel tubular spar (A) $2\frac{1}{2}$ in. o/d. × 24 s.w.g., six wood braced

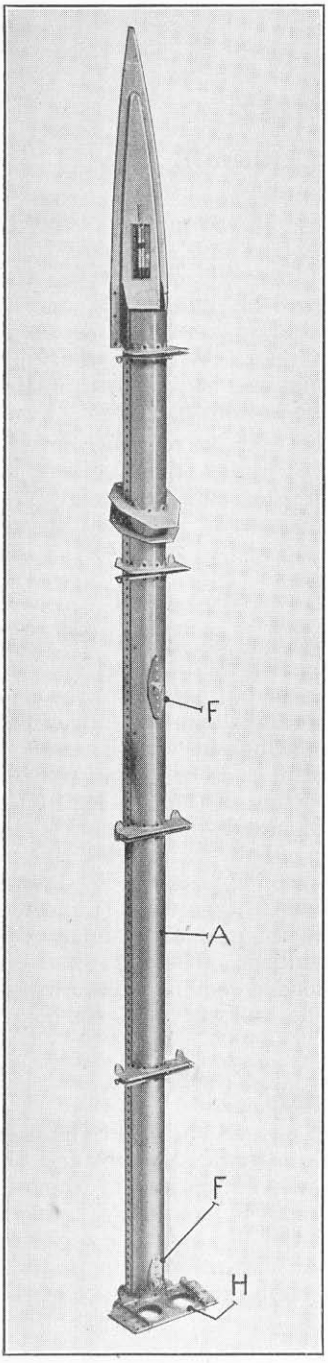

FIG. 54.—Rudder post.

ribs (B) and a trailing edge, the upper curved portion (C) of which is of duralumin, the remaining vertical and lower curved portion (D) being of stainless steel. The upper portion of the rudder is horned, the horned portion (E) being plywood covered, the remainder being fabric covered. Mass balance is effected by securing in the forward end of the horn a lead weight ($2\frac{1}{2}$ lb.) access to which is shown in fig. 53. The rudder is supported by two hinge supports mounted on the hull stern post, the rudder hinges at (F) being bolted through the tubular spar. The rudder is operated by means of levers (G) bolted, one on each side of the rudder, to a mounting (H) which is riveted to the tubular spar at rib No. 1 from the bottom. For the locking of the rudder, reference should be made to para. 179 and fig. 40.

94. *Servo - rudder.* — Supported at three hinge points (J) on the trailing edge of the rudder is a servo-rudder (*see* figs. 48, 53 and 95). It comprises a leading edge supported at the hinge points by duralumin rod, a strip trailing edge and shaped top and bottom edges, the servo-rudder being covered with alclad of 26 s.w.g. Between the centre and bottom hinges, on the starboard side is mounted the servo-rudder operating lever (K) to which is connected the tubular link (L), the forward end of the link being pin jointed to a plate bracket (M) mounted on the starboard side of the fin stern post.

CHAPTER IV

ALIGHTING GEAR

LAND UNDERCARRIAGE

General

95. The undercarriage (*see* figs. 55, 56 and 57) consists of separate units mounted on the port and starboard sides of the hull. These units are of the retracting type, the simultaneous raising and lowering of the units being effected hydraulically by means of a hand pump, centrally mounted, on the right-hand side of the first pilot. When in the fully retracted position the wheel units are housed within the recesses in the under surfaces of the bottom planes.

Note.—Items referred to in the text by reference letters are similarly indicated in the illustrations, the numbers of which are given *en bloc* early in the relevant paragraphs. These reference letters are not necessarily indicated in all these illustrations.

Undercarriage structure

96. Each undercarriage unit (*see* figs. 55, 56 and 57) comprises a radius rod (A), an oleo leg (B), and a wheel unit (C) mounted on an elbow fitting (D) at the bottom end of the oleo leg. The aft ends of the radius rods and the upper ends of the oleo legs are pin jointed to hull mountings (E) and (F) respectively, the forward ends of the radius rods being pin jointed to lugs integral with and at the bottom of the oleo leg upper chamber. The wheel unit is mounted on the outboard extending axle integral with the elbow fitting (D), rigidly secured to the bottom end of the oleo leg piston rod. Transverse structural rigidity of the undercarriage units is effected by means of the locking arms (G), integral with and at the bottom of the oleo leg upper chambers. The ends of these arms are eyed to engage spring-loaded locking bolts housed in the fittings (H) mounted on the hull port and starboard sides, at the chines.

Oleo leg and radius rod hull mountings

97. These fittings are shown in figs. 58 and 59. The oleo leg hull mountings (F) fitted between frames Nos. 8A and 8B are each provided with two inboard pointing lugs in which is fitted a hinge pin. On this hinge pin is mounted a cranked lever (J), the knuckle upper end of the oleo leg being socketed over the outboard stub of the lever and retained in position by means of a longitudinal pin engaging the inner face of the stub shoulder, below the stub neck.

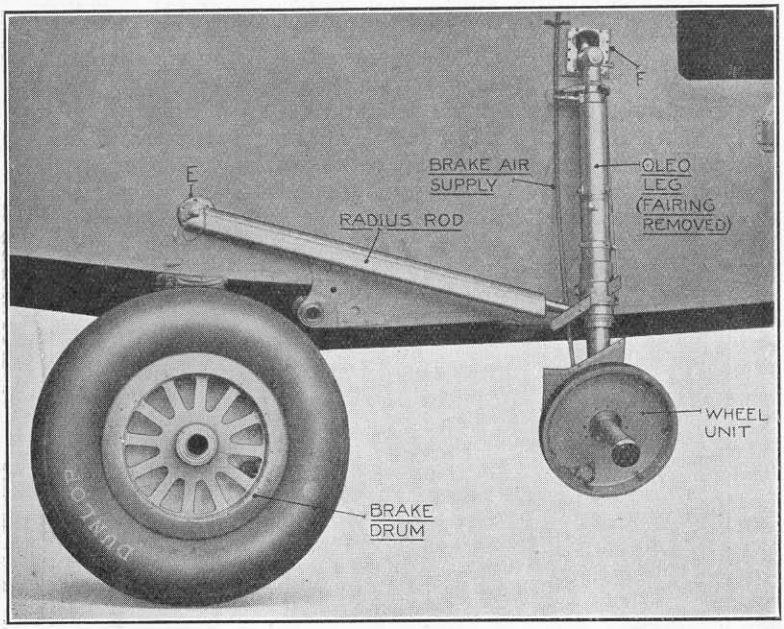

FIG. 56.—Undercarriage (starboard), down.

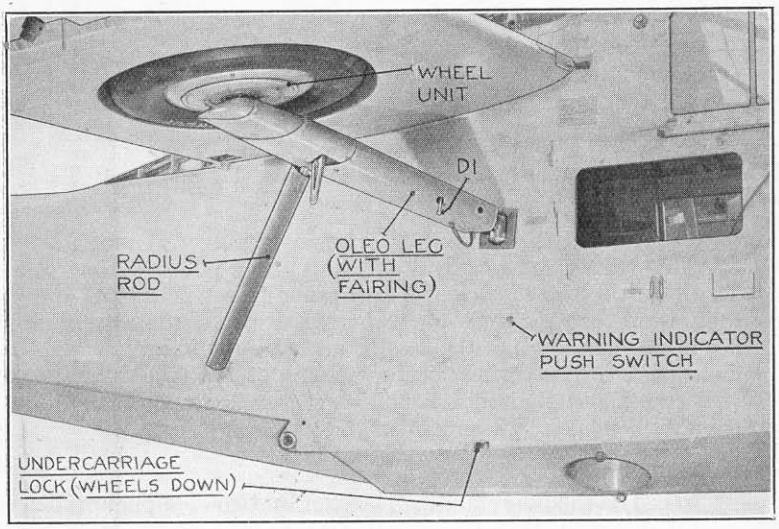

FIG. 57.—Undercarriage (starboard), retracted.

98. The inboard arm of the cranked lever (J) is double eyed at its end and provides means of pin joint attachment for the upper end of the corresponding hydraulic operating jack piston rod and the lower end of the air balance cylinder piston rod. The hydraulic jack and the air balance cylinder, on each side, are in tandem and approximately axially vertical, the lower end of the hydraulic jack and the upper end of the air balance cylinder being transversely pivoted between the hull frames Nos. 8A and 8B.

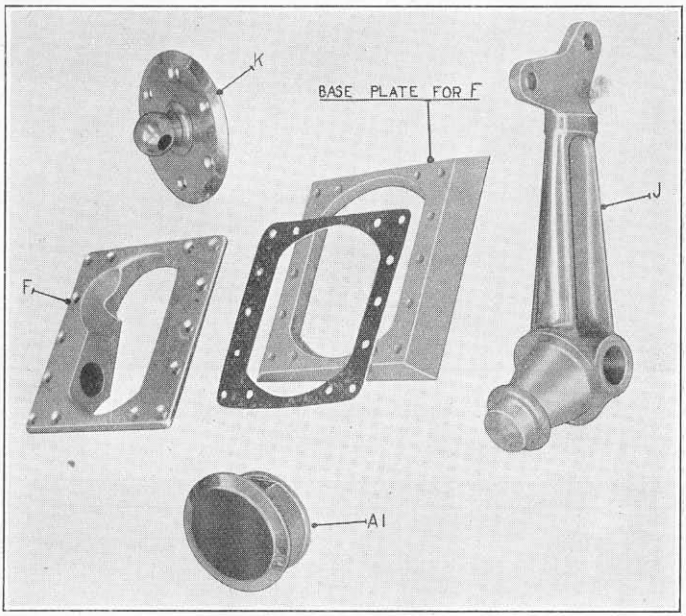

FIG. 58.—Undercarriage (starboard) retracting hinge and hull mountings.

99. The radius rod hull attachment fitting (K) mounted at frame No. 11 has a central ball stub which points outboard. To this ball stub is socketed and pinned the aft end of the radius rod, the securing pin being so disposed that its axis lies in the line joining the oleo leg and radius rod hull attachment points, thus permitting the folding of the undercarriage structure about its hull attachment points in response to the transverse angular movement of the cranked lever (J).

Oleo legs

100. The shock on landing is taken by two oleo-pneumatic legs mounted as described in paras. 96 to 98. These oleo legs (*see* figs. 60 and 61) comprise an upper chamber (A) closed at

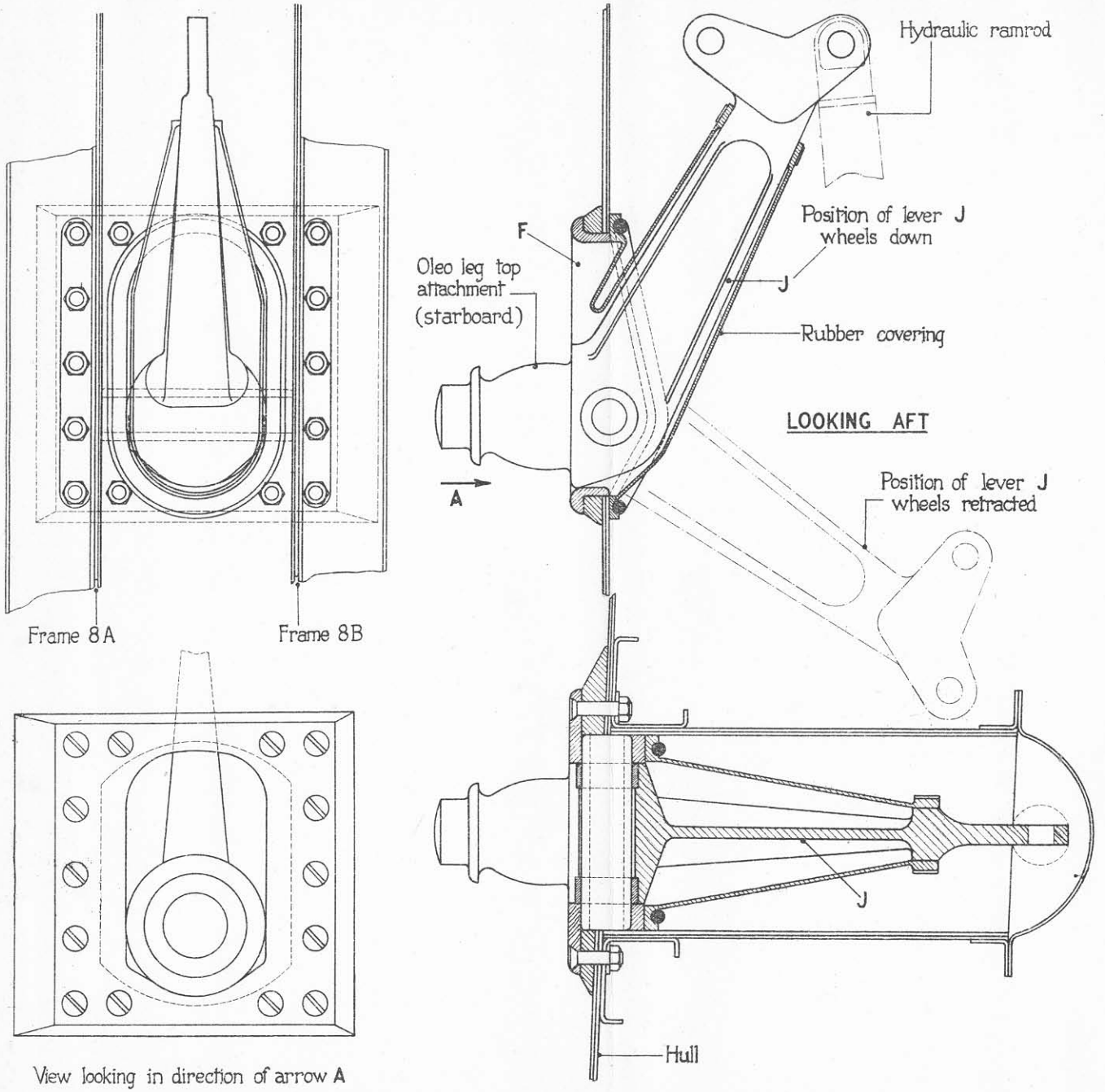

FIG. 59. UNDERCARRIAGE RETRACTING HINGE IN POSITION (STARBOARD)

its top end (except for the oil level valve (B1), and the air and oil valve (C1)) and arranged to take a gland at its lower end, and a lower tubular piston rod (B) at the upper end of which is secured a piston (C). The upper end of the upper chamber provides a socket into which is fitted and pinned the ball socket fitting (D) which receives the ball stud of the oleo leg retracting cranked lever (item (J) of fig. 58). Over the bottom end of the piston rod is socketed and bolted the inboard knee of the wheel axle (E).

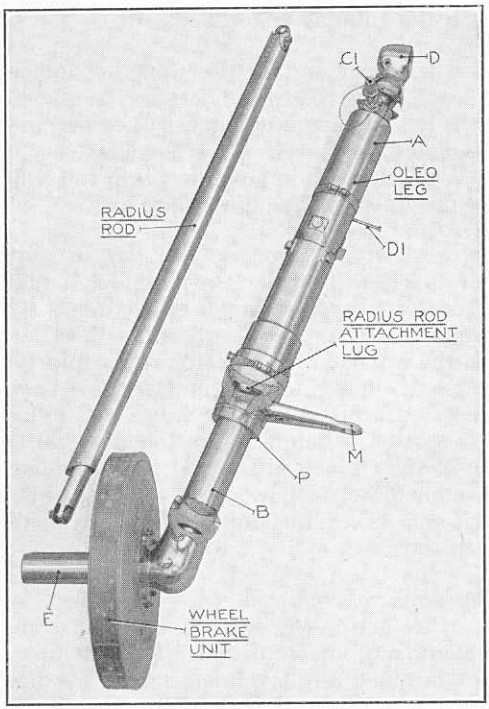

Fig. 60. Oleo leg (port) with axle and wheel brake unit

101. The gland at the lower end of the upper chamber is of the U-leather type and comprises a buffer ring (F), a U-leather support ring (G), two shaped U-leathers (H), a capping ring (J), and an externally screwed gland retaining nut (K). Over this retaining nut is threaded a cap ring (L) which is prevented from rotating by two protuding steps engaging corresponding recesses in the bottom end of the upper chamber. Below this cap ring (L) is fitted the undercarriage locking arm (M) which is prevented from turning by two integral steps

similar to those of the cap ring (L). The locking arm which also provides the radius rod attachment lug, is secured by the nut (N) which engages the screwed bottom end of the gland-retaining nut (K) and is prevented from turning by the locking plate (O) bolted to the web of the locking arm. Over the nut (N) is screwed a grease-retaining nut (P) within which is a sealing L-leather protected by a ring (Q) and supported by an axial spring (R). At approximately mid-length of the upper chamber, and secured by six set screws (S) with jointing washers, is a splined guide ring (T), which receives the splines integral with the tubular piston rod.

102. At the upper end of the upper chamber (A) is an axial cone-seated plug (U) to the bottom screwed end of which is secured the hollow tapered plunger (V), whilst in the bottom reduced diameter portion of which is sweated a vertical oil-level tube (W). Holes for oil overflow into the hollow tapered plunger are provided at the plunger top end.

103. Integral with the piston rod (B), at approximately one-third of its length from the top end, is a diaphragm which forms the base of a separate upper oil chamber, the top inner edge of which is circumferentially lipped. The piston (C) threaded to the top end of the piston rod comprises an upper and a lower half, in the outer annular space between which halves is inserted a holed damper valve ring (Y) of a special lipped cross section. Below the piston, integral with and on the outside of the tubular piston rod, are provided six splineways, and immediately below these splineways is a stiffened collar which acts as a limit stop to the downward movement of the piston rod.

104. *Operation of the oleo leg.*—The oleo leg is oleo-pneumatic in its action (*see* figs. 61 and 62), compressed air being the energizing medium and oil the damping medium. The oil is maintained at a level determined by the position of the bottom of the oil level tube (W). On the compression stroke the air above the oil is compressed and the oil reservoir in the upper end of the piston rod shrouds the plunger (V) secured to the top of the upper chamber, the plunger displacing oil from the reservoir through the annular channel between the circumferential lip at the top of the reservoir and the wall of the plunger. The plunger, being tapered, causes a progressive restriction in the annular channel to the escaping oil. This increased restriction creates an increasing damping resistance superimposed on the resistance of the further compressed air. A further means of escape for the oil in the reservoir is through the small hole in the bottom of the hollow plunger.

Amended (A.L.6)

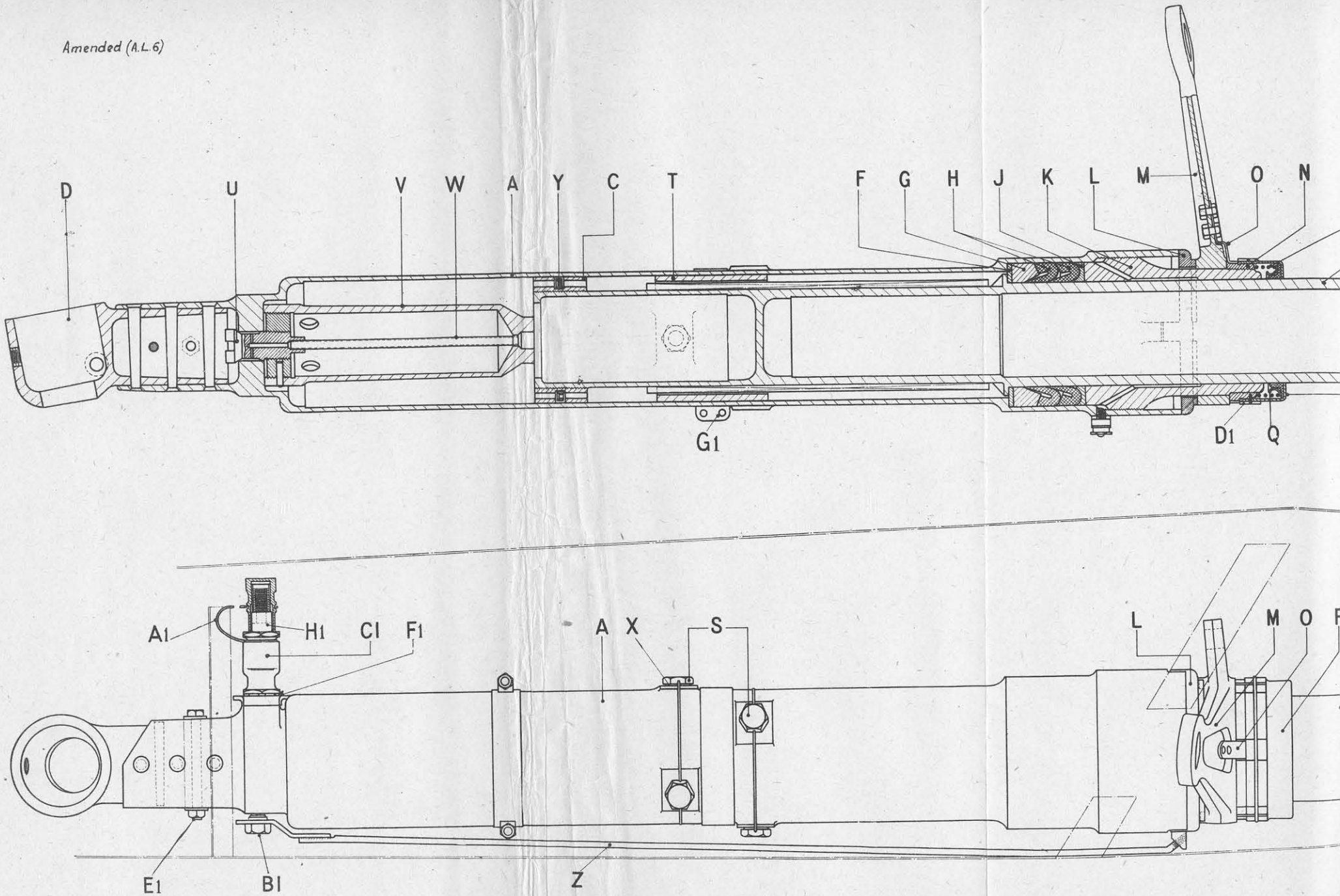

FIG. 61. OLEO LEG

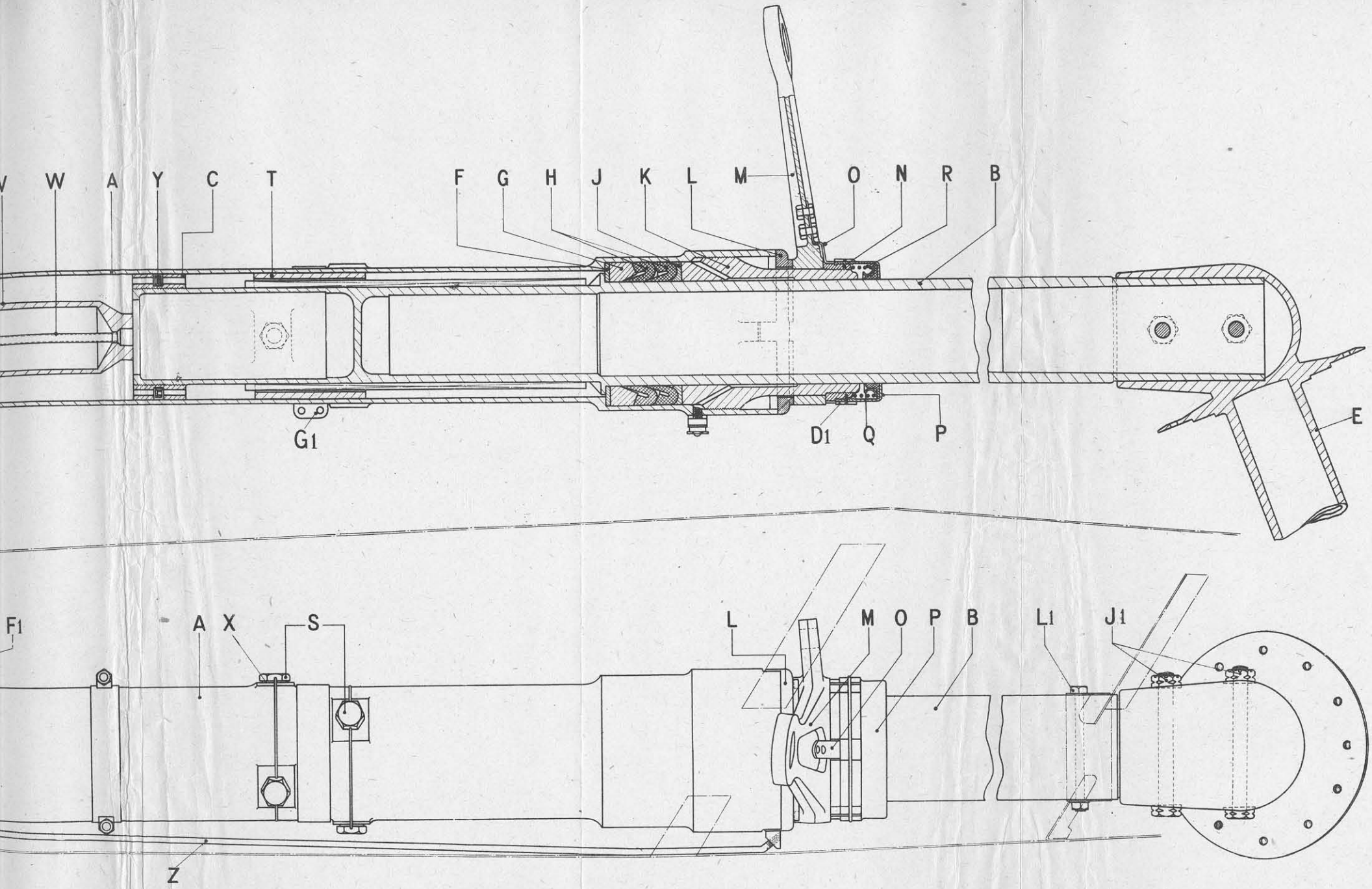

FIG. 61. OLEO LEG

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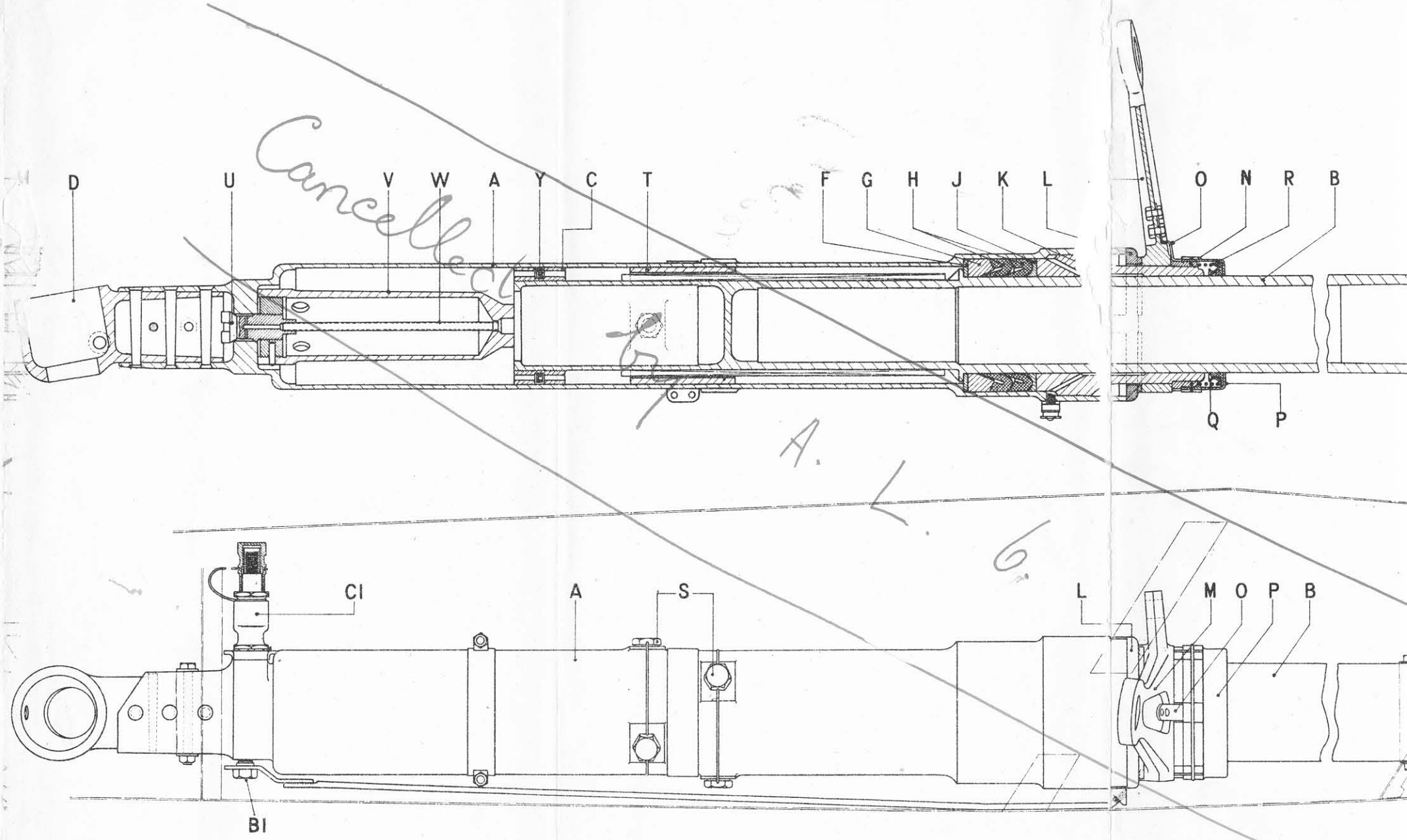


FIG. 61. OLEO LEG

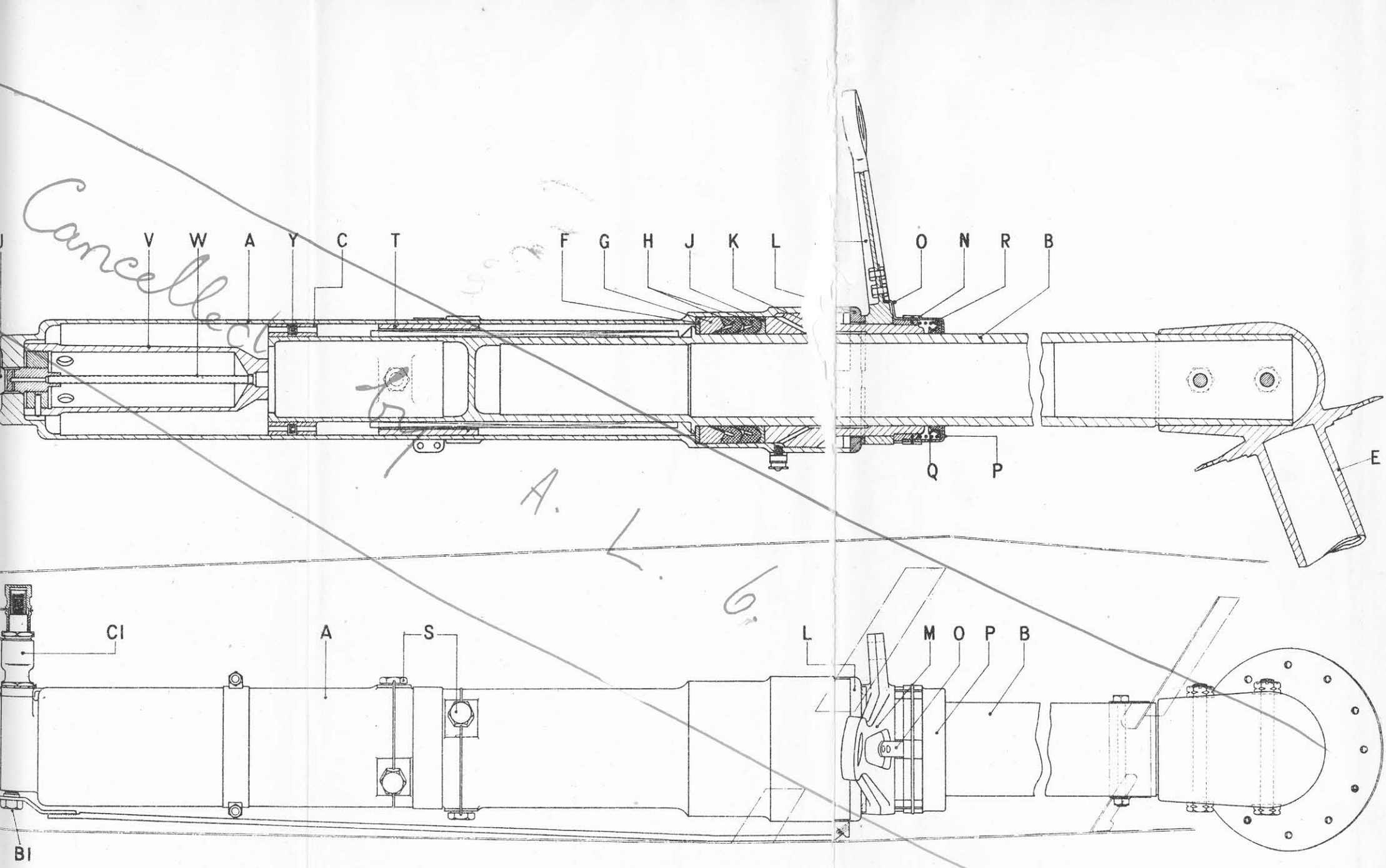


FIG. 61. OLEO LEG

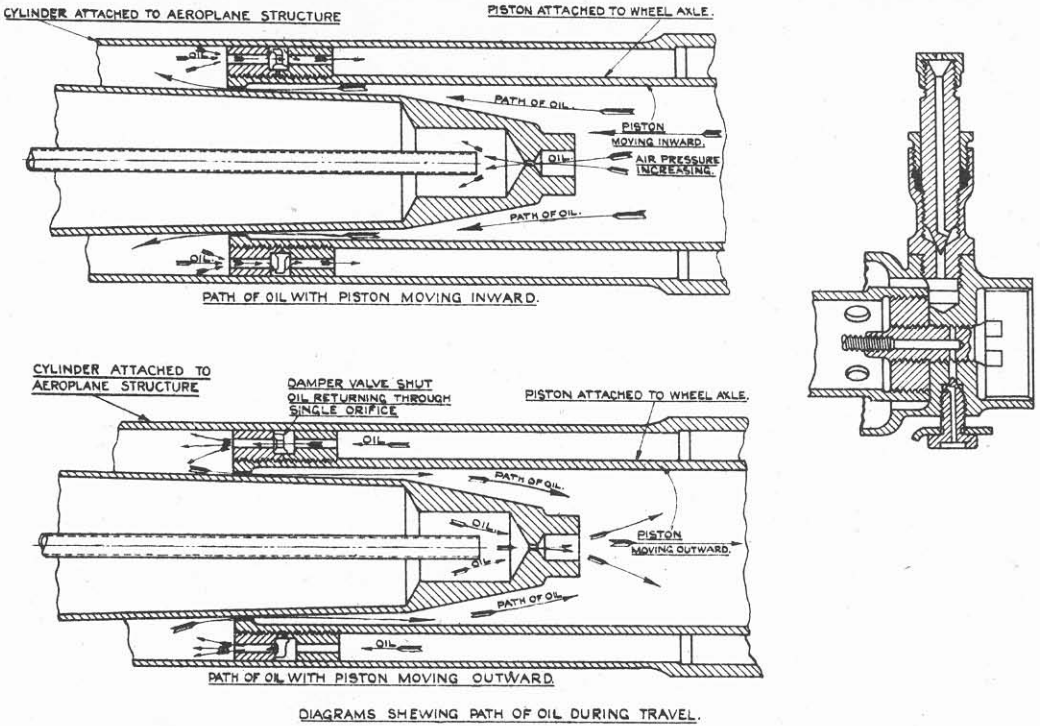


FIG. 62, OPERATION OF UNDERCARRIAGE OLEO LEG

105. The annular space below the piston, between the piston rod and the wall of the upper chamber, increases in volume thus causing a fall in pressure relative to the increasing pressure above the piston. Due to this pressure difference, the oil above the piston is forced through the holes in the piston (X) and damper valve ring (Y), the damper valve ring being in its lowest position, thus allowing greater freedom for the passage of the oil over the outer circumference of the damping valve ring. When the energy of landing has been absorbed by the compressed air and oil displacement, the compressed air energizes the outward stroke of the piston. The oil previously forced into the annular space below the piston and between the piston rod and wall of the upper chamber, is now, under piston pressure, forced up through the holes in the piston (C) and damper valve ring (Y) but, due to the oil flow, the damper valve ring is raised and seals the passage over its outer circumference thus restricting the oil passage to the damper valve ring holes. This restriction tends to impede the outward movement of the piston thus ensuring a slow and steady recovery from the compression stroke and eliminating all tendency to oscillation.

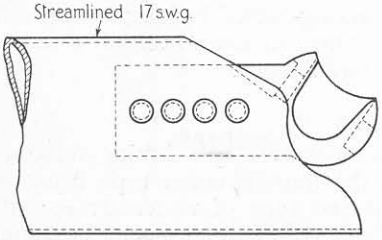


FIG. 63.—Radius rod, aft end (starboard).

106. On the ground the effective air pressure on the pistons of the oleo legs balances the weight of the aeroplane. Before fitting the oleo legs to the aeroplane the air pressure in each oleo leg must be raised to the figure stated on the instruction plate, ~~*i.e.* 425 lb. per sq. in. for the port oleo leg and 385 lb. per sq. in. for the starboard.~~ The correct oil contents is 1·7 pints of oil, lubricating, anti-freezing (Stores Refs. 34A/43 and 46). The maximum extension of the strut is 6 in., and the strut is so designed that under normal static load the approximate extension is 5 in.

107. For the dismantling, assembly, maintenance, adjustment of air pressure and the checking of oil level reference should be made to paras. 284 to 287.

Radius rods

108. The undercarriage radius rods (*see* figs. 56, 60 and 63) are constructed of stainless steel seamless streamlined tubes,

105. The annular space below the piston, between the piston rod and the wall of the upper chamber, increases in volume thus causing a fall in pressure relative to the increasing pressure above the piston. Due to this pressure difference, the oil above the piston is forced through the holes in the piston (C) and damper valve ring (Y), the damper valve ring being in its lowest position, thus allowing greater freedom for the passage of the oil over the outer circumference of the damping valve ring. When the energy of landing has been absorbed by the compressed air and oil displacement, the compressed air energizes the outward stroke of the piston. The oil previously forced into the annular space below the piston and between the piston rod and wall of the upper chamber, is now, under piston pressure, forced up through the holes in the piston (C) and damper valve ring (Y) but, due to the oil flow, the damper valve ring is raised and seals the passage over its outer circumference thus restricting the oil passage to the damper valve ring holes. This restriction tends to impede the outward movement of the piston thus ensuring a slow and steady recovery from the compression stroke and eliminating all tendency to oscillation.

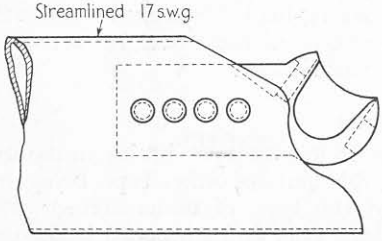


FIG. 63.—Radius rod, aft end (starboard).

(46) Para. 106, lines 5 and 6. *Delete* ", i.e. 425 lb./sq. in. . . . for the starboard."

of the oleo legs balances the weight of the aeroplane. Before fitting the oleo legs to the aeroplane the air pressure in each oleo leg must be raised to the figure stated on the instruction plate, ~~*i.e.* 425 lb. per sq. in. for the port oleo leg and 365 lb. per sq. in. for the starboard.~~ The correct oil contents is 1·7 pints of oil, lubricating, anti-freezing (Stores Refs. 34A/43 and 46). The maximum extension of the strut is 6 in., and the strut is so designed that under normal static load the approximate extension is 5 in.

107. For the dismantling, assembly, maintenance, adjustment of air pressure and the checking of oil level reference should be made to paras. 284 to 287.

Radius rods

108. The undercarriage radius rods (*see* figs. 56, 60 and 63) are constructed of stainless steel seamless streamlined tubes,

and end fittings the tubular shanks of which are fitted within and riveted to the ends of the tubes. The section of the tubes is approximately $2\frac{7}{8}$ in. over the major axis and $1\frac{1}{2}$ in. over the minor axis, the wall thickness being 17 s.w.g.

109. The aft end fitting is ball ended and jawed to take the radius rod hull mounting ball stub to which it is pin jointed (*see* note to para. 258). The forward end fitting is double lugged and is pin jointed to the oleo leg, the attachment lug being provided by the oleo leg locking arm (item (M) of fig. 61).

Wheel axles

110. These axles (*see* figs. 56, 58, 60 and 61) are constructed of stainless steel, each axle consisting of a plain tubular shank (E) at the inboard end of which is an integral collar of tapering cross section, and a kneed socket. To the collar is bolted the wheel brake unit, the kneed socket being fitted over and bolted to the bottom end of the oleo leg piston rod (B). At the outboard end of the axle is bolted a shouldered plug cap (A1), the shouldered portion being eccentric with the axle axis and chamfered, thus providing means of engagement with the spring-loaded locking bolt, positioned approximately at the centre of the wheel retracted position recess, in the bottom outer plane.

Wheel brake units

A.L.6. 111. Dunlop or Palmer ~~tyre~~ type brake units are fitted to the undercarriage, the units of either type being interchangeable independent of the type of undercarriage wheel fitted (*see* para. 118). Each port and starboard brake unit (*see* figs. 56 and 60) is of Dunlop type and consists of a rimmed disc which is bolted to the brake unit collar on the inboard end of the axle. Full details of the construction and operation of the Dunlop and Palmer brake units are given in Chapters 7 and 8, respectively, of the Engineering Manual for the Royal Air Force, Air Publication 1464B, Vol. 1, Part 5, Section 5.

Wheel brake system

112. *General.*—The undercarriage wheel brake system comprises (*see* fig. 64) two pneumatic brake units (*see* para. 111), one air container (A) (also shown in fig. 91), a dual relay valve (B) with control rod ~~(C)~~ and operating cable ~~(D)~~, an air filter (E), a triple air-pressure gauge (F), and necessary tubing, couplings, etc. Full details of the construction and operation of the dual relay valve control unit and general description of the pneumatic brake system are given in the Engineering Manual for the Royal Air Force, Air Publication 1464B, Vol. 1, Part 5, Section 5, Chapter 7.

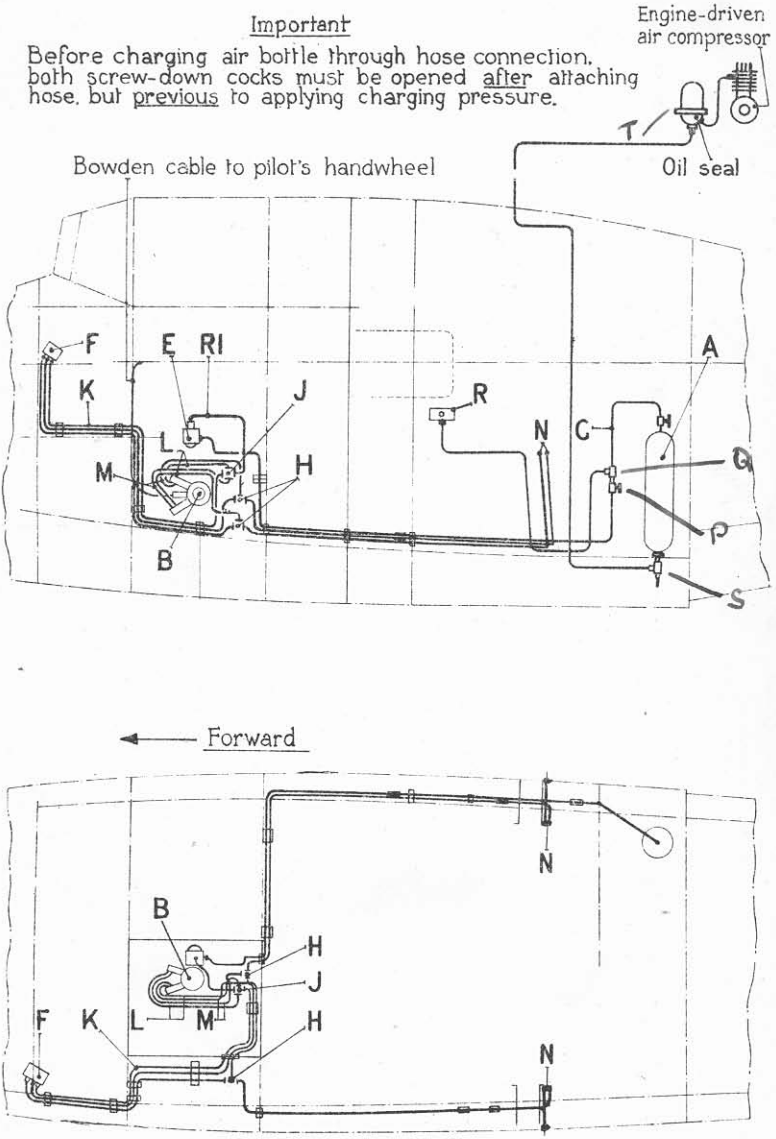


FIG.64. WHEEL BRAKE SYSTEM

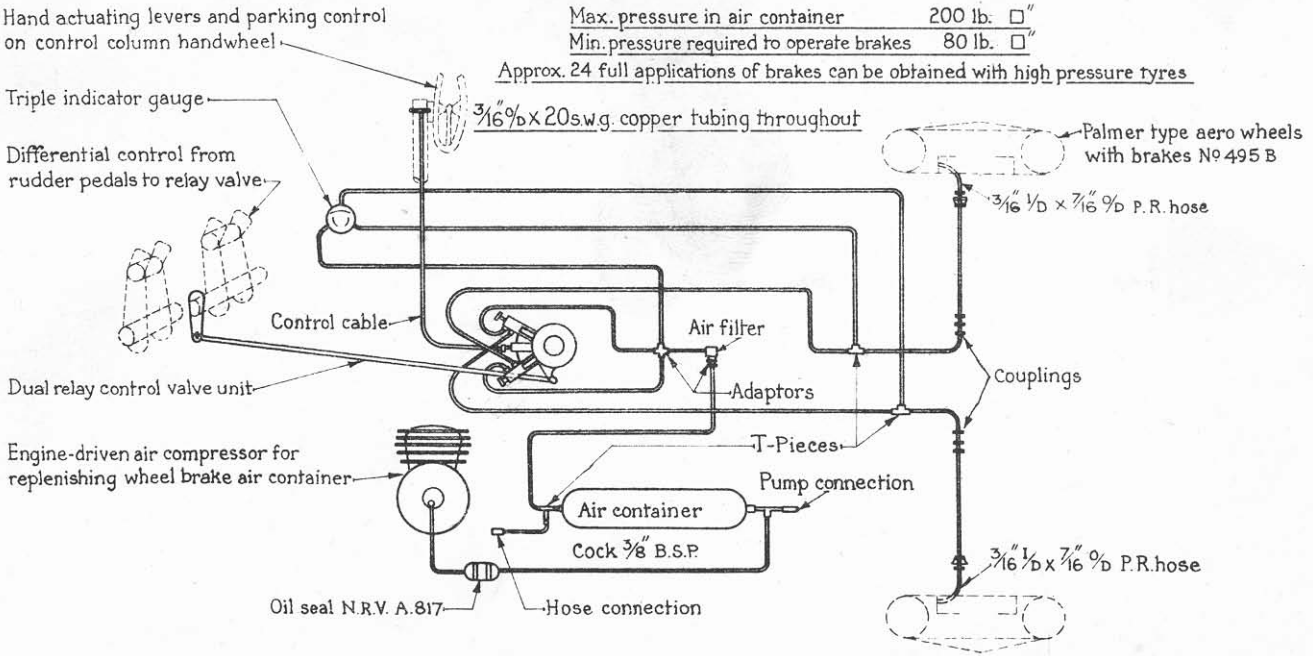


FIG. 65, DIAGRAM OF WHEEL BRAKE SYSTEM

113. *Brake system.*—The brake air system is shown in figs. 64 and 65. The air container (A) (also shown in fig. 91) is mounted vertically in plate brackets on the starboard side of the hull, immediately forward of the hull frame No. 10. A copper air brake supply pipe (G), $\frac{3}{8}$ in. o/d × 20 s.w.g., is led from the connection at the top of the container forward and down to the chine, at which level the supply pipe runs forward to bulkhead No. 5, where it is led inboard, behind the keel portion of the bulkhead, to a point immediately to port of the centre line from which point it is led forward to the air filter (E) mounted on a vertical U-channel strut below the first pilot's seat. From the top of this filter a copper air supply pipe (R1), $\frac{3}{16}$ in. o/d × 20 s.w.g., is led to the four-way piece (J) from which a lead (K), $\frac{3}{16}$ in. o/d × 20 s.w.g., is taken along to the port side and thence to the air brake triple pressure gauge (F) mounted on the pilot's instrument panel. From the two remaining connections of the four-way piece (J), pipes (L), $\frac{3}{16}$ in. o/d × 20 s.w.g., are led to the dual relay control valve (B) port and starboard brake branches. From each of these branches a $\frac{3}{16}$ in. o/d × 20 s.w.g. copper pipe (M) is taken to a corresponding three-way piece (H) from which similar pipes are taken to the air brake triple pressure gauge (F) and to the corresponding brake air pipe coupling (N), immediately aft of the oleo leg hull attachment mounting. From each of these couplings a $\frac{3}{16}$ in. i/d × $\frac{7}{16}$ in. o/d P.R. hose (O) is led to the corresponding brake unit.

114. From the screw-down valve (P) below the three-way piece (Q) on the brake air supply pipe (G), immediately aft of frame No. 9, a pipe is led down, then forward along the chine to the forward side of frame No. 8A, where it rises to join the hose connection (R) (*see* fig. 109) immediately below the aft portion of the cabin starboard window. At the bottom of the air container is the wheel brake engine-driven air compressor connection (S) from which a pipe is led to an oil seal non-return valve (T) (also item (P7) of fig. 104), thence to the wheel brake engine-driven air compressor in the engine nacelle.

115. *Brake operating cable.*—This cable is shown in fig. 64, 65 the cable operating mechanism being shown in figs. 66, 81, 82 and 83. The wheel brake control levers (U) are mounted on the control column handwheel on each side of the handwheel spindle. Simultaneously or singly these levers actuate a rod (V) which passes axially through the handwheel spindle. Forward of and at the top of the control column, and transversely set, is a spindle (W) mounted in the support bracket (X). On the inboard end of this spindle is a ball-ended lever (Y), the ball end shrouding and in press contact with the forward end of the axial rod (V). On the outboard end of the transverse spindle (W) is a lever (Z) which is connected to a bowden cable,

the cable casing running down the control column from its adjustment attachment (A1) secured to the control column. The bowden cable, passing through the chassis top, is led to the air brake dual relay valve (B). Immediately below the outboard lever (Z) is an eccentrically mounted hand-operated stop (B1) which, when raised, retains the lever (Z) in its ON position.

116. Mounted immediately outboard of the rudder starboard pedal (*see* fig. 81) on the starboard pedal transverse shaft is a lever (C1) to which is pin jointed the dual relay valve differential control rod (D1), the aft end of which is connected to the dual relay valve swivel block lever.

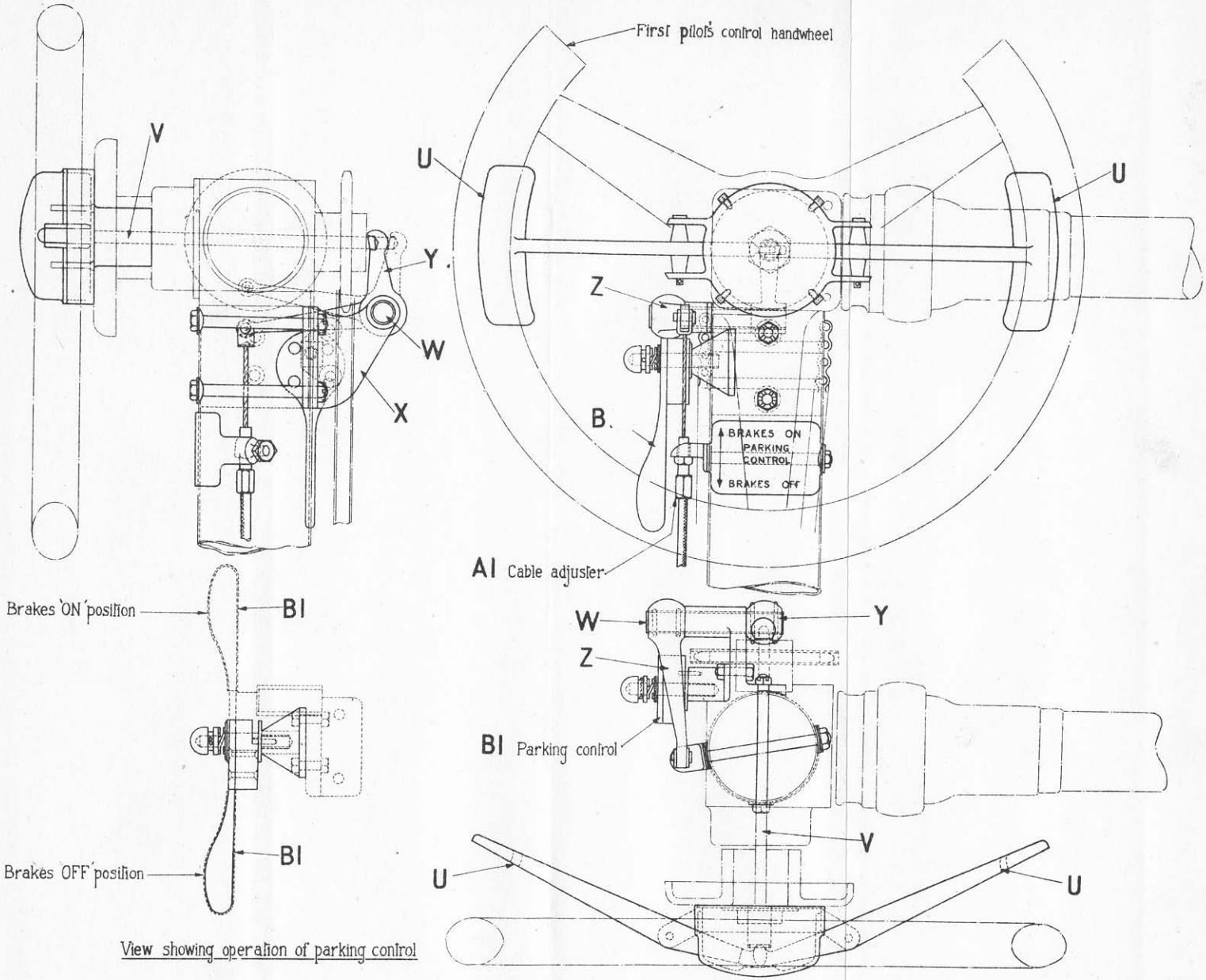
117. The brake hand levers on the control column handwheel govern, by means of the bowden cable, the air supply to the dual relay control unit, which controls, either differentially or simultaneously, the air pressure supply to the brakes. When the rudder pedals are in their neutral position (*see* fig. 64), the movement of the hand levers (U) or Stop (B1) to the ON position ensures an equal air pressure supply to both port and starboard wheel brake units simultaneously. The differential functioning of the dual relay valve control unit is dependent on the "displaced from neutral" position of the rudder pedals, the control unit swivel block lever being interconnected by means of the operating rod (D1) and lever (C1) with the starboard rudder pedal lever transverse shaft.

Wheels

118. Dunlop type (A.H.2074) or Palmer type (No. 495/B) are fitted to the undercarriage, the former, fitted with roller bearings, being interchangeable with the latter, fitted with plain bearings, independent of the type of brake unit fitted (*see* para. 111). The Dunlop wheels, 19·0 in. × 3·12 in. width rims, and the Palmer wheels, 19 1/16 in. × 3 3/4 in. width rims, are both fitted with high-pressure tyres 8 in. ×19 in. and 895 mm. × 200 mm. respectively.

Retracting gear

119. The undercarriage units are retractable, the starboard unit being shown in the "full down" and the retracted positions in figs. 56 and 57 respectively, whilst in fig. 55 both of these positions of the starboard undercarriage unit are shown. The retracting mechanism for each port and starboard unit (*see* figs. 67 to 70) consists of a hydraulic ram (A) the cylinder of which is pivoted at its bottom end on two longitudinal trunnions supported in mountings secured to frames Nos. 8A and 8B, near the chine, whilst the top end of the ram piston rod is pin jointed to the lower lug of the cranked lever (C) (*see* also item (J) of fig. 58). Approximately in the vertical line of the hydraulic ram and above the cranked lever is a



View showing operation of parking control

(3481).

FIG. 66. ASSEMBLY OF PARKING CONTROL LEVERS ON CONTROL COLUMN

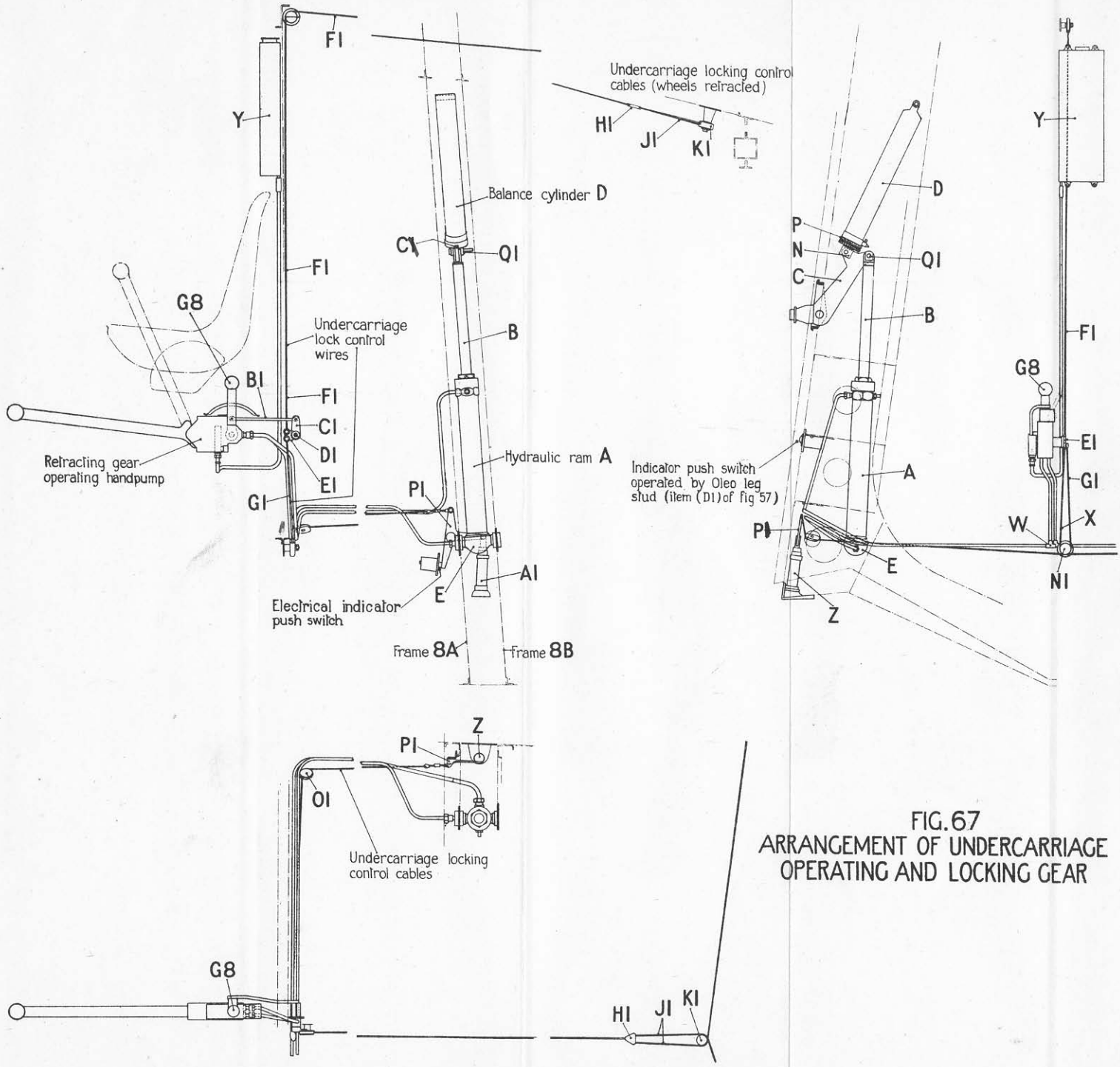


FIG. 67
ARRANGEMENT OF UNDERCARRIAGE OPERATING AND LOCKING GEAR

balance cylinder (D) pivoted at its top end on a longitudinal bolt secured to frames Nos. 8A and 8B, the balance cylinder piston rod being pin jointed to the upper lug of the cranked lever.

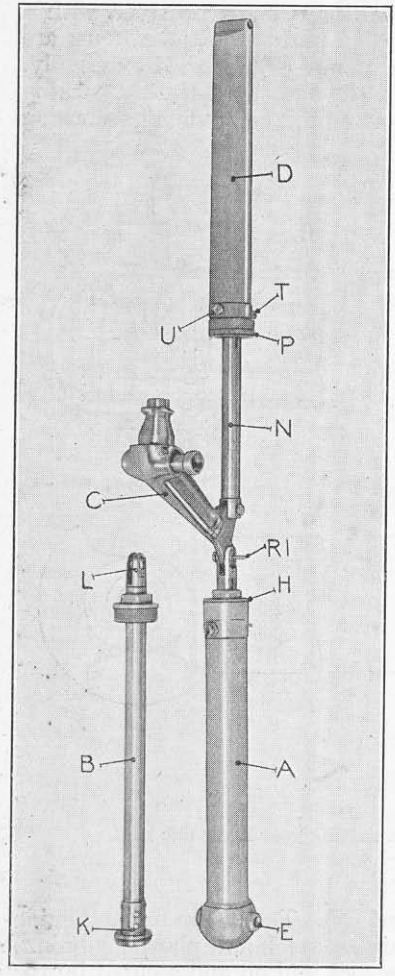


FIG. 68.—Undercarriage retracting hydraulic ram and balance cylinder (port).

120. *Hydraulic ram.*—Each port and starboard ram unit (*see* figs. 68 and 69) comprises a cylinder (A) and a ram (B). At the bottom of the cylinder is a trunnioned end cover (E), and at the top end, below the internally-screwed gland portion, is a rigidly secured ring (F). Above the top of this ring, the upper portion of which is slotted radially and pyramidal in section, is a U-shaped Walkerite packing ring (G) secured within the top gland cover (H) which is sealed by a monel metal joint ring (J). Oil pipe connections are provided at the top of the cylinder, below the gland, and at the bottom end cover, axially central in the forward trunnion boss. The ram comprises a piston rod (B) and a piston (K), the piston rod being constructed of stainless steel tube to the top end of which is secured a forked plug end fitting (L), and to the bottom end of which is secured a socketed piston (K).

121. *Balance cylinder.*—Each balance cylinder unit (*see* figs. 68 and 70) comprises a cylinder (D), a piston rod (N) with a guide piston (O), and at the bottom a gland unit which consists of a gland nut (P), packing support rings (Q) and (R) and a U-leather packing ring (S). The cylinder (D) is of light alloy construction, its top end providing means of pin jointed

attachment to the hull frames, its bottom end being externally screwed to receive the gland nut (P). Internally fitted to the bottom of the cylinder is the packing support ring (Q) which is rigidly secured by the air supply connection (T) and the set screws (U), each of the last two items being provided with a coned shoulder which serves as a seal when these items are screwed hard home. The gland nut (P), knurled externally, U-leather support ring (Q) and (R) and the U-leather packing ring (S) are assembled on the piston rod before finally screwing

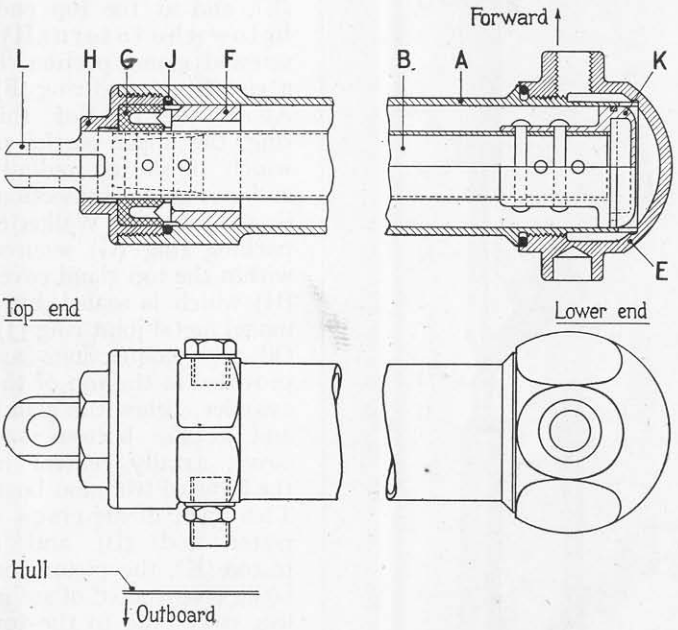


FIG. 69.—Undercarriage retracting gear hydraulic ram.

the piston (O) to the piston rod (N). The piston rod and guide piston are constructed of stainless steel, and phosphor bronze respectively, the piston being socketed on and secured by the bolt (V) to the upper end of the piston rod, the lower end of which is forked and provides for pin joint attachment to the upper lug of the crank lever (C) (item (J) of fig. 58). When the balance cylinder unit is fully extended the air pressure within the cylinder is 400 lb. per sq. in. and when compressed, 500 lb. per sq. in. The gland is sealed by the injection of 10 c.cm. of oil, anti-freezing, type A, the cylinder being kept vertical after charging.

122. *Operating hand pump.*—The hydraulic retracting rams are operated by means of a handpump (*see* figs. 67, 68, 71, 73 and 101) mounted on the right-hand side of the first pilot's seat. The pump is of the double-acting type, each of its two cylinders having a spring-loaded inlet and outlet valve. The valve passages are connected to a plug cock situated at the after end of the pump, the cock barrel having its ports so arranged that a reversal of oil flow to the hydraulic rams is effected when the cock barrel is turned through 90°.

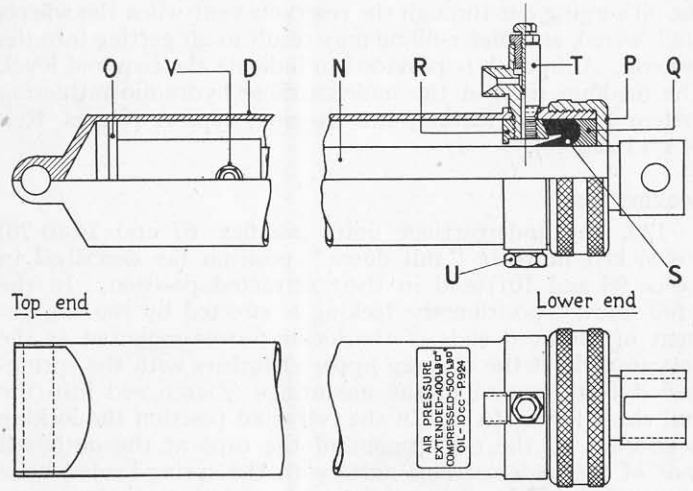


FIG. 70.—Undercarriage retracting gear balance cylinder.

123. From the pump three pipe lines are taken and connected as follows :—

(i) One to a three-way piece (W), the remaining two connections of the three-way piece being connected to the top connections of the hydraulic rams.

(ii) One to a three-way piece (X), the remaining two connections of the three-way piece being connected to the forward trunnion connections at the bottom of the hydraulic rams.

(iii) One to the oil reservoir (Y) positioned centrally, at the top and on the forward side of bulkhead No. 5.

The pipe lines consist of $\frac{3}{8}$ in. o/d × 20 s.w.g. copper piping.

124. When the cock handle (G8) is aft of its mid position the pressure side of the handpump is opened to the pipe lines leading to the connections on the upper ends of the hydraulic rams, when the working of the handpump will raise the undercarriage units. When the cock handle is forward of its mid

position the pressure side of the handpump is opened to the pipe lines leading to the forward trunnion connections at the bottom of the hydraulic rams, when the working of the handpump will assist in the lowering of the undercarriage units, the undercarriage wheels normally falling to their "down" position automatically.

125. *Reservoir.*—An oil reservoir (Y) with a capacity of half a gallon is fitted to the bulkhead behind the pilot. This reservoir should be kept half-filled. Over-filling will result in the oil surging out through the reservoir vent when the wheels are lowered, and under-filling may result in air getting into the system. A dipstick is provided to indicate the required level. The medium used in the undercarriage hydraulic retracting system is oil, lubricating, anti-freezing, type A (Stores Ref. 34A/43 and 46).

Locking gear

126. The undercarriage units (*see* figs. 67 and 74 to 76) are locked in their "full down" position (as described in paras. 96 and 101) and in their retracted position. In the "full down" position the locking is effected by the engagement of the eyed ends of the locking arms mounted at the bottom ends of the oleo leg upper chambers with the spring-loaded bolts housed in the mountings (Z) screwed into the hull chine fitting (A1). In the retracted position the locking is effected by the engagement of the caps at the outboard ends of the undercarriage axles with the spring-loaded bolts mounted approximately at the centre of the wheel recesses in the bottom planes. These spring-loaded locking bolts are illustrated in figs. 75 and 76.

127. The locking bolts are controlled by 5-cwt. cables operated from the pilot's cockpit by means of the retracting gear handpump cock handle (item (G8) of figs. ~~68,~~ 71, ~~72~~ and 101) the attitude of which predetermines either the raising or lowering of the undercarriage units when the handpump is operated. To the cock handle of this handpump (*see* figs. 71 and 74) is connected a link (B1) the aft end of which is pin jointed to a lever (C1) at one end of a transverse spindle (D1) mounted on bulkhead No. 5 stiffener. At the other end of this spindle is a double-eyed second lever (E1) to which is connected the thimble ends of the locking bolt operating cables (F1) and (G1), the upper vertical cable (F1) controlling the locking bolts in the bottom plane wheel recesses, and the lower vertical cables (G1) controlling the locking bolts at the hull chines.

128. The upper vertical cable (F1) passes over a pulley mounted immediately behind and at the top of No. 5 bulkhead stiffener, and runs aft, below the hull deck, to join the shackle

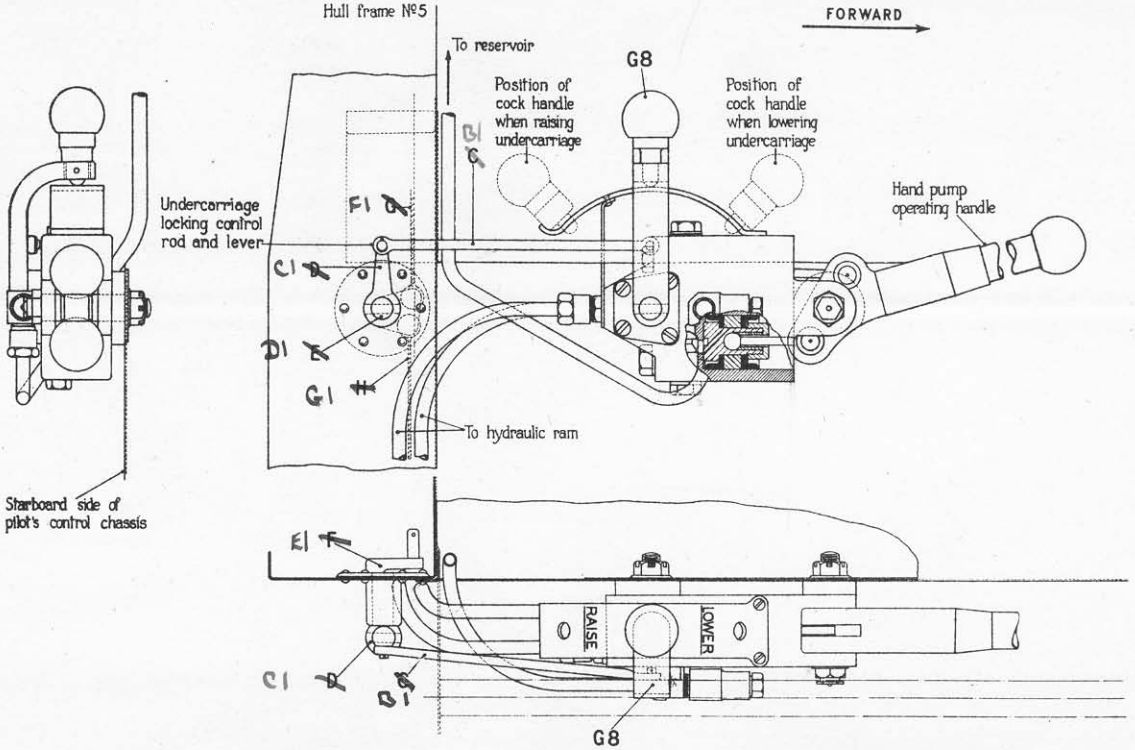


FIG. 71 ARRANGEMENT OF HYDRAULIC HAND PUMP FOR UNDERCARRIAGE RETRACTING GEAR

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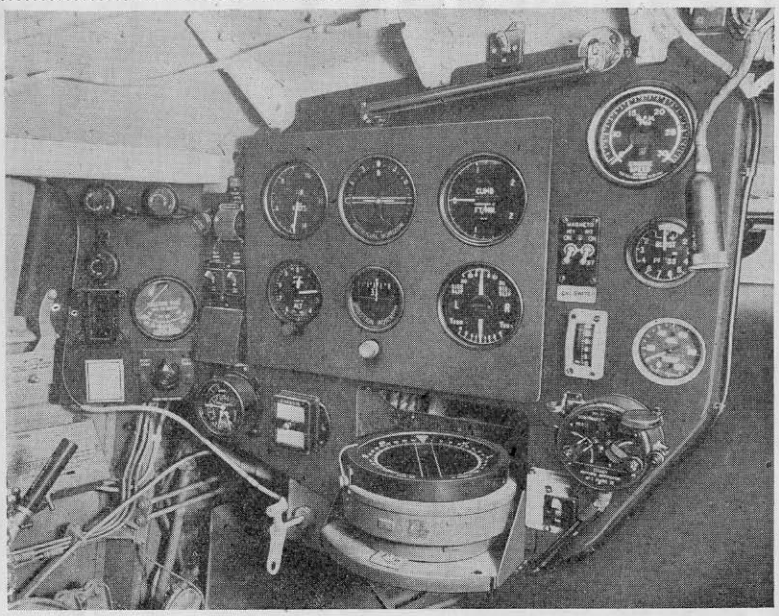

FIG. 72.—PILOT'S COCKPIT—FROM CABIN STARBOARD WINDOW (A.L. 8)

fitting (H1) (*see also* fig. 91) to which are connected two cables (J1). These cables pass over a double pulley (K1) mounted under the hull deck, one cable running to port and one to starboard, each passing over a guide pulley (L1) mounted in the roots of the bottom planes. From these guide pulleys (L1) the cables run outboard through the plane, forward of the rear spar, and passing over pulleys (M1) are led forward to the locking bolts mounted approximately at the centres of the undercarriage wheel recesses in the bottom planes.

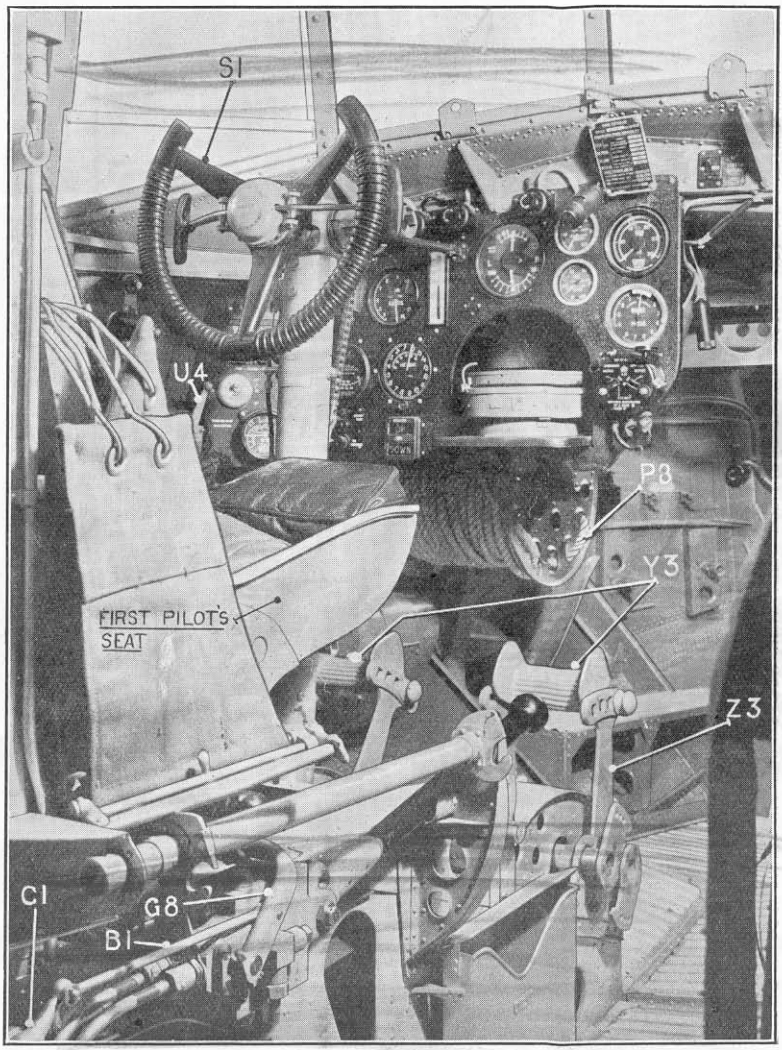

Fig. 72.—Pilot's cockpit—from cabin starboard window.

129. The lower vertical cables (G1), connected to a double-eyed lever (E1), are led to the double pulley (N1) immediately below. From this double pulley the cables run outboard, one to port and one to starboard, immediately aft of the lower portion of bulkhead No. 5, and pass over the pulleys (O1) mounted just above the hull chines. From these pulleys the port and starboard cables run aft to the corresponding three-armed levers (P1) mounted on the hull, immediately forward of frame No. 8A. The forked ends of the aft pointing arms of the three-armed levers (P1) engage in the double collars of the undercarriage chine locking bolts.

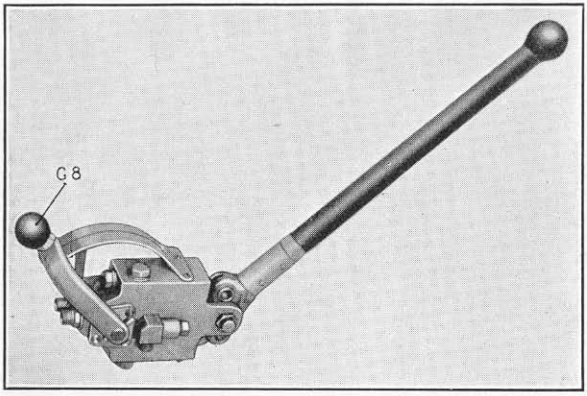

FIG. 73.—Undercarriage retracting handpump.

Warning devices

130. An electrical indicator is mounted at the bottom, on the port side, of the pilot's instrument panel to show when the undercarriage is up or down. This indicator is operated by electrical switches in series which are automatically controlled (*see* figs. 67 and 68) by the undercarriage retracting mechanism, as follows :—

(i) For "wheels down" position of the undercarriage units the corresponding switches (~~items (C_p) (C_s) and (B_p) (B_s) of fig. 132~~) are operated by the downward pointing arms of the port and starboard three-armed levers (P1), and by the inboard protruding studs (item (D1) of figs. 57 and 60) rigidly mounted on the upper portion of the oleo leg upper chambers. For the removal of switches (~~items (B_p) and (B_s) of fig. 132~~) reference should be made to para. 261.

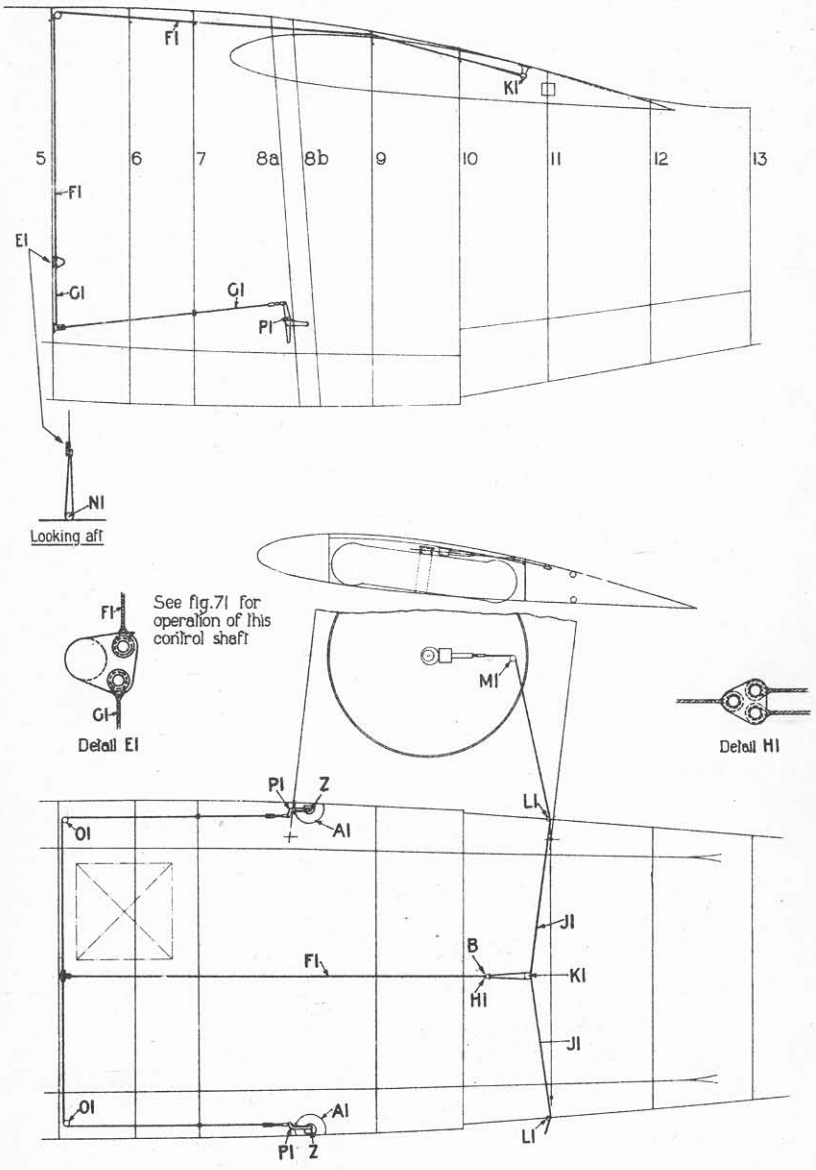

FIG.74. ARRANGEMENT OF UNDERCARRIAGE LOCK CONTROL WIRES.

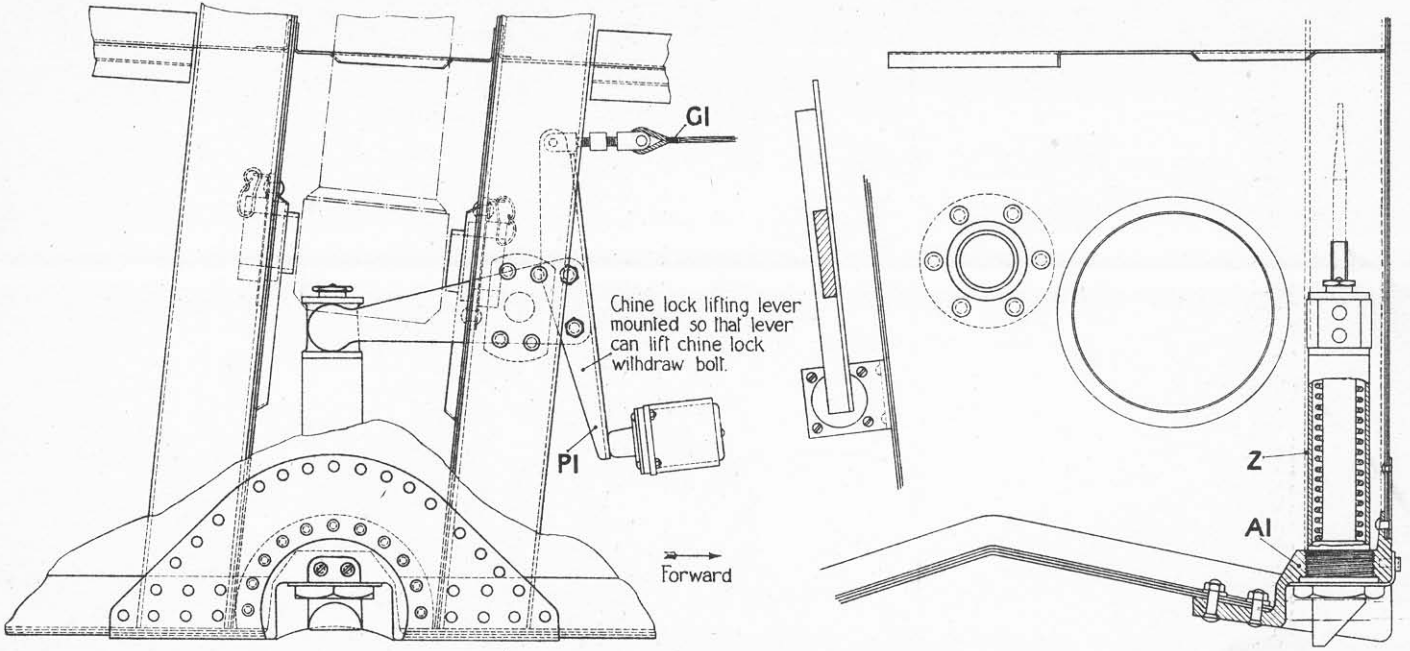

FIG. 75. UNDERCARRIAGE CHINE LOCKING BOLT

(ii) For " wheels up " position of the undercarriage units the corresponding switches are operated by the port and starboard hydraulic ram fork pins (Q1).

A description and the method of operation of these switches are given in paras. 228 to 231.

131. Additional to the electrical indicator is an electrical horn which sounds, when the engine throttle is closed, to remind the pilot to look at the indicator. The horn switch is operated by the engine throttle lever when in the closed position. The pilot may stop the horn sounding by depressing the push in the side of the switch. When the throttle is advanced again beyond one-quarter of its travel the switch is released and the horn will again sound on the return of the throttle lever. A description and the method of operation of this switch are given in para. 231 and illustrated in figs. 132 and 134.

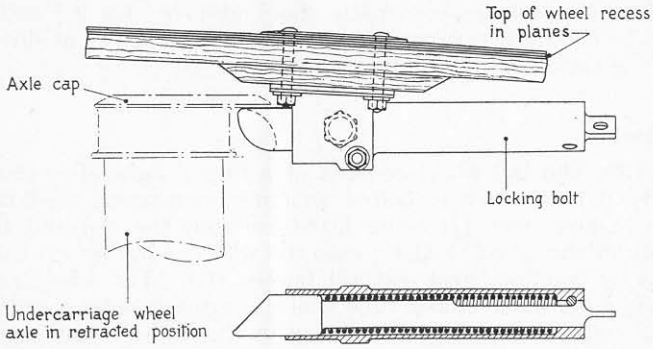

FIG. 76.—Undercarriage retracted position locking bolt.

132. A master switch, cutting out the indicator but not the horn, is moved to the " on " position by the throttle lever. It should be switched off only when the aeroplane is standing, its purpose being to conserve electric current when the aeroplane is standing for any length of time. If this switch is moved to its " off " position when the throttle lever is in an advanced position, the switch lever will interfere with the full return of the throttle lever, and damage to the switch may result.

Special Note.—It is important that the accumulator indicated in the electric diagram fig. 131, be always in position and connected up for service when the aeroplane is in flight, otherwise the electrical warning devices will not operate.

133. *Emergency indicators.*—Should the indicator system fail to function owing to an electrical fault, it is possible to verify that the wheels are safely down and engaged with the chine locks by examining the "down" indicator circuit switches. Each of these four switches is provided with a nipple which should protrude about $\frac{1}{4}$ in. from the face of the switch remote from the push contact. If one of the nipples be flush instead of protruding, it indicates that the corresponding oleo leg or chine lock is not properly engaged and it is unsafe to alight on land.

SOLID TYRED TAIL WHEEL UNIT (WITH WATER RUDDER)

General

134. The tail wheel unit (*see* figs. 77 to 79) consists of a wheel housed within a combined tail skid (A) and water rudder (B), an oleo-pneumatic shock absorber leg (C) and a torque tube (D) operating in bearings (E) and (F) mounted on the stern post.

Wheel

135. The tail wheel consists of a forged light alloy inner body (G) to which is bolted an outer manganese steel rim (H), a zinc liner (J) being fitted between the rim and the body of the wheel. At its axle the wheel is bushed on each side by stainless steel collared bushes (K). The wheel axle (L) is a phosphor-bronze tube which is supported by stainless steel collared bushes (M) mounted in the limbs of the shock absorber leg fork end (N). The wheel axle (L) is secured by an axial bolt (O) in conjunction with the tail skid recessed mountings (P).

Tail skid, wheel and water rudder

136. The tail skid (A) is a 14 s.w.g. U-sectioned staybright pressing pin jointed at its forward end to the bottom end of the torque tube (D) (*see* fig. 78). At approximately its mid length the tail skid is pin jointed to the bottom end of the shock absorber leg, recessed mountings (P) secured on the inside of the tail skid walls together with the axial bolt (O) providing means of attachment. On the base of the tail skid, in the region of the wheel, is a rubbing protective plate (Q), whilst welded across the inside of the tail skid are suitable diaphragms which lessen scoop action when a landing is made on soft earth. Aft of the tail wheel a transverse tube is provided for use of the tiller arm.

133. *Emergency indicators.*—Should the indicator system fail to function owing to an electrical fault, it is possible to verify that the wheels are safely down and engaged with the chine locks by examining the "down" indicator circuit switches. Each of these four switches is provided with a nipple which should protrude about $\frac{1}{4}$ in. from the face of the switch remote from the push contact. If one of the nipples be flush instead of protruding, it indicates that the corresponding oleo leg or chine lock is not properly engaged and it is unsafe to alight on land.

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SOLID TYRED TAIL WHEEL UNIT (WITH WATERRUDDER)

General

134. The tail wheel unit (*see* figs. 77 to 79) .....

If stocks of this unit permit, it is to be fitted to all aircraft operating from airfields. Aircraft operating from water may be fitted with the solid-tyred tail wheel unit (*see* para. 134) at the discretion of the Commanding Officer. (A.L.8)

Wheel

135. The tail wheel consists of a forged light alloy inner body (G) to which is bolted an outer manganese steel rim (H), a zinc liner (J) being fitted between the rim and the body of the wheel. At its axle the wheel is bushed on each side by stainless steel collared bushes (K). The wheel axle (L) is a phosphor-bronze tube which is supported by stainless steel collared bushes (M) mounted in the limbs of the shock absorber leg fork end (N). The wheel axle (L) is secured by an axial bolt (O) in conjunction with the tail skid recessed mountings (P)

(47) Para. 135. At the end of this paragraph *add* the following:—

Note.—Alternatively, on aeroplanes incorporating Mod. 251, a pneumatic tail wheel is fitted (*see* Leading Particulars).

(48) Para. 138. At the end of this paragraph *add* the following:—

On aeroplanes incorporating Mod. 251 (Pneumatic tail wheel) the shock-absorber leg is generally similar but of larger diameter and higher pressure than the type fitted with the metal tail wheel; the strut is a Vickers type, Part No. 90792, Sheet 1.

the inside of the tail skid walls together with the axial bolt (O) providing means of attachment. On the base of the tail skid, in the region of the wheel, is a rubbing protective plate (Q), whilst welded across the inside of the tail skid are suitable diaphragms which lessen scoop action when a landing is made on soft earth. Aft of the tail wheel a transverse tube is provided for use of the tiller arm.

137. The water rudder (B) is a stainless steel pressing, the two shaped sides, stiffened by light angles, being welded together at the aft ~~and aft~~ portion of their top edges, and riveted to the tail skid sides at their bottom edges.

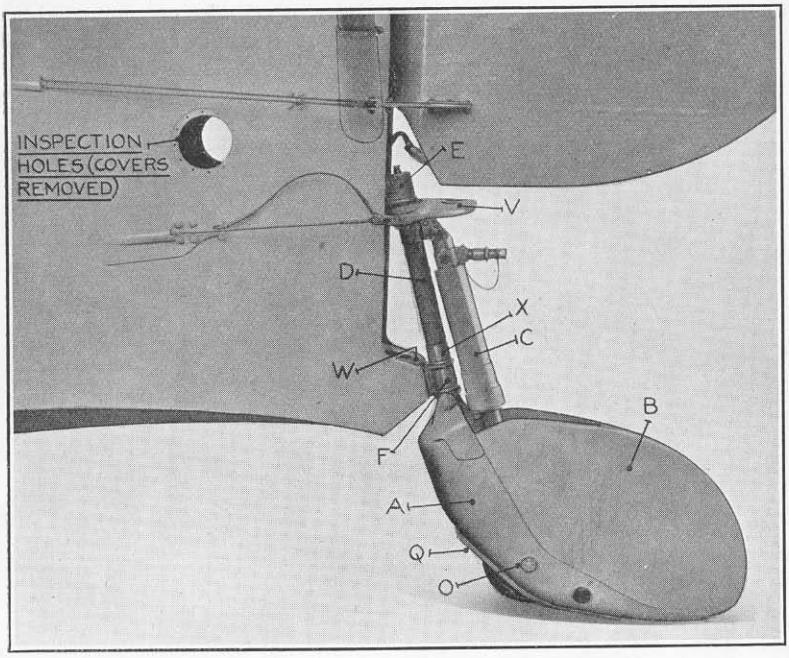

FIG. 78.—Tail skid, wheel and water rudder (fully extended).

Shock absorber leg

138. The shock absorber leg (*see* fig. 79) is oleo-pneumatic, its construction and action being similar to those of the main undercarriage, as described in paras. 100 to 105. The top end of this leg is pin jointed to a lugged collar (R) secured on the top end portion of the torque tube, the bottom forked end being pin jointed to the tail skid as described in para. 136.

Torque tube assembly

139. This assembly comprises a stainless steel torque tube (D), in the top and bottom ends of which are secured bearing plug ends (S) and (T), a lugged tubular fitting (U) providing means of attachment for the shock absorber leg top end, being secured immediately below the top end bearing. A collar is provided on the top bearing plug end (S) to which

the water rudder double-armed operating lever (V) is bolted, whilst the bottom bearing plug end (T) provides means of pin jointed attachment for the forward end of the tail skid.

140. The torque tube bearings (E) and (F) are mounted on the stern post, the bottom bearing (F) being mounted on an outstanding bracket (W) thus inclining the torque tube (D) away from the stern post at its bottom end. The torque tube is located in its bearings by the collar (X) pinned to the torque tube immediately above its bottom bearing.

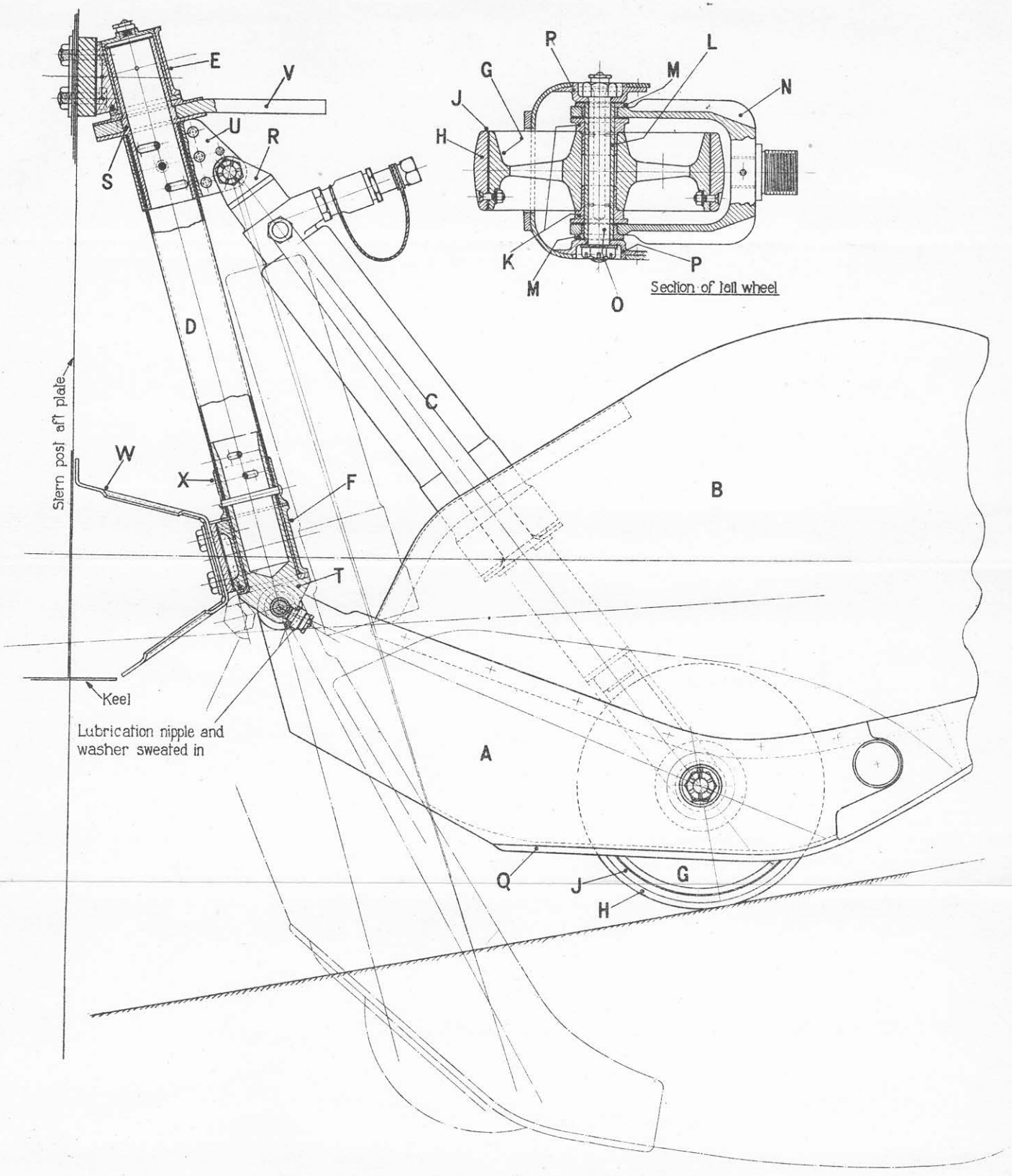

FIG. 77. TAIL WHEEL UNIT AND WATER RUDDER

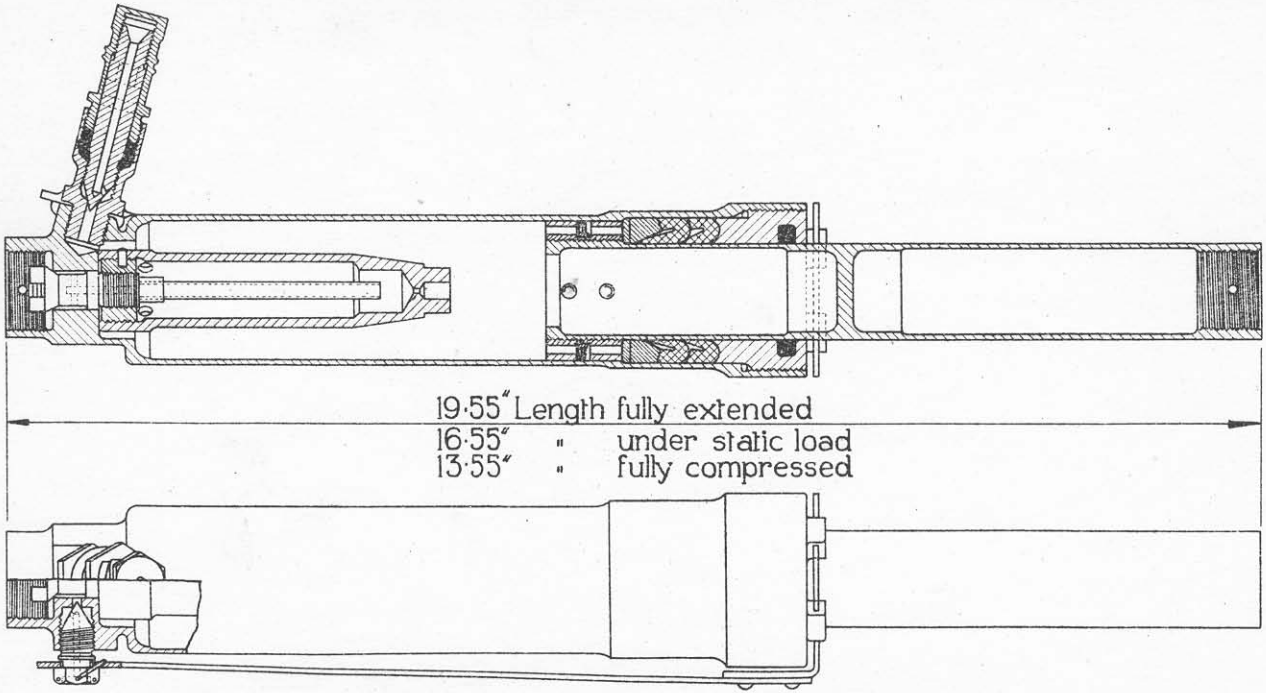

FIG. 79. TAIL WHEEL SHOCK ABSORBER LEG

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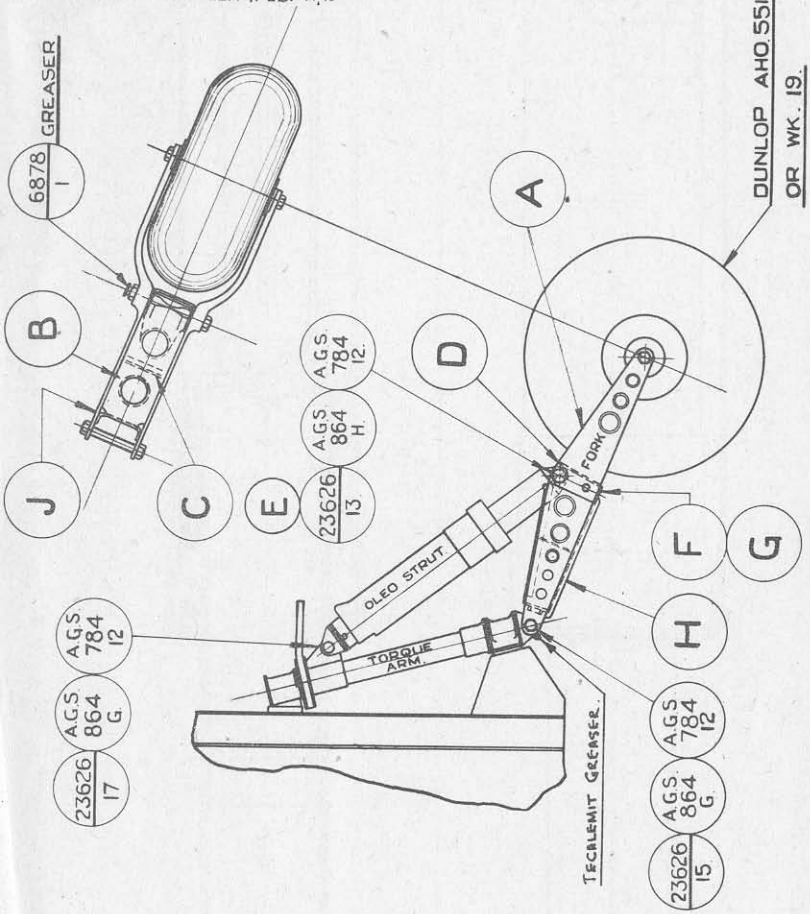


IG. 79A. PNEUMATIC TAIL WHEEL UNIT

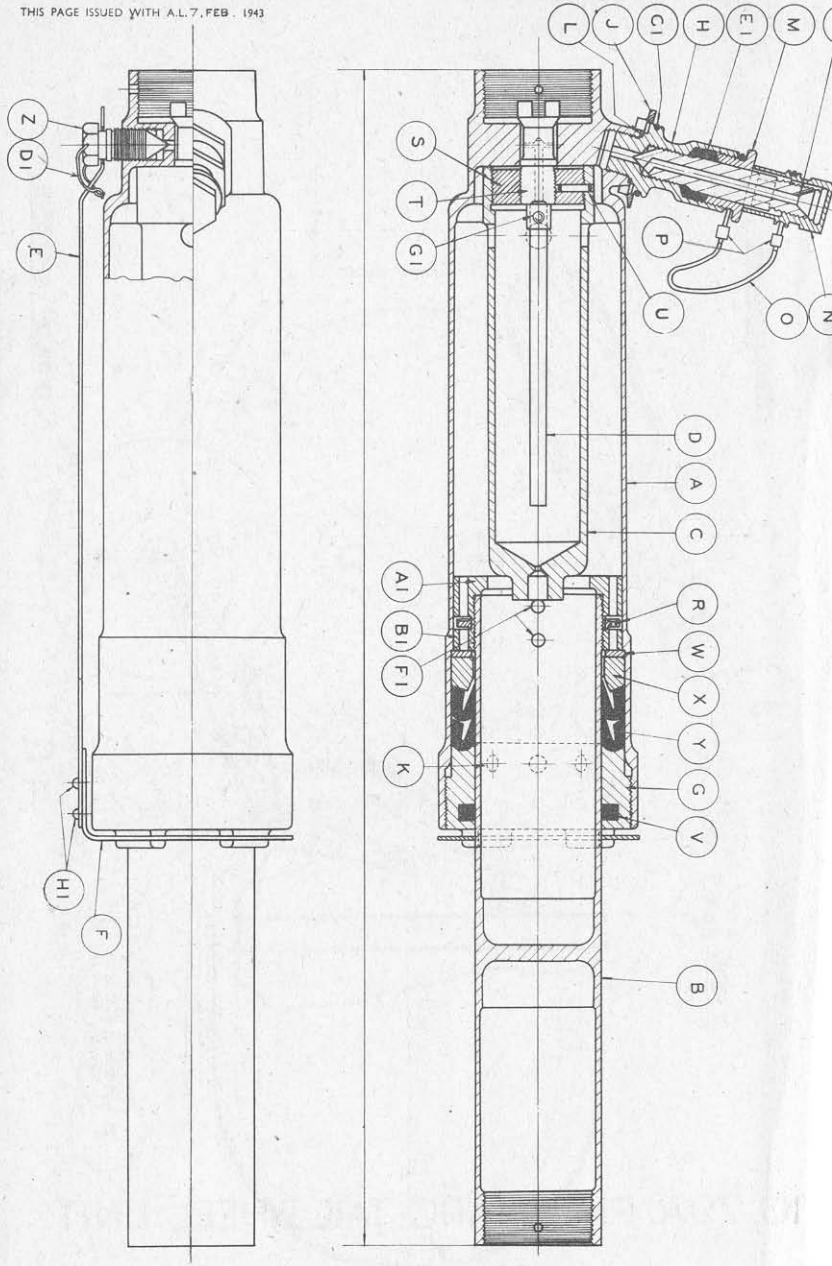
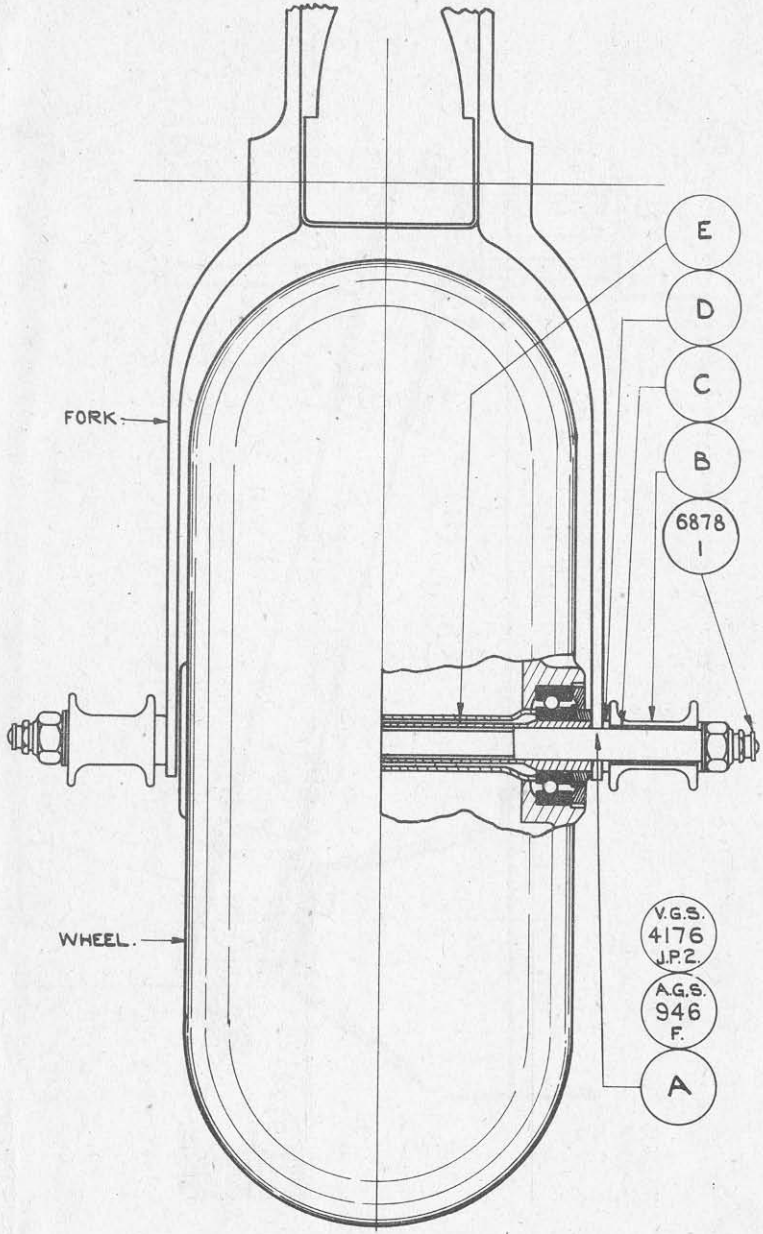


FIG. 79B. PNEUMATIC TAIL WHEEL UNIT
SHOCK-ABSORBER STRUT



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G.79C. PNEUMATIC TAIL WHEEL

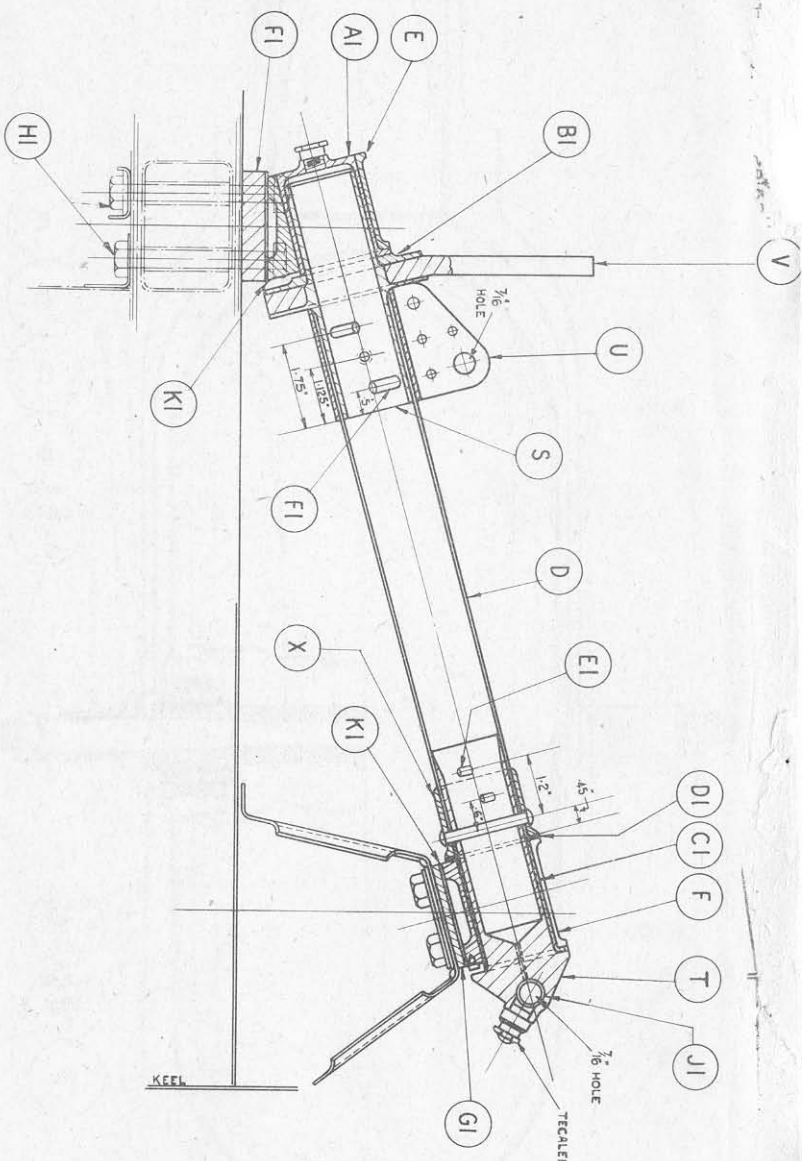


FIG. 79D. TAIL WHEEL UNIT TORQUE TUBE

PNEUMATIC TYRED TAIL WHEEL UNIT

(Land operations only)

General

140A. This tail wheel unit (*see* fig. 79A) is fitted on later aircraft and consists of a pneumatic tyred wheel housed in a fork connected to the bottom of the torque tube. The fork is also connected to the shock-absorber strut (*see* fig. 79B) which in turn is connected to the top of the torque tube. No water rudder is fitted, and aircraft with this unit are not to be used for operations on water. To prevent damage to the controls in the cockpit, the tail wheel steering controls (water rudder controls) must be locked after take-off and released before landing.

Wheel

140B. The mounting of the wheel in the fork is shown in fig. 79C, and the following is a list of the parts:—

Part No.	*Description*	*Fig. Ref.*
23626/87	Spindle	A
23626/89	Flanged sleeve	B
23626/91	Bush	C
23626/93	Bronze washer	D
23626/9	Axle	E

Fork

140C. The fork (*see* fig. 79A) is a built up member which carries the wheel and is connected to both the torque tube and the shock-absorber strut. The following is a list of the parts comprising the fork assembly:—

Part No.	*Description*	*Fig. Ref.*
23626/19–20	Fork	A
23626/21	Centre plate	B
23626/23	Diaphragm middle	C
23626/25	Diaphragm bottom	D
23626/13	Pivot bolt	E
23626/27	Tie bolt	F
23626/29	Distance tube	G
23626/83	Bottom closer	H
23626/85	End diaphragm	J

Torque tube

140D. The torque tube (*see* fig. 79D) is the same as for the solid tyred tail wheel unit (*see* fig. 77) and the following is a list of the parts:—

Part No.	*Description*	*Fig. Ref.*
23626/45	Torque tube	D
22326/135	Top bearing bracket	E
22326/141	Bottom bearing bracket	F
22326/47	Top socket	S
22326/33	Bottom socket	T
22326/55	Lug for oleo	U
22326/59	Lever	V
22326/35	Collar	X
22326/49	Top bush	A1
22326/53	Flange	B1
22326/25	Bush	C1
22326/87	Washer, bronze	D1
22326/137	Top packing	F1
22326/175	Bottom packing	G1
22326/23	Bush for item 33	J1

140E. The procedure for assembly is as follows:—

(i) Assemble collar (X) on lower end of torque tube (D) and fit bush (C) and bottom bearing bracket (F) on bottom socket (T).

(ii) Fit washer (D1) over socket (T) on shoulder of bottom bearing bracket (F) and insert into tube (D). Mark off and drill for three $\frac{3}{16}$ in. taper pins (E1) AGS.859/47, positioned as shown in fig. 79D. Fit taper pins and rivet over.

(iii) Slide the oleo strut lug (U) over the upper end of tube (D) and insert the top socket (S) into tube (D).

(iv) Place the parts thus assembled in jig J.902, thus locating the $\frac{7}{16}$ in. bolt hole in lug (U) and the $\frac{7}{16}$ in. hole in bottom socket (T).

(v) Fit lever (V) and flange (B1) over the top socket (S), and bolt together by seven 2 B.A. bolts, nuts and washers. The lever (V) must now be truly aligned in a fore-and-aft direction. At this stage the movement of torque tube in the bearings should be checked and the washers (D1) filed, if necessary, to obtain smooth and free rotation.

(vi) Mark off and drill for $\frac{3}{16}$ in. taper pins (F1) in upper end of torque tube as shown in fig. 79D. Fit $\frac{3}{16}$ in. taper pins, AGS.859/47, and rivet over.

(vii) Fit top bush (A1) over the top socket (S) and the top bearing bracket (E) over the bush (A1). The torque tube is now ready for mounting on the aircraft where it is attached to the sternpost by four $\frac{5}{16}$ in. bolts (H1) in the top bracket (E) and four in the bottom bracket (F). Duralumin packing blocks (F1) and (G1) are fitted between (E) and (F) and the sternpost, and 28 s.w.g. zinc shims (K1) are fitted between the packing blocks and the bearing brackets. The packing blocks may be filed if necessary to obtain correct alignment. Care must be taken to allow the bearings to work freely and smoothly.

Shock-absorber strut

140F. The shock-absorber strut (*see* fig. 79B) is oleo pneumatic and similar in construction and operation to those of the solid tyred unit and the main undercarriage (*see* para. 100 to 105). The following is a list of the parts of the strut:—

Part No.	*Description*	*Fig. Ref.*
90792/1	Cylinder	A
90792/3	Sustaining ram	B
90792/5	Hydraulic ram	C
90792/7	Oil level tube	D
90792/9	Locking plate	E
90792/11	Safety lock	F
90792/13	Gland nut	G
90792/15	Air valve body	H
90109/15	Locking plate	J
90109/17	Plugs	K for G
28550/511	Joint washer	L
27519/29	Packing nut	M
27519/93	Valve cap	N
27519/115	Securing wire	O
27619/139	Fastener	P for O
5650/30	Valve	Q
A.673/20	Return V Plt.	R
A.675	Hydraulic ram plug	S
A.676/15	Hydraulic ram screw	T
A.677/20	Hydraulic ram pin	U
A.679/20	Gland nut felt ring	V
A.680/20	Buffer ring	W
A.685/20	Gland pack support ring	X
A.686/20	Gland pack ring	Y
A.870/1	Oil level plug	Z
A.1029/20	Sustaining ram head, long	A1
A.1030/20	Sustaining ram head, short	B1
	Locking wire 16 s.w.g.	C1
	Locking wire 18 s.w.g.	D1
	Grease packing	E1
AGS.397/20	Rivets	F1
AGS.167/1	Taper pin	G1
AS.461/420	Rivets $\frac{1}{8}$ in. $\times$ $1\frac{1}{4}$ in.	H1

(7771) Wt. T.16834/2423/M.29517. 1,000. 4/43. P.L.H. & CO. LTD. G.3.

CHAPTER V

FLYING CONTROLS

General

141. The aeroplane is controlled normally from the port side of the pilot's cockpit but may also be controlled from the starboard side when dual control is fitted. The aileron and elevator controls consist of the conventional type of wheel control column, the rudder controls being pedal operated, the water rudder controls being interlocked with those of the air rudder. The elevators are provided with trimmer flaps inset into the trailing edge, the air rudder being fitted with a servo rudder hinged to the trailing edge.

Note.—Items referred to in the text by reference letters are similarly indicated in the illustrations, the numbers of which are given *en bloc* early in the relevant paragraphs. These reference letters are not necessarily indicated in all these illustrations.

Pilot's control Chassis

142. This chassis, on which are mounted the control column and rudder operating pedals and shafts (*see* figs. 80 and 81), is a separate unit of alclad construction and of braced box form, the forward portion being wedge shaped.

Control column

143. The first pilot's control column (F1) (*see* figs. 72, 80 to 84 and 120) is constructed of light alloy tube and is socketed and pinned at its lower end to a tubular T-piece fitting (G1) mounted on the stainless steel transverse rocking shaft (H1). At the top end of the control column is pinned a plug end fitting (J1) which provides at its upper end a housing for the aileron dual control bevel wheels (K1) and (O1) and a branch (P1) pointing to starboard, the branch being internally and externally screwed. Into the internally screwed portion is screwed the dual control extension arm support (L1) at the port end of which is mounted a ball journal (M1). Axially central within this dual control extension arm support is a hollow spindle (N1) the starboard end of which is dogged for engagement with the aileron dual control operating shaft, the port end, on which is mounted the aileron dual control bevel wheel (O1), being supported by the ball journal (M1).

144. In the upper portion of the plug fitting (J1) and supported at its aft end by a ball journal (Q1) is the longitudinal spindle (R1), on the aft end of which is mounted the first pilot's aileron control handwheel (S1), and on the forward end of which is mounted the aileron control upper sprocket

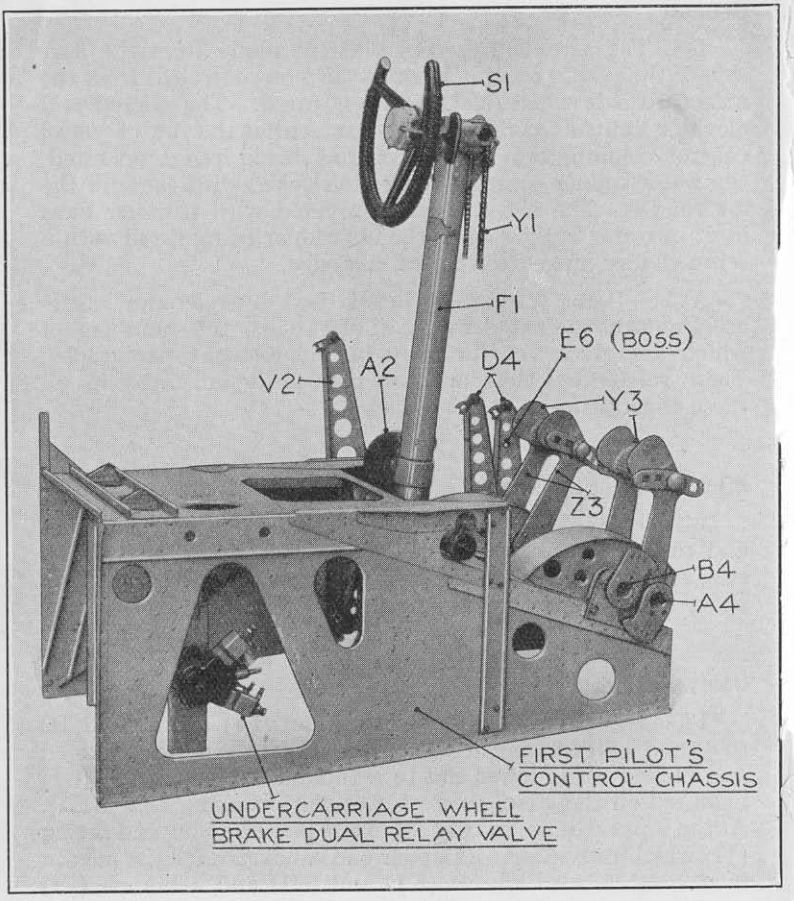


FIG. 80.—Pilot's control chassis (starboard three-quarter rear view).

wheel (T1). On this longitudinal spindle is also mounted the bevel wheel (K1) which engages with the aileron dual control bevel wheel (O1), and axially central with this spindle is the wheel brake actuating rod (V) which is operated by the brake hand levers (U) pivoted one on each side of the first pilot's handwheel (S1).

145. The transverse rocking shaft (H1) is provided with lugged fittings (V1) which are pin jointed to the chassis upper structure. On this rocking shaft, on the port side of the control column, two elevator control levers (V2) and (W2) are mounted, the levers, of lightened H-girder section, being provided at their ends with cable attachment shackles (X1).

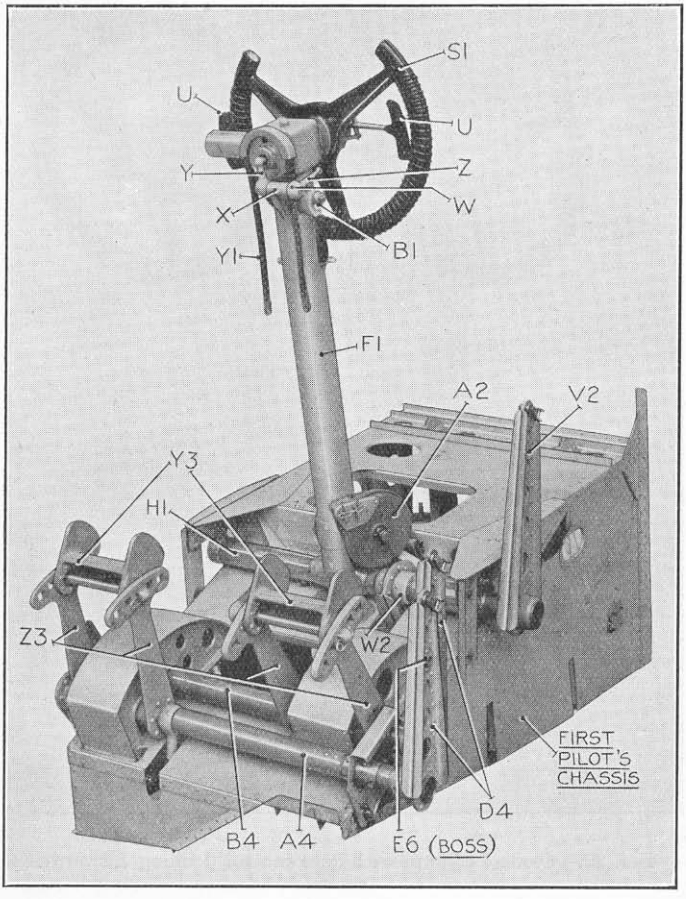


FIG. 81.—Pilot's control chassis (port three-quarter front view).

Aileron control

146. The aileron control system (*see* figs. 33, 39, 81, and 85 to 92) is operated by the control column handwheel (S1) (*see* para. 144), the chain (Y1) engaging the sprocket wheel

(T1) mounted on the forward end of the handwheel spindle, being connected at its ends to the aileron operating cables (Z1) which are single, 20-cwt., and to Specification D.T.D.181A.

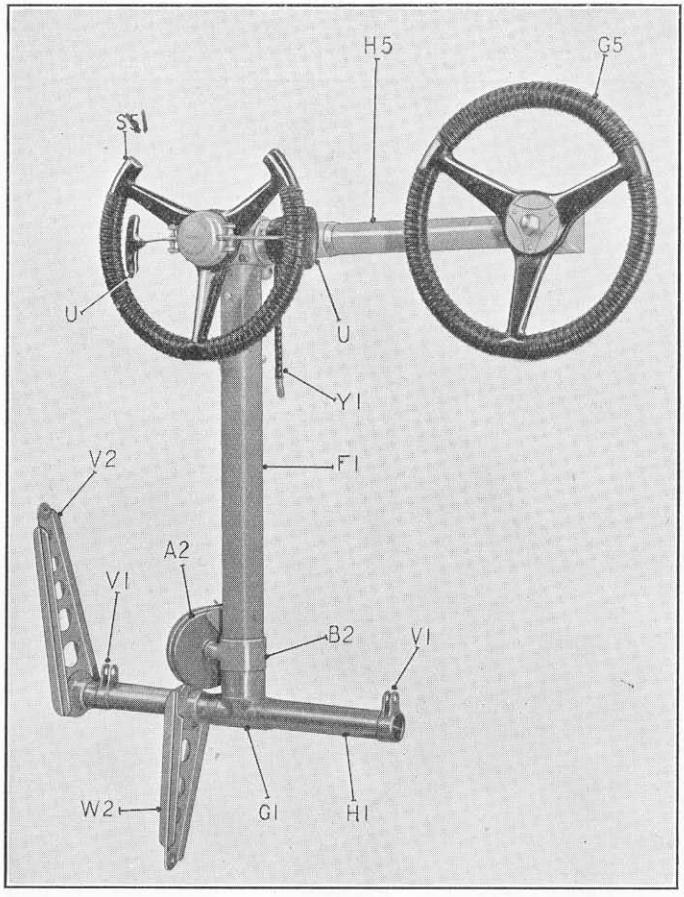


FIG. 82.—Control column with dual control (looking forward).

These cables are led down, inclined to the left of the control column, and passed under grooved double pulleys (A2) mounted on a spindle secured to a light alloy ring bracket (B2) encircling the stem of the T-piece fitting (G1) at the bottom of the control column.

147. From the pulleys (A2) which are set in a vertical plane inclined to the aeroplane longitudinal plane, the aileron control cables (Z1) are led aft and to port, over the double pulley (C2) mounted on the aft side of bulkhead No. 5. From these pulleys the cables run aft along the port side of the hull

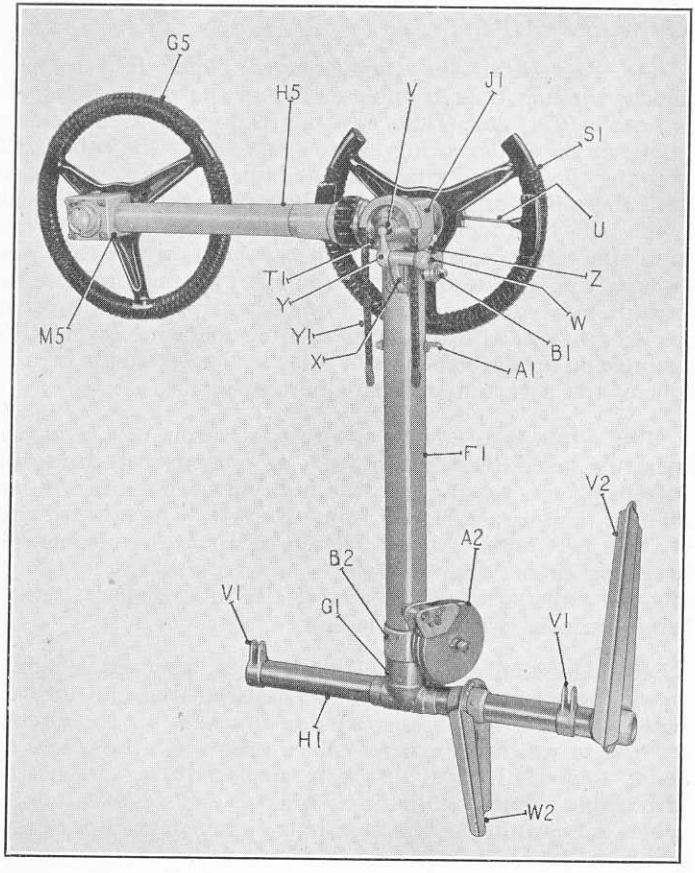


FIG. 83.—Control column with dual control (looking aft).

to two pulleys (D2) and (E2) set approximately vertical and mounted on the aft side of frame No. 11. The cables are then led vertically up to a transversely set three-grooved pulley (F2) and after passing over approximately a quarter of the aft circumferential groove, each is radially led in and secured to the pulley by means of a pin passing through the pulley discs

and the cable thimble end. The cable originating from the end of the starboard portion of the control column aileron control sprocket chain is led to the outboard pulley (D2) and thence to the port side of the three-grooved pulley (F2), the cable originating from the end of the port portion of the control column aileron control sprocket chain being led to the inboard pulley (E2) and thence to the starboard side of the three-grooved pulley (F2).

148. Secured to the three-grooved pulley (F2) by pins passing through their thimble ends and the pulley discs, are two cables (G2) and (H2), the cable (G2) engaging the centre groove of the pulley being led to port, whilst the cable (H2) engaging the forward groove of the pulley is led to starboard. Both these port and starboard cables pass through fairleads in the hull, then along the aft side of the rear spar to points approximately 8 in. from the rear spar joints where they pass through the spar webs to the pulleys (J2) mounted on the forward faces of the spars. From these pulleys the cables are led to the aft arms of the aileron operating levers (K2) mounted on the outboard side of box ribs No. 4 from the inboard ends of the port and starboard bottom planes.

149. From the ends of the forward arms of the aileron operating levers (K2), cables (L2) are led inboard, inside the bottom planes, passing into the hull via fairleads in the hull side, on the forward side of frame No. 11. The inboard ends of these port and starboard aileron cables are interconnected by a short cable (M2), which passes under a centrally positioned grooved pulley (N2), the ends of the interconnecting cable being provided with turnbuckles.

150. Mounted on the hull at the rear spar hinge joints, where the aileron control cables pass from the hull into the bottom planes, are radiused guide brackets on the circumferences of which the control cables wrap when the planes are being folded. Lugged brackets mounted on the bottom plane inboard ends retain the aileron port and starboard control cables, forward of the rear spar hinge joint, in the lips of their guide brackets.

151. The aileron operating levers (K2) in the bottom planes are of alclad construction and of flanged lightened girder section. They are pivoted in vertical bearings (O2) and (P2) bolted respectively to the top and bottom of the mountings (Q2) which are bolted to the outboard faces of box ribs No. 4 (*see* para. 69), the tubular central spindles (R2) of the levers (K2) extending below the bottom edges of the box ribs. On the lower ends of these spindles are secured flanged sleeves (S2) to which are bolted the inboard pointing levers (T2).

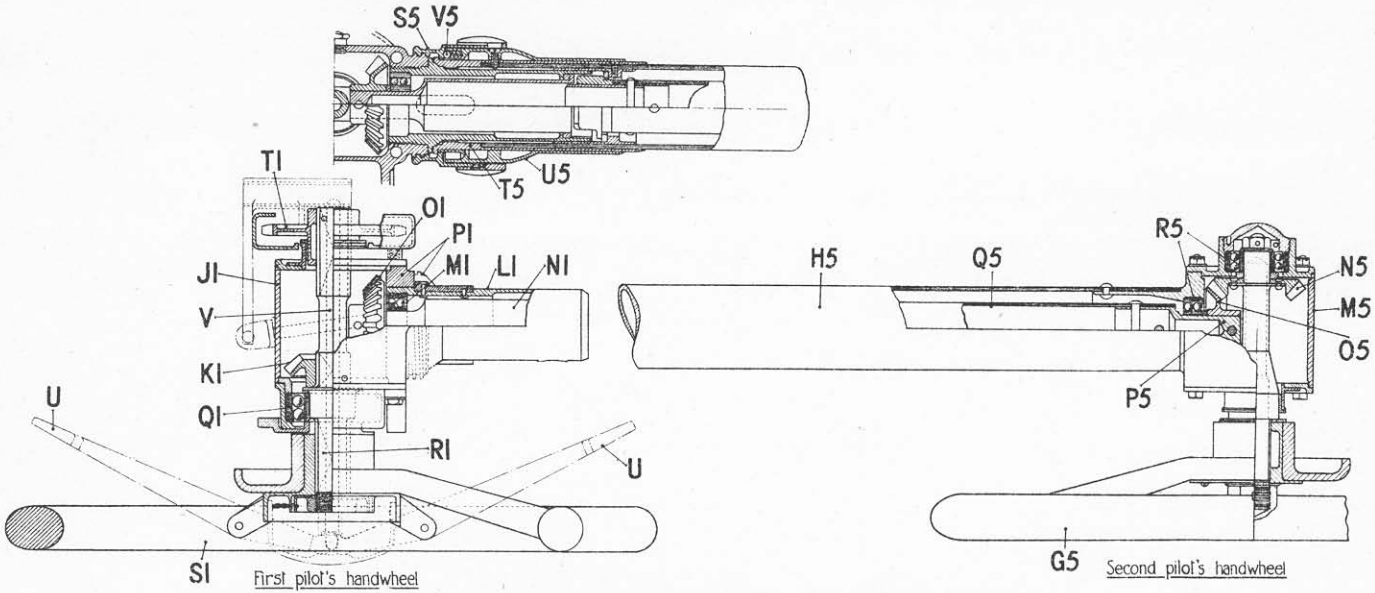


FIG.84. CONTROL HANDWHEELS (FIRST AND SECOND PILOTS')

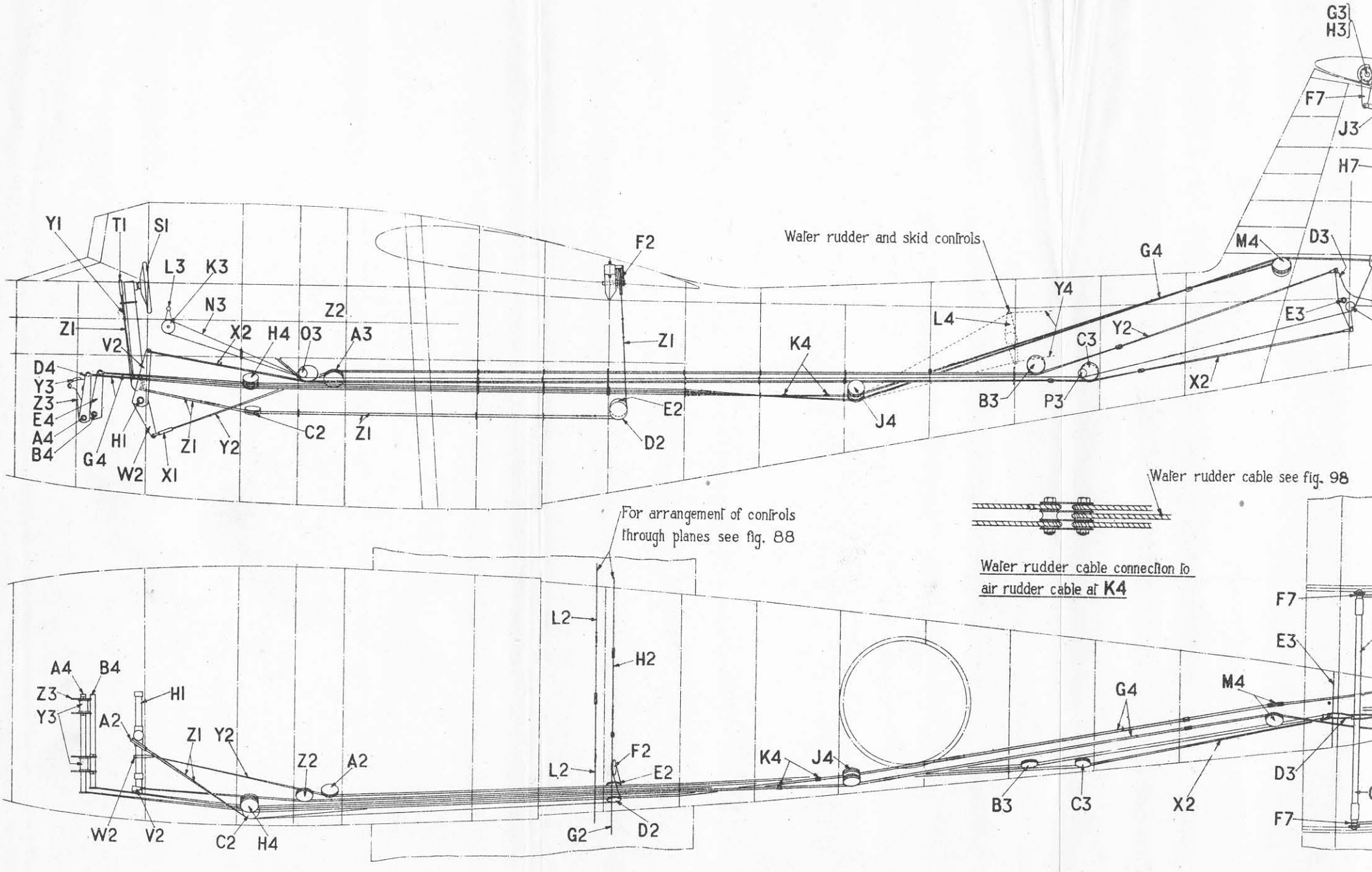


FIG.85. FLYING CONTROLS IN HULL.

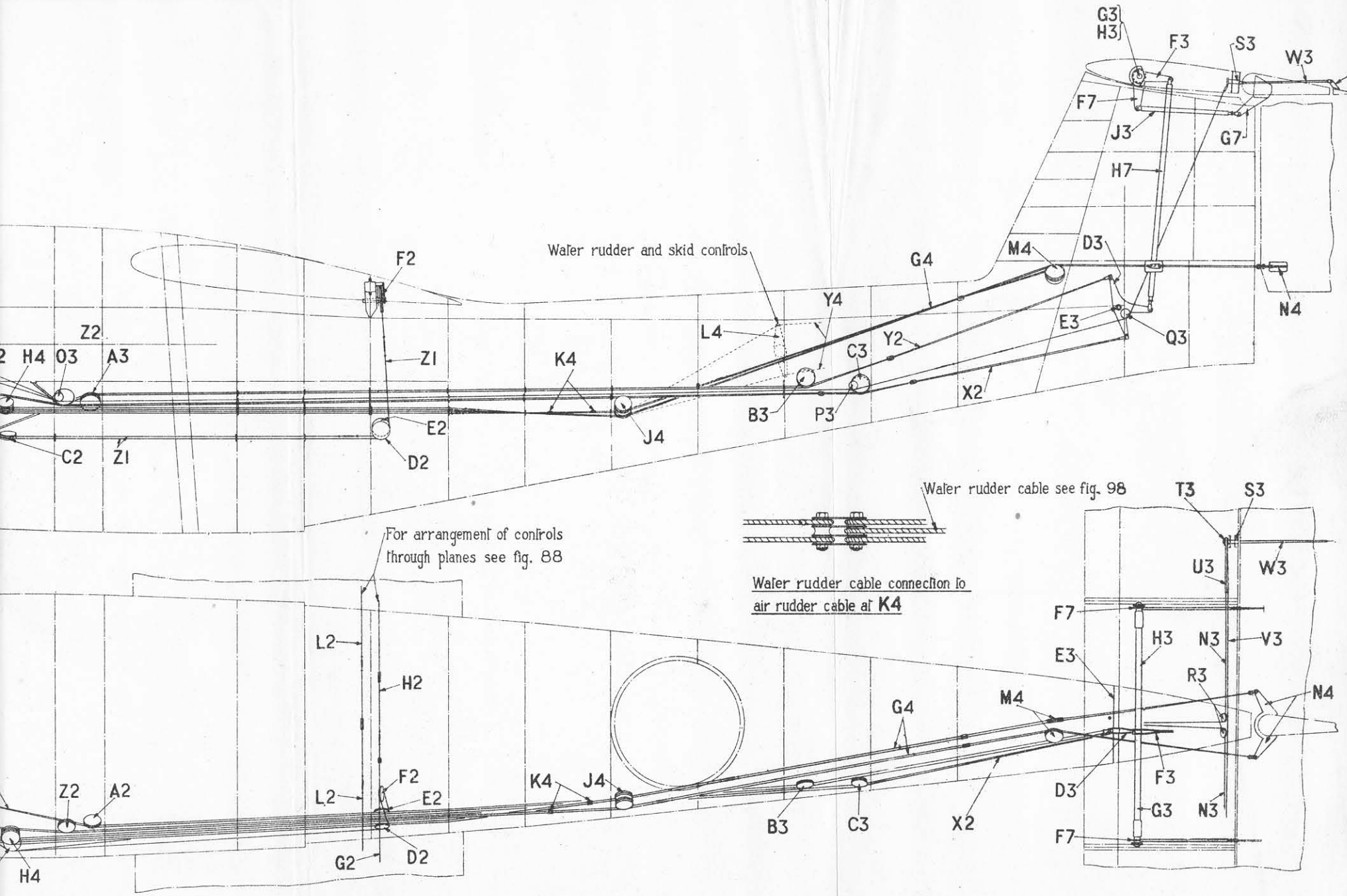


FIG. 85. FLYING CONTROLS IN HULL.

The ends of these levers are connected by the rods (U2) to the levers (E) mounted below the aileron as described in para. 76, the aft ends of these connecting rods being adjustable.

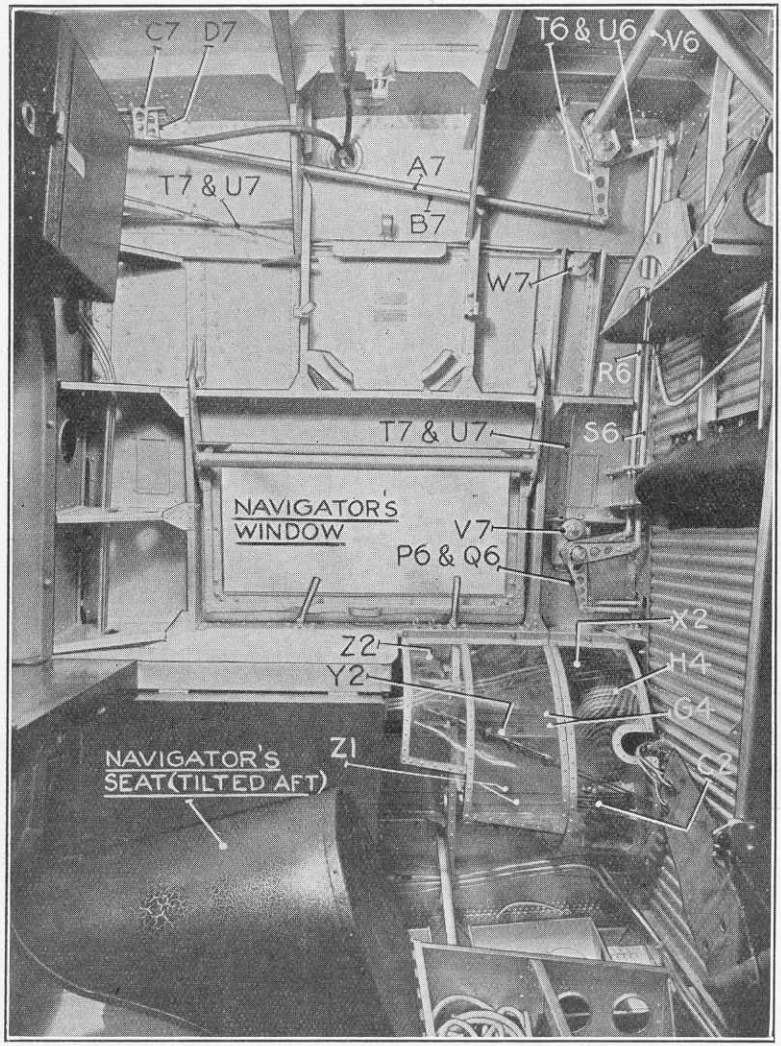


FIG. 86.—Cabin (through starboard window).

152. On each port and starboard side the top and bottom ailerons are interconnected (*see* para. 76) by adjustable-ended tubular rods, the ends of which are pin jointed to the

aileron interconnecting levers (D). These aileron interconnecting rods are positioned immediately aft of the interplane outer struts and housed within the interplane strut fairings.

Elevator control

153. The elevator control system (*see* figs. 49, 81, 82, 85, 86 and 93 to 95) is operated by the fore-and-aft movement of the control column, the maximum movement forward and aft of its neutral position being 20°, this movement being limited

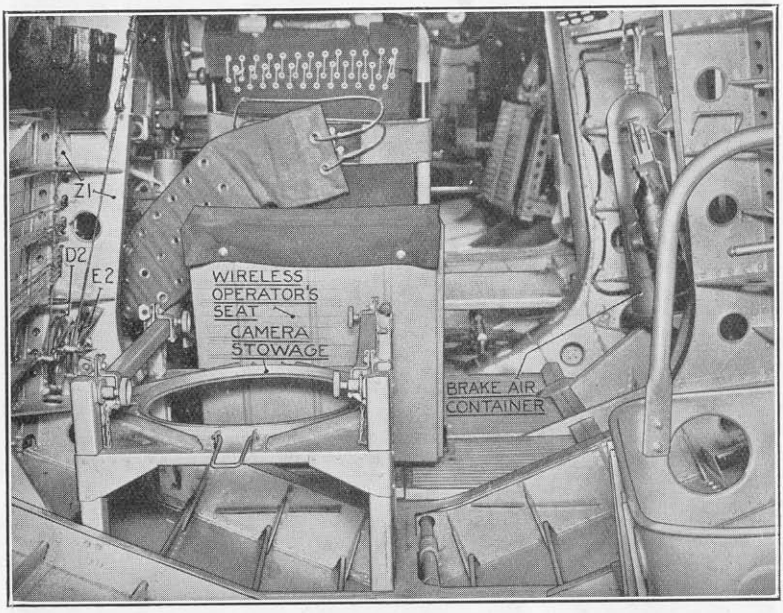


FIG. 87.—Hull interior (looking forward).

by stops, mounted on a bracket on the port side of the hull, engaging the control column transverse shaft upper elevator lever at these extreme positions. The fore-and-aft movement of the control column is transmitted by means of the transverse shaft upper and lower levers (V2) and (W2) respectively, to duplicated cables, 15-cwt., and to Specification D.T.D.181A, the upper cables (X2) being connected to the end of the upper lever (V2) by means of a double-pinned shackle, and the lower cables (Y2) connected to the end of the lower lever (W2) by a similar shackle and a long double link. The elevator upper control cables are provided with turnbuckles, in line transversely with the pilot.

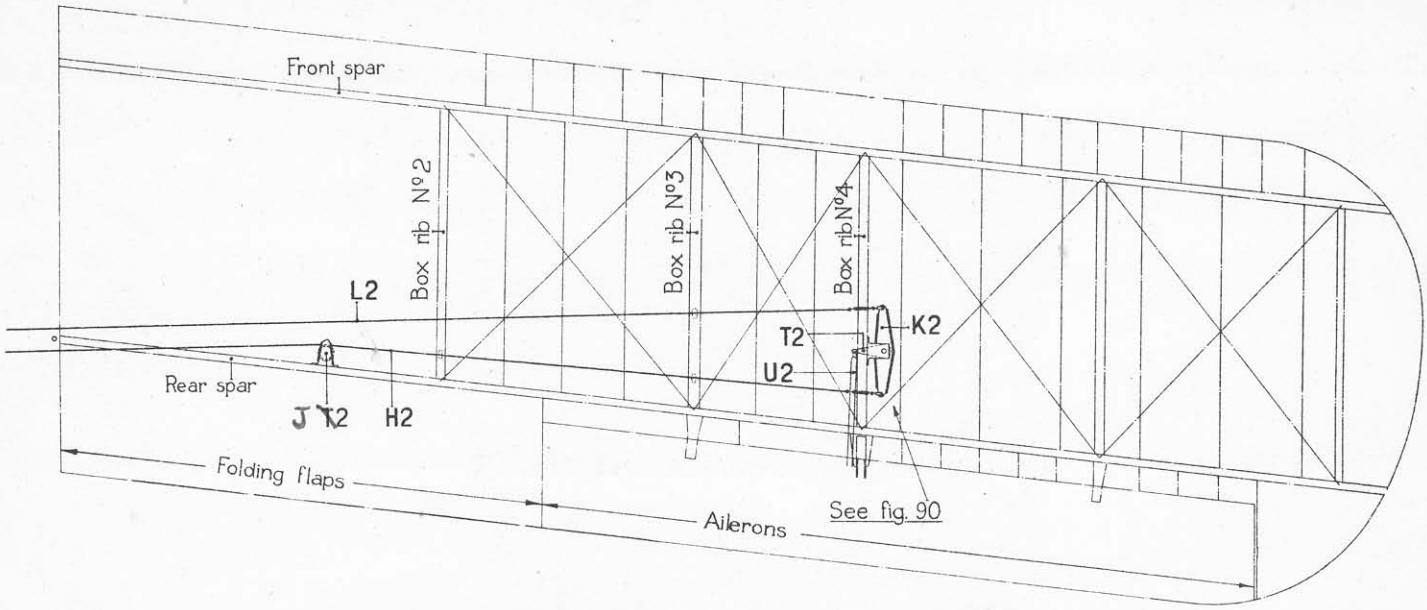


FIG. 88. AILERON CONTROL CABLES IN BOTTOM MAIN PLANES

154. From the transverse shaft levers the control cables run aft to double pulleys (Z2) and (A3) mounted on the port side of the hull, below the cabin window, between frames Nos. 6 and 7, thence through fairleads mounted on the hull frames to pulleys (B3) and (C3) between frames Nos. 16 and 17, the duplicated cables originating from the upper lever (V2) passing under the double pulleys (C3), the duplicated cables originating from the lower lever (W2) passing under the double pulley (B3). From these pulleys the cables are taken direct to the ends of the two vertically-set arms of the three-armed lever (D3) mounted on a transverse shaft (E3) at frame No. 20. To the end of the third arm of lever (D3) is pin jointed a vertical connecting rod (H7), pin jointed at its upper end to the aft pointing lever (F3) which couples the elevator port and

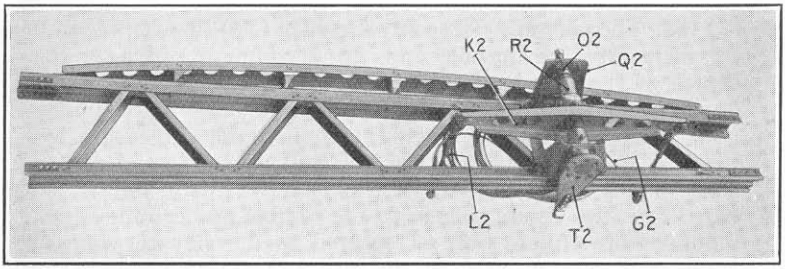


FIG. 89.—Aileron control levers in bottom main plane (port).

starboard transverse operating shafts (G3) and (H3) mounted on the tail plane. The connecting rod is of tubular duralumin construction, a plug end eyepiece fitting being provided at the top end and an internally screwed plug end and screwed eyepiece for pin centre length adjustment purposes, at the bottom end.

155. The elevator transverse operating shafts (G3) and (H3) in the tail plane are of tubular duralumin construction and are fitted with end plugs which provide end bearings and stepped collars, the elevator operating levers (F3) being mounted on the latter. The outboard ends of the shafts are reinforced with external sleeves. Housings for the shaft support bearings are mounted on the tail plane centre and adjacent box ribs, the bearings consisting of stainless steel collars in which are sweated brass bushes. The shafts are axially in line, the centre bearing support being common to the port and starboard shafts, simultaneous movement of the shafts being effected by bolting together the ends of the centre operating levers (F3).

156. The port and starboard end levers (F7) of these shafts are alclad and are interconnected with the levers (G7), also of alclad construction, bolted to the underside of each port and starboard portion of the elevator by the tubular duralumin pin jointed rod (J3), the aft end fitting of which is adjustable.

157. *Elevator trimmer flap control.*—The elevator trimmer flaps (*see* figs. 48, 52, 83, 93, 96 and 120) are controlled by means of the cable drum (K3) to which is secured the operating hand lever (L3). This flap control unit is mounted on the port side of the pilot's cockpit, in line transversely with the pilot's seat. Indication of the attitude of the elevator flaps is given by the pointer (M3), the aft position of which indicates that the flaps are " down," and the forward position that the flaps are " up."

158. The elevator flap control cables (N3), 5-cwt., secured by their forward thimble ends to a common pin near the centre of the drum, are led aft and down through fairleads on the port side of frame No. 5 to the double guide pulley (O3) at frame No. 6. From this pulley the cables are led through a series of fairleads at the hull frames to the double guide pulley (P3) mounted on the forward side of hull frame No. 17 at the chine, thence to the double guide pulley (Q3) mounted on a plate bracket secured to the elevator control transverse fulcrum shaft in the hull at frame No. 20 on the starboard side of lever (D3). Deviating sharply upwards at this point the cables are taken inside the fin to the two transversely set pulleys (R3) mounted on the forward side of the tail plane rear spar, from which the cables run outboard, the cable originating from the top side of the elevator trimmer flap operating drum being led to port, the cable originating from the bottom side of the operating drum being led to starboard.

159. Mounted on the forward face of the tail plane rear spar, on each port and starboard side, at approximately 3 ft. 9 in. from the centre line of the aeroplane is a longitudinal spindle (S3) which is axially operated by means of a sprocket wheel (T3). The end of the bottom portion of the chain (U3) engaging each sprocket wheel is coupled to the end of the corresponding outboard running control cable (N3), the end of the upper portion of each chain being interconnected by a short cable (V3).

160. Connected to the aft end of each of the longitudinal spindles (S3) is a tubular duralumin link (W3) the aft end of which is pin jointed to the operating lever (X3) mounted on the upper side of the corresponding elevator flap.

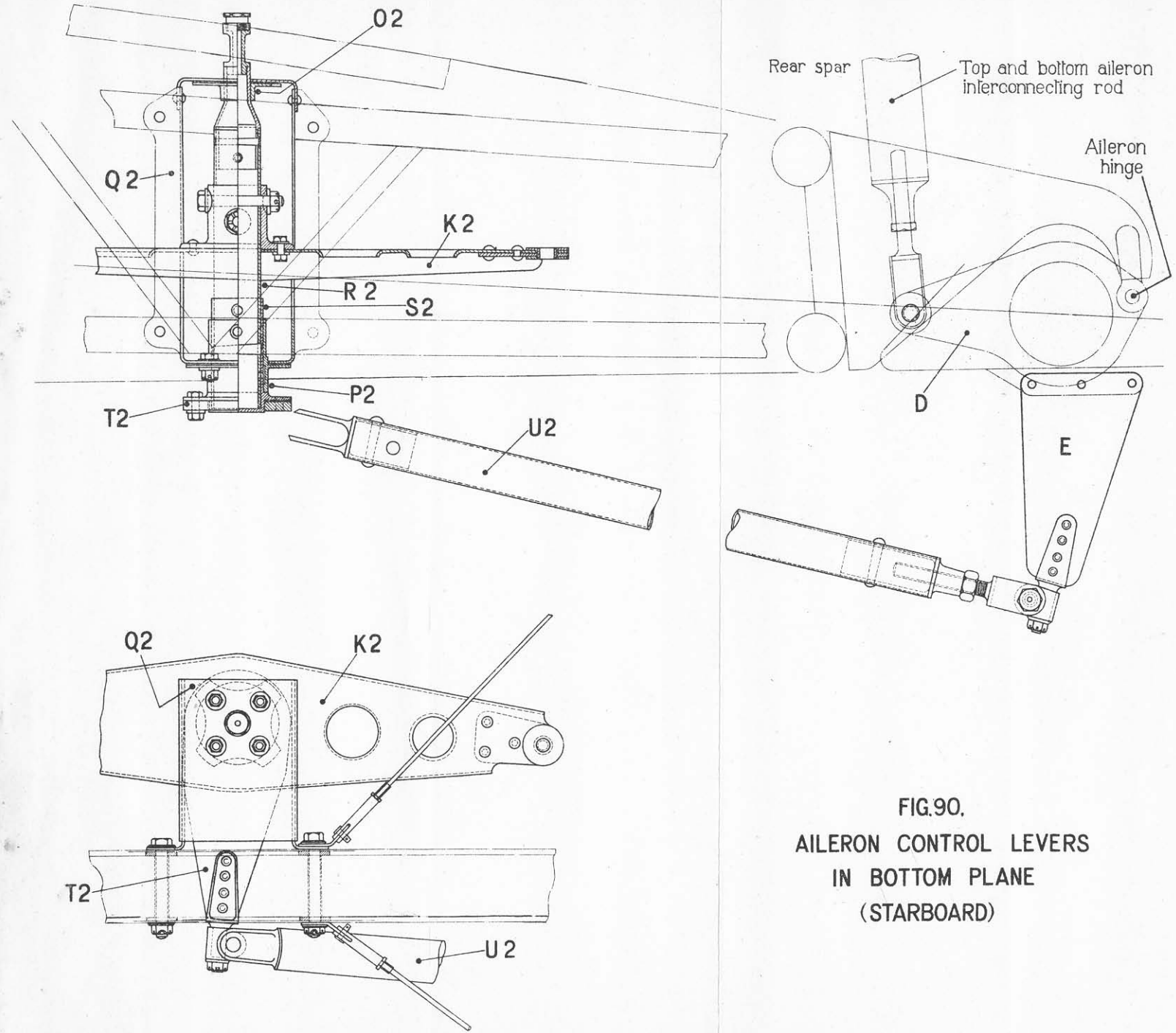


FIG.90.
AILERON CONTROL LEVERS
IN BOTTOM PLANE
(STARBOARD)

161. Additional to the indicator plate behind the elevator flap operating drum and lever is a graduated plate, the graduations representing degrees of elevator flap movement. A movement of $\pm$ 10° of the elevator flap is effected by $\pm \frac{3}{4}$ of a complete rotation of the operating drum.

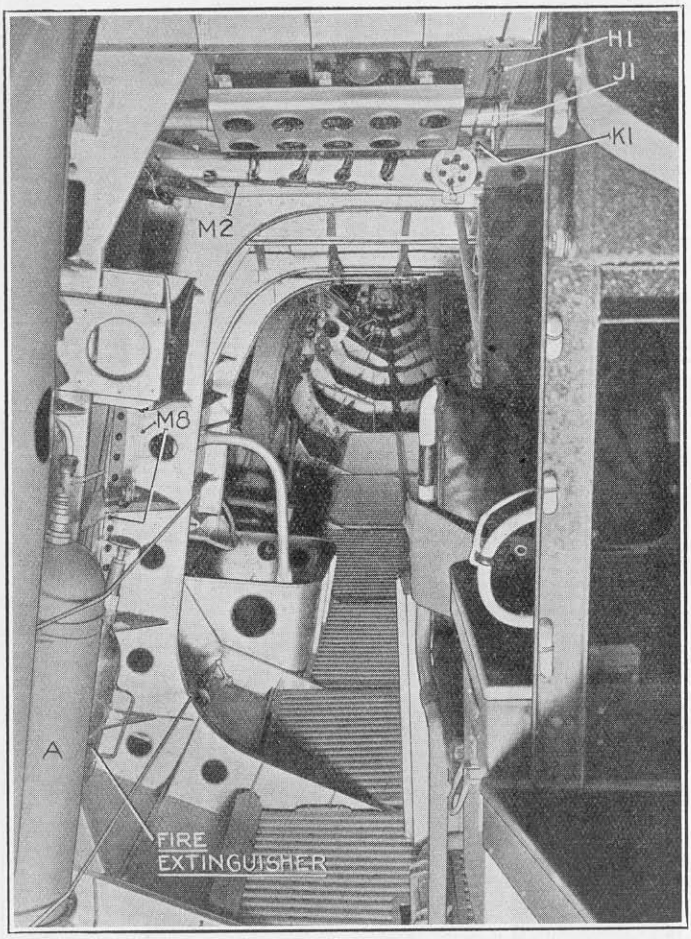


FIG. 91.—Hull interior (looking aft).

Rudder control

162. The aeroplane is fitted with an air rudder, a servo-rudder and a water rudder, as described in paras. 6 and 141 respectively, the water rudder control circuit being designed to allow engagement or disengagement with the air rudder control circuit.

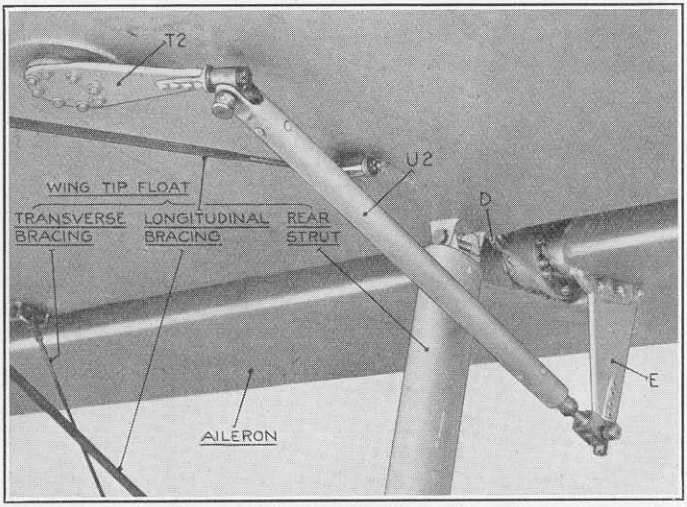


FIG. 92.—Aileron control levers and rod—bottom plane (starboard).

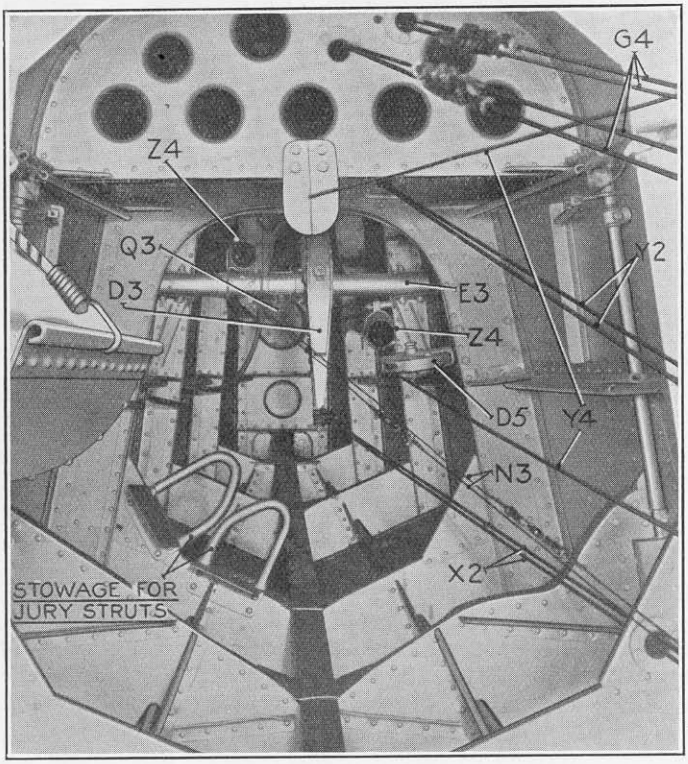


FIG. 93.—Elevator and rudder internal controls at aft end of hull.

163. The air rudder is controlled (*see* figs. 48, 72, 78, 80, 81, 85, 93, 95 and 126) by foot pedals (Y3) each pedal being mounted between the quadrant ends of two levers (Z3) secured to a corresponding transverse shaft (A4) or (B4) at the forward end of the pilot's chassis (*see* para. 142). The pedal lever end quadrants, in each of which are four square holes, allow fore-and-aft adjustment in the positioning of the pedals. Intermeshing toothed quadrants ~~(E4)~~ are mounted on the rudder pedal transverse shafts (A4) and (B4), immediately outboard of the chassis support bearing on the port side, whilst on the starboard end of the transverse shafts are mounted shaped sector plates which provide means of securing the dual control rudder pedal transverse shafts and limit stops, the latter allowing $7\frac{1}{2}$ in. of rudder pedal movement forward and aft of the rudder pedal mid-position. On the starboard rudder pedal transverse shaft is mounted an adjustable ended

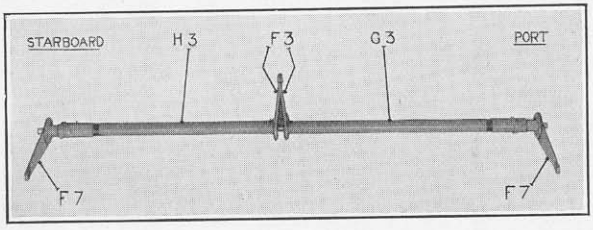


FIG. 94.—Elevator control torque shaft (in tail plane).

lever (C1) which by means of a pin jointed link ~~(D1)~~ operates the undercarriage wheel brake dual relay valve swivel block lever. On the outboard ends of the rudder control transverse shafts (A4) and (B4) are mounted the operating levers (D4) and (E4) respectively, to the ends of which are pin jointed the shackles ~~(F4)~~. From these shackles duplicated cables (G4), which are 15-cwt. and to specification D.T.D. 181A, are led aft to two double pulleys (H4) mounted on the aft side of frame No. 5, then along the port side through fairleads mounted on the hull frames to two three-grooved pulleys (J4) mounted on the aft side of frame No. 14.

164. Between frames Nos. 13 and 14 each rudder control duplicated cable is interrupted by a four plate pin jointed link (K4) a single cable being led from the aft pin joints, between the centre plates, to the corresponding ends of the vertically set water rudder control lever (L4) mounted on the forward side of hull frame No. 16. The duplicated cables are then taken to the double guide pulleys (M4) mounted at the base of the fin, from which point the cables are led

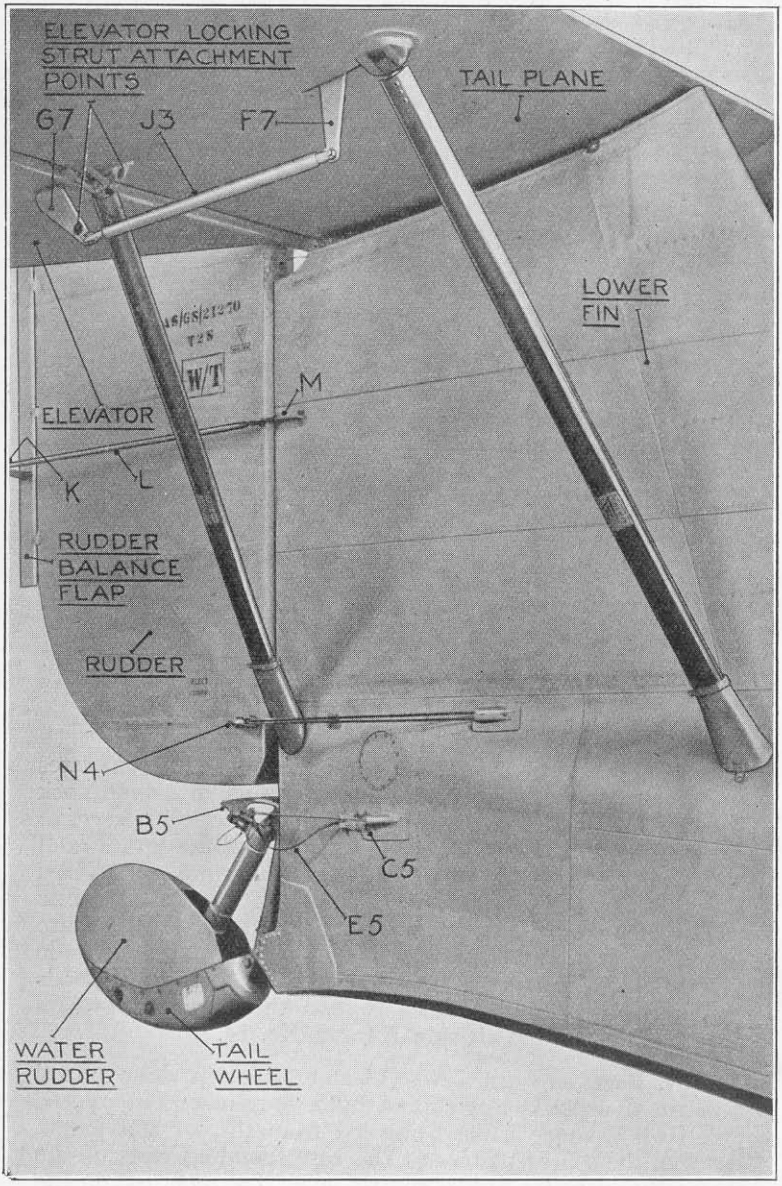


FIG. 95.—Elevator and rudder external controls at aft end of hull.

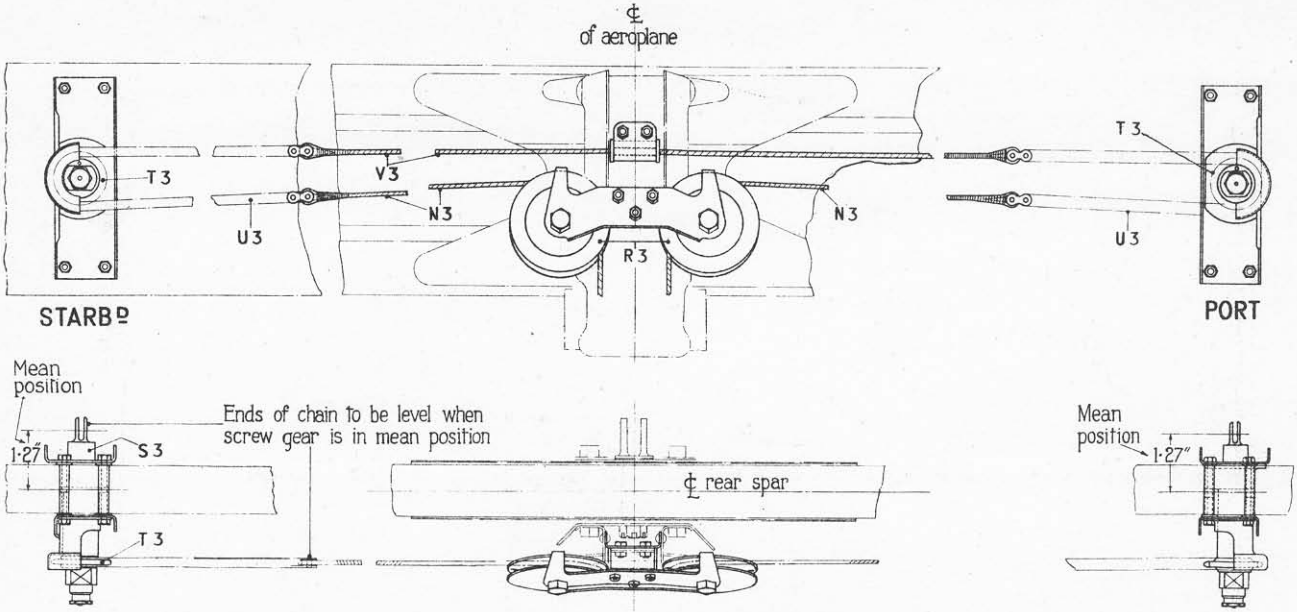


FIG. 96. ELEVATOR FLAP CONTROL (IN TAIL PLANE)

through the hull skin, at the base of the fin, direct to the levers (N4) (also item (G) of fig. 53) mounted on the rudder post. For the servo-rudder control reference should be made to para. 94.

165. *Air and water control interlock.*—The interlocking of levers (L4) and (O4) (*see* figs. 85, 97, and 120) mounted at frame No. 16 is effected by a spring-loaded taper-ended bolt (P4) which is housed within a cylindrical mounting (Q4) secured

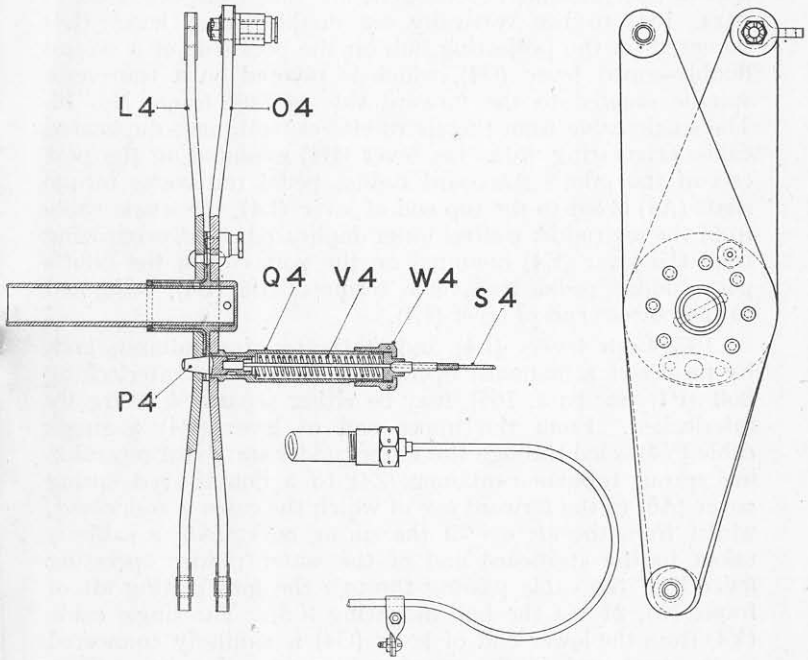


FIG. 97.—Air and water rudder control interlocking gear.

to the inboard lever (O4). The interlocking bolt (P4) which is mounted on lever (O4) and registers in a hole positioned in lever (L4) so as to give the correct lever relative settings, is retained in engagement by the spring (V4), this spring, being retained in its housing (Q4) by the end nut (W4) which also secures the aft end of the bowden casing. To the inboard end of the bolt (P4) is secured a bowden cable (S4) which is led forward in its casing, along the port side, to the water rudder cut-out lever (T4) mounted on the port side between frames Nos. 14 and 15. From this cut-out lever a cable is

taken along the port side of the hull to the actuating lever (U4) mounted on the port side of the pilot's cockpit, in line transversely with the pilot's rudder pedals. Above the actuating lever (U4) an instruction plate is secured with arrows indicating the direction of lever movement for engagement and disengagement of the water rudder.

166. *Water rudder control.*—From the aft pin joint between the centre plates (*see* figs. 4, 93, 95, 98 and 99) of the air rudder control cable links (K4) single cables ~~(X4),~~ which are 15-cwt. and to Specification D.T.D.181A, are taken (as described in para. 164) to the vertically set double-armed lever (L4) mounted on the projecting hub on the port side of a second double-armed lever (O4), which is pivoted on a transverse spindle secured to the forward side of hull frame No. 16. The single cable from the air rudder control inner duplicated cable originating from the lever (D4) mounted on the port end of the pilot's starboard rudder pedal transverse torque shaft (A4) is led to the top end of lever (L4), the single cable from the air rudder control outer duplicated cable, originating from the lever (E4) mounted on the port end of the pilot's port rudder pedal transverse torque shaft (B4), being led to the bottom end of lever (L4).

167. Both levers (L4) and (O4) are of duralumin and, by means of a manually-operated spring-loaded interlocking bolt (P4) (*see* para. 165), may be either separated or rigidly interlocked. From the upper end of lever (O4) a single cable (Y4) is led through the water rudder starboard centralizing spring tubular container (Z4) to a double-eyed spring cover (A5) to the forward eye of which the cable is connected, whilst from the aft eye of the spring cover (A5) a cable is taken to the starboard end of the water rudder operating lever (B5) the cable passing through the hull plating aft of frame No. 21 via the hull mounting (C5). The single cable (Y4) from the lower end of lever (O4) is similarly connected to the port end of the water rudder operating lever (B5), a pulley (D5), mounted inside the hull at frame No. 19, centralizing the cable in its run through the port centralizing spring tubular container (Z4). Aft of the hull mountings (C5) and secured to the hull skin are lugs to which the forward ends of the water rudder check cables (E5) are connected.

168. The water rudder centralizing spring containers (Z4) are supported on the elevator three-armed lever transverse shaft (E3) at frame 20 at their forward ends and bolted to hull stringers at their aft ends. Between the aft plug ends of the containers and the double-eyed spring covers are fitted the compressor springs (F5) which serve to keep the water rudder central when the water rudder operating lever (O4) is freed from the air rudder controls.

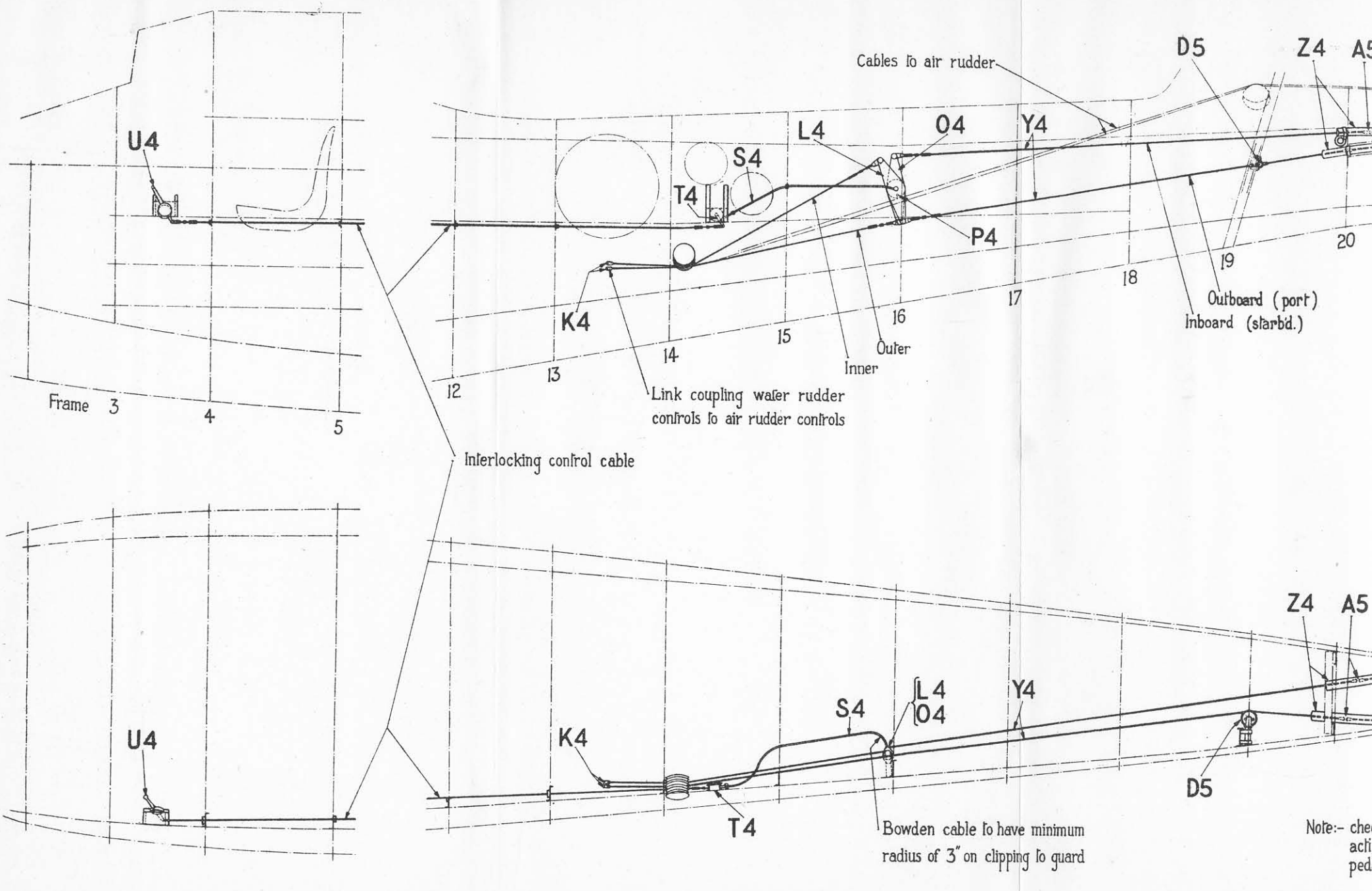


FIG. 98. WATER RUDDER CONTROLS IN HULL

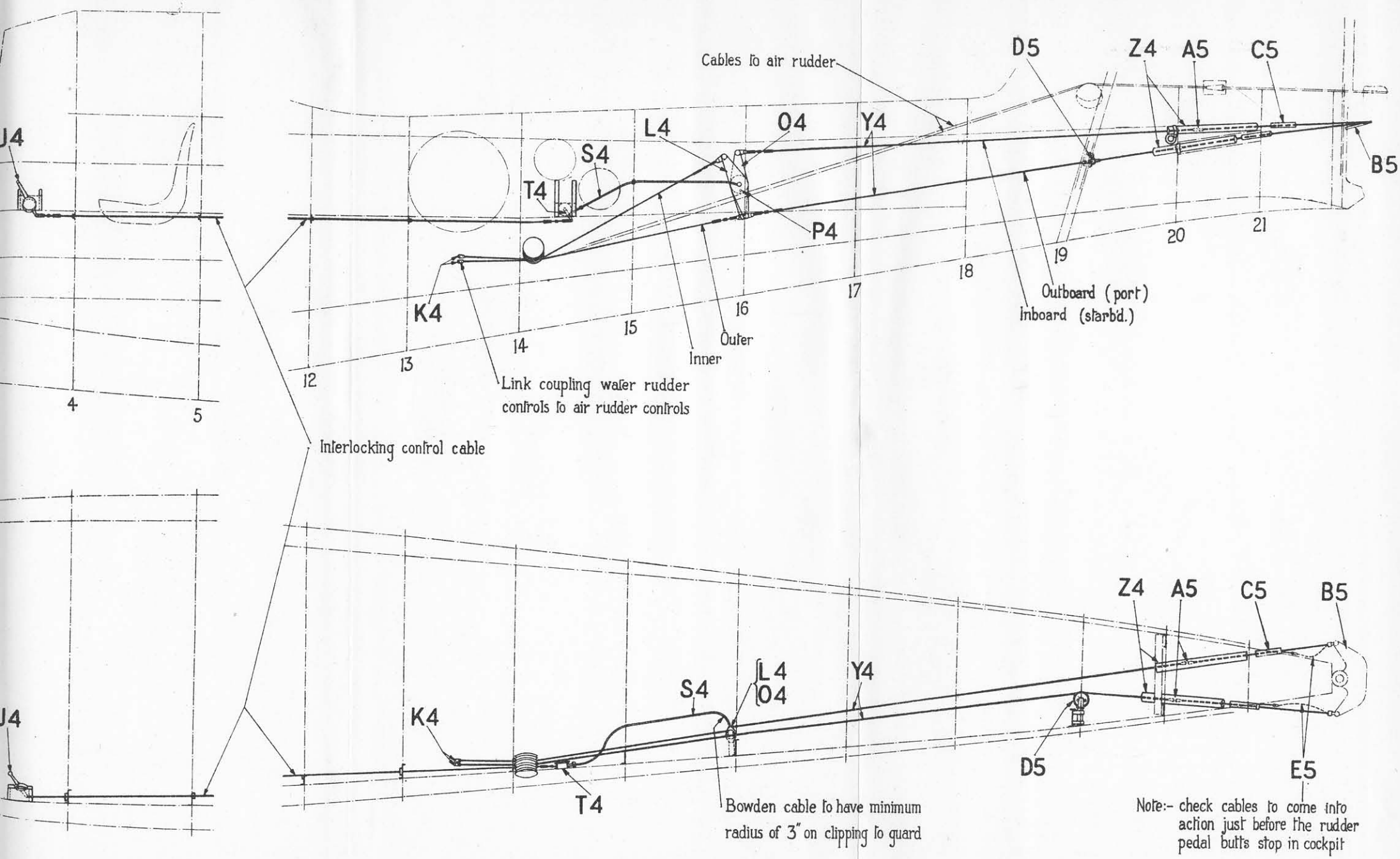


FIG. 98. WATER RUDDER CONTROLS IN HULL

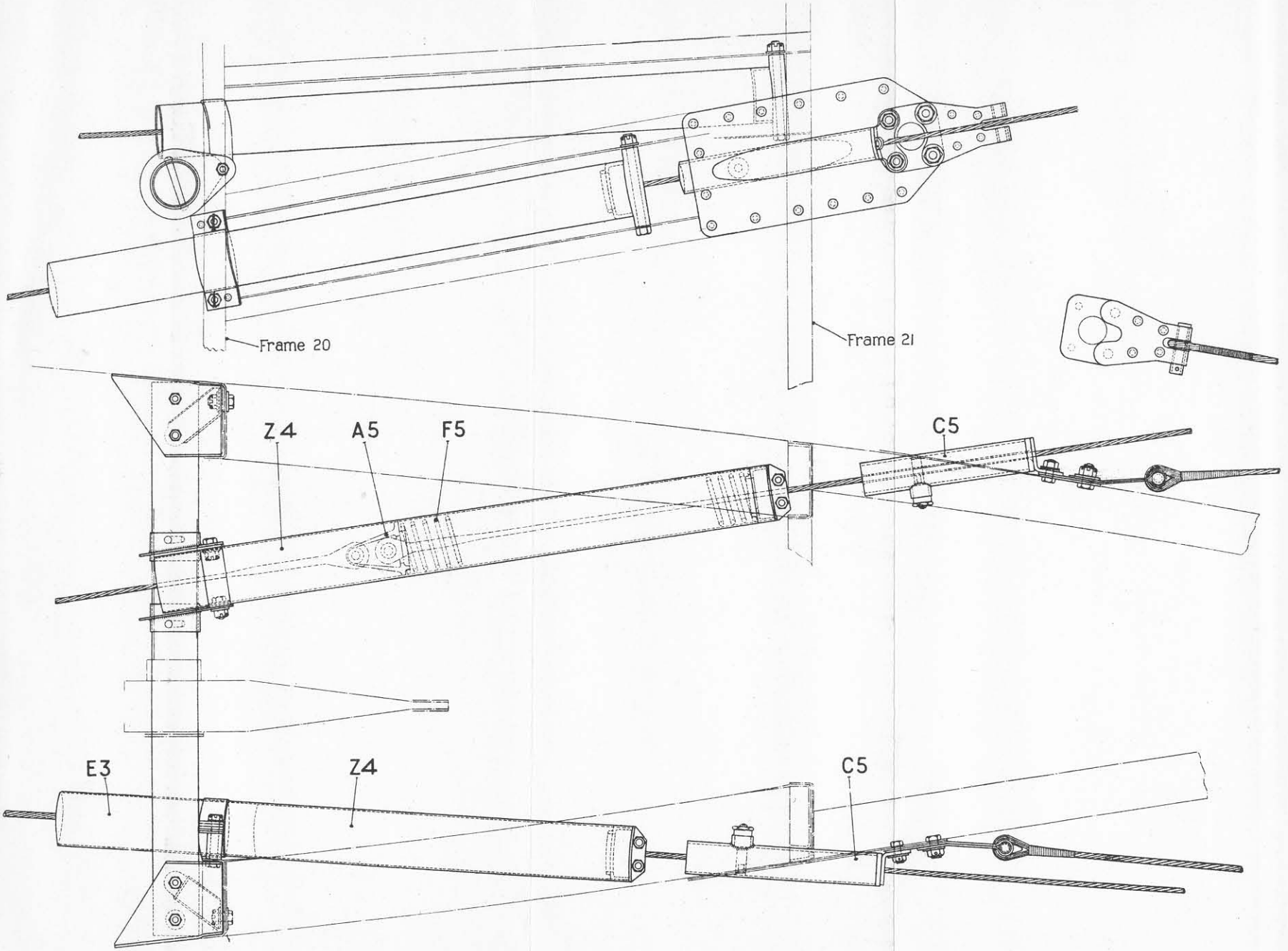


FIG.99. WATER RUDDER CONTROLS (AFT)

Dual control

169. For training purposes dual control is fitted, the second pilot's control handwheel, rudder pedals and rudder control torque shafts being on the starboard side of the cockpit, in line transversely with those of the first pilot. Movements of the second pilot's rudder and elevator controls are transmitted to the first pilot's controls by the direct coupling of the first and second pilot's corresponding rudder torque shaft and handwheel mountings. Movement of the second pilot's

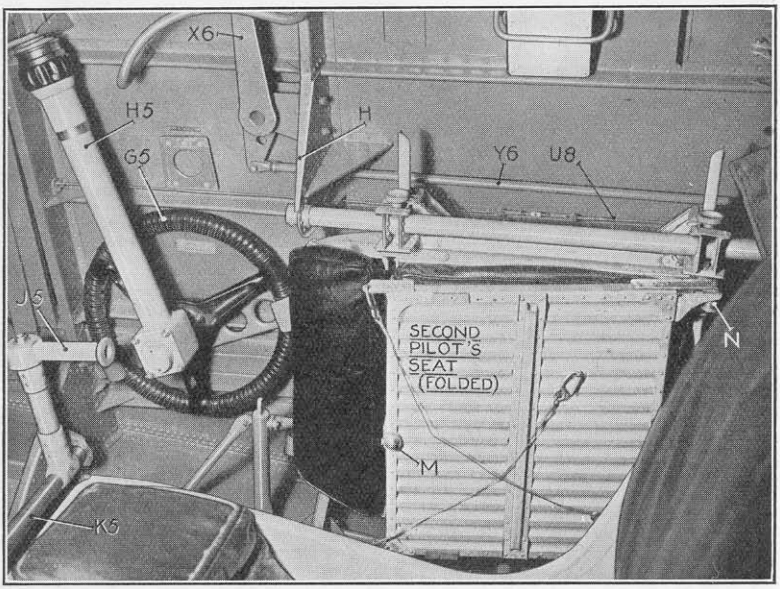


FIG. 100.—Pilot's cockpit (from port window).

aileron control handwheel is transmitted to that of the first pilot by means of bevel gears and a dogged transverse torque shaft operating within the dual control handwheel interconnecting tube.

170. When it is desired to dispense with dual control (*see* figs. 8, 82 to 84, 100 and 126), the second pilot's controls can be removed without structural interference. Easy access to the forward gun station is obtained when the dual control rudder pedals (J5) are in service by rotating the pedals into their longitudinal position as shown in fig. 100. When dual control is removed the second pilot's handwheel (G5) with tubular extension (H5) is stowed on the starboard side of the cockpit as shown also in fig. 100, the second pilot's rudder

pedals (J5) with torque shafts being stowed on the starboard side of the hull, forward of frame No. 3, as shown in fig. 126. The assembly of the dual control handwheel (G5), interconnecting tube (H5), rudder pedals (J5) and starboard rudder pedal transverse torque shaft (K5), together with the second pilot's seat (folded) is shown in figs. 100 and 101.

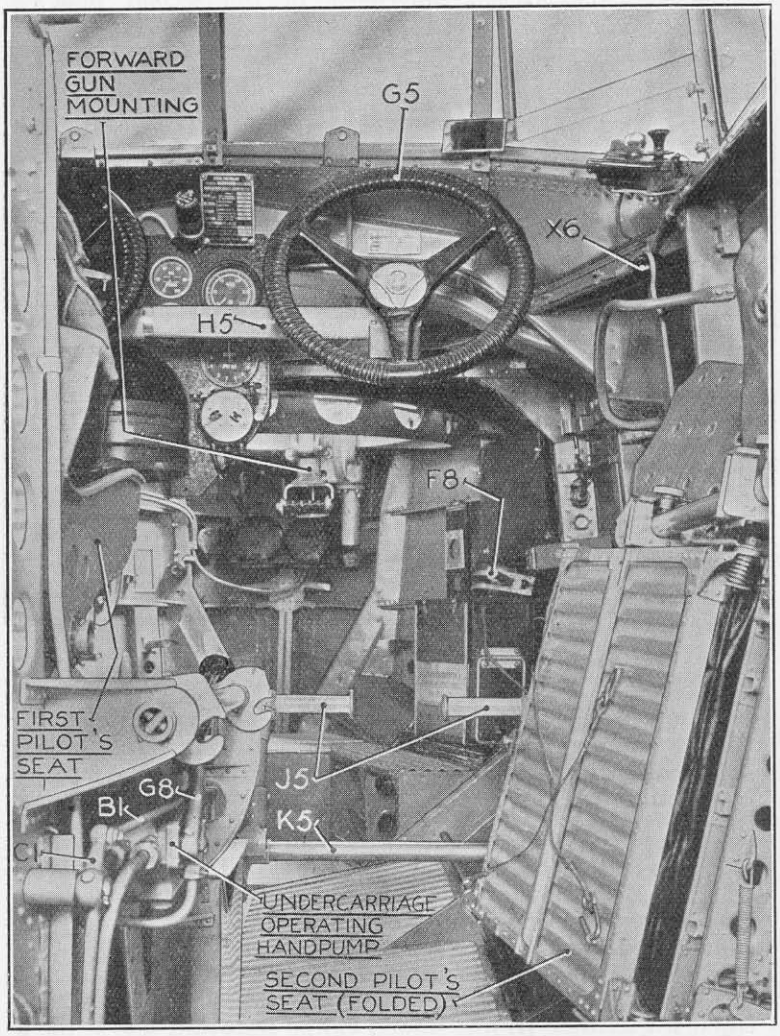


FIG. 101.—Pilot's cockpit (showing dual control).

171. *Handwheel and interconnecting tube.*—The second pilot's handwheel spindle (~~L5~~) (*see* figs. 82 to 84) is supported by the fore-and-aft end covers of the interconnecting tube starboard end boxed fittings (M5). The bevel wheel (N5) mounted at the forward end of the handwheel spindle engages a second bevel wheel (O5) mounted on the plug end spindle (P5) of the torque tube (Q5) positioned axially central within the interconnecting tube (H5), both bevel wheels being supported by self aligning ball bearings (R5). When coupled to the first pilot's control column handwheel mounting, the torque tube (Q5) engages the dogged starboard end of a second torque tube (N1) positioned axially central within the extension supporting arm (L1) (*see* para. 143), thus providing means of transmission of movement of the second pilot's handwheel to the first pilot's handwheel which is connected by bevel wheels (K1) and (O1) to the port end of the torque shaft (N1).

172. The interconnecting tube, $1\frac{3}{4}$ in. o/d by 17 s.w.g. and of duralumin construction, is coupled by a square threaded nut (S5) to the first pilot's control column handwheel mounting (J1). On the port end of the interconnecting tube is mounted a collared sleeve (T5) over which the nut (S5) is threaded. Superimposed over the sleeve (T5) is a second sleeve (U5) which is threaded between the rim of the aft portion of the nut (S5) and the sleeve (T5) to which it is rigidly secured by a setscrew, the setscrew also securing the sleeve (T5) to the end of the interconnecting tube. Recesses drilled axially parallel in the internally collared end of the outer sleeve (U5) house spring-loaded balls (V5) which engage in corresponding recesses in the internal collar integral with the nut (S5), thus providing means of automatic locking of the dual control extension arm with the first pilot's control column handwheel mounting.

173. *Rudder pedals.*—The second pilot's rudder pedals (J5) are of inverted L-form, (*see* fig. 100) both pedals being free to be swung back into longitudinal positions when desired. Each pedal is mounted at the upper end of a tubular lever, the lower end of the starboard pedal lever being secured by a tubular T-piece to the starboard end of a transverse torque shaft (K5). At the port end of this torque shaft, a portion of the shaft end protruding, is mounted a flanged collar integral with which is a plate lever with a stud rigidly secured at its end, the stud being provided with a knurled nut. The starboard end of the starboard pedal torque shaft is first entered into its plate support (~~Y5~~) then the protruding port end is socketed into the inboard end of the first pilot's starboard pedal transverse torque shaft (A4), the flanged collars abutting, the stud engaging one of the three holes in the plate lever at the

end of the first pilot's starboard pedal transverse torque shaft. The interlocking of the first and second pilot's starboard pedal torque shafts is secured by the knurled nut. The second pilot's port pedal lever is similarly mounted to the first pilot's port pedal transverse torque shaft (B4), the flanged collar being integral with the port pedal lever lower fitting.

174. *Foot rest.*—Provision is made in the second pilot's position for a foot rest which is pin jointed to a mounting on the starboard side of the cockpit and supported at its inboard end by a U-shaped fitting mounted on the starboard side of the pilot's chassis.

Locking of flying controls

175. *Control column and aileron handwheel.*—The first pilot's control column and aileron handwheel are locked simultaneously (*see* figs. 102 and 120) by a tubular strut (Z5) which is pin jointed to a universal joint (A6) connected to the top of the instrument panel. In its stowed position this strut is vertical, the screw (B6) pin jointed to a universal joint (C6) at the bottom end of the strut being screwed into the mounting provided at the bottom of the instrument panel. When in use, the strut, pivoted at its top end, is raised to the horizontal position, the screw previously securing the strut in its stowed position being screwed into a boss (D6) on the aft side of the aileron sprocket wheel guard, the sprocket wheel first being centralized to allow entry of the screw through the hole in the sprocket wheel disc (T1).

176. *Rudder levers.*—The rudder pedals are locked in the mid position (*see* figs. 81 and 120) by means of a plain ended winged screw which is screwed through a boss (E6) on the lever (D4) on the port end of the first pilot's starboard rudder pedal transverse torque shaft, engaging a corresponding hole in a plate bracket mounted on the port side of the hull. When stowed this winged screw is screwed into a boss secured to a plate bracket (F6) mounted on hull frame No. 3.

Locking of aerofoils

177. *Ailerons.*—With the planes spread the ailerons are locked in their normal position, but with the planes folded both the ailerons are locked in their 15° up position which is automatically taken up when the planes are being folded. It is essential therefore to free the ailerons if they are locked in their normal position before attempting to fold the planes. The ailerons are locked as shown in fig. 40, section A. At the bottom of the rear outer interplane strut fairings is a reinforcing plate painted vermillion, in which are provided three holes. Through either the top (when the planes are spread)

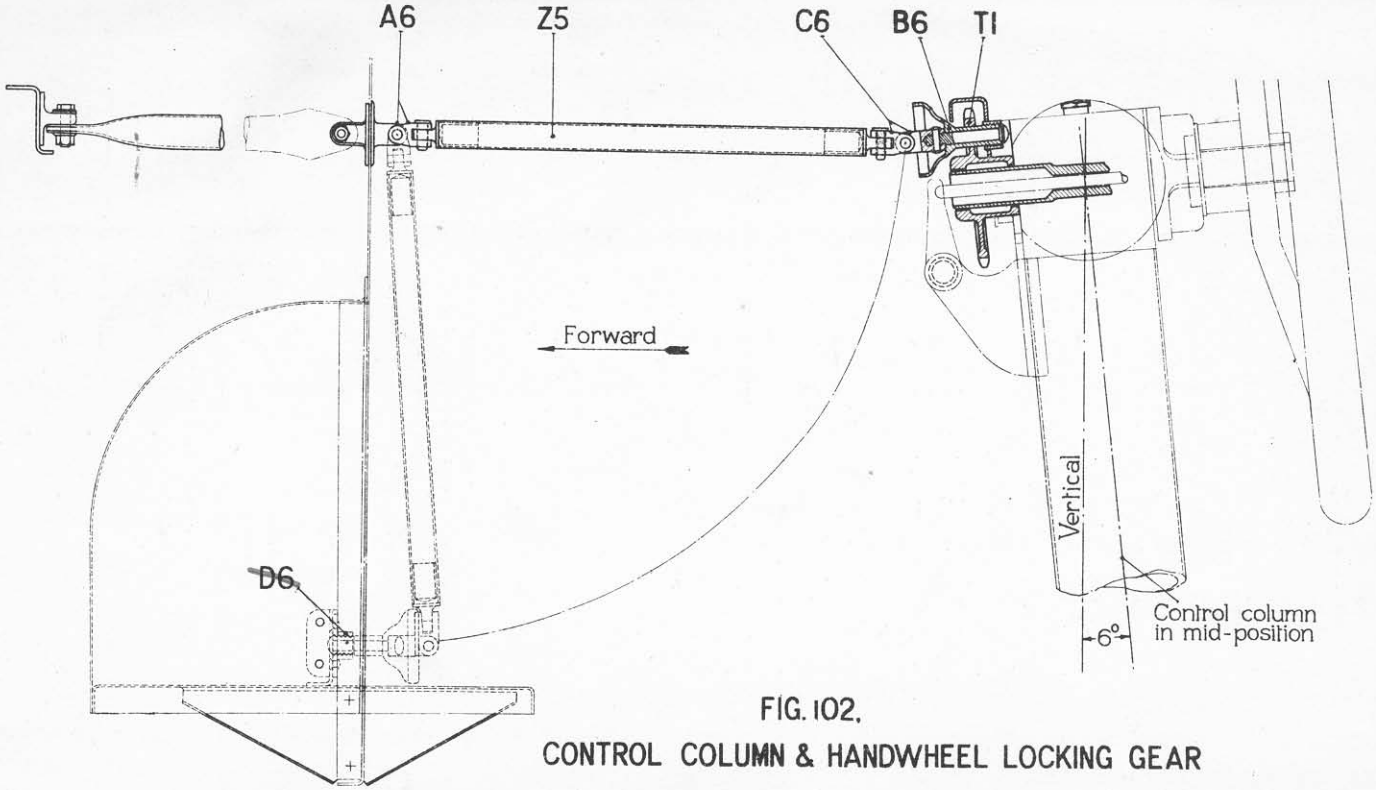


FIG. 102.

CONTROL COLUMN & HANDWHEEL LOCKING GEAR

or bottom (when the planes are folded) of these holes an inserted pin locks the aileron control vertical interconnecting rods to the strut fairings. The locking pin is stowed in the ~~forward~~ hole.

178. *Elevators.*—The elevators are locked as shown in fig. 40, ~~section B~~. The locking strut shown rigidly connects a lugged eyed bracket on the underside of the tail plane, to the elevator operating lever. The locking strut, lugged-eyed bracket and attachment point on the elevator lever are painted vermillion.

179. *Rudder.*—The air rudder is locked similarly as described in para. 178, and shown in fig. 40, ~~section C~~. A locking device is also provided at the top of the fin and forward end of the rudder horn portion.

180. The bottom plane folding flaps are locked in their folded position as shown in fig. 44, the locking struts ~~(A),~~ and method of locking being similar to those as described for the elevator and rudder in paras. 178 and 179.

CHAPTER VI

ENGINE INSTALLATION

General

181. The power unit consists of a Pegasus II.M.2. or Pegasus VI engine mounted on the aft end of a barrelled nacelle positioned between the top centre plane and the hull deck.

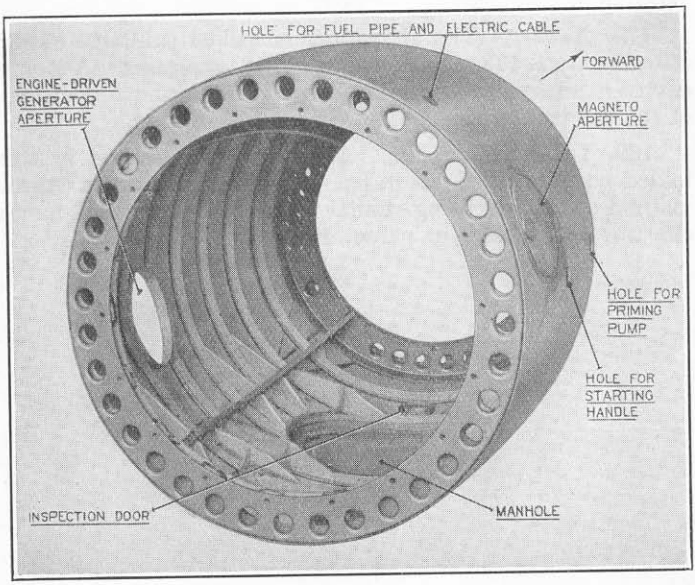


FIG. 103.—Engine mounting.

182. Both these types of engines are nine cylinder, air-cooled, radial engines, fitted with hand-energized inertia starter, the Pegasus II.M.2 being also fitted with a gas starter. Both types of engine are equipped with a 500-watt engine-driven generator, the respective r.p.m. of which for the Pegasus II.M.2 and the Pegasus VI are 2·5 and 2·353 times that of the engine, the respective normal setting of the automatic boost control being zero lb. per sq. in. and + 2 lb. per sq. in.

183. Two fuel tanks are mounted in the top outer planes, one at each inner end. At the forward end of and in streamline continuity with the barrelled nacelle is the oil tank. The port and starboard fuel tank control cock controls are situated on the starboard side of the pilot's cockpit in a

position accessible to all members of the crew, whilst the engine throttle and mixture controls are mounted on the port side of the cockpit in line transversely with the control column.

Note.—Items referred to in the text by reference letters are similarly indicated in the illustrations, the numbers of which are given *en bloc* early in the relevant paragraphs. These reference letters are not necessarily indicated in all these illustrations.

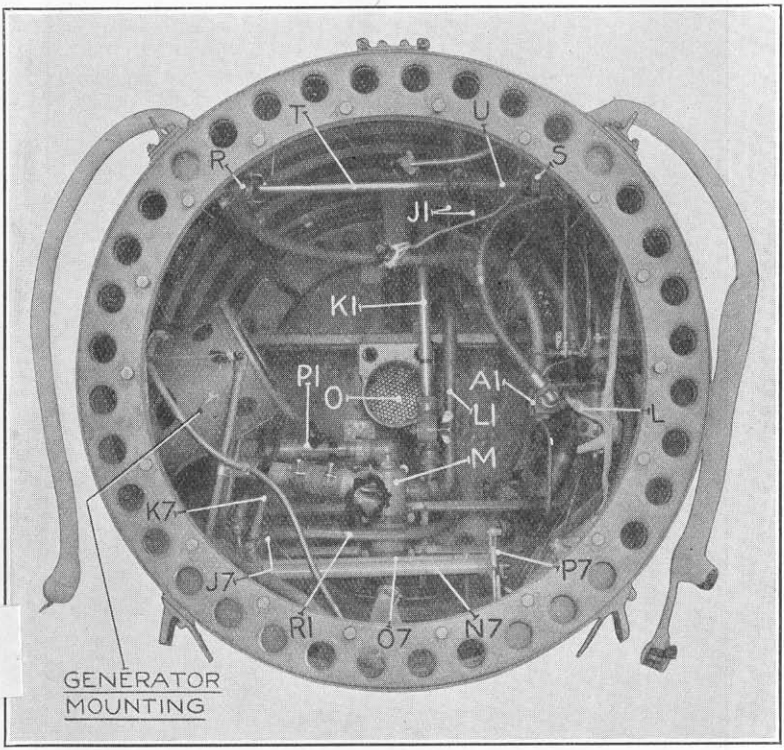


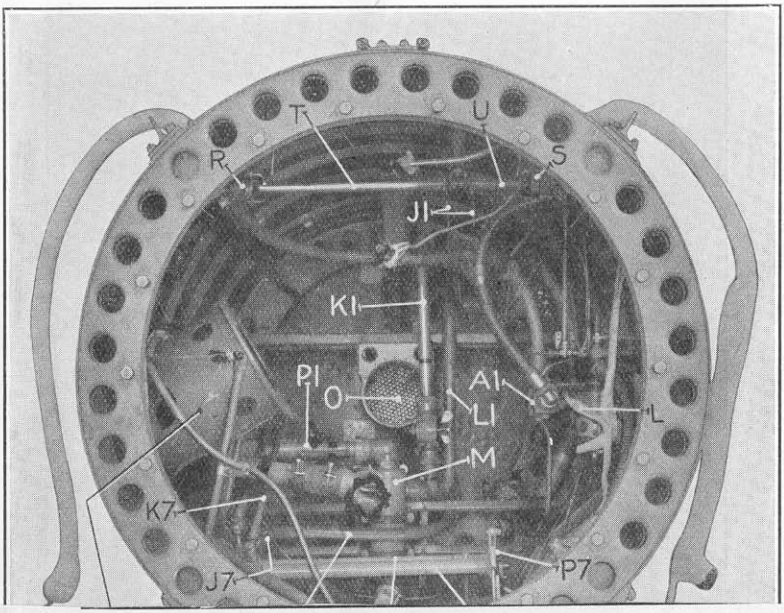
FIG. 104.—Engine mounting with internal fittings (looking forward).
(Filler fuel pump connection not shown).

Engine mounting

184. The engine mounting (*see* figs. 13, 103, 104 and 105) is an alclad barrel-shaped structure, consisting of four lightened longitudinal ribs (A), two end rings (B) and (C), and seven intermediate circular formers (D). The aft end ring (A) supports the engine by means of the securing bolts (E). Hinged doors (F), (G) and (H) at the port, starboard

position accessible to all members of the crew, whilst the engine throttle and mixture controls are mounted on the port side of the cockpit in line transversely with the control column.

Note.—Items referred to in the text by reference letters are similarly indicated in the illustrations, the numbers of which are given *en bloc* early in the relevant paragraphs. These reference letters are not necessarily indicated in all these illustrations.



(1) Fig. 104. Immediately below the title of this illustration *add* " (Filter fuel pump connection not shown) " A.L.1.

MOUNTING

FIG. 104.—Engine mounting with internal fittings (looking forward).
(Filter fuel pump connection not shown).

Engine mounting

184. The engine mounting (*see* figs. 13, 103, 104 and 105) is an alclad barrel-shaped structure, consisting of four lightened longitudinal ribs (A), two end rings (B) and (C), and seven intermediate circular formers (D). The aft end ring (A) supports the engine by means of the securing bolts (E). Hinged doors (F), (G) and (H) at the port, starboard

and bottom respectively of the nacelle allow access to those parts of the engine and engine installation which require periodic attention.

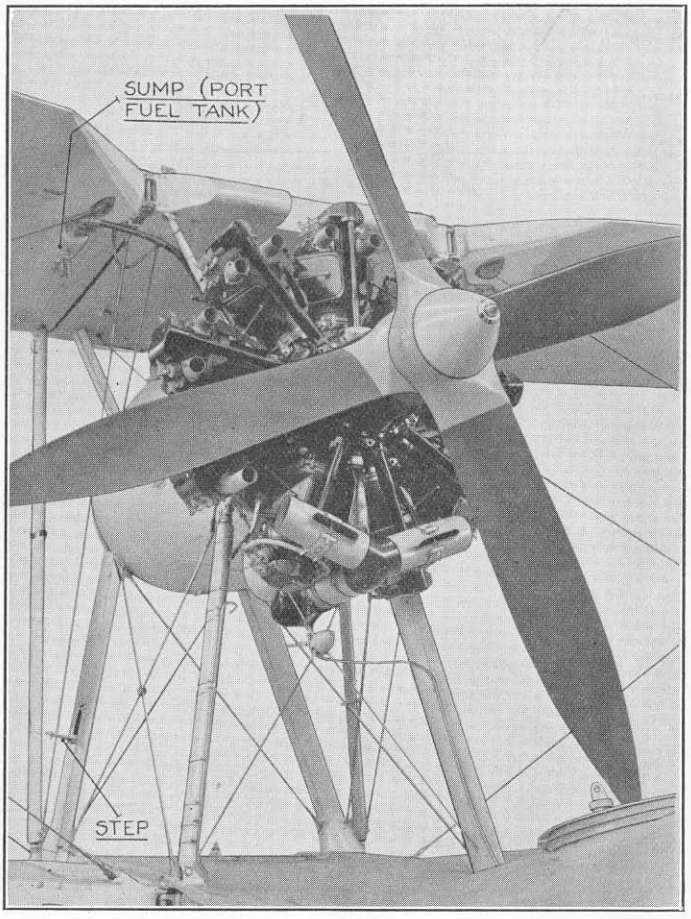


FIG. 105.—Engine mounting and engine in position.

185. The nacelle is supported by four stainless steel struts (*see* paras. 54 and 55) braced transversely and longitudinally by streamline-section wires, the port and starboard front struts being $1\frac{3}{4}$ in. o/d × 17 s.w.g., the port rear strut $2\frac{1}{4}$ in. o/d × 16 s.w.g. and the starboard rear strut $2\frac{1}{4}$ in. o/d × 17 s.w.g. Lugged mountings (U), secured to the underside of the nacelle, provide for pin-jointed attachment of the nacelle

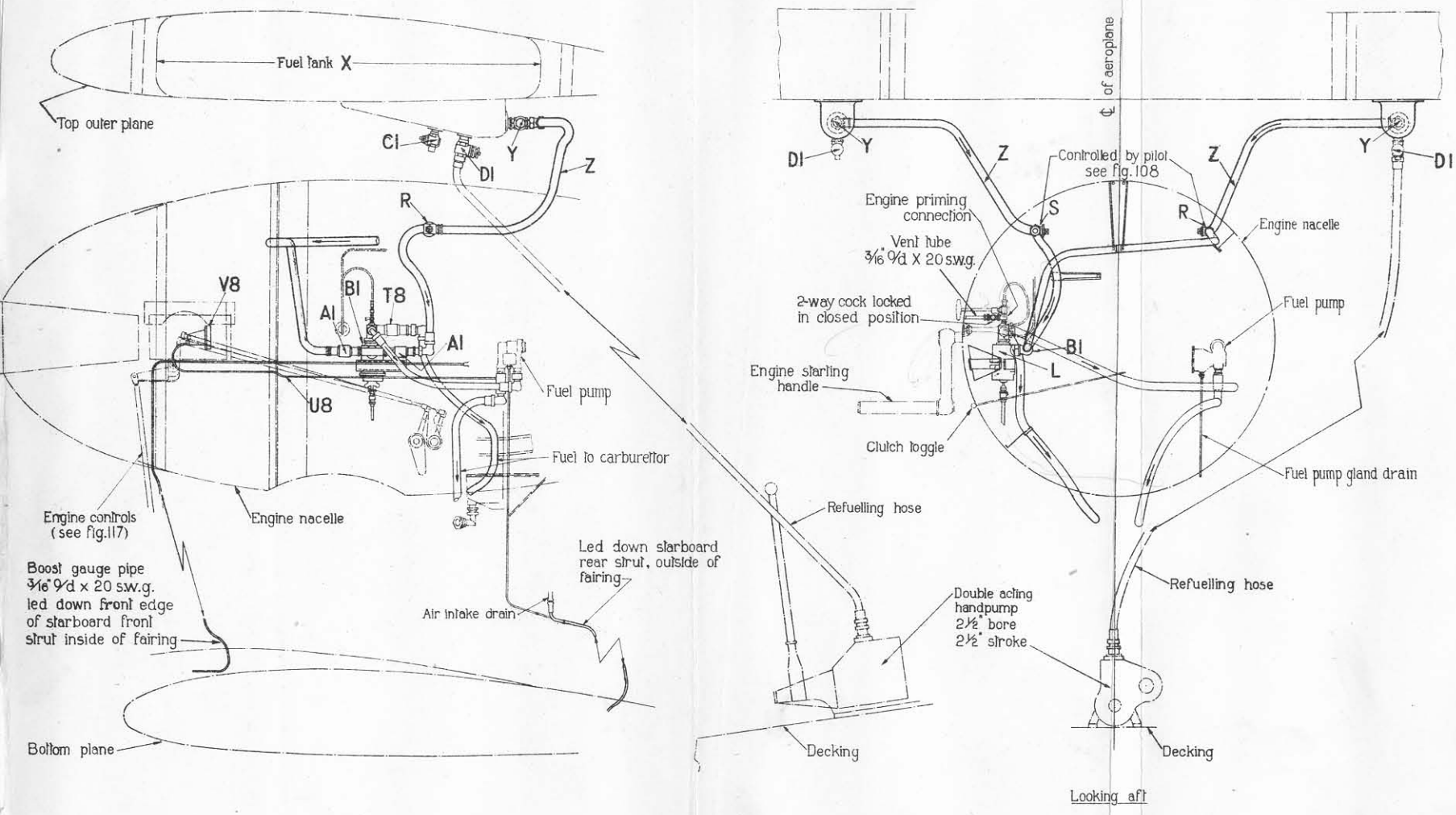


FIG. 106. FUEL SYSTEM

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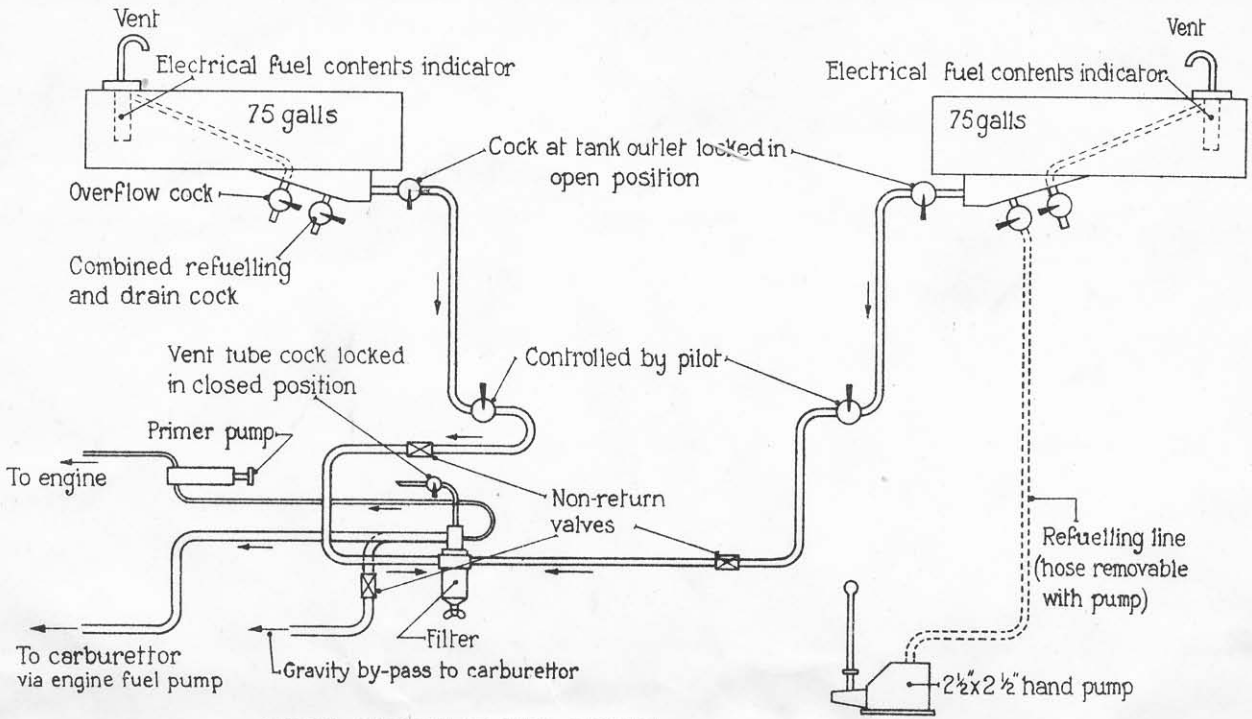

FIG.107, DIAGRAM OF FUEL SYSTEM

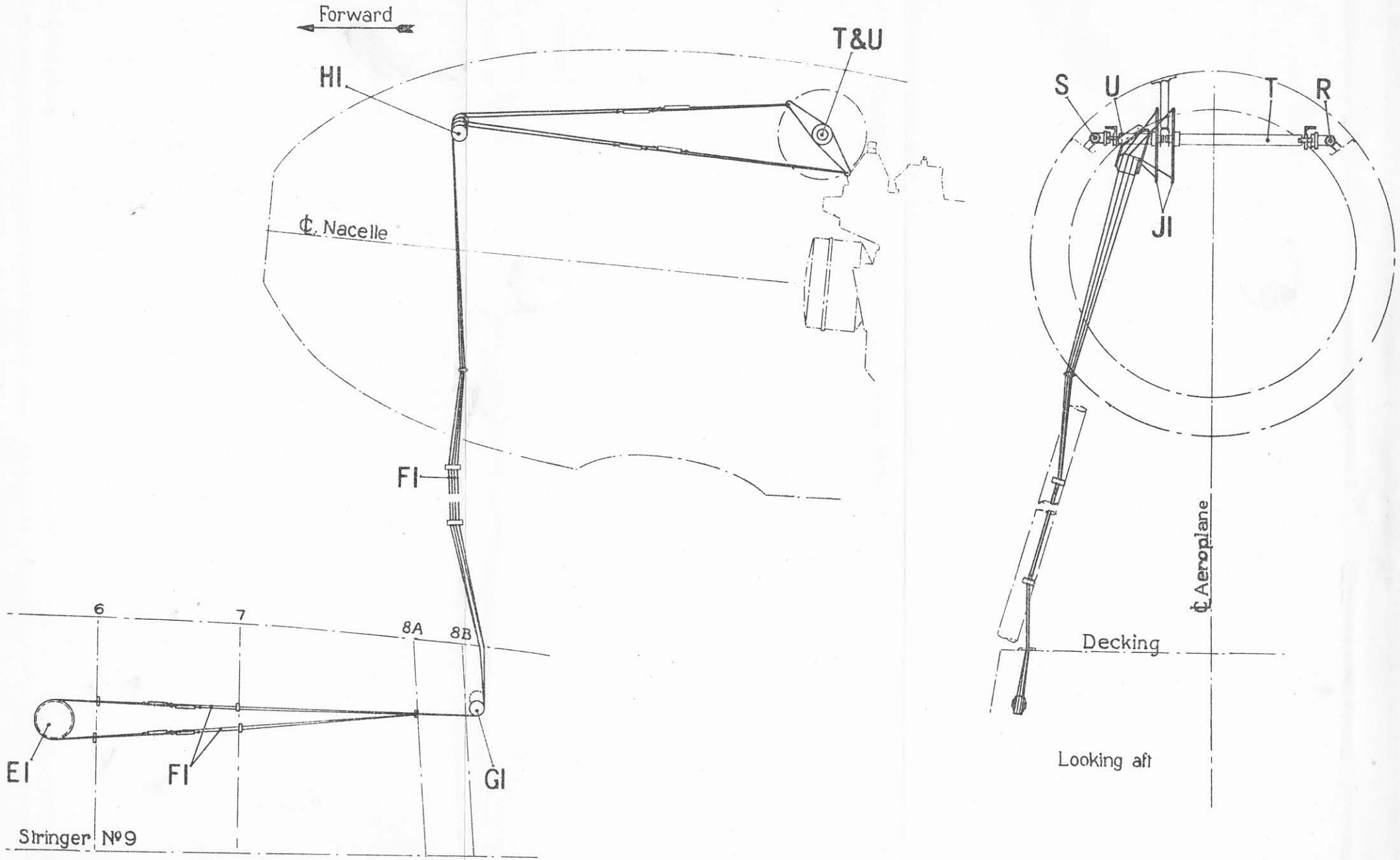

FIG. 108. FUEL COCK CONTROLS

supporting struts, the bottom end of which are pin jointed to lugged mountings (*see* item (B) of fig. 15 for front strut bottom attachment) secured to the hull.

186. The centre line of the engine nacelle is offset 3° to port at its forward end, the centre of the nacelle rear datum circle being in the vertical plane through the centre line of the aeroplane. In side elevation the thrust line is at an incidence of 5°.

187. Housed in the nacelle are the 500-watt engine-driven generator secured to the generator mounting (K), the fuel and oil filters (L) and (M) respectively, the oil tank (N) secured to the nacelle forward end, the oil cooler (O), the revolution counter generator, the engine mixture and throttle control transverse torque shafts (P) and (Q) respectively, the port and starboard fuel control cocks (R) and (S) and their corresponding operating torque shafts (T) and (U). Oil supply and return pipes (V and W) and (K1 and L1) respectively are run within the nacelle, between the oil tank and the engine. Below the nacelle, at its aft end and immediately forward of the engine cold air intakes, is a cowling.

Fuel system

188. The fuel system (*see* figs. 104, 106 and 107) principally comprises two fuel tanks (X), two control cocks (R) and (S), one filter (L), branch pieces and necessary piping. The tanks are housed in the top outer planes, at the inboard ends. From the cock (Y) normally wired open and mounted on the sump of each fuel tank (X) a pipe (Z) (Avioflexus $\frac{5}{8}$-in.) is led inboard to the fuel control 2-way cock (R) or (S) mounted within and on the corresponding side of the engine nacelle. Similar pipes are taken from these fuel control cocks via on-return valves (A1) to a T-piece (B1) mounted on the el filter (L) which is positioned on the starboard side of the nacelle. From the outlet at the top of the filter an Avioflexus $\frac{5}{8}$-in. pipe is led aft and down through the bottom of the nacelle to the engine carburettor. A copper air vent pipe $\frac{3}{16}$-in. o/d × 20 s.w.g. is also led from the top of the fuel filter to the starboard side of the nacelle.

189. Fuel supply to the engine carburettor is by gravity. Electrical fuel contents gauges are fitted to both fuel tanks, the selector switch and indicator being mounted on the left of the pilot's instrument panel. The diagram of the electrical circuit is shown in fig. 132, the current being derived from the 12-volt general electrical supply accumulator. A full description of the electrical fuel contents gauge is given in A.P. 1275, General Instrument Equipment for Aircraft. On the underside of the sump of each fuel tank are mounted an

overflow cock (C1) and a combined refuelling and drain cock (D1). The tanks are refuelled by a double-acting handpump which is mounted, when in use, on the hull deck, immediately aft of the rear gun turret. When not in service this hand-

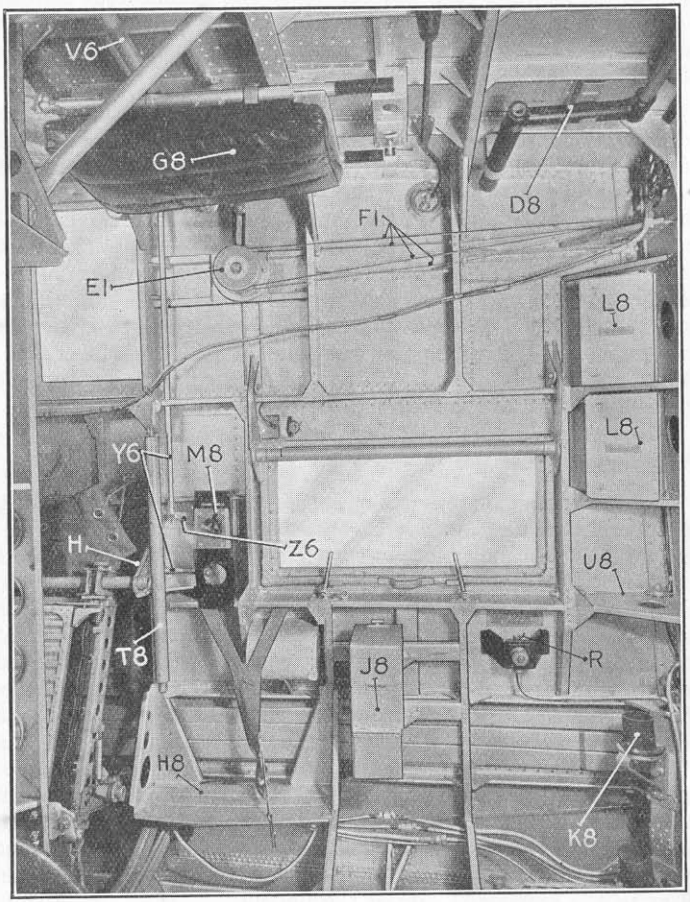

FIG. 109.—Cabin—showing starboard side.

pump is stowed within the hull, to the left of the wireless operator's seat. It is essential when refuelling that the overflow cocks (C1) are open in order to ensure rapid release of the air within the tanks.

190. *Fuel controls.*—The fuel control cocks (R) and (S) (*see* figs. 104, 108 and 109) mounted within the engine nacelle as described in para. 187 are operated from the cabin by means

(3) Para. 188, lines 13 and 14. *Delete* " led aft . . . . . carburettor " and *substitute* " led, via a non-return valve (T8), aft and down through the bottom of the nacelle to the engine carburettor, whilst a second similar pipe is led aft to the engine-driven fuel pump, from which a pipe is taken down also to the engine carburettor. From the fuel pump a pipe (U8) is taken to the fuel pump pressure gauge (V8) mounted in the forward portion of the engine nacelle."

(4) Para. 189, line 1. *Delete* this line and *substitute* " Normal fuel supply to the engine carburettor is via the engine-driven fuel pump, but should failure of this pump occur fuel supply is automatically maintained by means of the gravity by-pass. In the event of a renewal of the engine-driven fuel pump relief valve spring being necessary, the Part No. of this spring is FB. 63112." A.L.1.

of the quadrant control (E1) mounted on the starboard side, between frames Nos. 5 and 6. The control for each port and starboard fuel tank control cock is separate although both control quadrants are mounted on the same spindle mounting, the inner quadrant actuating the port fuel tank control cock,

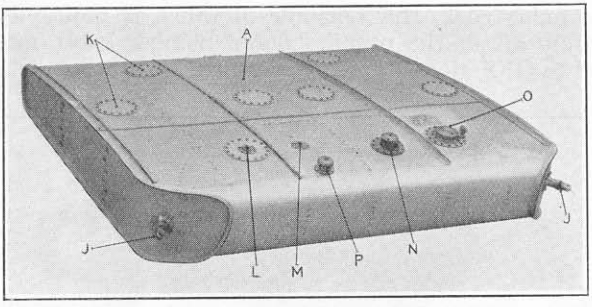

FIG. 110.—Fuel tank (starboard)—looking on top.

the outer quadrant the starboard fuel tank control cock. On each quadrant is mounted a handlever on which is indicated the tank, to the fuel control cock of which the control cables are connected. The fuel cock control cables (F1) run aft, rising slightly, to the pulleys (G1) mounted immediately aft of frame No. 8B. From these pulleys the cables are

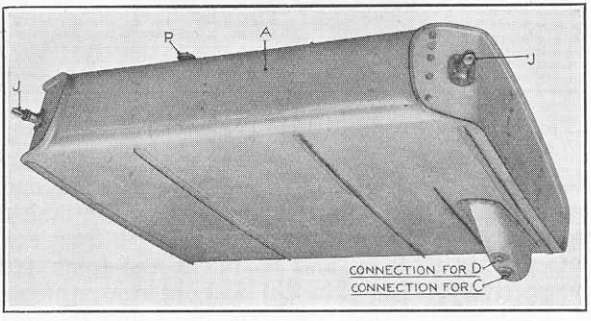

FIG. 111.—Fuel Tank (starboard)—looking on underside.

taken up through fairleads in the deck and bottom end of the nacelle starboard front lower strut fairing, then up through the strut fairing into the nacelle where, after being led through fairleads, the cables are taken to pulleys (H1) mounted in the nacelle, on the upper starboard portion. The cables are then taken to their corresponding levers (J1) mounted on the fuel cock control transverse torque shafts (T) and (U).

191. *Priming pump.*—This pump is mounted in the engine nacelle, on the starboard side. The pump plunger is operated from the walkway on the starboard bottom plane, the plunger being freed by unscrewing the plunger knob from its housing. Fuel for priming is drawn, via a priming cock, from the filter (L) and delivered to the engine cylinder induction pipes. The priming cock, the T-handle of which is positioned immediately aft of the priming pump plunger knob, must be turned to OFF after priming the engine.

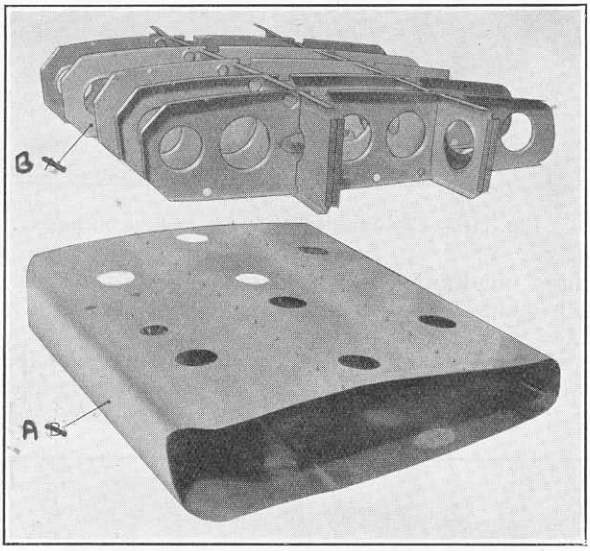

FIG. 112.—Fuel tank (starboard)—showing construction.

192. *Tanks.*—The fuel tanks (*see* figs. 110, 111 and 112) are approximately rectangular in plan view, the tank depth, approximately 9½ in. at one-third of its length from the front edge, decreasing to 9 in. and 6½ in. at the front and rear ends respectively. The skin (A) and internal stiffeners (B) are of alclad construction, the structure being shown in fig. 110. At the rear end of each tank, inboard and on the underside, is riveted a sump (G) on which are mounted three cocks. The forward cock (D) on the underside of the sump is for overflow, the aft cock (E) being a combined refuelling and drain cock, whilst the cock (F) on the aft face of the sump is for supply to the engine fuel system.

193. From the overflow cock (D) a pipe (G) is led forward within the tank, along the inboard edge, then across to the outboard end, to within 0·3 in. of the tank top. Extending

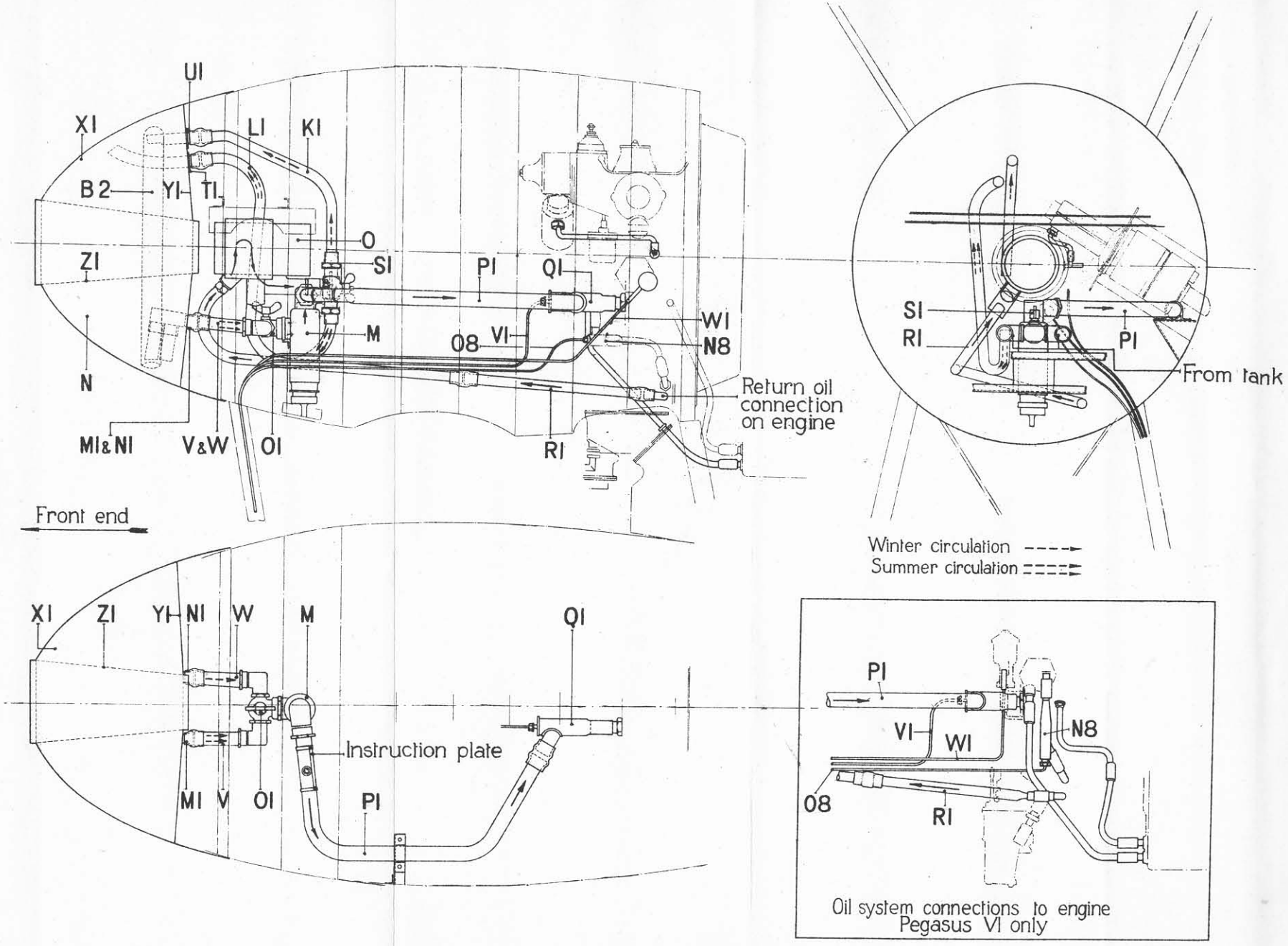

FIG.113. OIL SYSTEM

from the forward corners, within each tank, to approximately mid-position of the rear end, are duralumin stay tubes (H), which connect the tank external fore-and-aft attachment mountings (J) thus providing means of diagonal bracing for the fuel tank housing panels in the top planes. On the tank tops six inspection handholes (K) are provided, whilst at the forward portion of the tank tops are a dipstick mounting (L) for use on catapult, a dipstick mounting (M) for normal use, a contents gauge mounting (N), a filler and bonding connection (O), and an air vent (P).

Oil system

194. This system (*see* figs. 104 and 113) comprises an oil tank (N), a cooler (O), a filter (M), pressure and temperature gauges, oil tank outlet and return pipes (V) and (W), and (K1) and (L1) respectively, and necessary connections, piping and capillary tubing. The oil tank (N), of 16 gallons total capacity, is secured to the forward end of the engine nacelle (*see* para. 183), the oil cooler (O) being mounted within the nacelle, axially central and immediately aft of the venturi tube running centrally through the tank. The oil cooler for the Pegasus IIM.2, engine is a Serk type, W.S. 5124, and that for the Pegasus VI engine is a U.A.P. type, No. U-2053.

195. The oil supply and return pipes are of copper. The oil supply to the engine is led by two pipes (V) and (W), $1\frac{1}{4}$ in. o/d $\times$ 20 s.w.g., from two connections (M1) and (N1) on the bottom portion of the tank, one on each side of the centre line, to a two-way cock (O1) the stem of which is screwed into the body of the oil filter (M). From this filter the oil supply pipe (P1), $1\frac{1}{2}$ in. o/d $\times$ 20 s.w.g., is taken along the port side of the nacelle to the thermometer chamber (Q1) secured to the engine oil pressure pump. The oil return is taken by a 1 in. o/d $\times$ 20 s.w.g. pipe (R1) from an elbow mounted on the engine carburettor jacket, along the starboard side of the nacelle to the forward end of the oil cooler (O). On the aft end of the cooler, at the bottom, is mounted a two-way cock (S1) from which pipes (L1) and (K1) are led to the oil tank summer and winter inlet connections (T1) and (U1) respectively, mounted on the upper portion of the oil tank, the two-way cocks (O1) and (S1) prefixing the summer or winter oil circulation. When the ground temperature is below 20° C. (68° F.) these winter connections (N1) and (U1) are used, thus restricting the oil in circulation to the tank secondary reservoir (B2) and permitting a speedier decrease in the initial low-temperature viscosity of the oil feed to the engine pressure pump. When the oil temperature in the tank is above 20° C. (68° F.) the alternative summer connections (M1) and (T1) are used, thus bringing into direct circulation the

from the forward corners, within each tank, to approximately

(27) Para. 193. After this paragraph *insert* the following new paragraph:—

193A. *Tank drainage.*—When draining fuel from tanks on aeroplanes in which Mod. No. Walrus/210 has been incorporated, the sequence of operations is as follows:—

(i) Fold planes.

(ii) Screw reducing adaptor (Part No. A.G.S./626/E $\frac{3}{4}$ in. B.S.P. male and $\frac{5}{8}$ in. B.S.P. male) supplied with drain hose adapter (Part No. 22895/181) into the $\frac{3}{4}$ in. B.S.P. female connection on valve of new drain plug.

(iii) Attach drain hose to adapter (22845/181) and unscrew valve of new drain plug in order to drain fuel tank.

Note.—The reducing adapter is only required when draining tank from new drain plug.

(iv) Drain remaining fuel from tank at drain connection on sump in accordance with current procedure.

nacelle, axially central and immediately aft of the vertical tube running centrally through the tank. The oil cooler for the Pegasus IIM.2, engine is a Serk type, W.S. 5124, and that for the Pegasus VI engine is a U.A.P. type, No. U-2053.

195. The oil supply and return pipes are of copper. The oil supply to the engine is led by two pipes (V) and (W), $1\frac{1}{4}$ in. o/d $\times$ 20 s.w.g., from two connections (M1) and (N1) on the bottom portion of the tank, one on each side of the centre line, to a two-way cock (O1) the stem of which is screwed into the body of the oil filter (M). From this filter the oil supply pipe (P1), $1\frac{1}{2}$ in. o/d $\times$ 20 s.w.g., is taken along the port side of the nacelle to the thermometer chamber (Q1) secured to the engine oil pressure pump. The oil return is taken by a 1 in. o/d $\times$ 20 s,w.g. pipe (R1) from an elbow mounted on the engine carburettor jacket, along the starboard side of the nacelle to the forward end of the oil cooler (O). On the aft end of the cooler, at the bottom, is mounted a two-way cock (S1) from which pipes (L1) and (K1) are led to the oil tank summer and winter inlet connections (T1) and (U1) respectively, mounted on the upper portion of the oil tank, the two-way cocks (O1) and (S1) prefixing the summer or winter oil circulation. When the ground temperature is below 20° C. (68° F.) these winter connections (N1) and (U1) are used, thus restricting the oil in circulation to the tank secondary reservoir (B2) and permitting a speedier decrease in the initial low-temperature viscosity of the oil feed to the engine pressure pump. When the oil temperature in the tank is above 20° C. (68° F.) the alternative summer connections (M1) and (T1) are used, thus bringing into direct circulation the

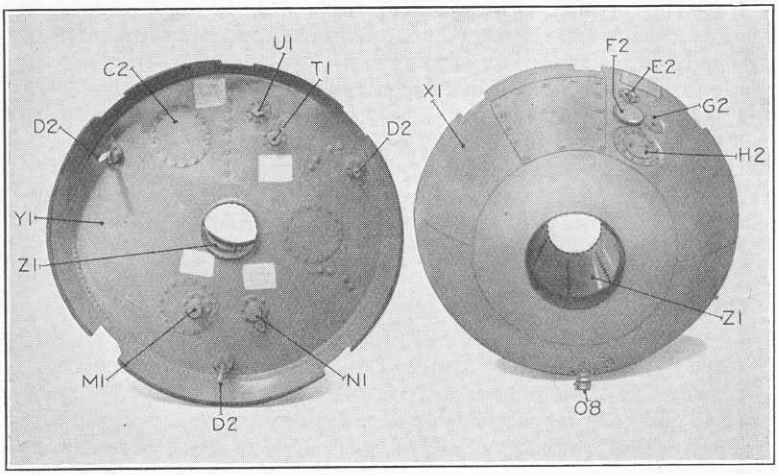

FIG. 114.—Oil tank.

main tank contents. The tank oil outlet and inlet connections (M1), (N1), (T1) and (U1) are also referred to in para. 196. The return oil normally flows through the cooler, but a thermostatically-controlled pressure relief valve is provided so that when the engine is first started, and the oil is of relatively low temperature high viscosity, it is returned to the tank without cooling. From the engine oil inlet thermometer

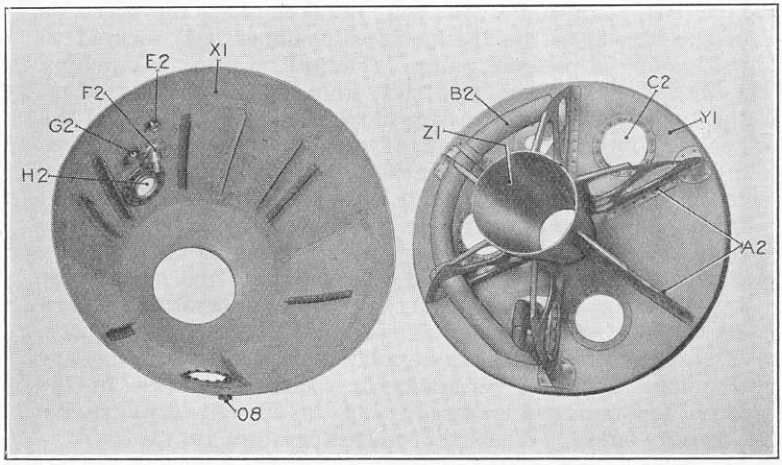

FIG. 115.—Oil tank—showing construction.

chamber (Q1), the outlet thermometer chamber (N8) and the oil pressure pump, capillary tubes (V1) (O8) and (W1) respectively, are led to their corresponding gauges mounted on the pilot's instrument panel.

196. *Oil tank.*—This tank is conical and of alclad construction, its structure being shown in figs. 104, 114, and 115. Axially connecting the forward portion (X1) and the rear plate (Y1) of the tank is an alclad venturi tube (Z1) (the larger diameter of which is forward) through which the air stream is directed to the oil cooler (O), whilst support to the

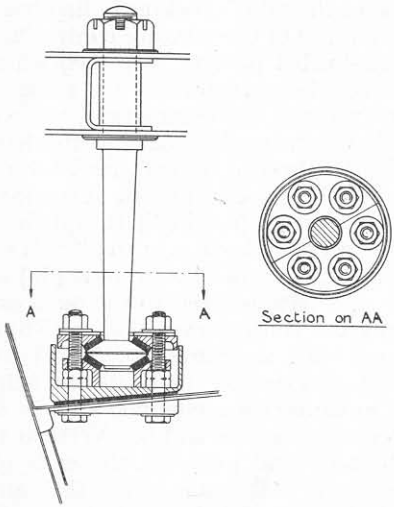

FIG. 116.—Oil tank flexible mounting studs.

tank rear plate (Y1) is given by six radial lightened alclad baffles (A2). On the tank rear plate, at the top, are the two inlet connections (T1) and (U1), on the starboard side of the centre line, whilst at the bottom are the two outlet connections (M1) and (N1), one on each side of the centre line. To the upper inlet connection (U1) on the forward side and starboard portion of the tank rear plate is secured a secondary tubular reservoir, or partial circulator (B2) of a capacity 2 pints oil and 0·25 pint air space, which is in direct communication with the tank starboard outlet connection (N1). (*See* also para. 195).

197. Handhole inspection doors (C2) are provided in the tank rear plate, together with three flexible mounting studs (D2) (*see* also fig. 116). On the forward portion of the tank, at the top and on the port side, are an air vent connection (E2), a dipstick and bonding plug mountings (F2) and (G2)

chamber (Q1), the outlet thermometer chamber (N8) and the oil pressure pump, capillary tubes (V1) (O8) and (W1) respectively, are led to their corresponding gauges mounted on the pilot's instrument panel.

196. *Oil tank.*—This tank is conical and of alclad construction, its structure being shown in figs. 104, 114, and 115. Axially connecting the forward portion (X1) and the rear plate (Y1) of the tank is an alclad venturi tube (Z1) (the larger diameter of which is forward) through which the air stream is directed to the oil cooler (O), whilst support to the

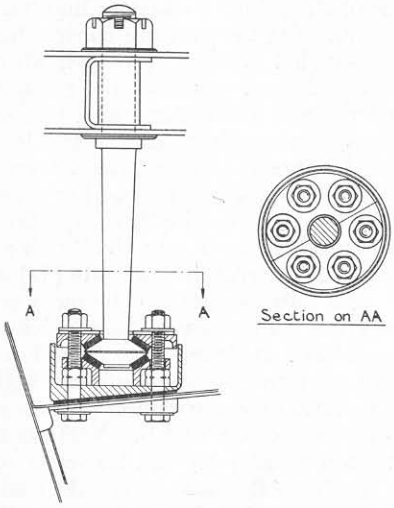

FIG. 116.—Oil tank flexible mounting studs.

tank rear plate (Y1) is given by six radial lightened alclad baffles (A2). On the tank rear plate, at the top, are the two inlet connections (T1) and (U1), on the starboard side of the centre line, whilst at the bottom are the two outlet connections (M1) and (N1), one on each side of the centre line. To the upper inlet connection (U1) on the forward side and starboard portion of the tank rear plate is secured a secondary tubular reservoir, or partial circulator (B2) of a capacity 2 pints oil and 0·25 pint air space, which is in direct communication with the tank starboard outlet connection (N1). (*See* also para. 195).

197. Handhole inspection doors (C2) are provided in the ... mounting studs

(28) Para. 197. After this paragraph *insert* the following new paragraph:—

197A. *Oil dilution* ...

(49) Para. 197A. *Delete* this paragraph. ... to be started under adverse ... conditions. The approximate time of operation is four minutes.

A.L. 5.

respectively and a filler cap (H2). At the bottom of the tank, on the forward portion and 2 in. on the port side from the centre line, is provided a drain valve (O8). This drain valve and the filler cap (H2) are accessible to a man standing on the hull decking.

Engine controls

198. The engine controls are shown in figs. 86, 100, 104, 108, 117 to 120, and 126, and consist of hand levers, bell cranks, tie rods and torque shafts. Engine throttle and mixture control hand levers (G6) and (H6) respectively are mounted on the port side of the pilot's cockpit in line transversely with the control column. On the mixture control hand lever (H6) is fitted a spring-loaded plunger stop (Q8) which secures the hand lever in its desired position by engagement with a suitable hole on the rim of the quadrant, the stop (Q8) being freed from its engagement by means of the lever (R8) at its top end, whilst the throttle control hand lever (G6) is fitted with spring-loaded adjustable friction discs (S8). When the hand levers are in their aft position in the quadrant the throttle is closed and the mixture lever is in the " rich automatic with over-ride " position. Horizontal tie rods (J6) and (K6) from the levers (L6) and (M6) secured to the outboard ends of the throttle and mixture control lever sleeves (N6) and (O6) pass through the bulkhead at frame No. 5 and connect to the downward pointing arms of the built-up bell crank levers (P6) and (Q6) mounted on a common spindle secured to the hull, between frames Nos. 5 and 6. Vertical rods (R6) and (S6) couple the universal joints at the ends of the forward pointing arms of the bell crank levers (P6) and (Q6) to the universal jointed ends of bell crank levers (T6) and (U6) pivoted in a mounting secured to the underside of the deck.

199. At this point in the run of the engine controls, the second pilot's throttle control joins that of the first pilot by means of a transverse torque shaft (V6) extending between the second pilot's bell crank lever (W6) mounted on the starboard and underside of the hull deck, immediately aft of frame No. 5, and the bell crank levers (T6). The arrangement of the hand lever (X6) (*see* also fig. 101), links (Y6) and bell crank (Z6) of the second pilot's engine controls leading to the bell crank lever (W6) is in general similar to that described in para. 198, for the first pilot's engine controls.

200. From the downward pointing arms of the bell crank levers (T6) and (U6) are the tie rods (A7) and (B7) which, rising slightly in their run aft, are coupled to the downward pointing arms of the built-up bell cranks (C7) and (D7) pivoted in a mounting on the upper surface of the deck, on the starboard side, immediately forward of frame No. 8A. From the

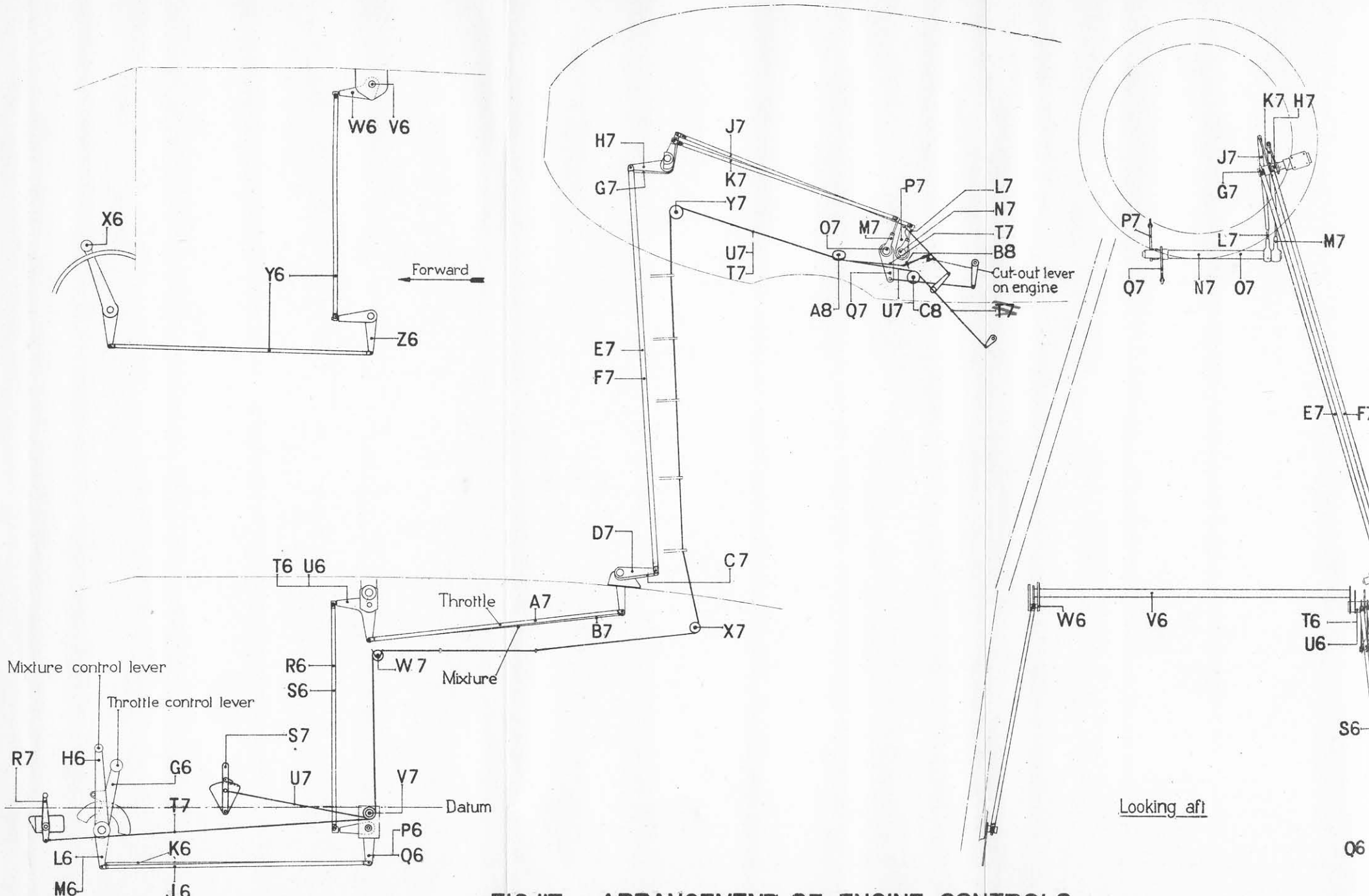

FIG.117 ARRANGEMENT OF ENGINE CONTROLS

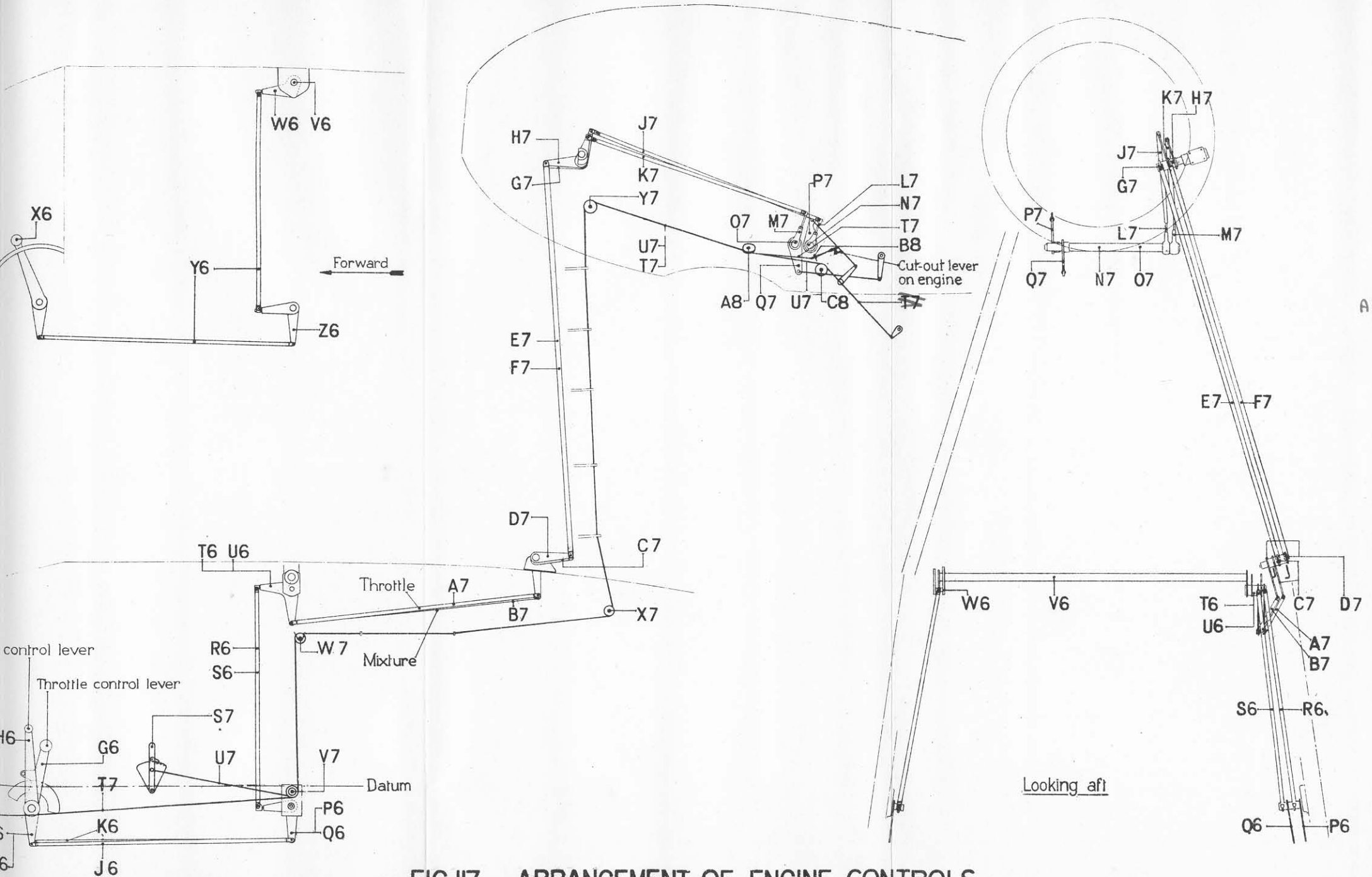

FIG. 117 ARRANGEMENT OF ENGINE CONTROLS

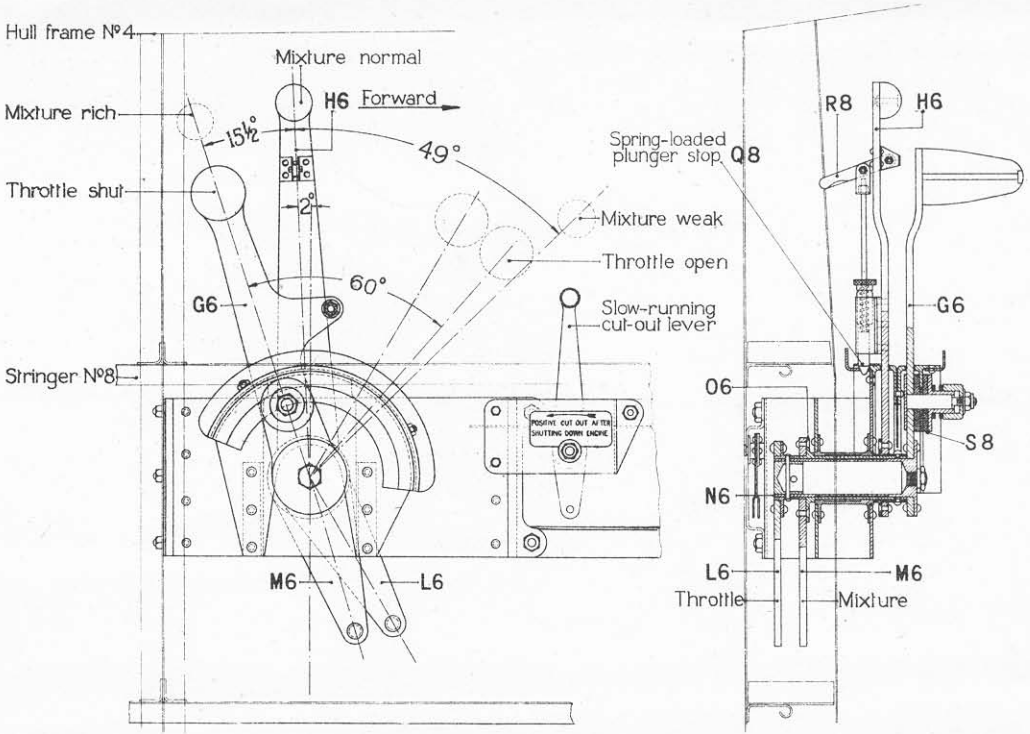

FIG. 118. ENGINE CONTROL QUADRANT

aft pointing arms of these bell crank levers tie rods (E7) and (F7) are taken up within the fairing of the engine nacelle front port supporting strut to the ends of the forward pointing arms of the built up bell crank levers (G7) and (H7) pivoted on a spindle securely mounted within the nacelle, on the port side, on the rear face of the nacelle forward end ring. Longitudinal operating rods (J7) and (K7) connect the universal joints of the upward pointing arms of the bell crank levers (G7) and (H7) to similar joints at the ends of the upward pointing arms of levers (L7) and (M7) which are secured at the

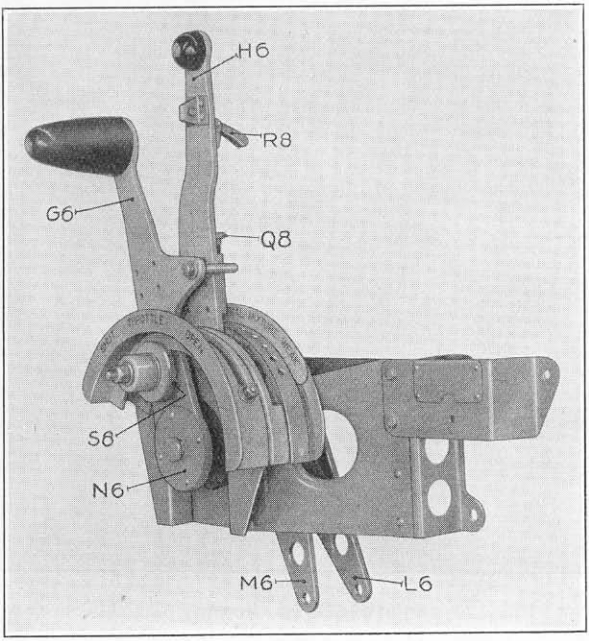

FIG. 119.—Engine control quadrant.

port end of the respective engine control transverse torque shafts (N7) and (O7) mounted between the nacelle formers Nos. 6 and 7. At the starboard end of these torque shafts are levers (P7) and (Q7), the upward pointing lever (P7) controlling the engine throttle whilst the downward pointing lever (Q7) controls the mixture by means of links connected to the engine corresponding control operating levers.

201. *Slow-running cut-out and carburettor shutter hand control.*—The engine is fitted with a slow-running cut-out device comprising two valves incorporated in the carburettor,

an operating cable and hand lever. A carburettor shutter hand control is also provided. These separate controls are on the port side of the pilot's cockpit, the slow-running cut-out lever (R7) being mounted immediately forward of the engine throttle and mixture control hand levers (G6) and (H6), whilst the carburettor shutter hand control (S7) is mounted immediately aft of the elevator trimmer flap control quadrant (K3). Cable leads (T7) and (U7) respectively from the slow-running cut-out lever and the carburettor shutter hand control lever are taken to the two guard-encased pulleys (V7) which

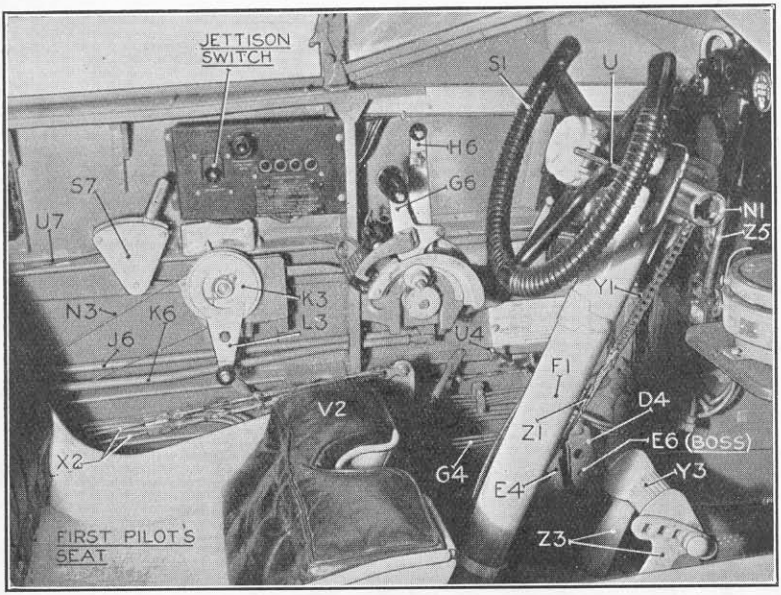

FIG. 120.—Pilot's cockpit—showing port side.

rotate on a common spindle secured to the bell crank lever (P6) hull mounting between frames Nos. 5 and 6. From these pulleys both the cables are taken to a second pair of similar pulleys (W7) vertically above and mounted on the underside of hull stringer No. 9, from which pulleys the cables run aft, through a fairlead in the hull frame No. 7, thence rising slightly to a third pair of pulleys (X7) mounted on the aft side of frame No. 8B. The cables are then led up through a fairlead in the deck, then along the nacelle front port lower strut, through a fairlead on the strut, at mid-length, thence to the pulleys (Y7) mounted on the aft face of the nacelle forward end ring on the port side. From these pulleys the cables (T7) and (U7) are led to the pulleys (A8) mounted on the aft

side of the nacelle frame No. 5. From this point the cables deviate, the slow-running cut-out control cable (T7) being led to a quadrant lever (B8), whilst the carburettor shutter hand control cable (U7) is led to pulley (C8), both the quadrant lever and the pulley being mounted on support brackets secured to the nacelle frame No. 7. From the quadrant lever (B8) and the pulley (C8) the control cables are led direct to the controls on the engine. When using the engine slow-running cut-out device to stop the engine, it is necessary to close the throttles, switch off the magnetos, press down the lever (R7) and hold it in its SHUT, *i.e.*, its aft, position until the engine stops firing. The carburettor shutter hand control lever (S7) is provided with a toothed quadrant and a spring-loaded pawl.

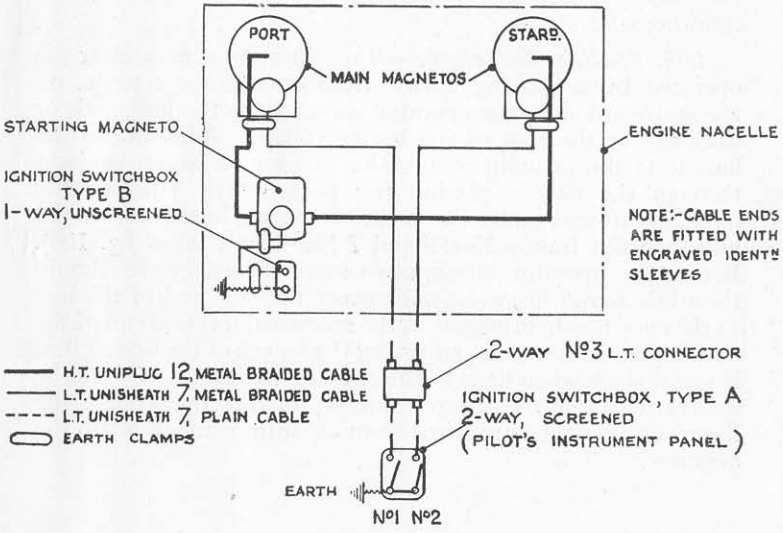

FIG. 121.—Ignition diagram.

202. *Ignition and starting.*—A diagram of the ignition system is given in fig. 121. Dual ignition is provided by two magnetos, one port and one starboard, mounted on the engine forward cover, the magnetos being controlled by a screened, type A, two-way switchbox mounted on the oblique left portion of the pilot's instrument panel. Low-tension cables are led from the switchbox to a two-way connector in the hull roof, from which connector the cables are continued, with the main electrical wiring, up the engine nacelle starboard front strut to the magnetos.

203. A hand-starting magneto is housed in the nacelle on the starboard side, two low-tension wires being employed for the earth connection to the nacelle, through an unscreened, type B, one-way switchbox. High-tension cables are led to the port and starboard main magnetos. The hand-starting magneto is rotated by a cranked handle projecting from the starboard side of the nacelle.

204. *Priming the engine.*—To prime the engine, turn the primer cock to its ON position by means of the T-handle projecting from the starboard side of the engine nacelle. A direction plate, inscribed " OFF—Primer—ON " is fitted adjacent to the cock. Operate the plunger of the priming pump (*see* para. 191). The number of strokes of the pump necessary to prime the engine correctly will depend on whether the engine is hot or cold and upon the prevailing climatic conditions.

205. *Starting the engine.*—The inertia-type starter is operated by a starting handle from outside the nacelle, on the starboard side, the operator standing on the hull deck or walkway at the root of the bottom plane. Adjacent to the handle is the priming pump, the plunger of which projects through the nacelle plating (*see* para. 191). The starting handle is stowed under the deck, on the starboard side of the hull, between frames Nos. 6 and 7 (*see* item (D8) of fig. 108). Before the operator attempts to start the engine he should tie a line round his waist and secure the free end of the line to the eyed fitting provided on the starboard forward end of the nacelle for this purpose, adjusting the length of the line so that it is not slack when he is in the starting position. Should he inadvertently slip rearwards during starting operations, the line will prevent him from coming into contact with the airscrew.

203. A hand-starting magneto is housed in the nacelle on the starboard side, two low-tension wires being employed for the earth connection to the nacelle, through an unscreened, type B, one-way switchbox. High-tension cables are led to the port and starboard main magnetos. The hand-starting magneto is rotated by a cranked handle projecting from the starboard side of the nacelle.

204. *Priming the engine.*—To prime the engine, turn the primer cock to its ON position by means of the T-handle projecting from the starboard side of the engine nacelle. A direction plate, inscribed " OFF—Primer—ON " is fitted adjacent to the cock. Operate the plunger of the priming

(29) Para. 204. At the end of this paragraph *add* the following:— It will also depend on whether the oil dilution system (*see* A.P.2095) was operated when the engine was stopped.

operated by a starting [illegible] the starboard side, the operator standing on the hull deck or walkway at the root of the bottom plane. Adjacent to the handle is the priming pump, the plunger of which projects through the nacelle plating (*see* para. 191). The starting handle is stowed under the deck, on the starboard side of the

(30) Para. 205. After this paragraph *insert* the following new paragraph:—

205A. *Carburettor de-icing.*—Provision is made for de-icing the carburettor by pumping de-icing spirit from a reservoir to the carburettor air intake. The reservoir is mounted in the navigator's compartment, immediately above the window on the starboard side, and is provided with a dipstick. A hand-operated wobble pump is mounted on the starboard side of the pilot's cockpit. A filter is provided in the nacelle on the starboard side just aft of the attachment of the forward lower strut, and situated in line with the aft end of the access door is an anti-syphoning valve to prevent loss of spirit. A nozzle on the air intake permits entry of the de-icing spirit into the stream of air to the carburettor. The system is completed by a pipe-line which is led from the reservoir to the pump, from the pump through the slot at the base of the starboard lower nacelle strut, up the aft side of the strut, inside the fairing to the filter, thence to the anti-syphoring valve, and terminating at the nozzle. With the exception of the copper pipe from the anti-syphoning valve to the nozzle, the pipes are of aluminium and all are $\frac{1}{4}$ in. o/d $\times$ 20 s.w.g. Operation of the pump draws de-icing spirit from the reservoir and forces it along the pipe-line through the filter and anti-syphoning valve to the nozzle where it is sprayed into the air intake. The fluid used in the system is de-icing spirit for carburettors, Spec. D.T.D.386 (Stores Ref. 34A/104).

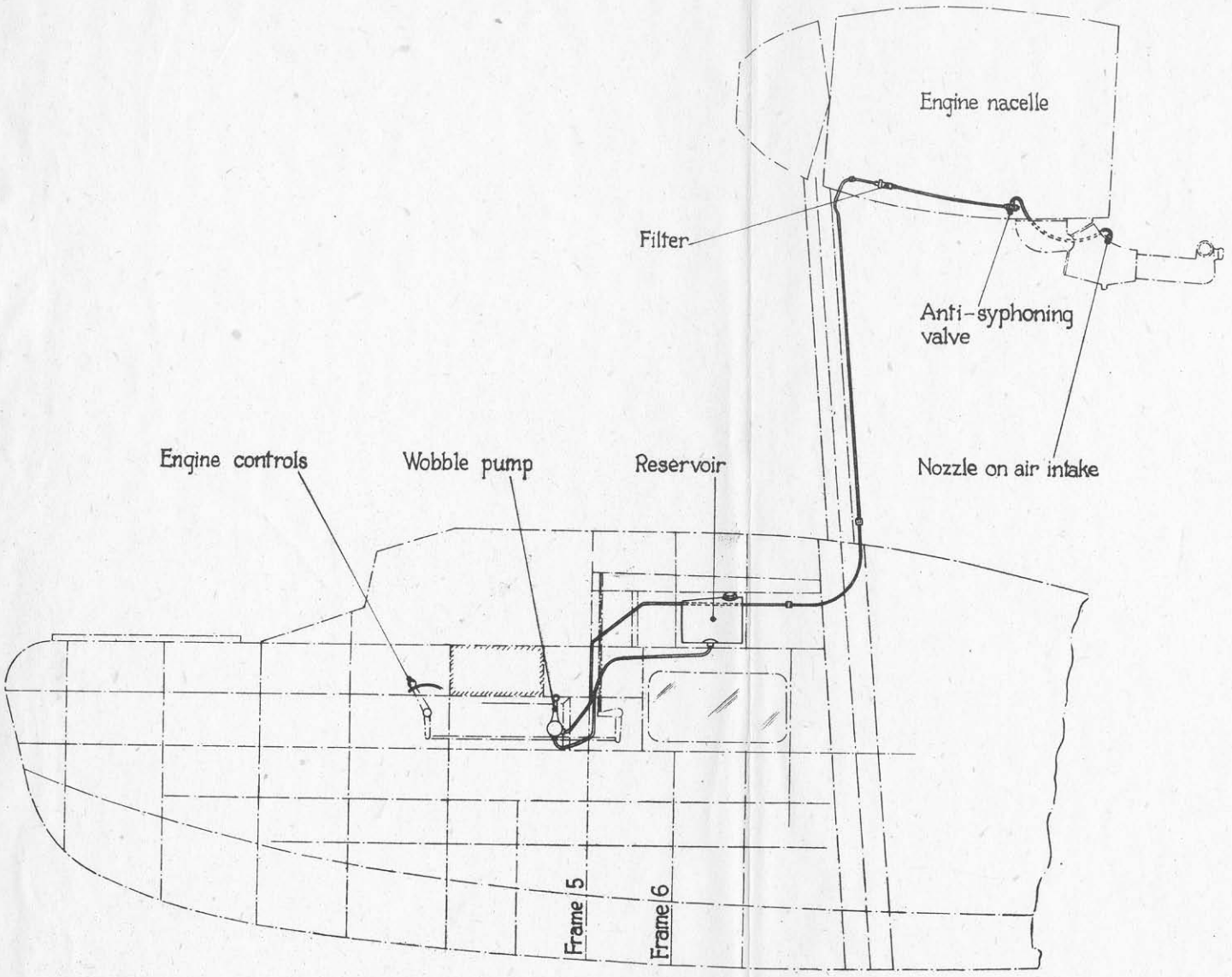

FIG. 121A, CARBURETTOR DE-ICING SYSTEM

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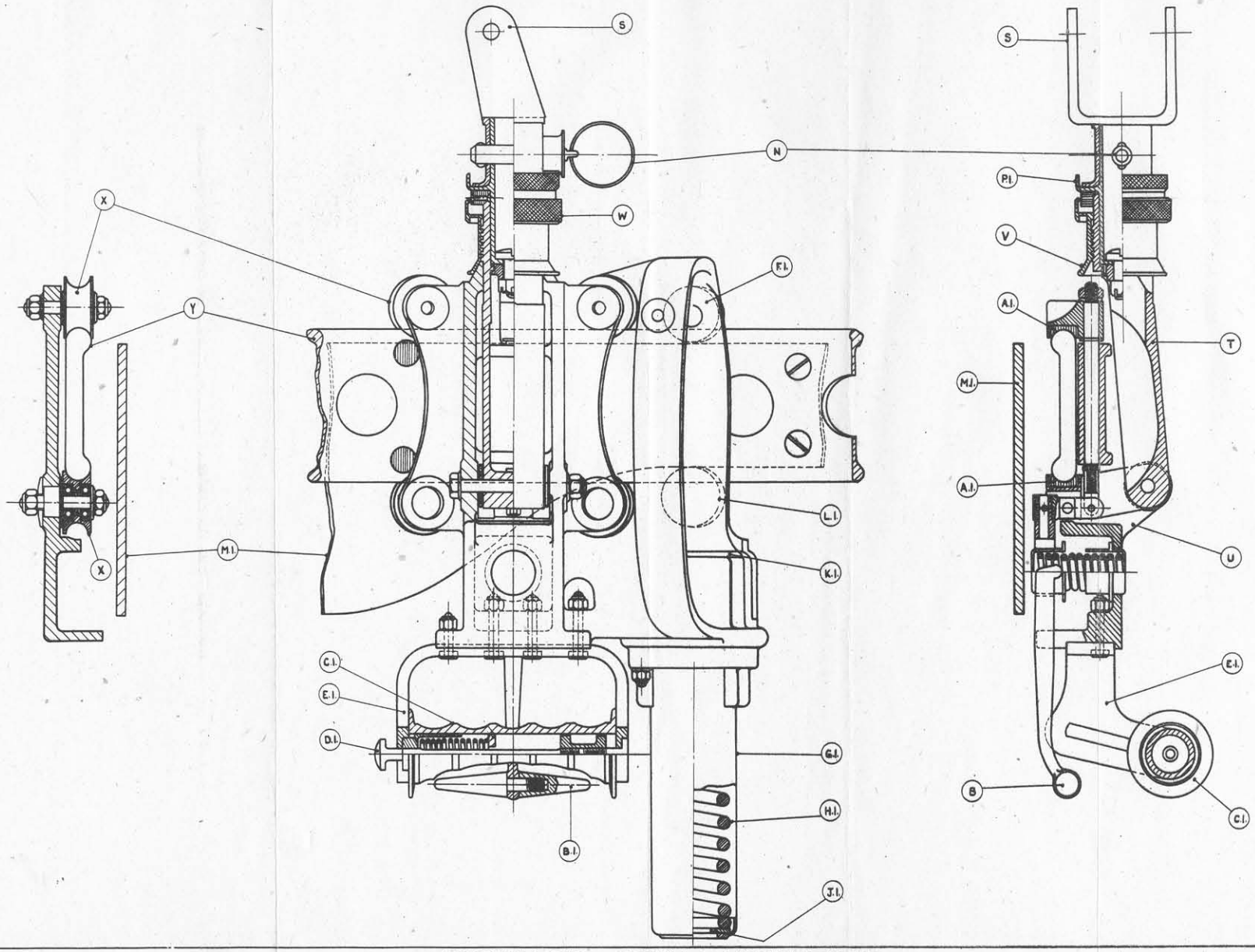


FIG. 122

FORWARD GUN MOUNTING

FIG. 122

PP2660 M /1904 1-44 1000 C&P Gp. 959 (4)

CHAPTER VII

EQUIPMENT

ARMAMENT

General

206. The aeroplane is equipped with two ·303 Mk. III.A Lewis guns, both guns being pivoted on jockey mountings which traverse circular tracks integral with the forward and aft gun turrets. The forward gun turret is wind balanced.

207. Bombs are carried for which are provided four No. 1 type E.M./M.F. bomb carriers, two mounted under each port and starboard bottom plane. Under each of these planes provision is made for carrying an E.M. light series carrier.

Note.—Items referred to in the text by reference letters are similarly indicated in the illustrations, the numbers of which are given *en bloc* early in the relevant paragraphs. These reference letters are not necessarily indicated in all these illustrations.

(36) Para. 207, lines 1–4. *Delete* these lines and *substitute* the following—"Two universal bomb carriers and a light-series carrier are mounted under each bottom plane (*see* fig. 127A). A twin A.S. carrier can be fitted under each inboard universal carrier".

Vickers G.O

~~Lewis~~ guns and mountings

insert slip here.

208. These guns are similarly mounted, each being pivoted (*see* figs. 122 to 125) between the vertical lugs (S) of the vertical support (T) which is horizontally pivoted at its bottom end to the jockey mounting (U). The support (T) is retained in its service position by means of the coned collar of the sleeve (V) which beds on a coned seating integral with the jockey mounting body, the bedding of the collar on the coned seat being effected by turning the sleeve which is provided with a knurled hand grip (W), clockwise. Four grooved rollers (X) mounted at the top and bottom of the jockey mountings engage the top and bottom rounded edges of the corresponding forward or aft runway (Y) or (Z) secured within the turret circular mountings. Normally the jockey mountings are locked in position by an arrangement of spring-loaded brake blocks (A1) fitted to the top and bottom edges of the runways, between the rollers (X). When the finger lever (B1) is pulled radially inwards, towards the hand grip (C1), the brake block housings are moved apart, thus giving the gun mountings freedom to traverse. The handgrip of each gun mounting is freed from its service position by the thumb press button (D1) on its left when it can then be displaced along the slots provided in the handgrip bridle (E1), thus giving clearance for the lugs (S) of the gun mounting support (T) when this is swung into its stowed position.

209. The forward gun mounting is provided with wind balance mechanism additional to the normal traversing mechanism common to both the forward and aft gun mountings. This wind balance mechanism consists of a C-bracket integral with the forward turret jockey mounting, in the top jaw of which is pinned a ball bearing roller (F1), the bottom jaw housing a shouldered cylinder (G1). Within this cylinder is a compression spring (H1) which is supported at its bottom end by the cylinder bottom end ring (J1), the upper end of the spring being housed by the end cap (K1) in the lugged upper

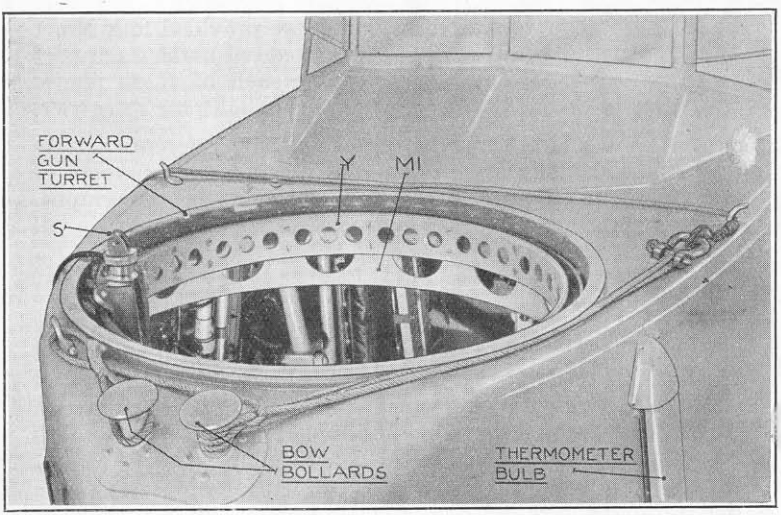
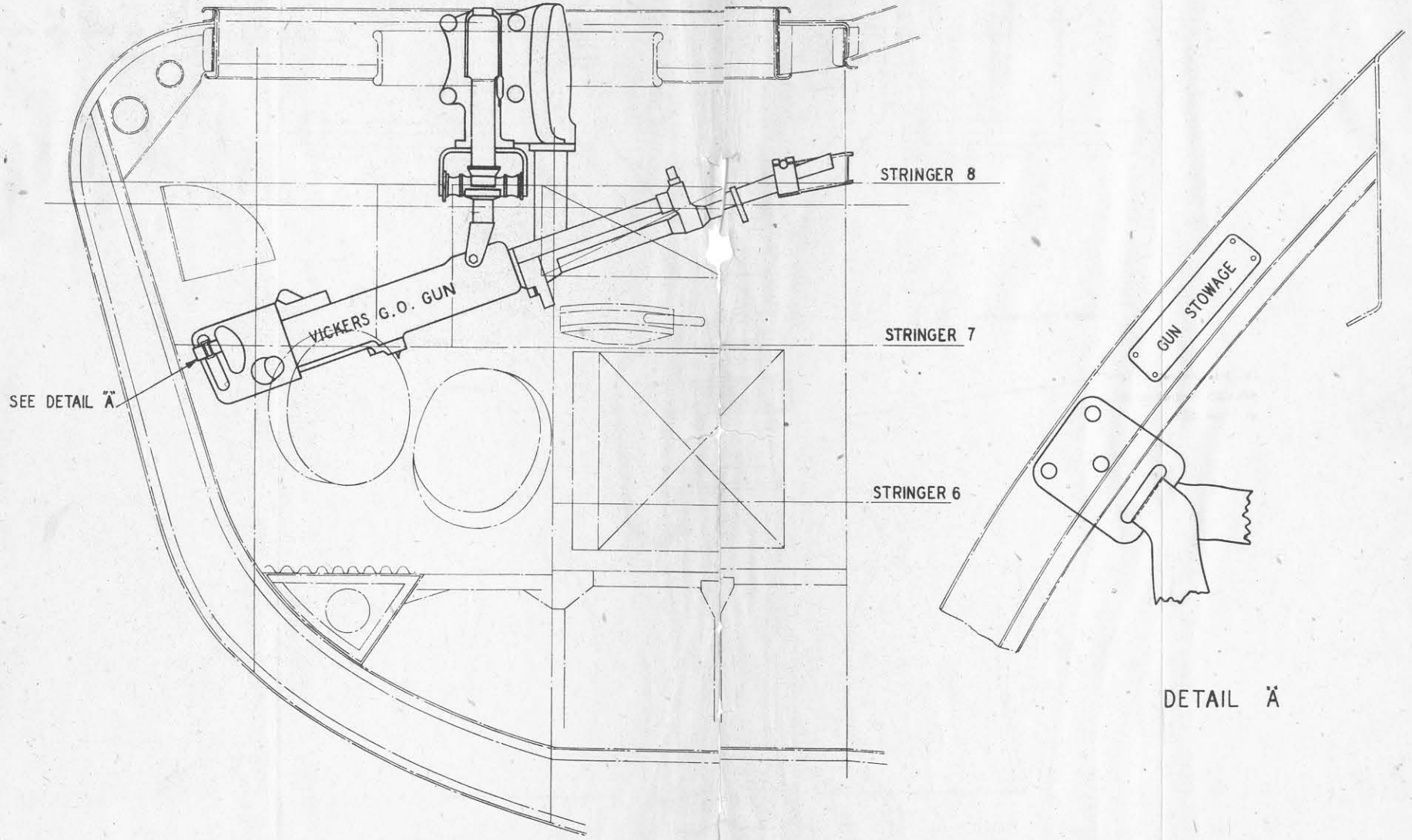


FIG. 123.—Forward gun turret.

end of which is pinned the lower ball bearing roller (L1). When the finger lever (B1) is pulled radially inwards and the brake blocks are freed, the jockey mounting responds to the action of the spring-loaded rollers (F1) and (L1) on the profiled ring (M1) which is secured between the inner runway (Y) and the circular turret mounting (*see* para. 210).

210. *Forward gun turret.*—The hull structure supporting the turret (K) is described in para. 23. Within this turret support ring are mounted two concentric rings (M1) and (Y), the former being the profiled turret ring, the latter the runway on which the jockey mounting (U) is traversed. Both the profiled ring and the runway form complete circles thus providing for 360° of gun traverse.



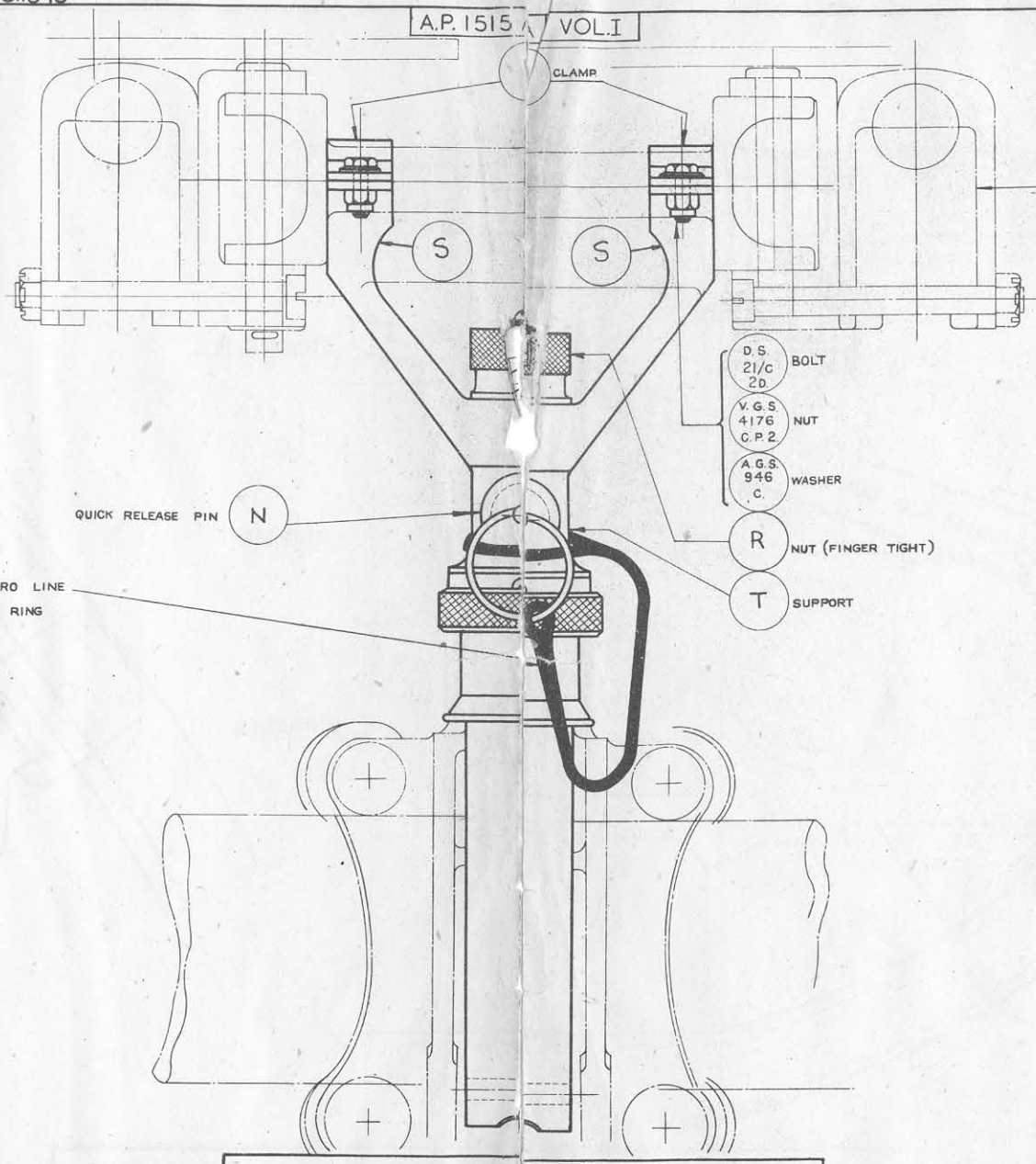
DETAIL Ä

FIG. 123A

VICKERS GUN STOWAGE IN BOW COCKPIT

FIG. 123A

PP2660 M /1904 1/44 1000 C & P Gp. 959 (4)



To erect the rear guns from the stowage to the firing position, proceed as follows (*see* fig. 123B):—

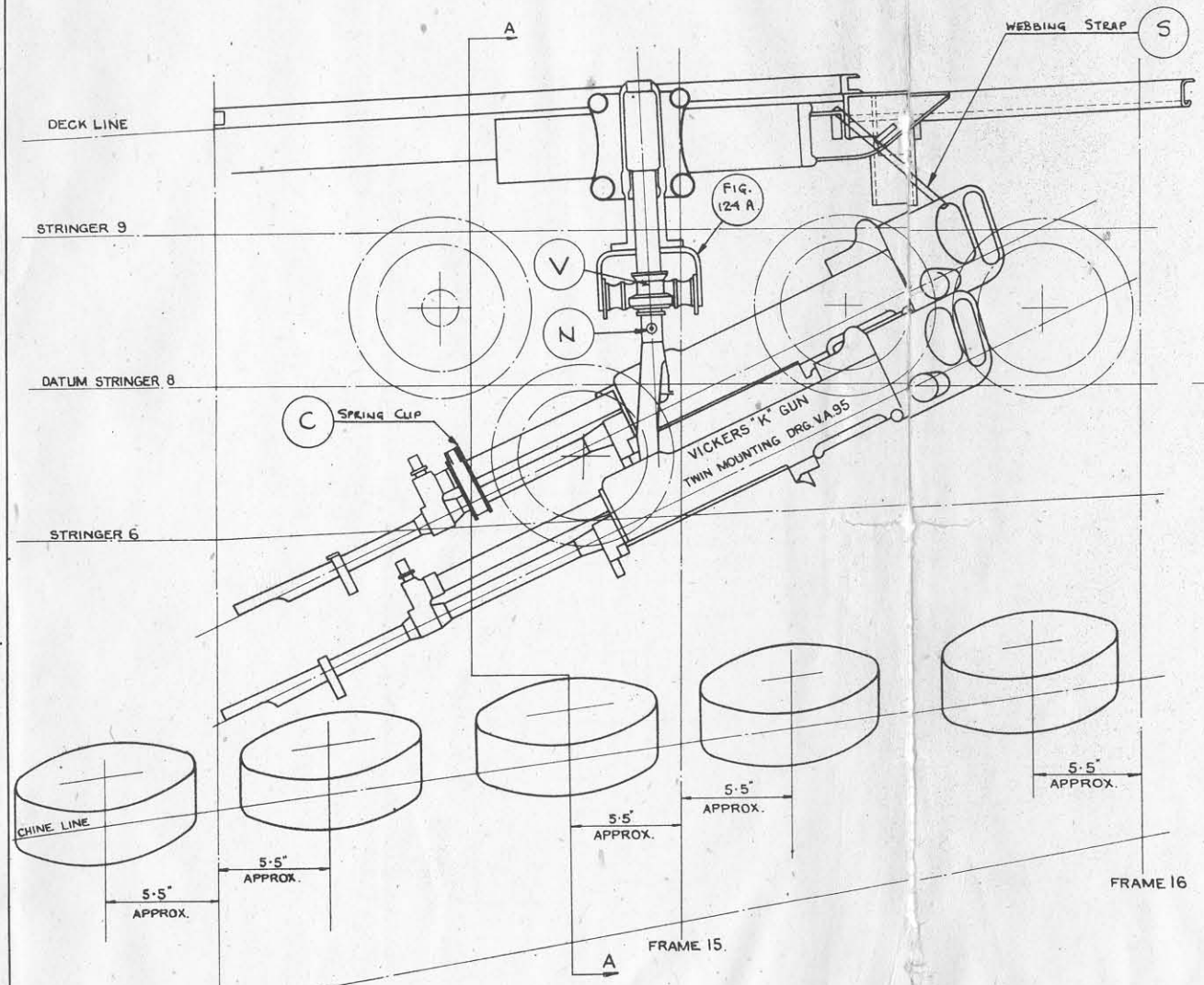
(i) Release gun barrels from spring clip (C).
(ii) Release the webbing strap on the gun handle (S).
(iii) Remove the quick-release pin (N).
(iv) Traverse the guns round to the centre-line of the aircraft.
(v) Swing the barrels up clear of the hatch coamings and get the guns into the firing position.
(vi) Secure the mounting in that position by means of the screws (V). (A.L.8)

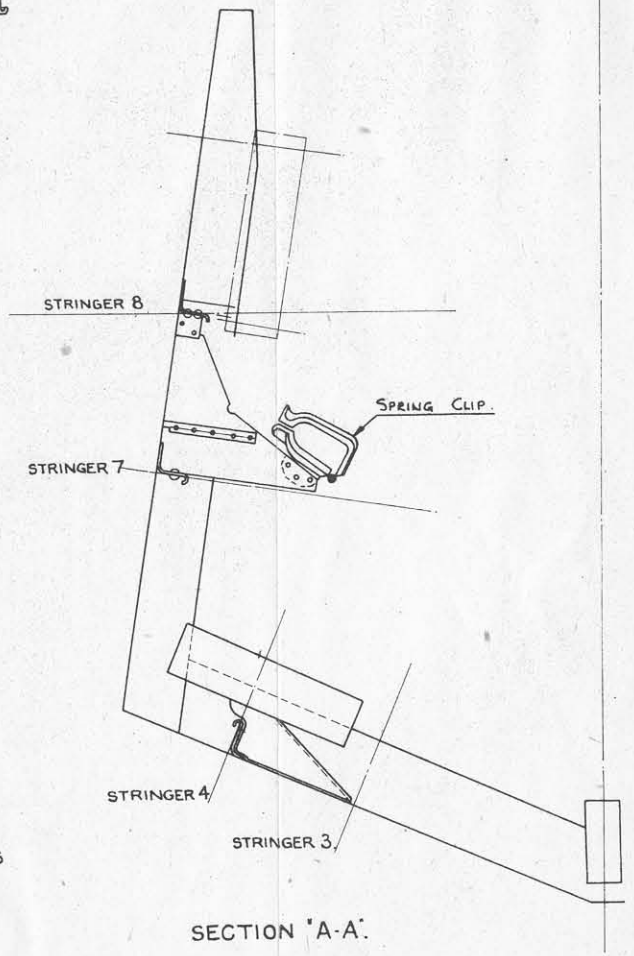
See Page 102

FIG. 123B

TWIN GUN MOUNTING, AFT COCKPIT

FIG. 123B





SECTION "A-A".

FIG. 123c

TWIN GUNS STOWAGE IN AFT TURRET

FIG. 123c

PP2660 M /1904 1/44 1000 C & P Gp. 959 (4)

211. *Aft gun turret.*—This turret is described in para. 25. The lightened gun track or runway (items (Z) and (N1) of figs. 124 and 125 respectively) forms a partial circle, stops (O1) at its port and starboard ends limiting the forward travel, on either side, of the jockey mounting.

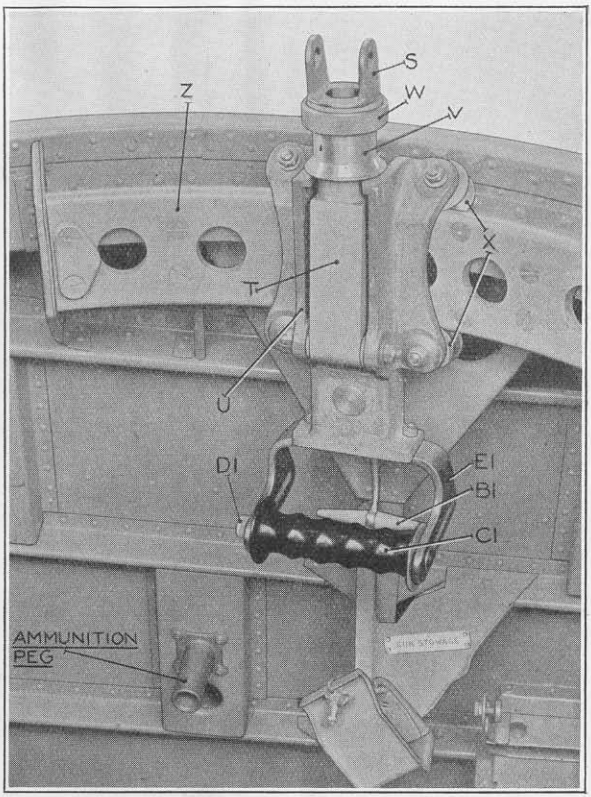


FIG. 124.—Aft gun mounting.

212. From the forward gun turret an unrestricted field of fire is obtained whilst from the rear gun turret the field of fire is restricted to the port and starboard sides, below the aeroplane and horizontally, and to the port and starboard sides and aft, above the aeroplane. The forward gun is stowed on the starboard side of the hull, at mid height below the forward turret, the rear gun being similarly stowed below the rear gun turret, its muzzle end pointing forwards and down. Five ammunition drum stowage pegs (item (E8) of fig. 126)

are provided below the forward gun turret, two on the starboard side and three on the port side, whilst five ammunition pegs (item (G6) of fig. 4) are also provided below the rear gun turret, four on the starboard side and one on the port side. (*See* also fig. 139, item 32), insert ship here.

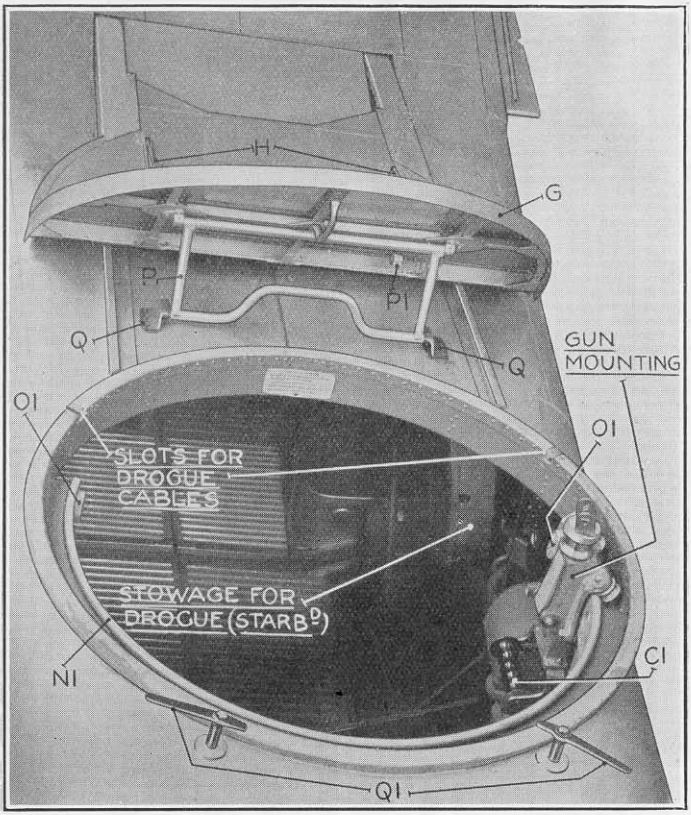


FIG. 125.—Aft gun turret.

Signal Pistol

213. A signal pistol (*see* fig. 139, item 27), 1½ in. No. 2, is provided and is mounted on the port side of the cockpit, immediately aft of the transverse line through the pilot's seat, within easy reach of the pilot. Stowage for two signal pistol and four smoke puff cartridges are also provided on the port side, below and in line transversely with the pilot's seat.

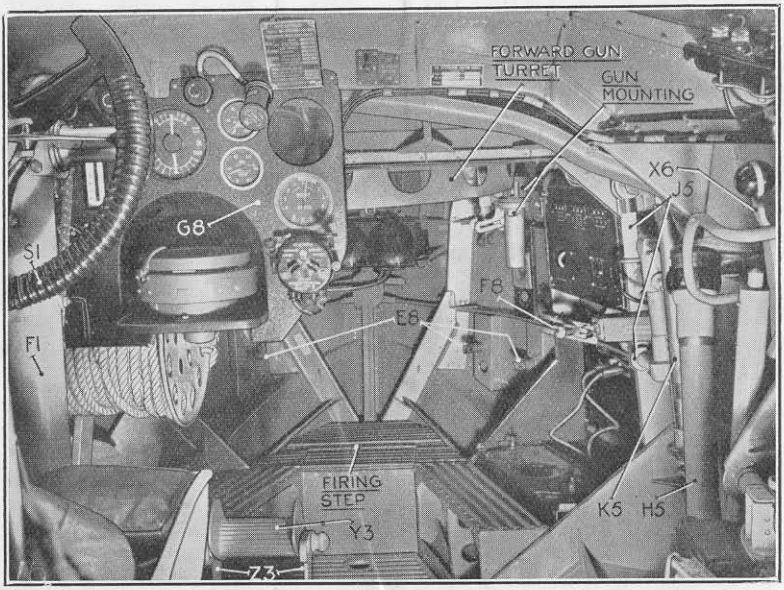


FIG. 126.—Forward gun station.

Bombs

214. Provision is made for carrying and releasing the ollowing alternative bomb loads (*see* fig. 127) :—

(i) 4— { 100-lb. A.S. or 112-lb. R.L. or 120-lb. G.P. } with light series carrier on port side only.

(ii) 2— { 250-lb. R.L. or 250-lb. A.S. or 250-lb. G.P. or 250-lb. S.A.P. } with light series carrier on port side only.

(iii) 8— { 20-lb. or 8½-lb. practice bombs } on light series carriers 1 port side, 1 starboard side.

With (i) and (ii) the following are alternatives to the light bombs :—

4— { Reconnaissance flares or Smoke floats }

The bombs referred to above are carried by universal and light series carriers as described in para. 207.

214. For alternative bomb loads, *see* fig. 127A.

The following table gives miximum permissible angles of flight for releasing bombs:—

Bomb item	Carrier	Ref. on Fig. 127A	Bank level flight
250 lb.	inboard universal	(a) (b)	25°
250 lb. depth charge	inboard universal	(f)	25°
100 lb.	twin	(c)	18°
100 lb.	outboard universal	(c)	45°
40 lb.	inboard bomb on twin	(d) (e)	30°
40 lb.	outboard bomb on twin	(d) (c)	45°
40 lb.	light series	(a) (d)	25°
20 lb.	light series	(e)	25°
Alternative loads (A)	light series	(a) (b) (d) (e)	25°

Diving angle (0°–10° bank) 90° in every case. (A.L.8)

Universal bomb carrier, Mk. III (Alternative to Mk. II)

214A. Owing to the forked support lugs on this carrier having one side of the forks tapped $\frac{1}{4}$ in. B.S.F. and the other side plain $\frac{1}{4}$ in. hole, it is only possible to insert the securing bolt from one side. It will, therefore, be necessary to ream out the tapped holes to $\frac{1}{4}$ in., fit "B" on the front support lug, of which there are four per aircraft. The rear support lugs may either have their tapped holes reamed to $\frac{1}{4}$ in., fit "B", or the aluminium box fairing in the way of the lug may be beaten in neatly, with a wooden mallet, to the extent of 0·08 in. (*see* fig. 127B).

214B. First assemble the carrier to the front lug and, after partly inserting the bolt through one side of the fork on the rear lug, swing the carrier up into position, and then work the bolt right through. (A.L.8)

215. *Bomb loading.*—Before commencing loading operations, verify that the bombs mounted on the universal carriers No. 1 are safe in their slips by pressing the release lever towards the slip. This ensures that the hook of the lever is fully engaged with the recess in the slip toggle bar. The external arm of the release lever assumes an approximately vertical position when the engagement is as indicated in position (ii) of plate 13, Chapter 7 of A.P. 1243, Volume I. See that the master control switch on the port side of the pilot's instrument panel is in the " off " position.

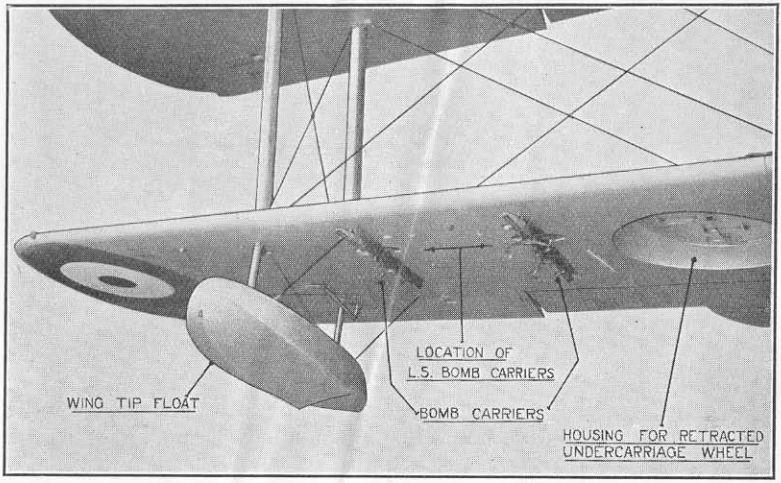


FIG. 127.—Bomb carriers—under bottom plane (starboard).

216. The electrical supply for the operation of the electromagnetic bomb-release gear is derived from the 12-volt general services accumulator. The 100-lb., 112-lb., 120-lb. and 250-lb. bombs are fused mechanically by the operation of a lever (item (F8) of figs. 101 and 126) mounted on the starboard side of the front cockpit and a cable (*see* also fig. 128) (item (U8) of figs. 100 and 109). Electrical fusing is not provided but the aeroplane is wired for this service, provision being made for mounting bomb fusing switchboxes on the panels.

217. *Bomb sight mounting.*—Provision is made on the starboard bow, forward of the forward gun turret, for mounting a course-setting bomb sight which is slipped into a slide and secured by a single fastening. A stowage slide, similar to that on the starboard bow, is fitted to a mounting on the starboard side of the hull, aft of frame No. 11, the bomb sight being

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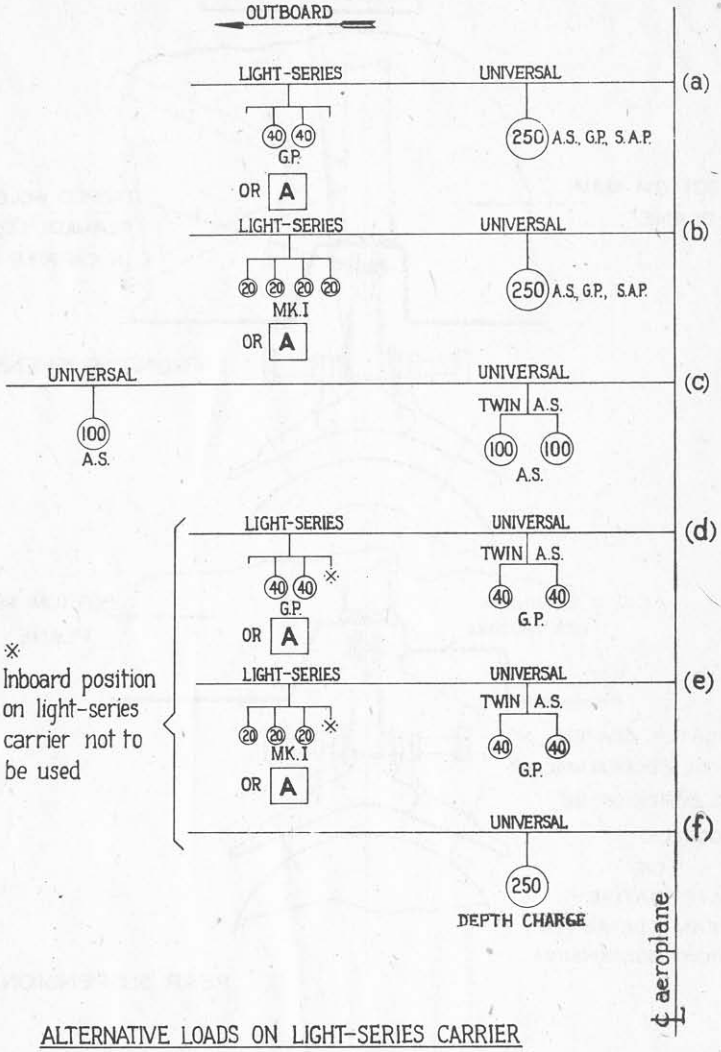

ALTERNATIVE LOADS ON LIGHT-SERIES CARRIER

A

- 4 – 11 lbs. smoke floats. Nº I. Mk. III 12D/267
- OR 4 – 101 lbs. practice bombs. Mk. I (flash) 12D/345
- OR 4 – 101 lbs. practice bombs. Mk. I. (smoke) 12D/344
- OR 4 – 4" training reconn. flares. Mk. III 12D/208
- OR 4 – 4·5" reconn. flares. Mk. III 12D/243

8 items can be carried, comprising any 2 of the named groups of 4

FIG. 127A, BOMB LOADING DIAGRAM

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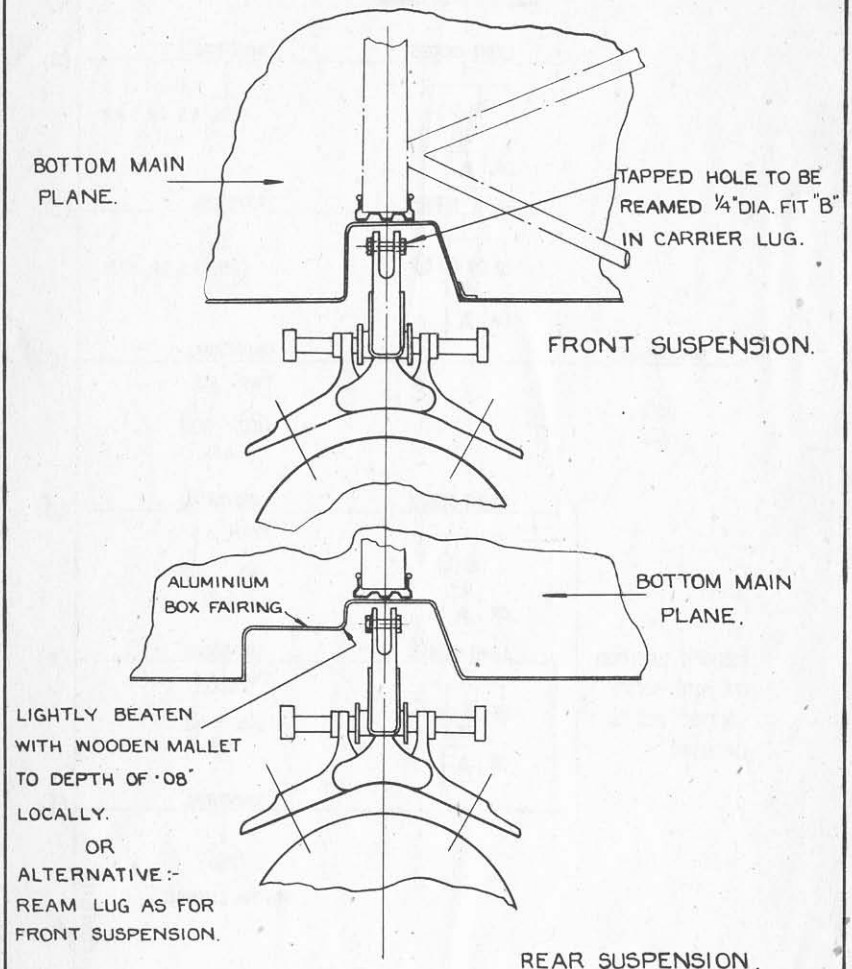
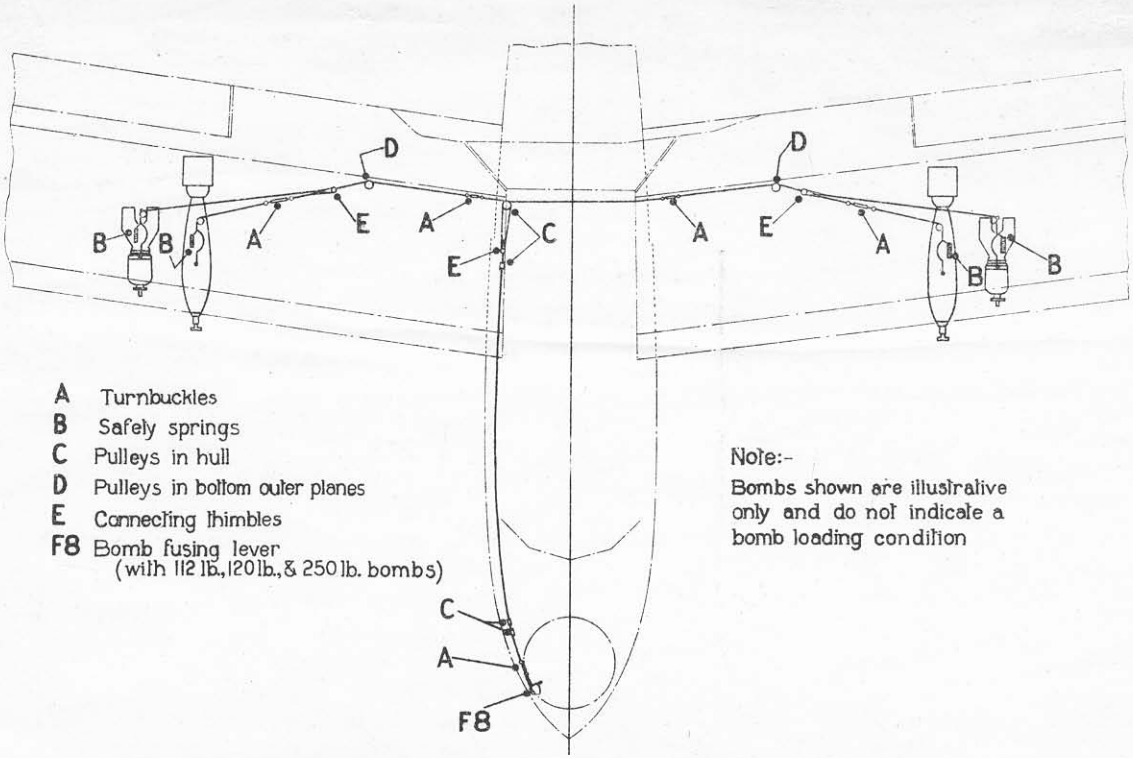


FIG. 127 B	SUSPENSION LUG ATTACHMENTS ON UNIVERSAL BOMB CARRIER MK III	FIG. 127 B



A Turnbuckles
B Safety springs
C Pulleys in hull
D Pulleys in bottom outer planes
E Connecting thimbles
F8 Bomb fusing lever (with 112 lb., 120 lb., & 250 lb. bombs)

Note:-
Bombs shown are illustrative only and do not indicate a bomb loading condition

FIG. 128, ARRANGEMENT OF BOMB FUSING CABLES

stowed vertically between frames Nos. 11 and 12 and clear of the gangway. It is most important that the safety lanyard be attached to the bomb sight, as shown in fig. 129, whenever the bomb sight is mounted for use.

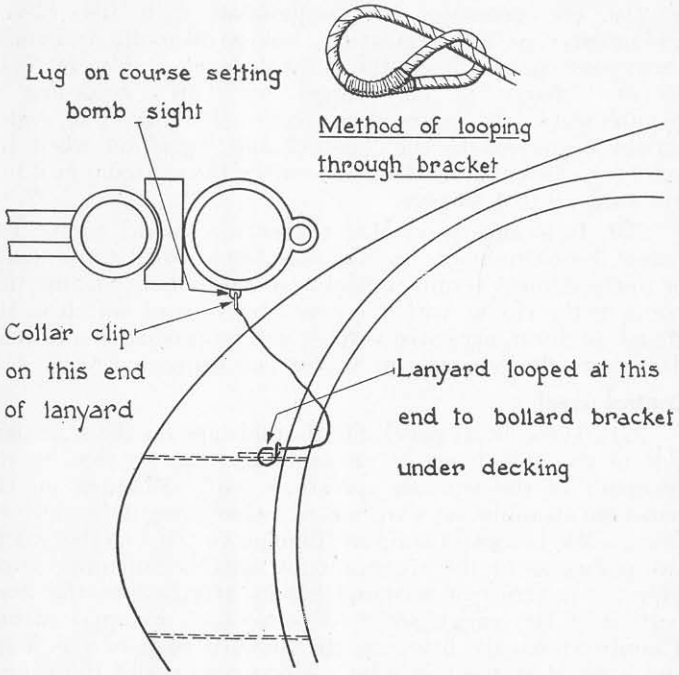


FIG. 129.—Bomb sight lanyard attachment.

ELECTRICAL

General

218. The electrical services are supplied from a 12-volt, 500-watt engine-driven generator which is mounted on the port side of the engine nacelle and driven by the engine by means of bevel gears and shafting. A cowl, on the port side of the nacelle, admits air into the nacelle through two pipes, the air stream circulating over and cooling the body of the generator. Access to the generator brush cover, which can be removed for inspection of the brushes, is afforded by a large door, on the port side of the nacelle, above and aft of the cowl, the door being hinged at its forward end. To facilitate inspection a lamp may be introduced at the holes in the generator mounting, opposite the brush positions. Should it be necessary to replace a brush or brushes it is advisable to withdraw the generator complete by releasing the four attachment bolts, at the upper end. It is essential that correct

alignment is obtained between the generator drive and the generator. To assist in this alignment the bolt holes in the mounting on the nacelle are $\frac{37}{64}$ in. diameter, thus making possible adjustment of the position of the $\frac{3}{8}$ in. diameter bolts.

219. The generator, in conjunction with the 12-volt accumulator, is self regulating, but a manually controlled three-position switch on the control panel enables it to be set at "charge", "half-charge" or "off" according to requirements. To prevent excessive charging, the switch should be moved to the "half-charge" position when the voltage exceeds 14·5. This will reduce the charging rate to a low value, 0 to 1 ampere.

220. It is imperative that the engine should not be run unless the accumulator leads are connected to an accumulator or to the dummy terminal block. Should a faulty connection occur in the circuit with the generator control switch in the charge position, excessive voltage will be produced and cause damage to the generator or any service connected to it.

Control panel

221. The control panel, fitted amidships on the starboard side of the hull, is set at an angle and can be seen by the occupant of the wireless operator's seat. Mounted on the panel are an ammeter, a voltmeter, a charge-regulating switch, fuses, a Mk. II cockpit lamp and dimmer switch, together with a two-pin socket for use in conjunction with the camera electrical supply. A series of terminal blocks attached to the fixed portion of the panel, serve to connect all external wiring. Thumb screws are fitted to the forward edge of the panel and a hinge at the rear edge. Upon removal of the thumb screws access to the rear of the panel may be obtained.

Accumulator

222. Provision is made on the starboard side of the front compartment between frames Nos. 1 and 2, for carrying a 12-volt 25 ampere hour, type N, accumulator.

Fused circuits

223. The twelve fused circuits together with the current carrying capacities of the fuses are as follows:—

(i)	Gun heating	10-amp.
(ii)	Pilot's instrument lamps	5-amp.
(iii)	Interior lighting and two-pin sockets	10-amp.
(iv)	Undercarriage indicators	5-amp.
(v)	Undercarriage horn	5-amp.
(vi)	Fuel-contents gauges	5-amp.
(vii)	Landing flares	10-amp.
(viii)	Identification lamps	5-amp.
(ix)	Navigation lamps	5-amp.
(x)	Bomb releases	20-amp.
(xi)	Motor generator	20-amp.
(xii)	Camera	10-amp.

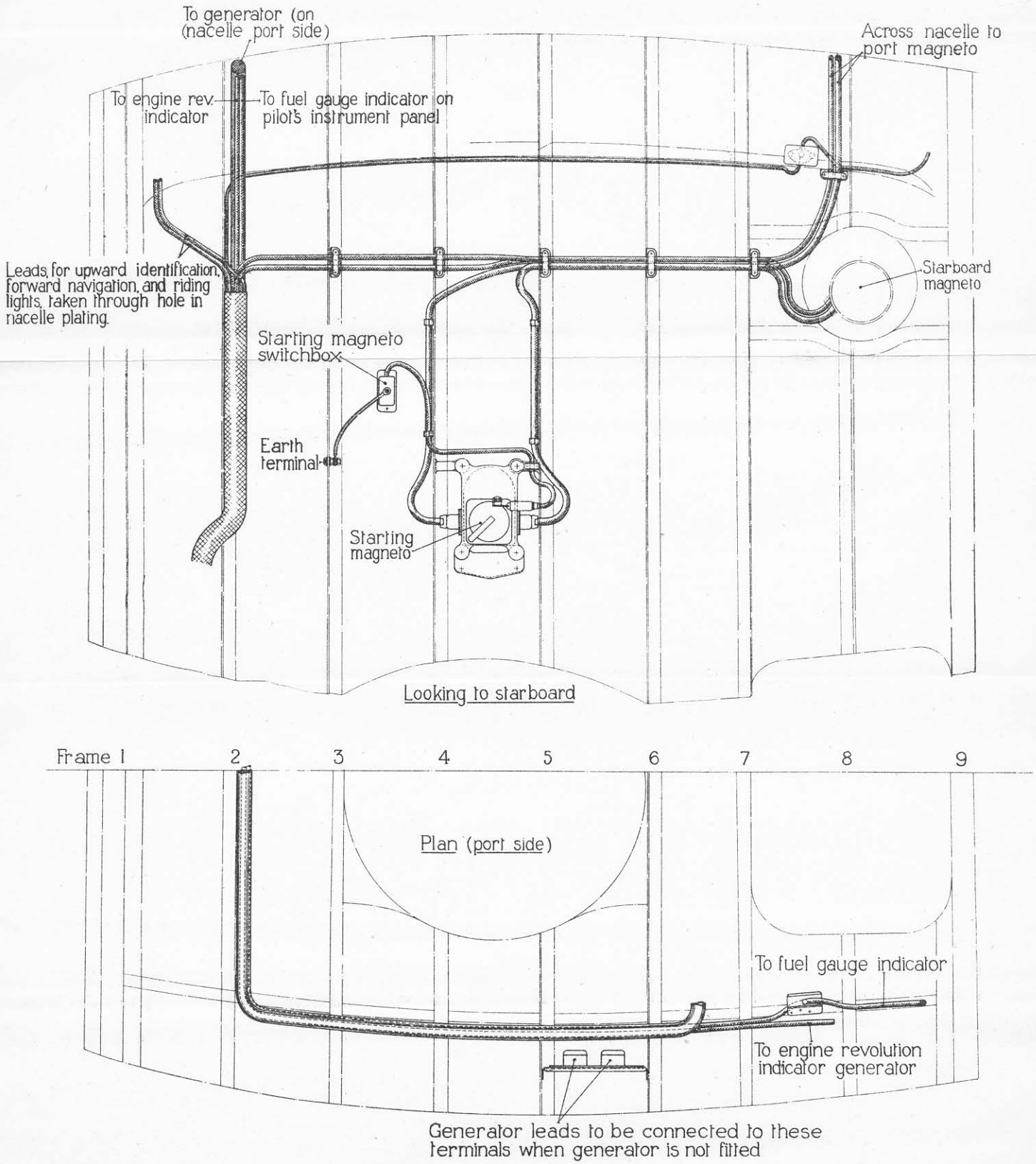
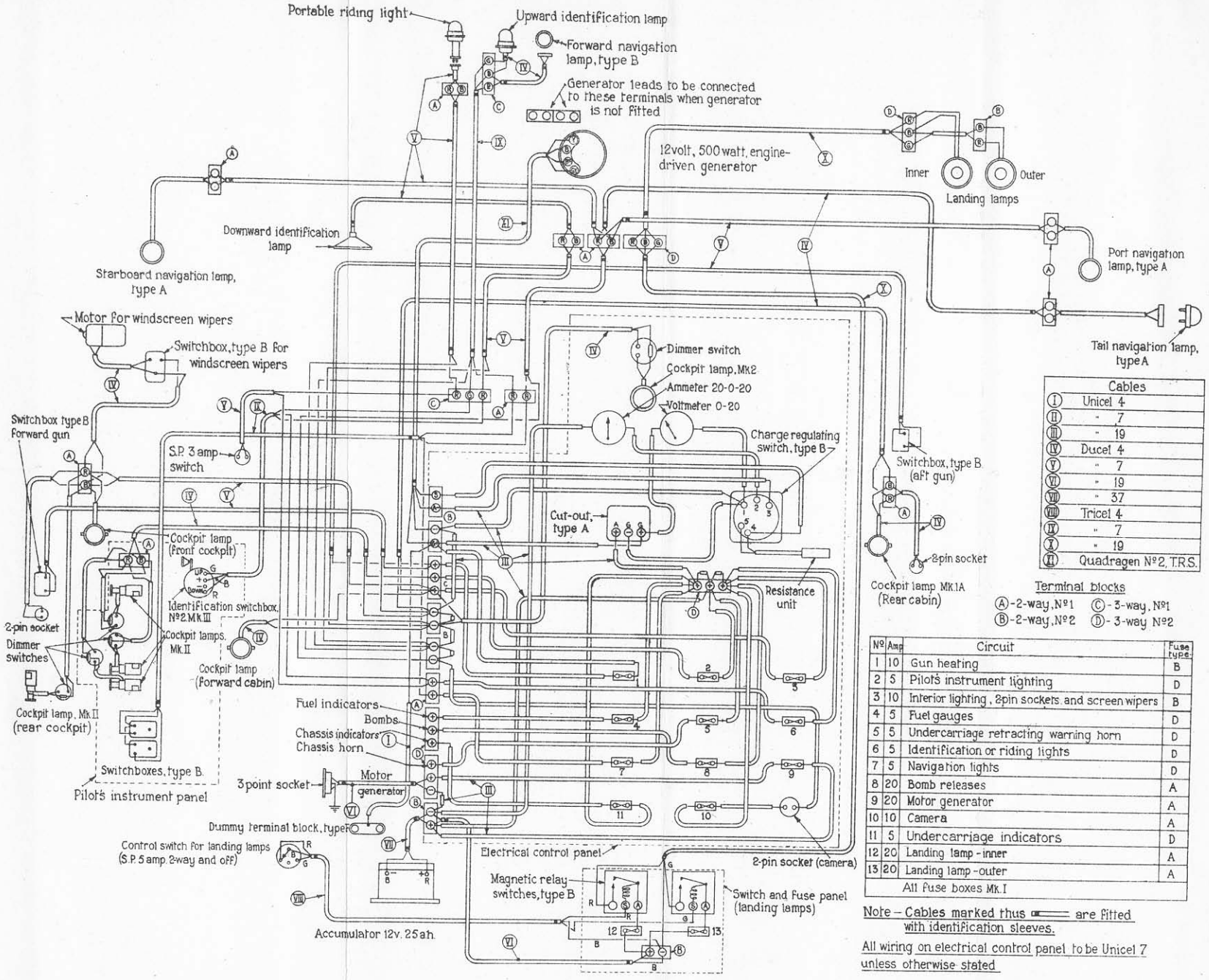


FIG. 130. ELECTRICAL EQUIPMENT OF ENGINE NACELLE



Cables	
I	Unicel 4
II	" 7
III	" 19
IV	Ducel 4
V	" 7
VI	" 19
VII	" 37
VIII	Tricel 4
IX	" 7
X	" 19
XI	Quadragen No2. T.R.S.

Terminal blocks

(A) - 2-way, No1 (C) - 3-way, No1
(B) - 2-way, No2 (D) - 3-way No2

No	Amp	Circuit	Fuse type
1	10	Gun heating	B
2	5	Pilot's instrument lighting	D
3	10	Interior lighting, 2pin sockets and screen wipers	B
4	5	Fuel gauges	D
5	5	Undercarriage retracting warning horn	D
6	5	Identification or riding lights	D
7	5	Navigation lights	D
8	20	Bomb releases	A
9	20	Motor generator	A
10	10	Camera	A
11	5	Undercarriage indicators	D
12	20	Landing lamp - inner	A
13	20	Landing lamp - outer	A
		All fuse boxes MK.I	

Note – Cables marked thus ═══ are fitted with identification sleeves.

All wiring on electrical control panel to be Unicel 7 unless otherwise stated

FIG.131. WIRING DIAGRAM OF ELECTRICAL EQUIPMENT

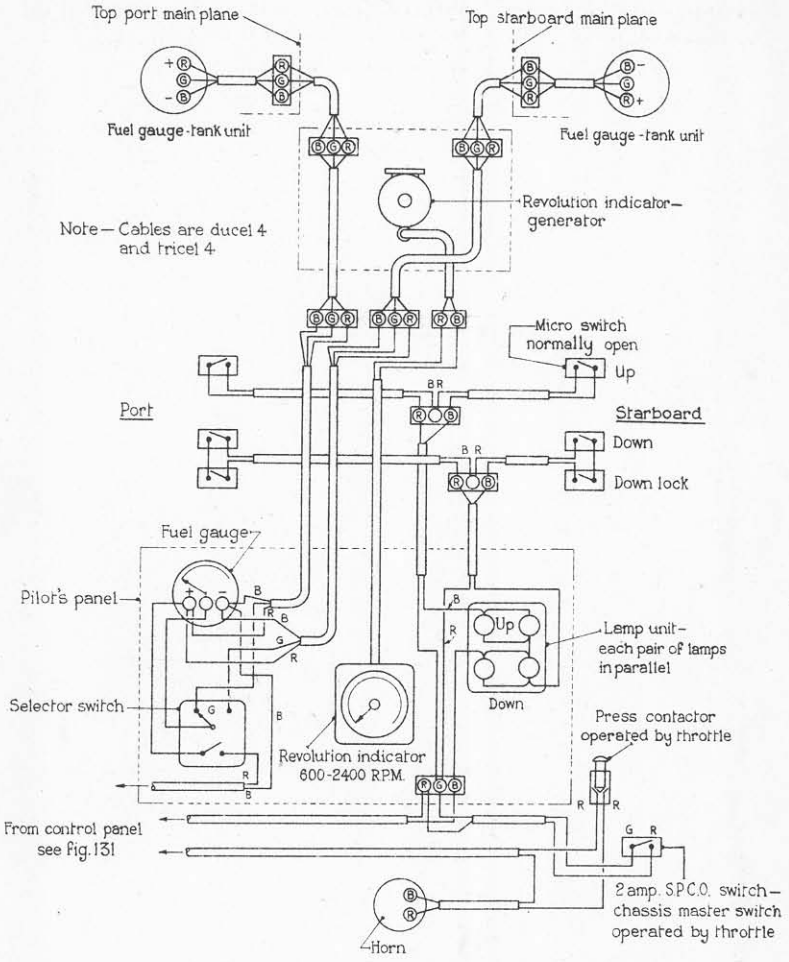


FIG.132. WIRING DIAGRAM OF ELECTRICAL INDICATORS

Wiring

224. The electrical wiring passing up the top centre plane starboard upper and lower front struts and through the main planes is carried in tubular conduits. The wiring from the electrical control panel amidships, forward to the pilot's cockpit and aft to the main plane distribution blocks, is enclosed in light channel members having sprung-on fronts.

225. The cables from the head navigation lamp, upward identification lamp and mooring lamp (*see* para. 50) on the top centre plane, are led down along the centre plane starboard upper front strut to the engine nacelle where they are joined by the ignition, engine speed indicator generator and fuel-contents gauge cables (*see* fig. 130), and continue down along the nacelle starboard lower front strut, to pass into the hull, above the control panel. The cables from the navigation lamps and flare brackets on the bottom planes are led into conduits just forward of the hinge positions. At these hinge positions extra length of cable is allowed which, when the planes are folded, is automatically taken up under a suitable cover provided over the terminal blocks amidships. A diagrammatic lay-out of the electrical services is given in fig. 131.

Mooring lamp and mast

226. The mooring lamp is mounted on a short mast which is inserted in the socket on the top centre section, adjacent to the identification lamp. The mooring lamp is controlled by a three-amp. tumbler switch positional above the forward edge of the cabin starboard window and arranged for push operation from inside and outside the hull. The mast is stowed inside the hull.

Signal lamp

227. A signal lamp and portable lamp are stowed on the port side of the hull amidships, and when required for use may be connected to the two-pin sockets in the front and rear gun cockpits.

Undercarriage and fuel-contents indicators

228. A diagram of these indicators is given in fig. 132. The undercarriage indicators, as stated in paras. 130 to 132, tell the pilot whether the undercarriage wheels are fully " up " or " down."

229. For the undercarriage wheels " down " position, two lamps, connected in parallel and housed behind the DOWN window of the undercarriage indicator on the pilot's instrument panel, are lighted when five switches connected in series are closed. These switches comprise one master switch (A) A27

(*see* para. 130) and four automatically-operated switches (B_p), (C_p), (B_s) and (C_s), the switches (B_p) and (C_p) being operated by the port undercarriage oleo leg striker (item (D1) of figs. 57, 60 and 133) and chine lock bolt three-arm operating lever (item (P1) of figs. 73 and 76) respectively, the switches (B_s) and (C_s) being similarly operated by the starboard undercarriage oleo leg striker and chine lock bolt three-arm operating lever respectively. Both port and starboard undercarriage units must be in the fully "down" position before the indicator DOWN lamps are lighted. The four switches (B_p), (C_p), (B_s) and (C_s) are press button in their action. For the removal of switches (B_p) and (B_s) reference should be made to para. 261.

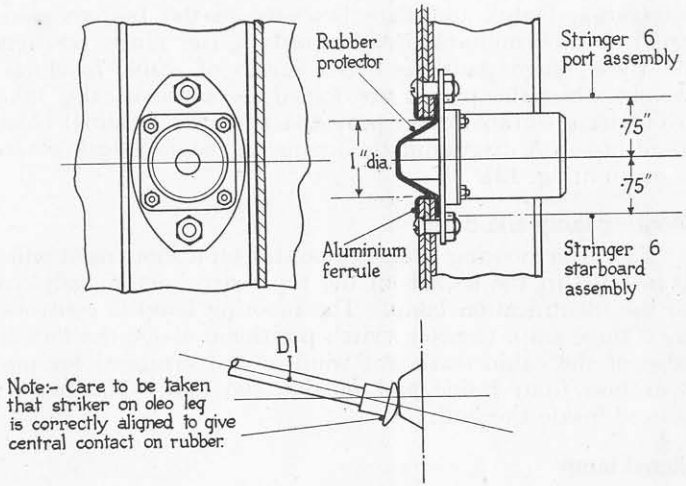


FIG. 133.—Oleo leg operated warning push switch.

230. For the undercarriage wheels "up" position, two lamps, connected in parallel and housed behind the UP window of the undercarriage indicator on the pilot's instrument panel, are lighted when three switches, connected in series, are closed. These switches comprise the master switch (A), (*see* paras. 130 and 229) and two automatically-operated switches (D_p) and (D_s), the latter being mounted on the forward side of hull frame No. 8B and operated by the corresponding undercarriage hydraulic ram crosshead pin (item (R1) of fig. 68) (*see* para. 130). The electric horn circuit is also shown in fig. 132, the purpose and operation of this horn being given in para. 231.

(*see* para. 130) and four automatically-operated switches which are controlled by the undercarriage oleo leg strikers and the chine lock bolt three arm operating levers. A4.7. starboard undercarriage oleo leg striker and chine lock bolt three-arm operating lever respectively. Both port and starboard undercarriage units must be in the fully "down" position before the indicator DOWN lamps are lighted. The four switches (B_p), (C_p), (B_s) and (C_s) are press button in their action. For the removal of switches (B_p) and (B_s) reference should be made to para. 261.

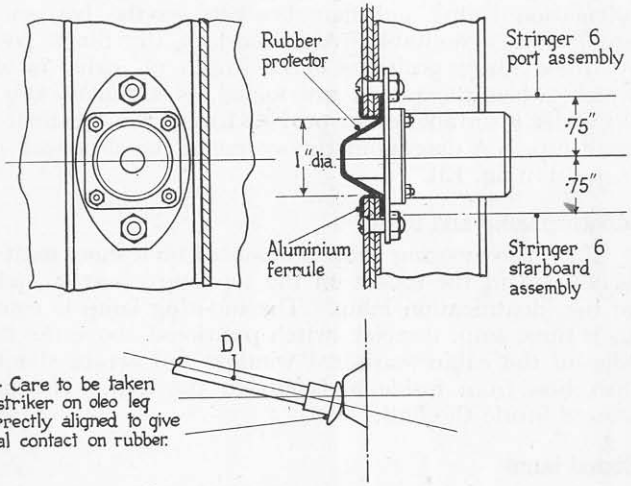


FIG. 133.—Oleo leg operated warning push switch.

230. For the undercarriage wheels "up" position, two lamps, connected in parallel and housed behind the UP window of the undercarriage indicator on the pilot's instrument panel, are lighted when three switches, connected in series, are closed. These switches comprise the master switch (A), (*see* paras. 130 and 229) and two automatically-operated switches (D_p) and (D_s), the latter being mounted on the forward side of hull frame No. 8B and operated by the corresponding undercarriage hydraulic ram crosshead pin (item (R1) of fig. 68) (*see* para. 130). The electric horn circuit is also shown in fig. 132, the purpose and operation of this horn being given in para. 231.

Warning horn contactor switch

231. The action of this switch is illustrated in fig. 134. The plunger (A) is depressed by the throttle lever against the action of the spring (B), and the contact (C) bridges the contacts (D) and (E) completing the circuit. If the push (F) is depressed by hand, the contact (E) is deflected away from (C) against the action of spring (K) and breaks the circuit. The push (F) will remain in the down position and the circuit remain broken as long as the plunger (A) is depressed, the tongue of the catch (G), by pressure of the spring (H), then being under the shoulder of the slot in (A). When the plunger (A) is released the tongue of catch (G) is cleared and the push (F) is returned by means of the spring (J) to its normal position.

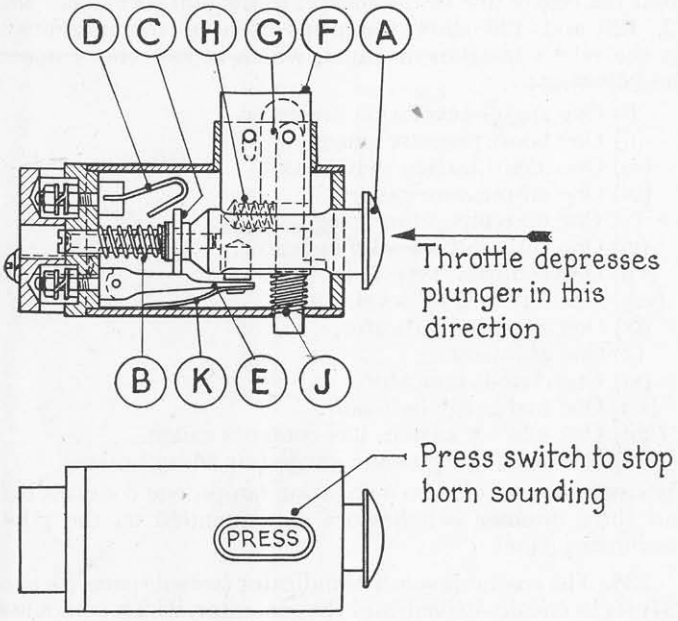


FIG. 134.—Warning horn contactor switch.

Windscreen wipers

232. The windscreen is fitted with twin wipers which are controlled by a switchbox, type B, located on the starboard side of the instrument panel. The driving motor for the wipers is positioned just forward of the throttle control lever and is coupled to the wipers by a length of flexible shafting encased in rigid tubing.

Camera

233. Provision is made for the installation and stowage of an air camera, type F.24. The position of the camera, together with the arrangement of the remote control electrical leads for the alternate positions are shown in fig. 135. The camera control ~~(item (178) of fig. 108)~~ is shown in its normal position.

Pilot's instrument panel

234. This is constructed of alclad, as a single unit, the port end deviating at an angle of approximately 45° rearwards. The instrument panel ~~(G8)~~ is mounted on the aft side of the upper portion of hull frame No. 3, extending approximately from the centre line of the cockpit to the hull port side. Figs. 72, 126 and 136 show the disposition of the instruments on the pilot's instrument panel, ~~which instruments comprise the following :-~~

(i) One engine-revolution indicator.
(ii) One boost pressure gauge.
(iii) One identification switchbox.
(iv) One oil pressure gauge.
(v) One oil temperature gauge.
(vi) One turn and ~~side-slip~~ bank indicator.
(vii) One compass, type P.4.
(viii) One fore-and-aft level.
(ix) One air-speed indicator.
(x) One altimeter.
(xi) One chassis indicator.
(xii) One fuel gauge indicator.
(xiii) One selector switch, fuel-contents gauge.
(xiv) One triple air pressure gauge (for wheel brakes).

Two main magnetos, two navigating lamps, one compass light and three dimmer switches are also mounted on the pilot's instrument panel.

235. The engine-revolution indicator (*see* sub-para. (i), para. 234) is electrically driven, and the generator, which is mounted in the nacelle and driven by a short length of flexible shafting, is coupled to a cirscale indicator on the pilot's instrument panel. A diagram of the connection for this electrically-driven engine-speed indicator is given in fig. 132.

Air temperature thermometer

236. The air thermometer bulb is mounted outside the nose of the aeroplane (*see* fig. 17) on the port side, immediately forward of hull frame No. 1. From the bulb, capillary tubing is led to a Mk. II type transmitting temperature indicator

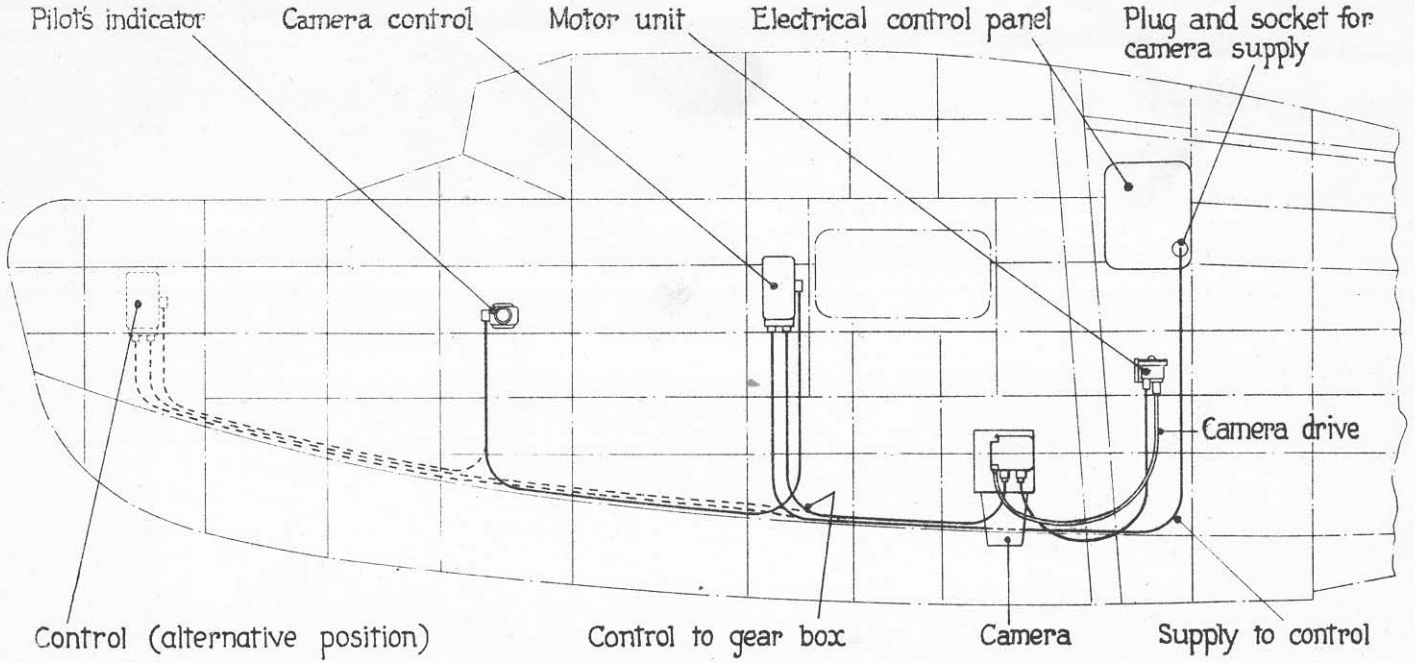


FIG. 135. CAMERA CONTROLS, (ON ST'BD. SIDE)

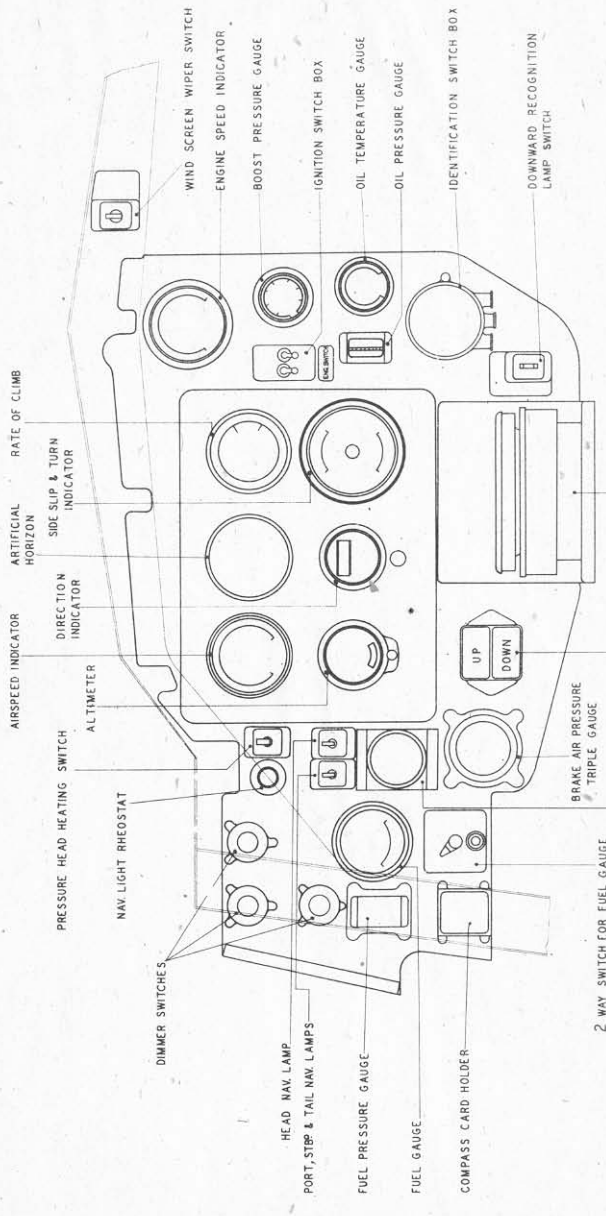


FIG. 136

INSTRUMENT PANEL IN PILOT'S COCKPIT

FIG. 136

PP2660 M /1904 1/44 1000 C & P Gp. 959 (4)

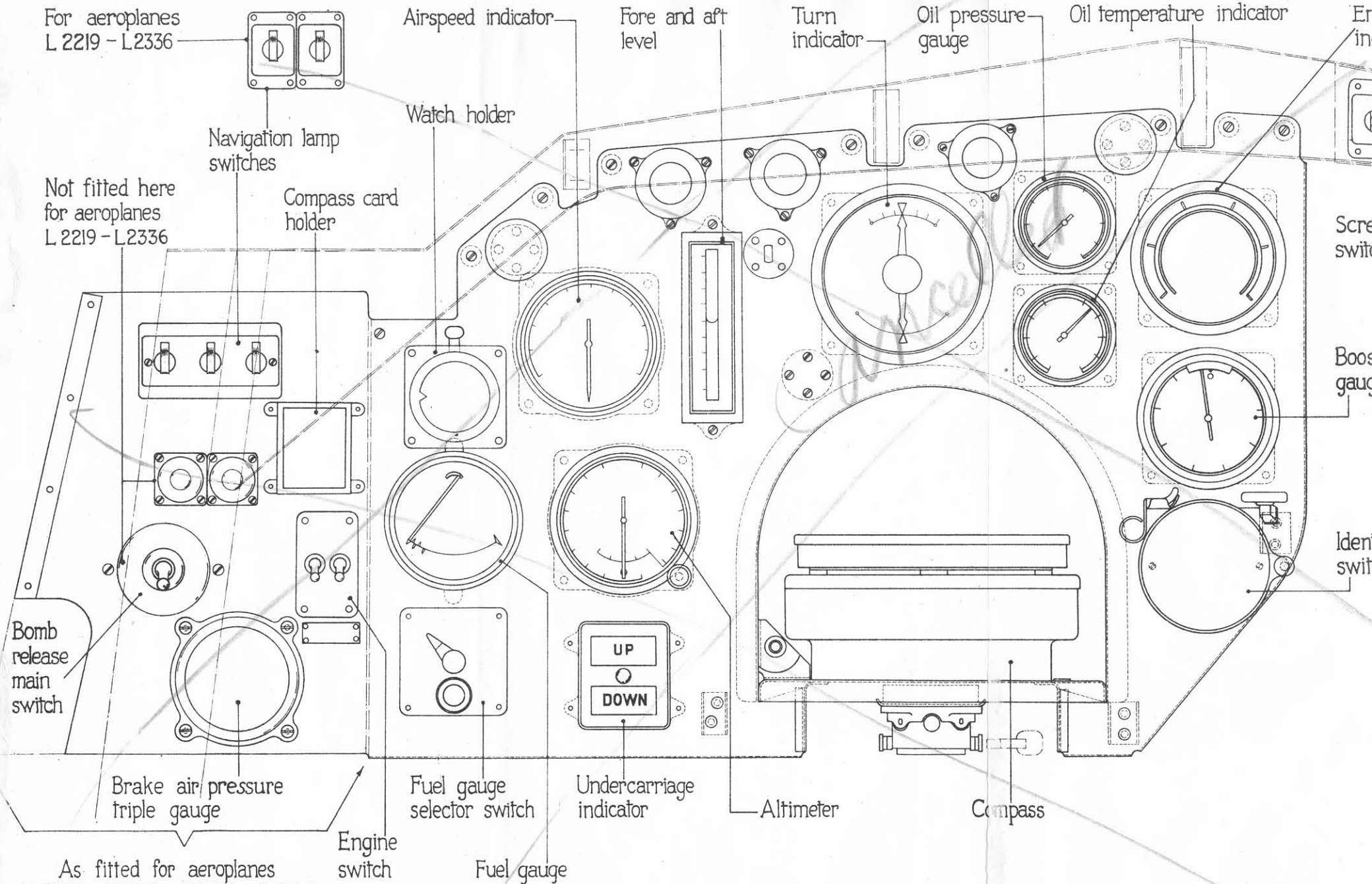


FIG.136. INSTRUMENT PANEL IN PILOT'S COCKPIT

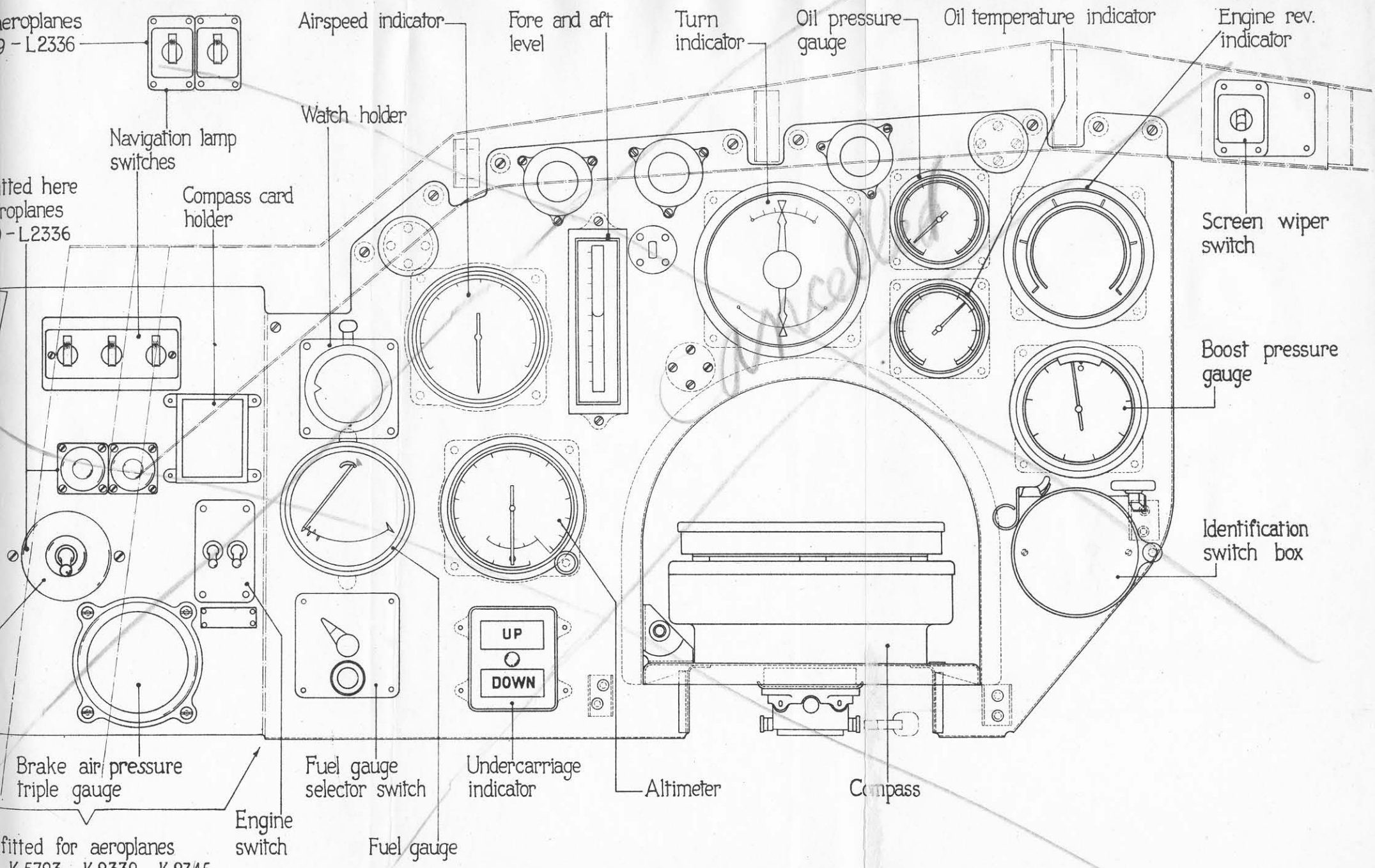


FIG.136. INSTRUMENT PANEL IN PILOT'S COCKPIT

mounted on the pilot's instrument panel. The thermometer bulb is protected by a vertical light alloy sun shield secured to the hull.

Pressure head

237. For the position and angular setting of the pressure head refer to "Leading Particulars," page xiv and figs. 1 and 17.

MISCELLANEOUS

Dinghy

238. A dinghy, type C, constructed of treated silk fabric, is provided, the dinghy being gas (carbon dioxide) filled when in use. A description of this dinghy, together with details of its construction and instructions for its maintenance, is given in Air Publication 1464B, Vol. I, Part 5, Section 12, Chapter 3, paras. 18 to 21. Stowage for the dinghy, gas cylinder (type CO_2 Mk. I), and operating head (type B), is provided (*see* fig. 139) within the hull, on the starboard side, between frames Nos. 12 and 13.

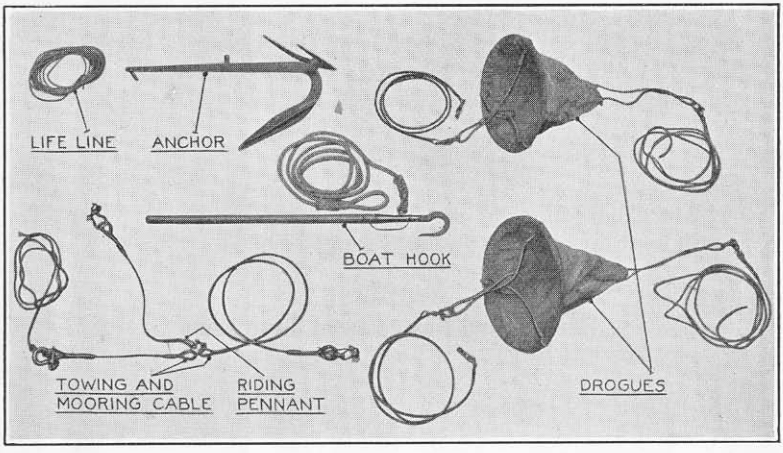


FIG. 137.—Marine equipment.

Slinging gear

239. Slinging gear, consisting of two 60-cwt. cables and two 140-cwt. cables, is attached to the top centre section for hoisting the complete aeroplane. The 60-cwt. cables are secured by shackles to fittings on the front spar and the 140-cwt. cables are similarly attached to fittings on the rear spar. The upper ends of the cables are spliced over thimbles carried by a triangular ring, through which the slinging hook is passed.

mounted on the pilot's instrument panel. The thermometer bulb is protected by a vertical light alloy sun shield secured to the hull.

Pressure head

237. For the position and angular setting of the pressure head refer to "Leading Particulars," page xiv and figs. 1 and 17.

(50) Para. 237. At the end of this paragraph *add* the following:—

On aeroplanes incorporating Mod. 361, drainage points are provided on the pressure head system between frames 6 and 7 (*see* fig. 2) on the port side just above the floor level. Two drainage points are also provided on the underside of the port bottom main plane at the root end and adjacent to the rear spar.

when in use. A description of this [illegible] details of its construction and instructions for its maintenance, is given in Air Publication 1464B, Vol. I, Part 5, Section 12, Chapter 3, paras. 18 to 21. Stowage for the dinghy, gas cylinder (type CO_2 Mk. I), and operating head (type B), is provided (*see* fig. 139) within the hull, on the starboard side, between frames Nos. 12 and 13.

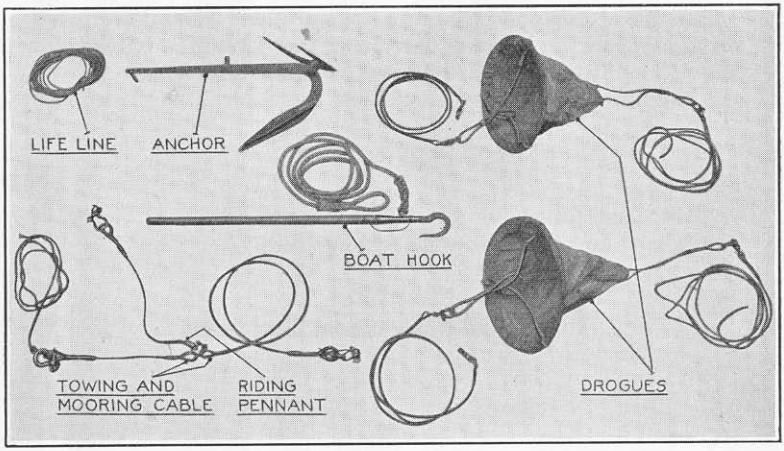


FIG. 137.—Marine equipment.

Slinging gear

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Jacking Pads

240. Jacking pads are fitted on each side of the hull at the chine on the front spar frame.

Marine equipment

241. The mooring cable (*see* figs. 1, 8 and 137) is led to the riding pennant forward U-shackle, thence to the mooring buoy. Portable double bollards (*see* para. 34) are fitted in the bows forward of the front cockpit. The disposition of the remainder of the marine equipment is given in para. 244, Table 1.

Holding-down fittings

242. An attachment point is provided on the tail wheel unit for holding down the aeroplane when running-up the engine. Fittings for lashing-down are located at the tops of the wing tip float struts (*see* para. 296).

Handling and stowage gear

243. The gear (to special order) illustrated in figs. 138 and 150 to 153 is employed to secure the aeroplane when it is stowed on a catapult, an aircraft carrier or the deck of a battleship. Fig. 138 illustrates the handling, towing and hoisting gear, the slinging cables being stowed on the top centre plane.

EQUIPMENT

Stowage

244. The following are tables of the principal items of equipment and their stowage (*see* fig. 139).

TABLE 1

Marine and Navigational Equipment

Item No. Fig. 139	Items	No.	Stowage position
1	Anchor	1	Port side of front cockpit.
2	Sea anchors	2	Between frames 13 and 14, port and starboard.
3	Cordage reel	1	Front cockpit (*see* item (P8) of fig. 72).
4	Marine distress signals ..	6	3 under deck between frames 16 and 17. 3 in top centre plane.
5	Boathook	1	Under control frame.
6	Map case..	1	On side of control frame.
7	Navigating instrument case.	1	Forward of frame 8A, port.

Jacking Pads

240. Jacking pads are fitted on each side of the hull at the chine on the front spar frame.

Marine equipment

241. The mooring cable (*see* figs. 1, 8 and 137) is led to the riding pennant forward U-shackle, thence to the mooring buoy. Portable double bollards (*see* para. 34) are fitted in the bows forward of the front cockpit. The disposition of the remainder of the marine equipment is given in para. 244, Table 1.

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5	Boathook	1	Under control frame.
6	Map case..	1	On side of control frame.
7	Navigating instrument case.	1	Forward of frame 8A, port.

(51) Para. 244, Table 4. At the end of the table *add* the following:—

Not shown	1¼ lb. Incendiary bomb (Mod. 343)	1	Just aft of frame 3, starboard

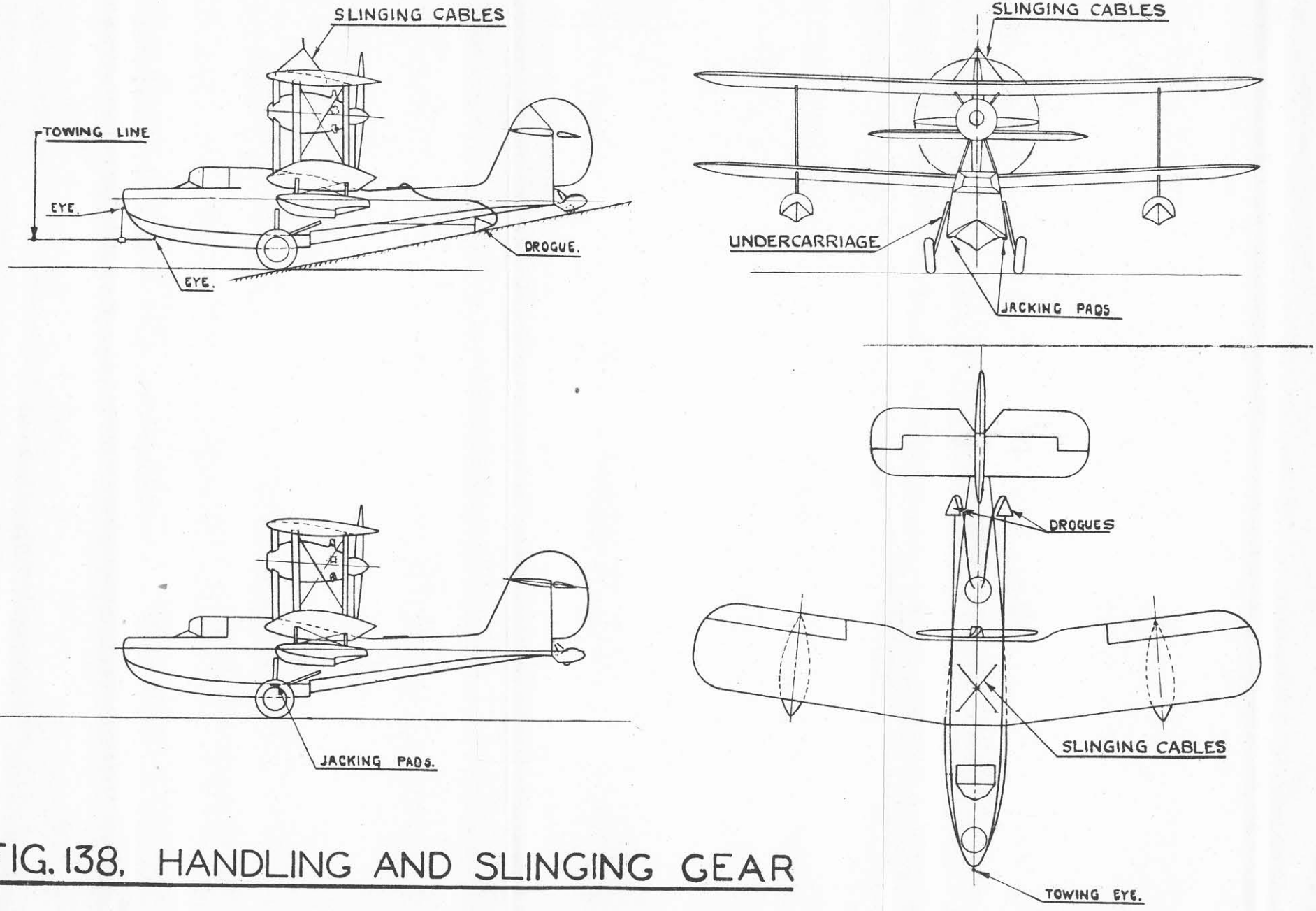

FIG. 138. HANDLING AND SLINGING GEAR

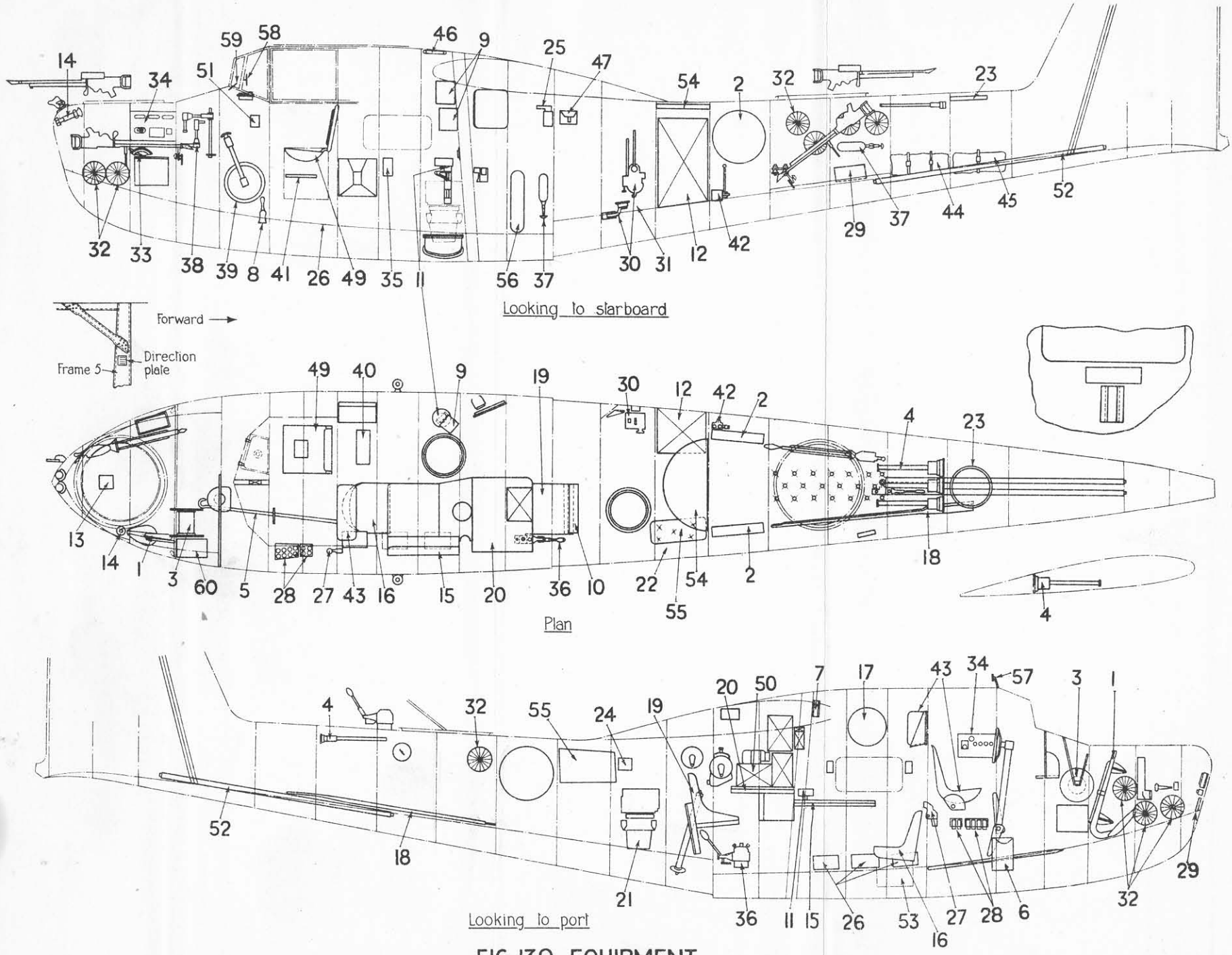

FIG.139. EQUIPMENT

TABLE 1—*contd.*

Item No. Fig. 139	Items.	No.	Stowage position.
8	Signal bell.	1	Forward of frame 4, starboard.
9	Sea markers	4	Forward of frame 8A, starboard (*see* items (L8) of fig. 109).
10	Charts and chart board..	1	Behind wireless seat.
11	0·2 compass	2	1 between frames 7 and 8A, starboard (*see* item (K8) of fig. 109). 1 on navigator's table.
12	Dinghy	1	Between frames 12 and 13, starboard.
13	Heaving line	1	Under fire step in front cockpit.
14	Mooring bollards ..	2	1 in bow. 1 between frames 1 and 1A, port
15	Navigating table ..	1	Between frames 5 and 6, port.
16	Navigating seat ..	1	Between frames 5 and 6, port.
17	Course-and-distance calculator.	1	Between frames 6 and 7, port.
18	Dinghy paddles ..	2	Between frames 14 and 18, port.

TABLE 2

Electrical and Photographic Equipment

Item No. Fig. 139	Items.	No.	Stowage position.
19	Wireless operator's seat	1	Between frames 9 and 11, port.
20	Wireless operator's table	1	Between frames 8A and 10, port.
21	Camera	1	Between frames 11 and 12, port.
22	Camera magazines ..	3	Between frames 12 and 13, port.
23	Sealing plate over camera opening.	1	Under deck between frames 17 and 18.
24	Signal lamp and aeroscope	1	Forward of frame 12, port.
25	Light filter	1	Forward of frame 10, starboard.

TABLE 3

Armament Equipment

Item No. Fig. 139.	Items.	No.	Stowage position
26	Flame-floats	3	1 between frames 5 and 6. 1 between frames 6 and 7. 1 between frames 7 and 8A
27	Signal pistol	1	Stowed within reach of pilot's hand, port.
28	Signal pistol cartridges..	8	Stowed within reach of pilot's hand, port.
	Signal pistol smoke puff cartridges.	4	Stowed within reach of pilot's hand, port.
29	Gun spares holdalls ..	2	1 front cockpit. 1 between frames 15 and 16, starboard.
30	Course-setting bomb sight	1	Between frames 11 and 12, starboard.
31	Guard for bomb sight ..	1	Between frames 11 and 12, starboard.
32	Magazine pegs	10	5 in front cockpit, port and starboard. 1 aft of frame 14, port. 4 rear cockpit, starboard.
33	Fusing lever	1	Aft of frame 1, starboard.
34	Bomb control panels ..	2	1 in front cockpit. 1 in pilot's cockpit.
35	Range finder	1	Under window of navigator's compartment, starboard (*see* item (J8) of fig. 109).

TABLE 4

Miscellaneous Equipment

Item No. Fig. 139.	Items.	No.	Stowage position.
36	Fuel handpump.. ..	1	Between frames 9 and 10, port.
37	Fire extinguishers ..	2	1 between frames 15 and 16, starboard. 1 between frames 10 and 11, starboard.
38	2nd pilot's rudder pedals	1	Between frames 2 and 3, starboard.

TABLE 4—*contd.*

Item No. Fig. 139.	Items.	No.	Stowage position
39	2nd pilot's control hand-wheel.	1	Between frames 3 and 4, starboard.
40	2nd pilot's headrest ..	1	Hinged under deck aft of bulkhead 5, starboard (*see* item (G8) of fig. 109).
41	2nd pilot's footrest ..	1	Between frames 4 and 5, starboard.
42	Bilge pump	1	Between frames 13 and 14, starboard.
43	Parachutes	3	1 pilot's seat. 1 between frames 5 and 6, starboard (*see* item (H8) of fig. 109). 1 aft of bulkhead 5.
44	Airscrew cover	1	Between frames 16 and 17, starboard.
45	Engine cover	1	Between frames 17 and 18, starboard.
46	Starting handle	1	Under deck between frames 7 and 8A, starboard.
47	First aid outfit	1	Between frames 10 and 11, starboard
Not shown	Fuel handpump hose ..	1	Port bottom outer plane.
49	2nd pilot's folding seat..	1	Between frames 4 and 5, starboard.
50	Power unit	1	Aft of frame 9, port.
51	Knee writing tablet ..	1	Between frames 3 and 4, starboard.
52	Jury struts	2	Between frames 15 and 20, starboard.
53	Safety belt	1	Underneath navigator's seat.
54	Front cockpit cover ..	1	Under deck between frames 12 and 13.
55	Rear cockpit cushion ..	1	Between frames 13 and 14, port.
56	Air container (brake system).	1	Aft of frame 9, starboard.
57	Pilot's mirror	1	On top of cabin, port.
58	Pilot's mirror	1	Inside cabin, starboard.
59	Engine data plate ..	1	In centre of cabin windscreen.
Not shown	Slinging gear	1	On the top centre plane.
60	0·2 compass frame ..	1	Between frames 2 and 3, port.

Towed target gear

245. Provision is made on the aeroplane, under Mod. No. Walrus/45, for carrying towed targets and the necessary manipulating gear. Normally, the aeroplane is loaded in accordance with Weight Sheet Summary No. 532, but when towed target gear is fitted (to special order) the following items are to be removed so that the total weight stated in the Weight Sheet Summary may not be exceeded.

(i) Guns and ammunition carried in front and rear cockpits.

(ii) Smoke floats situated in the port side of the pilot's cockpit.

(iii) Light series carriers on the underside of the bottom outer main planes.

(iv) Camera F.24 from its stowage on the port side, between hull frames Nos. 11 and 12.

(v) One of the crew (Navigator).

246. The arrangement of the towed target gear is shown in fig. 140, this gear principally comprising three targets, two containers, a windmill-driven winch, winch support structure and necessary cables, pulleys, mountings and controls. The targets are stowed in longitudinal containers fitted to the outside of the hull, immediately below the gunwales, between frames Nos. 10 and 17, a twin container being fitted to the port side and a single container fitted to the starboard side. The windmill-driven winch is a type B, Mk. II, and is described in A.P. 1492, Vol. 1, 2nd Edition, paras. 70 to 83, special reference to the diameter of the windmill for this aeroplane being given in para. 82.

247. The winch support shown in fig. 141 is a tubular duralumin rigid structure, the three forward feet of which are secured to internally fitted hull brackets mounted on the chine and keel, between hull frames Nos. 6 and 7, the two aft feet being secured to brackets mounted on the forward side of hull frame No. 8A. Longitudinal and transverse members (A) and (B) form a panel, to which the windmill-driven winch is bolted, the securing bolts passing vertically through the longitudinal members (A).

248. The cables securing the towed targets and the cables linking the launching frame to the target cables at the navigator's window are shown in fig. 140. The operations necessary to connect the launching frame cable to the target cables at the navigator's windows are as follows :—

(i) Remove the cover from the camera aperture.

(ii) Secure the pulley bracket (A) (*see* also item (C) of fig. 141) to the rear side of the camera circular

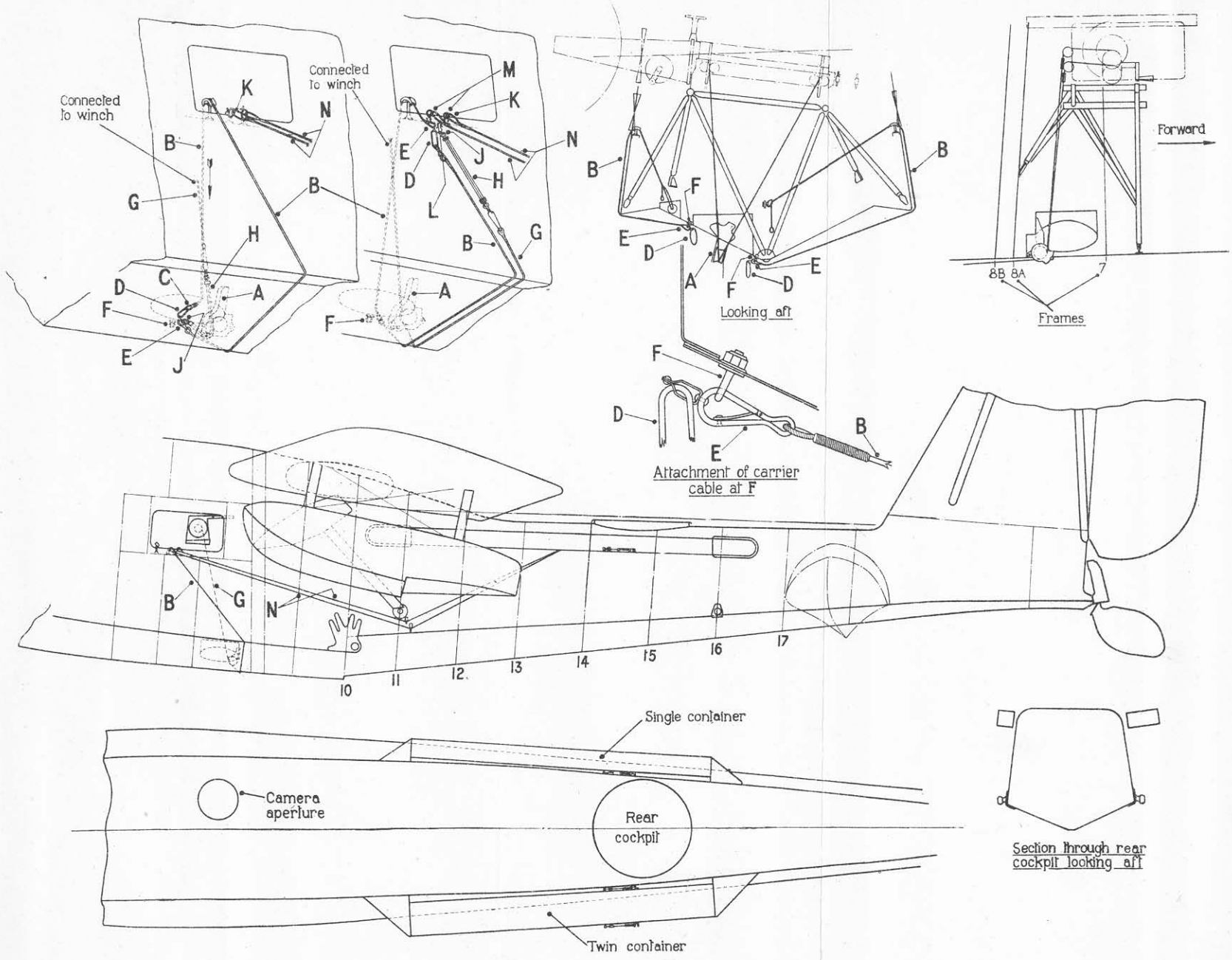

FIG.140. TOWED TARGET GEAR ARRANGEMENT

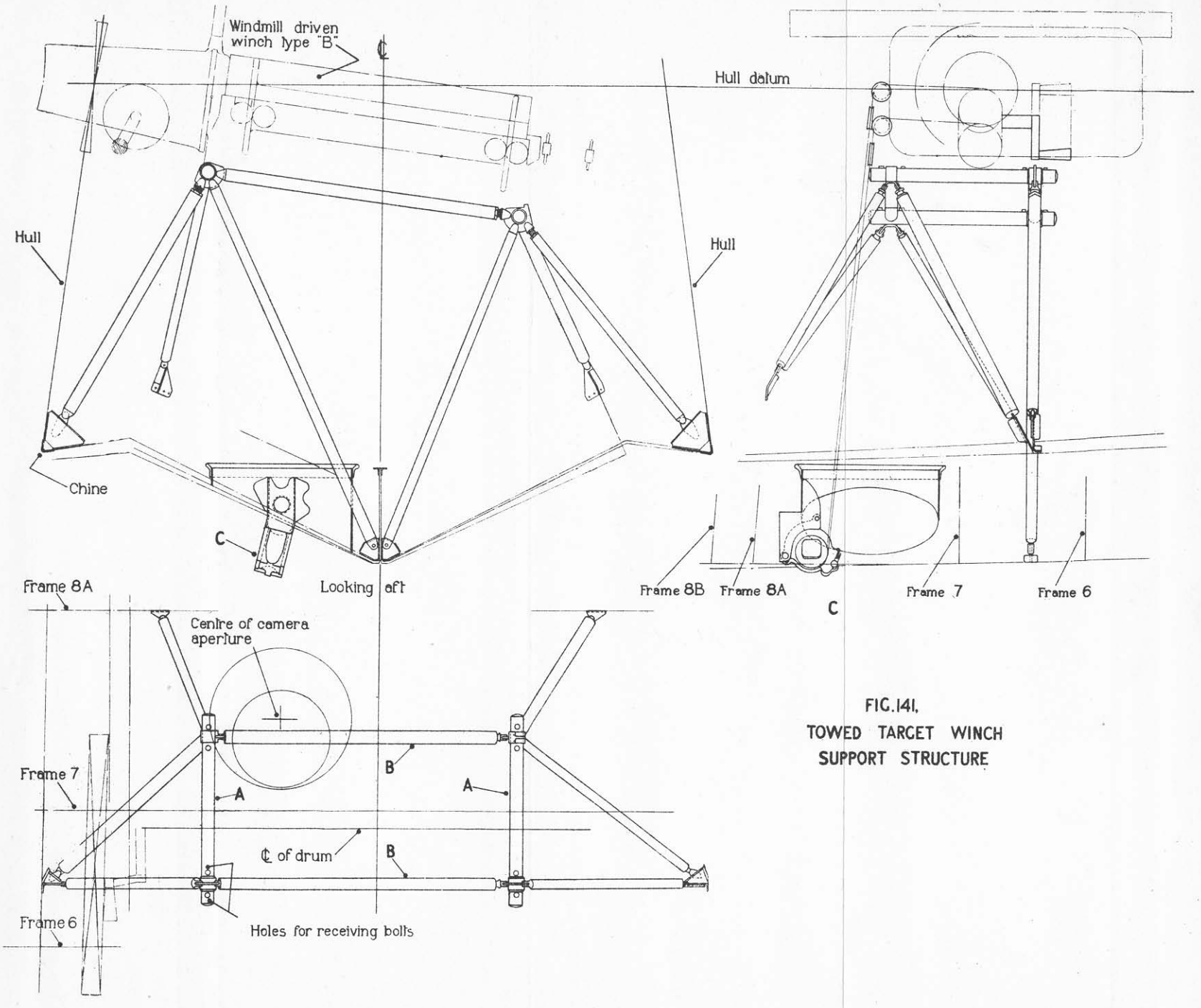

FIG.141.
TOWED TARGET WINCH
SUPPORT STRUCTURE

trunk by means of the three bolts forming an integral part of the bracket, a safety lanyard being first attached to the eyebolt on the cross girder adjacent to the camera trunk.

(iii) Unlash the carrier cable (B) inside the aeroplane from the struts or bracket, and attach hook (C) to loop (D).

(iv) Unhook hook (E) from the eyebolt (F) which is just outside the camera aperture, thus freeing the carrier cable, and pull the end of the carrier cable into the hull.

(v) Thread the signal halyard (G) and shock absorber (H) which has been previously attached to the winch cable, through the pulley (A), and attach the quick-release hook (J) at the free end of the shock absorber to hook (E). Care should be taken that the signal halyard is kept in a neat coil, preferably at the aft side of the camera aperture, and not allowed to cross or become entangled in the carrier cable as this may result in the interlocking of the cable when pulled round, thus making impossible the dropping of the target.

(vi) Pull the carrier cable (B) in the direction of the arrow shown, thus drawing the shock absorber and lower end portion of the signal halyard through the camera aperture, up the side of the aeroplane, to the forward side of the navigator's window.

(vii) Detach the shock absorber hook (J) from the carrier cable spring hook (E) and by means of a loose loop of cord (L) connect hook (J) to the loop (K) of the target cable (N) secured to the side of the aeroplane by means of the cord (M).

Note.—Several lengths of cord for looping hook (J) to the target cable should be carried in the aeroplane.

(viii) Cut the cord (M) on which action the flag is ready to be released by the operation of the bowden control.

(ix) The carrier cable (B) is then pulled round to its original position and its hook (E) again secured to its securing eyebolt (F), the other end being tied to its former anchorage in readiness for a new sequence of operations.

Note.—It is important to note that the flag targets can only be released when the undercarriage wheels are in their raised position, otherwise the cable would be trapped between the undercarriage leg and the side of the hull.

249. *Bowden control cables.*—The arrangement of these cables is shown in fig. 142. On the port side two bowden control cables are fitted, whilst on the starboard side one cable is fitted. On both port and starboard sides of the hull the ends of the cables (A) are secured to the operating bolts on the target containers (B), then led along the corresponding sides of the hull and containers to the navigator's window fixed covers (C), on which are mounted the bowden cable stops (D) and control pull rings (E).

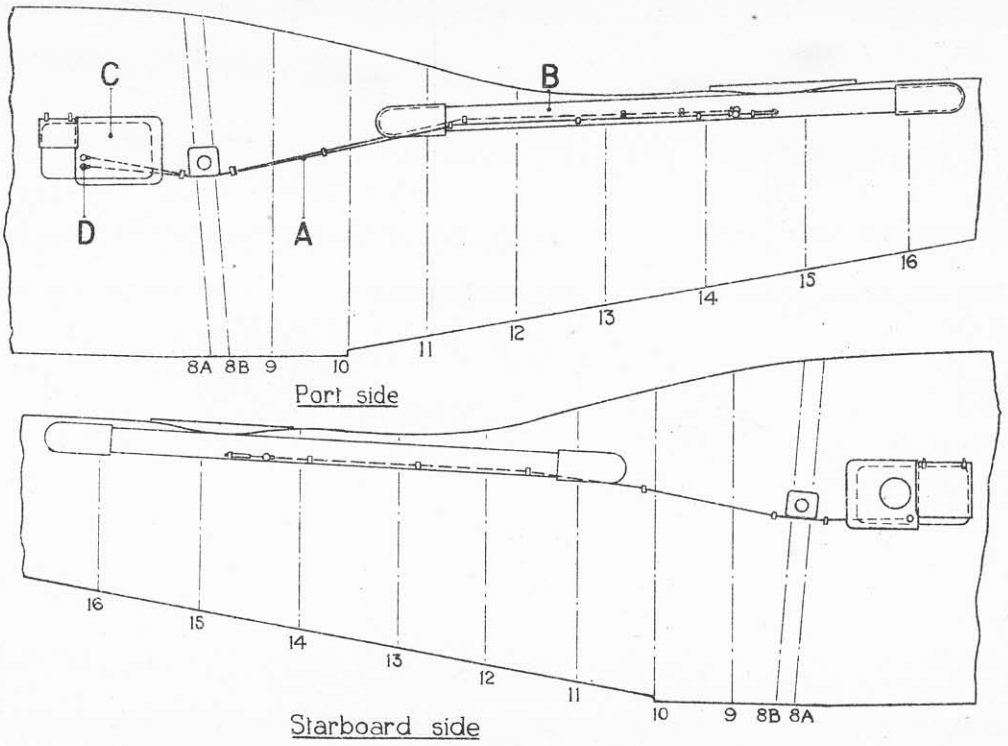

FIG.142. TOWED TARGET CONTROL CABLES

CHAPTER VIII

ERECTION, RIGGING AND MAINTENANCE

ERECTION

General

250. The components involved in the erection of the aeroplane are described and illustrated in the preceding chapters. The rigging operations and necessary dimensions are given in figs. 143 and 144.

Note.—Items referred to in the text by reference letters are similarly indicated in the illustrations, the numbers of which are given *en bloc* early in the relevant paragraphs. These reference letters are not necessarily indicated in all these illustrations.

Erection equipment

251. To erect the aeroplane the following ground equipment is necessary :—

(i) One cradle.
(ii) One portable castored crane with height of lift 17 ft. to 20 ft., or one overhead lifting gantry.
(iii) Two lifting gantries (light type G.S. 553).
(iv) One universal jacking trestle No. 7.
(v) One universal jacking trestle No. 4.
(vi) One padded chock.
(vii) Two 2-ton screw jacks with 15-in. wood blocks.
(viii) One lever jack (for use on Fleet carriers).

Order of erection

252. The order of erection and rigging operations should be as given by the sequence of the paragraphs 253 to 257, 262 to 267, and 269. The procedure for the removal of structural components is the reverse of that given for their erection.

Hull

253. The rigging levels and settings of the aeroplane components are relative to the hull datum and transverse level. It is essential therefore that the hull be first correctly set both longitudinally, as regards datum line, and laterally.

254. The hull is mounted (*see* fig. 13) on the cradle (A), the cradle V-cross beams bearing on the hull bottom at frames Nos. 14 and 11 and immediately aft of frame No. 8B. To do this the hull may be lifted by a jib crane, the slings being secured

to the engine nacelle lower strut bottom attachment points on the hull deck. Suitable packing is to be inserted between the hull and the cradle V-cross beams. The hull is then adjusted by means of block packing and shims (B) below the cradle front and rear cross beam supports until the fore-and-aft datum brackets on frames Nos. 11 and 14, and the transverse datum brackets on each port and starboard side of frame No. 11, are all level. This is checked by spirit levels and straightedges. The hull itself cannot be trued-up as a structure as it is of rigid construction.

Nacelle and top centre plane

255. The attachment fittings for the four lower and four upper struts, respectively, supporting the engine nacelle and the top centre plane, are secured to the nacelle while on the ground, as are the four lower struts and their bracing wires (*see* para. 185). The nacelle is then hoisted into position, the lower ends of the struts and bracing wires being attached to the corresponding hull fittings. The nacelle may now be rigged for both incidence and offset, as given in fig. 143, by adjustment of the struts and wires. In side elevation the incidence should be $5° \pm 5'$ and the offset, in plan view and facing forward, $3° \pm 5'$ to port.

256. The four upper struts and bracing wires are attached to the top centre plane while on the ground, the complete assembly being then hoisted into position and the lower ends of the struts and bracing wires attached to the engine nacelle corresponding fittings. The top centre plane should be symmetrical, in the front view, about the centre line of the hull and the incidence should be $7° \pm 15'$. After the top centre plane has been trued-up to comply with these conditions, the engine may be bolted to the nacelle.

Undercarriage

257. When erecting the undercarriage oleo legs and radius rods the following precaution should be observed. The upper end of each oleo leg should be secured to the stub arm of the cranked lever (item (J) of fig. 58) by means of the locking pin (item (B1) of fig. 56) before inserting the hinge pin at the rear end of the radius rod. In the event of oleo leg upper ends being freed from the stub shoulders of the cranked levers mounted on the hull when the radius rod is still secured by its locking pin, this locking pin may be damaged. When removing the oleo leg the radius rod hinge pin must first be removed.

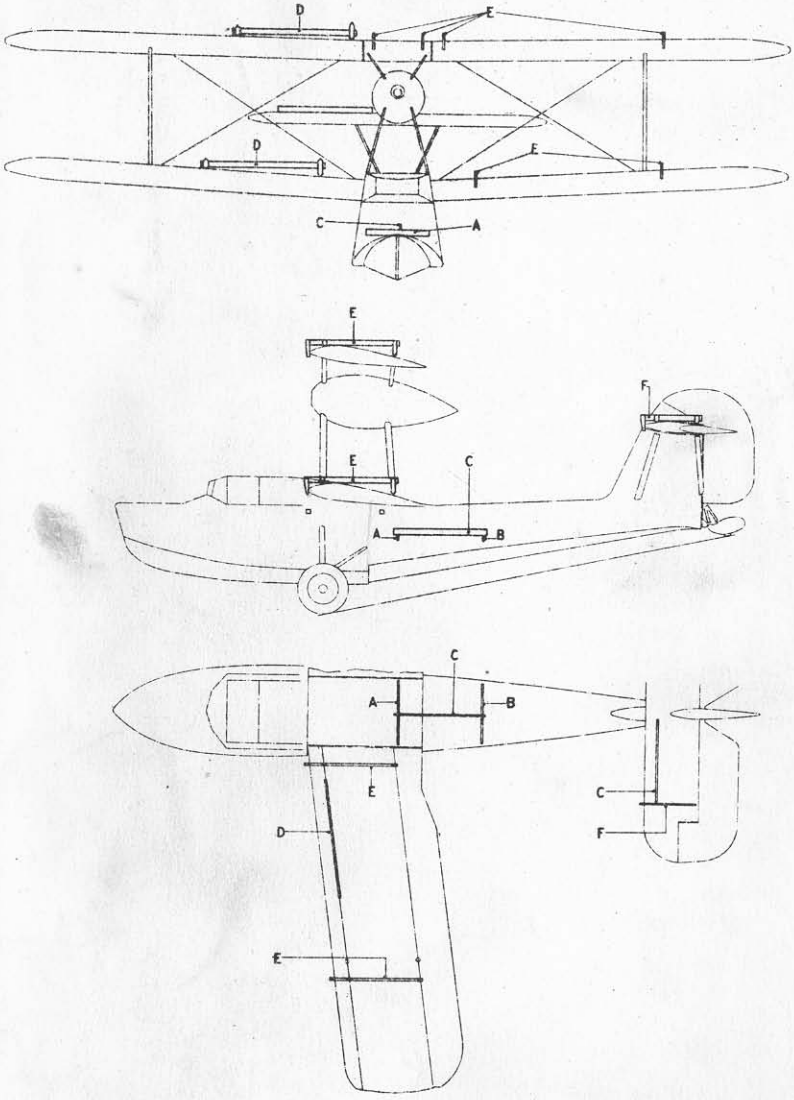

FIG. 144 INCIDENCE AND LEVELLING BOARDS IN POSITION

Removal of undercarriage

258. To remove this undercarriage the following procedure is adopted :—

(i) Set the prefixing cock handle (item (G8) of figs. 68, 71 and 72) mounted on the right-hand side of the pilot to " lower " position in order that the load imposed on the lever arm (J) by the counterbalance unit may be counter-acted by the hydraulic jack.

(ii) Remove the hinge pin at the rear end of the radius rod.

(iii) Remove the locking pin (item (B1) of fig. 56) securing the top of the oleo leg to the cranked lever (J).

Note.—In no circumstances is the locking pin, securing the oleo leg to the outboard stub end of its supporting cranked lever, to be withdrawn until the hinge pin securing the aft end of the radius rod is first removed (*see* para. 109 and 257).

Dismantling oleo leg

259. The oleo legs (*see* fig. 61) should be dismantled only if doubt exists as to the quantity of oil contained (*see* para. 284) or if it is necessary to replace worn packing rings (*see* fig. 61). The air and oil valve (C1) should be slowly unscrewed until air ceases to escape. The air and oil valve and safety lock may then be removed. The main gland nut (K) should then be unscrewed, great care being taken not to damage the thin walls of the air cylinder (A) or the piston (B). If difficulty is experienced in withdrawing the piston it should be forced out by pumping oil through the filling valve. Having dismantled the strut, all parts should be washed in paraffin and thoroughly drained.

Assembly of oleo leg

260. The air cylinder (A) should be inverted and clamped in a vertical position, with the valves (B1) and (C1) shut. The correct quantity of oil, *i.e.*, 1·7 pints (*see* para. 106) should be measured off and poured into the cylinder. The piston (B) should then be inserted, care being taken not to displace the oil, and the packing rings (H) placed singly over the piston. These packing rings may be tapped into place by a hard wood block, the rings being assembled so that the feather edges are inwards, great care being taken not to damage their edges. The gland nut (K) should be tightened up to bed the rings in position and then unscrewed one-half turn, after which the safety lock, cap ring (L), locking arm (M), nut (N), locking plate (O) and grease-retaining nut (P) with sealing leather, ring (Q) and spring (R) are refitted.

Removal of undercarriage indicator switches

261. Access to the undercarriage indicator switches (items (B_p) and (B_s) of fig. 132), positioned between hull frames Nos. 8A and 8B, in the proximity of the retracting crank lever (item (J) of fig. 58), for the purposes of removal, is obtained with the undercarriage wheels in their "up" position.

Outer main planes

262. To erect the outer planes the procedure is as follows :—

(i) Attach the ailerons, complete with control levers, to the outer planes and see that the top outer planes are fitted with their fuel tanks.

(ii) Place two gantries (*see* para. 251, sub para. (iii)) on one side of the partially erected aeroplane, in line transversely with the top centre section, the gantries having their cross beams longitudinal and approximately 11 ft. 1 in. apart, and lowered, the inboard gantry being set approximately 7 ft. 2 in. from the centre line of the aeroplane.

(iii) Place the corresponding top outer plane on the gantry cross beams with the inboard extremities of the front and rear spar attachments approximately longitudinal (sweepback of planes is 7° 30′), the inboard ends of the top outer plane spars being in line transversely with the top centre section spars, and with the pin centre of the rear spar hinge projecting approximately 4 ft. 11 in. inboard of the centre line of the inboard gantry cross beam. Suitable packing over 4 in. in transverse dimension is to be inserted between the cross beams and the front and rear spars.

(iv) Raise the top outer plane until the inner ends of the front and rear spars are in horizontal alignment with the top centre section front and rear spar corresponding ends adjusting the gantry cross beams to give approximately 1° dihedral.

(v) Ease the top outer plane inboard on the gantries and insert the rear spar hinge pin, then secure the front spar interrupted threaded joint by means of the securing lever. Make fast the securing lever by means of the spring-loaded transverse bolt fitted on the nose portion of the outer plane.

(vi) Remove the inboard gantry, first lowering and removing its cross beam.

(vii) Attach the outer interplane and aileron inter connecting struts, the lift and anti-lift wires, and the incidence bracing wires, and leave them hanging ready for attachment to the bottom plane.

(viii) Place the bottom plane on two standard jacking trestles, the trestles being arranged as given in sub. para. (ii) for the gantries, the plane positioned as given in sub. para (iii) for the top outer plane.

(ix) Raise the bottom plane on the jacking trestles until the inner ends of the front and rear spars are in horizontal alignment with the hull bottom plane attachment fittings, adjusting the trestles to give approximately 3° dihedral.

(x) Feed into the hull the landing flare, navigation lamp and bomb release electrical cables, and the aileron control, bomb fusing and undercarriage locking cables for both port and starboard bottom planes, and the additional electrical cable for the downward identification lamp for the starboard bottom plane.

(xi) Ease the bottom plane inboard on its trestles and insert the rear spar hinge pin, then secure the front spar as described in sub. para. (v) for the top outer plane.

(xii) Connect first the outer interplane struts, then the front and rear anti-lift wires. The lift wires and the incidence wires and jury strut are next secured, then the aileron interconnecting rod is coupled up.

(xiii) The outer gantry and the inner jacking trestle are then removed, leaving the outer jacking trestle to support the unbalanced aeroplane.

(xiv) Repeat the procedure outlined in sub. para. (i) to (xiii) for erection of the outer planes on the opposite side.

Tail unit

263. To erect the tail unit (*see* fig. 48) the procedure is as follows :—

(i) Assemble the elevators (*see* fig. 85) and upper fin on the tail plane and connect the elevator flap operating rods (W3) to the longitudinal spindles (S3), and the elevator vertical operating rod (E3) to the centre lever on the elevator transverse operating shaft mounted in the tail plane.

(ii) Raise the tail plane sufficiently high to allow the vertical rod to enter the fin from the top. Feed in the elevator flap operating cables through the top of the fin, then lower the tail plane into position.

Attach the tail plane to the eyed double lugs provided at the top of the fin, the front attachment being at the top of hull frame No. 19, the rear attachment being at the top and immediately forward of the stern post.

(iii) Fit the raking struts between the underside of the tail plane and the hull.

(iv) Connect the elevator port and starboard longitudinal operating rods (G3) and (H3) to the elevator operating levers projecting downwards from the elevators and tail plane.

(v) Fit the rudder, complete with servo-rudder, to the hull stern post.

(vi) Connect the servo-rudder operating link to the servo-rudder lever and to the bracket mounted on the starboard side of the stern post, and connect the main rudder control levers on both port and starboard side to the rudder control cables emerging from the root of the fin.

Wing tip floats

264. These floats are secured to their attachment points on the front and rear spars. The fore-and-aft bracing wires are next secured. On no account are the planes to be folded back unless these fore-and-aft bracing wires are in place and tensioned. The float transverse bracing wires are next secured. Great care must be exercised in the true alignment of the floats by means of the transverse bracing wires. Before the final tensioning of these bracing wires the planes should be folded and the swivel pins at the aft end of the floats properly engaged in their hull locks. This procedure would ensure the correct transverse alignment of the floats.

Water rudder and tail wheel

265. This is assembled as a complete unit (*see* fig. 77) the water rudder, skid, tail wheel and compression leg, and tubular stem with rudder lever and top and bottom journals being assembled prior to securing the unit to the stern post by the four bolts in each of the top and bottom journals. The securing bolts engage with nuts spot-welded to a nut plate for the top journal and spot-welded to the bottom journal transverse lugs for the bottom journal, the heads of the bolts being locked by wires.

Power unit controls

266. These controls are shown in figs. 108, 117 and 118. To connect up these various controls the procedure is as follows :—

(i) *Throttle and mixture controls.*—These controls from the engine nacelle to the pilot's cockpit are parallel, and can be coupled up simultaneously (*see* paras. 198 to 200). Couple up by means of the connecting rods (J7) and (K7) the throttle and mixture control levers (L7) and (M7) on their respective torque shafts between nacelle frames Nos. 6 and 7 to the corresponding levers (G7) and (H7) mounted on a common spindle on the port side of the nacelle between frames Nos. 1 and 2. The vertical connecting rods (E7) and (F7) are then coupled up within the nacelle port front lower strut fairing. From the downward pointing arms of the bell crank levers (C7) and (D7), immediately forward of hull frame No. 8A, the several bell crank levers of the first pilot's throttle and mixture and the second pilot's throttle controls are coupled up by their respective connecting rods as shown in fig. 117.

(ii) *Slow-running and air-intake controls*—These controls from the engine nacelle to the pilot's cockpit are parallel and can also be simultaneously coupled up. Couple up these controls by their respective cables to the corresponding levers mounted on the port side of the pilot's cockpit, as shown in fig. 117 and described in para. 201.

(iii) *Electrical cables*—These cables, for the main magnetos, fuel-contents gauges and engine-speed indicator, head navigation, upward identification and mooring lamps, are connected to their respective terminals, switches and indicating dials, mounted on the pilot's instrument panel.

(iv) *Fuel cock controls*—These control cables, from the ends of the corresponding levers mounted on the transverse shaft in the upper portion of the nacelle, between nacelle frames Nos. 6 and 7, to the fuel cock lever controls mounted on the starboard side of the hull, immediately forward of hull frame No. 6, are coupled up as shown in fig. 108 and described in para. 190.

Undercarriage locking controls

267. These control cables from the undercarriage wheel locking bolts in the port and starboard bottom planes are connected up as shown in fig. 78 and described in paras. 126 to 129.

Jacking and trestling

268. When slinging or jacking up the aeroplane for rigging, repairs, etc., use only the points marked on the aeroplane and which are indicated in fig. 138.

Flying controls

269. The flying controls, together with the control surface movements are shown in figs. 85, 88, 90, 92 and 96 to 99, the rudder and elevator control cables being duplicated. To connect up the various control circuits the procedure is as follows :—

(i) (*a*) *Aileron*—Couple up on each port and starboard side the top and bottom aileron interconnecting rod (*see* para. 152), and the longitudinal connecting rod (U2) between the bottom plane aileron operating lever (E) and the actuating lever (T2). Prior to erection, the aileron control cables in the bottom plane (*see* fig. 88) should be coupled to their corresponding ends of the double-armed lever (K2), then on the erection of the bottom plane the cable from the lever aft pointing arm should be led to the aft side of the hull frame No. 11, the cable from the lever forward pointing arm being led to the forward side of this hull frame.

(*b*) The cables on the forward side of hull frame No. 11 should be directly interconnected by the transverse cable ~~(M2)~~, by its end turnbuckles (*see* para. 149). In the hull the aileron control circuit is coupled up as described in para. 149, and shown in fig. 85.

(ii) *Elevator*—Connect the vertical connecting rod ~~(E3)~~ in the fin to the aft pointing arm of the three-armed lever (D3), the port and starboard longitudinal connecting rods (J3) being coupled up to the elevator levers and the actuating levers (F3) on erection of the tailplane. From the ends of the top and bottom arms of lever (D3) the elevator control circuit (duplicated cables) is coupled up as described in paras. 153 to 156, and shown in fig. 85.

(iii) *Elevator flap*—Couple up the elevator flap cables (N3) leading from the pulleys (R3) (*see* paras. 157 to 161) to the elevator flap control circuit shown in fig. 85.

(iv) *Rudder*—Connect the rudder control duplicated cables, emerging through the hull near frame No. 21, to the rudder operating levers (N4). The rudder control duplicated cables are then coupled up as described in paras. 162 to 164 and shown in fig. 85.

Jacking and trestling

268. When slinging or jacking up the aeroplane for rigging, repairs, etc., use only the points marked on the aeroplane and which are indicated in fig. 138.

Flying controls

269. The flying controls, together with the control surface movements are shown in figs. 85, 88, 90, 92 and 96 to 99, the rudder and elevator control cables being duplicated. To connect up the various control circuits the procedure is as follows :—

(i) (*a*) *Aileron*—Couple up on each port and starboard side the top and bottom aileron interconnecting rod (*see* para. 152), and the longitudinal connecting rod (U2) between the bottom plane aileron operating lever (E) and the actuating lever (T2). Prior to erection, the aileron control cables in the bottom plane (*see* fig. 88) should be coupled to their corresponding ends of the double-armed lever (K2), then on the erection of the bottom plane the cable from the lever aft pointing arm should be led to the aft

In order to prevent the aileron cable turnbuckles (*see* fig. 88) from fouling box rib No. 4 during wing folding operations, a shield or cover plate, 22333/2007 should be fitted to the rib bracing. Also the pins of the turnbuckle forks should be inserted with their heads facing aft.

.....than the aileron control circuit is coupled up as described in para. 149, and shown in fig. 85.

(ii) *Elevator*—Connect the vertical connecting rod (E3) in the fin to the aft pointing arm of the three-armed lever (D3), the port and starboard longitudinal connecting rods (J3) being coupled up to the elevator levers and the actuating levers (F3) on erection of the tailplane. From the ends of the top and bottom arms of lever (D3) the elevator control circuit (duplicated cables) is coupled up as described in paras. 153 to 156, and shown in fig. 85.

(iii) *Elevator flap*—Couple up the elevator flap cables (N3) leading from the pulleys (R3) (*see* paras. 157 to 161) to the elevator flap control circuit shown in fig. 85.

(iv) *Rudder*—Connect the rudder control duplicated cables, emerging through the hull near frame No. 21, to the rudder operating levers (N4). The rudder control duplicated cables are then coupled up as described in paras. 162 to 164 and shown in fig. 85.

(v) *Servo-rudder*—If not connected up on erection, couple the servo-rudder lever to the bracket mounted on the starboard side of the stern post.

(vi) *Water rudder*—Connect the water rudder control cables, emerging through the hull aft of hull frame No. 21, to the water rudder levers (B5). To these levers are also connected the check cables (E5). The water rudder control cables and centralizing spring containers (Z4) are then coupled up as described in paras. 165 to 168 and illustrated in figs. 98 and 99.

RIGGING

General

270. The rigging position, necessary data for checking the rigging of the main planes and tail plane, and the movement of the control surfaces are given in fig. 143. The special equipment required for rigging operations and the location of the checking points are given in fig. 144, the equipment consisting of the following :—

	Firm's Drg. No.	*Item*
Hull transverse levelling board..	22398/23	A
Hull longitudinal levelling boards	22398/21 and 25	B, C
Tail plane transverse levelling board	22398/25	C
*Main plane dihedral board—upper	22398/7	D
*Main plane dihedral board—lower	22398/7	D
Main plane incidence board ..	22398/1	E
Tail plane incidence board ..	22398/11	F

*The main plane dihedral board is adaptable to both top and bottom planes.

Procedure

271. When rigging the aeroplane, the towed target containers must be removed from the hull, otherwise the datum plates will be obscured. The procedure for rigging and the method of using these boards (*see* fig. 144) are as follows :—

(i) *Hull.*—After the erection of the aeroplane, re-check the hull for longitudinal and transverse level by setting the hull transverse levelling board (A) across the hull on the special levelling brackets mounted on each port and starboard side of hull frame No. 11. Set the longitudinal level board support (B) across the hull on the special brackets

mounted on the port and starboard sides of hull frame No. 14, then set the hull levelling board (C) longtitudinally on these transverse boards and adjust the hull for transverse and longitudinal level.

(ii) *Engine nacelle.*—Adjust the engine nacelle as illustrated in fig. 145.

272. The planes of reference and the points to and from which measurements are taken are as follows :—

(i) *Nacelle front datum circle.*—This circle is contained in the transverse plane through the centre of the nacelle frame No. 1.

(ii) *Nacelle rear datum circle.*—This circle is contained in the plane across the front face of the nacelle frame No. 9.

(iii) *Centre line of nacelle.*—This is the line passing through the centres of the nacelle front and rear datum circles.

(iv) *Datum plate on deck.*—The centre of this plate is 2·36 in. from the aeroplane centre line, on the port side, and 0·13 in. aft of the transverse line joining the nacelle front lower strut deck attachment fittings.

273. The centre of the nacelle front datum circle is in the transverse vertical plane through the centre line of the front spar joints, the centre of the nacelle rear datum lying in the vertical plane containing the centre line of the aeroplane. The nacelle centre line is set at an incidence angle of +5° and in plan view, forward of the rear datum circle, the nacelle centre line is offset 3° to port. With the engine nacelle rigged to these angles the nacelle lower struts and bracing wires should be positioned, as shown in fig. 145, relative to the nacelle centre line and longitudinal vertical plane. The angles given can be checked by an inclinometer.

274. When the engine nacelle is correctly rigged, the $\frac{1}{16}$ in. dia. datum hole on the centre line, at the bottom of the nacelle and 1·44 in. aft of the centre of nacelle frame No. 1, is vertically above the datum plate on the hull deck (*see* para. 272, sub-para. (iv)) and a point 0·18 in. aft of the rear face of nacelle frame No. 9, at the centre line on the bottom edge is vertically above the centre line of the aeroplane. This point 0·18 in. aft of the bottom edge of nacelle frame No. 9 permits the dropping of a plumb line, whereas a plumb line dropped from the centre of the rear datum circle would be unsatisfactory due to its fouling of the nacelle rear bottom edge. The dimension between the hull datum plate and the $\frac{1}{16}$ in. datum hole, on the bottom of the nacelle immediately aft of the frame No. 1, is 41·15 in.

Top centre plane

275. The top centre plane is checked and adjusted, the struts and bracing being positioned as shown in fig. 146 relative to the nacelle centre line and longitudinal vertical plane. The plane incidence is checked by the incidence board (item (E) of fig. 144). The transverse level and transverse symmetry of this top plane should also be checked.

Outer planes

276. The top and bottom outer planes are checked for incidence and dihedral by the respective boards (items (E) and (D) of fig. 144). The dihedral is adjusted by means of the bracing wires (*see* fig. 38), the incidence of the outer portions of the outer planes being adjusted by the incidence wires simultaneously with the dihedral adjustment. The incidence of the outer planes at the roots is fixed on the bottom plane by the hull spar joints and on the top plane by the top centre plane spar joints.

Tail plane

277. The tail plane is fixed at its attachment points to the fin, and cannot therefore be varied from its incidence given on erection except by means of modified attachment fittings. The incidence at the port and starboard outer portions may however be checked by incidence board (item (F) of fig. 144) the incidence at these outer portions being adjusted by the raking struts, which are adjustable at their bottom ends. The transverse level of the tail plane, indicated by the levelling board (item (C) of fig. 144), is adjusted simultaneously with the outer portion incidence adjustment.

Flying controls

278. To rig the flying controls the procedure is as follows :—

(i) Set the control column 6° forward from the vertical.

(ii) Set the control handwheel central, the open segment at the top.

(iii) Adjust the control circuits to bring

(*a*) the elevators in line with the tail plane, and

(*b*) the trailing edges of the top and bottom port and starboard ailerons simultaneously 0·75 in. below the trailing edges of the main planes.

Note.—Ailerons are to be rigged so that trailing edges of all ailerons are in line with the trailing edges of the planes when slack in the control system has been taken up by gently raising the aileron trailing edges, the control column and control handwheel being centralized.

(iv) Adjust the rudder cables so that the rudder is in line with the fin when the rudder pedals are in the neutral position, *i.e.*, in line transversely with each other.

General Note.—Care should be taken to see that all cables are reasonably taut and not overtightened. If the cables are too tight, the controls will be stiff and difficult to operate. For balancing the ailerons refer to para. 279.

Aileron trimming

279. *Balancing the ailerons.*—The aeroplane rigging is correct when the aeroplane flies level with the aileron control handwheel held central and the other flying controls centralized. If the aeroplane is now flown hands off and it is found that one wing drops with the control handwheel taking up a position indicating that the ailerons are out of alignment with the main plane trailing edges, then the balance of the ailerons is not correct. This out-of-balance effect, if present, should be corrected by fixing a suitable length of cord to the upper surface of the top aileron of the low flying wing. A single strand of No. 3 white balloon cord is used for this purpose, the cord being secured over the middle portion of the trailing edge with a doped-on strip of fabric with the edges frayed. The correct length is found by trial and error, and is such that the aeroplane will fly level with the control handwheel central and hands off the controls; a convenient length to try first is 2 ft. 6 in. When the aerodynamic balance has been corrected by this method, mass-balance of the aileron must be corrected due to added weight.

MAINTENANCE

Adjustment of the front spar locking mechanism

280. When these mechanisms are correctly adjusted (*see* fig. 23), the joints between the top outer planes and the centre section and between the bottom planes and the hull, should tighten evenly and smoothly with hand pressure on the operating handlevers (J) and permit the insertion of the draw-bolt (L) in the slot of the handlever. If, owing to wear or other causes, the lever (J) tends to pass the draw-bolt (L) before the corresponding front spar joint is tight the four setscrews (M) should be removed and the lever moved slightly in the unlocking direction relative to the nut. The setscrews should then be re-inserted in the next set of holes, thus effecting an adjustment of about 1° 30′. This adjustment may entail re-setting the stop (N) in the slot of the handlever. The stop (N) correctly positions the threads of the nut for sliding over the plain interrupted portion of the screw by coming into

Fabric patches

279A. To provide easy access to various parts of the aircraft during maintenance operations, fabric patches are provided as shown in figs. 146A and 146B.

contact with the lower end of the fixed slot (O). The thread portions of the screw and the nut are at 90° to each other when the lever is in its "joint-free" position. When the joint is correctly secured the lever (J) passes into the slot in plate (P). A faulty securing of the joint without engaging the full number of threads is indicated by the lever failing to drop into the slot in the plate (P).

281. After effecting any adjustments, it is important to check that with the joint secured, the index peg on the screw lies between the two index marks stamped on the nut. Should this not be the case, an insufficient length of thread is engaged and the necessary adjustment to correct this condition must be made before the aeroplane is flown. If excessive wear is present a thicker packing washer (Q) may have to be inserted in the nut. The index marks will be found on the underside of the joints on the top planes, and on the upperside of the joints on the bottom planes when the securing nuts are in the locked positions.

Folding the main planes

282. Before folding the main planes (*see* fig. 17 and 18) the control column, airscrew and rear gun (if fitted) should be centralized. The jury struts and incidence wires ~~(A) and (B) respectively~~ should then be fitted to the centre section as shown, the aileron locks (which are provided to meet catapult stowage requirements) released, and the locking bars (item (G) of fig. 42) securing the folding flaps released, the flaps being permitted to take up their folded position in which they are retained by coiled springs (*see* also para. 79). The planes may be unlocked by a man standing on the bottom planes.

283. To unlock the planes (*see* fig. 23), draw back the bolts (L) in the leading edge of the top and bottom planes and then pull the operating levers (J) one-quarter turn *down* for the top planes and one quarter turn *up* for the bottom planes. The planes may now be folded and secured to the hull by means of the attachments on the wing tip floats. When the planes are again spread they are relocked by reversal of the foregoing operations. Suitably inscribed instruction plates are attached to the sides of the hull, forward of the front spar frame and above the navigator's window.

Undercarriage oleo legs

284. Faults, which may occur in the functioning and condition of the undercarriage oleo legs, are summarized below :—

(i) Extension, under static load, of about 3 in. reduced, on taxying, to 1½ in. This is due to the air pressures being too low. The air pressures should be increased to the specified figure ~~given in paras. 106 and 285.~~ Figures (see Leading Particulars)

52) Para. 284 (i), line 4. *Delete* "figure given in paras. 106 and 285" and *substitute* "figures (*see* Leading Particulars)."

(ii) Extension, under static load, of 6 in. (*i.e.*, maximum) and movement, during taxying, not more than 1½ in. This is due to the air pressures being too high. These pressures must be reduced to the specified figure.

(iii) Air pressure correct but the struts give excessive piston travel. This is due to deficiency of oil and consequently too great a volume of air. The oil level should be checked (*see* para. 287).

(iv) Air pressure correct but piston travel restricted and action of strut harsh. This suggests excess of oil. The oil level should be checked (*see* para. 287).

(v) If more than a trace of oil is found on the piston, or if the gland is obviously leaking, the packing rings have perished. As a temporary expedient the gland nut may be tightened, but new rings should be fitted at the earliest opportunity.

285. *Undercarriage oleo leg air pressures.*—The air pressures in the oleo legs are as follows :—

Port oleo leg	.. ..	425 lb. per sq. in.
Starboard oleo leg	.. ..	365 lb. per sq. in.

286. *Adjustment of air pressure in oleo legs.*—When the air pressure in an undercarriage oleo leg is being adjusted, the leg should be fully extended, therefore the aeroplane must be jacked up on the jacking pads so that the wheels are clear of the ground. Compressed air may be obtained from a container or from a pump capable of supplying air up to 800 lb. per sq. in. The oil level and air filling valves (B1) and (C1) are shown in fig. 61. When making check tests it is advisable to compress the air in the pipeline coupled to the air filling valve to a pressure slightly in excess of that (*see* also paras. 106 and 285) printed on the instruction plate. If this is not done a low reading for the pressure previously existing in the air chamber will be obtained, owing to the escape of air to the pipe line. This drop may be as much as 100 lb. per sq. in.

287. *To check the oil level.*—The oil level must not be checked till a period of fifteen minutes has elapsed after the strut has been in use because the oil and air will be in the form of an emulsion. When this period has elapsed jack up the aeroplane so that the wheels are clear of the ground and the oleo legs are fully extended and carrying no load. Unscrew the air and oil valve (item (C1) of fig. 61) and release all the air pressure and then recharge with air up to 50 lb./sq. in. Wait for a few minutes to allow settling down, then open the oil level valve (item (B1) of fig. 61) one or two turns. If air and oil pass through this valve, the level can be taken as correct. If only oil flows, the level is too high, and if

(53) Para. 285, line 1. *Delete* "The air pressures . . . 365 lb./sq. in." and *substitute*:—

"For air pressures in the oleo legs reference should be made to the Leading Particulars."

(54) Para. 286, line 11. *Delete* "(*see* also paras. 106 and 285)"

287A. *Dismantling.*—Before attempting to dismantle an oleo unit (*see* fig. 61), the air pressure must first be released by opening the air valve (C1). After this, and before dismantling any part, check the position of the locking arm (M), using the gauge (*see* para. 287G). Next determine whether the oleo unit has previously been reconditioned. This can be found by examining the instruction plate, which may have the word RECONDITIONED and the date stamped on it. If this be so, a careful watch should be kept for any oversize or non-standard parts which may be present.

287B. The order of dismantling is as follows (referring to the items numbers on fig. 61):—

(i) Remove the axle from the leg by removing the two bolts (J1).

(ii) Remove the two bolts securing the locking plate (O), and then the grease seal assembly (P, Q, R).

(iii) Remove the locknut (N), the locking arm (M), the oil level plug (B1), and the locking rod (Z).

(iv) Remove the gland nut cap ring (L) and the gland retaining nut (K).

(v) Connect a pipe-line from an oleo pump (Vickers A.219) to the air valve (C1) and pump in oil until it flows from the oil level plug port.

(vi) Temporarily replace the plug and close the oil level plug port and continue to pump in oil until the gland rings (H) are forced downwards into the larger portion of the chamber.

(vii) Take note of the angular position of the sustaining ram relative to the cylinder in order that it may be correctly positioned on re-assembly.

(viii) Remove the six setscrews (S) securing the splined guide ring (T) in position, and the complete sustaining ram may then be removed.

287C. *Assembly.*

(i) Replace the sustaining ram in the correct position relative to the cylinder.

(ii) Anneal the six copper washers (X) and secure the guide ring (T) in place by assembling the six screws (S).

(iii) Assemble the buffer ring (F) and support ring (G) into the gland and carefully tap into place the new gland rings (H), using the packing ring assembly tool (*see* para. 287F), the end of which is shaped to suit the profile of the ring.

(iv) Assemble the capping ring (J) and gland nut (K), tightening the gland nut until the packing rings are right home. Slacken back the gland nut approximately one complete turn to allow the rings to expand and work automatically.

(v) Assemble the remaining parts, i.e. the locking arm (M), the locknut (N), the seal (P, Q, R), the locking plate (O), the locking rod (Z), and oil level plug (B1), but not the axle.

(vi) Secure the unit carefully in a vice, between soft V-jaws, and work the sustaining ram in and out to test freedom of motion. Whilst doing this, lightly lubricate the gland bearing (D.T.D.44D).

(vii) Check the position of the locking arm (M), using the gauge (*see* para. 287G), and proceed to oil-pressure test the unit (*see* para. 287D).

287D. *Testing.*

(i) Place the unit in the pressure test frame (*see* para. 287G), standing it vertically with the top socket uppermost and with the sustaining ram extended to the length allowed by the frame. This frame ensures that the gland nut is not subjected to the whole end load.

(ii) Take micrometer readings of the diameter of the cylinder, at, say, three points.

(iii) Completely charge the cylinder with oil to specification D.T.D.44D, by removing the oil level plug (B1), and substituting a pressure-tight adapter, to which is coupled an oil pipe-line from a pump or an oil service main. Open the air valve (C1) and pass oil through the oil plug port until the oil begins to flow from the air valve. Close the air valve and continue to pump in oil until the unit is extended against the stops and the pressure is raised to 1,760 lb./sq. in.

(iv) If it is not possible to fit a pressure-tight adapter in place of the oil level plug, fit any adapter that will serve the purpose of charging the cylinder and proceed as follows:—

(*a*) Pump in oil until it begins to flow from the air valve.

(*b*) Transfer the oil pipe to the air valve and replace the oil level plug.

(*c*) With the air valve still open, continue pumping in oil until the unit is fully extended against the stops and the pressure raised to 1,760 lb./sq. in.

Note.—The unit cannot be fully charged with oil through the air valve alone.

(v) Inspect for leakage at the gland, oil level plug, air valve body and the six guide ring screws.

(vi) Measure the cylinder diameters at the same points as previously. A slight increase may be noted.

(vii) If the oil pressure can be maintained for, say, 10 minutes, which would indicate that the plug (U) is not leaking (this not being visible during test), the pressure may be released and the cylinder diameters measured again. The diameters should have returned to the figures of the first reading. With the pressure given for this test there should not be any permanent set.

(viii) Remove the unit from the test frame and wire up the six screws (S).

(ix) Stand the unit vertically on a platform so that the sustaining ram can extend freely to its full travel, pump in more oil, and raise to a pressure of approximately 50 lb./sq. in.

(x) Ensure that the sustaining ram is fully extended and replace the oil pipe-line connected to the air valve.

(xi) Open the oil level plug several turns, or remove it entirely and proceed to "blow down" as follows:—

(*a*) Pass air through the cylinder at low pressure from a pump or air bottle at a low velocity until oil ceases to escape with the air.

(*b*) Shut off the air supply and wait two or three minutes to allow the oil level to equalise both inside the hydraulic ram, where it passes through a small annular orifice, and outside the hydraulic ram, where it will readily pass up the oil level tube (W).

(*c*) Again, pass air through the cylinder at low pressure until oil ceases to pass with the air, and again wait two or three minutes. Continue this cycle of operations until oil definitely ceases to escape.

Note.—Do not pass the air too rapidly through the cylinder, as this will cause a suction effect and cause the oil level to be too low.

If, at the beginning of this operation of "blowing down" no oil passes, it may indicate a stoppage in the oil-level passage, which should be investigated.

(xii) Charge the unit with air to 400 lb./sq. in. in the starboard leg, and 425 lb./sq. in. in the port leg. Close the air valve, remove the bolt (E1) passing through the top socket fitting, and immerse the whole unit in a paraffin bath and inspect for air leaks. The paraffin will flow into the hole from which the bolt has just been removed and air will bubble out until the space is full. If bubbles continue to emerge from the hole it may indicate that the screw securing the hydraulic ram is loose and requires tightening. This will necessitate removal of the top socket (D) and the use of the special tool (*see* para. 287F). Turn the unit about while in the bath in order to inspect every possible leakage point.

(xiii) Remove the unit from the bath, stand it in a vertical position, and gently release the air pressure, taking care not to lose any oil. This will ensure that the unit is charged with the correct quantity of oil and with air at atmospheric pressure, in which condition all units should be supplied or stored.

(xiv) Care must be taken to drain out all the paraffin from the space at the top of the cylinder before replacing the bolt (E1). The top socket (if removed), the axle (E), and the brake unit should now be fitted. Split-pin the nuts, and fit the necessary locking plates and wires.

287E. When a unit has been repaired or reconditioned, it must be marked by stamping the word RECONDITIONED, and the date of reconditioning, on the instruction plate (G1). When in store the unit must be kept in a vertical position with the cylinder uppermost.

287F. *Tools for dismantling and assembling*

Ref.	Description
27519–101	Gland nut spanner
27519–103	Locknut spanner
27519–105	Ram screw securing tool guide
27519–107	Hydraulic ram box spanner
27519–109	Hydraulic ram securing tool
27519–113	Spanner
90898 Sht. 1	Valve reseating tools
A.689/25	Sustaining ram head spanner
A.1189/103	Oleo packing ring assembly tool

287G. *List of testing equipment*

Ref.	Description
T.9067 Sht. 1	Gauge, checking locking arm
91260–1	Pressure test frame
A.219 Sht. 1	2-stage high-pressure pump, or any other suitable pump or any means of supplying air and oil at the pressures required

P1218 M16859/375 9/42 1000 C & P Gp. 1

air escapes, the level is too low. In the event of the latter, pump in an excess of oil by means of a high pressure pump, through the air and oil valve, then bring the oil to the correct level as follows :—

(i) Slacken the oil level valve slightly, and allow the extra oil to escape until the escape of air is evident.

(ii) Shut the valve and wait two or three minutes, and then repeat the process until such time as the escape of air is again evident.

The reason for this repeating and waiting is to allow the oil level to equalise both inside the hydraulic ram, from where the oil will readily pass up to the oil level tube, and the outside of the hydraulic ram from where the oil passes through a very small hole at the end of the ram.

(iii) Close the oil level valve and recharge with air to the correct pressure ~~given in para. 285~~.

It is essential that all valves should be tightened on their seats and the dust cap replaced on the air and oil filling valve.

(55) Para. 287 (iii), line 2. *Delete* "given in para. 285".

Retracting gear

288. Since the retracting gear is hydraulically operated the maintenance required is not great. Replacement of pump cups, or jack or counterbalance glands presents no difficulty, and reference to figs. 69, 70 and 71 indicates the manner of dismantling. If, during maintenance or repair operations the hydraulic circuit is broken, the air which has entered the system must be expelled. Rubber tubing should be placed on the bleeder valves at the top of each jack and the valves unscrewed one turn. The free end of the tube should be immersed in a suitable receptacle filled with anti-freezing oil, type A. The wheels should be down and the cock handle (item (G8) of figs. 71 and 72), of the retracting-operating hand pump on the right of the pilot, in the " lower " position. This hand pump should be slowly operated until air bubbles cease to emerge from the end of the rubber tubes. The bleeder valves should then be closed. It should be noted that when the jacks are replaced they should be filled with anti-freezing oil, type A, to reduce the amount of air to be expelled.

289. Before assembling the balance cylinders insert 10 c.cm. of oil, anti-freezing, type A. After assembly and charging with air to a pressure of 400 lb. per sq. in. with piston rod fully extended, the oil level should be checked by tilting the cylinder 30° from the vertical, valve uppermost, and slightly unscrewing the valve, when frothy oil should be expelled.

Wheel tyres

290. ~~The tyres should be kept inflated to a pressure of lb. per sq. in. which should be checked by gauge~~.

air escapes, the level is too low. In the event of the latter, pump in an excess of oil by means of a high pressure pump, through the air and oil valve, then bring the oil to the correct level as follows :—

(i) Slacken the oil level valve slightly, and allow the extra oil to escape until the escape of air is evident.

(ii) Shut the valve and wait two or three minutes, and then repeat the process until such time as the escape of air is again evident.

The reason for this repeating and waiting is to allow the oil level to equalise both inside the hydraulic ram, from where the oil will readily pass up to the oil level tube, and the outside of the hydraulic ram from where the oil passes through a very small hole at the end of the ram.

(iii) Close the oil level valve and recharge with air to the correct pressure ~~given in para. 285~~.

It is essential that all valves should be tightened on their seats and the dust cap replaced on the air and oil filling valve.

Retracting gear

288. Since the retracting gear is hydraulically operated the maintenance required is not great. Replacement of pump cups, or jack or counterbalance glands presents no difficulty, and reference to figs. 69, 70 and 71 indicates the manner of dismantling. If, during maintenance or repair operations the hydraulic circuit is broken, the air which has entered the system must be expelled. Rubber tubing should be placed on the bleeder valves at the top of each jack and the valves unscrewed one turn. The free end of the tube should be immersed in a suitable receptacle filled with anti-freezing oil, type A. The wheels should be down and the cock handle (item (G8) of figs. 71 and 72), of the retracting-operating hand pump on the right of the pilot, in the " lower " position. This hand pump should be slowly operated until air bubbles cease to emerge from the end of the rubber tubes. The bleeder valves should then be closed. It should be noted that when the jacks are replaced they should be filled with anti-freezing oil, type A, to reduce the amount of air to be expelled.

289. Before assembling the balance cylinders insert 10 c.cm. of oil, anti-freezing, type A. After assembly and charging with air to a pressure of 400 lb. per sq. in. with piston rod fully extended, the oil level should be checked by tilting the cylinder 30° from the vertical, valve uppermost, and slightly unscrewing the valve, when frothy oil should be expelled.

Wheel tyres

(56) Para. 290, lines 1 and 2. *Delete* "The tyres should . . . by gauge." and *substitute*:—

"The tyres should be inflated to the pressure given in the Leading Particulars and checked by gauge." ALS.

(55) Para. 287 (iii), line 2. *Delete* "given in para. 285".

Lubrication

291. The various points that require lubricating and the type of lubricant to be used are shown in fig. 147. The following deals briefly with the lubrication of controls :—

(i) *Control chains.*—All chains for various controls, including the elevator trimming flap controls, should be kept clean, lubricated and properly tensioned.

(ii) *Engine controls.*—Periodically inspect and lubricate all engine controls, the principal points to be lubricated being,

(*a*) the bearings at the pilot's control quadrant,

(*b*) the bearings and pin joints of the lever assemblies throughout the engine control system.

292. The threads of the screw and nut portions and all parts of the top and bottom plane front spar locking mechanisms must be kept well lubricated and oil must occasionally be injected through the hole in each roller (item (K) of fig. 23).

Hull

293. Seawater should not be allowed to remain inside the hull but should be run off through the drain holes provided (*see* fig. 3). Wire brushes should on no account be used for cleaning off weeds and barnacles which may accumulate after prolonged immersion, as the protective covering will be removed. An ordinary scrubbing brush is suitable for most cleaning and a small piece of wood may be used for dislodging barnacles.

Wing tip floats

294. The floats require the same attention as stated f the hull and given in para. 293.

Manœuvring on the ground and towing

295. To prevent the hull becoming buckled during rapid turn when taxying, turns of small radius are not to b made if they can be avoided. Where necessary, assistanc is to be obtained to lift the tail of the aeroplane round. Fo manœuvring the aeroplane on the ground a tiller arm (se fig. 148) is provided.

AL 7

Bonding

296. The aeroplane is bonded for electrical continuity in accordance with the principles laid down in A.P. 1464B, Volume 1, Part 5, Section 8, Chapter 4. To facilitate examination a diagram of the bonding points is given in figs. 149. and 149a. (A.L. 4)

Lubrication

291. The various points that require lubricating and the type of lubricant to be used are shown in fig. 147. The following deals briefly with the lubrication of controls :—

(i) *Control chains.*—All chains for various controls, including the elevator trimming flap controls, should be kept clean, lubricated and properly tensioned.

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(*a*) the bearings at the pilot's control quadrant,

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Hull

293. Seawater should not be allowed to remain inside the hull but should be run off through the drain holes provided (*see* fig. 3). Wire brushes should on no account be used for cleaning off weeds and barnacles which may accumulate after prolonged immersion, as the protective covering will be removed. An ordinary scrubbing brush is suitable for most cleaning and a small piece of wood may be used for dislodging barnacles.

Wing tip floats

294. The floats require the same attention as stated f

With the solid tyred wheel and water rudder, a tiller arm (*see* fig. 148) is provided for manœuvring the aircraft on the ground, but when the aircraft is stationary, assistance must be obtained to lift the tail round.

295A. With the pneumatic tyred tail wheel, the unit will steer easily when the aircraft is moving forwards, but the aircraft must not be towed backwards unless a skate or tail wheel steering arm is used. With this tail wheel unit, a stationary aircraft can be skidded fairly easily if the aircraft is pushed forwards a few inches during the operation.

in accordance with the principles laid down in A.P. 1464B, Volume 1, Part 5, Section 8, Chapter 4. To facilitate examination a diagram of the bonding points is given in figs. 149.

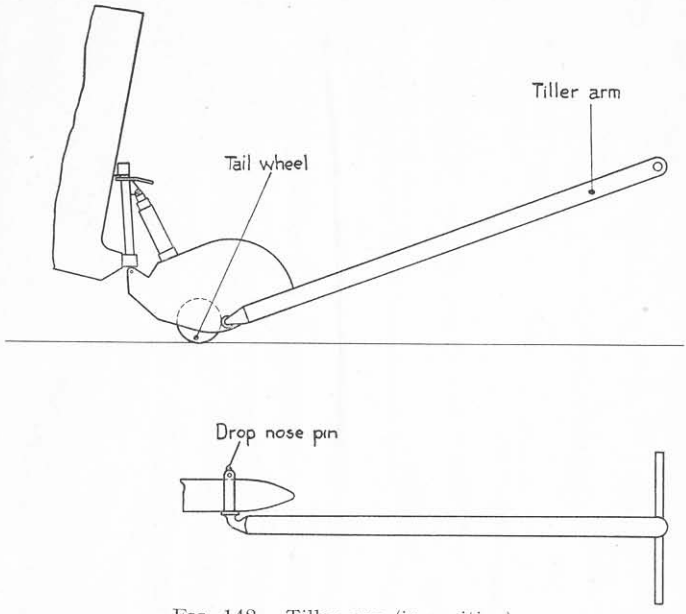


FIG. 148.—Tiller arm (in position).

Deck and catapult lashing gear

297. Lashing gear and the method of securing the aeroplane either with planes folded or spread, to the deck or the catapult of an aeroplane carrier, are illustrated in figs. 150 to 153. The points of attachment on the aeroplane for the securing struts are as follows :—

(i) Immediately below the bottom plane front spar attachment joint.

(ii) At the top end of the wing tip float front strut.

(iii) At the catapult attachment trunnion, at the chine, at the hull frame No. 16.

Th points of attachment for the lashing cables are as follows :—

(iv) On the hull stem, immediately above the chine.

(v) At the bottom of the stem, at hull frame No. 1.

(vi) On the wing tip float stem, below the chine.

(vii) On the wing tip float stern post, immediately below the wings folded locking swivel.

(viii) At the top end fitting of the catapult attachment trunnion securing strut.

(32) Para. 297. After this paragraph *insert* the following new paragraph:—

298. Two additional cables (Stores Ref. Nos. 27A/1451 and 27A/1446) are provided for securing the aeroplane from each wing tip float where it is stowed on a turntable type catapult, main planes folded. The following is the sequence of operations for attachment:—

(i) Attach the quick-release shackle A.G.S.960 at the end of cable 27A/1451, to the existing eye on the front of the starboard wing tip float.

(ii) Locate the securing position on the turntable and secure an eyebolt or other suitable fitting for the attachment of the cable.

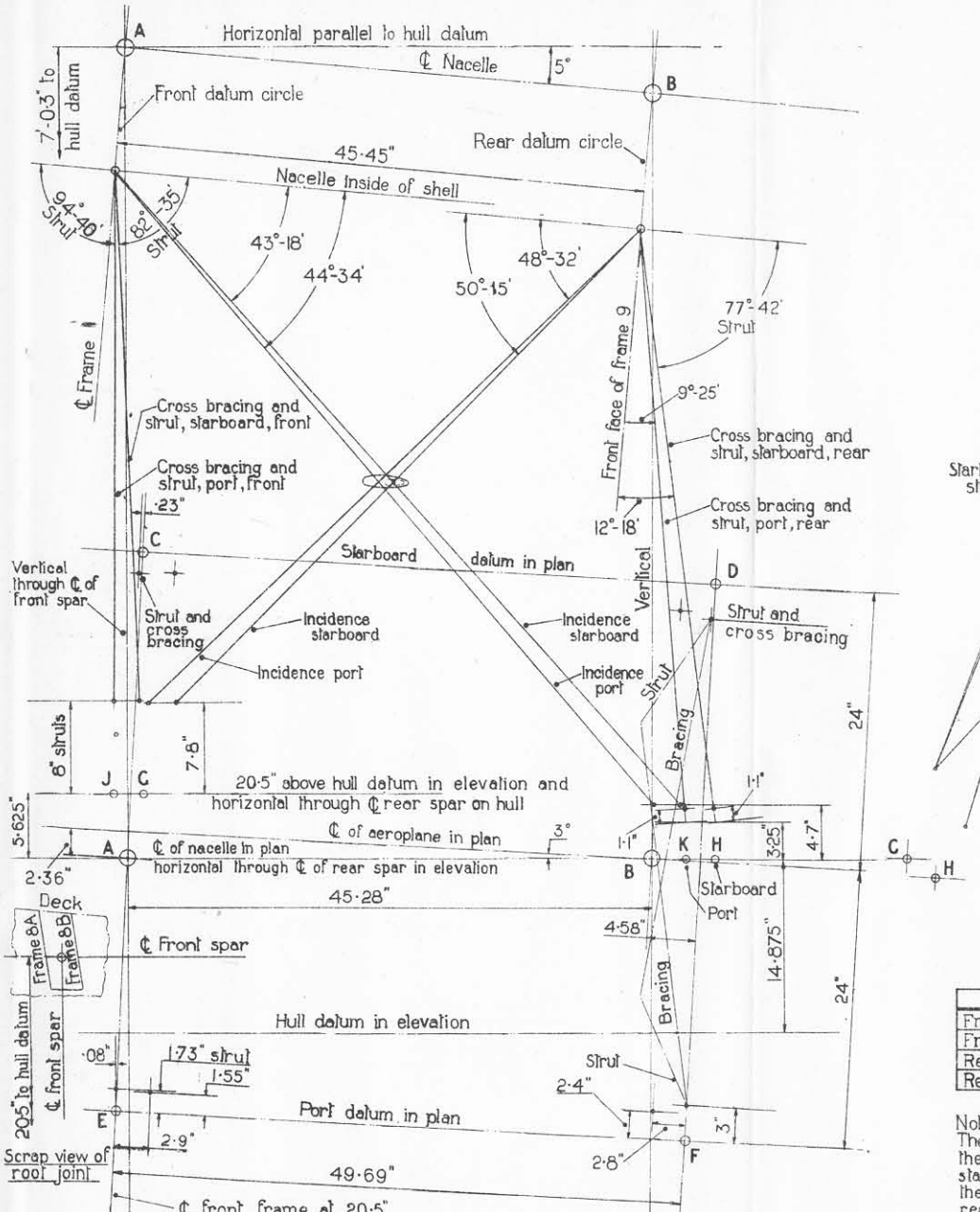
(iii) Secure the shackle, Admiralty Part No. 2051, on the cable to the fitting on the turntable and adjust if necessary the length of the lower cable; finally tighten with turnbuckle.

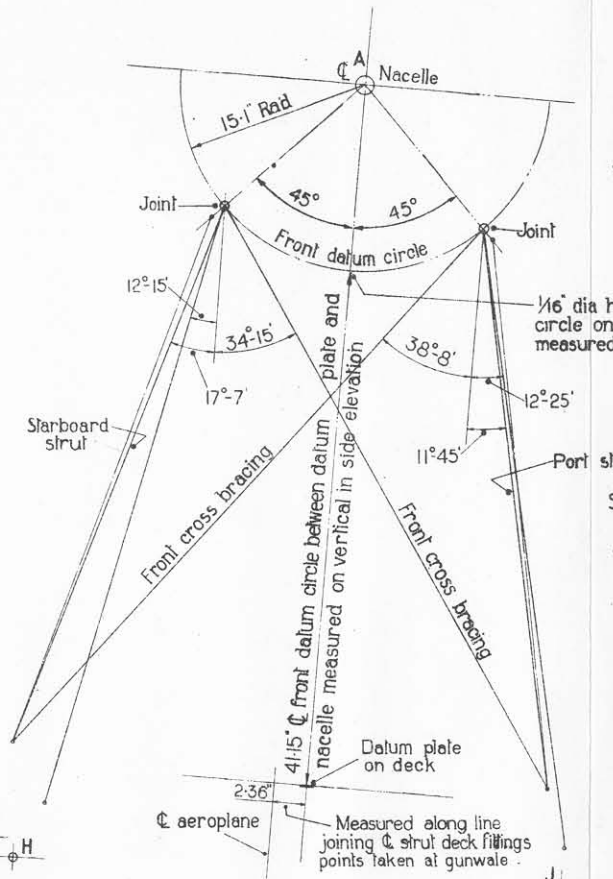
(iv) Repeat operations (i), (ii) and (iii) on the port wing tip float.

(v) Attach the quick-release shackle A.G.S.960 at the end of the cable 27A/1446, to the existing eye on the rear of the starboard wing tip float.

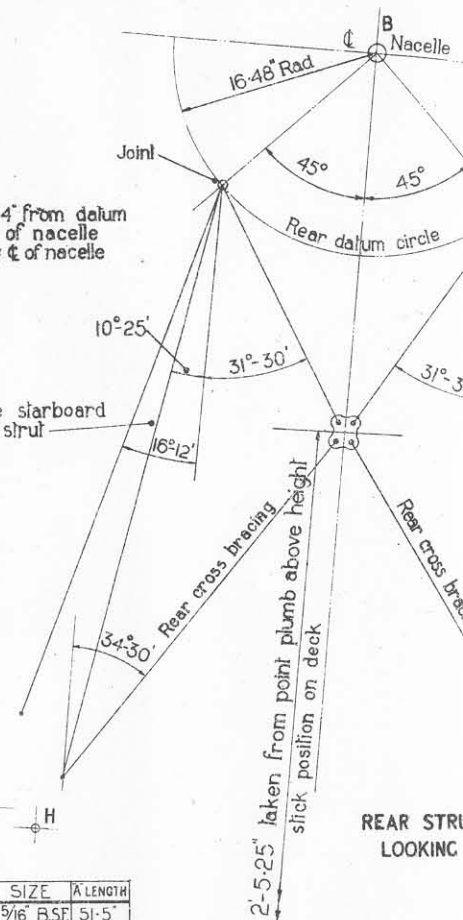
(33) Para. 298. After this paragraph *insert* the following new paragraph:—

299. *Inspection covers.*—For the purpose of venting and inspection, covers are provided in the main planes, ailerons, elevators, tail plane, rudder and flaps. To facilitate the removal and replacement of these covers, a special key to Part No. 23607/39 is provided and is stowed under the navigator's seat.





FRONT STRUTS ETC - LOOKING AFT



REAR STRU
LOOKING

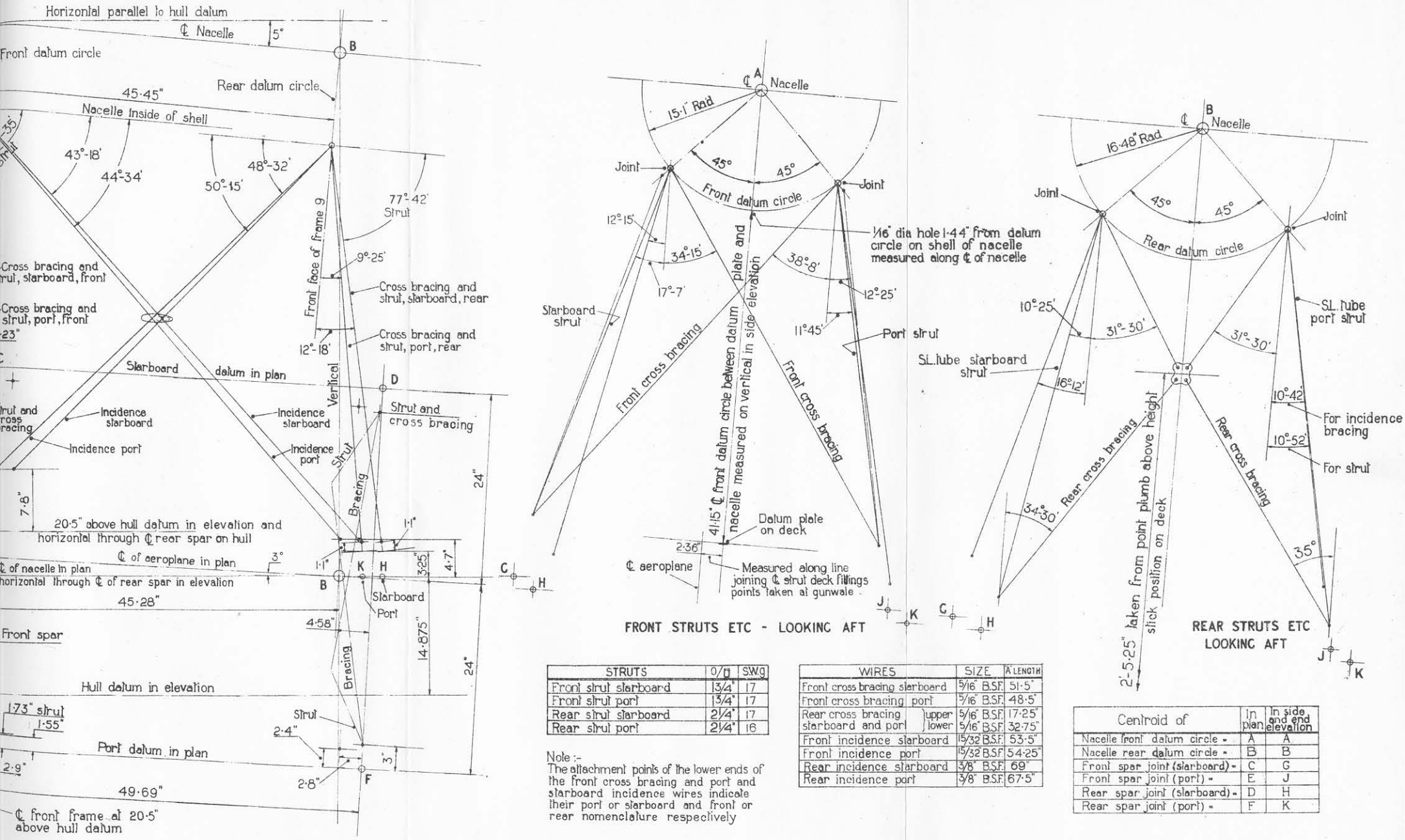
STRUTS	O/D	S.W.G
Front strut starboard	1 3/4"	17
Front strut port	1 3/4"	17
Rear strut starboard	2 1/4"	17
Rear strut port	2 1/4"	16

Note :-
The attachment points of the lower ends of the front cross bracing and port and starboard incidence wires indicate their port or starboard and front or rear nomenclature respectively

WIRES		SIZE	A LENGTH
Front cross bracing starboard		5/16" B.S.F.	51·5"
Front cross bracing port		5/16" B.S.F.	48·5"
Rear cross bracing starboard and port	upper	5/16" B.S.F.	17·25"
	lower	5/16" B.S.F.	32·75"
Front incidence starboard		15/32 B.S.F.	53·5"
Front incidence port		15/32 B.S.F.	54·25"
Rear incidence starboard		3/8" B.S.F.	69"
Rear incidence port		3/8" B.S.F.	67·5"

Centroid of	In plan
Nacelle front datum circle -	A
Nacelle rear datum circle -	B
Front spar joint (starboard) -	C
Front spar joint (port) -	E
Rear spar joint (starboard) -	D
Rear spar joint (port) -	F

FIG. 145. RIGGING — ENGINE NACELLE



FRONT STRUTS ETC - LOOKING AFT

REAR STRUTS ETC LOOKING AFT

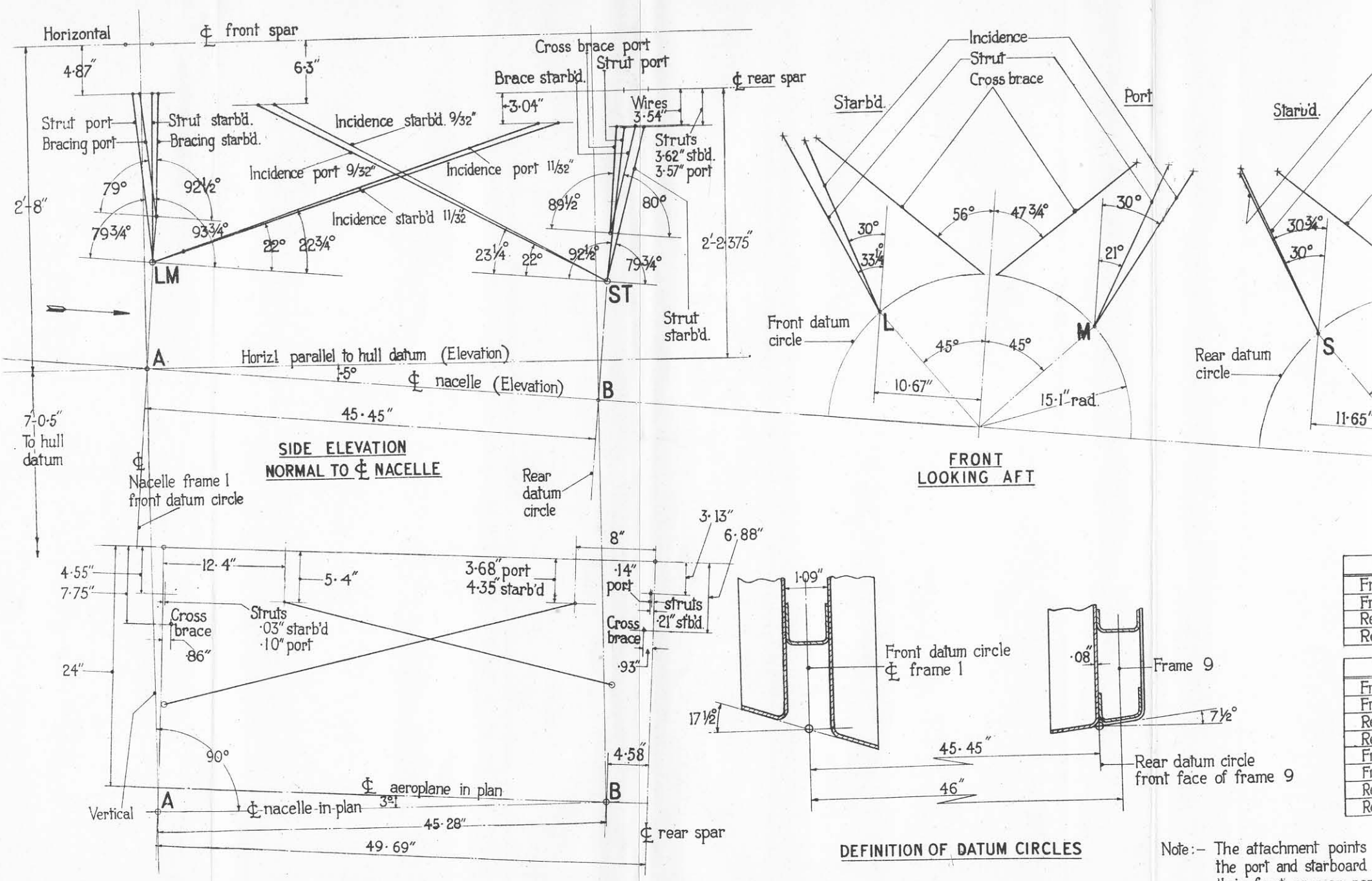
STRUTS	O/D	S.W.g
Front strut starboard	1 3/4"	17
Front strut port	1 3/4"	17
Rear strut starboard	2 1/4"	17
Rear strut port	2 1/4"	16

Note :-
The attachment points of the lower ends of the front cross bracing and port and starboard incidence wires indicate their port or starboard and front or rear nomenclature respectively

WIRES		SIZE	A LENGTH
Front cross bracing starboard		5/16" B.S.F.	51·5"
Front cross bracing port		5/16" B.S.F.	48·5"
Rear cross bracing starboard and port	upper	5/16" B.S.F.	17·25"
	lower	5/16" B.S.F.	32·75"
Front incidence starboard		15/32 B.S.F.	53·5"
Front incidence port		15/32 B.S.F.	54·25"
Rear incidence starboard		3/8" B.S.F.	69"
Rear incidence port		3/8" B.S.F.	67·5"

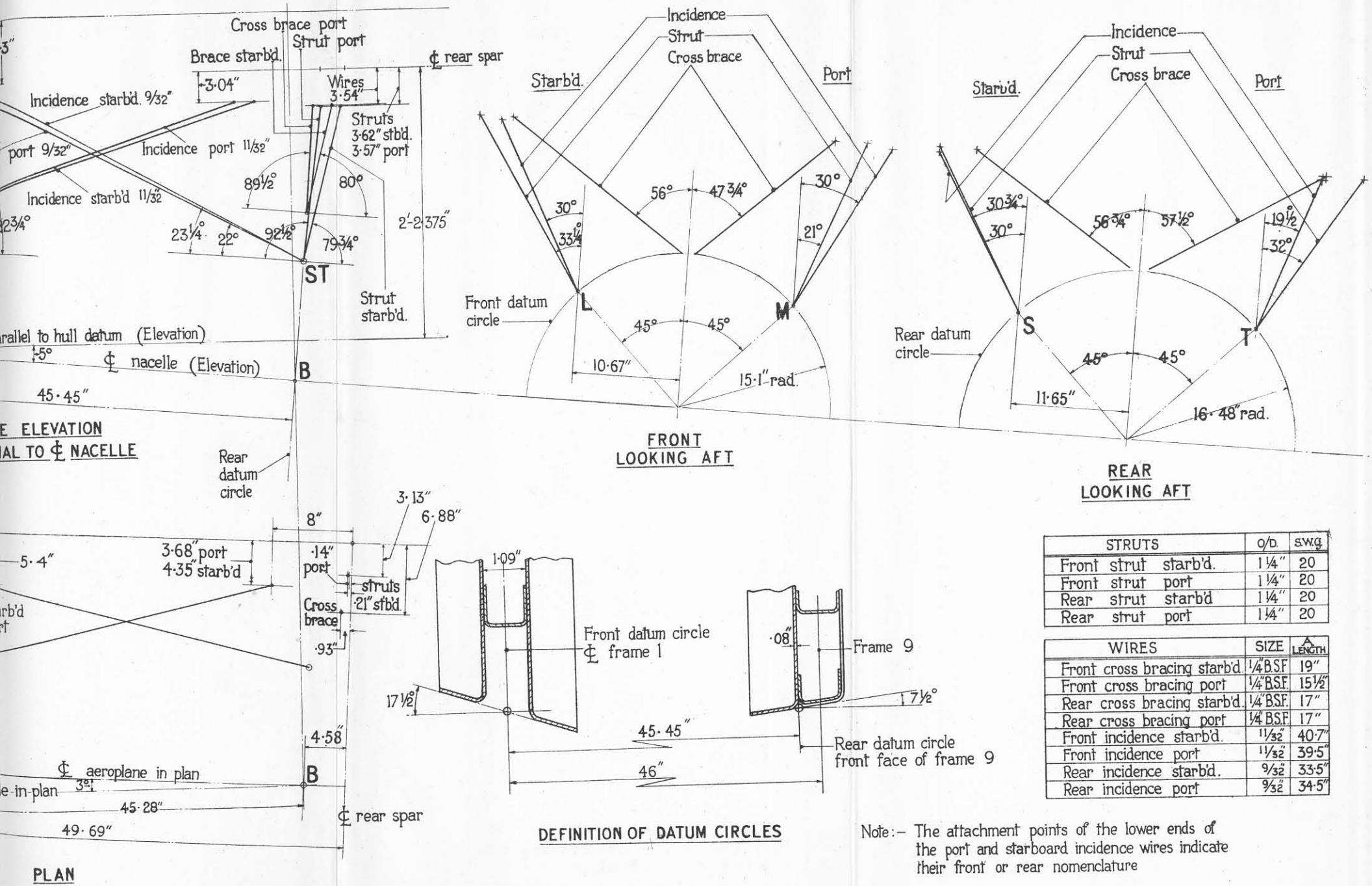
Centroid of	In plan	In side and end elevation
Nacelle front datum circle -	A	A
Nacelle rear datum circle -	B	B
Front spar joint (starboard) -	C	G
Front spar joint (port) -	E	J
Rear spar joint (starboard) -	D	H
Rear spar joint (port) -	F	K

FIG. 145. RIGGING — ENGINE NACELLE



Note:– The attachment points
the port and starboard
their front or rear nor

FIG. 146. RIGGING - TOP CENTRE PLANE



STRUTS	O/D.	S.W.G.
Front strut starb'd.	1¼″	20
Front strut port	1¼″	20
Rear strut starb'd	1¼″	20
Rear strut port	1¼″	20

WIRES	SIZE	A LENGTH
Front cross bracing starb'd.	¼″ B.S.F.	19″
Front cross bracing port	¼″ B.S.F.	15½″
Rear cross bracing starb'd.	¼″ B.S.F.	17″
Rear cross bracing port	¼″ B.S.F.	17″
Front incidence starb'd.	11/32″	40·7″
Front incidence port	11/32″	39·5″
Rear incidence starb'd.	9/32″	33·5″
Rear incidence port	9/32″	34·5″

Note:– The attachment points of the lower ends of the port and starboard incidence wires indicate their front or rear nomenclature

FIG. 146. RIGGING - TOP CENTRE PLANE

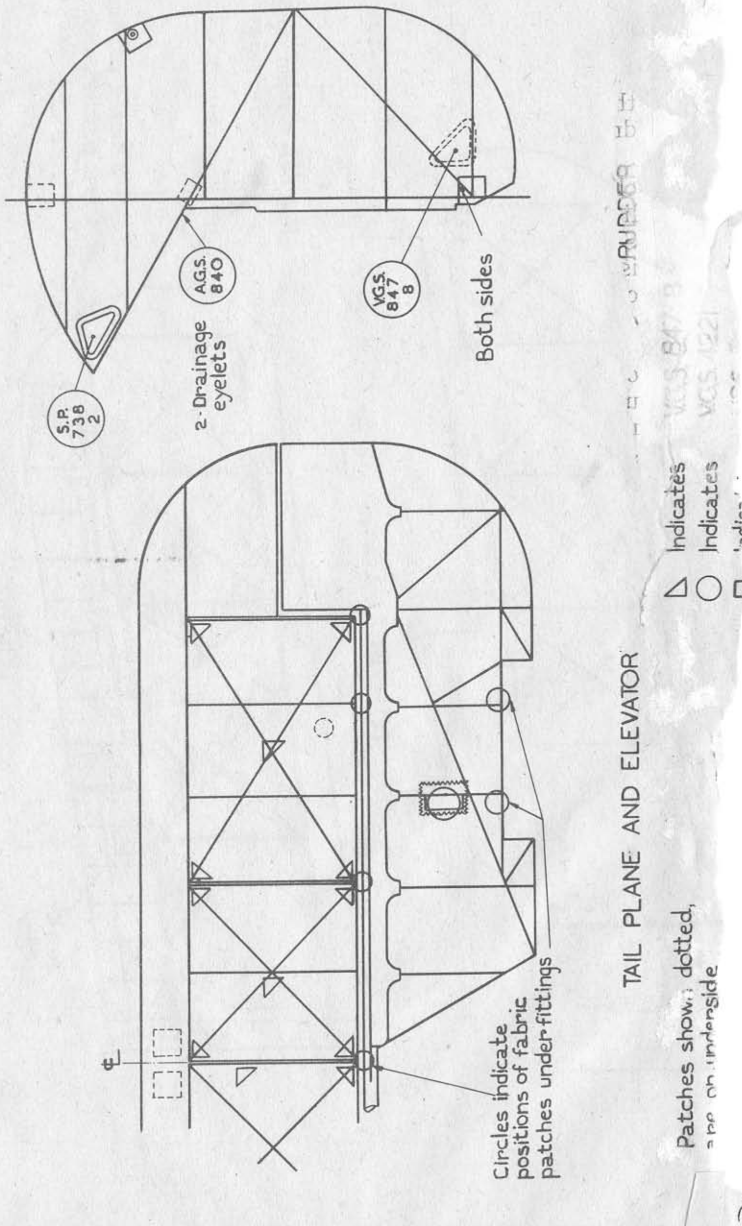
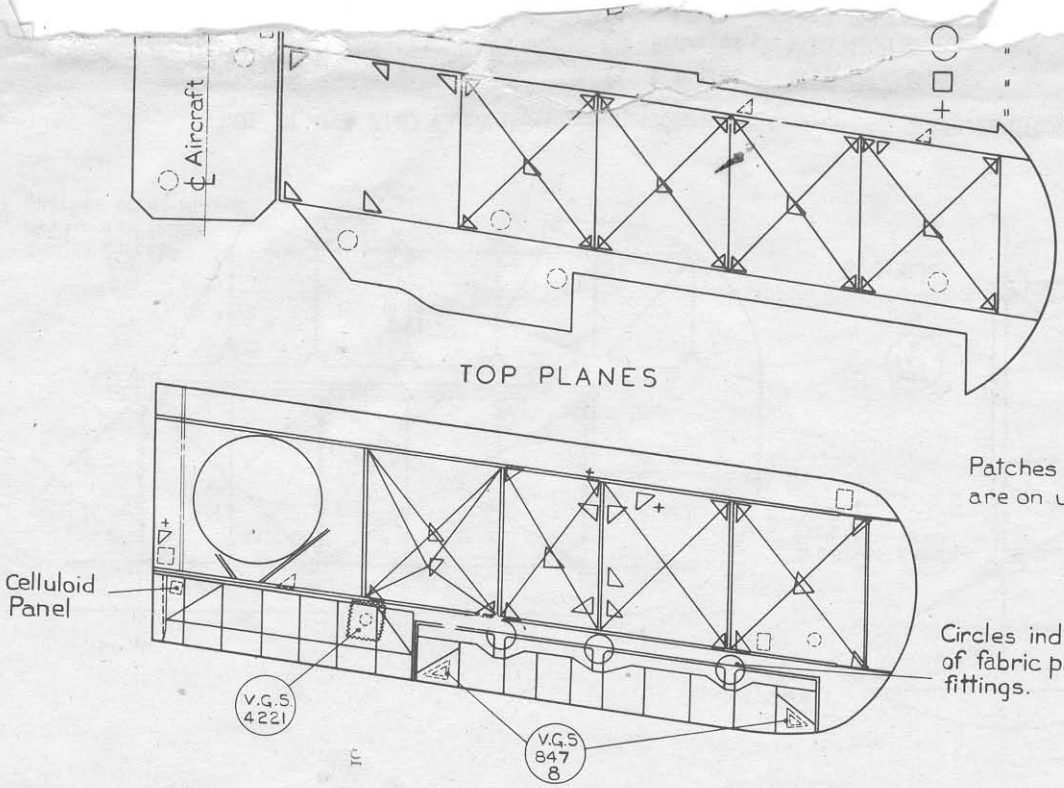


FIG.146B - FABRIC PATCHES, TAIL UNIT

(7772) Wt. T.16834/2423/M.29518. 1,250. 4/43. P.L.H. & CO. LTD. G.943.

FIG. 146A-FABRIC PATCHES, MAIN PLANES



THIS PAGE ISSUED WITH A.L. 7, FEB. 1943

Amended (A.L.6)

(57) Fig. 147. In the side elevation, illustrating the Undercarriage Chine Lock lubrication, *delete* the symbol for Oil, Lubricating, Anti-Freezing, Type B (Stores Ref. 34A/55 and 56) and *substitute* the symbol for Grease, Anti-freezing (Stores Ref. 34A/49).

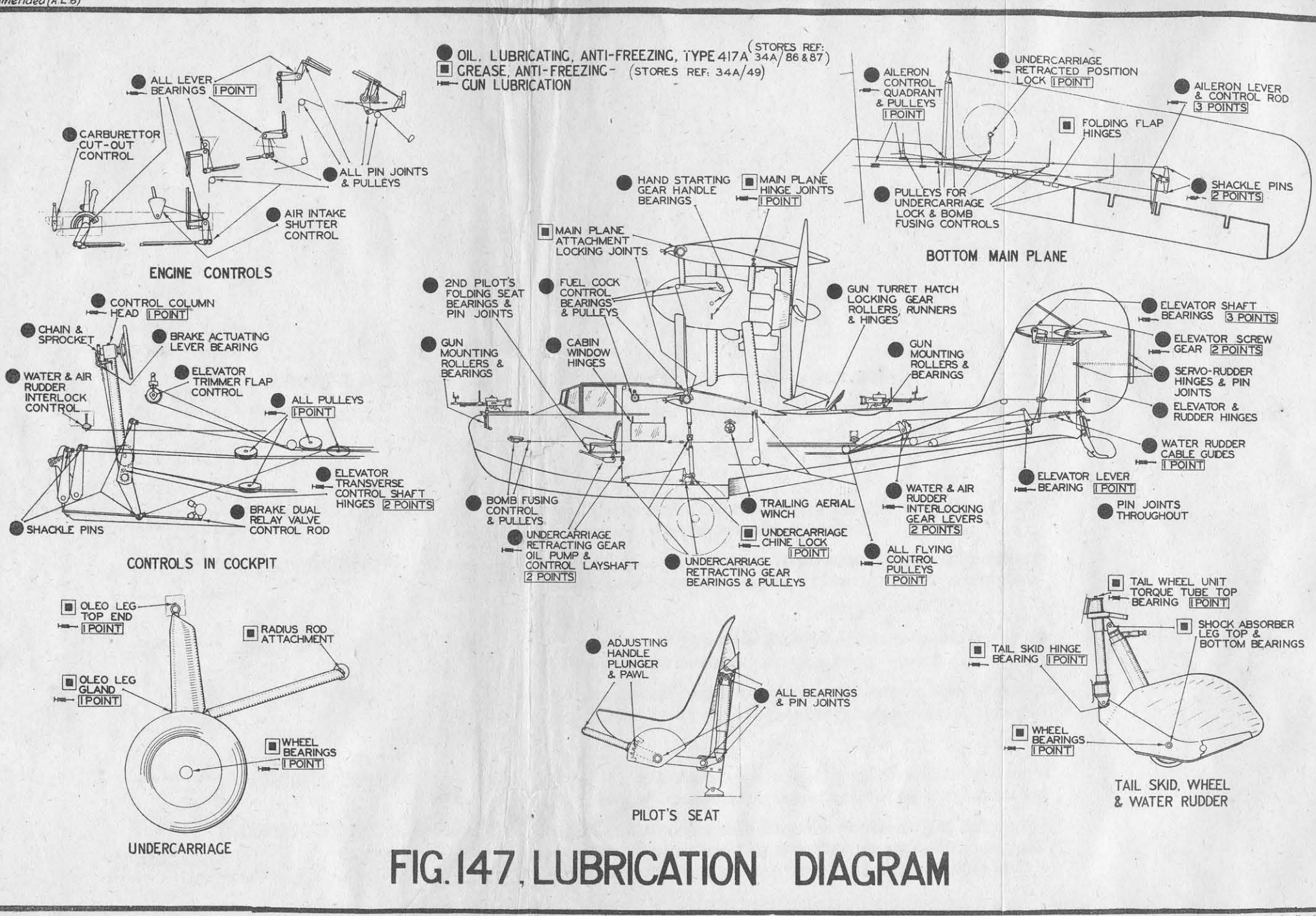
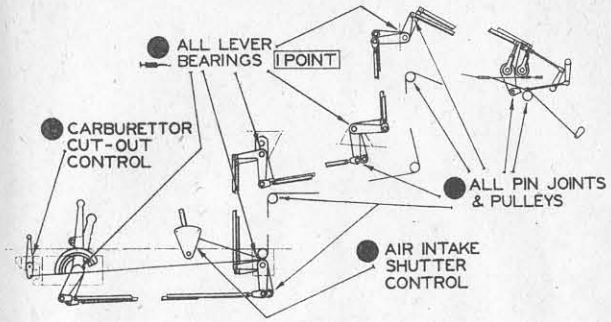


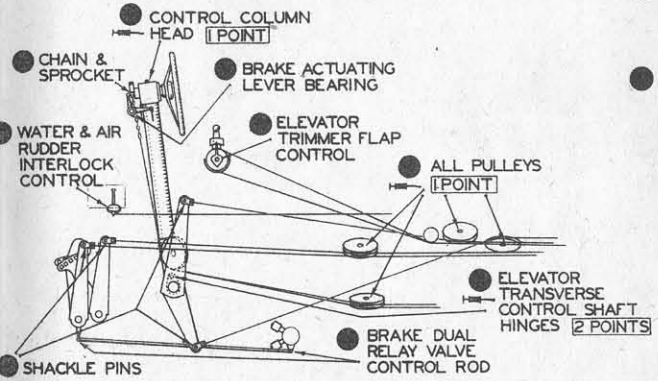
FIG. 147, LUBRICATION DIAGRAM

PP1837 M16860/376 8/42 1000 C & P Gp. 958

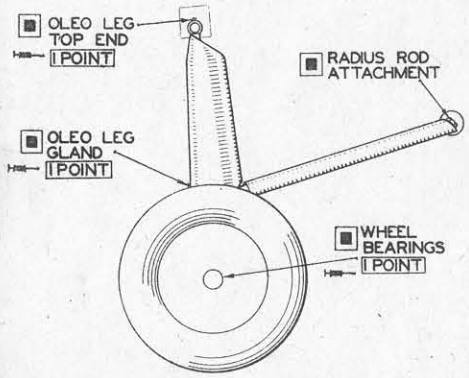
● OIL, LUBRICATING, ANTI-FREEZING, TYPE 417A (STORES REF: 34A/86 & 87)
■ GREASE, ANTI-FREEZING - (STORES REF: 34A/49)
⊢ GUN LUBRICATION



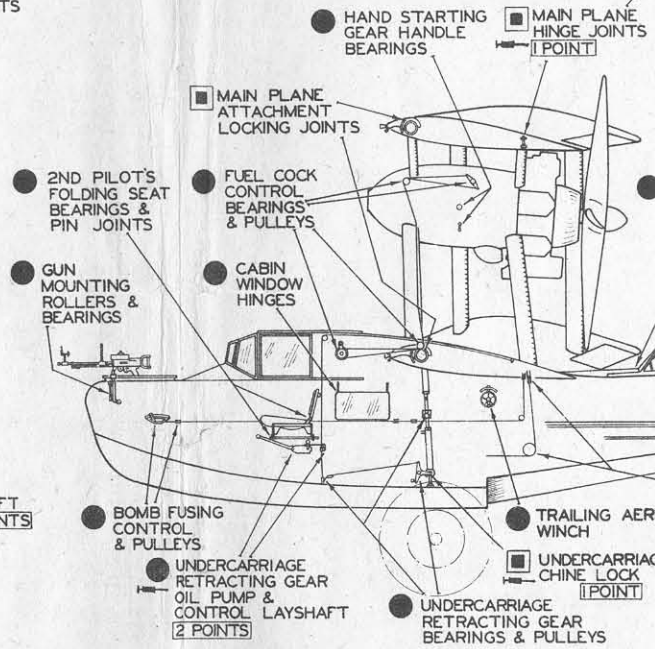
ENGINE CONTROLS

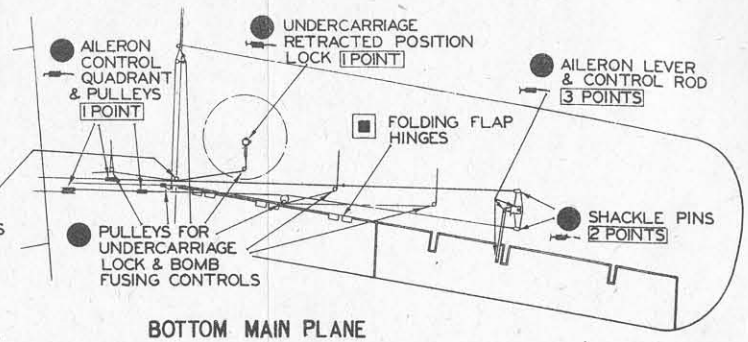


CONTROLS IN COCKPIT

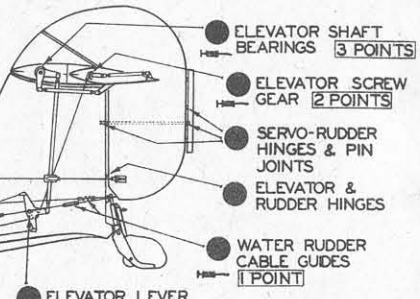


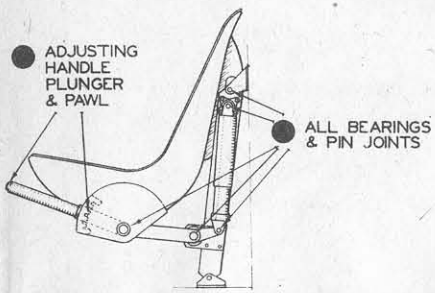
UNDERCARRIAGE



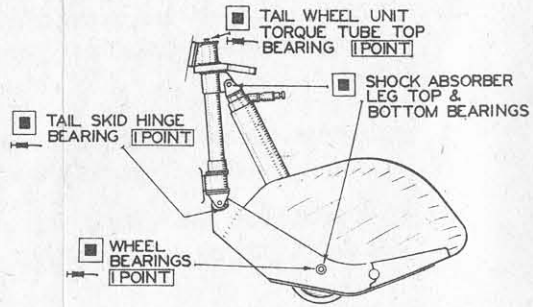


BOTTOM MAIN PLANE





PILOT'S SEAT



TAIL SKID, WHEEL & WATER RUDDER

FIG. 147. LUBRICATION DIAGRAM

PP1837 M16860/376 8/42 1000 C & P Gp. 959 (4)

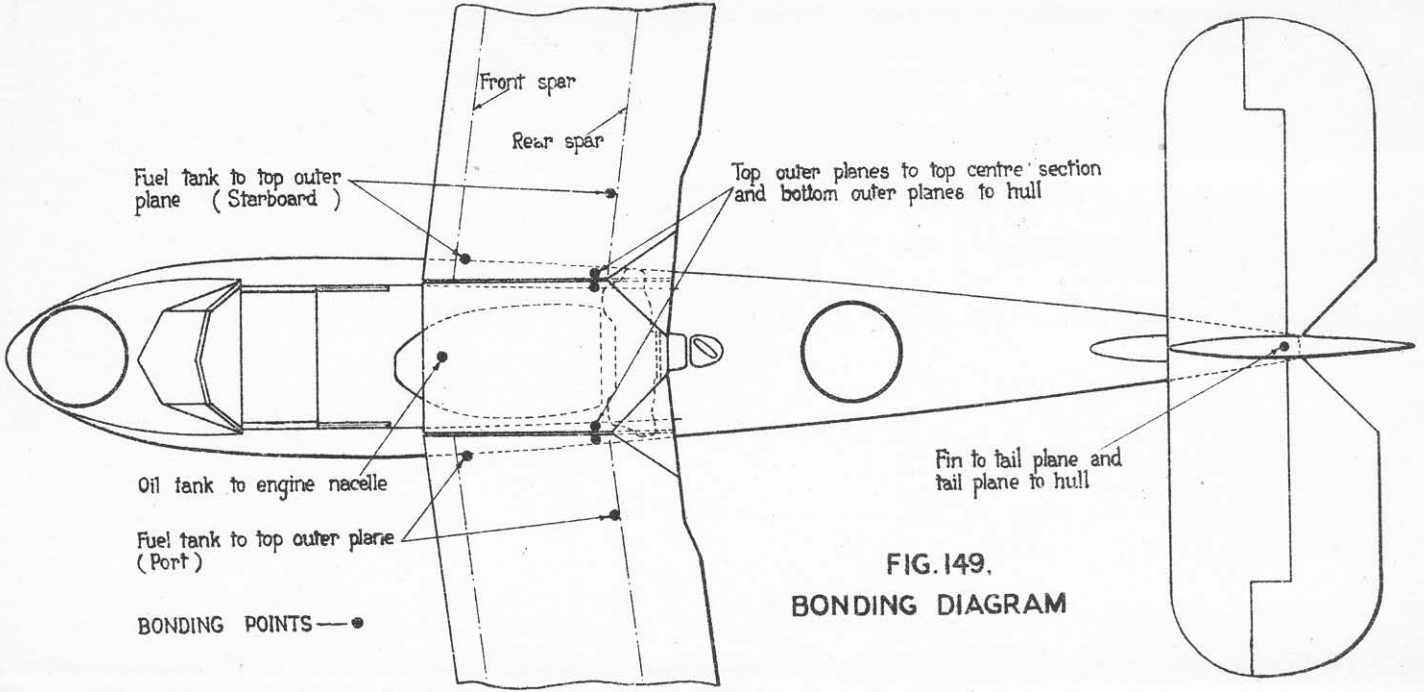
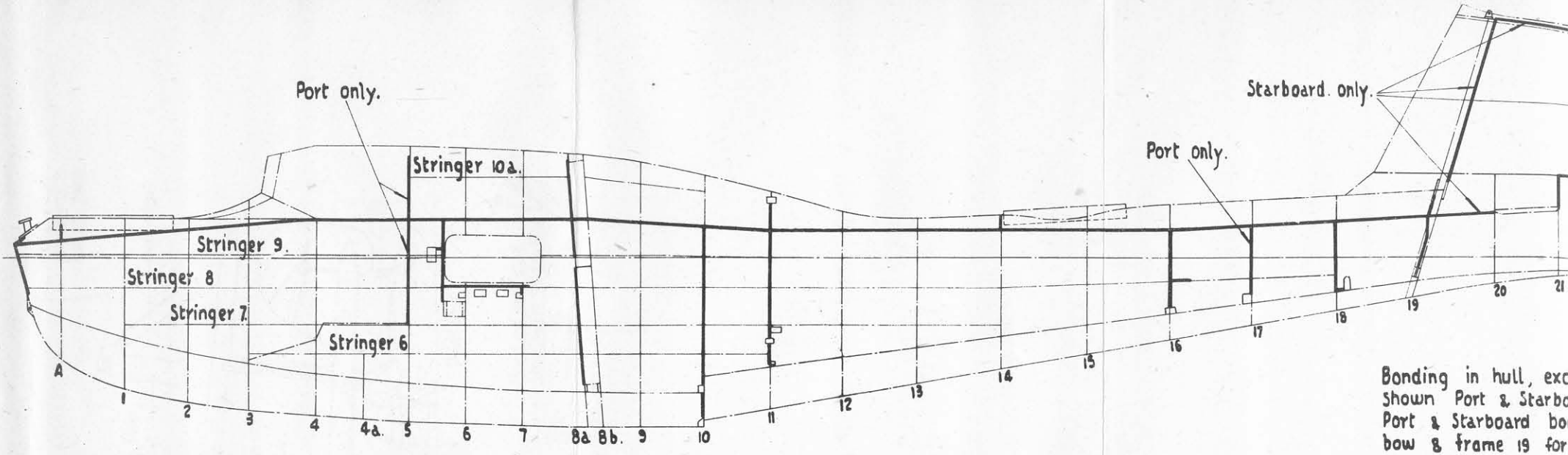
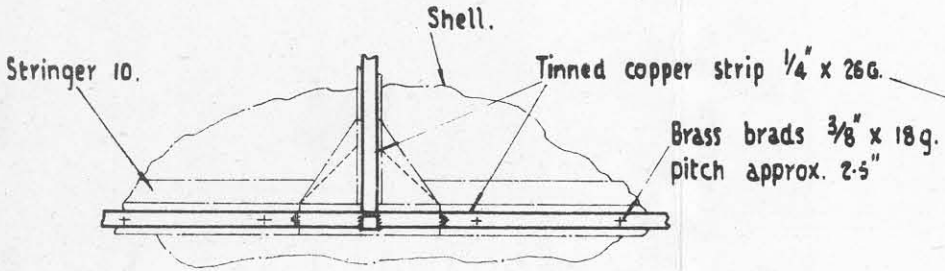


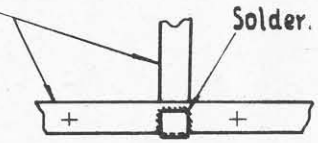
FIG. 149.
BONDING DIAGRAM



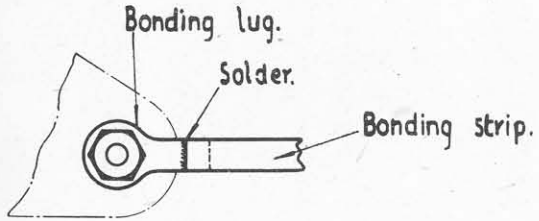
Bonding in hull, exc
shown Port & Starbo
Port & Starboard bo
bow & frame 19 for



Typical Run of Bonding Strip.

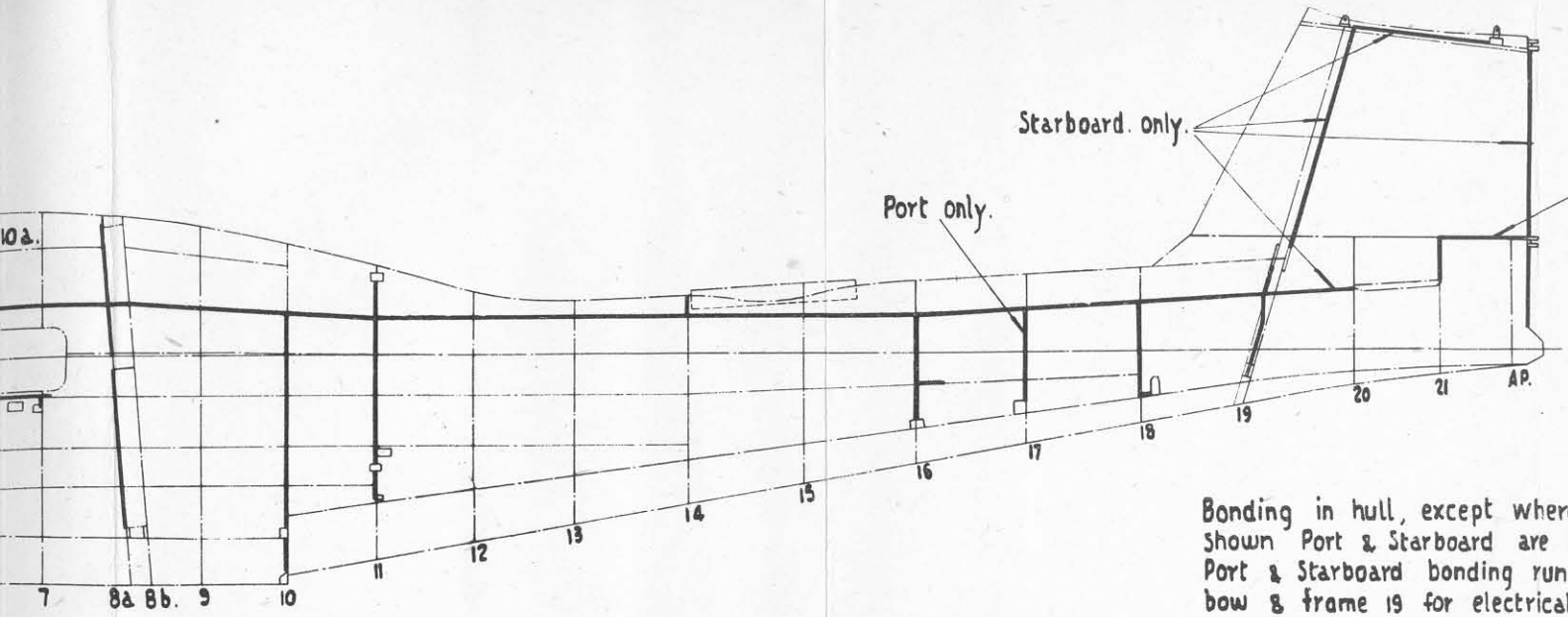


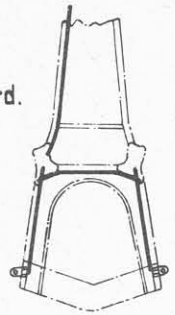
Typical Attachment of
Branches to Main Strip



Typical Attachment to
Main Fittings.

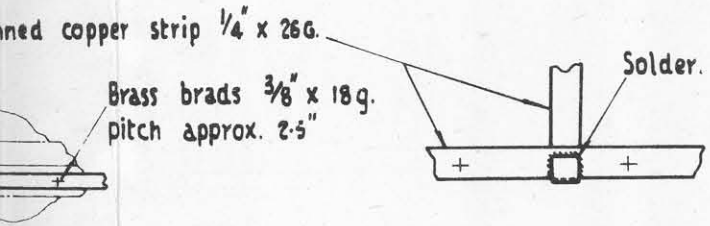
FIG. 149A, BONDING DIAGRAM (WOODEN HULL)



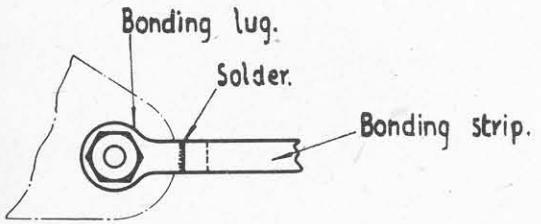


View Looking Aft on Frame 19.

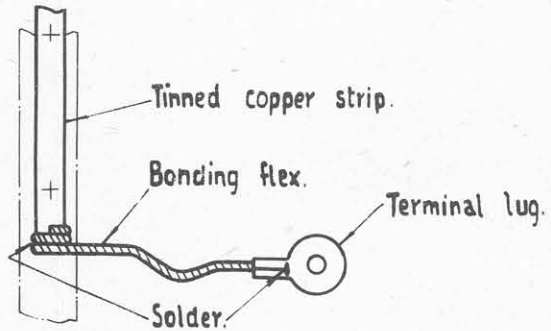
Bonding in hull, except where otherwise shown Port & Starboard are similar.
Port & Starboard bonding run connected at bow & frame 19 for electrical continuity.



Typical Attachment of Branches to Main Strip



Typical Attachment to Main Fittings.



Typical Bonding Attachment for 4 ba. Screws.

FIG. 149A, BONDING DIAGRAM (WOODEN HULL)

PP1654 M07219/1097 1/42 1000 C & P Gp. 959 (4)

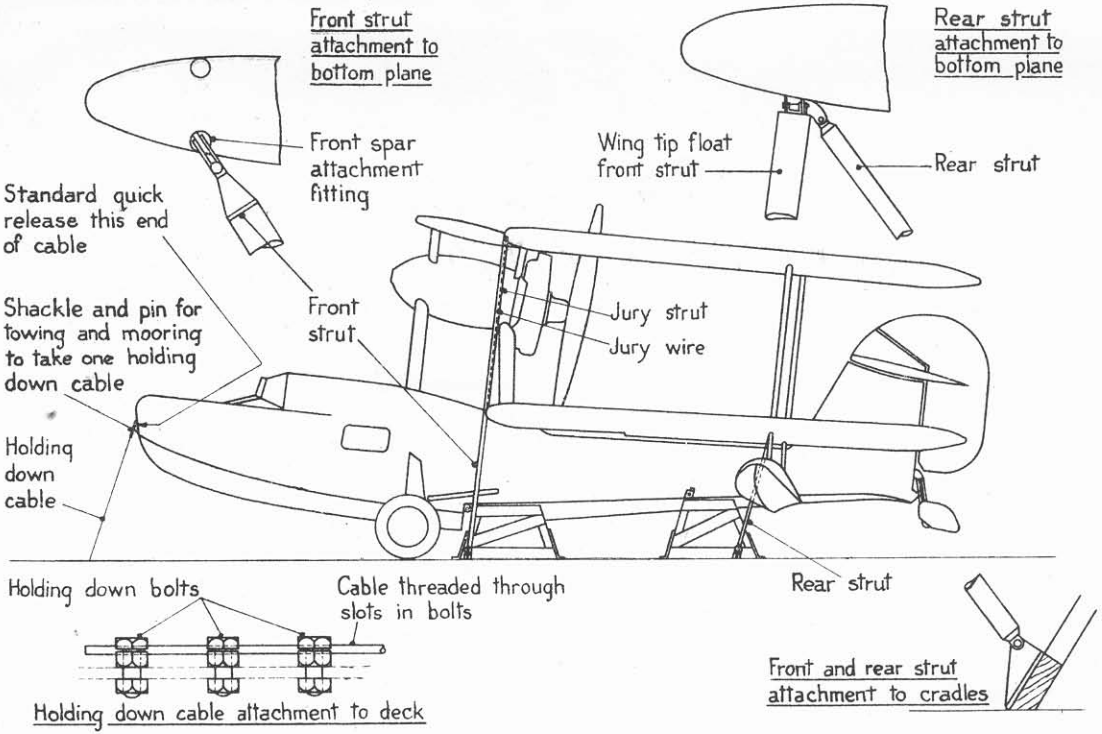


FIG. 150. AEROPLANE STOWED ON DECK (MAIN PLANES FOLDED)

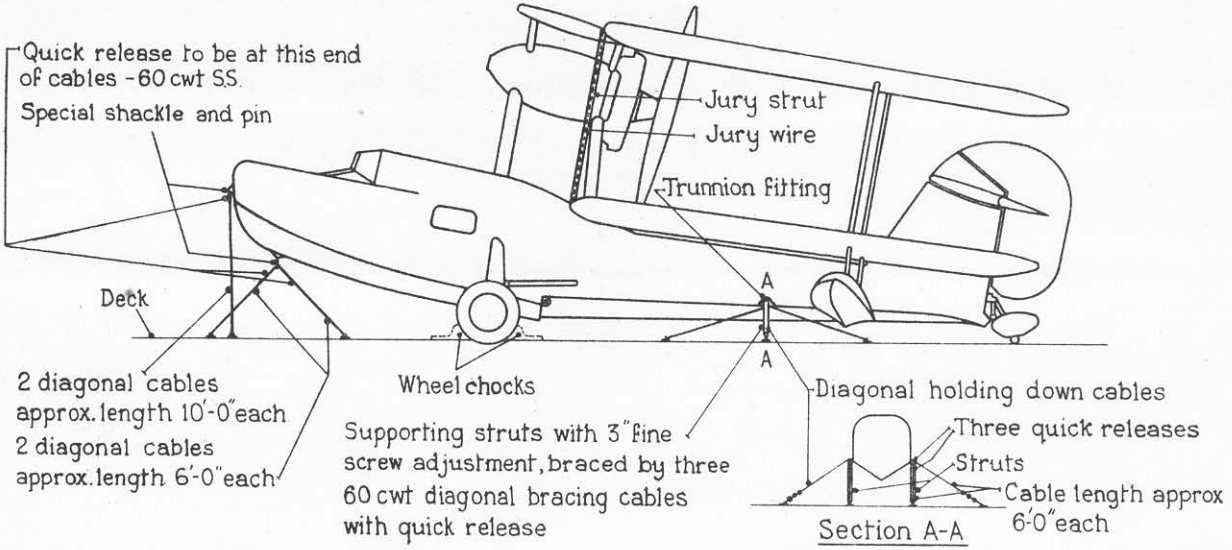


FIG. 151, AEROPLANE STOWED ON DECK IN HANGAR (MAIN PLANES FOLDED)

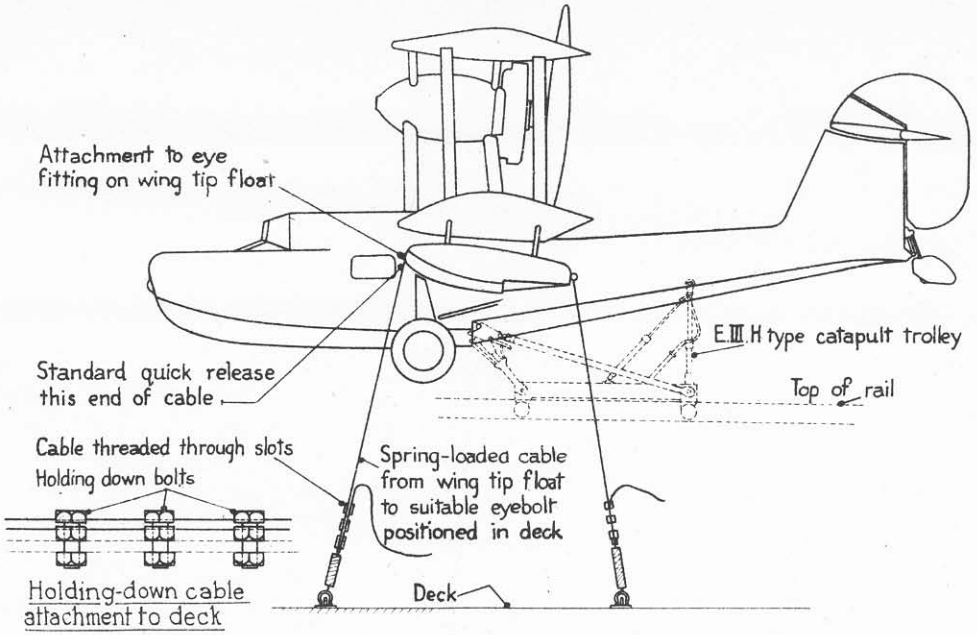


FIG. 152. AEROPLANE STOWED ON CATAPULT (MAIN PLANES SPREAD)

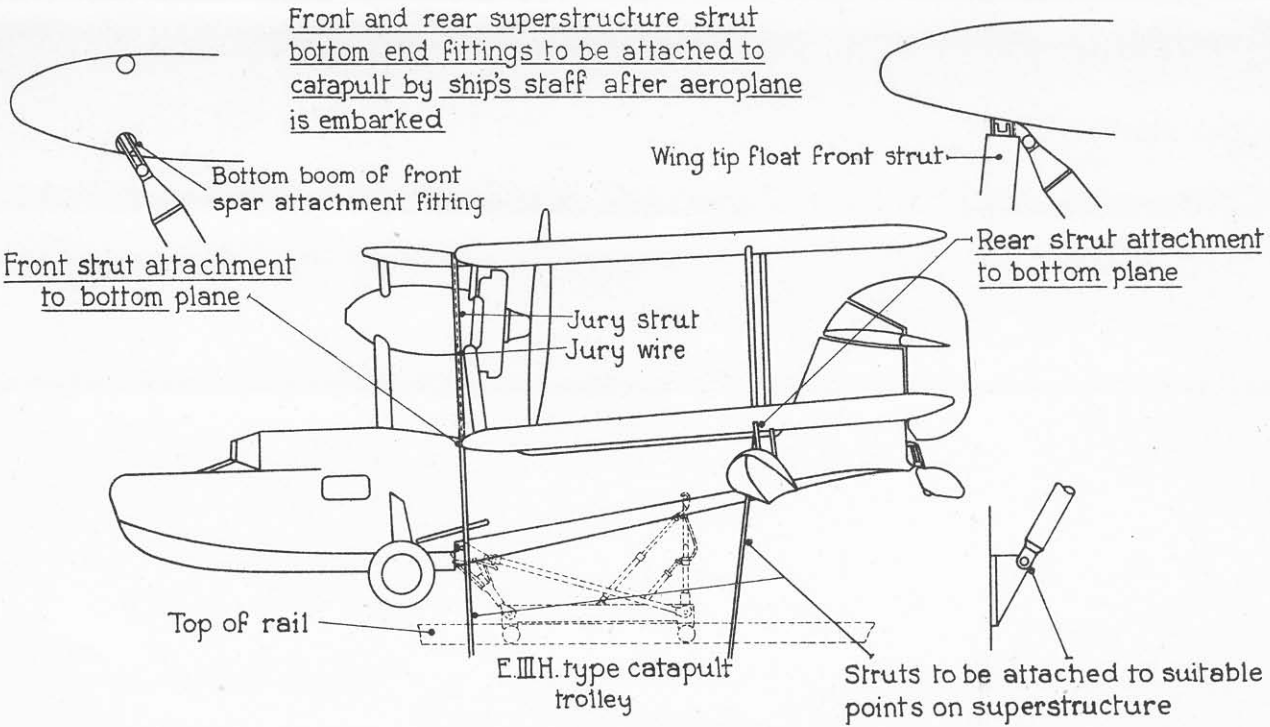


FIG. 153, AEROPLANE STOWED ON CATAPULT (MAIN PLANES FOLDED)

APPENDIX I

WALRUS I AEROPLANE

CONTENTS

LIST OF ILLUSTRATIONS

APPENDIX I

A.P. 1515A, Vol. I, 2nd Edition

THE WALRUS AEROPLANE

WIRELESS INSTALLATION

General

1. The aeroplane is equipped for wireless transmission and reception, the wireless apparatus consisting of a transmitting and a receiving unit, types T.1083 and R.1082 respectively, capable of receiving or radiating R/T, or C.W., or I.C.W. A morse key and a combined telephone and microphone, duplicated on the starboard side of the pilot's cockpit, are mounted on the wireless operator's table. Wiring is installed which provides for telephonic and microphonic communication between the pilot's and the wireless operator's head sets. The wireless installation, including the intercommunication system, is illustrated in fig. 1 of this appendix.

2. Two fixed aerials, which can be used when the aeroplane is on the water, are provided; one for short wave, the other for medium and long wave transmission and reception. A motor generator and hand-driven generator are fitted as alternative sources of H.T. supply for the transmitter, while L.T. supply for the transmitter is drawn from an 8-volt accumulator. For the receiver H.T. and L.T. electrical supply, one 120-volt battery and one 2-volt 20 amp. hr. accumulator respectively are provided. Provision is also made for a trailing aerial which can only be used when the aeroplane is in the air.

Equipment

3. The wireless position is between the spar frames, where a table and a seat (*see* fig. 16) are fitted, the seat, described in para. 43, being provided with a special backrest for prevention of shock to the operator when the aeroplane is being catapulted. On a fixed panel at the forward end of the table is the receiver and above it the transmitter. These are mounted on sponge rubber pads and are held in position with elastic cords, the frame to which the panel is secured being of sturdy construction to withstand the shock of catapulting. The neutralizing unit is similarly mounted and is secured to a bracket adjacent to the top right-hand corner of the transmitter.

4. The four 2-volt 20 amp. hr. accumulators supplying filament current to the transmitter are housed in a case at the back of the panel. The 2-volt 20 amp. hr. accumulator and 120-volt H.T. battery for the receiver are contained in a case under the table. The morse keys are mounted as stated in para. 1 above, the combined telephone and microphone socket being mounted on the wireless operator's table.

5. On the top of the table, at the forward end, is the H.F. smoothing unit which is fitted on a detachable mounting plate. To this plate are secured an 80-watt motor generator, the generator starting switch and a 4-point socket for connection to the transmitter power plug. In the wireless operator's table is a drawer with a press-down locking handle, the drawer having compartments for alternative sets of transmitter coils and a space for code books, etc. A rack under the table provides stowage for three sets of receiver coils.

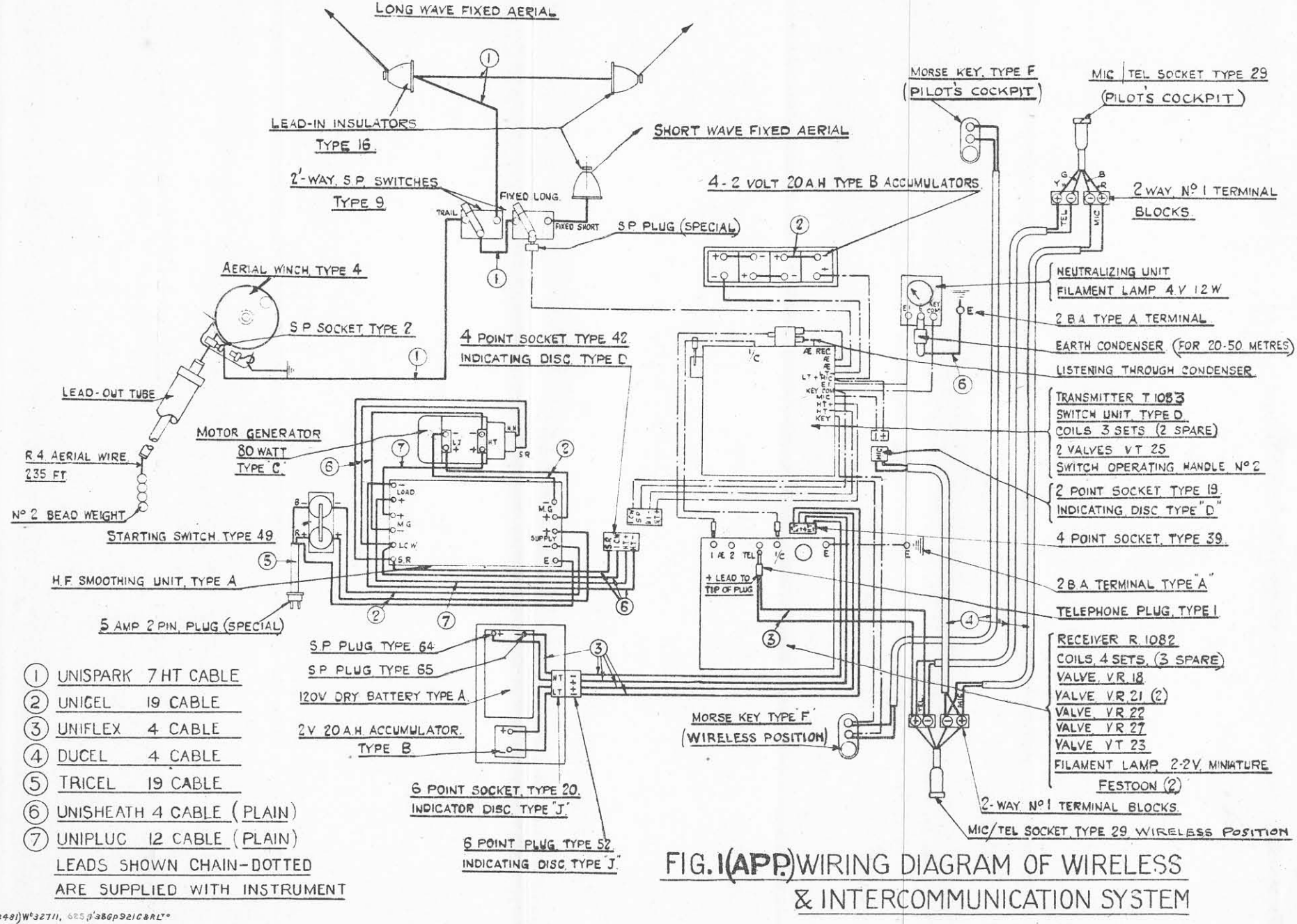
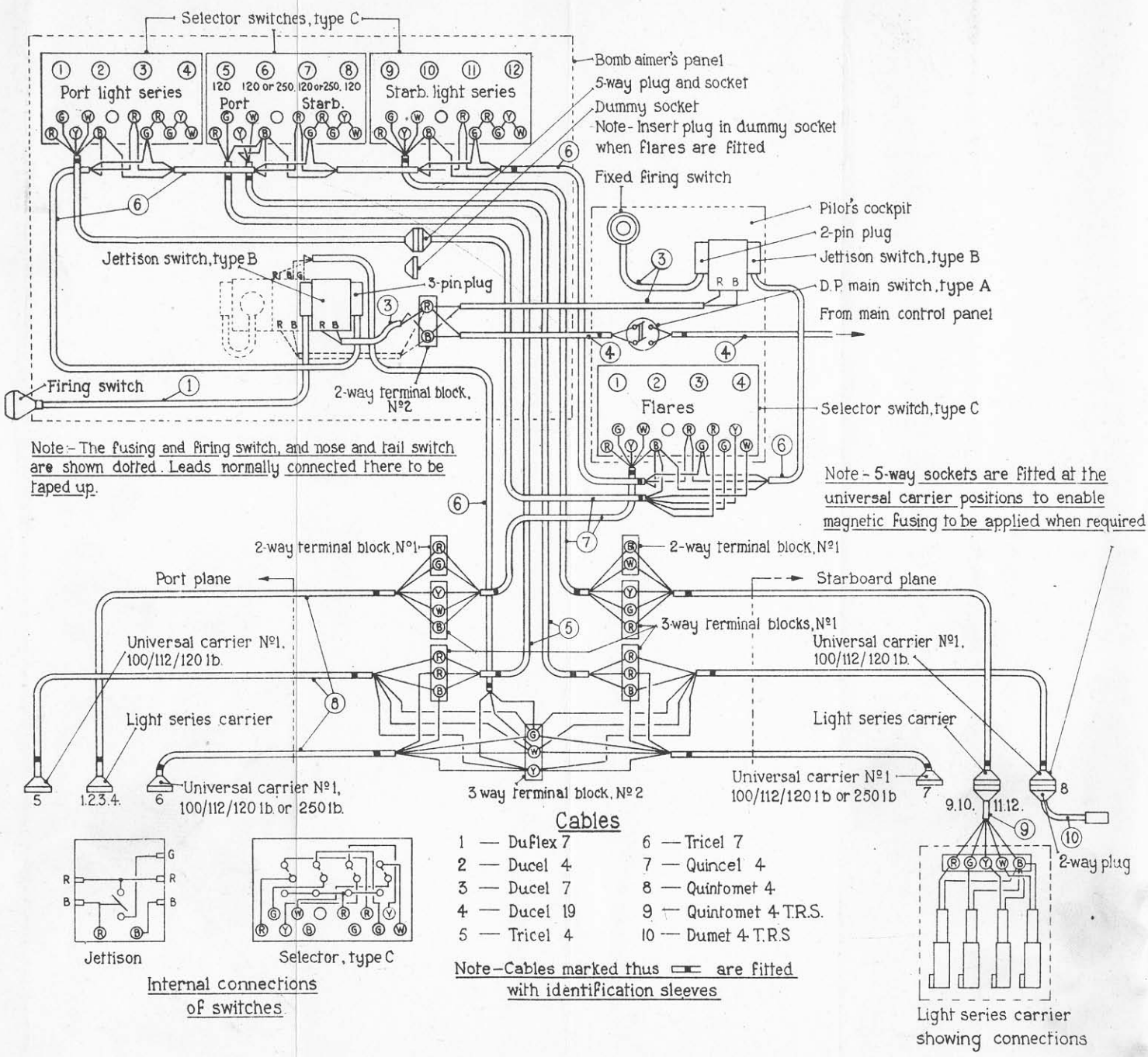


FIG. 1(APP.) WIRING DIAGRAM OF WIRELESS & INTERCOMMUNICATION SYSTEM

(3481) W° 32711, 625 3/38 GP 921 C & R L° .



(3481)

FIG. 2, (APP.) BOMB RELEASE WIRING DIAGRAM

Aerials

6. *Fixed aerials.*—The short wave aerial consists of a single cable extending between the top of the port front interplane strut and a leading-in insulator mounted on the hull decking above the wireless position. The medium and long wave aerial consists of two limbs which extend from a mast on top of the rudder to stub masts projecting above the top main planes inboard of the front outer interplane struts. The lead-in for this medium and long wave aerial is taken from the top plane stub masts to leading-in insulators on the corresponding port or starboard side of the hull, at frame 7, and at the top just below the decking.

7. *Trailing aerials.*—The aeroplane is equipped with a standard, type 4, winch to provide for a trailing aerial, which may be used when the aeroplane is in the air. Underneath the winch, which is mounted alongside the wireless position and communicating with the outside of the hull, is a watertight trunk accommodating an insulated fairlead tube for the trailing aerial. When not in use the fairlead tube is withdrawn and stowed in clips on the side of the watertight trunk, the top of which is then sealed by a cover. It is important to see that this cover is seated hard down immediately the tube is withdrawn.

8. The aerials are connected to two change-over switches which enable the short wave or medium and long wave fixed aerials, or the trailing aerial to be selected. A short wave earth condenser is supplied for use in series with the earth lead from the neutralizing unit when working on higher frequencies.

BOMB RELEASE

Bomb release electrical circuits

9. The bombs, both on the light series as well as the universal carriers, are electro-magnetically released as described in paras. 215 and 216. The supply cable from the 12-volt general services accumulator is led from a fuse on the electrical control panel in the hull to the main switch on the port side of the pilot's instrument panel.

10. The bomb-aimer's bomb release controls are mounted on a hinged panel, on the starboard side of the forward gun cockpit. These release controls comprise three 4-unit selector switch boxes, type C, a jettison switch, type B, and a firing switch. Stowage for the firing switch and lead is provided by a pocket in the panel. The pilot's bomb release controls are mounted on a panel positioned on the port side of the pilot's cockpit and slightly aft of the engine control levers. These release controls comprise a jettison switch, type B, a fixed firing switch, a double pole main switch, type A, and a 4-unit selector switch box, type C.

11. Aft of the bomb-aimer's panel are located a 5-point plug and a socket which should be disconnected when flares are carried, and the plug inserted in the adjacent dummy socket. When bomb-aiming operations are not in progress the panel should be protected from spray, etc., by the roll cover which is secured in position by press-type fasteners. A diagram of the bomb release electrical circuits is given in fig. 2 of this appendix.

12. The fusing of the bombs is mechanically operated, but 5-way sockets are fitted at the universal carrier positions to enable the application of electro-magnetic fusing when required, and provision is made for mounting bomb fusing switch boxes on the panels. Direction plates, numbered to correspond with the switches of the selector boxes, are fitted at each bomb position.

(40150) Wt. 32711/2326 625 3/38 Hw. G.371