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R.A.A.F. PUBLICATION NO. 779
AUGUST, 1946

THE "MUSTANG" OVERHAUL MANUAL

MARK NOS. 20 AND 21
22 AND 23

ISSUED FOR THE INFORMATION AND GUIDANCE
OF ALL CONCERNED

BY COMMAND OF THE AIR BOARD

SECRETARY

PREPARED BY
SERVICE DEPARTMENT
AIRCRAFT DIVISION
COMMONWEALTH AIRCRAFT CORPORATION
MELBOURNE

AIR FORCE HEADQUARTERS
MELBOURNE, S.C.1

R.A.A.F. PUBLICATION. No. 779.

MUSTANG

OVERHAUL MANUAL

(Mark 20-21)
22-23

SERVICE DEPARTMENT AIRCRAFT DIVISION

COMMONWEALTH AIRCRAFT CORPORATION PTY. LTD.

MELBOURNE AUSTRALIA

FOREWORD

The purpose of this Manual is to furnish information on the maintenance of the Mustang Airplane. All information available as of 1st August, 1946, has been incorporated.

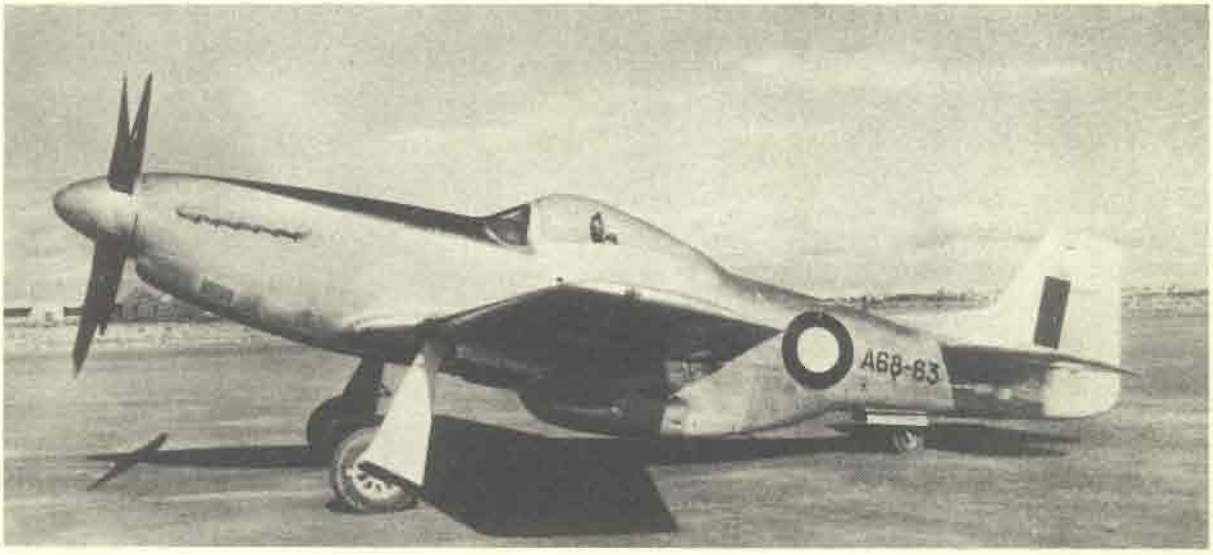
Modifications made on the Airplane subsequent to 1st August will be incorporated in "Amendment Lists," which will be issued as necessary. The amendments must be recorded in the Manual as they are issued.

Detailed information regarding the repair of the Aircraft will be found in the "Mustang Repair Manual." The "Repair Manual" should be consulted before attempting to repair any damaged portion of the Airplane.

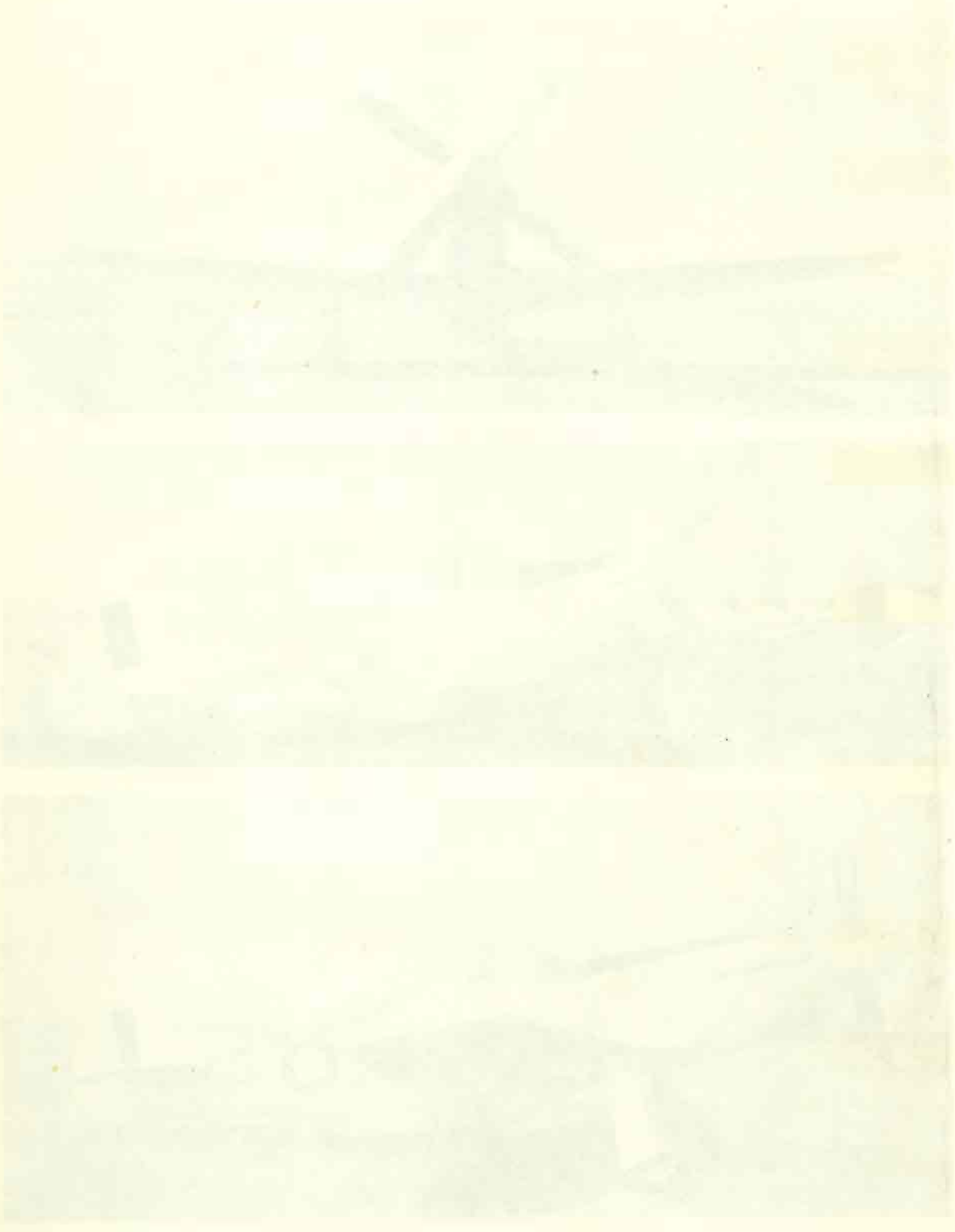
AMENDMENT CERTIFICATE

CERTIFIED that the amendments promulgated in the under-mentioned AMENDMENT LISTS have been made in this publication:—

Amendment List No.	Amendment List Dated	Amendment made by	Date	Amendment List No.	Amendment List Dated	Amendment made by	Date
1	APR 1951	R. MULLER 2240	15/5/51				



THREE VIEWS OF AIRPLANE



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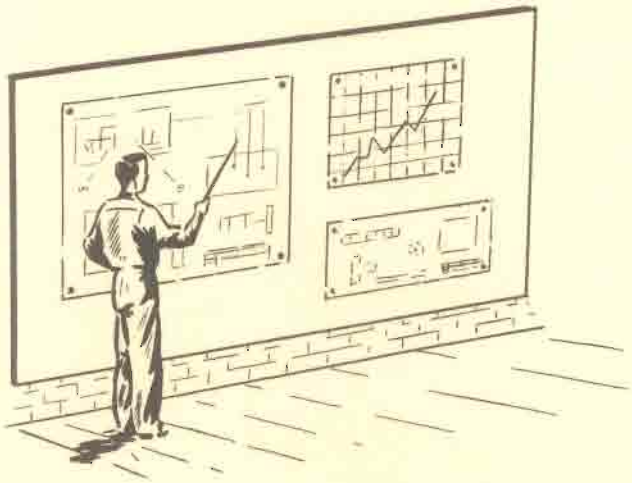
CHAPTER 1

GENERAL DATA



MUSTANG OVERHAUL MANUAL

CHAPTER 1. – GENERAL DATA.

Section A. – MAIN DIMENSIONS.

1. GENERAL.

Span	37 ft. 5/16 in.
Length (over-all)	32 ft. 3.5/16 in.
Height	12 ft. 2.1/16 in.
Height (approx. height tail wheel on ground, propeller blade vertical)	13 ft. 4.⅜ in.

2. WING.

Airfoil Section	NAA-NACA LOW DRAG AIRFOIL
Chord at root	8 ft. 2 in.
Chord near tip (215 inches from fuselage centreline)	4 ft. 2 in.
Incidence (variable) approximate	1 degree
Dihedral (at 25 % line)	5 degrees
Sweepback (leading edge)	3 degrees 35 min. 32 sec.

3. STABILIZER.

Span	13 ft. 2.1/8 in.
Maximum chord	2 ft. 6 in.
Incidence—Metal Elevators	½ degree
Fabric Elevators	2 degrees
Dihedral	None

4. FUSELAGE.

Width (maximum)	2 ft. 11 in.
Height (maximum)	6 ft. 9.¼ in.
Length (without engine mount) (from firewall to end of fuselage without rudder)	20 ft. 11.⅜ in
Length (with engine mount)	27 ft. 10.⅞ in.

5. AREAS.

Wings (less ailerons)	227.33 sq. ft.
Ailerons (total)	12.73 sq. ft.
Flaps (total)	32.22 sq. ft.
Horizontal stabilizers	27.98 sq. ft.
Elevators (including tabs)	13.05 sq. ft.
Elevator trim Tabs (total)	1.92 sq. ft.
Vertical stabilizer	9.61 sq. ft.
Rudder (including tabs)	10.41 sq. ft.
Rudder trim tab (total)	.81 sq. ft.

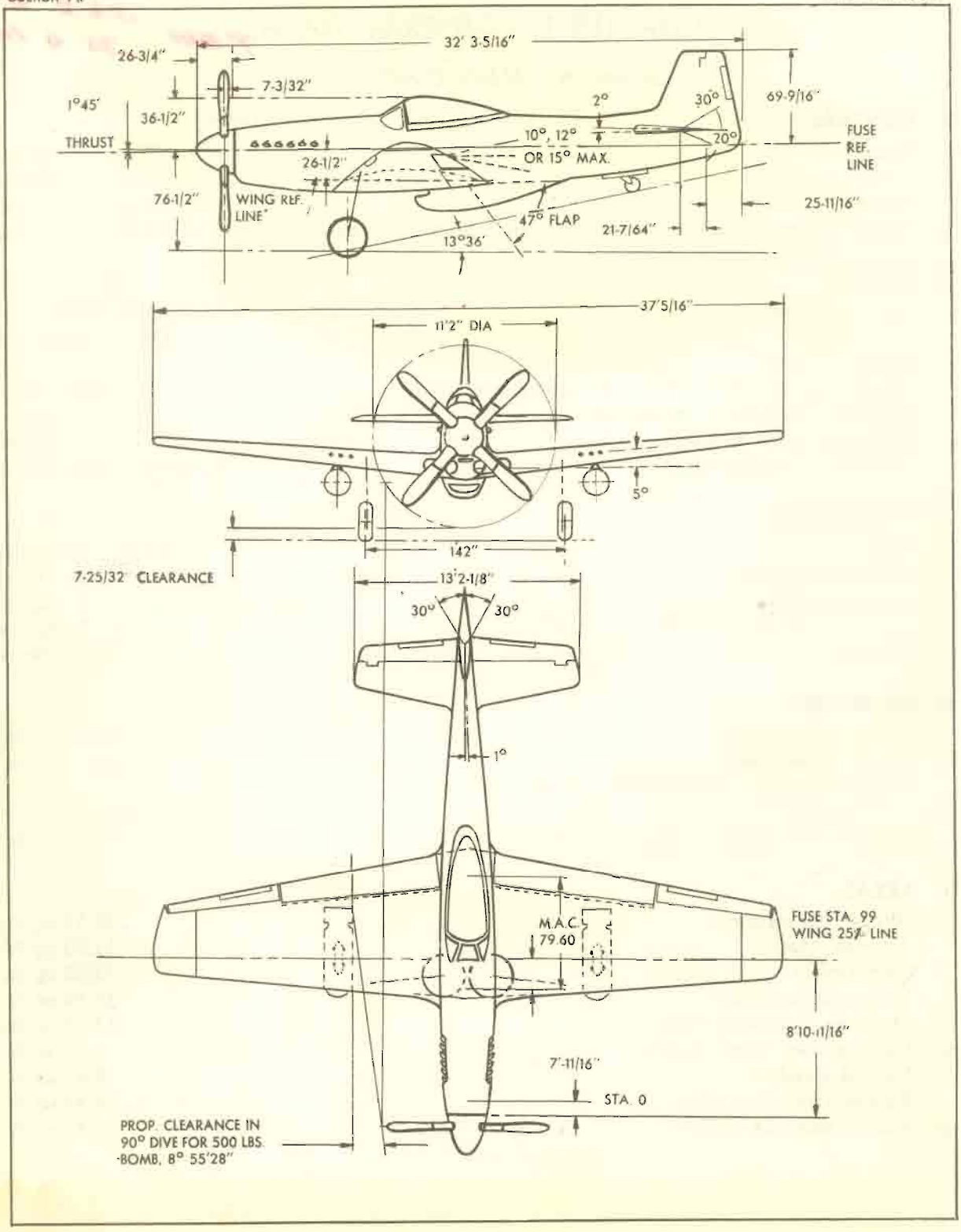


FIGURE 101—THREE VIEW DIAGRAM

6. SETTINGS AND RANGES OF MOVEMENT OF CONTROL SURFACES.

	Degrees	Inches (Maximum Chord)
Stabilizer (incidence)	½ positive	—
Fin, offset (measured from fuselage centerline)	1 left	—
Ailerons—up (from neutral)	*10, 12 or 15	2.¼ / 2.⅝ / 3.⅜
down (from neutral)	*10, 12 or 15	2.¼ / 2.⅝ / 3⅜
Flaps (total)	47	18.⅞
Elevators—up (from streamline with stabilizer)	30	8.¾
down (from streamline with stabilizer)	20	5.¾
Rudder—right (from streamline with fin)	30	13
left (from streamline with fin)	30	13
Trim Tabs—		
Elevator—up (from elevator trailing edge)	10	¾
down (from elevator trailing edge)	25	1.⅞
Rudder—right (from rudder trailing edge)	10	15/16
left (from rudder trailing edge)	10	15/16
Aileron—up (from aileron trailing edge)	10	¾
down (from aileron trailing edge)	10	¾
Tolerance on control surface movements	½	⅛

* See Chapter 3, Section A, for alternate control settings of ailerons.

7. LANDING GEAR.

WHEEL-TYPE LANDING GEAR.

Type	Hydraulically retractable
Tread (width from centre of tyre to centre of tyre)	11 ft 10 in.
Shock Struts (Main)—	
Type	Air-Oil Combination
Manufacturer and Part No.	Bendix 67270 and 67271 or C.A.C. 17-33101
Fluid Required—	
Specification	CA412
R.A.A.F. Indent. No.	K2/138
Appropriate Pressure—Strut Extended	90 lbs./sq. in.
Wheels (Main)—	
Type—Airplanes A68-1 to A 68-80 with 7-in. dia. Brakes	Smooth-Contour 27 in. Goodyear No. 530441M
Airplanes A68-81 and Subs. with 10-in dia. Brakes	Smooth-Contour 27 in. Goodyear No. 530761M
Tyre	Smooth-Contour 27 in. tread all weather
Tyre Pressure	Fill to inflation rib, approx. 45 lbs./sq. in.

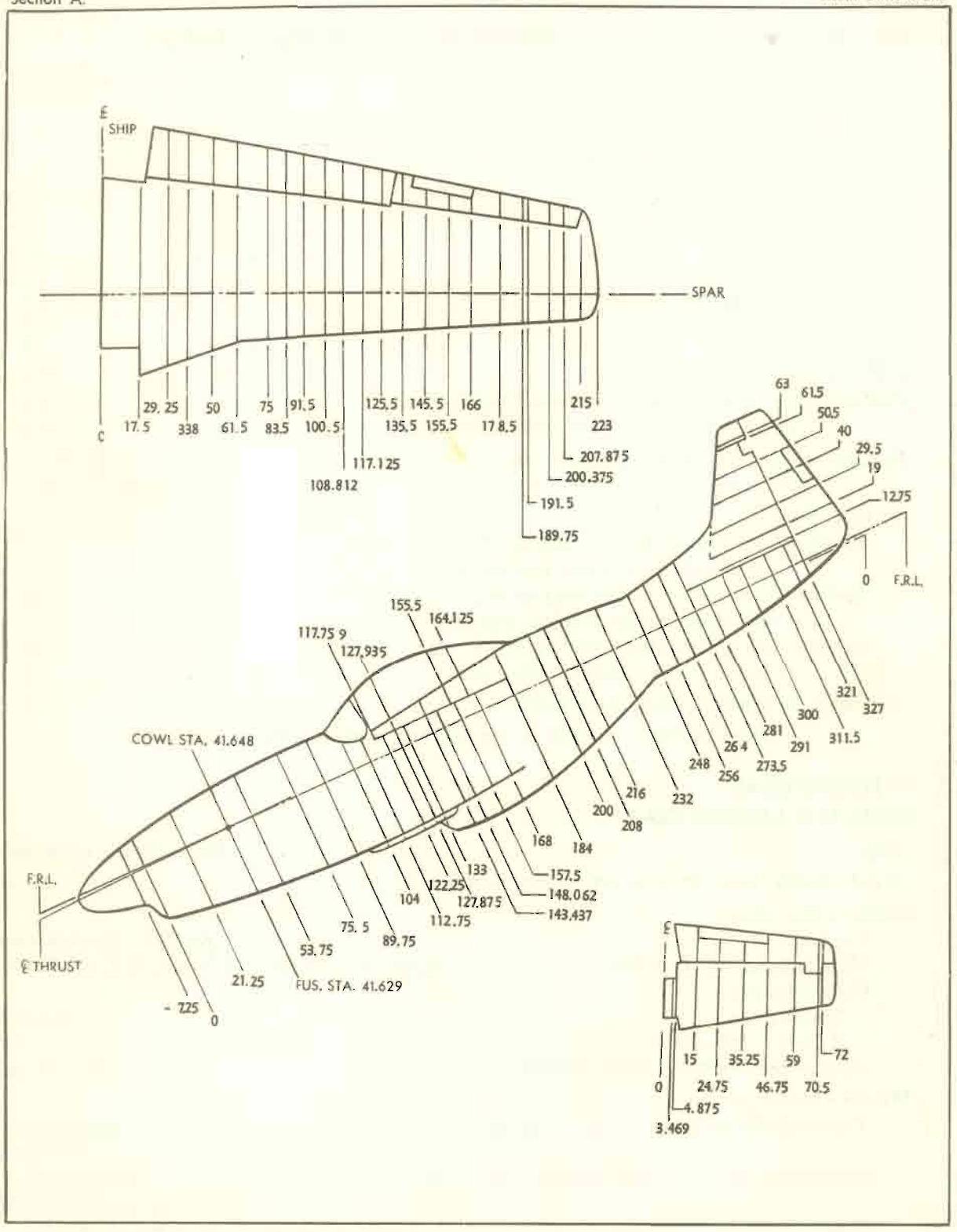


FIGURE 102–STATIONS DIAGRAM

Brakes—	
Type—Airplanes A68-1 to A68-80—	
7-in Multiple-disc Brake	Goodyear No. 511124M
(Airplanes A68-81 and Subs)—	
10-in dia. Multiple-disc Brake	Goodyear No. 511638M
Tail Wheel Unit—	
Type	Hydraulically retractable
Shock Strut—	
Type	Air-Oil Combination
Manufacturer and Part No.	C.A.C. 17-34101
Fluid Required—	
Specification	CA412
R.A.A.F. Indent. No.	K2/138
Approximate Maximum Pressure	300 lbs./sq. in.
Wheel (Tail)—	
Type (G.F.E.)	Channel-Tread 12.50 x 4.½ Goodyear No. 05-978
Tyre (G.F.E.)	Channel-Tread 12.50 x 4.½ Approx. 70 lbs/sq. in.

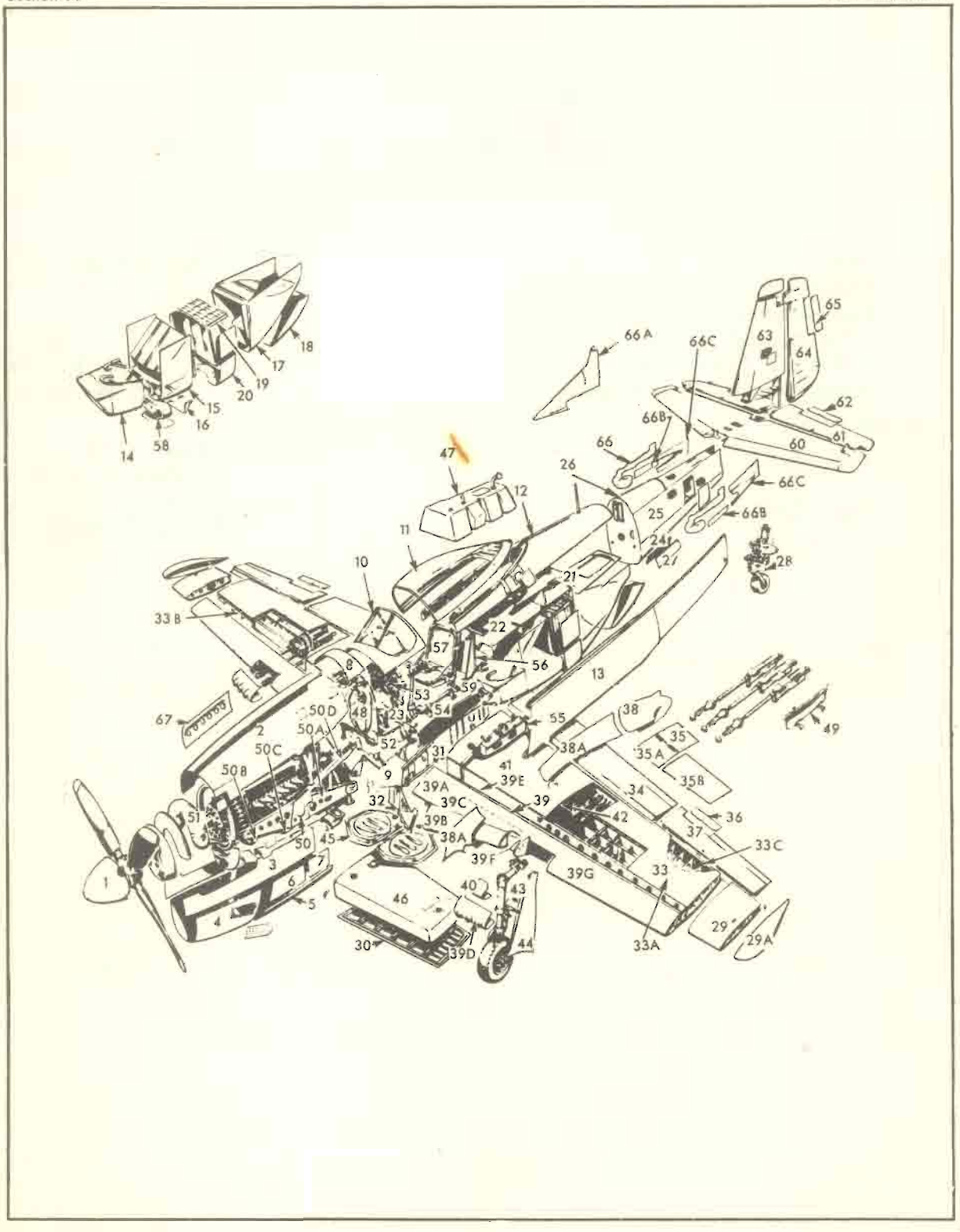


FIGURE 103–EXPLODED VIEW OF AIRPLANE

ENGINEERING ITEM BREAKDOWN.

REF. No.	PART No.	TITLE
1	17–44067	Spinner Assembly
2	18–32073	Engine Top Cowl
3	17–32013	Engine Inter. Cowl
4	17–32045	Engine Bottom Cowl, Forward
5	17–32028	Engine Bottom Cowl, Aft
6	17–32050	Engine Inter. Cowl, Centre
7	17–32027	Engine Inter. Cowl, Rear
8	17–31464	Cover, Firewall to Windshield
9	17–31499–100	Firewall Assembly
10	17–31864–50	Windshield Assembly
11	17–31873	Canopy
12	17–31129	Fuselage Top Deck
13	17–31008 & –1	Fuselage Side Panel
14	17–31041	Radiator Air Scoop, Forward
15	17–31016	Radiator Air Duct, Forward
16	17–31023	Air Cooler Outlet Door
17	17–31079	Aft Air Duct
18	17–31025	Radiator Outlet Door
19	17–46006	Radiator Assembly
20	17–31042	Radiator Bottom Cover
21	17–31202	Fuselage Aft Shear Web
22	17–31205	Fixed Radio Shelf
23	17–31137	Fixed Instrument Panel
24	17–31110	Fuselage Rear Section, Lower
25	17–31026	Fus. Rear Sect. Side Panel, L.H.
25A	17–31027	Fus. Rear Sect. Side Panel, R.H.
26	17–31153	Fus. Rear Section Top Deck
27	17–31066	Tail Wheel Doors
28	17–34101	Tail Wheel Assembly
29	17–14014	Wing Tip Assembly, Inner
29A	17–14018	Wing Tip Assembly, Outer
30	17–14060	Fuel Tank Door
31	17–14300	Wing Rib, Sta. 0
32	17–14091	Wing Centre Bulkhead
33	17–14701	Wing Trailing Edge Assembly
33A	17–14035	Upper Inter. Outboard Skin
33B	17–14038	Lower Inter. Outboard Skin
33C	17–14005	Wing Rear Spar
34	17–18001	Wing Flap
35	18–14236	Gun Bay Door, Rear
35A	18–14234	Gun Bay Door, Forward
35B	18–14235	Ammunition Bay Door
36	17–16003	Aileron Trim Tab Assembly
37	17–16001	Aileron Assembly
38	17–31443	Wing Fillet, Rear
38A	17–31447	Wing Fillet, Forward
38B	17–31446	Wing Fillet, Inter.
39	17–14030	Wing Leading Edge
39A	17–14033	Top Forward Inboard Skin
39B	17–14031	Auxiliary Nose Assembly
39C	17–14036	Lower Forward Inboard Skin
39D	17–14029	Gun Nose Assembly
39E	17–14004	Front Spar
39F	17–14101–10	Landing Gear Support
39G	17–14040	Upper Outboard Nose Assy.
40	17–14032	Landing Gear Access Door
41	17–14034	Upper Inter. Inboard Skin
42	17–14802	Wing. Sta. 75 Rib Assembly
43	17–33101	Landing Gear Strut
44	17–33302	Strut Fairing
45	17–33301	Wheel Fairing Doors
46	17–48257	Fuel Cell, Wing
47	17–48242	Fuel Cell, Fuselage
48	18–47002	Oil Tank
49	18–63018	Wing Bomb Rack
50	17–31901	Engine Mount Assembly
50A	18–31902	Main Beam
50B	17–31909	Front Frame
50C	17–31996	Canted Frame
50D	17–31948	Brace
51	17–46003	Coolant Header Tank
52	17–52403	Rudder Pedal Assembly
53	18–51005	Instrument Panel
54	17–52111	Control Column
55	17–52506	Pedestal Assembly
56	17–53706	Rear Armour Plate
57	18–53101	Seat Assembly
58	17–47006	Oil Cooler
59	17–52608	Flap Torque Tube
60	17–21001–100	Horizontal Stabilizer
61	18–22001	Elevator
62	17–22003	Elevator Trim Tab
63	17–23001	Vertical Stabilizer
64	17–24001	Rudder
65	17–24003	Rudder Trim Tab
66	18–31456 & –1	Fin Fillet, Forward
66A	17–31621	Fairing
66B	18–31461–4 & –5	Fillet
66C	18–31461–14 & –15	Fillet Assembly
67	17–42023	Stack Fairing

NOTE.—For Installation Drawing Nos. refer to C.A.C. Drawing 17–01001.

KEY TO FIGURE 103.

5. ENGINE ACCESSORIES.

R.R. Merlin—(Airplanes A68-121 & Subs.).

Carburettor	R.R. Bendix Stromberg Type [illegible]
Fuel Pump	Thompson
Vacuum Pump	Huppet
Hydraulic Pump	BHM Mk. IV.
Starter	Eclipse Type 840
Generator	Rotax or Lucas Type KXB
Spark Plugs	Refer E.G.I. No. 28.
Magnetos	BTH or Rotax Type C65E125/2
Propeller	De Havilland
Tachometer Generator	General Electric

6. FUEL.

	Gallons Each	
Wing Tanks	76.5 Imp.	(92 U.S.)
Fuselage Tanks	70.5 Imp.	(85 U.S.)
Droppable Combat Tanks (2)	62.5 Imp.	(75 U.S.)
	91.6 Imp.	(110 U.S.)
Total Fuel (Wing Tanks)	153 Imp.	(184 U.S.)
Total Fuel (Wing and Fuselage Tanks)	224 Imp.	(269 U.S.)
Total Fuel (Wing, Fuselage and 75 U.S. Gallon Combat Tanks)	348 Imp.	(419 U.S.)
Total Fuel (Wing, Fuselage and 110 U.S. Gallon Combat Tanks)	407 Imp.	(489 U.S.)

7. OIL.

Tank capacity	11.5 Imp.	(13.8 U.S.)
Expansion space	1.1 Imp.	(1.3 U.S.)
Total oil (tank only)	10.4 Imp.	(12.5 U.S.)
Total system capacity (including tank)	17.7 Imp.	(21.2 U.S.)

8. COOLANT.

Engine Cooling System—

Tank capacity	4.4 Imp.	(5.2 U.S.)
Expansion space	1.67 Imp.	(2.0 U.S.)
Total system (including tank)	13.9 Imp.	(16.7 U.S.)

After-cooling System—

Tank capacity (Packard Merlin).	0.4 Imp.	(0.5 U.S.)
Tank capacity (R.R. Merlin)	0.77 Imp.	(0.93 U.S.)
Expansion space (system)	0.4 Imp.	(0.5 U.S.)
Total system (including tank)	4.0 Imp.	(4.8 U.S.)

Hydraulic System. 3.12 Imp. Gallons (3.75 U.S.)
Ent. 675 (CA412)

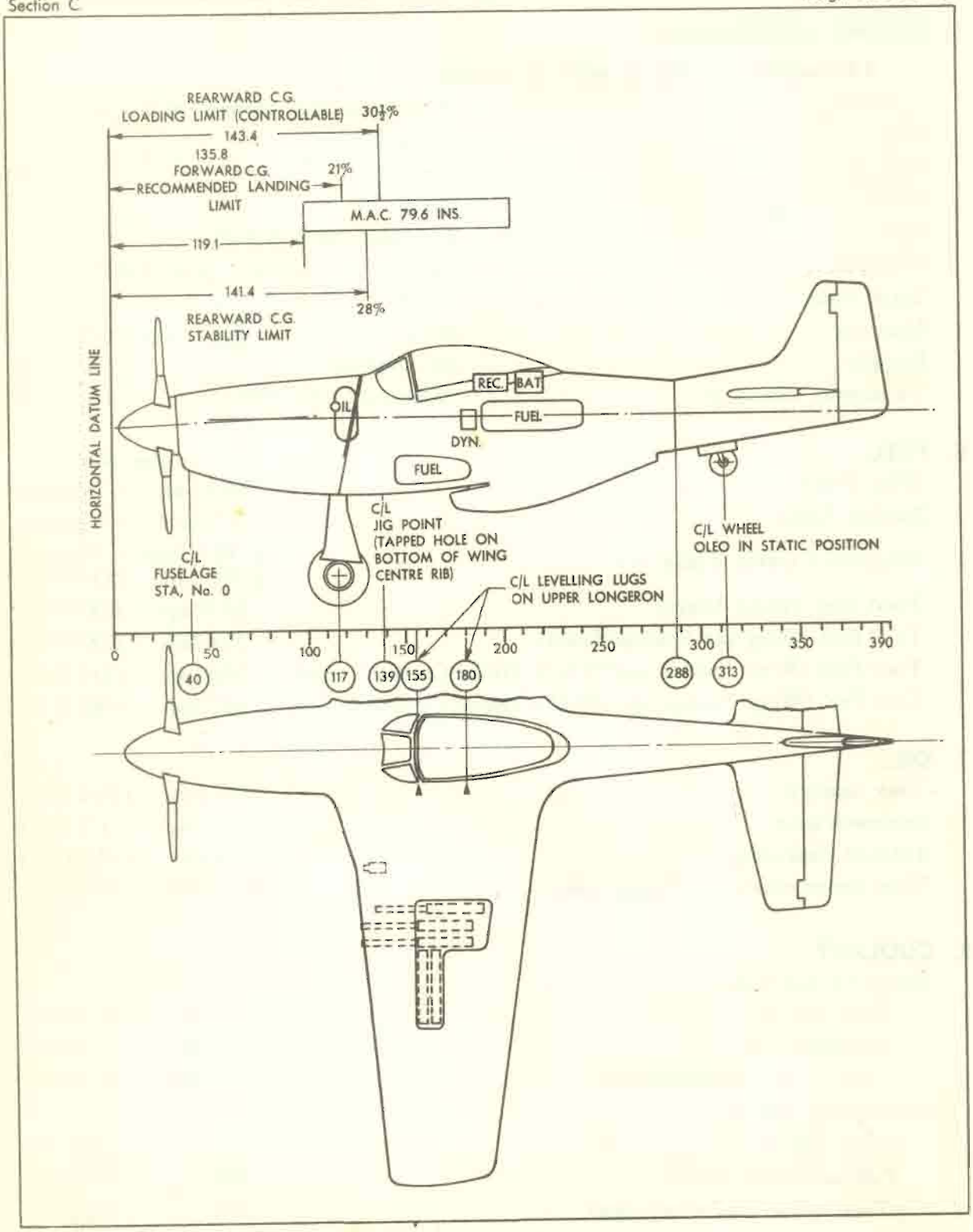


FIGURE 104–WEIGHT AND BALANCE DIAGRAM

Section C. — WEIGHT SUMMARY

1. GENERAL.

The normal gross weight shown below covers the airplane with fuselage tank installed and I.F.F. radio omitted. For overload and further details R.A.A.F. Publication No. 660, "Mustang Weight Summary Sheet," should be consulted.

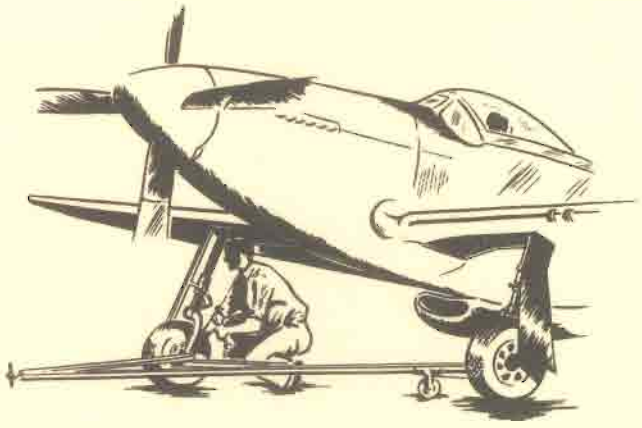
2. NORMAL LOADING.

Description	Item Weight	Total Weight	C.G. Aft of Datum	Position % M.A.C.
Airplane at Tare Weight		7,141		
Crew—				
Pilot and Parachute		200	169	
Fuel and Oil—				
Fuel in Wing Tanks (90 gals.)	650	776	163	
Fuel in System	7		120	
Oil Tank (6 gals.)	54		116	
Oil in System	65		110	
Armament—				
2 Inboard Browning Guns (.50 cal.)	130	522	158	
2 Outboard Browning Guns (.50 cal.)	129		155	
800 Rounds Ammunition (.50 cal.)	240		153	
Gun Camera	3		109	
Gun Sight (Mk. IIL.)	4		147	
Pyrotechnics	6		170	
Feed Chutes	10		153	
Normal Gross Weight & C.G. (Wheels Down)		8,639	138.31	24.13
Normal Gross Weight & C.G. (Wheels Up)		8,639	138.62	24.52

CHAPTER 2

HANDLING AND GENERAL MAINTENANCE

Section A—
GROUND HANDLING
Section B—
SERVICING INSTRUCTIONS



CHAPTER 2.—HANDLING AND GENERAL MAINTENANCE

Section A.—GROUND HANDLING

1. GENERAL.

The access provisions for inspection and maintenance are identified in Figure 201. All handling facilities are marked and identified on the airplane. A flush-type handhold and a step are located on the left side of the fuselage; wing-to-fuselage fillets constitute walkways.

2. HOISTING.

A lift tube to accommodate a bar up to 1⅝-inches in diameter in the tail of the fuselage, a hoisting lug in each wing panel, and a hoisting lug on each side of the engine mount constitute the hoisting facilities on this airplane. (See Figures 202 through 206.) The wing hoisting fittings are stowed in the tool kit furnished with the airplane. (See Figure 220.) When not in use, the wing hoisting lugs are fitted with flush plugs. The engine cowling must be removed to gain access to the engine mount hoisting lugs.

(a) HOISTING COMPLETE AIRPLANE:—

There are two methods of hoisting the completely assembled airplane, which weighs approximately 7,000 pounds (dry).

(i.) One-Point Lift—

The complete airplane can be hoisted with a single hoisting cable if a CA126/10 hoisting sling (Figure 202) is used. The sling fastens to the engine mount hoisting lugs, and to each end of CA126/6 lift-tube bar. (See Figure 203.)

(ii.) Three-Point Lift—

The complete airplane can be hoisted by means of a hoisting cable connected to the tail lift tube bar, and two hoisting cables connected to the wing hoisting fittings. Since the centre of gravity of the airplane is located just aft of the wing hoisting lugs, a 200-pound weight should be suspended from the fuselage lift tube before the engine is hoisted.

CAUTION.

Do not permit the lifting cables connected to the wing hoisting fittings to exceed a 30-degree departure from the vertical position. Do not lift at the wing hoisting fittings if the fuel compartment doors are not installed.

(b) TAIL:—

The tail of the airplane, complete with empennage, can be hoisted with a hoisting sling attached to the lift-tube bar. The airplane weighs approximately 1,600 pounds at the lift tube.

WARNING

Do not lift the tail of the airplane by means of the horizontal stabiliser.

(c) **FUSELAGE:—**

The fuselage can be hoisted with or without the engine installed. The fuselage weighs approximately 4,100 pounds with the engine and 2,100 pounds without the engine.

(i.) Complete Fuselage.—

The fuselage with the engine can be hoisted with a single hoisting cable if a CA126/10 hoisting sling (Figure 202) is used. The sling fastens to the engine mount hoisting lugs, and to each end of a CA126/6 lift-tube bar. (See Figure 203.)

(ii.) Fuselage Without Engine.—

The fuselage without the engine can be hoisted with a single hoisting cable if a hoisting sling (as illustrated in Figure 204) is used. The sling fastens to a bar bolted to the upper engine mount attachment lugs, and to each end of a CA126/6 lift-tube bar.

(d) **WING:—**

The wing can be hoisted with a single hoisting cable if a CA119/17 hoisting sling (Figure 205) is used. The sling bolts to the four wing-to-fuselage attachment mounts. By connecting the sling cables to the different holes in the sling frame, the wing can be hoisted horizontally or with the leading edge down. The wing weighs approximately 2,500 pounds.

1. Rudder, Lower Hinge Access
2. Vertical Stabilizer, Aft, Right Hand
3. Vertical Stabilizer, Forward
4. Fuselage to Horizontal Stabilizer
5. Aft Wing to Fuselage
6. Oxygen Filler Valve Access
7. Hydraulic Reservoir Access
8. Oxygen Lines and Instruments
9. Engine Access Upper Cowlings
10. Engine Access Side Cowlings
11. Engine Crank Access
12. Engine Heating Access
13. Engine Access Lower Forward Cowling
14. Engine Access Lower Intermediate Cowling
15. Engine Access Lower Aft Cowling
16. Wing to Fuselage Forward Fairing
17. Wing to Fuselage Intermediate Cowling
18. Main Landing Gear Pivot Shaft Access
19. Running Light Access
20. Ammunition Bay Access
21. Gun Bay Access Door
22. Aileron Cable Turnbuckle Inspection Cover
23. Wing Fuel Tank Filler Cap
24. Front Scoop Attachment Bolt Access
25. Oil Radiator Line Access
26. Aftercooler Line Hose Access
27. External Power Plug Access
28. Radiator Cover Bolts Access
29. Radiator Cover Attachment Bolts Access
30. Radiator Cover Assembly
31. Tail Gear Down-Lock Access
32. Tail Gear Up-Latch Access
33. Elevator Trim Tab Actuating Drum Access
34. Coolant Tank Filler Neck Access
35. Aftercooler Tank Access
36. Oil Tank Filler Neck Access
37. Engine Controls and Instruments Access
38. Horizontal Stabilizer Forward Access
39. Elevator Trim Tab Cable Access
40. Rudder Trim Tab Actuating Cable Drum Access Door
41. Vertical Stabilizer Aft Left-Hand Fairing
42. Rudder Bellcrank Access Door
43. Tail Gear Up-Latch and Actuating Strut Access Door
44. Remote-Reading Compass Access Door
45. Propeller Governor Access Door
46. Aileron Centre Hinge Access Door
47. Aileron Trim Tab Actuating Drum Access Door
48. Fuel Tank Doors
49. Fuel Booster Pump Access Doors
50. Fuel Tank Drain Cock Access
51. Oil Radiator Access Door
52. Oil Radiator Rear Scoop Actuating Rod Access Plate
53. Coolant Drain Access Door
54. Rear Scoop Hinge Access Door
55. Rear Scoop Actuating Rod Access Plate
56. Control Cable and Oxygen Cylinder Access Door
57. Aftercooler Drain Access Door
58. Aileron Boost Tab Actuating Fitting Door
59. I.F.F. Mast Access Door
60. Recognition Light and Access
61. Wheel Well Fairing Doors

KEY TO FIGURE 201.

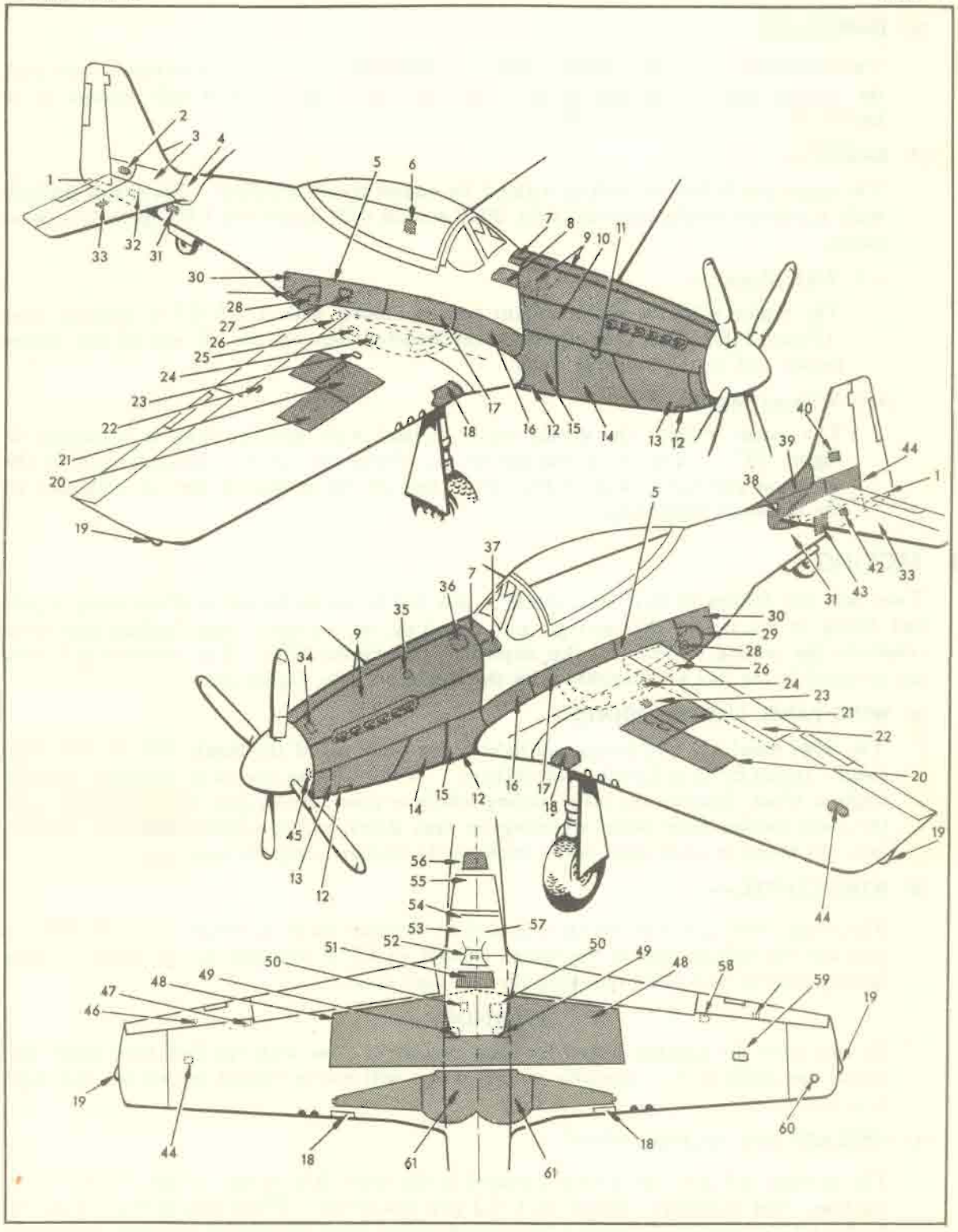


FIGURE 201–ACCESS AND INSPECTION PROVISIONS

(e) **EMPENNAGE:—**

The empennage is installed in three units: the horizontal stabiliser and elevators assembled, the vertical stabiliser, and the rudder. Any one of the assemblies is light enough to be handled without a hoisting sling.

(f) **ENGINE:—**

The engine can be hoisted with or without the engine mount installed. The engine drained, with accessories weighs approximately 2000 pounds with mount and 1,800 pounds without mount.

(i.) With Mount.—

The engine with the engine mount can be hoisted with a CA121/6 hoisting sling (Figure 206.) The sling attaches to the hoisting lugs on the aft end of the engine mount and to the propeller shaft.

(ii.) Without Mount.—

The engine without the mount can be hoisted with hoisting sling as illustrated in Figure 207. The sling attaches to the lifting eye on the crankcase half of the reduction gear casing and to the lifting lugs of the mounting feet on each side of the crankcase supercharger.

3. JACKING.

Two jack pad fittings in each wing panel, a jack pad fitting in the centre of the wing, a jack pad fitting in the tail of the fuselage, and a jacking lug on each main landing gear strut constitute the jacking facilities for this airplane. (See Figure 209.) The necessary jack pads are provided in the tool kit furnished with the airplane. (See Figure 220.)

(a) **WING PANEL JACKING POINTS:—**

The wing panel jack pad fittings are located just outboard of the bomb rack on each wing panel. Install E/52 jack pads in the fittings. These jacking points are used to jack the airplane when changing the main landing wheels or main landing gear, in combination with the centre jacking point when removing the tank doors, and in combination with the tail jack pad fitting or a tail stand when checking the hydraulic system operation.

(b) **WING CENTRE:—**

The wing centre jack pad fitting is located on the centre rib of the wing between the forward spar and the leading edge of the wing. Install an E732 jack pad in the fitting. This jacking point is used when removing the fuel tank doors.

WARNING.

Do not leave the airplane jacked for long periods of time with the fuel tank doors off. Install the doors at least partially so that wings will not be twisted in case one jack slips or settles.

(c) **FUSELAGE TAIL JACKING POINT:—**

The fuselage tail jack pad fitting is located in the lower skin of the fuselage directly below the horizontal stabilisers. Install an E772 jack pad fitting. When jacking the airplane to the level flight position, suspend a 200-pound weight from the fuselage lift tube to prevent

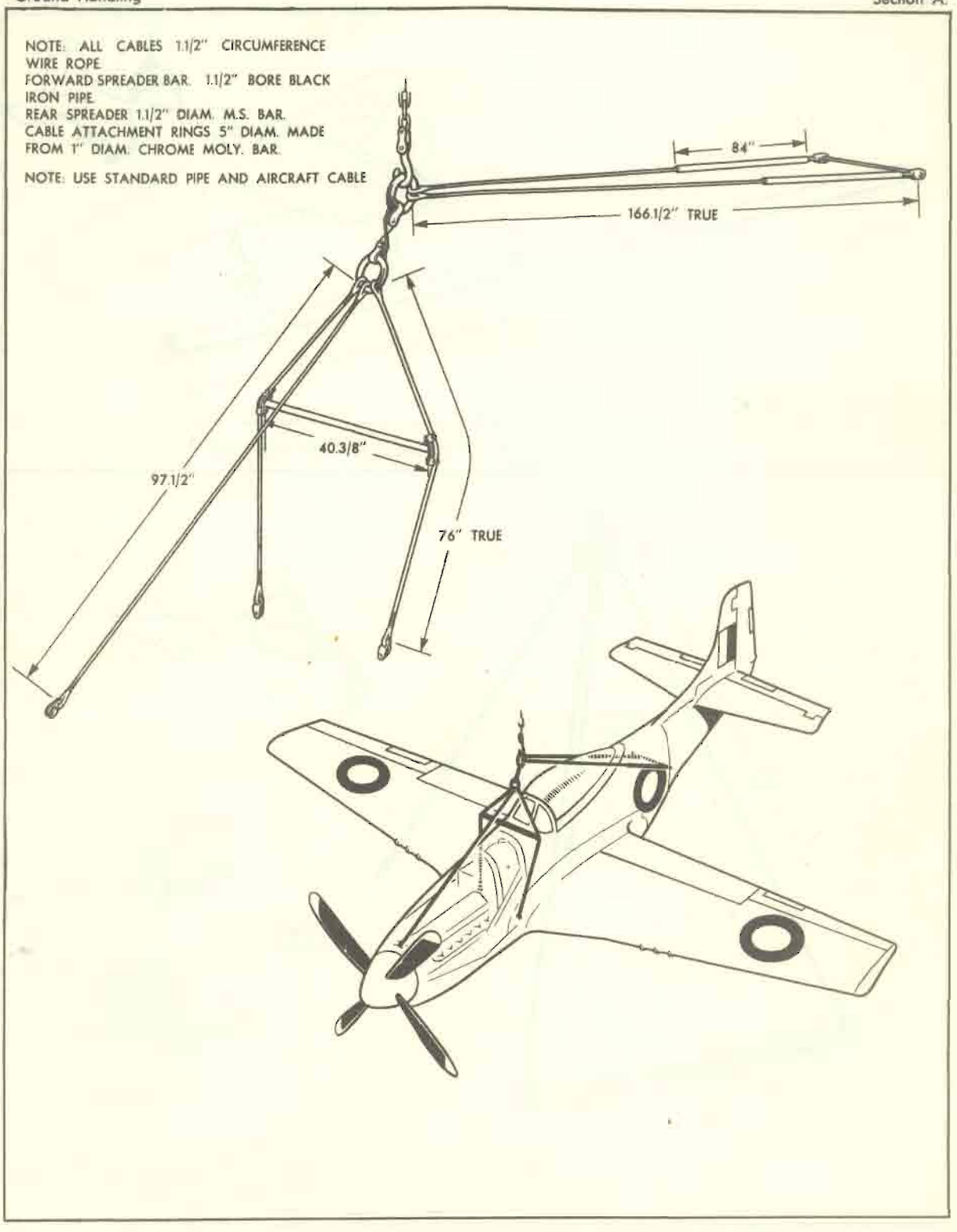


FIGURE 202–COMPLETE AIRPLANE HOISTING SLING

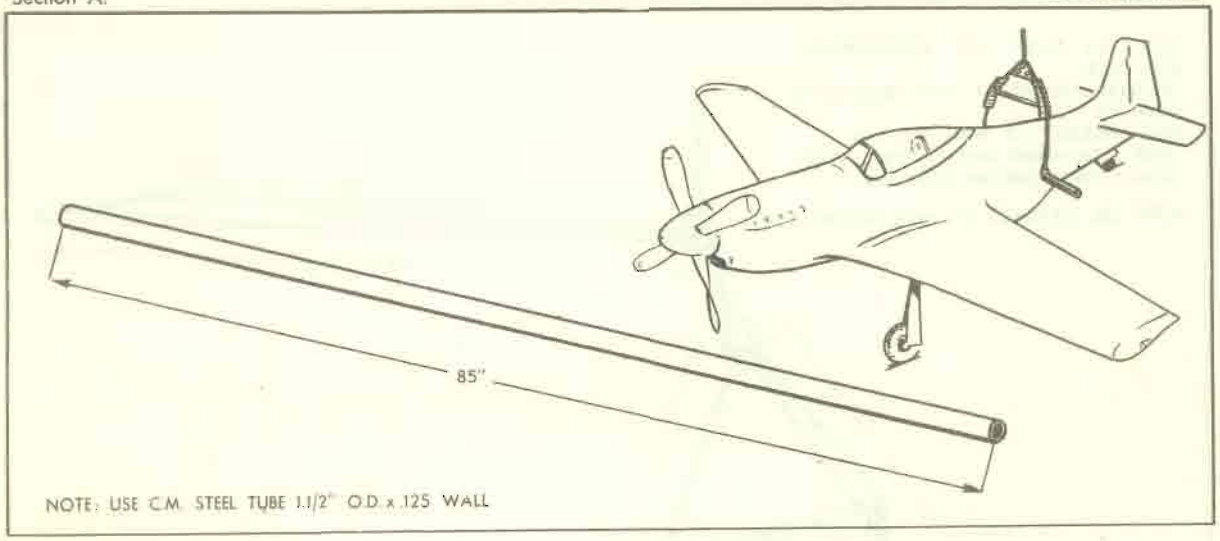


FIGURE 203--FUSELAGE TAIL HOISTING SLING AND LIFT TUBE BAR

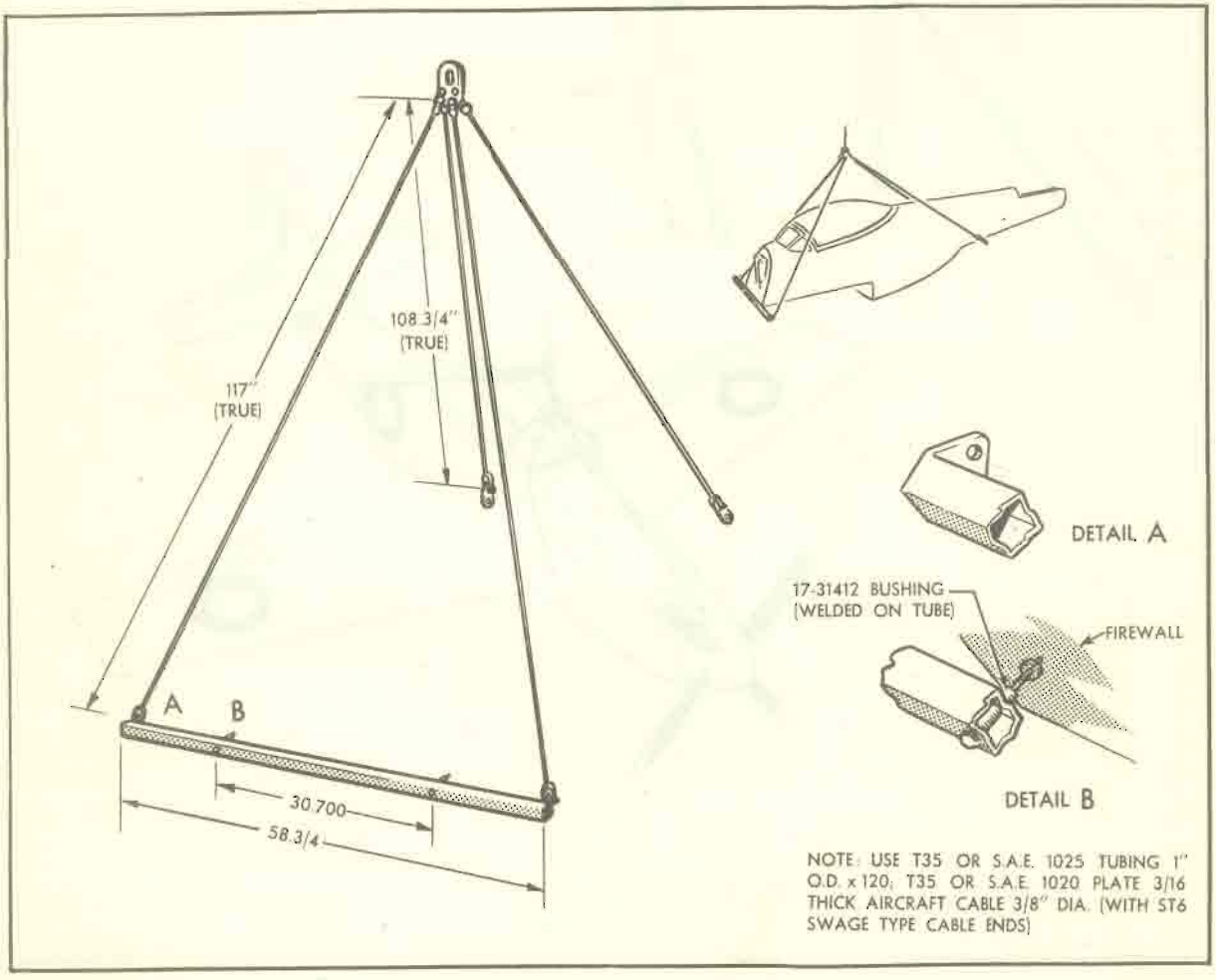


FIGURE 204--FUSELAGE (WITHOUT ENGINE MOUNT) HOISTING SLING

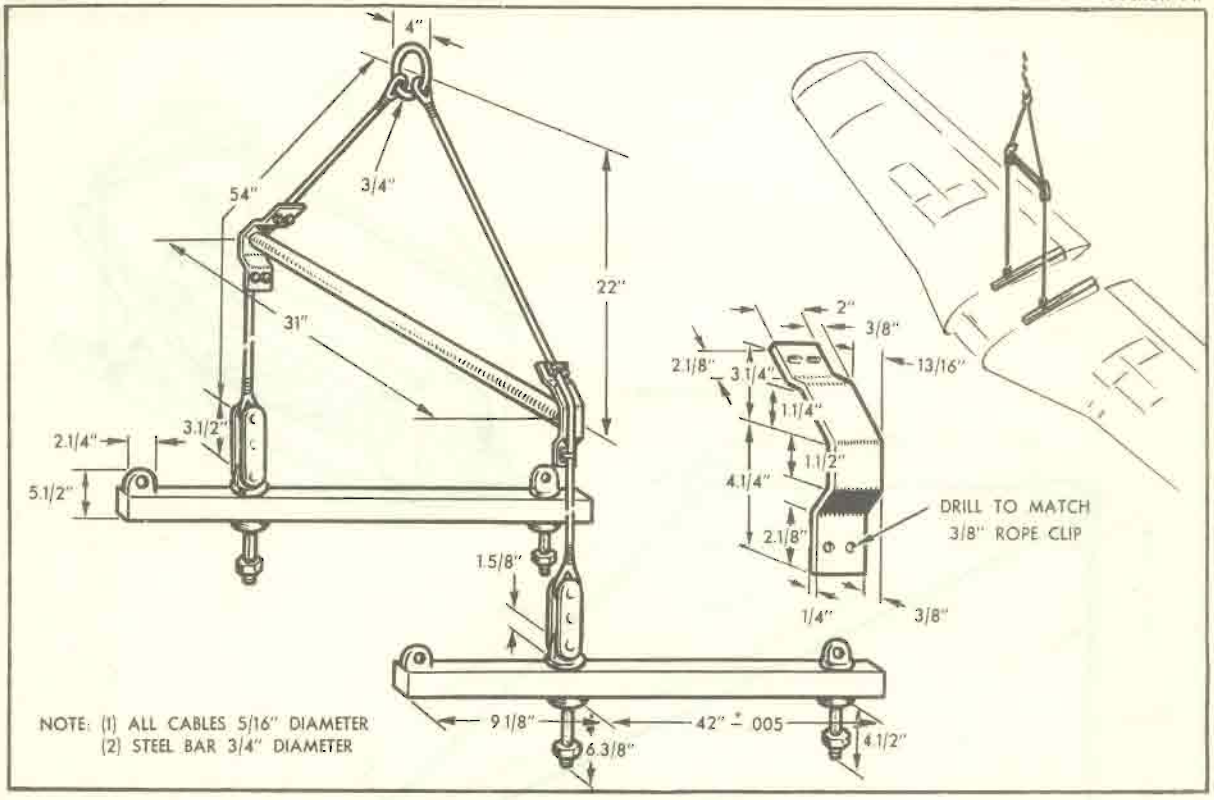


FIGURE 205–WING HOISTING SLING

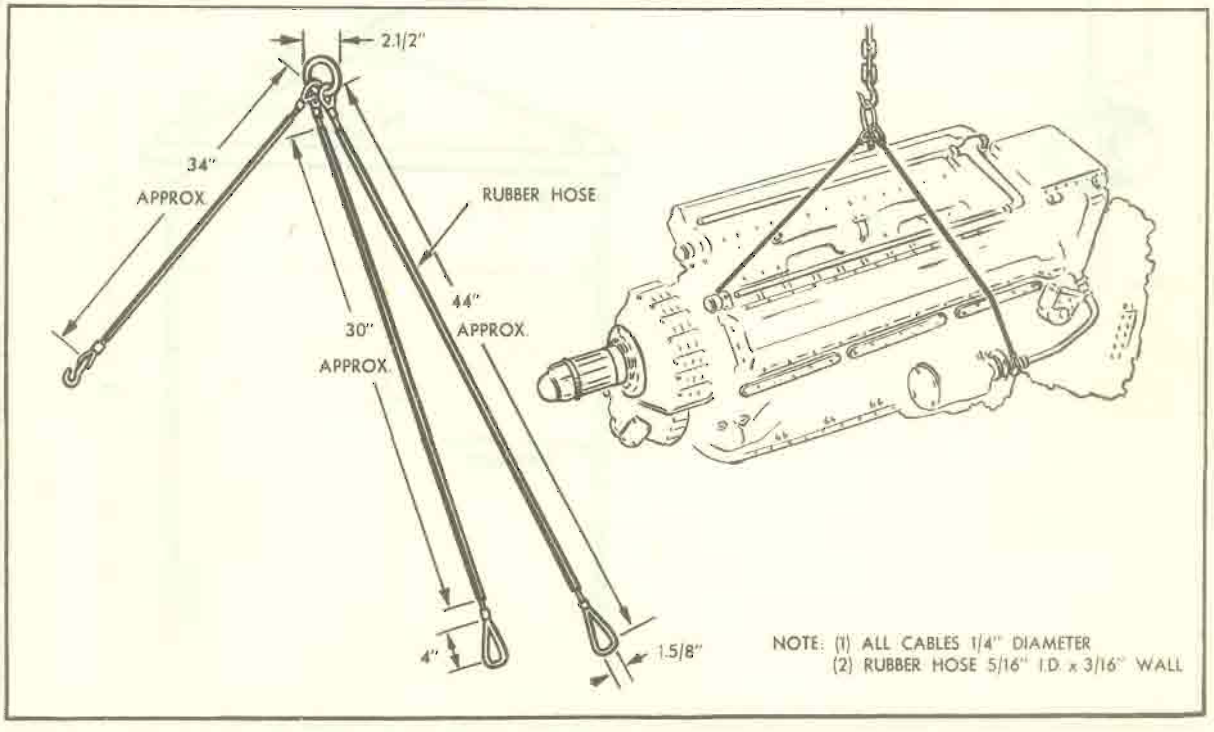


FIGURE 206–ENGINE (WITHOUT MOUNT) HOISTING SLING

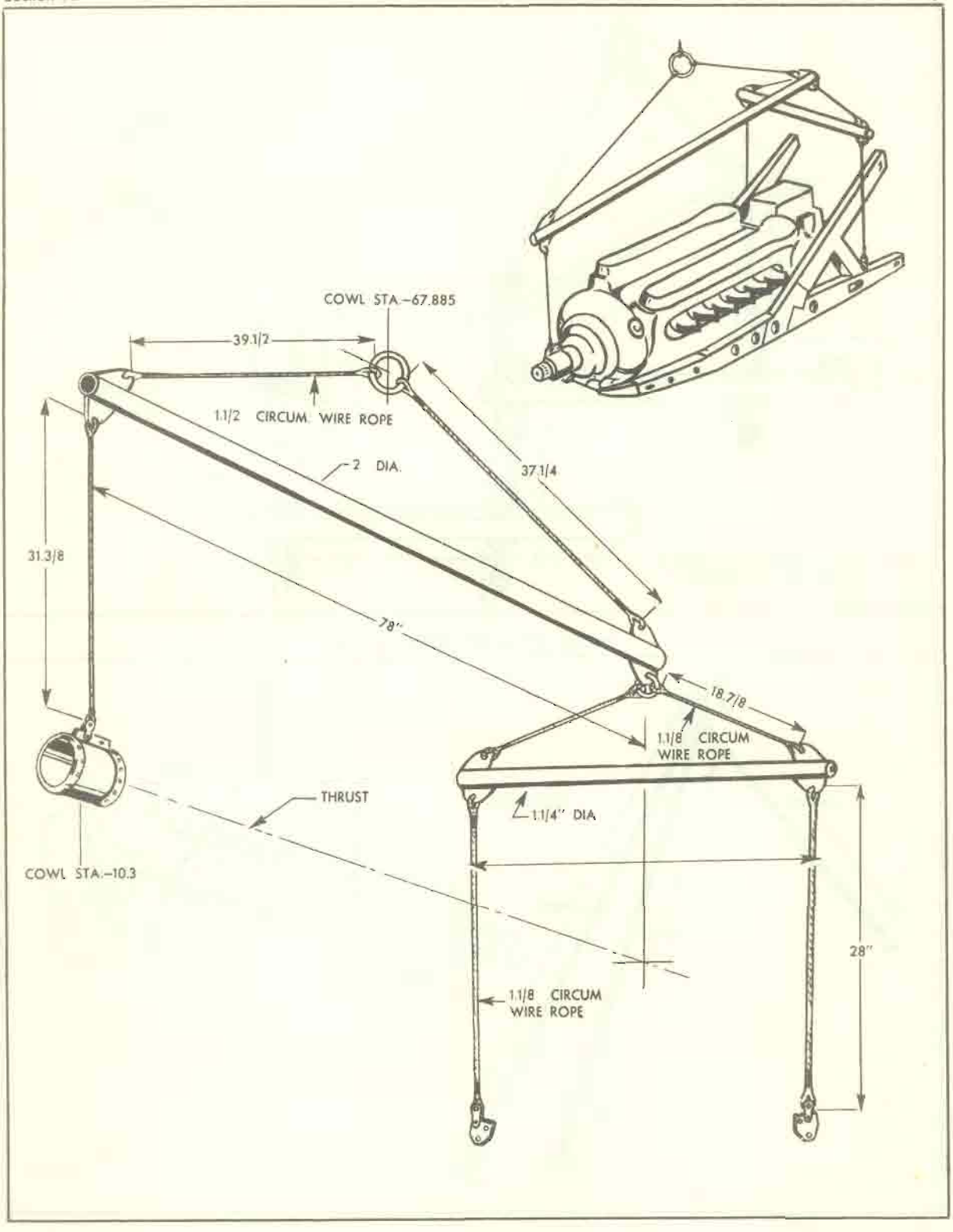


FIGURE 207–ENGINE (WITH MOUNT) HOISTING SLING

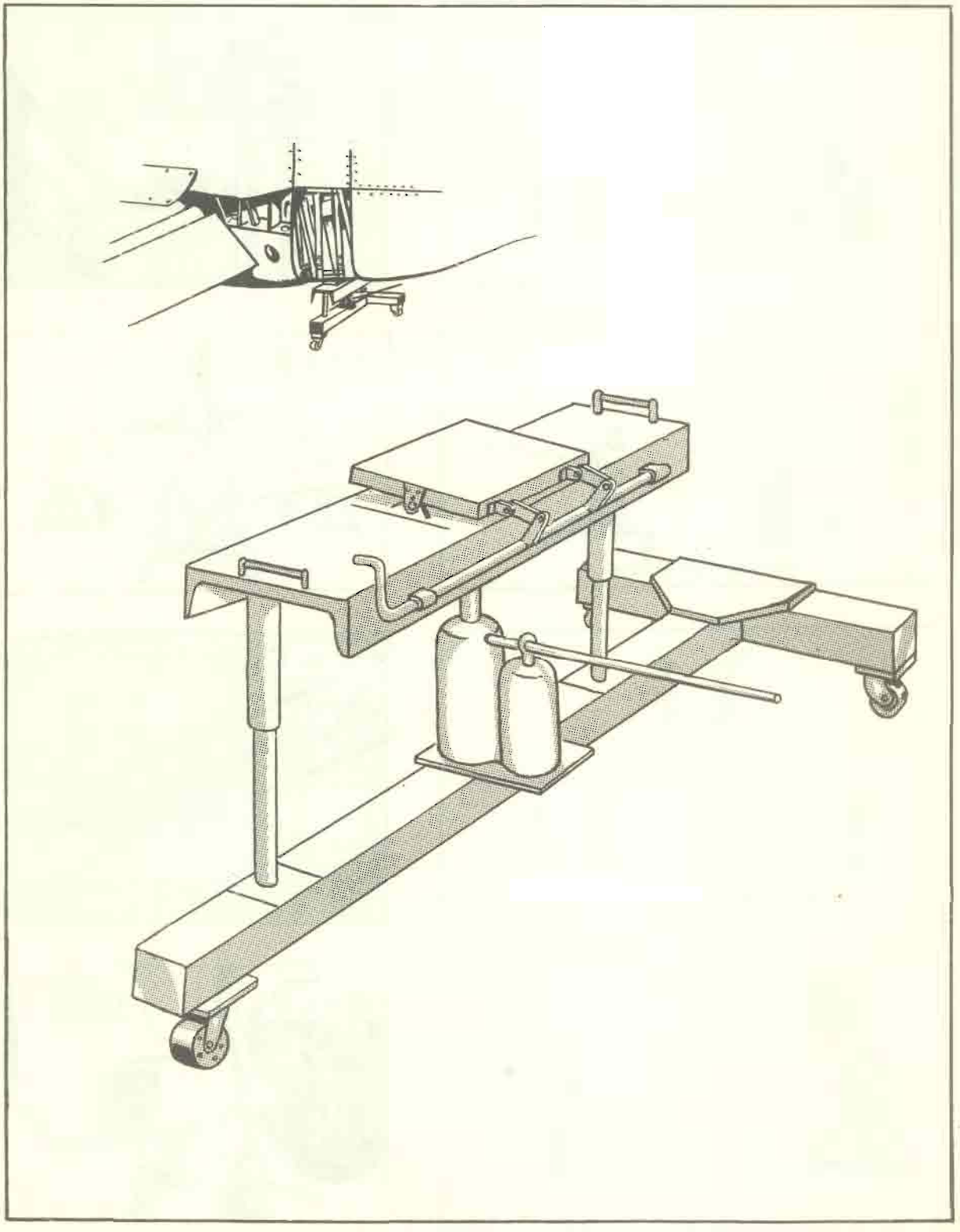
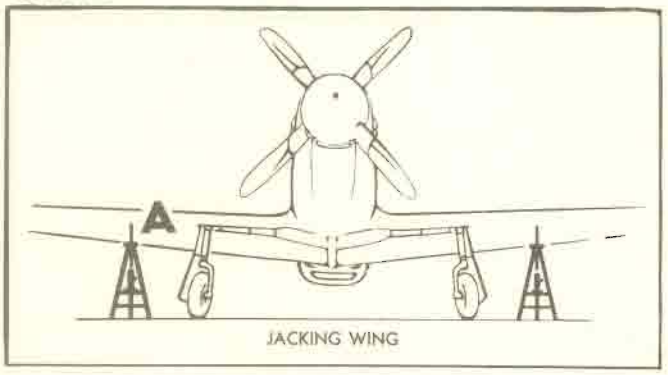
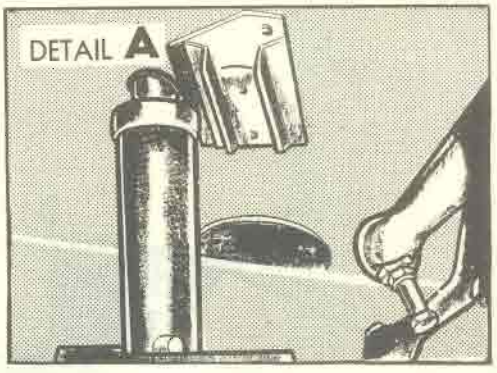
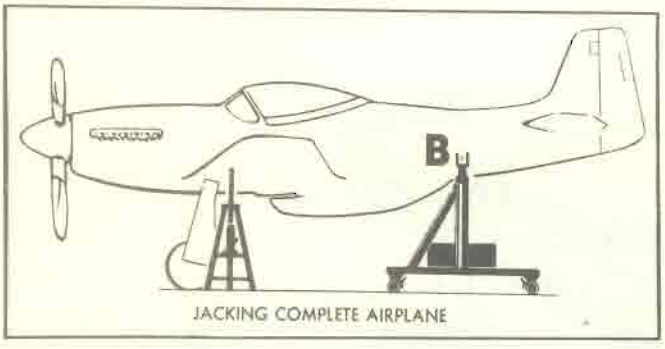


FIGURE 208–CA126/8 RADIATOR HOISTING TROLLEY

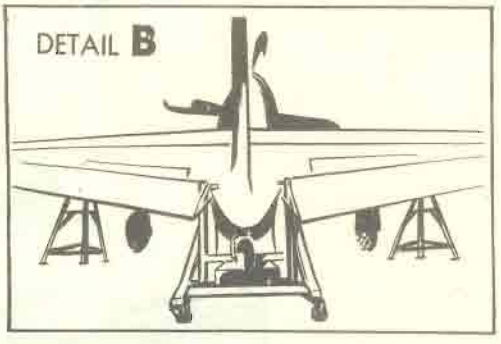


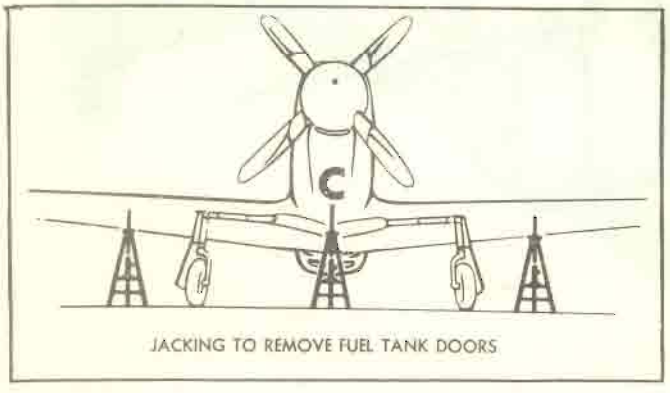
JACKING WING



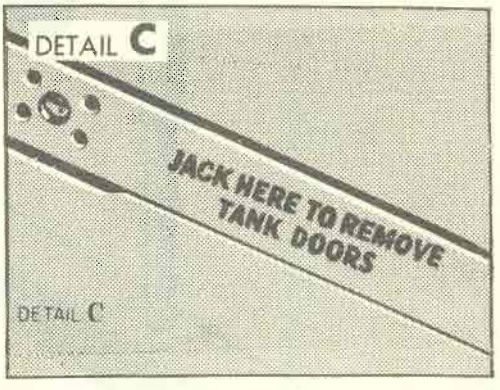


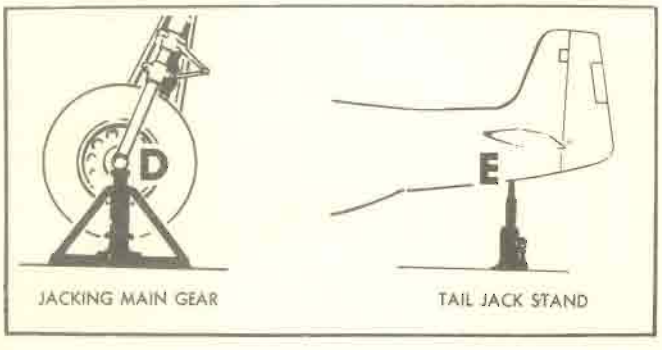
JACKING COMPLETE AIRPLANE





JACKING TO REMOVE FUEL TANK DOORS





JACKING MAIN GEAR
TAIL JACK STAND

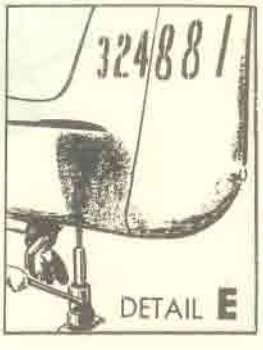


FIGURE 209–JACKING THE AIRPLANE

the airplane nosing over. This jacking point is used to jack the airplane when removing the tailwheel, to raise the airplane to the level flight position for firing or bore sighting the guns, and in combination with the wing panel jacking points when checking the hydraulic system operation. After the tail section has been raised, a tail stand may be used to support the tail at the fuselage lift tube. The stand should incorporate a 200-pound weight for balancing the airplane and is especially valuable when test-firing the guns.

(d) MAIN LANDING GEAR JACKING LUG:—

The main landing gear jacking lugs are located below the inboard end of the main wheel axles. These jacking points are used when removing the main wheels and main wheel brakes if the wing panel jacking points cannot be used.

CAUTION.

A bolt and spacer are located directly forward of each main gear jacking lug. Do not jack the airplane at these points.

4. LEVELLING.

The levelling lugs are located aft of the pilot's seat on the upper longerons.

(a) TRANSVERSELY. (See Figure 210.)

(i.) Lay a straight bar across the fuselage from either of the levelling lugs on the upper right longeron to the one lug on the upper left longeron.

(ii.) Place a levelling protractor on the bar, and then raise or lower one wing as required.

(b) LONGITUDINALLY. (See Figure 210.)

(i.) Lay a straight bar across the two levelling lugs on the upper right longeron.

(ii.) Place a levelling protractor on the bar, and then raise or lower the tail of the fuselage as required to position the airplane in the predetermined attitude of flight.

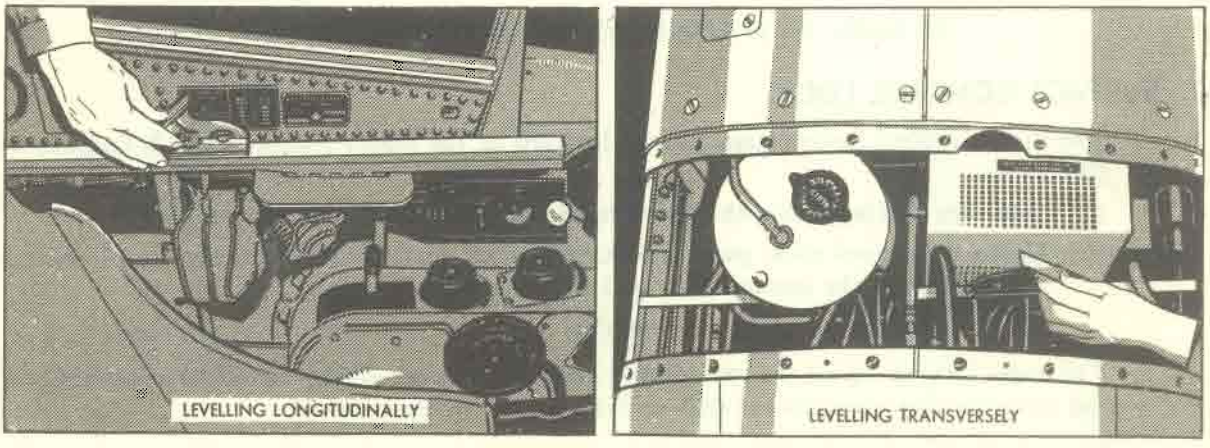


FIGURE 210–LEVELLING THE AIRPLANE

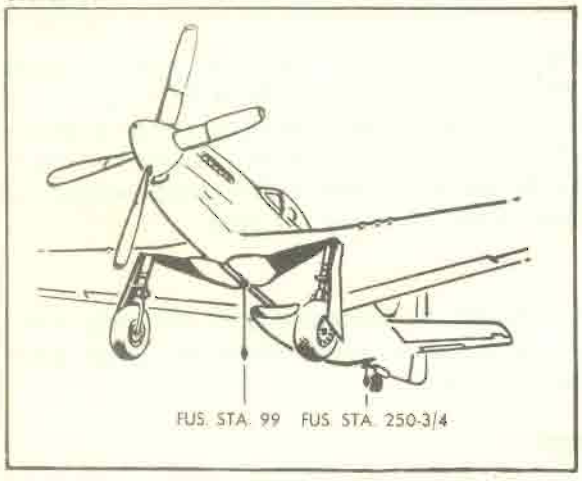


FIGURE 211–AIRPLANE DATUM POINTS

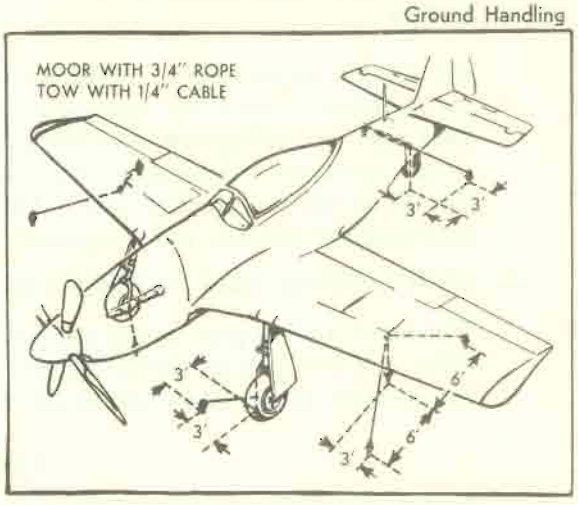


FIGURE 212–MOORING THE AIRPLANE

5. DATUM POINTS.

Two datum points are located on the lower surface of the airplane. (See Figure 211.) One point is on the centre rib of the wing at station 99 just forward of the wing spar, and the other is just forward of the tail wheel well at station 250-375. The points are well marked with red circles and are provided with special nut plates for attaching plumb bobs.

6. PARKING BRAKES.

The parking brake control handle is centrally located below the instrument panel. To apply the parking brakes, proceed as follows:—

(a) Pull the control handle part way back.
(b) Press both brake pedals to their full extent.
(c) Pull the control handle back as far as it will go.
(d) Release the brake pedals.
(e) Release the control handle.

NOTE.

To release the parking brakes, depress both brake pedals.

7. SURFACE CONTROL LOCK.

The surface control locking gear, located forward of the pilot's control stick, is operated as follows:—

(a) Grasp the locking arm with the left hand and pull the lock plunger outboard.
(b) Centre the control stick, pull the locking gear aft until the lock arm engages the desired locking lug on the control stick, and then release the plunger.

NOTE.

The upper locking lug on the control stick positions the stick so that the tail wheel is unlocked, and the lower lug positions the stick so that the tail wheel is locked.

Move the rudder control pedals until the rudder lock engages; the rudder pedals will only lock in the neutral position.

8. MOORING.

(a) MOORING PROVISIONS:—

(i.) Wing.—

A mooring ring is provided on the lower surface of each wing panel approximately in line with the outboard end of the wing flap. (See Figure 212.) The rings retract flush into the wing surface when not in use. Pry at the inboard part of the rings to disengage them from the stowed position.

(ii.) Main Landing Gear.—

A mooring ring is on the inboard end of each main landing gear axle. (See Figure 212.)

(iii.) Fuselage.—

The lift tube in the fuselage just aft of and below the insignia provides a means of mooring the tail of the airplane. (See Figure 212.)

(b) MOORING INSTRUCTIONS:—

The following mooring instructions represent minimum precautions:—

(i.) Head the airplane into the wind.

(ii.) Lock the surface controls at the lower locking lug and neutralize the rudder pedals so that the rudder controls lock. With the stick in this position, the tail wheel is locked.

(iii.) Moor the airplane with $\frac{3}{4}$-inch ropes or $\frac{1}{4}$-inch cable. (See Figure 212.) If mooring facilities are not available, use mooring kit as instructed in the following paragraph.

CAUTION.

When warning of storms or high winds is received, install felt-padded wooden clamps to lock all movable control surfaces securely. These clamps should be used in addition to the surface control locks.

(c) USE OF MOORING KIT:—

(i.) Screw the anchor rod into the arrow, and then slip the driving rod over the anchor rod into the socket of the arrow. The cam on the driving rod must be turned so that the prongs of the arrow will not spread when the arrow is driven into the ground. If the ground is hard, the surface may be broken with a ground-breaking pin.

(ii.) Align the rod with the mooring point on the airplane, and then drive the arrow down until the driving rod handle is within approximately 3 inches of the ground.

(iii.) Rotate the handle 90 degrees and strike the driving rod a sharp blow to spread the prongs of the arrow, return the handle to the driving position, and then pull the driving rod from the ground.

(iv.) Align the squared socket of the "eye" assembly with the square end of the anchor rod, fit the "eye" on the rod, and then tighten down the knurled nut.

(v.) To withdraw the anchor rods, detach the mooring ropes and unscrew the rods. Leave the arrows in the ground and replace the expanded arrows as soon as possible so as to keep the mooring kit complete.

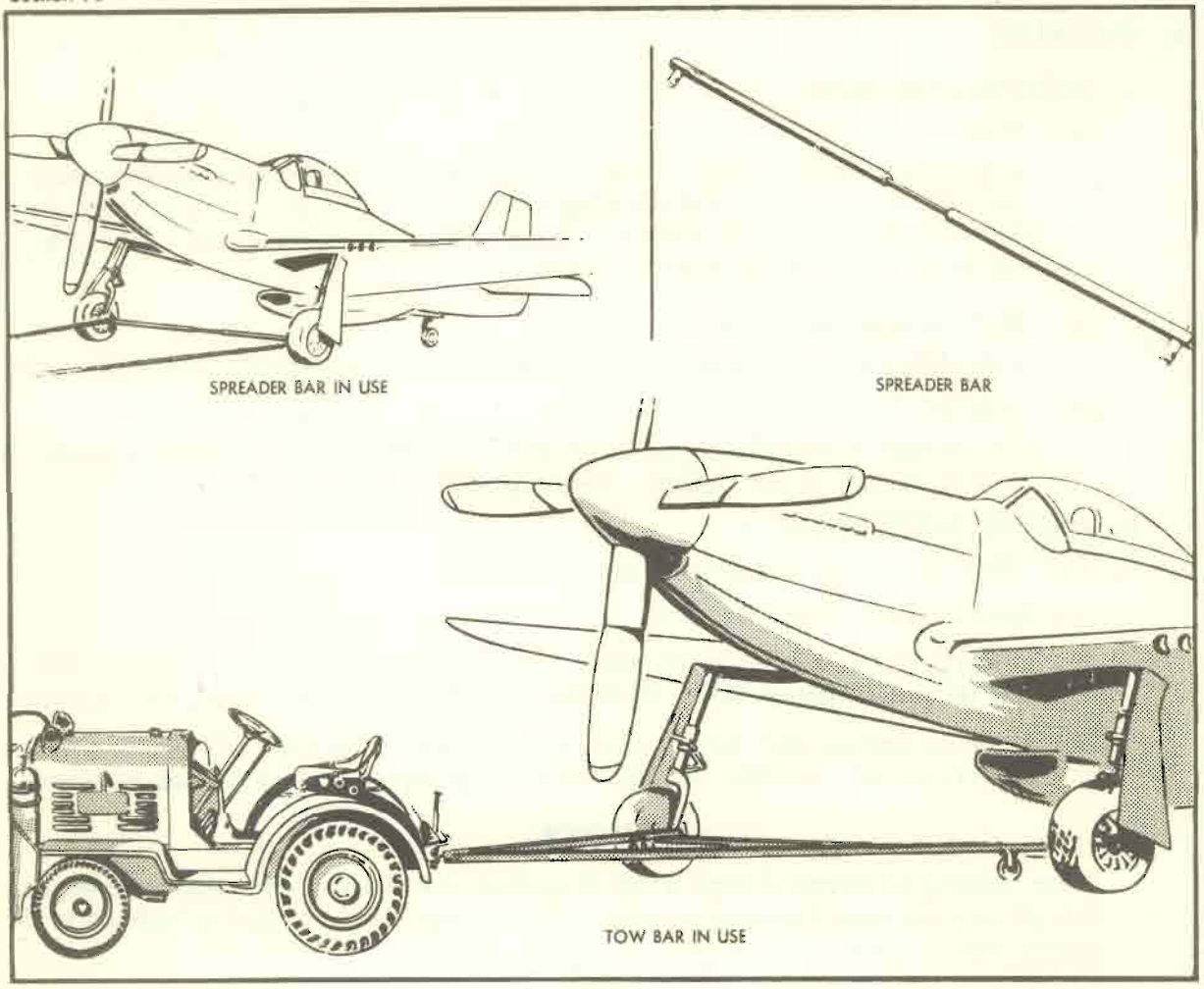


FIGURE 213–TOWING THE AIRPLANE

9. TOWING.

A towing ring is at the inboard end of each main landing wheel axle. The use of a CA126/5 tow bar will facilitate towing the airplane within an area limited by ground equipment or other aircraft. (See Figure 213.) If tow ropes are used, a CA126/3 spreader bar or some similar bar arrangement will prevent the landing gear from collapsing should the landing gear control handle be inadvertently moved. Release the parking brakes and unlock the tail wheel before attempting to move the airplane. When the airplane is being towed near other equipment, station one man in the cockpit to operate the brakes, and assign a man to each wing tip. Whenever towing is being done by ropes or cables, station a man in the cockpit to operate the brakes so that the airplane will not run down the towing equipment.

Section B.—SERVICING INSTRUCTIONS

1. FUEL SYSTEM.

(a) FUEL:—

100 Octane, Grade 130. R.A.A.F. Ident. No. K1/10010.

(b) TANK CAPACITIES:—

(i.) Wing Tanks (2)—76.5 Imperial (92 U.S.) gallons each.

(ii.) Fuselage Tank (1)—70.7 Imperial (85 U.S.) gallons.

(iii.) Combat Tanks (2)—62.4 Imperial (75 U.S.) or 92 Imperial (110 U.S.) gallons each.

(c) FILLING MAIN FUEL TANKS:—

The main tanks are filled individually through filler necks on the upper surface of the respective wing panels. (See Figure 214.) The ground jacks are located just forward and inboard of each filler neck. When filling the tanks, observe the following precautions:—

(i.) Before filling the tanks, examine the fuel system for leaks, ground the airplane, and drain a small amount of fuel from the two drain cocks at the forward end of the radiator scoop and from the fuel strainer at the base of the firewall in order to eliminate accumulated water and foreign matter.

(ii.) Avoid filling the tanks to overflowing, as there are no filler neck drain lines.

(iii.) After filling the tanks, check the filler caps for security, and wipe any spilled fuel from the surface of the wing.

(d) DRAINING MAIN FUEL TANKS:—

(i.) Ground the airplane at the ground jacks just forward and inboard of each main tank filler cap. (See Figure 214.)

(ii.) Place suitable container near booster pump on tank to be drained.

(iii.) Remove booster pump access door.

(iv.) Remove Allen head drain plug in booster pump discharge nipple. Obtain a funnel or devise some method of directing the fuel from the pump nipple to the container. A hose attached to a fitting which will screw into the pump nipple is very satisfactory.

(v.) Turn "OFF" fuel shut-off valve, place the fuel selector control handle in proper position for the tank being drained, and set booster pump switch in "ON" position.

(vi.) Either plug in external power supply, or turn "ON" the battery-disconnect switch.

(vii.) Drain any fuel which has settled in aft end of tanks by opening the drain cocks on the aft inboard end of each tank. (See Figure 215.)

(viii.) Replace Allen head drain plugs in booster pump discharge nipples, and safety drain cocks.

(e) FILLING FUSELAGE FUEL TANK:—

Before filling the fuselage tank, ground the airplane at the ground jack located just below the fuselage tank filler neck, and then drain a small amount of fuel from the drain cock, which is accessible through a Dzus-fastened door on the left underside of the fuselage; this will eliminate accumulated water and foreign matter. Fill the tank through the filler neck on the left side of the fuselage just aft of the canopy. (See Figure 214.)

(f) **DRAINING FUSELAGE FUEL TANK:—**

Ground the airplane at the ground jack just aft of the fuselage tank filler cap (Figure 214), and then open the drain cock which is accessible through a Dzus-fastened door on the left underside of the fuselage. (See Figure 215.) After draining the tank, tighten and safety the drain cock.

(g) **FILLING COMBAT TANKS:—**

Ground the airplane at either of the ground jacks just forward and inboard of the wing tank filler caps, and then fill the combat tanks to overflowing at the filler neck on the upper forward end of each tank. No gauges are provided. If the tanks are permitted to stand for several hours after filling, drain out a small amount of fuel through the drain plug on the bottom of each tank, replace and safety drain plug, and refill the tanks with fuel. This removes any moisture or foreign matter which may accumulate in the tanks.

(h) **DRAINING COMBAT TANKS:—**

Place a suitable container beneath the drain plug at the bottom of the tank to be drained, and then remove the plug. After draining, install and safety the drain plugs.

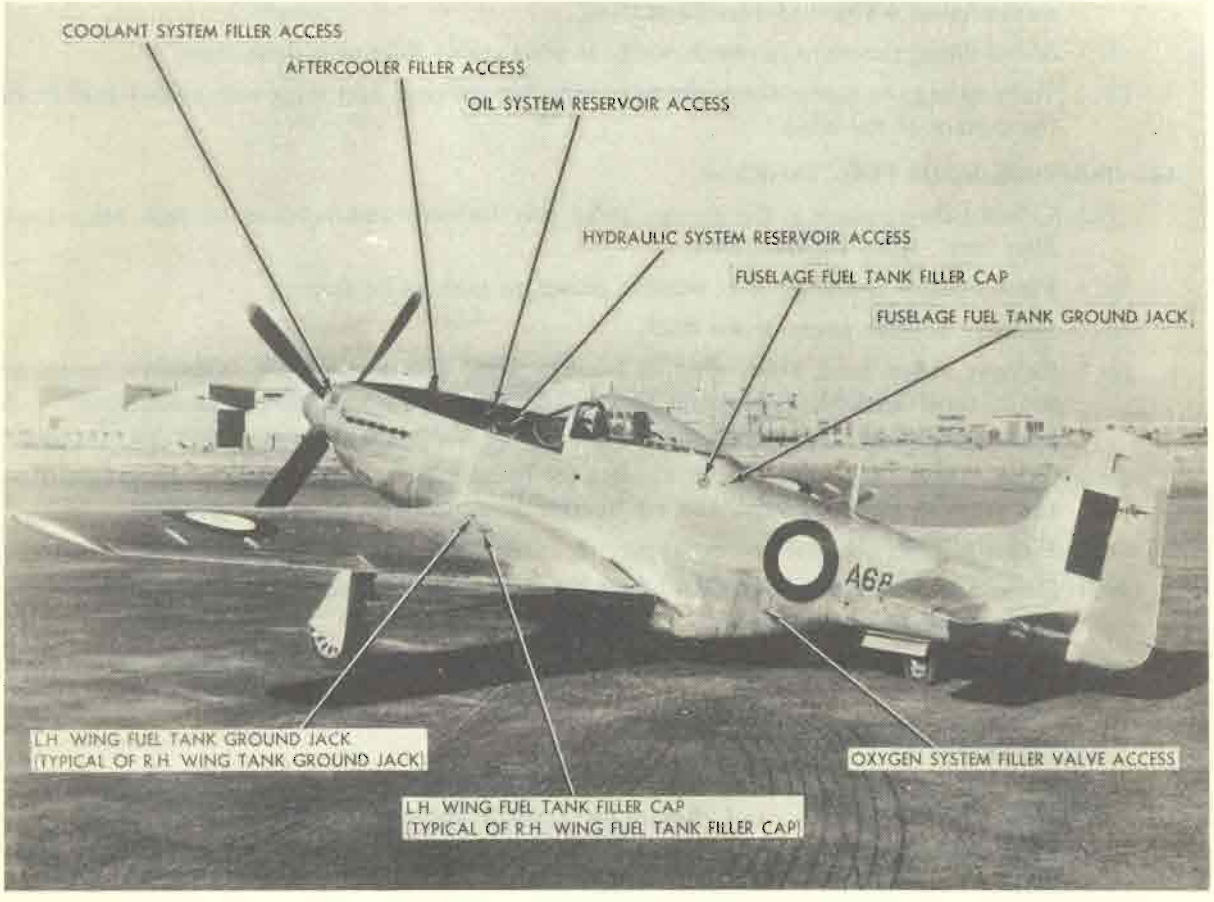


FIGURE 214—SERVICING PROVISIONS

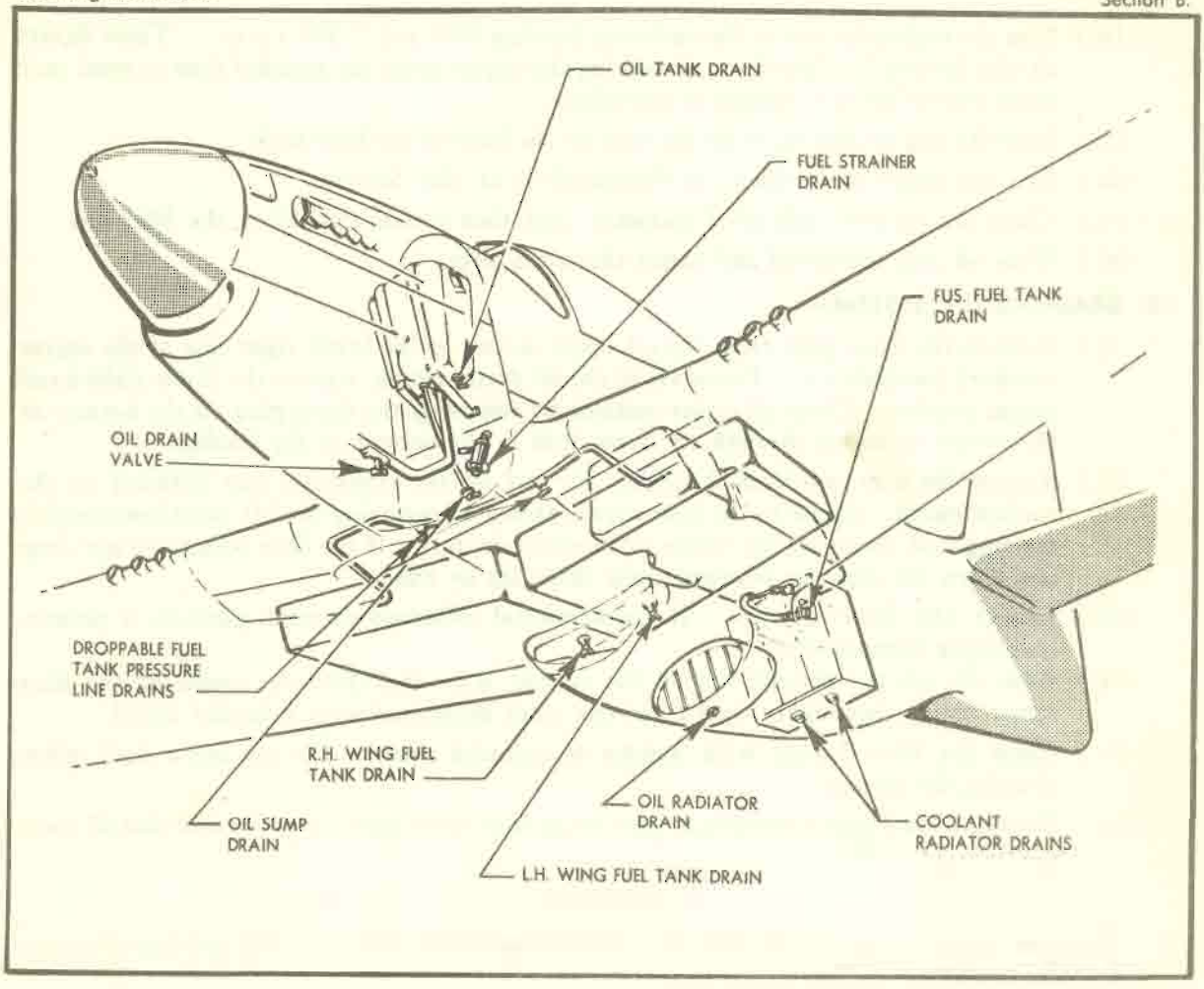


FIGURE 215–FUEL, OIL AND COOLANT DRAINS

2. OIL SYSTEM.

(a) **OIL:—**

100 Min. R.A.A.F. Indent No. K2/128 or DTD 472 Grade B

OR

120 Min. R.A.A.F. Indent No. K2/139 or DTD 472 Grade C

(b) **SYSTEM CAPACITY:—**

17.5 Imperial (21 U.S.) gallons.

(c) **FILLING OIL SYSTEM:—**

The oil filler neck is accessible through a small Dzus-fastened door on the left side of the upper engine cowling. (See Figure 214.) If foam is present when replenishing the tank, be careful to get a proper reading of the oil level.

(i.) Fill the oil tank to the level of the filler neck. This will require approximately 12 gallons if the tank is empty.

(ii.) Run the engine for one or two minutes between 800 and 1,000 r.p.m. These figures should be closely adhered to, as running the engine above the specified time or speed may cause serious internal damage to the engine.

(iii.) Stop the engine and again fill the tank to the level of the filler neck.

(iv.) Run the engine as instructed in Paragraph 6 of this Section.

(v.) Check the oil level, add oil if necessary, and then install and safety the filler cap.

(vi.) Wipe off any spilled oil and fasten the access door.

(d) DRAINING OIL SYSTEM:—

(i.) Remove the drain plug from the oil drain casting in the lower right side of the engine accessory compartment. For access to the oil drain casting, remove the lower right-hand engine cowling. Drain oil cooler radiator by removing the drain plug on the bottom of the cooler, accessible through an access door in the bottom of the fuselage.

(ii.) Remove the filter caps from the lower left end of the crankcase, just forward of the coolant pump. Access to the filter caps is gained by removing the left-hand lower engine cowling and removing the centre carburettor air duct. If the filter screens do not drop out when the caps are removed, take them out by hand.

(iii.) Inspect the filter screens. If an abnormal collection of metal particles is present, investigate immediately.

(iv.) After the oil has drained out of the system, wipe and clean the inside of the filter screen casings thoroughly with a lint-free cloth moistened with unleaded petrol.

(v.) Clean the filter screens with naptha or unleaded petrol. Do not use a cloth when cleaning the screens.

(vi.) Re-install the filters, making sure that the gaskets are in good condition and that all joint surfaces are clean.

WARNING.

Excessive tightening of cap nut will result in damage to filter screen housing and loss of proper scavenging action.

3. ENGINE COOLING AND AFTERCOOLING SYSTEMS.

(a) COOLANT:—

70/30 Ethylene Glycol (inhibited with NaMBT).

R.A.A.F. Indent No. K4/10584.

(b) SYSTEM CAPACITIES:—

(i.) Engine Cooling System.—13.9 Imperial (16.7 U.S.) gallons.

(ii.) After Cooling System.—4 Imperial (4.8 U.S.) gallons.

(c) FILLING COOLING SYSTEMS:—

The header tank filler cap is accessible through the Dzus-fastened door at the forward end of the upper left engine cowling just aft of the propeller spinner. (See Figure 214.) The after-cooler expansion tank is accessible through the door on the top left engine cowling just forward of the oil tank filler cap access door. Because the pressure-type cooling systems require closed circuits, air traps are likely to occur when filling the system. Therefore, sealed vent lines are provided to bleed off the air when the system is being filled. The vents for both systems are located just inside the left wing rear fillet.

(i.) Remove the two vent line caps inside the left rear wing fillet.

(ii.) Fill the header tank and the after-cooler expansion tank until coolant overflows the respective vent lines.

(iii.) Quickly install and safety the vent line caps.

(iv.) Continue filling each system until the tanks overflow; then install the filler caps.

(v.) Run the engine at 800 r.p.m. from one to two minutes. Stop the engine and inspect both tanks for coolant level. Fill coolant tanks. Install and safety the filler caps. Repeat this procedure as often as necessary to completely fill the system.

(d) DRAINING ENGINE COOLING SYSTEM:—

(i.) Remove the drain plugs from the coolant pump and engine cooling section of the radiator. (See Figure 215.) The pump drain plug is accessible through the lower left engine cowling. A door beneath the coolant radiator provides access to the engine cooling system drain plug located on the left-hand side of the radiator.

(ii.) Remove the header tank filler cap to allow air to enter the system as the coolant drains. The filler cap is accessible through the Dzus-fastened door at the forward end of the upper left engine cowling just aft of the propeller spinner. (See Figure 214.)

(e) DRAINING AFTER COOLING SYSTEM:—

(i.) Remove the drain plug from the after-cooling section of the radiator. (See Figure 215.) A door beneath the coolant radiator provides access to the after-cooling system drain plug on the right-hand side of the radiator.

(ii.) Remove the after-cooler expansion tank filler cap to allow air to enter the system as the coolant drains. The filler cap is accessible through the door of the top left engine cowling just forward of the oil tank filler cap access door. (See Figure 215.)

NOTE.

Collect the coolant liquid drained from the cooling systems and test it for proper percentages of water and glycol with a glycol hydrometer If the liquid is not contaminated it may be strained and used again.

4. HYDRAULIC SYSTEM.

(a) FLUID:—

Specification CA412. R.A.A.F. Indent No. K2/138.

(b) SYSTEM CAPACITY:—

(i.) Complete System Capacity.

2.9 Imperial (3.5 U.S.) gallons.

(ii.) Reservoir Capacity—

1 Imperial (1.21 U.S.) gallon

(c) EXHAUSTING HYDRAULIC SYSTEM PRESSURE:—

The hydraulic system is exhausted by operating the wing flaps or by pulling the emergency release knob on the instrument sub-panel and opening the controllable check valve. The hydraulic pressure gauge on the lower right-hand side of instrument sub-panel should read zero. The hydraulic system pressure should be exhausted before:—

(i.) Replenishing the hydraulic reservoir or checking the fluid level.

(ii.) Draining and filling the complete hydraulic system.

(iii.) Checking the air pressure in the accumulator.

(iv.) Disconnecting any hydraulic line or removing any hydraulic unit.

CAUTION.

Be sure to push in the emergency lowering knob as soon as the refilling is accomplished.

(d) REPLENISHING HYDRAULIC RESERVOIR FLUID:—

When filling the reservoir, it is recommended that a suitable receptacle be placed under the reservoir drain line which bottoms at the left side of the lower firewall. On airplanes subsequent to A68-80 this drain line has been removed. Clean the reservoir filler neck strainer at each refilling and make sure the filler cap and dip stick are correctly secured in place. Fill the reservoir as follows:—

(i.) Exhaust the system pressure.

(ii.) Fill the reservoir to overflowing. The reservoir dip stick is calibrated to show when one quart or two quarts of fluid need to be added.

CAUTION.

Do not fill the reservoir through the dip-stick hole.

(e) FILLING SYSTEM WITH TEST STAND:—

The hydraulic test stand should be used when filling the complete hydraulic system. Before filling the complete hydraulic system, place the airplane on jacks to permit operation of the landing gear. It is also necessary to inflate the accumulator to 400 (± 25) pounds per square inch. The system has a total fluid capacity of approximately 2.9 Imperial (3.5 U.S.) gallons. Hydraulic fluid must be absolutely clean. Filter the fluid before putting it in the system. Avoid working on the hydraulic system out of doors where units are subject to contamination.

(i.) Connect the test stand lines to the firewall disconnect couplings. A return line must be run from the vent connection at the top of the reservoir to the test stand reservoir, leaving the airplane reservoir filler cap tight.

(ii.) Circulate fluids through the system thoroughly, and then operate each unit several times to purge the system of as much air as possible. If necessary, loosen the B nuts on the lines at units such as the tail wheel operating strut, the hydraulic pressure gauge, and the fairing door operating strut to relieve trapped air. After bleeding be sure to tighten and safety where required. Units will bleed automatically when the system is operating.

(iii.) Operate each unit several times. The pressure gauge reading should return to 1,000-1,100 pounds per square inch after each operation.

(iv.) Stop the test stand pump and disconnect the test stand from the airplane.

(v.) Connect the engine-driven pump suction and pressure lines to the disconnect couplings at the firewall.

(vi.) Make sure the landing gear control handle is in the down position, take the airplane off the jacks, start the engine, and then test the engine-driven pump by operating the wing flaps.

(vii.) Carefully inspect the lines and equipment for leaks, and replenish the reservoir if necessary.

(f) FILLING SYSTEM WITH HAND PUMP:—

Complete filling of the hydraulic system by means of the hand-pump entails a great amount of labor. Use this method only when no other means are available. Use the applicable instructions in Sub-paragraph (e) of Paragraph 4, and keep filling the reservoir as fluid is used.

(g) DRAINING HYDRAULIC SYSTEM:—

Disconnect system return line at landing gear selector valve to drain system. To drain reservoir, disconnect any brake line in the wing.

5. OXYGEN SYSTEM.

(a) OPERATING PRESSURE.

1,800 pounds per square inch.

(b) FILLING OXYGEN SYSTEM:—

The oxygen filler valve is accessible through the access door on the left side of the fuselage just below the insignia. (See Figure 214.) A standard trolly using six oxygen bottles and with pressure gauge installed in the filling line should be used in filling the oxygen system.

(i.) Remove filler valve dust cap by unscrewing.

(ii.) Attach the filling hose to the valve and open the shut-off valve in the airplane alongside the filler valve.

(iii.) Using the lowest pressure supply bottle first, commence filling the system to the capacity of that bottle.

Repeat this operation with each bottle until the desired pressure (1,800 p.s.i.) is reached. During charging, the bottles will generate heat and after filling to 1,800 p.s.i., should be allowed to cool off for some time and then finally "topped up."

NOTE.

A pressure gauge is required in the filling line when re-charging the oxygen system as a contents gauge only is installed in the airplane.

(iv.) Turn off the supply valve, the airplane shut-off valve and disconnect the filling hose.

(v.) Replace dust cap on the filler opening.

(c) DRAINING THE OXYGEN SYSTEM:—

The oxygen system can be drained by removing the supply line on the regulator side of the cockpit shut-off valve; and then opening the valve.

6. GROUND OPERATING INSTRUCTIONS

(a) STARTING ENGINE:—

(i.) See that ignition switch is "OFF."

(ii.) Move mixture control to "IDLE CUT OFF."

(iii.) Have ground personnel turn the propeller several revolutions.

(iv.) Turn "ON" generator-disconnect switch. If external power supply is not used, turn "ON" battery-disconnect switch. These switches are on the right-hand switch panel.

(v.) Open throttle one inch (early airplanes) or to "START" position (late airplanes).

(vi.) Move propeller control to full "INCREASE."

(vii.) On early airplanes, make certain boost control, at lower left side of instrument panel, is at "AUTOMATIC." On late airplanes, see that throttle gate is safety wired.

(viii.) See that supercharger blower switch on pilot's switch panel is in "AUTO."

(ix.) Turn oil and coolant radiator air control switches at left side of cockpit to "AUTOMATIC."

(x.) Move carburettor air control, at aft end of control pedestal, to "RAM AIR." ("UNRAMMED FILTERED AIR." if required.)

(xi.) Turn "ON" fuel shut-off control, adjacent to the fuel selector; place booster pump switch in "ON" or "NORMAL," and turn fuel selector to "FUS. TANK," or "MAIN TANK L.H." if fuselage tank is not serviced.

(xii.) Check fuel pressure gauge for 12 to 14 pounds per square inch with booster pump switch "ON."

(xiii.) Electric Prime: Three or four seconds when cold, one when hot. Hand Prime: Three to four strokes when cold, one when hot.

(xiv.) Make sure propeller is clear.

(xv.) Turn ignition switch to "BOTH."

(xvi.) Lift guard on starter switch, on front switch panel, and press switch to "START."

NOTE.

Whenever possible, use an external power supply to start the engine. If external power is not available, use handcrank. Use airplane's battery in an emergency only.

(xvii.) As engine starts, move mixture control to "AUTO RICH" or "RUN." If engine does not start after several turns, continue priming by hand.

WARNING.

When engine is not firing, mixture control should be in "IDLE CUT OFF."

(xviii.) Check oil pressure. If pressure is not up to 50 pounds within 30 seconds, stop engine and investigate.

(b) WARM UP:—

Warm up the engine at 1,300 r.p.m. until the oil temperature shows a definite increase and the oil pressure remains steady when the throttle is opened. The desired oil and coolant temperatures will be maintained by having the radiator air controls in "AUTOMATIC."

	Desired.	Maximum
Oil temperature . .	70°— 80°C (158°—176°F)	90°C (194°F)
Coolant temperature . .	100°—110°C (212°—230°F)	121°C (250°F)

If coolant and oil temperatures exceed limits with controls in "AUTOMATIC," shut engine off and investigate.

(c) **STOPPING ENGINE:—**

(i.) Turn "OFF" booster pump switch.

(ii.) Run engine to 1,500 r.p.m., set mixture control in "IDLE CUT OFF," and move throttle fully open. Leave mixture control in "IDLE CUT OFF" as a precaution against accidental starting.

(iii.) Turn "OFF" ignition switch after the engine ceases firing.

(iv.) Turn "OFF" fuel shut-off valve.

7. LUBRICATION REQUIREMENTS.

Specific lubrication points are illustrated in Figure 218. A two-man lubrication team can be employed, one man to clean and lubricate and another man to inspect and clean the lubricated parts.

(a) **LUBRICATION PROCEDURE:—**

The following is to be carried out in conjunction with the check chart:—

(i.) Wipe zerk or mechanism with a clean rag. If necessary, moisten the rag with cleaning solvent.

(ii.) Lubricate zerk or mechanism with the lubricant specified.

(iii.) Inspect zerk or mechanism for proper lubrication.

(iv.) Remove excess lubricant.

(b) **GENERAL LUBRICATION NOTES:—**

(i.) Bearing Surfaces—

Excessive lubrication of bearing surfaces will attract dirt and grit. These items must be inspected and cleaned after lubrication.

(ii.) Zerk Fittings—

All zerk fittings, painted orange for identification, should be lubricated with a pressure gun.

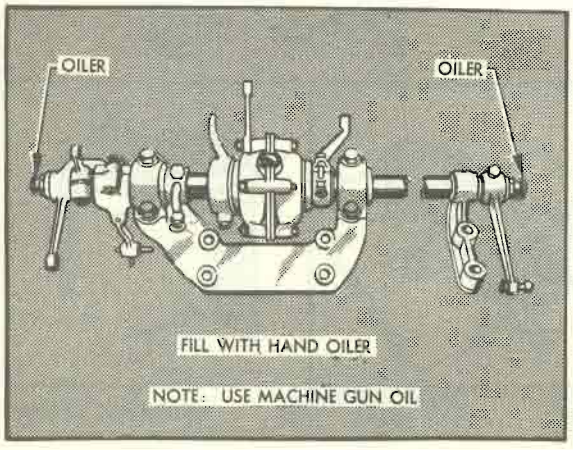


FIGURE 216–ENGINE CONTROL SHAFT LUBRICATION

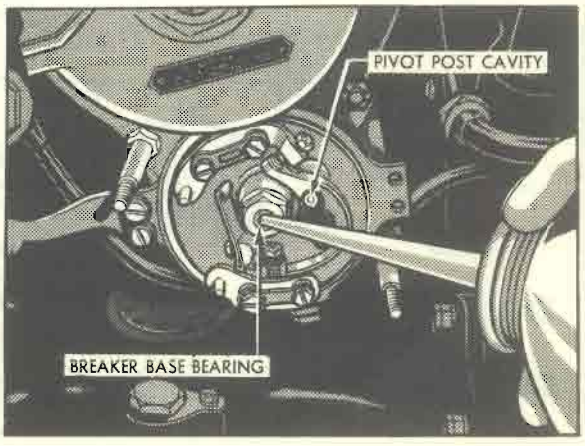
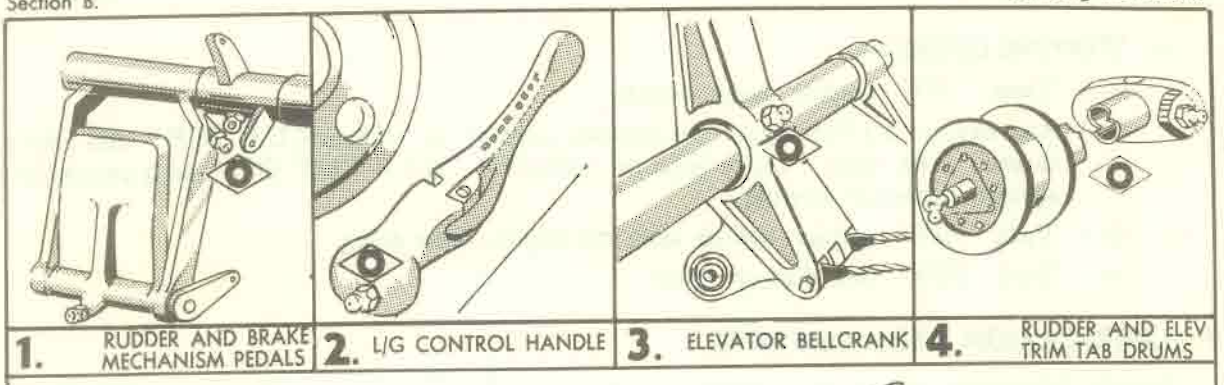
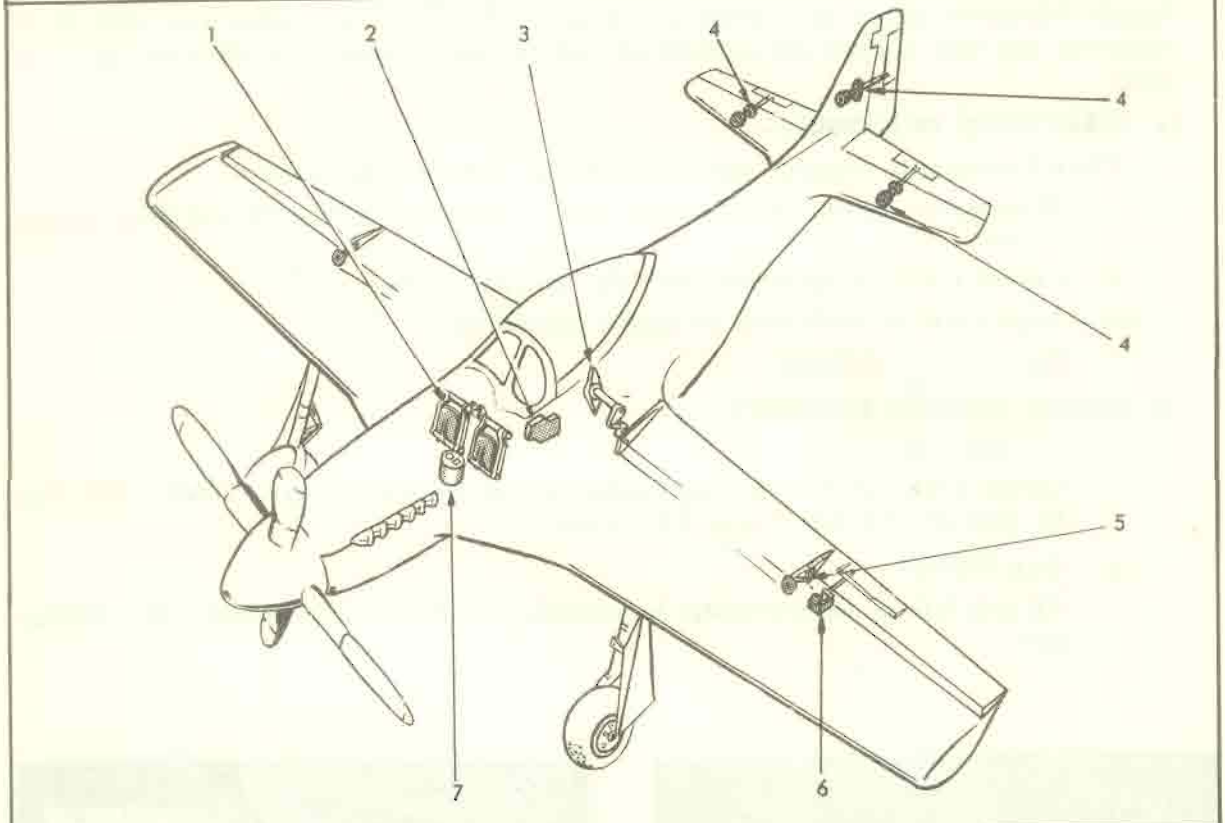
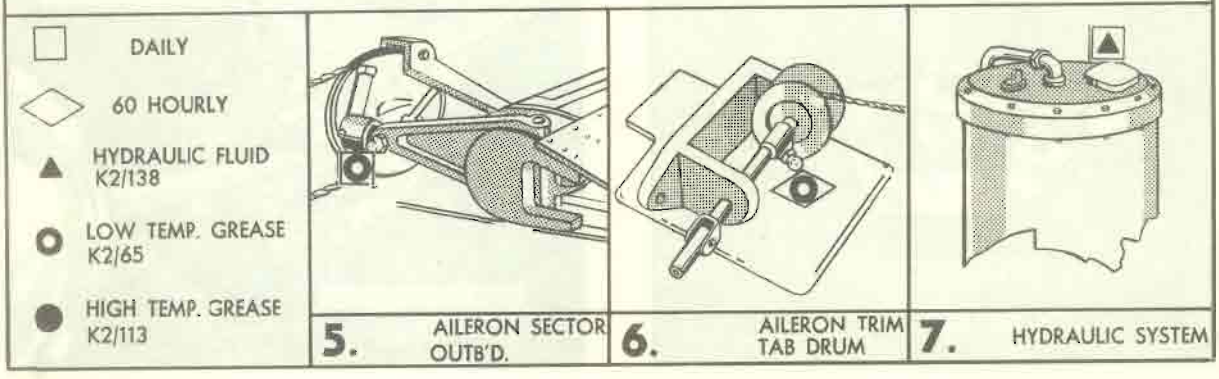


FIGURE 217–MAGNETO BREAKER LUBRICATION



1. RUDDER AND BRAKE MECHANISM PEDALS
2. L/G CONTROL HANDLE
3. ELEVATOR BELLCRANK
4. RUDDER AND ELEV TRIM TAB DRUMS





5. AILERON SECTOR OUTB'D.
6. AILERON TRIM TAB DRUM
7. HYDRAULIC SYSTEM

FIGURE 218 (SHEET 1 OF 2 SHEETS)--LUBRICATION DIAGRAM

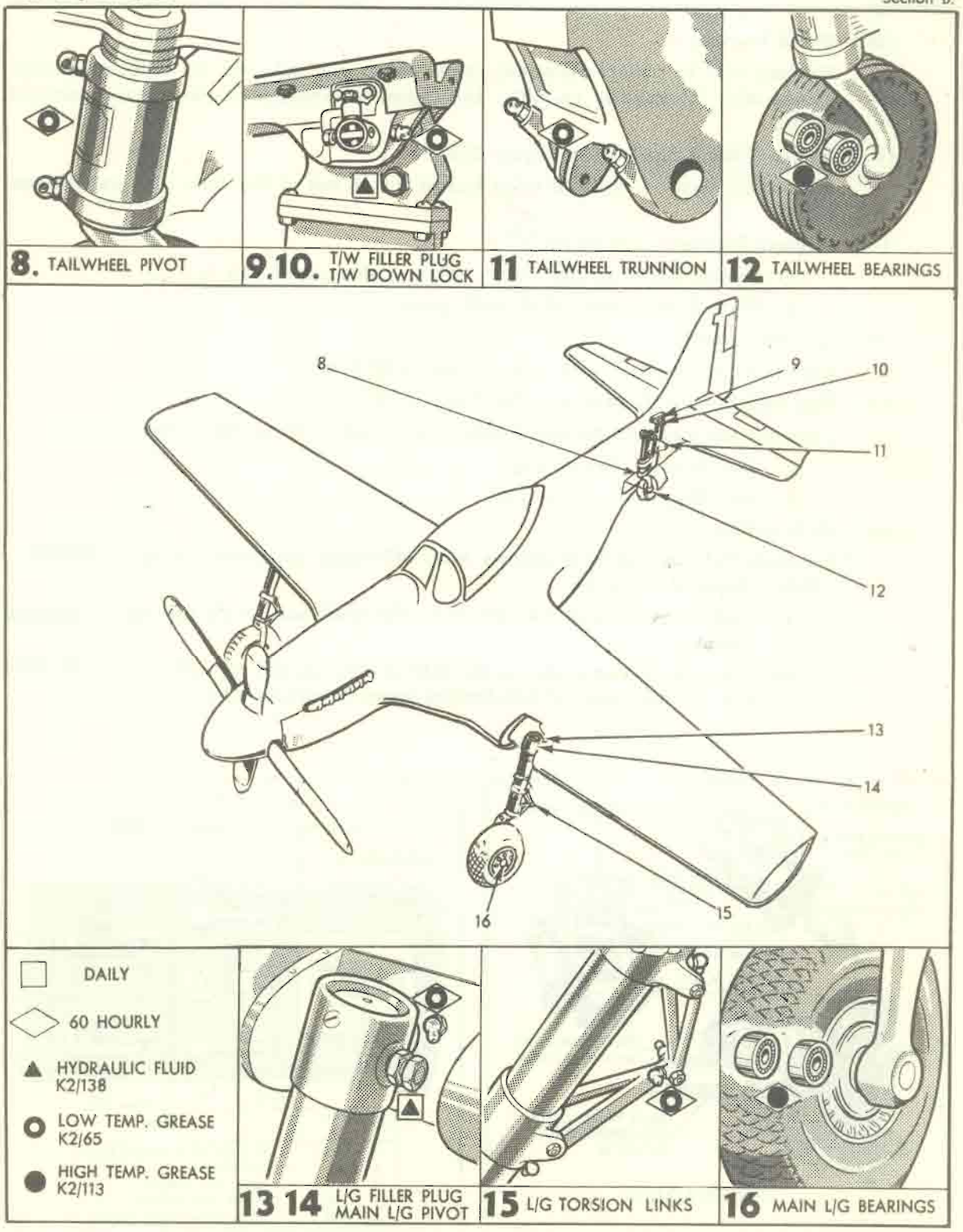


FIGURE 218 (SHEET 2 OF 2 SHEETS)--LUBRICATION DIAGRAM

(iii.) Sealed Bearings—

Bearings used in pulleys bellcranks, hinge points, rod ends, etc., are of the sealed type packed with lubricant at assembly, and require no lubrication between major overhaul periods.

(iv.) Engine Control Shaft—(See Figure 216).

Fill control shaft on engine at oilers located at each end of this shaft with machine gun oil.

(v.) Magneto Breaker—(See Figure 217).

(a) Breaker Base Bearing.—Coat lightly with machine gun oil.

(b) Pivot Post Cavity.—Fill with grease.

(vi.) Coolant Pump—

Lubricate coolant pump with high melting point grease.

(vii.) Manifold Pressure Regulator—(See Figure 219).

Lubricate the manifold pressure regulator with engine oil at the following points:—

(a) Cam housing bakelite ring—coat lightly.

(b) Adjusting screw—two drops.

(viii.) Dynamotors—

Lubricate the dynamotors as follows every 480-hour inspection period, if necessary. (Refer Chapter 7, Section C.)

(a) Apply three drops of SAE 20 oil to the small hole in the top of each bearing housing.

(b) Through the same hole in the bearing housing, add approximately 0.05 cubic inch ($\frac{3}{8}$-inch cube) of ball-bearing grease to each bearing.

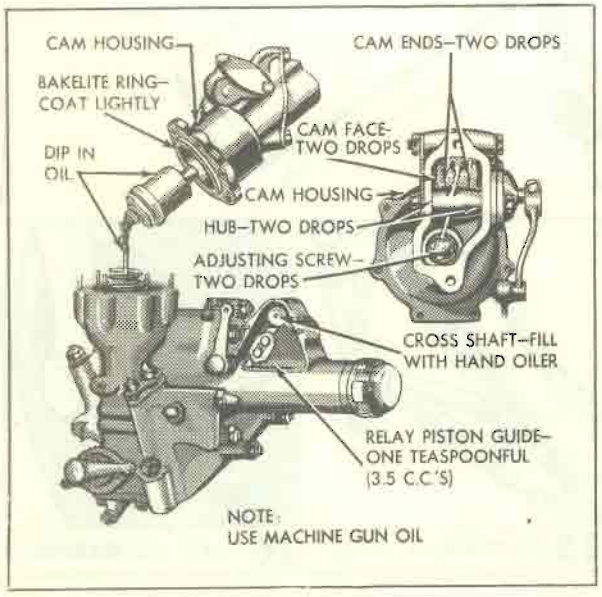
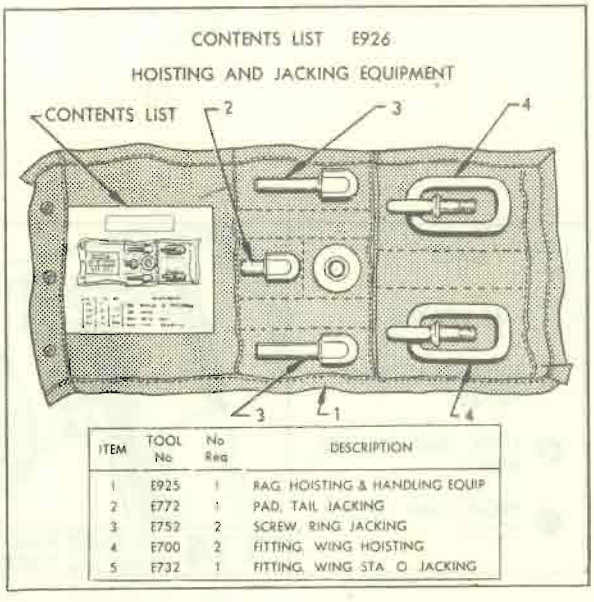
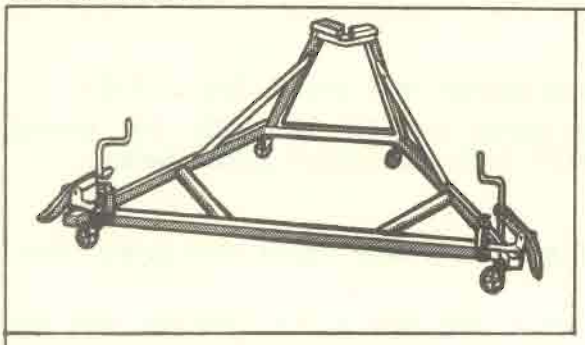


FIGURE 219
MANIFOLD PRESSURE REGULATOR LUBRICATION

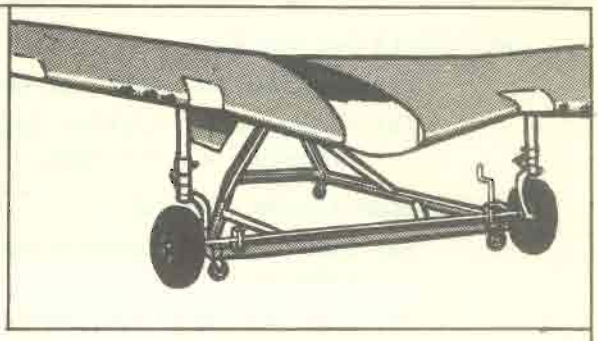


ITEM	TOOL No	No Req	DESCRIPTION
1	E925	1	BAG, HOISTING & HANDLING EQUIP
2	E772	1	PAD, TAIL JACKING
3	E752	2	SCREW, RING JACKING
4	E700	2	FITTING, WING HOISTING
5	E732	1	FITTING, WING STA. O JACKING

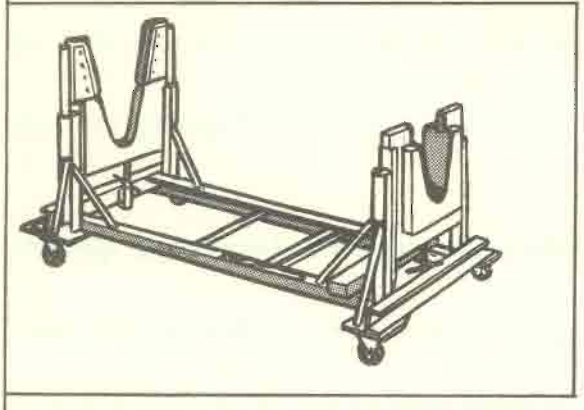
FIGURE 220—TOOL KIT FURNISHED WITH AIRPLANE



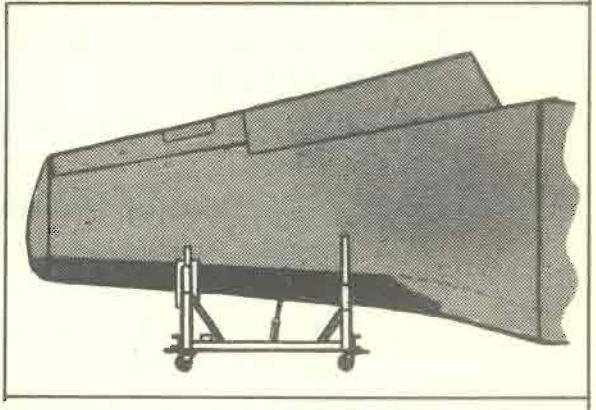
CA126/9 WING CONVEYOR



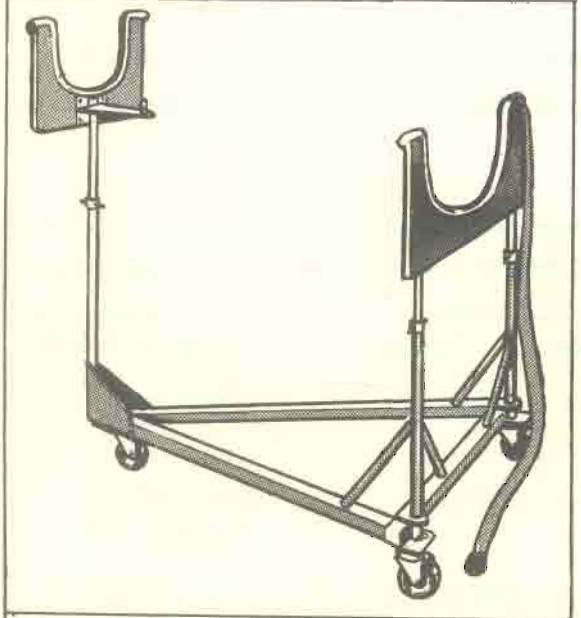
CA126/9 WING CONVEYOR



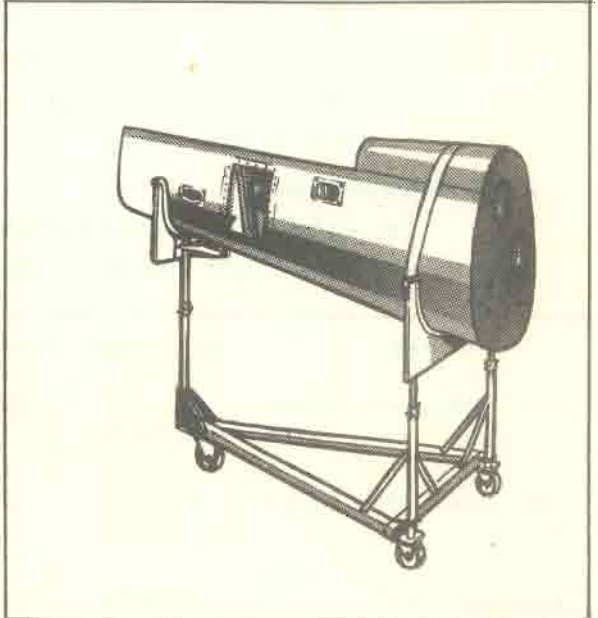
CA119/3 WING PANEL CONVEYOR



CA119/3 WING PANEL CONVEYOR



CA123/9 FUSELAGE REAR SECTION CONVEYOR



CA123/9 FUSELAGE REAR SECTION CONVEYOR

FIGURE 221--SPECIAL HANDLING JIGS

(ix.) Pilot's Seat and Harness—

(a) Lubricate seat slides seat elevating plunger with grease (Spec. CA424).

(b) Grease (Spec. CA424) harness spring assembly generously (to prevent corrosion) and oil (Spec. CA413) latch pins, pinned joints sparingly.

(x.) Cockpit Control Pedestal—

(a) Lubricate aileron trim tab control mechanism chain lightly with grease (Spec. CA427).

(b) Lubricate clevis pin connection on landing gear position indicator with one drop of oil (Spec. CA413).

(xi.) Engine Control Linkage—

Lubricate all clevis connections of engine bay control linkages with one drop of oil (Spec. CA413).

CAUTION.—Do not oil ball-bearing rod ends or substitute ball-bearing rod ends (friction type).

(xii.) Cockpit Canopy Operating Mechanism—

(a) Lubricate actuating handle assembly articulating pin and drive chain sparingly with oil (Spec. CA413).

CAUTION.—Do not lubricate sprocket shaft bearings as these are oilite (self-lubricated) bearings.

(b) Lubricate emergency release handle bearings with one drop of oil (Spec. CA413).

(c) Lubricate canopy truck assemblies, using one drop of oil (Spec. CA413) per bearing. Oil cam, lock pins and truck rollers.

(d) Lubricate emergency trip bar posts with one drop of oil (Spec. CA413).

NOTE.—Do not oil tracks, oiling of tracks will result in unnecessary accumulation of dust.

(xiii.) Miscellaneous—

(a) Lubricate surface control lock plunger as necessary with grease (Spec. CA424).

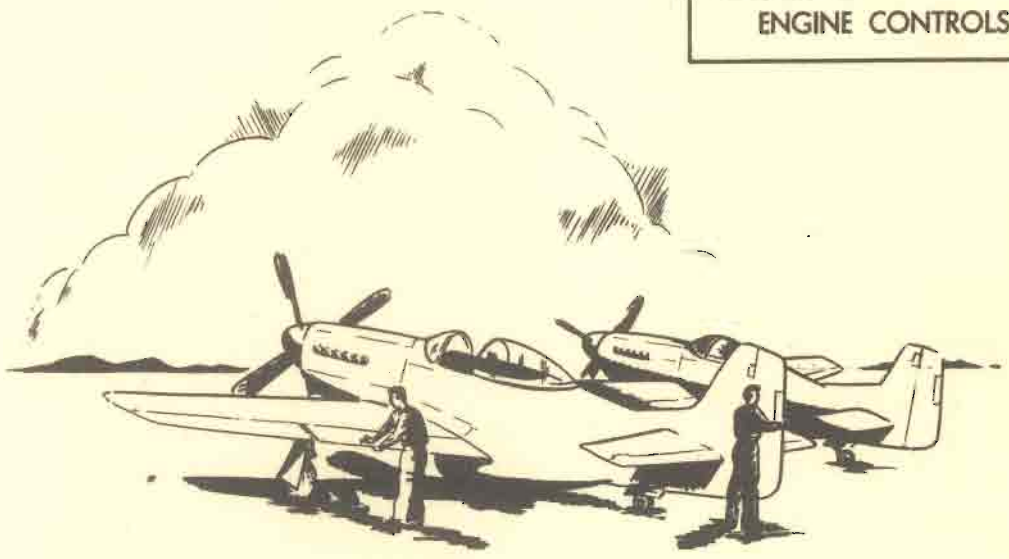
(b) Apply light film of oil (Spec. CA413) to main landing gear locking surfaces.

Lubricant	R.A.A.F. Ident.	C.A.C. Spec.	A.N. Spec.	Commercial Product
Low Temperature Grease	K2/65 (DTD577)	CA424	AN–G–3A	Intava 669
High Temperature Grease	K2/113 (DTD558)	CA426	AN–G–5	Intava 672 Aeroshell 18B
Hydraulic Fluid	K2/138	CA412	AN–VV–0–3660 AC–3580 Red Colour	Intava Fluid 675
Lubricating Oil - -	K2/55	CA413	——	Intava Oil 663
E.P. Anti-Freezing Grease	K2/189	CA427	AN–G–10	Intava 674

CHAPTER 3

CONTROL SYSTEMS

Section A–
FLYING CONTROLS
Section B–
ENGINE CONTROLS



MUSTANG OVERHAUL MANUAL

CHAPTER 3.–CONTROL SYSTEMS

Section A –FLYING CONTROLS

1. GENERAL.

(a) DESCRIPTION:—

The ailerons and elevators are conventionally controlled by the pilot's control stick and the rudder by hanging-type pedals. All primary control surfaces, except right aileron, are equipped with adjustable trim tabs operated from the cockpit. The tab on the right aileron is adjustable only on the ground and is used to correct wing heaviness. Tinned steel cables connect the control stick, rudder pedals and trim tab controls to their respective control surfaces. Turnbuckles are incorporated in each system to facilitate installing and rigging of the cables. The wing flaps are hydraulically actuated and selectively positioned by a control handle in the cockpit.

(b) RIGGING NOTES:—

(i) Establish the exact neutral position of each control system, work from that position, and the results will be more effective.

(ii) When setting tensions, tighten all cables to about 25 pounds above normal, operate the control thoroughly, and then rig the cables to the normal tensions. This will eliminate the loss of tension due to stretch, cables seating in pulleys, etc.

(iii) Operate the control surfaces through the complete range of travel while checking the components for clearance. This particularly applies to actuating rods and links.

(iv) Always tape trim tab cables to the cable drums before releasing the cable tensions. Otherwise, the cables will unwind, causing unnecessary work and trouble.

(v) Set the cable guards so that the clearance between the guard and the cable equals one-third the diameter of the cable ± 1/64-inch. If the clearance is greater than this, the cable can twist off the pulley.

(vi.) When removing a cable, obtain a cord that is at least as long as the cable, tie the cord to the link or attachment to which the cable was fastened, and then draw the cable and cord through the system. This procedure will provide a positive means of routing another cable correctly.

(c) RIGGING TOLERANCES:—

(i) Control Surface Travel.—
Maintain the control surface throws within ½ degree of the correct angular travel.

(ii) Control Surface Play.—
The maximum control surface play allows only ⅛-inch travel at the trailing edge of the respective main control surface, and only 1/16-inch travel at the trailing edge of the respective trim tabs.

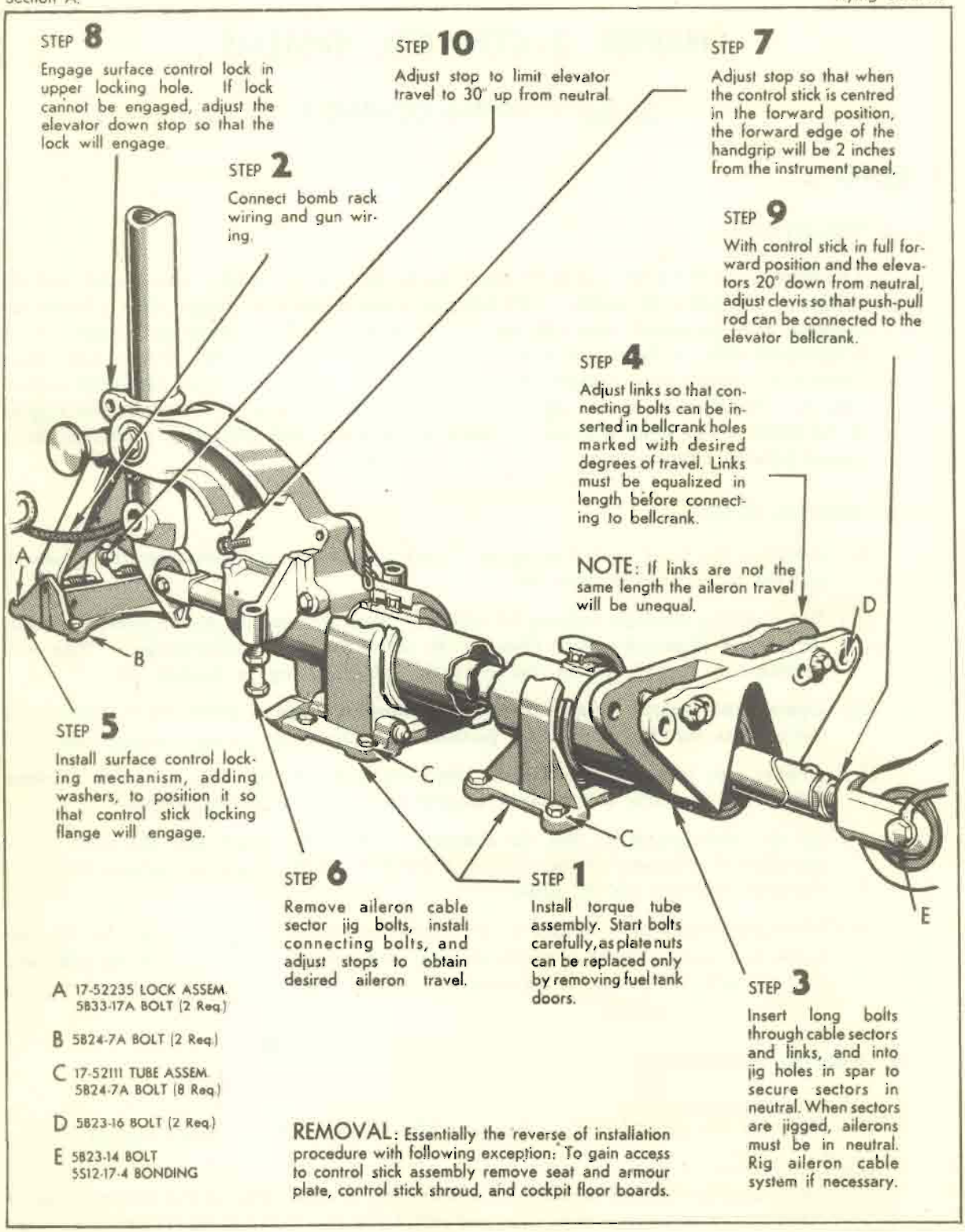


FIGURE 301—INSTALLING CONTROL STICK AND LOCKING MECHANISM

(iii) Control Cable Tensions.—
Maintain the cable tensions within 5 pounds of the correct tension.

(d) TURNBUCKLE SAFETY REQUIREMENTS:—

(i) Turnbuckle Adjustment Tolerance.—
A maximum of three threads on the clevis or swaged fitting may be exposed outside the turnbuckle barrel.

(ii) Turnbuckle Safety Wire.—
Safety turnbuckles on cable up to $\frac{1}{8}$-inch in diameter with .032 wire. Safety turnbuckles on cable larger than $\frac{1}{8}$-inch in diameter with .040 wire. Use brass or stainless steel wire. Tie the .032 wire with 5 to 6 wraps at each end of the turnbuckle barrel, and the .040 wire with 6 to 8 wraps.

(e) PUSH-PULL ROD SAFETY REQUIREMENTS:—

All push-pull rods must be adjusted so that the threaded rod is visible through the inspection hole provided in the bearing or clevis end, and so that at least one thread is visible beyond the jam nut.

(f) DRILLED-HEAD BOLT SAFETY REQUIREMENTS:—

Safety $\frac{3}{8}$-inch and 5/16-inch drilled-head bolts with .051 wire, and safety No. 10 and $\frac{1}{4}$-inch drilled-head bolts with .040 wire.

(g) GENERAL CAUTIONS:—

(i) Do not use long-nose pliers with rough jaws when pulling or twisting safety wire. Rough jaws will scar and weaken the wire.

(ii) Do not tighten one end of a turnbuckle before the other. If available, use some type of turnbuckle wrench.

(iii) Do not twist the cable to shorten or lengthen it. This could result in the cable breaking the turnbuckle safety and becoming slack in flight. If the cable is too long or too short, replace it.

(iv) Do not force turnbuckle on cable swages or clevis ends. If the turnbuckle binds, it is usually because the swage was not clean or was scarred and nicked at the threads.

(v) Do not adjust a turnbuckle without first breaking the safety wire.

(vi) Do not use pliers on control bolts, turnbuckles, rods, etc. Use a good wrench that fits.

(vii) Never use a split pin twice.

WARNING.

Failure to install a split pin or safety wire may cost human lives.

(h) SURFACE CONTROL CABLES:—

(i) Description.—

The control cables are fabricated of preformed tinned steel cable. The main control cable terminals are of the die-swaged friction type. The remaining cables are either sweat-soldered into tinned terminals or woven-spliced.

(ii) Control Cable Identification Color Banding.—

The control cables are color banded to facilitate installation and rigging procedures. The color banding is shown in the chart below:

ELEVATORS	
Control Stick Horn	
(upper cable)	Black
(lower cable)	Yellow
Elevator Horn	
(upper cable)	Yellow
(lower cable)	Black
ELEVATOR TRIM TAB	
Cockpit Drum	
(upper cable)	Black
(lower cable)	Yellow
Elevator Drums	
(upper cable)	Black
(lower cable)	Yellow
AILERONS	
Right Wing Drum	
(upper cable)	Red
(lower cable)	Blue
Left Wing Drum	
(upper cable)	Blue
(lower cable)	Red
AILERON TRIM TAB (Left Wing Only)	
Wing Drum	
(upper cable)	Blue
(lower cable)	Red
RUDDER	
Rudder Pedal	
(left cable)	White
(right cable)	Green
Rudder Horn	
(left cable)	White
(right cable)	Green
RUDDER TRIM TAB	
Cockpit Drum	
(outboard cable)	White
(inboard cable)	Green
TAIL WHEEL	
Wheel Horn	
(left cable)	White
(right cable)	Green

(iii) Control Cable Tensions.—

Cable adjustments should not be made with the airplane in the direct sun if any other location is available. The air temperature around the airplane should be 21°C. ± 3°C. (70°F. ± 5°F.), if possible, because the aluminium alloy fuselage and the tinned steel cables do not expand and contract proportionately.

2. CONTROL STICK AND SURFACE CONTROL LOCK.

(a) CONTROL STICK:—

The control stick is a swaged tube of aluminium alloy, the upper end of which is fitted with a plastic pistol-type grip. The lower end of the tube is fitted into a socket which is mounted in a trunnion-like manner on a fitting integral with the aileron torque tube. The aileron torque tube has stops to limit the movement of the ailerons. (See Figure 301.)

(b) SURFACE CONTROL LOCK:—

The surface control locking mechanism is installed forward of the base of the control column. (See Figure 301.) The lock is an inverted V-shaped bracket, slotted at the top and fitted

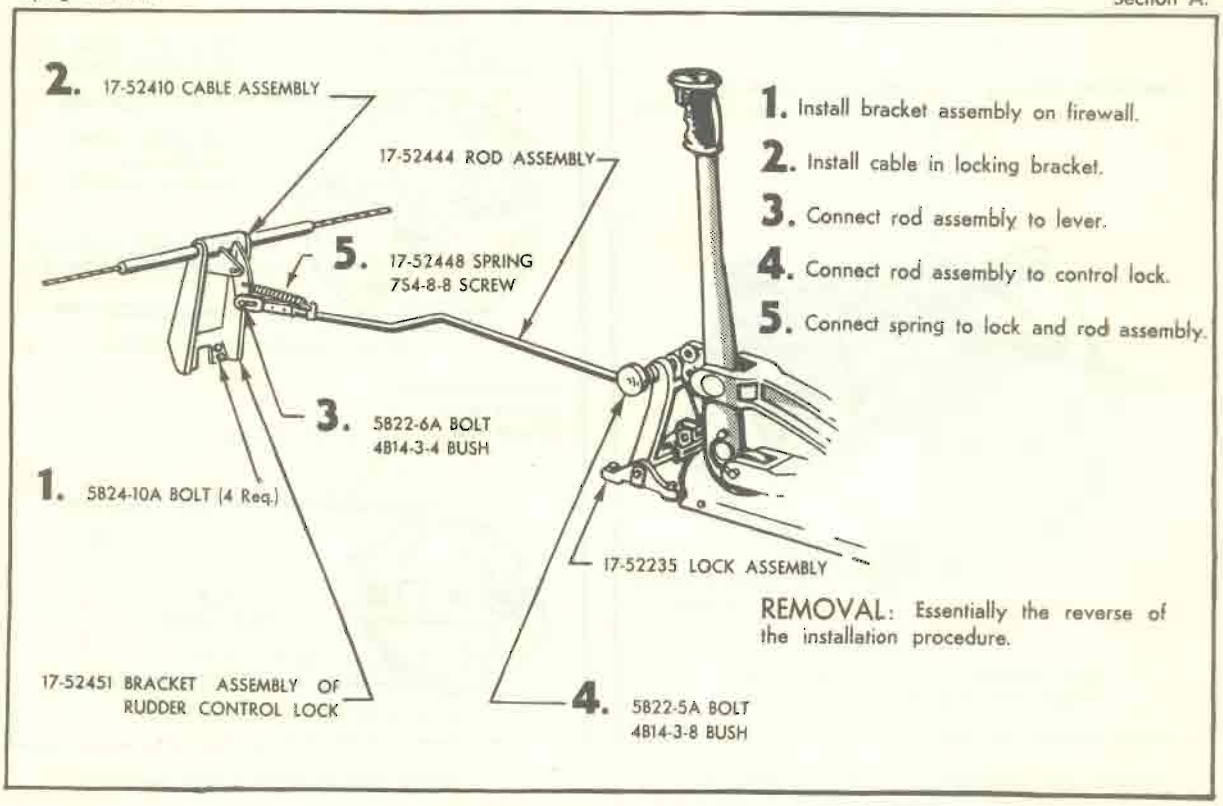


FIGURE 302–RUDDER LOCKING MECHANISM

with a spring-loaded plunger which will engage either of two holes in the locking flange on the control stick. Engaging the lock in the upper hole locks the ailerons and rudder in the neutral position and the elevators in the down position. Engaging the plunger in the lower hole locks all the control surfaces in the neutral position.

NOTE.

The position of the control stick also controls the tail wheel lock.

(c) **INSTALLATION, REMOVAL, AND ADJUSTMENT OF CONTROL STICK AND SURFACE CONTROL LOCK ASSEMBLY.** (See Figures 301 and 302.)

3. AILERON CONTROL SYSTEM.

(a) **DESCRIPTION:—**

The movement of the ailerons is controlled by the lateral movement of the stick. The ailerons are not differentially controlled. Movement of the control stick simultaneously imparts movement to both ailerons from a V-shaped bellcrank on the aft end of the control stick torque tube. Linkage attaches the aileron bellcrank to the inboard cable sectors, fastened to the rear spar, and by means of cable imparts the movement of the control stick to the outboard cable sectors. (See Figure 304.) The outboard sectors impart the movement to a fork and block assembly integral with the aileron. (See Figure 306, Detail A.) The aileron bellcrank has three link attachment holes on each arm. By attaching the link at the desired hole, aileron travel of 10, 12, or 15 degrees up and down can be obtained. Aileron travel is limited by adjustment bolts located at the base of the control stick. Access to the aileron cables is gained by removing the aft wing-to-fuselage fairing and disconnecting the flap actuating linkage.

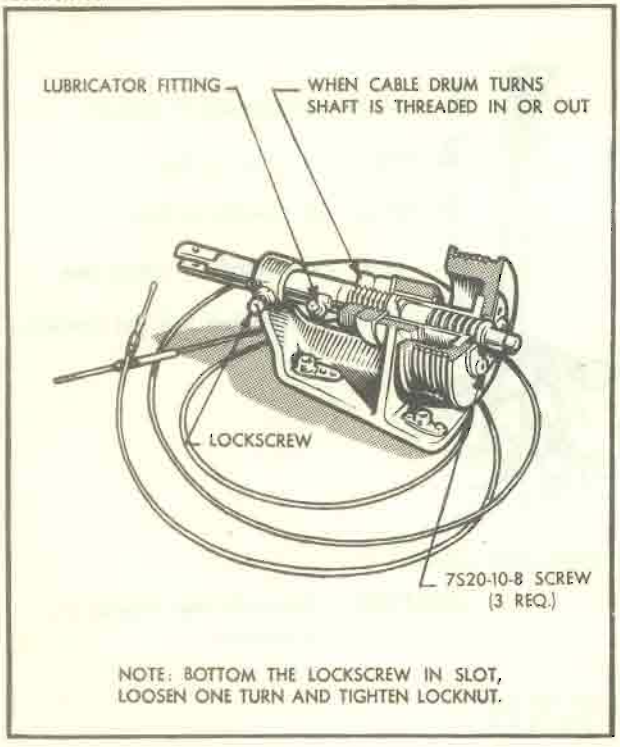


FIGURE 303–AILERON TRIM TAB MECHANISM

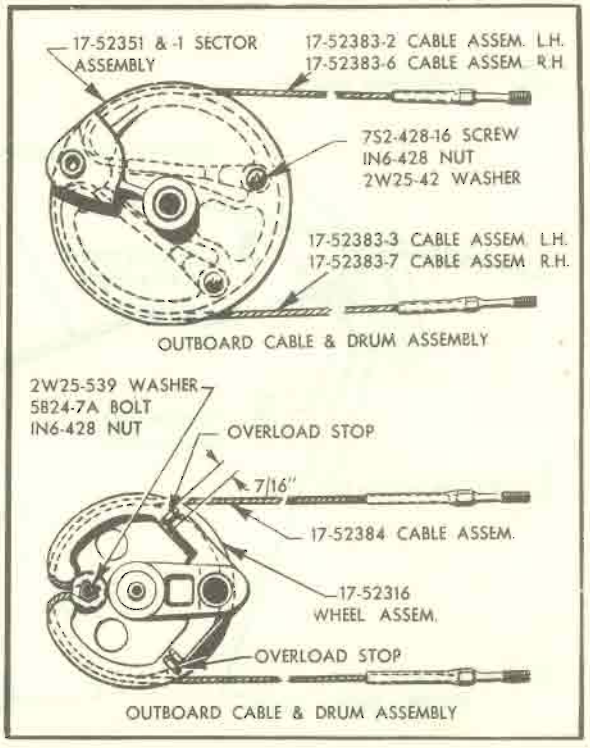


FIGURE 304–AILERON CABLE SECTORS

(b) **INSTALLATION, REMOVAL, AND ADJUSTMENT OF THE AILERON CONTROL SYSTEM.** (See Figure 306.)

(c) **CHECKING AILERONS FOR WARP.** (See Figure 305.)

4. AILERON TRIM TAB CONTROL SYSTEM.

(a) **DESCRIPTION:—**

The trim tab on the right aileron is a fixed tab and adjustable on the ground only. The trim tab on the left aileron is controllable from the cockpit. The aileron trim tab control knob on the control pedestal is connected to the inboard cable drum by a chain. Cables from the inboard cable drum extend to the outboard cable drum which is mounted in a housing secured to the rear spar of the wing at the inboard end of the aileron. The tab is limited to a travel of 10 degrees up and down from neutral by cable stops just inboard of the aileron. To gain access to the cables, remove the wing trailing edge to fuselage fairing, disconnect the flap hinge link to lower the flap, and remove the aileron.

(b) **INSTALLATION, REMOVAL, AND ADJUSTMENT OF AILERON TRIM TAB CONTROL SYSTEM.** (See Figure 307.)

(c) **ADJUSTING FIXED TAB LINKAGE ON RIGHT-HAND AILERON.**

(i) Engage the surface control lock.

(ii) Adjust the link which secures the tab in neutral so that the tab is in direct alignment with the aileron trailing edge.

5. AILERON TRIM TAB ACTUATING MECHANISM.

The aileron trim tab actuating mechanism consists of a housing bolted to the wing trailing edge structure, a cable drum assembly, and actuating shaft. The actuating shaft engages the threads in the cable drum. When the cable drum is rotated, the actuating shaft is threaded either fore or aft, as the actuating shaft is prevented from turning by a setscrew in the aft end of the housing. The fore-and-aft movement of the actuating shaft moves the tab up or down through an adjustable link. (See Figure 303.)

6. ELEVATOR CONTROL SYSTEM.

(a) DESCRIPTION:—

The elevators are controlled by the fore-and-aft movement of the control stick. A push-pull rod connects the control stick to the elevator bellcrank mounted on the flap torque tube. (See Figure 308.) A dual set of cables extends aft from the bellcrank to the elevator horn assembly which is pivoted on a bracket in the horizontal stabilizer. An elevator bob-weight of approximately 20 pounds is fastened to the upper arm of the elevator bellcrank.

Elevator travel is limited to 30 degrees up and 20 degrees down by adjustment bolts on the base of the control stick and surface control lock. (See Figure 301.) To gain access to the elevator cables, remove the Dzus-fastened dome at the aft end of the radiator air scoop, and the fairing attached to the dorsal fin, the horizontal stabilizer, and the vertical stabilizer, also remove the access door below the horizontal stabilizer and the wing trailing edge to fuselage fairing.

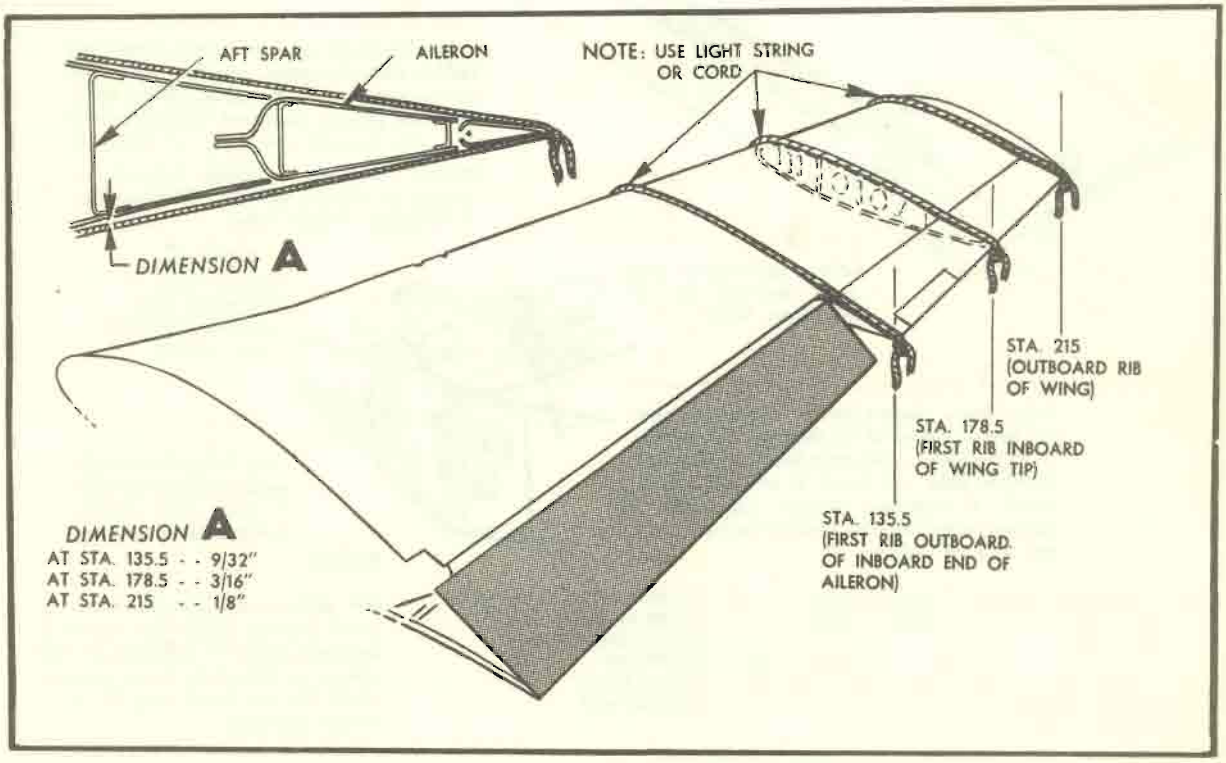


FIGURE 305—CHECKING AILERON FOR WARP

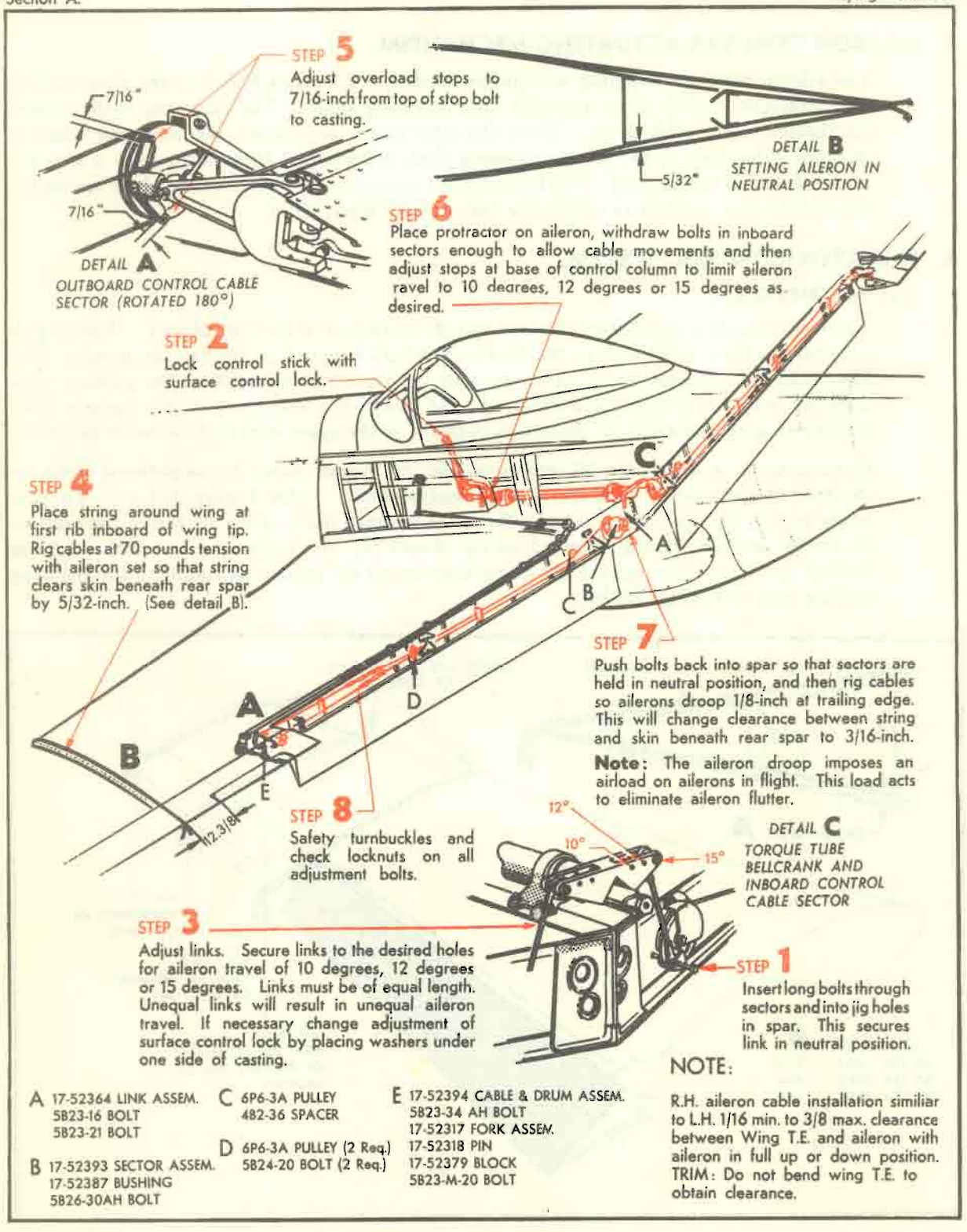


FIGURE 306—AILERON CONTROL SYSTEM

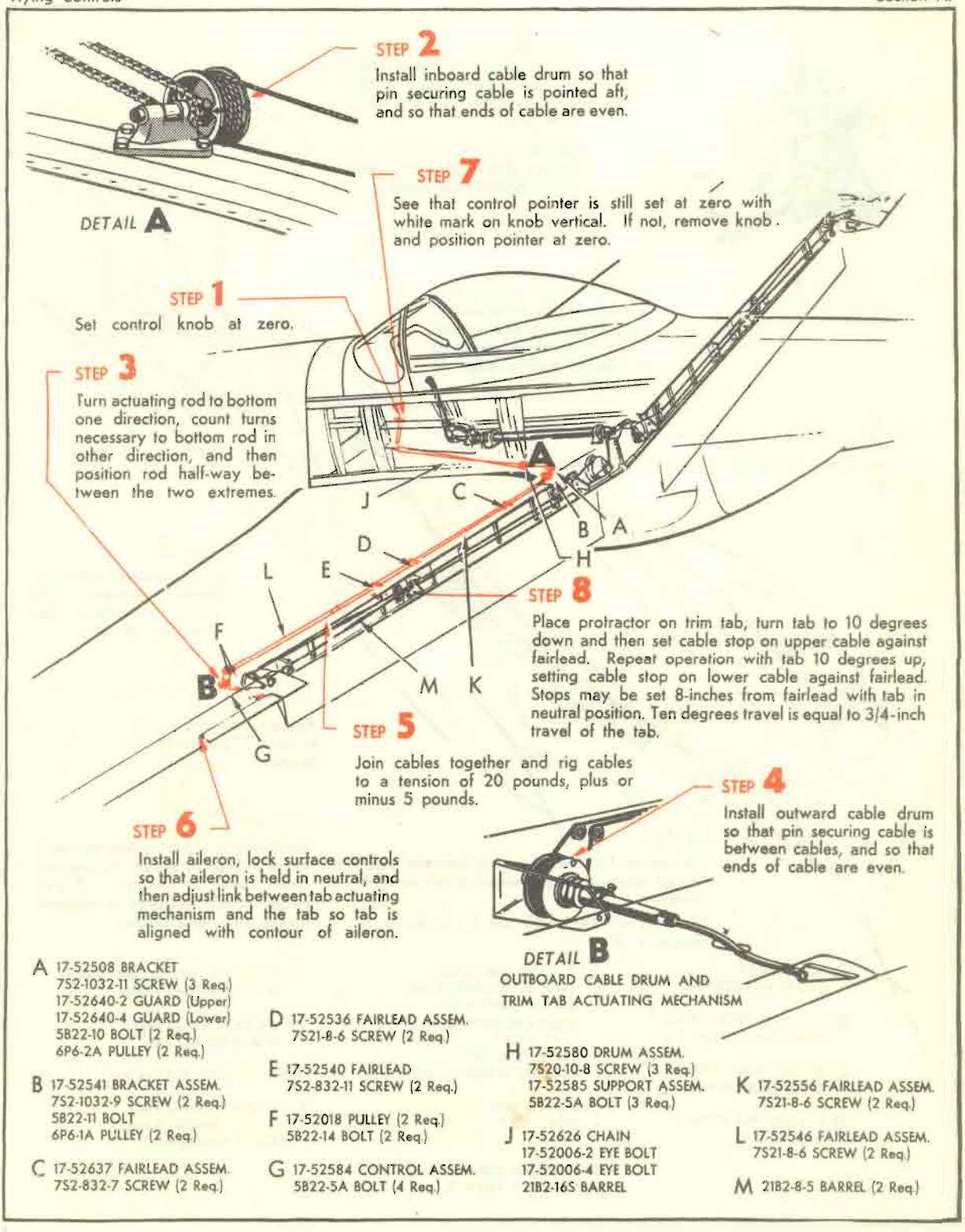


FIGURE 307—AILERON TRIM TAB CONTROL SYSTEM

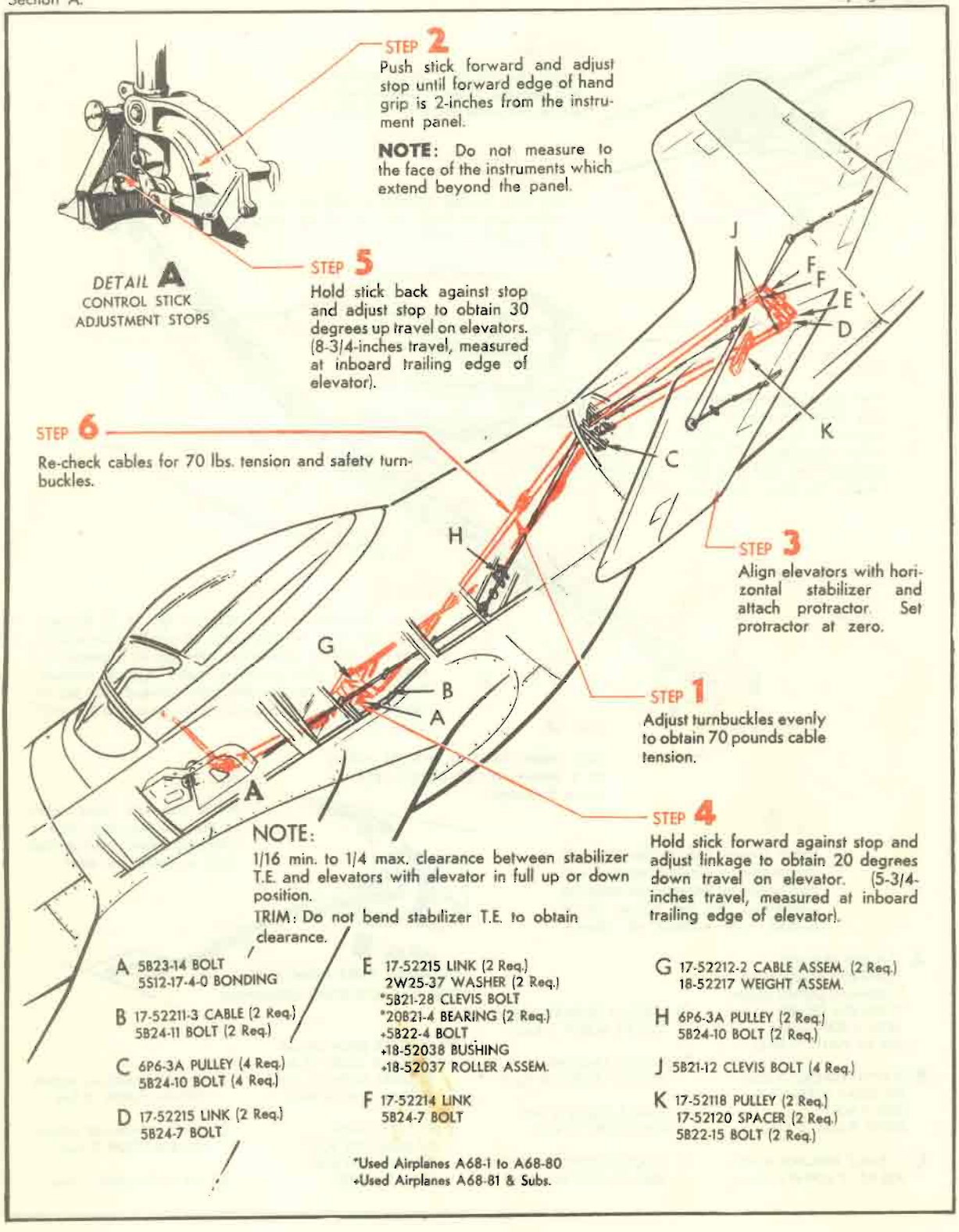


FIGURE 308—ELEVATOR CONTROL SYSTEM

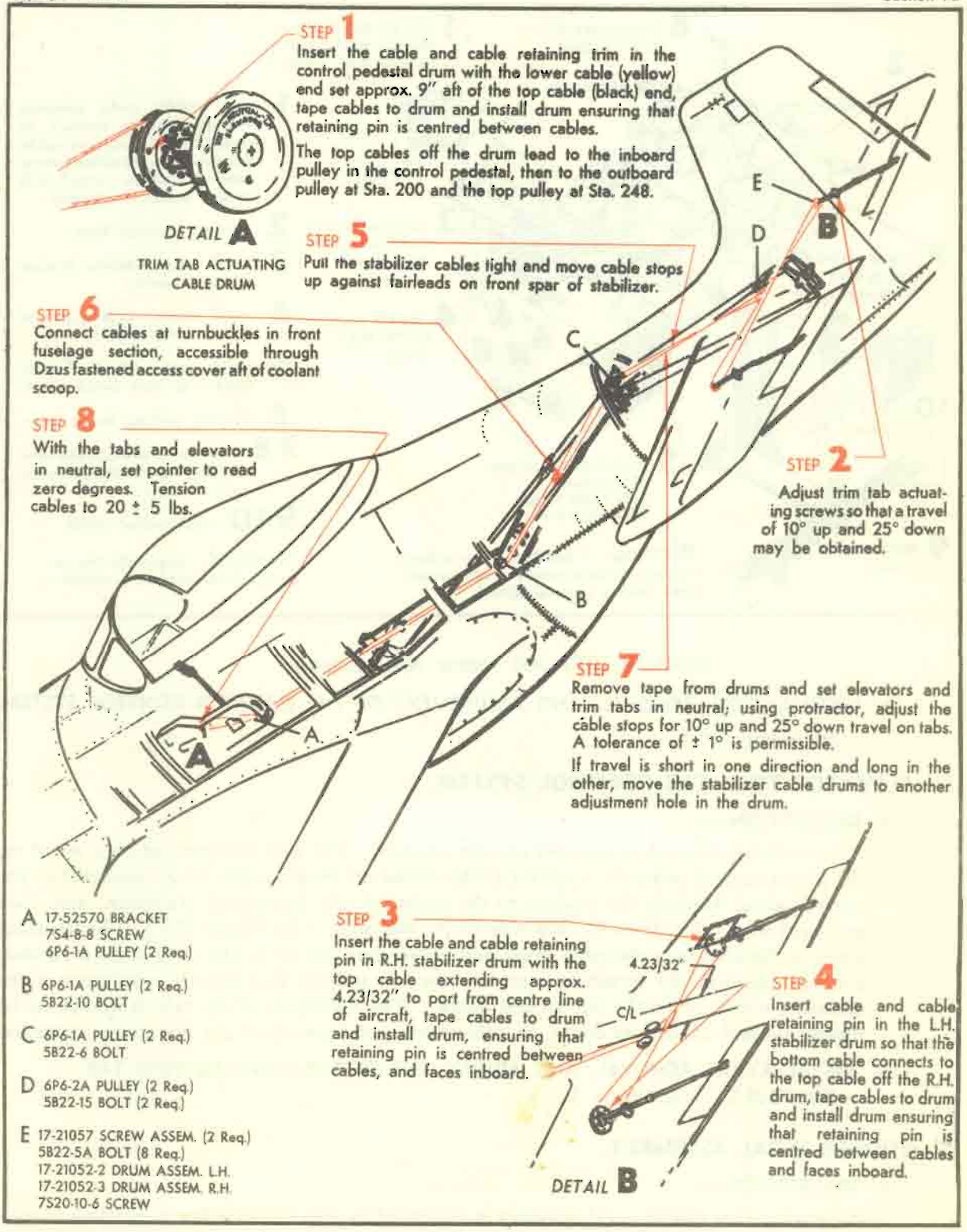


FIGURE 309—ELEVATOR TRIM TAB CONTROL SYSTEM

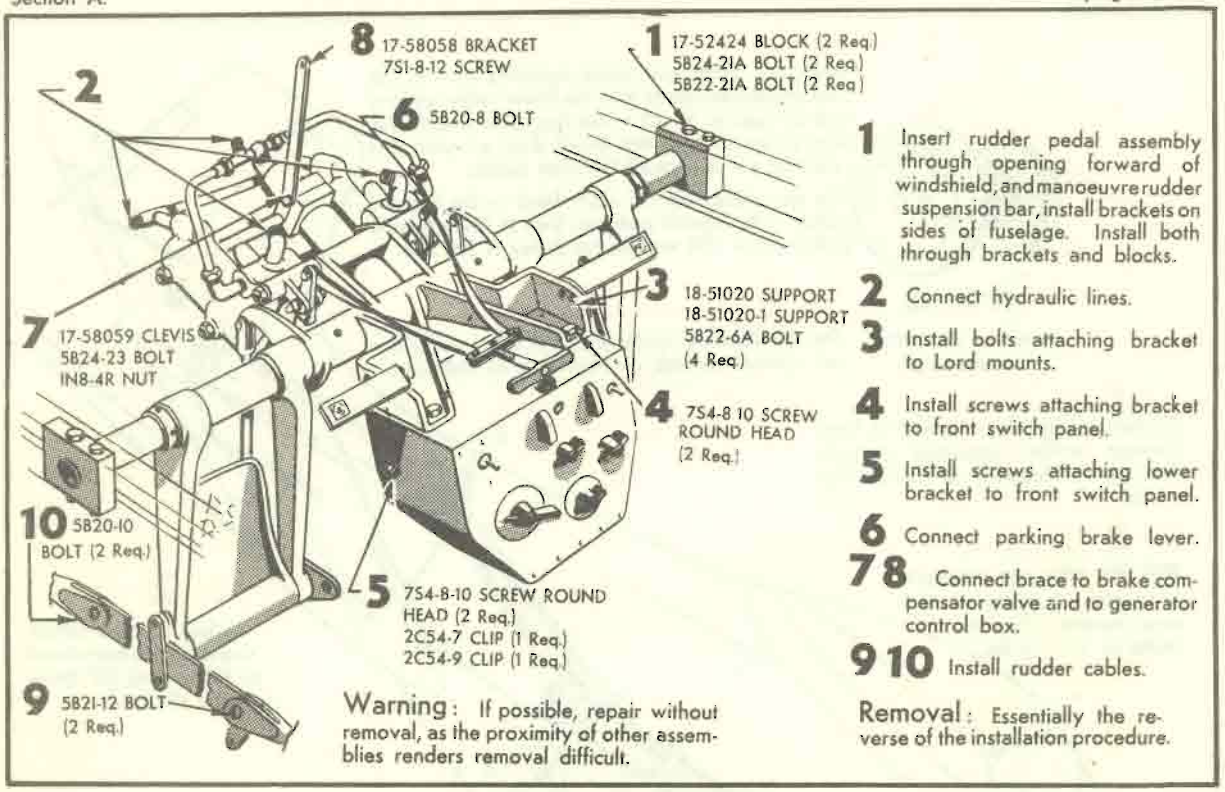


FIGURE 310–INSTALLING RUDDER PEDAL ASSEMBLY

(b) **INSTALLATION, REMOVAL, AND ADJUSTMENT OF THE ELEVATOR CONTROL SYSTEM.** (See Figure 308.)

7. ELEVATOR TRIM TAB CONTROL SYSTEM.

(a) **DESCRIPTION:—**

A controllable trim tab is installed on each elevator. The tabs are operated by a wheel on the pilot's control pedestal. Control cables extend aft from a cable drum connected to the control wheel, through the fuselage to the centre of the horizontal stabilizer, and then outboard to a cable drum in each side of the stabilizer. (See Figure 309.) The actuating screw is threaded into the cable drum and moves fore and aft as the cable drum is rotated. Linkage connects the actuating screw to the tab and the fore-and-aft movement of the actuating screw moves the tab up and down. The movement of the tabs is limited to 10 degrees up and 25 degrees down, by cable stops just forward of the horizontal stabilizer.

(b) **INSTALLATION, REMOVAL, AND ADJUSTMENT OF THE ELEVATOR TRIM TAB CONTROLS.** (See Figure 309.)

8. RUDDER PEDAL ASSEMBLY.

(a) **DESCRIPTION:—**

A hanging-type rudder pedal assembly is suspended by two blocks bolted to brackets on each side of the fuselage. The pedals are adjustable for leg length by means of a spring-loaded release on the inboard side of each pedal.

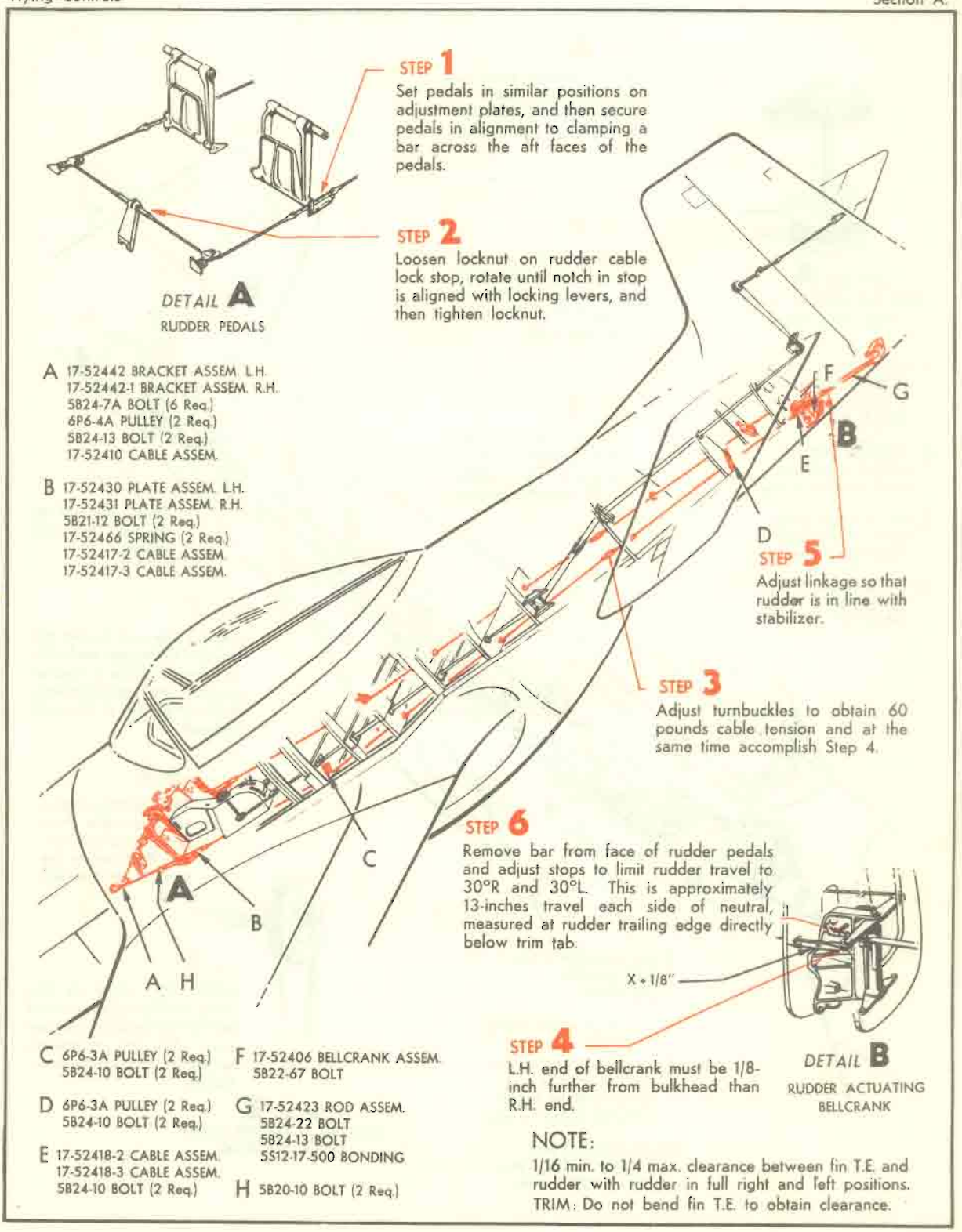


FIGURE 311—RUDDER CONTROL SYSTEM

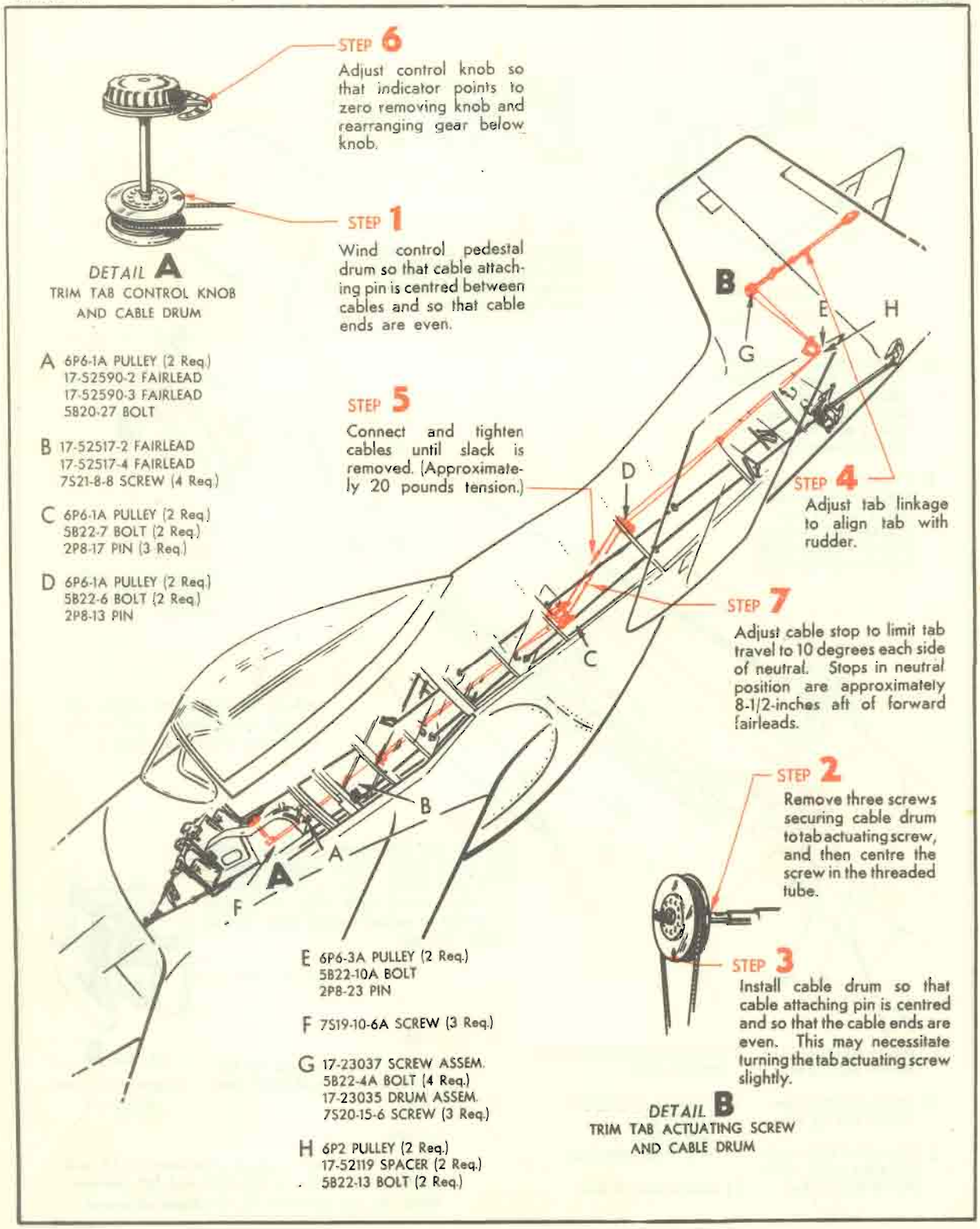
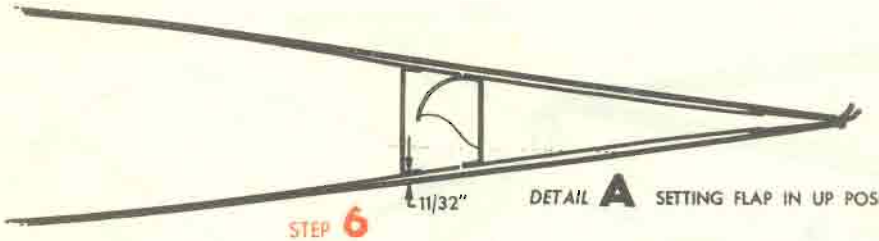


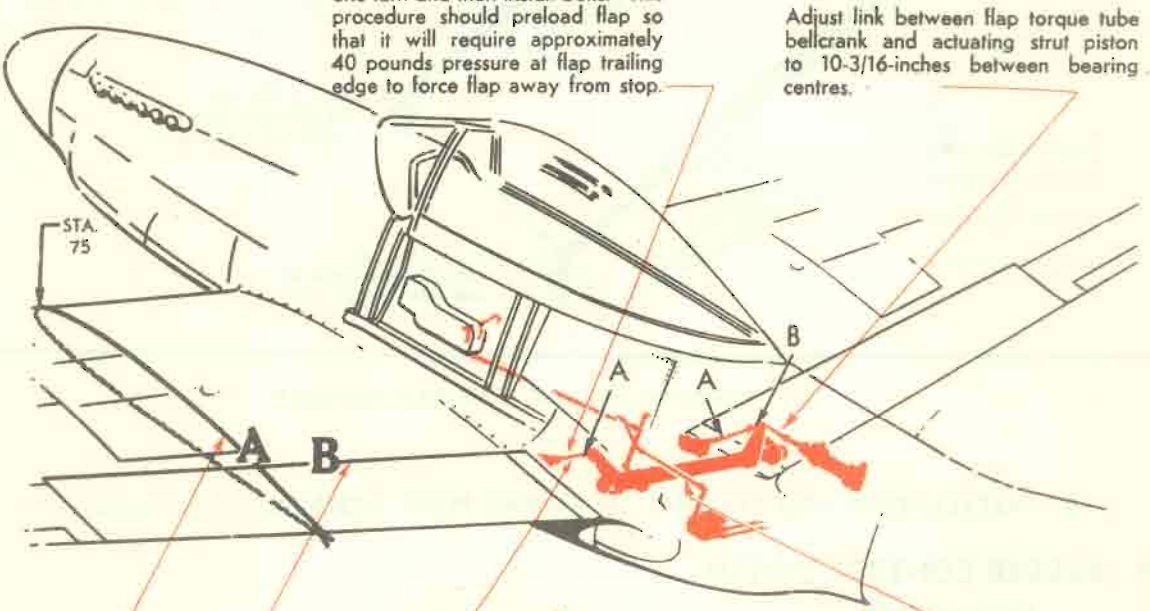
FIGURE 312—RUDDER TRIM TAB CONTROL SYSTEM



DETAIL A SETTING FLAP IN UP POSITION

STEP 6
With flap control handle set at zero and hydraulic pressure on the system, adjust link between flap and torque tube so that bolts fit without binding. Shorten link approximately one turn and then install bolts. This procedure should preload flap so that it will require approximately 40 pounds pressure at flap trailing edge to force flap away from stop.

STEP 4
Adjust link between flap torque tube bellcrank and actuating strut piston to 10-3/16-inches between bearing centres.

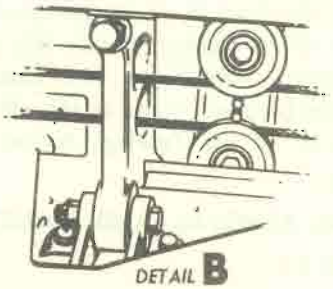


STEP 1
With flaps completely installed, disconnect link between flap and torque tube.

STEP 5
Adjust selector valve linkage so that actuating strut piston will bottom in the retracted position when the control handle is set at zero and the selector valve is in neutral position.

STEP 3
When the flap is in up position, there should be a clearance of 1/16-(±1/32) inch between trailing edge of wing and skin of flap.

STEP 2
Place string around wing at rib between gun bay and fuel tank bay. Raise the flap manually against the stop on flap centre hinge (detail B), and pull the string tight. Adjust the stop so that the string clears the skin beneath the rear spar by 11/32-inch. (See detail A.)



DETAIL B

A 17-52622 LINK ASSEM. (2 Req.)
5853-26 BOLT (2 Req.)
5823-20 BOLT (2 Req.)

B 17-52618 LINK ASSEM.
5821-21 BOLT
5821-19 BOLT

WING FLAP ADJUSTMENT STOP

FIGURE 313—FLAP CONTROL SYSTEM

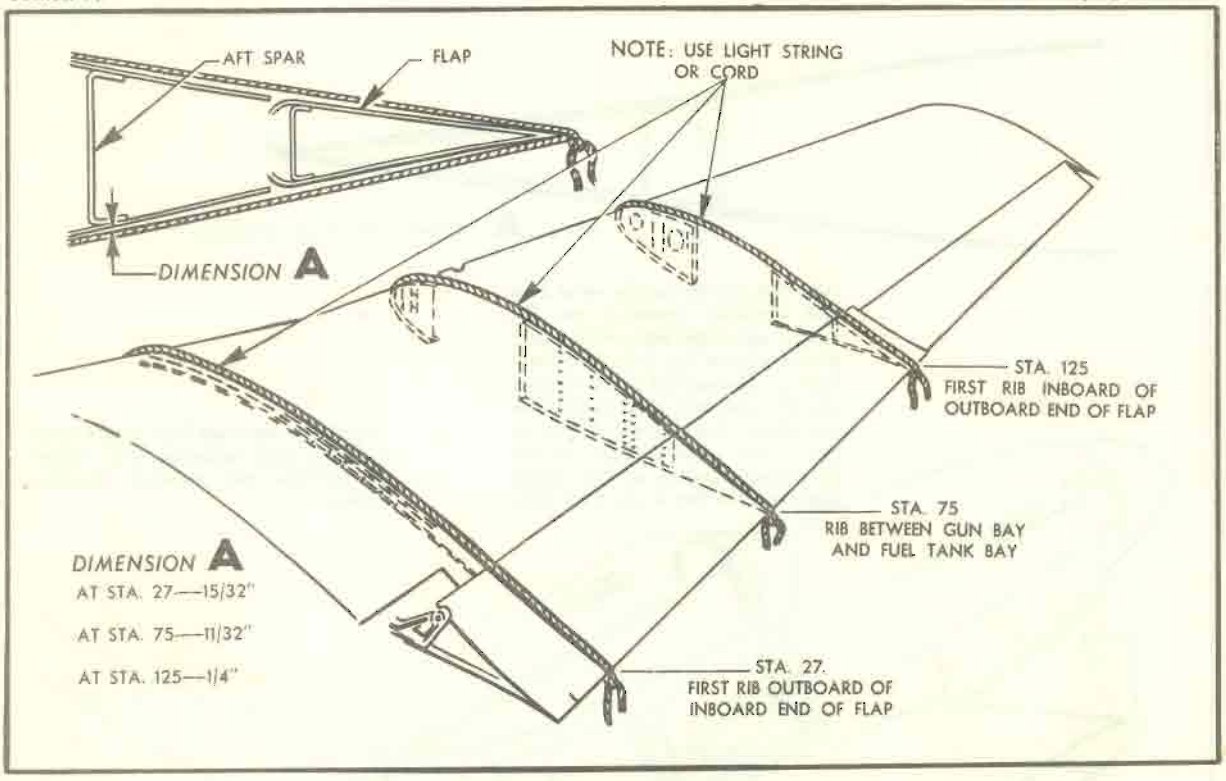


FIGURE 314—CHECKING WING FLAPS FOR WARP

(b) INSTALLATION AND REMOVAL OF RUDDER PEDAL ASSEMBLY. (See Figure 310.)

9. RUDDER CONTROL SYSTEM.

(a) DESCRIPTION:—

The rudder control cables extend aft from each pedal to a bellcrank in the aft end of the fuselage. (See Figure 311.) A rudder pedal-balance cable, extending forward from one pedal, across the fuselage, and then aft to the other pedal, maintains a constant tension forward on each pedal. A push-pull rod connects the rudder bellcrank to the rudder actuating horn; the horn is an integral part of the rudder lower hinge casting. Rudder travel is limited to 30 degrees on each side of the neutral position by stops on the rudder bellcrank assembly. (See Figure 311, Detail B.) To gain access to the rudder cables, remove the Dzus-fastened dome at the aft end of the radiator air scoop, the access covers on the right side of the fuselage below the horizontal stabilizer, and the aft wing-to-fuselage fairing.

(b) INSTALLATION, REMOVAL, AND ADJUSTMENT OF THE RUDDER CABLE SYSTEM. (See Figure 311.)

10. RUDDER TRIM TAB CONTROL SYSTEM.

(a) DESCRIPTION:—

A controllable trim tab is installed on the rudder. The trim tab is operated by a control

knob on the pilot's control pedestal. Reverse boost is imparted to the tab by the link rod. Control cables from the cable drum connected to the control knob extend aft through the fuselage to a point aft of the tail wheel installation, and then up to the cable drum in the vertical stabilizer. (See Figure 312.) The actuating mechanism is similar to that of the aileron tab. The tab is limited to an angular travel of 10 degrees each side of neutral by cable stops forward of the rear section bulkhead. To gain access to the rudder trim tab cables, remove the Dzus-fastened dome at the aft end of the radiator air scoop, remove access covers on left side of fuselage, remove access cover below the horizontal stabilizer, and remove the access cover on the left side of the vertical stabilizer.

(b) **INSTALLATION, REMOVAL, AND ADJUSTMENT OF RUDDER TRIM TAB SYSTEM.** (See Figure 312.)

11. WING FLAP CONTROL SYSTEM.

(a) **DESCRIPTION:—**

The wing flaps are operated by an hydraulically actuated strut located on the right-hand side of the fuselage above the radiator air scoop. The strut piston is connected to a bellcrank integral with the flap torque tube, and the torque tube is connected to the flap hinge casting by a short adjustable link. (See Figure 313.) The flaps have a movement of 47 degrees down from the neutral position, and are selectively controlled by a control handle on the aft end of the control pedestal. The sector of the control handle is slotted in the positions which indicate each 10 degrees of flap movement. The control handle may be placed in any one of the slotted positions and hydraulic pressure will move the flap to the indicated angular position.

(b) **INSTALLATION, REMOVAL, AND ADJUSTMENT OF THE WING FLAP SYSTEM.** (See Figure 313.)

The adjustment procedure for the flap preselector linkage is given in Chapter 7, Section A, Paragraph 6.

(c) **CHECKING FLAPS FOR WARP.** (See Figure 314.)

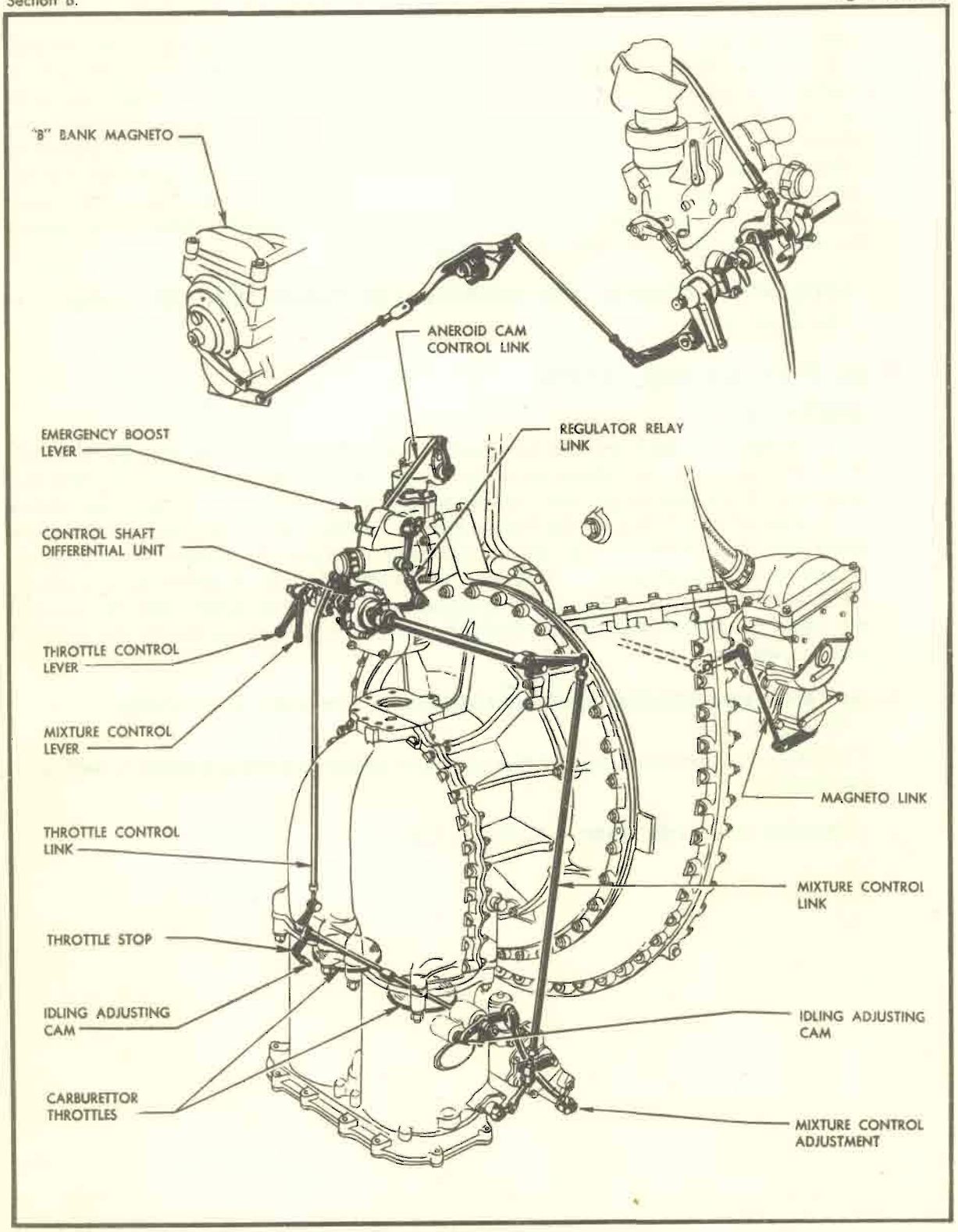


FIGURE 315–ENGINE CONTROL SHAFT LINKAGE
(Packard Merlin)

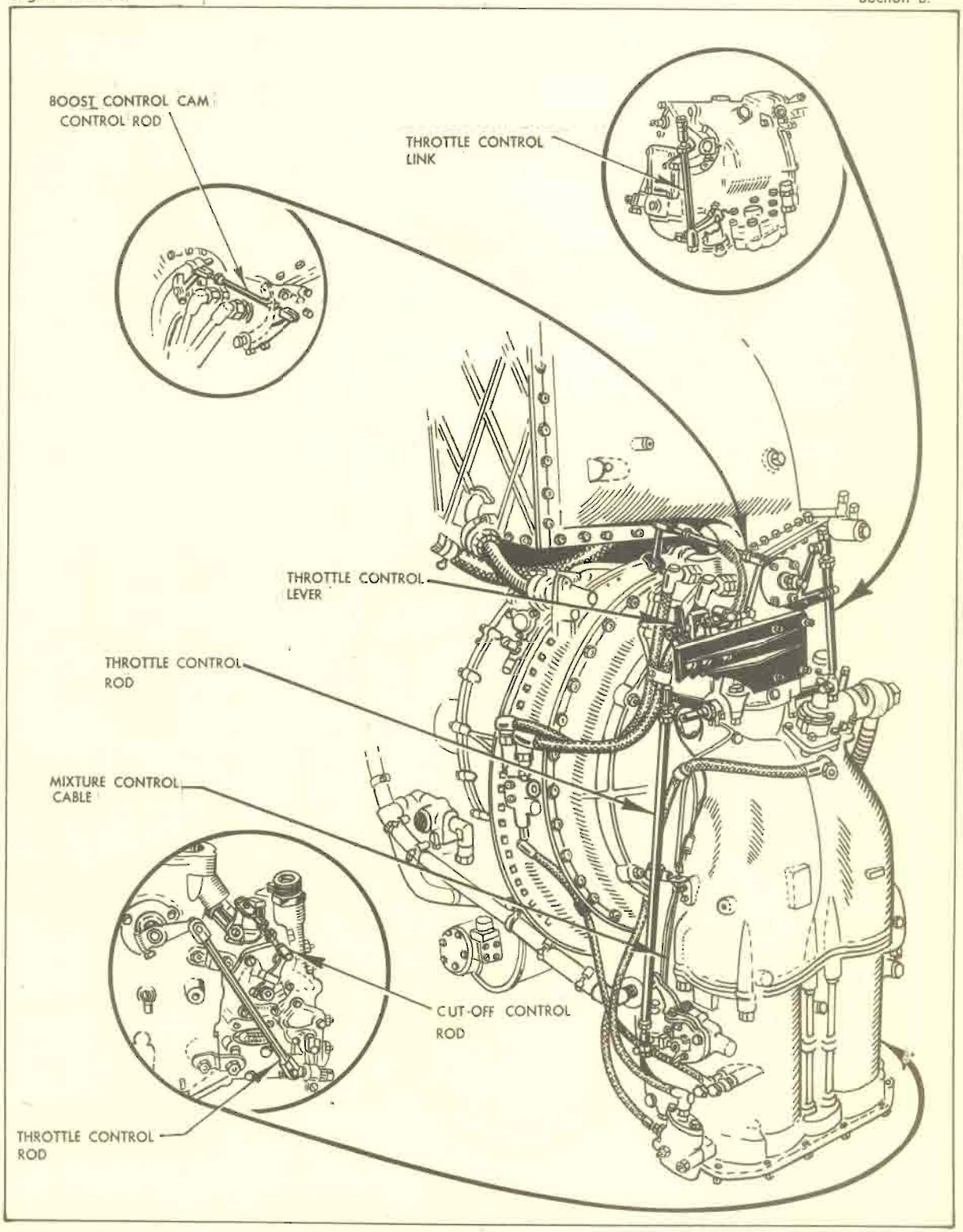


FIGURE 315 A—ENGINE CONTROL SHAFT LINKAGE
ROLLS-ROYCE MERLIN 70

Section B – ENGINE CONTROLS

1. GENERAL DESCRIPTION.

The engine is controlled by the cockpit control quadrant levers which are interconnected by rods, flexible cables, and bellcranks to their corresponding units. The control quadrant is equipped with two friction locks, one for the throttle and one for the propeller and mixture controls. A control shaft (Figure 315), mounted on the rear supercharger casing, serves as an intermediate connection between the cockpit control quadrant and the linkage to the magnetos, carburettor, and manifold pressure (boost) regulator. A differential unit, incorporated in the control shaft, permits the manifold pressure regulator to operate the carburettor throttle independently of the cockpit throttle control for variations corresponding to changes in altitude or engine speeds, and to obtain war emergency rating. Linkage on the control shaft connecting the throttle with the magnetos advances or retards the ignition timing as the throttle is opened or closed. The supercharger clutch control is automatic and operates electrically.

2. REMOVING AND INSTALLING.

When removing the engine control rods and bellcranks, tag or mark each part to establish its location in the airplane. This will save considerable time when the control rods are reinstalled. To replace broken control quadrant discs or spring, refer to Figure 316 for the correct order of assembly. The control quadrant may be removed or installed as a unit. When assembling control quadrant, coat the levers, discs and spacers with a thin film of grease. When the quadrant is assembled and secured to the upper longeron, connect, throttle, mixture, and propeller controls, making certain the controls have full travel and do not bind. Before making a final adjustment of the control system, check to determine that control quadrant, control arms, and bellcrank have full travel without binding. Rig control rods so that they assume a 90-degree position to the bellcranks and arms. This will set the system in the neutral or half-way position, which will give maximum travel obtainable when the controls are operated. The control rods may then be adjusted from this point to meet any particular adjustment for the various systems. After the adjustment is accomplished, install the quadrant name plate.

3. THROTTLE CONTROL.

(a) DESCRIPTION:—

The throttle control lever is connected to a control shaft built integral with the engine. (See Figure 317.) A throttle stop assembly on the upper longeron allows full travel of the throttle control lever to obtain 67 in. Hg. manifold pressure. A throttle gate on the longeron stops the lever at the 61 in. Hg. manifold pressure position. A safety wire is installed across the gate at this position and as the gate is passed to obtain the war emergency rating (67 in. Hg. manifold pressure), the wire will be broken, indicating that 61 in. Hg. manifold pressure has been exceeded
(54 in. Hg. for R-R. Merlin, 61 in. Hg. for Packard Merlin)

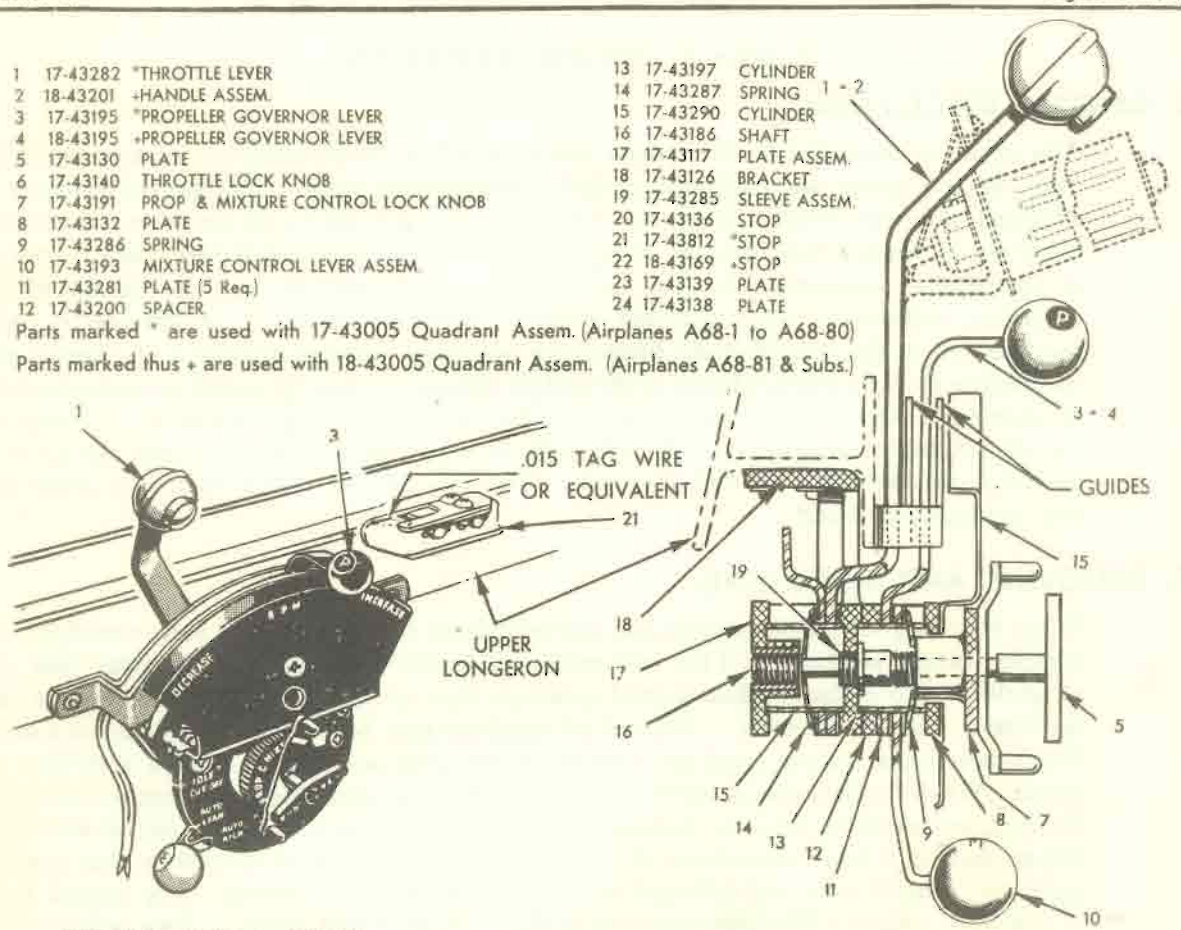
(b) ADJUSTMENT:—

(i) Loosen screws holding throttle lever stop.

(ii) Move throttle lever toward the full closed position, allow 1/16 to ¼-inch between throttle lever and guide on longeron for spring-back, and then lock in this position.

1	17-43282	*THROTTLE LEVER
2	18-43201	+HANDLE ASSEM.
3	17-43195	*PROPELLER GOVERNOR LEVER
4	18-43195	+PROPELLER GOVERNOR LEVER
5	17-43130	PLATE
6	17-43140	THROTTLE LOCK KNOB
7	17-43191	PROP & MIXTURE CONTROL LOCK KNOB
8	17-43132	PLATE
9	17-43286	SPRING
10	17-43193	MIXTURE CONTROL LEVER ASSEM.
11	17-43281	PLATE (5 Req.)
12	17-43200	SPACER
13	17-43197	CYLINDER
14	17-43287	SPRING
15	17-43290	CYLINDER
16	17-43186	SHAFT
17	17-43117	PLATE ASSEM.
18	17-43126	BRACKET
19	17-43285	SLEEVE ASSEM.
20	17-43136	STOP
21	17-43812	*STOP
22	18-43169	+STOP
23	17-43139	PLATE
24	17-43138	PLATE

Parts marked * are used with 17-43005 Quadrant Assem. (Airplanes A68-1 to A68-80)
Parts marked thus + are used with 18-43005 Quadrant Assem. (Airplanes A68-81 & Subs.)



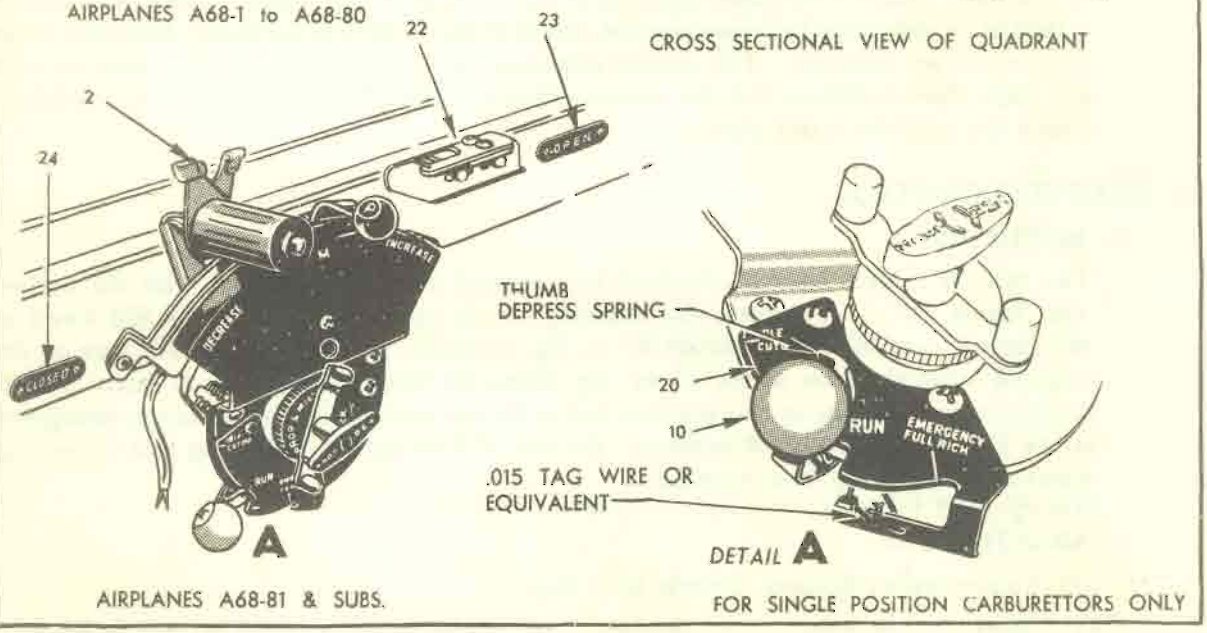


FIGURE 316–ENGINE CONTROL QUADRANT

(iii) Set carburettor throttle arm against the closed position stop.

(iv) Adjust the throttle control rod until it can be attached to the engine control shaft throttle arm without moving the arm of the throttle lever from its previous position.

(v) Loosen lock and operate throttle lever. Make any adjustment required to obtain a spring-back of 1/16 to ¼-inch at fully closed position end of travel, by shortening or lengthening the throttle rod between the firewall and the engine control shaft. If still further adjustment is required, adjust the length of the rod between the throttle lever in the cockpit and the firewall.

(vi) Operate controls several times to make sure the rods do not bind at any point of their travel.

(vii) Tighten all nuts and bolts on the rods, and safety with cotter pins where cotter pin holes are provided. Move throttle lever to full open position: then check that full throw has been obtained at carburettor.

(viii) Start engine and advance throttle lever until 61 in. Hg. manifold pressure at 3,000 r.p.m. is obtained. (54 in. Hg. for RR Merlin, 61 in. Hg. for Packard Merlin)

CAUTION

Do not start engine until it is known that all other controls and carburettor settings are correctly set and adjusted.

(ix) Set throttle assembly stop so that its shoulder is against the throttle lever; then tighten screws locking the stop to the longeron. Stop the engine.

(x) Loosen the screws holding the sliding upper plate of the stop. Deflect throttle lever inboard past the stop shoulder, and move lever into the U-shaped slot of the stop until full travel of the throttle lever is reached.

(xi) Move the upper plate of the stop against the throttle lever, then tighten screws locking the plate to the main body of the stop.

(xii) Move the throttle back, out of the stop slot. Install .015 tag wire (or equivalent) across the slot of the stop, using the holes at the entrance to the slot.

4. EMERGENCY BOOST CONTROL.

(a) DESCRIPTION:—

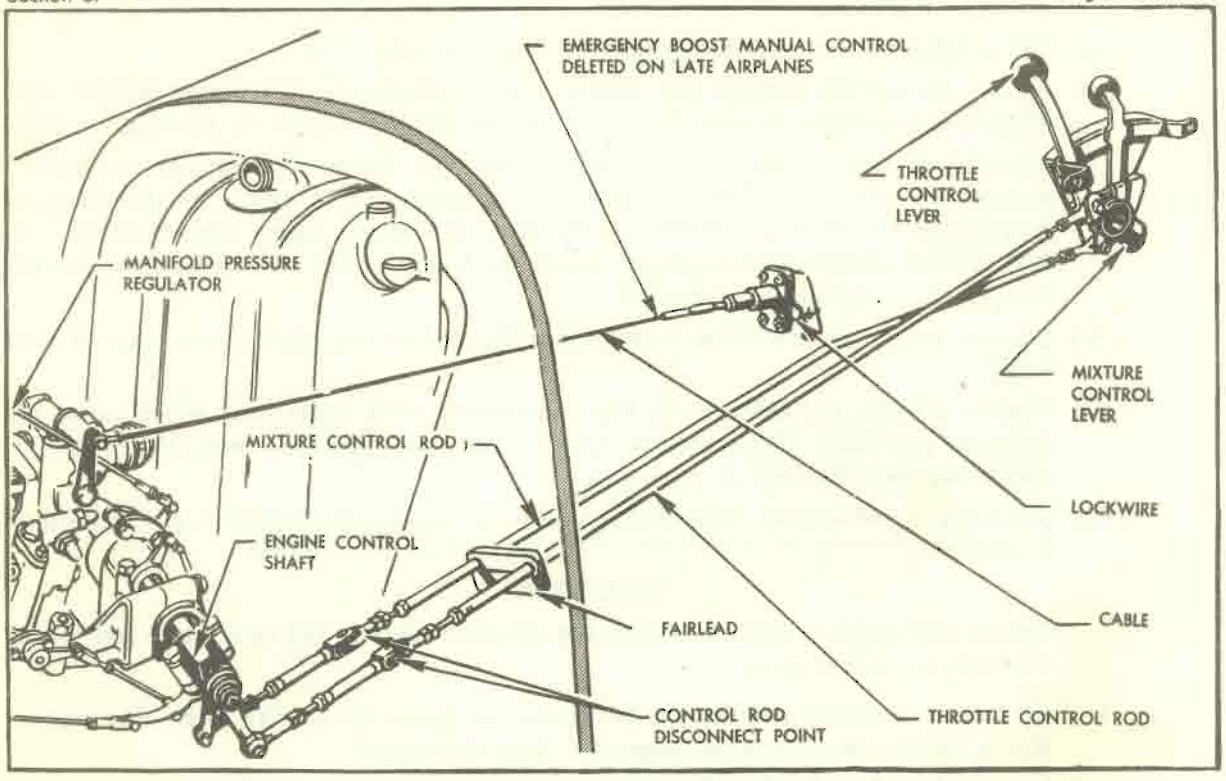
A lock-wired control handle on the left corner of the pilot's instrument panel is connected by a flexible cable to the emergency boost lever on the automatic manifold pressure regulator. (See Figure 317.) This control is used to obtain war emergency rating from the engine. Ground crews should check this control following each flight to make certain that the lock-wire on the handle remains unbroken. If the lockwire is broken, a special inspection of the engine should be made.

(b) ADJUSTING EMERGENCY BOOST CONTROL:—

(i) Thread cable through firewall and fairleads, and attach to control handle on the instrument panel.

(ii) Wind cable in or out of the control handle until the clevis end of the cable can just be connected to the control arm on the engine with the cable taut.

(iii) Pull control handle up until its narrow flat side is against the instrument panel; then



PACKARD-MERLIN FIGURE 317–THROTTLE MIXTURE AND BOOST CONTROLS

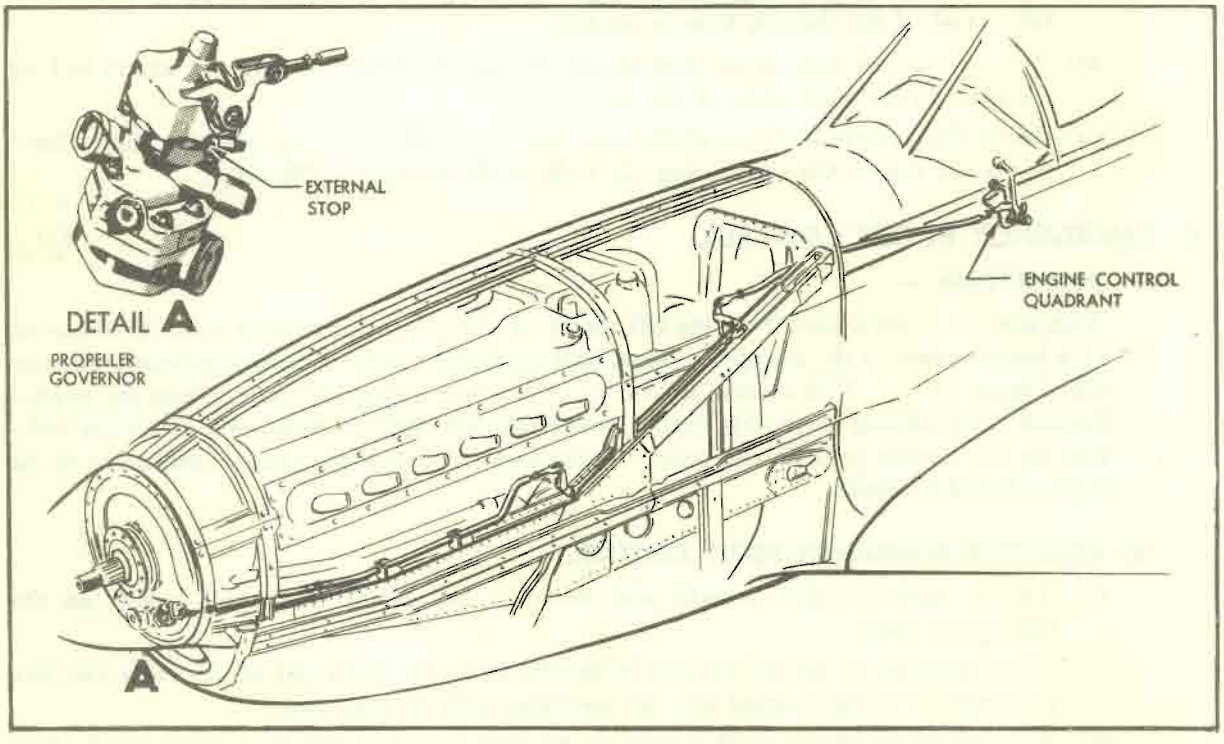


FIGURE 318–PROPELLER GOVERNOR CONTROL SYSTEM

check the control arm on the engine to determine that the control is fully back against the internal stop or not over 3 degrees off the stop. Move handle to its normal position.

(iv) After adjustment, check the cable end to make sure that not less than five threads are screwed into the control handle.

(v) Tighten locknut on cable, and safety clevis pin on boost control arm. Safety the control handle to the instrument panel with .015 tag wire (or equivalent).

5. MIXTURE CONTROL.

on Aircraft A68-121 to 186 the mixture control has only two positions: "IDLE CUT OFF" and "RUN"

(a) DESCRIPTION:—

The pilot's mixture control lever is also connected to a lever on the engine control shaft, which is in turn connected to the carburettor. (See Figures 315, 316, 317.) On some airplanes there are three mixture control positions: "AUTO RICH," "AUTO LEAN," and "IDLE CUT OFF." The "FULL RICH" position is blocked off by stops which prevent the control lever from going to its full forward position.

On other airplanes, which are equipped with the single-position carburettor, the mixture control has "IDLE CUT OFF," "RUN," and "EMERGENCY FULL RICH" positions. The lever is stopped in the "RUN" position by a stop incorporated on the control quadrant name plate. A lockwire across the stop slot prevents inadverdent movement of the lever into the "EMERGENCY FULL RICH" position. Under extreme emergency conditions, the pilot can move the lever into the "EMERGENCY RICH" position by depressing the thumb spring, moving the lever forward, and breaking the lockwire.

(b) ADJUSTING MIXTURE CONTROL:—

(i) Move the mixture control lever until it strikes the stop in the "RUN" position on single position carburettors ("AUTO RICH" position on standard carburettors), and lock control with friction lock.

(ii) Move control arm on the engine control shaft until it sets the mixture control on the carburettor in the "RUN" position or "AUTO RICH" position.

(iii) Connect control rod, protruding through the firewall, to the rod extending from the engine control shaft. Tighten bolts, but do not safety

(iv) Unlock and move control lever to determine the travel and spring-back. Spring-back should be from 1/16 to ¼-inch at the "IDLE CUT OFF" end of lever travel. This adjustment may be obtained by lengthening or shortening the rods between the firewall and the engine control shaft.

(v) Check to ensure that control lever moves the mixture control on the carburettor into the "EMERGENCY FULL RICH" position.

(vi) When the correct adjustment has been obtained, tighten all nuts and bolts on the rods, and safety with cotter pins where cotter pin holes are provided. On control quadrants equipped with name plate, install .015 tag wire across stop slot at the "RUN" position.

(vii) Operate the control several times to make sure there is no bind.

6. PROPELLER GOVERNOR CONTROL.

(a) DESCRIPTION:—

The propeller control lever is connected to the governor by a control rod extending along the left-hand beam of the engine mount. (See Figure 318.) There is no provision for feathering the propeller.

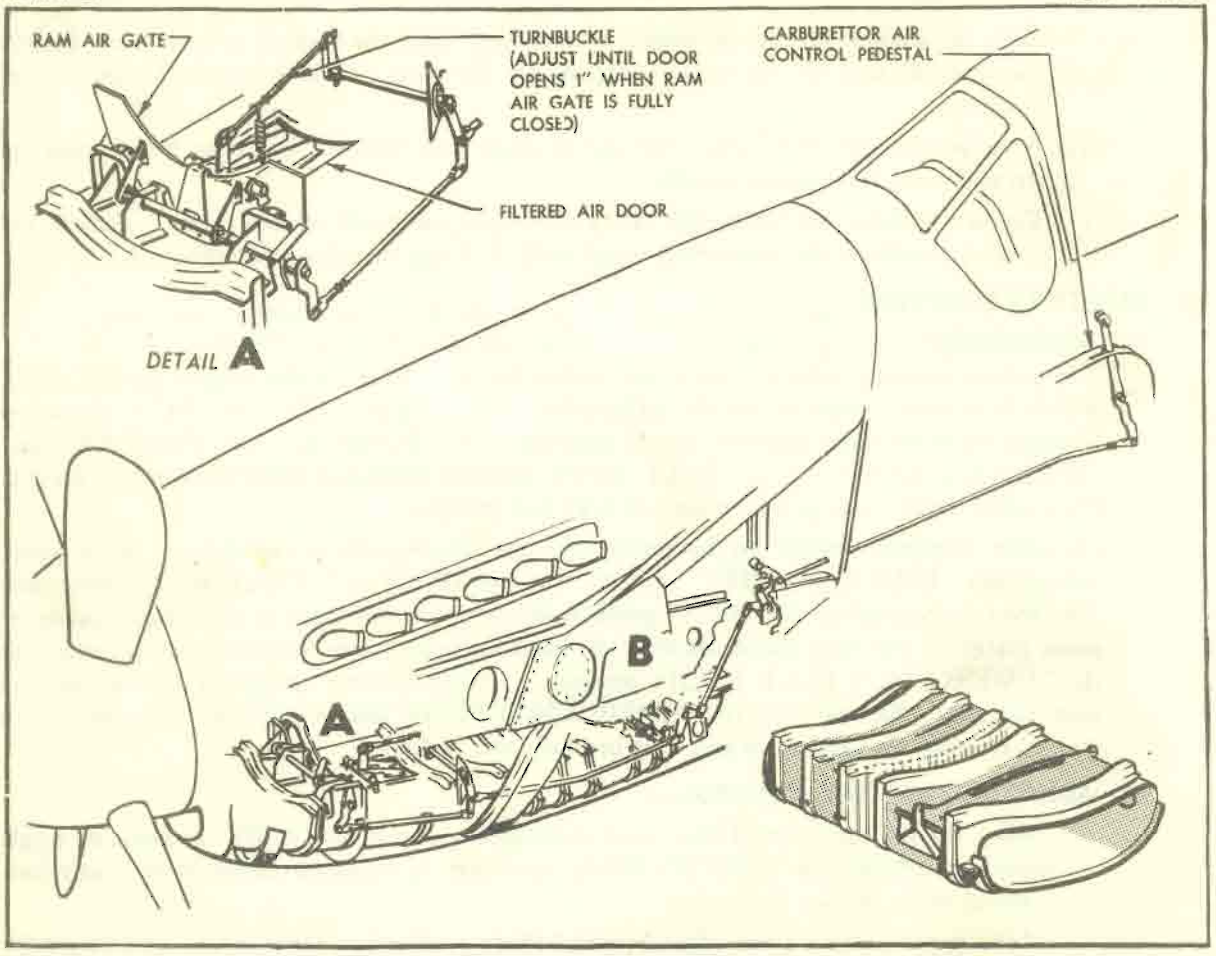


FIGURE 319—CARBURETTOR AIR CONTROL SYSTEM

(b) ADJUSTING PROPELLER GOVERNOR:—

(i) Move propeller governor control lever in cockpit to the full "DECREASE R.P.M." position, and lock.

(ii) Move control on propeller governor until it hits the internal stop (decrease position): then move in opposite direction at least one degree. Adjust control rod so that rod end can be attached to governor control arm at this set position.

NOTE

This is done to obtain full travel of the governor without damaging the internal gears.

(iii) Operate the cockpit control to make sure of full travel and spring-back. There should be a spring-back of 1/16 to ¼-inch in the "INCREASE R.P.M." position; however, ½-inch maximum spring-back is allowable because of the variations in various governors. No spring-back is required in the "DECREASE R.P.M." position.

(vi) Tighten and safety all bolts.

7. CARBURETTOR AIR CONTROLS.

(a) DESCRIPTION:—

The carburettor air control is located on the control pedestal at the left side of the cockpit. (See Figure 319.) The two positions are "RAM AIR" and "UNRAMMED FILTERED AIR." In the "RAM AIR" position, air is taken through the air scoop directly to the carburettor. In the "UNRAMMED FILTERED AIR" position the air scoop is blanked off and the air is drawn through filters placed on either side of the normal air duct.

(b) ADJUSTMENT:—

Cold Air Control.—

(i.) Move the ram gate to the closed position.

(ii.) Place control lever in cockpit in the "UNRAMMED FILTERED AIR" position. Connect rod to ram air gate, and adjust so that the ram air gate will be in the closed position.

(iii.) With ram air gate closed, adjust filtered air door rod by its turnbuckle adjustment until this door is open to one inch maximum at its trailing edge. Tighten turnbuckle locknuts.

(iv.) Move the cockpit control to the "RAM AIR" position. Check ram air gate to determine that it is fully open.

(v.) If necessary, adjust the control rods until the cockpit lever falls into the notches at each end of travel, with the doors opening and closing properly.

NOTE.

Approximately $\frac{1}{8}$-inch spring-back should be obtained in the "UNRAMMED FILTERED AIR" end before lever falls into notch.

(vi.) Tighten all bolts and nuts, and safety. Operate controls several times to determine that rods clear in all positions and do not bind.

8. SUPERCHARGER CONTROL.

(a) DESCRIPTION:—

The automatic aneroid switch which controls the supercharger shifting system is activated by carburettor entrance air pressure. A control switch on the pilot's switch panel is used to shift from high to low blower in case of aneroid switch failure. This switch has three positions: "AUTO," "LOW" and "HIGH." The "AUTO" position is normally used. The momentary "HIGH" switch position is used to operate high blower for ground check only. The aneroid switch is calibrated to change the supercharger from low to high blower when aircraft is climbing, and from high to low blower when aircraft is descending. Air pressure at carburettor entrance for climbing and descending is equivalent to the approximate heights for the following engine types:—

Engine	Climbing	Descending
Packard Merlin type V1650–3	20,000 feet	21,000 feet
Packard Merlin type V1650–7	17,500 feet	17,000 feet
Rolls Royce Merlin type 66	14,000 feet	12,000 feet
Rolls Royce Merlin type 70	21,000 feet	18,500 feet

(b) **ADJUSTMENT:—**

For adjustment of aneroid switch and solenoid, see Chapter 7, Section C.

9. OIL AND COOLANT AIR OUTLET FLAP CONTROLS.

(a) **DESCRIPTION:—**

The oil and coolant air outlet flaps are operated by electric motor-driven screw jacks. The units are controlled by switches located on the left side of the pilot's cockpit above the control pedestal. Each switch has four positions: "OFF," "AUTOMATIC," "CLOSE," "OPEN." The "AUTOMATIC" position is normally used and a safety guard is provided on each switch to prevent accidental movement from this position. In the event of failure of the automatic mechanism the actuators can be operated by holding the switch in either the "CLOSE" or "OPEN" position.

In the event of a total failure of the coolant air outlet flap actuator an emergency manual control is provided on the right side of the cockpit below and aft of the pilot's seat. The control handle is normally lockwired in position. By pulling upwards and breaking the lockwire, a special toggle device releases the lower portion of the jack shaft attached to the flap and air pressure will open the flap. A minimum flap opening of 7 inches may then be obtained depending on the position of the actuator before release.

NOTE.

After operation of the emergency release, the shutter cannot be closed in flight.

(b) **ADJUSTMENT:—**

As these controls are electric, adjustment details will be found in Chapter 7, Section C, Paragraph 10.