* * * * * * *

BERMUDA DIVE BOMBER

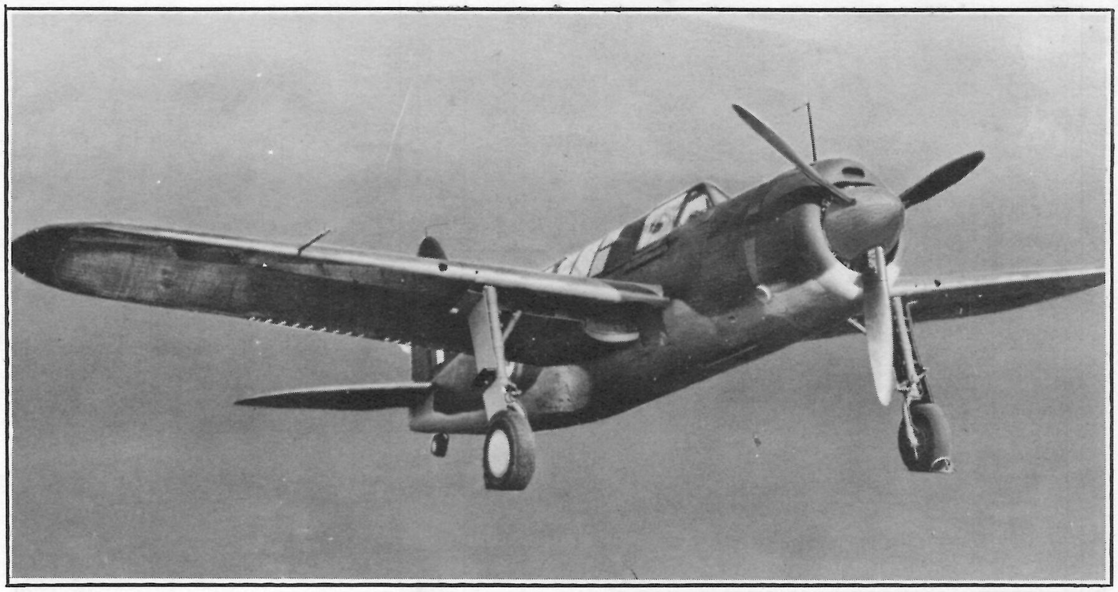
MODEL 340-14 AEROPLANE

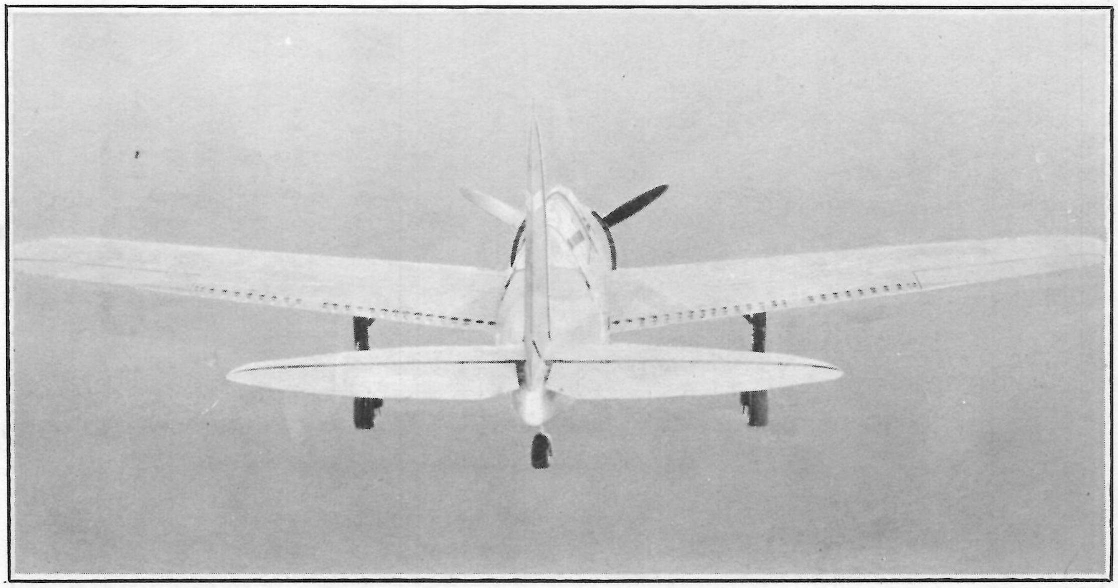
MANUFACTURED BY

BREWSTER AERONAUTICAL CORP.

JOHNSVILLE, PA.
U.S.A.

* * * * *





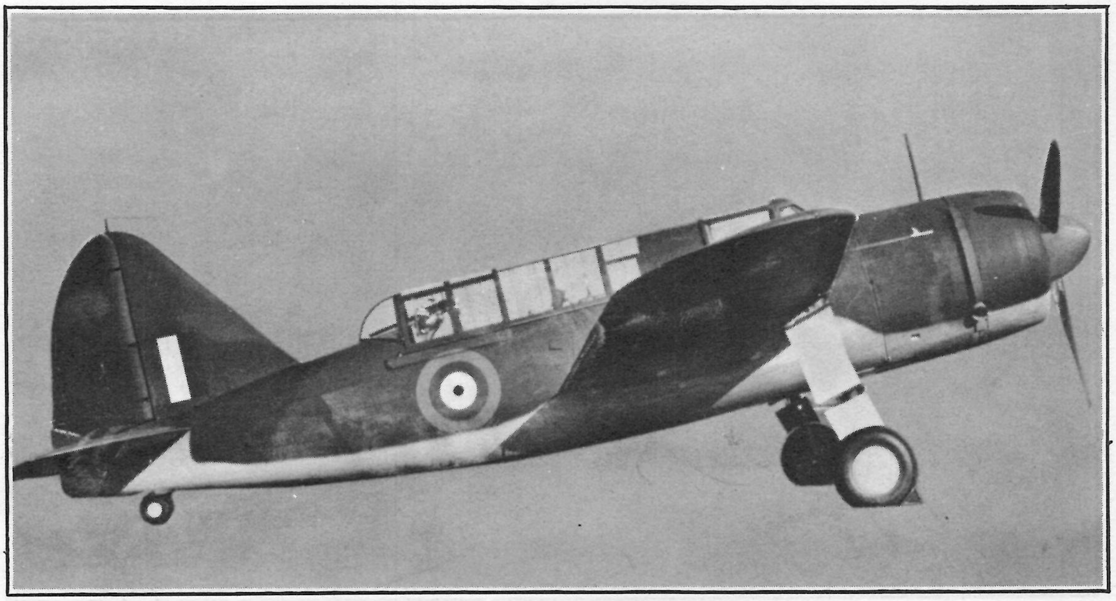
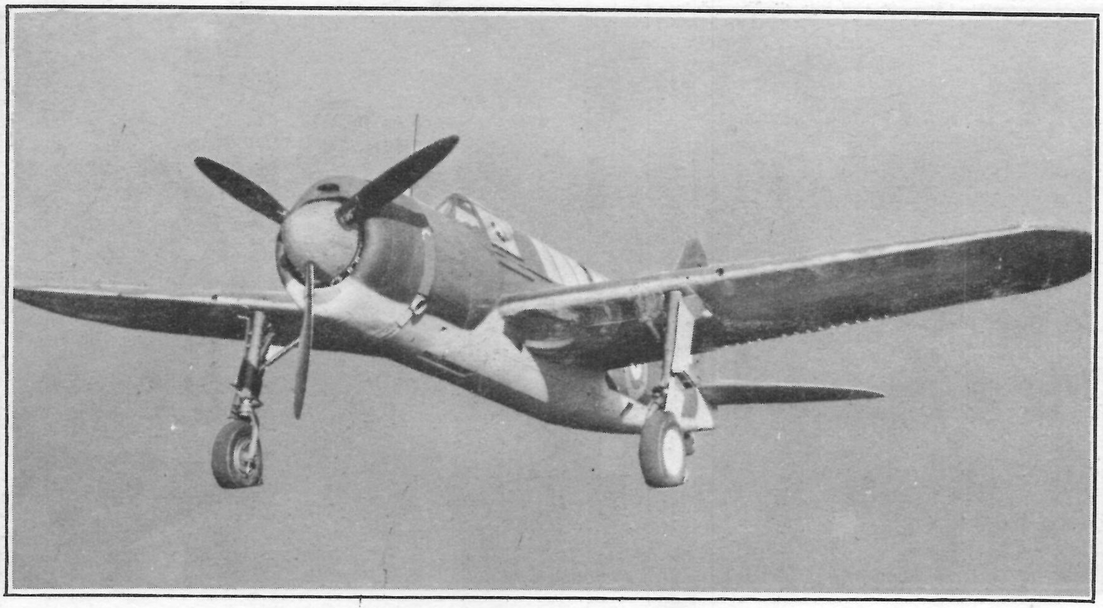
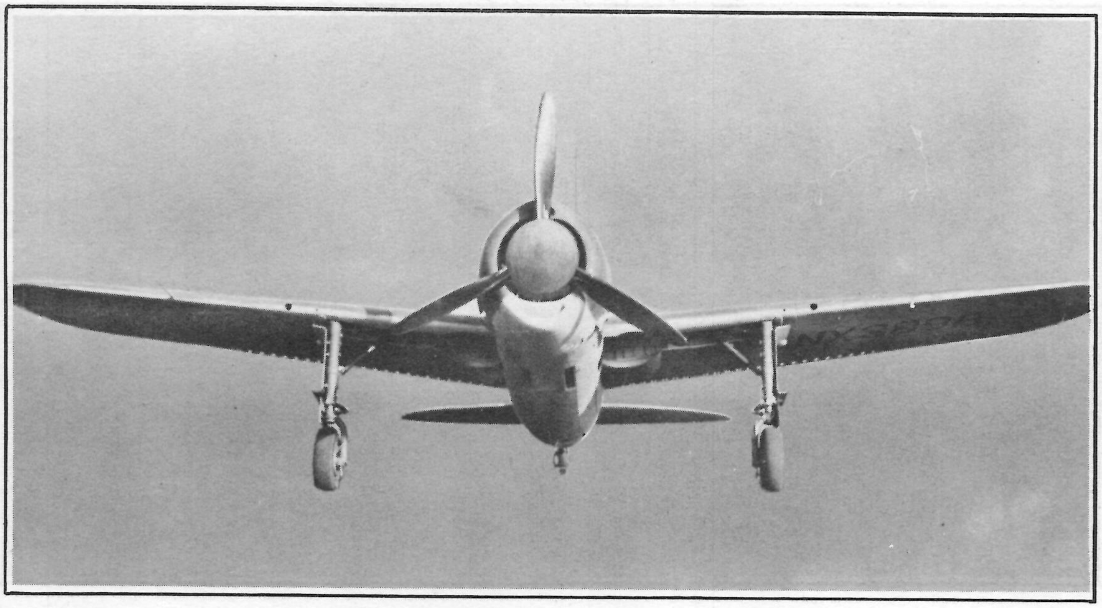


FIG. 1-1





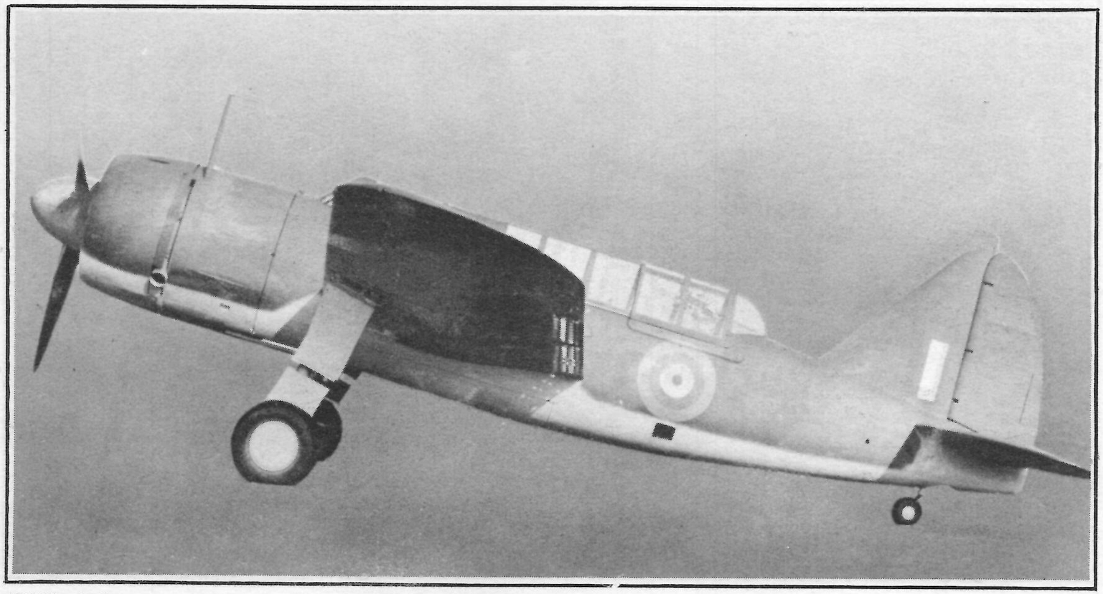


FIG. 1-1

Amendment Certificate

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

Amendment List		Amendment made by	Date
Number	Date		

Notes to Official Users

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

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

Where amendment action has taken place, the number of the amendment list concerned will be found at the top of each page affected, and amendments of technical importance will be indicated by a vertical line on the left-hand side of the text against the matter amended or added. Vertical lines relating to previous amendments to a page are not repeated. If complete revision of any division of the book (e.g., a Section) is made this will be indicated in the title page for that division and the vertical lines will not be employed.

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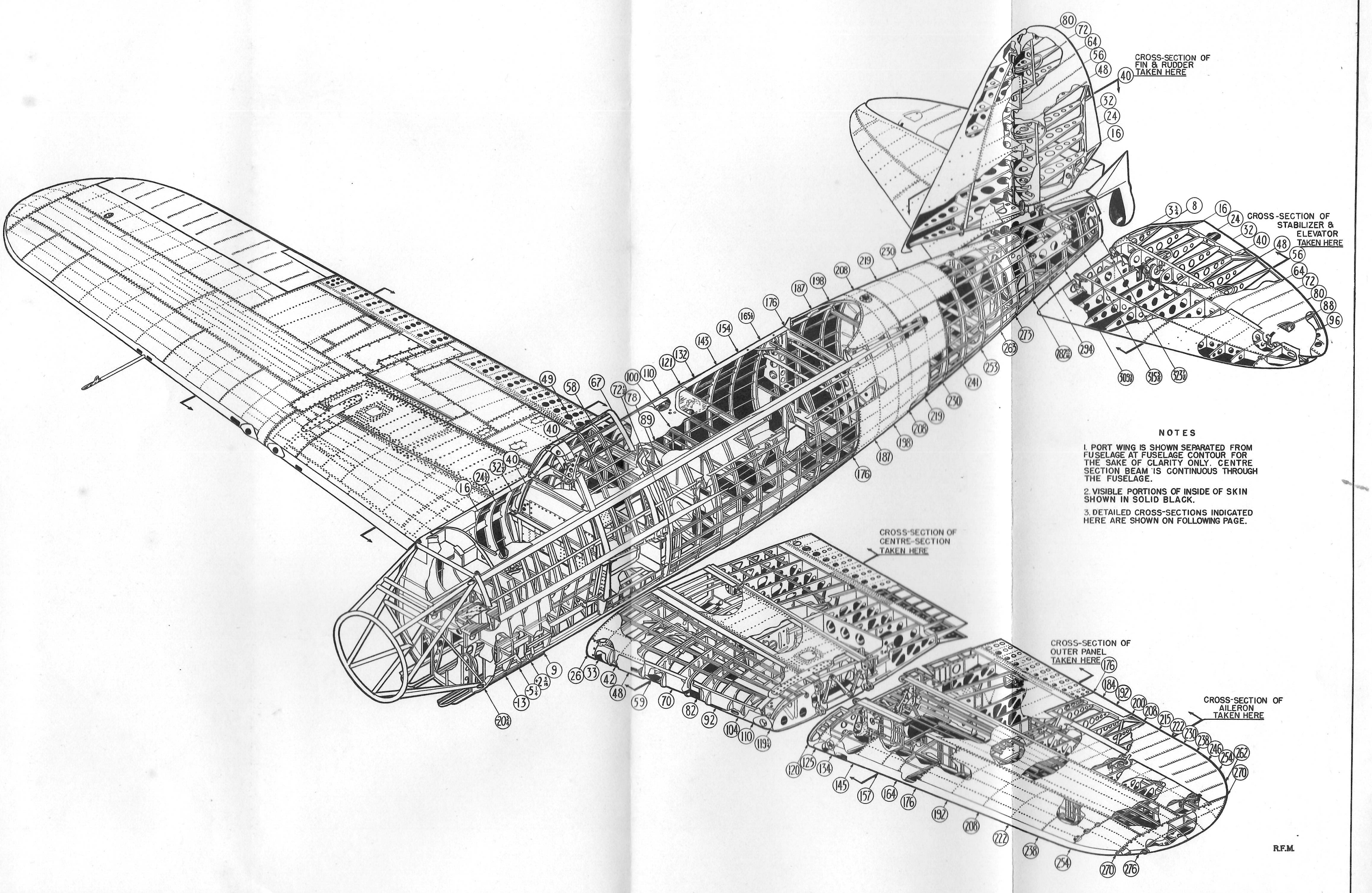
LIST OF DIAGRAMS

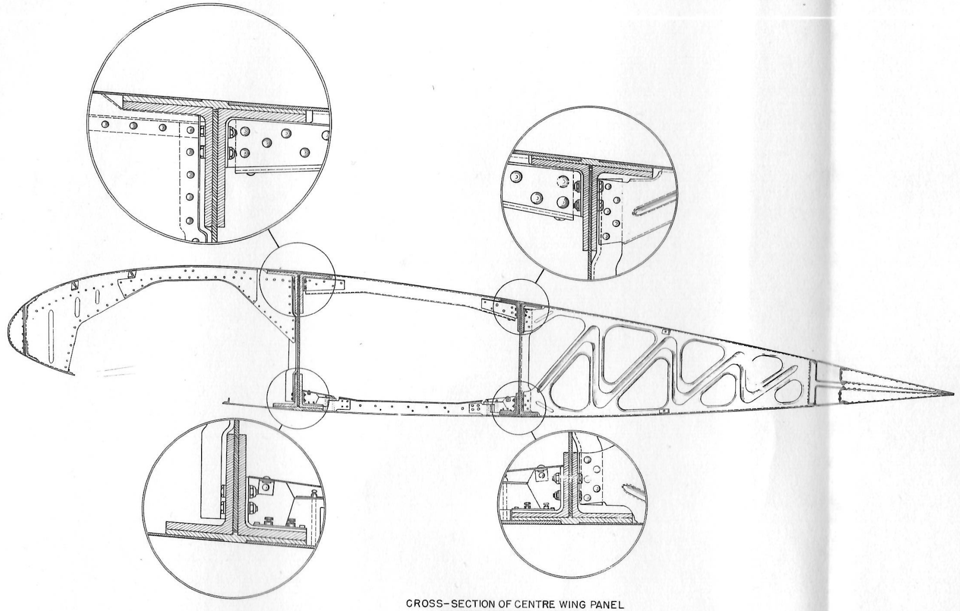
NOTE: The diagrams will be found at the end of the appropriate Section of the manual, e.g., the diagrams numbered 1- will be found at the end of Section I, the diagrams numbered 2- at the end of Section II, etc. The only exception is in the case of Section IV, where the text is so lengthy that the diagrams comprising that Section are segregated into groups and each group placed immediately after the text relating to that group of diagrams.

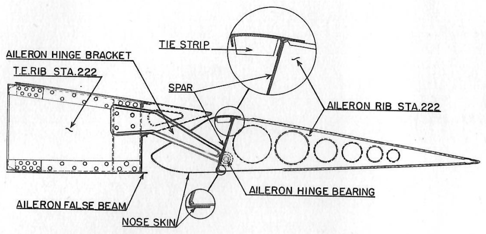


NOTES

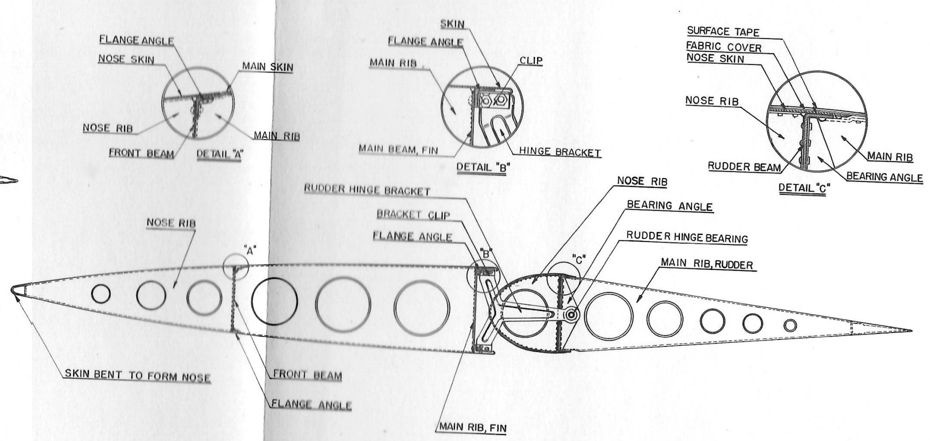
1. PORT WING IS SHOWN SEPARATED FROM FUSELAGE AT FUSELAGE CONTOUR FOR THE SAKE OF CLARITY ONLY. CENTRE SECTION BEAM IS CONTINUOUS THROUGH THE FUSELAGE.
2. VISIBLE PORTIONS OF INSIDE OF SKIN SHOWN IN SOLID BLACK.
3. DETAILED CROSS-SECTIONS INDICATED HERE ARE SHOWN ON FOLLOWING PAGE.

STRUCTURAL DIAGRAM - FIG. 1-2


CROSS-SECTION OF CENTRE WING PANEL LOOKING INBOARD, WING STA. 56.

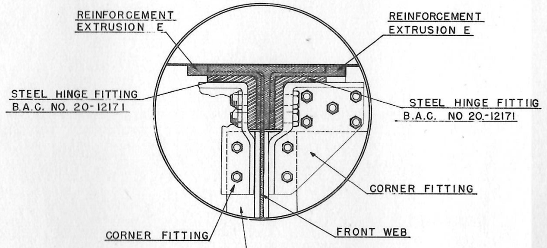


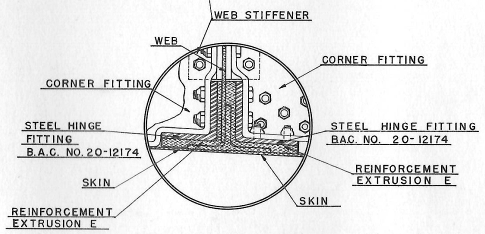
OUTER WING PANEL
CROSS SECTIONS, TRAILING EDGE RIB & AILERON, STA. 222



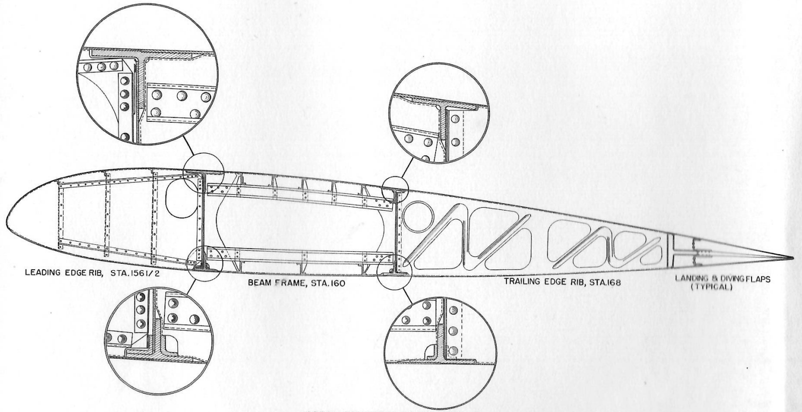
CROSS-SECTION OF FIN & RUDDER, VERTICAL TAIL STA. 40

CROSS SECTION OF UPPER SPAR ASSEMBLY - OUTER PANEL FRONT BEAM STA. 125

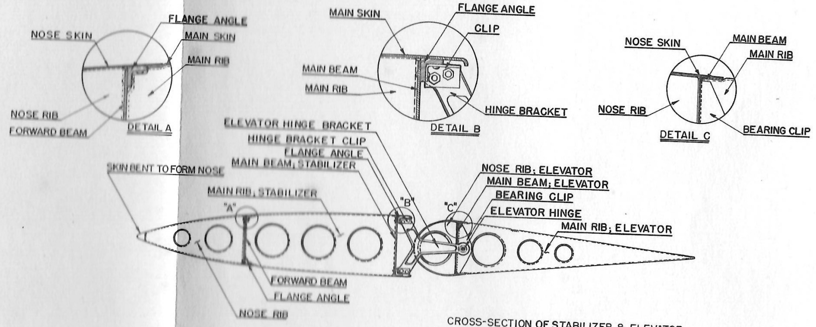




CROSS SECTION OF LOWER SPAR ASSEMBLY - OUTER PANEL FRONT BEAM STA. 125



CROSS SECTION OF WING OUTER PANEL LOOKING INBOARD FROM STA. 168 THROUGH STA. 156 1/2.



CROSS-SECTION OF STABILIZER & ELEVATOR AT HORIZONTAL TAIL STATION 56.

R.F.M. 4-42

Introduction

1 The Model 340-14 Dive Bomber Aeroplane (Bermuda) is a two-seater single-engined low wing monoplane with a conventional type two wheel main undercarriage and a single pneumatic tail wheel. The aeroplane is of all-metal construction with an overall span of 47′ 0″ and an overall length of 39′ 2¼″. It has an overall height, tail wheel down, of 13′ 1″. Accommodations provide for a pilot and a gunner. A set of primary flight controls (dual) is provided in the gunner's cockpit.

2 The wing is a full cantilever box spar structure of stressed skin construction. The wing is made up of the port and starboard outer wing panels and a wing centre section. The aircraft is equipped with landing and diving flaps which are broken at the joints between the outer panel and the wing centre section. Each outer panel incorporates an aileron and a detachable wing tip. The wing flaps are hydraulically operated. A flap position transmitter provides a continuous electrical recording of the position of the landing flaps to the pilot. The ailerons are of metal frame construction, covered by fabric, and are dynamically balanced by means of lead weights in the leading edge. The port aileron has a trim tab which is controllable by the pilot in flight. This tab is also equipped with a servo mechanism by means of which the tab automatically rotates in the opposite direction to the aileron movement. This mechanism may not be altered during flight but must be pre-set on the ground. The starboard aileron is equipped with a servo movement tab which is not controllable by the pilot in flight.

3 The empennage is stressed skin full cantilever structure with the movable surfaces being fabric covered metal structures. The two fixed horizontal stabilizers are each attached to the fuselage by four bolts. Each elevator is attached to its stabilizer by three hinges. The elevators are rigidly interconnected by a torque tube system. This torque tube incorporates the control bell crank which actuates the elevators. The fixed fin is attached to the fuselage by four bolts. The rudder is attached to the fin by three hinges and is actuated by a vertical torque tube which connects to the bottom of the rudder. The elevators and rudder have aerodynamic balance and are dynamically balanced by lead weights in their leading edges. The rudder and both elevators are equipped with servo movement tabs which may also be manually controlled by the pilot in flight to serve as trim tabs.

4 The fuselage is of semi-monocoque construction and is divided into two main sections; the forward section or engine compartment and the main fuselage section. A fireproof bulkhead separates the two sections. The engine compartment incorporates the engine cowl, the engine mounts and the engine accessories as well as the engine and the airscrew. The main fuselage section contains compartments for a pilot and gunner.

5 The aircraft is equipped with one Wright GR-2600-A5B-5 twin row 14 cylinder Cyclone engine. The airscrew is a Curtiss 12 foot diameter 3-bladed airscrew and has a variable pitch feature which can be governed by either automatic or manual control.

6 The oil supply for the engine is carried in a tank which is attached to the engine mount structure just forward of the fireproof bulkhead. The tank has a gross capacity of 22.6 Imperial gallons of which 4.0 Imperial gallons form a foaming space. A sounding rod (dip stick) is provided on the port side of the tank in order to measure the volume of the oil. The tank is provided with an internal hopper which is designed to operate in conjunction with the oil dilution system. An oil cooler is mounted in the lower portion of the engine compartment. It is cooled by an air flow which is obtained from an opening in the lower portion of the engine nose cowl. The oil cooler provides an automatic means of regulating the oil temperature.

7 The aeroplane is provided with three fuel tanks. Two of these are built into the structure of the wing beam, port and starboard, and the third is mounted in the fuselage between the pilot's and gunner's cockpit. Each wing beam tank is divided

into two sections which are protected by individual self-sealing internal fuel cells. The fuselage tank is also provided with a self-sealing internal cell. Each wing tank has a capacity of 72 Imperial gallons and the fuselage tank has a capacity of 81 Imperial gallons. The starboard tank is provided with a standpipe by means of which a reserve supply of 25 Imperial gallons may be maintained. For long range reconnaissance work a tank of 125 Imperial gallons capacity may be mounted upon a bomb rack in the bomb bay. This tank is not protected by a self-sealing liner. All fuel lines are self-sealing. The fuel quantities in the three normal tanks are measured by means of an electrically operated fuel gauge which is mounted on the pilot's main instrument panel. The quantity of fuel in the bomb bay tank is measured by a mechanical gauge mounted on top of the tank. The normal operating pressure of the fuel system (approximately 6 to 7 lb./sq. in.) is obtained by an engine driven fuel pump. A wobble pump may be manually operated by the pilot.

8 Flight controls, consisting of a control column and rudder pedals, are provided for both the pilot and the gunner. The gunner's control stick may be dismounted from its socket and stowed in the forward portion of his compartment.

9 Hydraulic fluid under pressure is used to operate the undercarriage, the brakes, the landing and dive flaps, the bomb doors and the cowl flaps. An engine driven pump mounted to the engine supplies fluid to the system through a pressure accumulator. A minimum normal operating pressure of 800 lb./sq. in. is maintained in the accumulator by an unloader valve. The accumulator provides a reserve supply of fluid under pressure in case of failure of the engine driven pump. The amount of fluid in the accumulator will permit the undercarriage to be lowered and the landing flaps to be extended. A hand pump is mounted on the right-hand side of the pilot's cockpit in order to provide fluid under pressure for the operation of any of the units if the engine pump is not running.

10 The electrical system is a single wire, 24 volt, earthed return system. Miscellaneous electrical switches on the instrument panel are clearly marked. The pilot's electrical panel incorporates a combined voltmeter and ammeter. A storage battery is mounted in the lower part of the aeroplane just aft of the bomb bay and a generator is mounted to the engine.

11 Two retractable landing lamps are incorporated into the lower surface of the wing's centre section, one on the port side and the other on the starboard side. A port and starboard navigation lamp is mounted in each wing tip. A tail navigation lamp is mounted on the aft end of the tail cone. Formation lamps for the port and starboard wings are mounted on the upper surface of the wings slightly inboard from the wing tips. A tail section formation lamp is mounted just above the tail navigation lamp. An upper and a lower identification lamp is provided. The upper lamp is mounted just aft of the gunner's cockpit on top of the fuselage and the lower lamp just underneath the pilot's seat on the bottom of the fuselage. The pilot's cockpit is provided with two fluorescent lamps, one of which is mounted on the left side of the overturn structure and one on the right side, just above and aft the pilot's seat. The markings on the instrument dials are chemically treated so that they will become activated by the fluorescent lamps and will fluoresce when all visible lamps are turned off in the cockpit. All circuits are protected by circuit breakers. These breakers are installed in the electrical distribution panel on the right-hand side of the pilot's seat.

12 The pilot's seat is adjustable in height. The gunner's seat is mounted on a single support upon which it may be pivoted through a complete 360° circle. It is also adjustable in a vertical direction. Each seat is equipped with a safety belt.

13 The pilot's cockpit is provided with controls for the four tabs located on the two elevators, the port aileron and the rudder. The cowl flap push-pull control is mounted on the right hand side of the pilot's cockpit just under the main instrument panel. On the opposite side of the cockpit and in the same relative position is a push-pull control for selecting the source of carburetor air.

14 The fuel selector valve is mounted directly under the centre of the main instrument panel directly in front of the pilot. The controls for operation of the undercarriage and flaps are mounted on the port side of the pilot's cockpit. The

control for the undercarriage is mounted immediately in front of the flap control. The flap control may be moved into one of two slots. Movement in the inboard slot operates the landing flaps, movement in the outboard flap operates the dive brake flaps.

15 The panel containing the bomb releases is located on the left-hand forward side of the cockpit directly under the main panel. On the inboard face of this panel is a Mallory intervalometer which is used for a timing device in dropping the bombs.

16 The bomb bay is located amidships under the wing centre section. It is equipped to carry two 500 lb. G.P. or S.A.P. bombs. It may carry in place of these bombs a load of two 250 lb. G.P., S.A.P. or L.C. bombs. In place of either of these, two 250 S.B.C. units may be carried or two 250 lb. supply dropping containers. Two wing bomb racks are provided (one on each wing) and each rack is capable of carrying one 250 lb. G.P., S.A.P. or L.C. bomb. A substitute load may be made of either of the three following items: one 250 lb. S.B.C., one 250 lb. S.C.I. bomb, or one 250 lb. supply dropping container.

17 The pilot's compartment is equipped with a set of gun charging handles which charges six .30 caliber guns which point forward and are mounted in the wing and the fuselage. Four guns are mounted in the wings, one in the port outer panel immediately outboard of the wing attaching point and one immediately inboard of this gun in the wing centre section. The other two guns are similarly disposed in the starboard wing. A fuselage gun is mounted in the port and starboard sides of the fuselage immediately above the engine. The gunner's compartment is provided with two .30 caliber machine guns in a flexibly mounted twin carriage.

Section II—Shipment of Aircraft

Figure Index

SECTION II

Shipment of Aircraft

GENERAL

1 The Bermuda aeroplane may be disassembled and crated for shipment in the following units (see fig. 2-1):

a. Airscrew spinner.
b. Airscrew—2 Blades.
—1 Blade.
c. Engine compartment.
d. Fuselage main section.
Tail wheel.
Tail cone.
e. Wing centre section.
Undercarriage.
f. Wing outer panel.
Wing tip.
g. Ailerons.
h. Bomb bay doors.
i. Stabilizers.
j. Elevators.
k. Fin.
l. Rudder.
m. Pitot head.
n. Radio antenna mast.

SHIPMENT UNITS

2 The airscrew spinner may be crated in a box approximately 2′ 3″ × 2′ 10″ × 2′ 10″. Net weight, 25 lb.

3 The airscrew itself, separated into two units of one and two blades, respectively, may be crated in a box approximately 10′ 10″ × 4′ 5″ × 1′ 6″. Padded supports must be provided to hold the single blade stationary and free from contact with the other unit. Net weight, 386 lb.

4 The engine compartment unit, consisting of the entire assembly forward of the fireproof bulkhead, but not including the airscrew spinner and airscrew, may be crated in a box 7′ 8″ × 4′ 9″ × 5′ 6″. Net weight, 2600 lb.

5 The main fuselage section may be crated in a box 30′ 0″ × 4′ 9″ × 8′ 0″. The tail wheel may be included in this crate as well as the tail cone. Net weight, 2412 lb.

6 The wing centre section with the undercarriage installed may be crated in a box 20′ 7″ × 10′ 2″ × 2′ 8″. Net weight, 2920 lb.

7 Both outer wing panels may be crated in one box 13′ 2″ × 8′ 10″ × 2′ 8″. The wing tips may be conveniently included. Net weight, 810 lb.

8 The two ailerons may be crated in a box 8′ 1″ × 1′ 7″ × 0′ 8″. Net weight, 62 lb.

9 The four sections of the bomb bay door may be crated in a box 8′ 9″ × 2′ 7″ × 2′ 0″. Net weight, 72 lb.

10 Each stabilizer may be crated in a box 9′ 0″ × 4′ 11″ × 1′ 0″. Net weight, 60 lb.

11 Each elevator may be crated in a box 9′ 5″ × 3′ 9″ × 0′ 11½″. Net weight, 42 lb.

12 The fin may be crated in a box 7′ 3″ × 6′ 4″ × 1′ 3″. Net weight, 45 lb.

13 The rudder may be crated in a box 7′ 7″ × 4′ 4″ × 12′ 0″. Net weight, 47 lb.

14 The pitot head should be carefully packed to ensure against any damage. Use a box 4′ 5″ × 0′ 6″ × 0′ 3½″. Net weight, 2 lb.

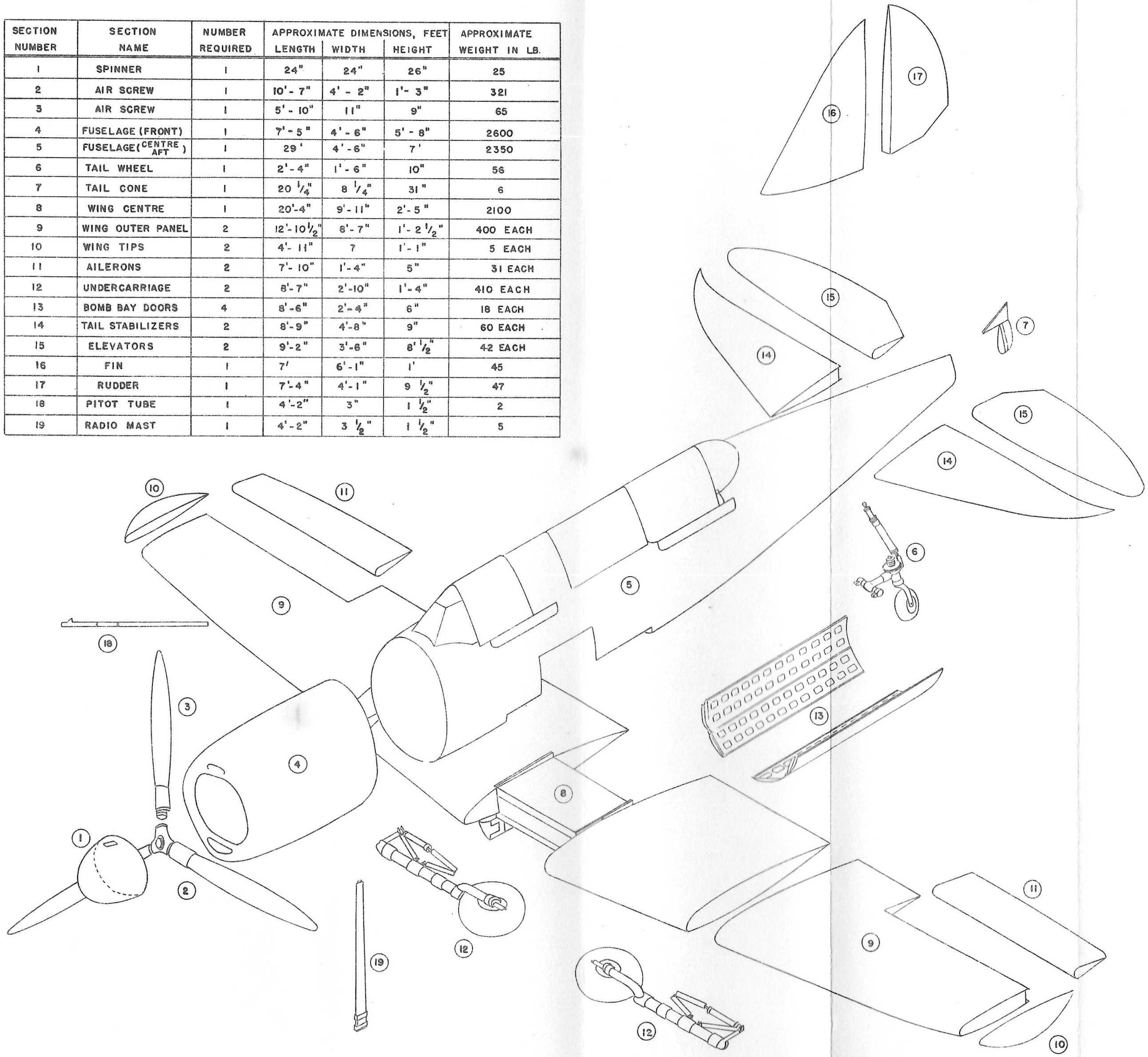
15 The radio antenna mast may be crated in a box 4′ 5″ × 0′ 6½″ × 0′ 3½″. Net weight, 5 lb.

USEFUL LOAD ITEMS

16 The above do not contain the weights of useful load items, which, if included, will add the following:

a. 145 lb. for fuselage guns (paragraph 4).
b. 201 lb. for wing guns (paragraph 6).
c. 67 lb. for wing guns (paragraph 7).
d. 4 lb. for gun sights (paragraph 5).
e. 180 lb. for flexible guns (paragraph 5).
f. 112 lb. for bomb installation (paragraph 5).
g. 156 lb. for pyrotechnics (paragraph 5).
h. 197 lb. for radio (paragraph 5).
i. 7 lb. for navigating equipment (paragraph 5).
j. 163 lb. for miscellaneous equipment (paragraph 5).

SECTION NUMBER	SECTION NAME	NUMBER REQUIRED	APPROXIMATE DIMENSIONS, FEET			APPROXIMATE WEIGHT IN LB.
			LENGTH	WIDTH	HEIGHT	
1	SPINNER	1	24"	24"	26"	25
2	AIR SCREW	1	10'-7"	4'-2"	1'-3"	321
3	AIR SCREW	1	5'-10"	11"	9"	65
4	FUSELAGE (FRONT)	1	7'-5"	4'-6"	5'-8"	2600
5	FUSELAGE (CENTRE AFT)	1	29'	4'-6"	7'	2350
6	TAIL WHEEL	1	2'-4"	1'-6"	10"	56
7	TAIL CONE	1	20 1/4"	8 1/4"	31"	6
8	WING CENTRE	1	20'-4"	9'-11"	2'-5"	2100
9	WING OUTER PANEL	2	12'-10 1/2"	8'-7"	1'-2 1/2"	400 EACH
10	WING TIPS	2	4'-11"	7	1'-1"	5 EACH
11	AILERONS	2	7'-10"	1'-4"	5"	31 EACH
12	UNDERCARRIAGE	2	8'-7"	2'-10"	1'-4"	410 EACH
13	BOMB BAY DOORS	4	8'-6"	2'-4"	6"	18 EACH
14	TAIL STABILIZERS	2	8'-9"	4'-8"	9"	60 EACH
15	ELEVATORS	2	9'-2"	3'-6"	8' 1/2"	42 EACH
16	FIN	1	7'	6'-1"	1'	45
17	RUDDER	1	7'-4"	4'-1"	9 1/2"	47
18	PITOT TUBE	1	4'-2"	3"	1 1/2"	2
19	RADIO MAST	1	4'-2"	3 1/2"	1 1/2"	5



TRANSPORT SECTION SCHEME - FIG. 2-1

Section III—Erection and Dismantling Operations

Figure Index

SECTION III

Erection and Dismantling Operations

GENERAL

1 The Bermuda aeroplane consists of the following main assemblies:

- Airscrew spinner.
- Airscrew.
- Engine compartment.
- Fuselage-main section.
- Tail cone.
- Wing centre section.
- Wing outer panels.
- Wing tips.
- Main undercarriage.
- Tail wheel.
- Wing flaps.
- Ailerons.
- Elevators.
- Stabilizers.
- Fin.
- Rudder.
- Bomb bay doors.

> Note: Refer to the Transport section scheme, fig. 2-1 and the Rigging diagram, fig. 3-1.

2 Constructional drawings of the proper supporting fixtures facilitating rapid assembly of the aeroplane's components are given in figs. 3-2, 3-5, 3-9, 3-10 and 3-19. A chain hoist having a capacity of 5 tons is required for use in attaching the wing centre section to the main fuselage section. The ground clearance at the wing trestling point is 61 inches with tyres deflated and u/c oleo fully compressed. The clearance with tyres inflated and oleo fully extended is 79 inches. Note: Dismantling operations, unless otherwise indicated, are the reverse of erection operations.

DETAIL ERECTION PROCEDURE

3 Assembly of Engine Compartment to Fuselage (see figs. 3-3 and 3-10)

a. Remove all engine compartment cowling.

b. The engine alone may be hoisted by attaching the engine hoisting sling at the following four places: at the inboard side of the cylinder head of the two top cylinders in the front bank, and at the inboard side of the cylinder head of the two cylinders (one on each side of the top centre cylinder) in the rear bank. The links of the hoist sling are fastened to each of the cylinder heads in an identical manner, namely:

Remove the nut from the through bolt which passes through the rocker box.

Reverse the nut, inserting it through the hole in the terminals of the hoisting sling link.

Replace the nut in its reversed position onto the rocker box bolt, thus fixing the sling in place.

> Note: The short cable section of the engine hoist sling attaches to the front bank cylinders.

c. Support the fuselage approximately horizontal on a low dolly and guide the suspended power plant unit, with the thrust line level, into the proper position for attachment to the four conical fittings provided on the fireproof bulkhead. The four aft extremities of the engine mount structure are designed to engage the conical fittings which are fastened to the fuselage structure. An AN81 steel bolt (¾ inch diameter × $2\frac{9}{32}$ inch long) is used to fasten each of the engine mount legs to the conical fittings. The bolt is passed aft through the ends of the engine mount and threaded into the conical fitting.

d. Draw up the attaching bolts with a torque wrench limiting the torque to 160 foot pounds. Lockwire the bolts through the holes provided in the engine mount tubing.

e. Connect all the control lines and tubing which pass aft through the fireproof bulkhead.

> Note: For recommended procedure for replacing the power plant in the event of an engine change, see paragraph 24 of this section, and the fireproof bulkhead quick disconnect diagram (figs. 3-17 and 3-18).

4 Assembly of Fuselage to Wing Centre Section (see fig. 3-4)

a. Support the wing centre section on two trestles. The trestles may be provided with fittings for attachment to the wing hinges.

b. Hoist the fuselage unit with a 5 ton capacity chain hoist; then, maintaining the fuselage with thrust line horizontal, lower the fuselage onto the wing. Great care must be exercised when guiding the fuselage into position on the wing spar as any fore and aft tilting would damage the spar flanges.

c. Support the fuselage tail on the tail support dolly, fig. 3-5.

d. Bolt wing to fuselage in accordance with the bolt sizes and locations as specified in paragraph 5 of this section. The angle of incidence and dihedral of the wing are established by the jigs in which the wing and the fuselage were constructed.

e. Attach the inverter box (see paragraph 205 of Section IV) to the aft side of fuselage frame No. 32¼ and connect the conduit to the box. Interferences necessitate the installation of the inverter box at this time instead of prior to the wing-fuselage assembly.

f. Connect the aileron push-pull rod extending inboard through each wing to the spider located just aft of fuselage station No. 72½.

g. Connect the aileron trim tab cables from the wing panel to the corresponding cables in the pilot's cockpit by using the turnbuckles provided. Safety wire the turnbuckles.

h. Connect the electrical disconnect plug located forward of the wing beam on each side of the fuselage with the wing leading edge conduit line. The plug is readily accessible from within the wheel well. Connect the wing trailing edge conduit to the junction box located within the bomb bay at fuselage station 80.

i. Connect three fuel lines from the starboard wing tank sumps and standpipe, and two fuel lines from the port wing tank sumps, to the fuel selector valve. The sump fittings are accessible through hand holes.

j. Connect two flap hydraulic lines extending outboard to the flap operating cylinders (jacks).

k. Connect two undercarriage hydraulic lines in each wheel well to the line continuations in the fuselage just forward of the front wing spar.

l. Connect one hydraulic brake line in each wing panel.

m. Connect the flap position indicator link to the bracket on the forward edge of the flap. The link is accessible through the landing lamp well.

n. Connect two airspeed lines located in the starboard wing.

o. If not already installed fasten the undercarriage and wing contour fairing to the under side of the wing panels and fuselage.

5 **Wing Erection Bolts**: The following list comprises the bolts used for the attachment of the wing centre section to the fuselage.

(Refer to Brewster drawing No. 14-31847 L/R, wing-fuselage joint.)

a.	AN4-6A AN960-D416 AC365-428	2 Bolts 4 Washers 2 Nuts	Attachment of rivet detail (20-31994) between stations 36 and 38$^1/_4$
b.	AN4-10A AN960-D416 AC365-428	1 Bolt 2 Washers 1 Nut	Attachment of angle to channel between stations 31$^3/_8$ and 36
c.	AN4-7A AC365-428 AN960-D416	4 Bolts 4 Nuts 4 Washers	Attachment of tie plate assembly (20-32768) at station 36
d.	AN8-26 AN310-8 AN960-D816 AN380-C3-3	2 Bolts 2 Nuts 4 Washers 2 Cotter Pins	Attachment of frame assembly 40 (20-31810) to front spar
e.	AN8-26 AN310-8 AN960-D816 AN380-C3-3	2 Bolts 2 Nuts 2 Washers 2 Cotter Pins	Attachment of frame assembly 40 (20-31810) to front spar
f.	AN5-6A AC365-524 AN960-D516	18 Bolts 18 Nuts 18 Washers	Attachment of wing rail (14-31855) to stringer 3
g.	AN8-55 AN310-8 AN960-D816 AN380-C3-3	2 Bolts 2 Nuts 4 Washers 2 Cotter Pins	Attachment of frame 67 (20-31808) to rear spar
h.	AN8-62 AN310-8 AN960-D816 AN380-C3-3	2 Bolts 2 Nuts 4 Washers 2 Cotter Pins	Attachment of frame 67 (20-31808) to rear spar
i.	AN4-10A AC365-428 AN960-D416	1 Bolt 1 Nut 1 Washer	Attachment of tie plate assembly (20-32768) at station 36
j.	AN4-10A AC365-428 AN960-D416	6 Bolts 6 Nuts 6 Washers	Attachment of stringer 15 (20-31875) to stringer 5A
k.	AN4-6A AC365-428 AN960-D416	1 Bolt 1 Nut 1 Washer	Attachment of upper clip (20-32057) to stringer 6
l.	AN4-5A AC365-428 AN960-D416	2 Bolts 2 Nuts 2 Washers	Attachment of splice plate at station 36
m.	AN6-14A AC365-624 AN960-D618	5 Bolts 5 Nuts 10 Washers	Attachment of upper clip (20-32057) to stringer 6
n.	AN6-20A AC365-624 AN960-D618	6 Bolts 6 Nuts 12 Washers	Attachment of upper clip (20-32057) to stringer 6
o.	AN4-6A AC365-428 AN960-D416	1 Bolt 1 Nut 1 Washer	Attachment of stringer 15 (20-31875) to stringer 5A
p.	AN6-15A AC365-624 AN960-D618	1 Bolt 1 Nut 2 Washers	Attachment of upper clip (20-32057) to stringer 6
q.	AN5-12 AN310-5 AN380-C3-3 AN960-D516	4 Bolts 4 Nuts 4 Cotter Pins 4 Washers	Attachment of fitting (20-31935) to stringer 6
r.	ES421-21 AN310-5 AN380-C3-3 AN960-D516	2 Screws 2 Nuts 2 Cotter Pins 2 Washers	Attachment of fitting (20-31935) to stringer 6
s.	AN3-11 AN310-3 AN960-D10 AN380-C2-2	6 Bolts 6 Nuts 6 Washers 6 Cotter Pins	Attachment of plate reinforcement (20-329356) to stringer 5A
t.	AN4-5A AC365-428 AN960-D416	1 Bolt 1 Nut 1 Washer	Attachment at station 72$^1/_2$ between stringers 3 and 4
u.	AN4-6A AC365-428 AN960-D416	1 Bolt 1 Nut 2 Washers	Attachment at station 72$^1/_2$ and stringer 4
v.	AN5-6A AC365-524 AN960-D516	1 Bolt 1 Nut 1 Washer	Attachment at station 72$^1/_2$ between stringers 4 and 5
w.	AN4-7A AC365-428 AN960-D416	1 Bolt 1 Nut 1 Washer	Attachment of splice clip on stringer 5 to station 72$^1/_2$
x.	AN5-6A AC365-524 AN960-D516	1 Bolt 1 Nut 1 Washer	Attachment at station 72$^1/_2$ between stringers 5 and 5A
y.	AN7-12 AN310-7 AN960-D716 AN380-C3-3	1 Bolt 1 Nut 1 Washer 1 Cotter Pin	Attachment of plate reinforcement, fuselage connection between stringer 5A and frame 72$^1/_2$
z.	AN4-10A AC365-428 AN960-D416	1 Bolt 1 Nut 2 Washers	Attachment of splice clip (20-31849) at station 72$^1/_2$ and fuselage stringer 5B joint
aa.	AN5-6A AN960-D516 AC365-524	1 Bolt 1 Washer 1 Nut	Attachment at station 72$^1/_2$ between stringers 5B and 6

ab.	AN10-15	1 Bolt	Plate reinforcement connection stringer 6 at station 72$\frac{1}{2}$
	AN310-10	1 Nut	
	AN960-D1016	1 Washer	
	AN380-C4-4	1 Cotter Pin	

6 Assembly of Undercarriage to Wing Panel (see fig. 3-6)

a. With the undercarriage oleo supported upright manoeuvre it into approximate position for the oleo fittings to engage the wing fittings. Using drift pins line up the attachment points and make secure with the two bolts, 20-33003-2 and -3, which are 1 inch diameter by lengths of 3$\frac{5}{16}$ inches and 4$\frac{3}{16}$ inches, respectively.

b. Install the inboard strut using a 20-33004 bolt (1 inch diameter × 3$\frac{13}{32}$ inches long) at the inner wing fitting and an AN320-14 shear nut to attach the outboard end of the strut to the oleo.

c. Install the retracting cylinder (jack) in place between the horn on the oleo strut trunnion and the horn on the inboard strut. Use two AN26-18 clevis bolts and AN320-6 shear nuts.

d. Attach the wheel to the strut and inflate tyre to 50 lb./sq. in.

e. Connect the brake line by fastening rubber hose between the fitting on the brake drum and the metal tubing on the oleo. Connect the metal tubing line to the line extending inboard within the wing panel.

f. Connect the undercarriage position indicator link from the transmitter arm to the bracket on the undercarriage oleo leg. *Warning:* This link should always be disconnected when the inboard strut is out of the aeroplane.

g. Install the "up-lock" emergency release cable, connecting the outboard end of the cable to the release hook and the inboard end to the metal ring, located beneath the instrument panel in the pilot's cockpit adjacent to the fuel selector valve.

h. Install the "down-lock" cable by connecting the outboard end at the "down-lock" fork and the inboard end to the pilot's undercarriage hydraulic control valve lever which is located to the left and forward of the pilot's seat.

i. Install the two cables extending between the centre joint of the inboard folding strut and the two metal rings installed under the main instrument panel.

j. Remove the undercarriage oleo strut filler neck plug, allowing the air to escape. With the strut fully compressed fill to overflowing with 1$\frac{1}{4}$ Imperial gallons of hydraulic fluid (see paragraph 365 of Section IV). Attach a high pressure air hose to the air valve, and inflate until the piston extension is 2$\frac{3}{16}$ inches with the aeroplane load on the wheels; or approximately 100 lb./sq. in. with the oleo strut fully extended. It requires a pump capable of producing air pressures of 800 lb./sq. in.

k. Install the undercarriage fairing.

l. Bond all undercarriage parts.

m. Adjust the "down-lock" micro-switch.

7 Assembly of Tail Wheel to Fuselage (see fig. 3-7)

a. Bolt the tail wheel chassis drag truss and the oleo shock strut to their respective fittings on the aft side of fuselage frame 273, using an AN26-40 bolt at each drag truss attachment point and an AN30-29 bolt at the shock strut attaching point.

b. Remove access door on the starboard side of the fuselage below the horizontal tail plane. If not serviced, remove the plug from the shock strut filler neck located at top of strut and fill to overflowing with fluid (see paragraph 370 of Section IV). Use a funnel with extension, keeping the source of fluid well above the filler plug. Replace the filler plug.

> NOTE: It is imperative that no substitutions be made of castor oil base fluids for previously used mineral base fluids. Not only would a mixture of the two result in a gummy substance which would coat the inner walls of the shock strut, and cause malfunctioning of the unit, but the packing materials might also swell.

c. Bond the upper end of tail wheel oleo to main fuselage structure approximately 6 inches forward of station 273.

d. Inflate the tail wheel tyre to 50 lb./sq. in.

e. Inflate the tail wheel oleo strut with a high pressure (600–800 lb./sq. in.) air pump to extend the strut four inches with the aeroplane load on the tail wheel.

8 Assembly of Tail Cone to Fuselage

Complete the electrical connections for tail lamps and fit the tail cone over the aft end of the fuselage. Thirty-six buttonhead screws (AN526-1032-8) are used in the attachment.

9 Assembly of Outer Panels to Wing Centre Section (see fig. 3-8)

a. Support the outer panel upon a padded movable fixture having an upper surface shaped to fit the wing contour and sloped to conform with the panel dihedral (see fig. 3-9), thus facilitating the engagement of the hinge fittings at the correct elevation and angle. Manoeuvre the unit into position, using drift pins to aid alignment of the outer panel's hinge points with the mating fittings on the centre section. Join the outer panel to the centre section by inserting four bolts per panel, namely: one bolt (14-10015), 1$\frac{1}{8}$ inch diameter × 4 inches long; two bolts (14-10016) $\frac{15}{16}$ inches diameter × 3$\frac{7}{16}$ inches long; one bolt (14-10012) 1$\frac{1}{8}$ inches diameter × 3$\frac{61}{64}$ inches long. The 1$\frac{1}{8}$ inch diameter bolts should be limited to a torque of 40 foot pounds, the 1$\frac{1}{16}$ inch diameter bolts 35 foot pounds and the $\frac{15}{16}$ inch diameter bolts 25 foot pounds.

> NOTE: The bolts are all installed with the heads forward, except the upper aft bolt which is installed with the head aft to provide clearance for the aileron push-pull tube connecting idler bell-crank, fitted to the outboard face of station 120 at the rear spar.

b. Connect the outer panel aileron push-pull tube to the idler located just inboard of the wing joint using ¼ inch diameter × 1¼ inch long bolts and 5/16 inch diameter × 1⅝ inch long bolts.

c. Connect conduit to junction box and attach wires to terminals in box.

d. Connect the two flap hydraulic lines to the outer flap operating cylinder by means of the fittings at the wing joint.

e. Connect the dive flap engaging system rod in the outer panel to the arm in the bomb bay. Use one bolt AN24-21.

f. Connect the flap position indicator arm to the flap horn on the leading edge of the port flap only.

g. Connect the airspeed tubes at the wing joint on the starboard wing panel only.

h. Connect the aileron trim tab control system, in the port wing only, by threading both lengths of the tab control cable over two pulleys in the outer panel and to the tab drum. The cables will each be wound four times around the drum and the end of the cable locked to the drum by means of a screw.

i. Connect the wing gun charging cables at the four guns.

j. Bond all connections.

k. Close all access doors in wing.

10 Assembly of Wing Tip to Wing

Complete the electrical connection to the wing tip navigation lamp and fit wing tip over the edge of the outer panel. Sixty-five screws (AN510-10-32) are required to make the attachment.

11 Assembly of Landing and Dive Flaps to Wing Panels (for reference see figs. 4-46 and 4-47 in Section IV)

a. *Landing Flaps*

(i) Attach the four sections of the inboard and outboard landing flaps to the wing panel by inserting the respective piano hinge pin. The inboard hinge pin is inserted first.

(ii) Attach the four flap cylinder (jack) piston rods to each landing flap operating horn with an AN24-15 clevis bolt.

(iii) Connect the landing flap position indicator wiring and conduit between the wing panel and the flap.

b. *Dive Flaps*

(i) Attach the four sections of the inboard and outboard dive flaps to the wing panel by inserting the respective piano hinge pins.

(ii) Attach the dive flap operating rods to the four dive flap operating bell-cranks with AN24-21 clevis bolts, two per unit.

(iii) Check the setting of the flap position indicator in the cockpit with the actual position of the flaps.

12 Assembly of Ailerons to Wing

a. Set the aileron trim tab to 0° by turning the shaft on the inboard end of the left aileron.

b. Set the aileron trim tab control wheel in the pilot's cockpit at 0°.

c. Collapse the telescoping shaft on the inboard end of the port aileron. Attach the ailerons to the wings by using three AN4-13 bolts for each aileron.

d. The squared end of the tab shaft engages the broached gear located on the left wing rib.

e. Connect each aileron control push-pull rod to the operating bell-crank on the aileron with an AN6-14 bolt.

f. Rig each aileron to its required throw (12° down, 16° up) by adjusting the length of the push rod at the aileron bell-crank.

g. Bond all hinges and controls.

13 Assembly of Tail Surfaces to Fuselage (see figs. 3-11, 3-12, 3-13, 3-14, 3-15 and 3-16)

a. Attach each stabilizer to the fuselage fittings by four AN10-16 bolts. Insert bolts with nuts facing each other thus providing clearance.

b. Attach each elevator to the stabilizer with two AN4-12 bolts, one at the outboard hinge point and one at the centre hinge point; and one AN8-15 bolt at the inboard hinge point.

c. Attach the elevator to the elevator torque tube in the fuselage with eight AN75A5 bolts.

d. Wind elevator tab cables around operating drum, starting each cable from the outer edge of the drum. Attach the trim tab control push rod to the tab with an AN3-7 bolt, 3/16 inch diameter × 7/16 inch long.

e. Connect the lead screw end of the trim tab push rod to the stabilizer.

f. Lock cables to drum by tightening drum fastening nut.

g. Adjust the lead screw so that the tab is at 0°, when the elevator is at 0° and the tab control wheel in the pilot's cockpit is at 0°.

h. Attach the vertical fin to the fuselage structure with four AN27-21 bolts.

i. Attach the rudder to the fin with two AN4-13 and one AN26-20 bolts through the hinge points.

j. Use AN4-5A bolts to attach the rudder to the rudder torque tube.

k. Attach the tab control push rod to the tab with an AN3-7 bolt through the hinge fitting.

l. Connect the lead screw end of the trim tab push rod to the control in the vertical stabilizer.

m. Attach the rudder trim tab cables in a manner similar to the elevator trim tab system.

n. Adjust the lead screw so that the tab is at 0°, with the rudder at 0° and the tab control wheel in the pilot's cockpit at 0°.

14 Assembly of Bomb Bay Doors to Fuselage

a. Attach the fuselage bomb bay doors to the fuselage structure with piano type hinge pins. Three hinge pins are required for each bomb bay door.

b. Attach each bomb bay door to the hinge fittings located at fuselage stations No. 9 and 110, with two AN25-10 clevis bolts.

c. Fix the lower end of the bomb bay door operating mechanism to the U-shaped fitting located at the end of each door assembly. AN25-30 clevis bolts, one for each fitting, and special spacers are required.

d. Bond all connections.

e. With the doors in the closed position make sure that each door fairs smoothly into the contour of the fuselage skin. Adjustable lengths are provided on fuselage frames 9 and 110 in the fore and aft ends of the bomb bay for this purpose.

15 Assembly of Airscrew and Spinner to Engine

For this installation refer to the Curtiss-Wright Instruction Manual.

16 Check-out of Hydraulic System

a. Preload accumulator with air to a pressure of 500 lb./sq. in. There must be no hydraulic fluid in the accumulator during preloading.

b. Fill hydraulic tank on forward face of fireproof bulkhead (starboard side) with fluid (see paragraphs 288 and 289 of Section IV).

c. Run the engine and operate (through at least 5 cycles) the cowl flaps, landing flaps, dive flap engaging cylinder and the bomb bay doors. Disconnect the piston end of the undercarriage operating cylinder and four way control valve.

d. Bleeding can be done with engine stopped. Each bleed valve on the cylinders will be opened as the piston bottoms toward that end of the cylinder. Move piston by operating cockpit control valve and actuating hand pump.

e. Bleed the brakes by opening the bleeder valve. Allow the fluid to run out as the hand pump is operated until no more bubbles can be observed emerging from the bleeder valve.

f. Run the engine until the accumulator is full (1000 lb./sq. in. on cockpit gauge). Fill the hydraulic tank so that its level is even with bottom of threaded portion of filler neck. (At this time the under carriage should be extended, the flaps closed and the accumulator loaded.) Check the system for leaks.

17 Check-out of Fuel System

a. Fill all fuel tanks.

b. Check the operation of the fuel tank selector valve.

c. Operate the primer, turn the engine over by hand and operate the hand fuel pump until 6 lb./sq. in. is recorded on the fuel pressure gauge.

d. Run the engine.

e. Check the system for leaks.

18 Check-out of Oil System

a. Fill the oil tank.

b. Run the engine and check the oil pressure on the cockpit gauge.

c. Refill the oil tank to the 18.6 Imperial gallon mark.

19 Check-out of Control System

a. Operate the rudder pedals (both cockpits) and check the movement of rudder (30° port, 30° starboard from neutral).

b. Check the neutral position of control column against ailerons and elevators. Use control column fixture (fig. 3-20) to hold the controls steady.

c. Operate the control column (both cockpits) fore and aft and check the movement of elevators (16° down, 20° up).

d. Operate the control column (both cockpits) from side to side and check the movement of ailerons (12° down, 16° up).

e. Check the operation of "up-" and "down-locks" on undercarriage, using trestles under the wings. As the undercarriage is retracted and extended, check operation "c" of paragraph 20.

f. Check pilot's and gunner's engine controls.

g. Check tab controls for freedom of movement.

20 Check-out of Electrical System

a. Install battery and check level of electrolyte.

b. Operate all switches, except the gun switches, and observe functioning. Check the lamp operation.

c. Check the operation of the undercarriage position indicator gauge and functioning of the warning horn.

d. Set up the aeroplane on a firing range and check the operation of guns.

e. Check the gun sight operation.

f. Install a radio mast and a trailing antenna and check the operation of the radio.

g. Check the bomb operation.

h. Check all conduits and bonding.

21 Check-out of Power Plant

Check the operation of power plant according to the Wright Instruction Manual.

22 Check-out of Instruments

a. Check the instrument panels and location of instruments.

b. Remove the compass vents.

c. Check the operation of instruments in flight.

23 Check-out of Miscellaneous Items

a. Fill the anti-icer fluid tank. Check the anti-icer control.

b. Weigh and install the fire extinguisher bottle.

c. Check the installation of pilot's and gunner's seats, safety belt and head rest.

d. Check the inter-cockpit communication system.

e. Check the operation of all sliding canopies.

f. Check the condition of exterior finish, including stencilling.

g. Check the armour plate installation.

h. Check the operation of camera.

i. Check the operation of flares.

j. Check the structure for security of rivets, nuts and bolts.

24 Replacement of Power Plant (see fig. 3-17)

The power plant and the engine accessory compartment may be detached as a unit from the fuselage. This procedure is facilitated by quick disconnect fittings provided at the fireproof bulkhead (fuselage station No. $-20\frac{3}{4}$), and by the four bolts attaching the engine mount to the fuselage, which are also at this station.

a. Remove the engine accessory compartment cowling.

b. Disconnect the throttle control rod by removing the lockwire from the two attaching turnbuckles and withdrawing the aft turnbuckle.

c. Disconnect the mixture control by pushing aft on the quick disconnect fitting.

d. Disconnect the supercharger control by pressing aft on the quick disconnect fitting.

e. Disconnect the manual airscrew pitch control by detaching aft end of control at engine quadrant. One clamp between quadrant and fireproof bulkhead has to be removed. One side of the guide on the bulkhead should be loosened and pushed aside for clearance of the rod end bearing on the control.

f. Disconnect the magneto wiring and conduit by unscrewing the disconnect receptacle.

g. Disconnect the two conduits to the electrical junction box located on the starboard side of the engine compartment by unscrewing the two plugs.

h. Disconnect the conduit to the impact actuator at the actuator by removing two clamps.

i. Disconnect the electrical wiring and conduit to the airscrew pitch control by unscrewing the plug.

j. Disconnect radio aerial at the top of the mast.

k. Disconnect two hydraulic system Aeroquip disconnect valves by unscrewing from bracket on the lower starboard side of fireproof bulkhead.

l. Disconnect three instrument lines located near the starboard top side of the fireproof bulkhead. These are: the manifold pressure line, the fuel pressure line and the oil pressure line.

m. Disconnect the main fuel line at the AEL unit by removing the fuel line hose clamp.

n. Disconnect the fire extinguisher line on the starboard centre face of the fireproof bulkhead by unscrewing the tubing nut.

o. Disconnect the vacuum line located on the upper port face of the fireproof bulkhead by unscrewing the tubing nut.

p. Hoist the entire engine and engine mount unit with the hoisting sling shown on Brewster drawing ER-234.

q. Remove the four bolts ($\frac{3}{4}$ inch diameter, $2\frac{9}{32}$ inch long) attaching the engine mount to the four conical fittings on the fireproof bulkhead.

25 Replacement of Wing Tank Fuel Cell

a. Drain fuel system. (See Fig. 4-8.)

b. Remove the wheel fairing which covers the fuel sumps.

c. Disconnect the main fuel lines at the fuselage. On the starboard side remove two sumps (14-48051), reserve tank standpipe and the inboard fuel gauge transmitter. On the port side remove two sumps (14-48050).

d. Remove the undercarriage reinforcement plate on the under surface of the wing by removing all the screws. When this operation is performed the wing should be supported so as to take as much load as possible off the wing centre section.

e. Remove the two reinforcement plates near the sump.

f. Remove the screws from the cover plate on the bottom surface of the wing beam. If these screws turn hard it signifies that too much load still remains on the wing.

NOTE: Make careful record of location of various screw sizes used.

g. Remove the bottom inspection plate in the cell and take off the filler cap.

h. Remove the five countersunk head screws in the wing beam. These hold the cell in position. The fuel gauge transmitters must be removed in order to obtain access to these screws.

i. Remove the clamps holding the tubes which interconnect the two cells in each compartment, then remove the bolts and the ring which connects the two cells.

j. Remove the five screws which hold the cells tight against the top skin. Make sure that all the five screws are removed, as the cell may be severely damaged if an attempt is made to remove the cell before taking out all these screws.

k. Disconnect the two Kenyon valves on wing bulkhead $110^3/_8$. Remove the valves and attaching lines.

l. Remove ten screws from the top surface of the wing that protrude into fittings located on top of the fuel cells.

m. Check to make sure that the cell is entirely disconnected from the wing beam structure and then pull out cell.

26 Removal of Fuselage Fuel Tank

a. Drain tank.

b. Disconnect bomb door controls (links).

c. Disconnect vents and fuel connections.

d. Disconnect filler unit at tank.

e. Disconnect electrical connection to fuel gauge.

f. Disconnect tank bonding.

g. Disconnect aileron cables from spider.

h. Disconnect rudder cables from rear rudder pedals.

i. Remove aileron spider and spider bracket.

j. Disconnect elevator push rod between pilot's and gunner's control columns.

k. Remove torque tube assembly (brackets and all).

l. Disconnect tab control cables at turnbuckles.

m. Remove supporting beam at fuselage station 89.

n. Remove rear rudder pedal covers.

o. Disconnect wobble pump and throttle connecting rods.

p. Remove wobble pump bracket at fuselage station 89.

q. Remove all radio equipment in rear cockpit on draft screen shelf.

r. Remove shelf and draft screen.

s. Loosen all straps on tank and remove tank strap support on fuselage station $72^1/_2$.

t. Pull out tank.

27 Removal of Fuel Cell from Detached Fuselage Tank

a. Drain tank completely.

b. Remove aft face of fuselage tank by cutting safety wires and removing screws.

c. Disconnect fuel level transmitter (five screws on outside and five more flat head screws inside).

d. Remove aft sump by cutting safety wire and removing screws.

e. Remove forward sump by cutting safety wire and removing screws.

f. Remove pins from four tabs on upper surface of tank which completely releases cell from shell.

g. Pull out cell.

28 Removal of Oil Tank

a. Remove accessory cowling just above and on the sides of the oil tank.

b. Drain oil tank.

c. Remove oil tank armour plate.

d. Disconnect bonding and oil lines.

e. Disconnect oil tank straps.

f. Pull out tank through the top.

29 Removal of Hydraulic Tank

a. Drain all hydraulic units.

b. Remove engine and mount from fireproof bulkhead.

c. Disconnect hydraulic lines at tank (vent, return, vacuum, handpump).

d. Release tank from the two straps holding it to the fireproof bulkhead by removing the two AN5-17 bolts.

e. Pull out tank.

30 Removal of Anti-Icing Tank

a. Remove pilot's seat and armour plate.

b. Disconnect piping fittings from anti-icing tank.

c. Disconnect two bonding points on tank.

d. Disconnect two straps holding tank.

e. Pull out tank.

31 Removal of Windscreen

a. Disconnect electrical conduit leading to top of windscreen.

b. Remove 23 screws around base of windscreen.

c. Pull off windscreen.

d. Remove rubber stripping around sections of glass with sharp edge and remove glass.

32 Adjustment of Bomb Bay Doors

Adjustments may be made as follows (see fig. 3-22):

a. Travel of door inboard—loosen B.
Travel of door outboard—tighten B.

b. Travel of door upward toward contour of fuselage—tighten C.
Travel of door downward toward contour of fuselage—loosen C.

c. Travel of inner and outer panels of door inboard—loosen D.
Travel of inner and outer panels of door outboard—tighten D.

d. To adjust overhead installation consisting of 3 turnbuckles—tighten H.

e. K is provided for making adjustments on the bomb bay door microswitches which are found only in the forward port and starboard corners.

Since most of these units are interdependent, they must be adjusted together on each door. WARNING: Make sure that controls in the cockpits are locked before making any adjustments on the doors.

BERMUDA AEROPLANE MODEL 340-14

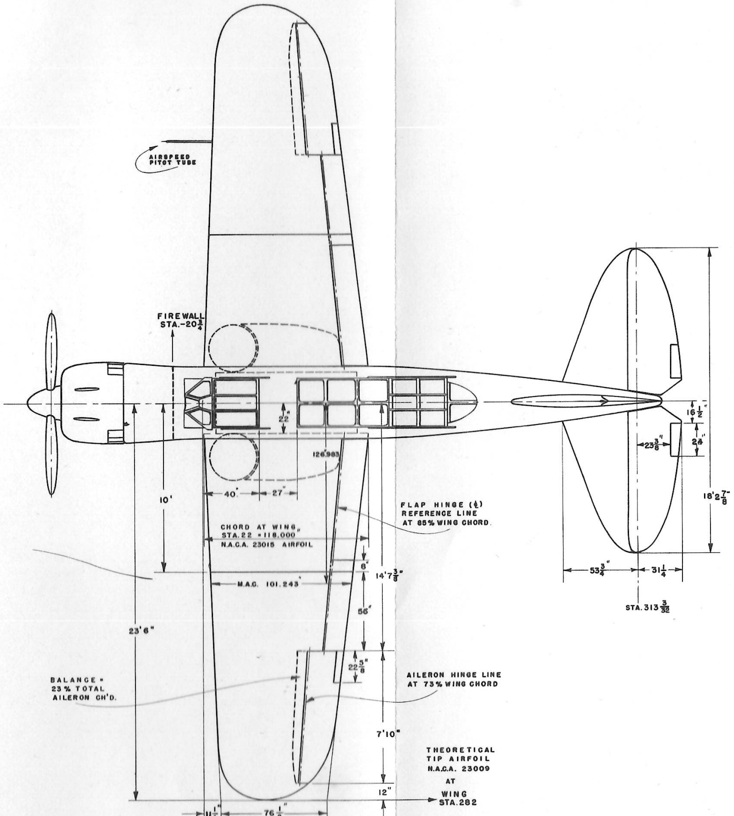
CONTROL SURFACES — AREAS

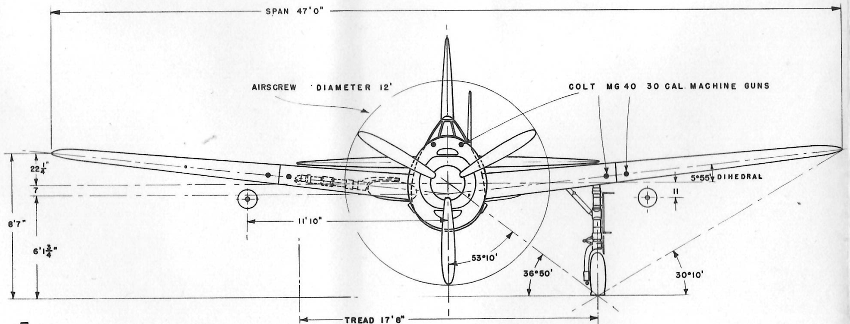
ITEM	EACH	TOTAL
• WING	——	379.2 SQ. FT.
AILERONS MINUS TABS	18.9	37.81
AILERON TABS	.072	.144
UPPER FLAPS	15.53	31.06
LOWER FLAPS	16.45	32.90
• FIN	——	20.01
RUDDER MINUS TAB	——	18.23
RUDDER TAB	——	1.14
• STABILIZER	——	41.15
ELEVATORS MINUS TABS	16.01	32.02
ELEVATOR TABS	1.14	2.28

CONTROL SURFACES — MOVEMENT

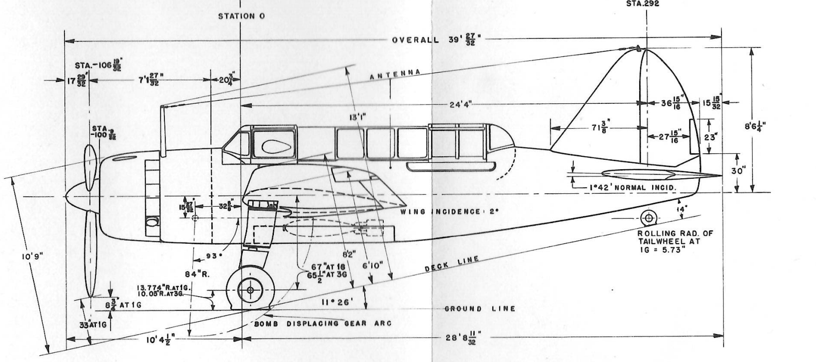
• CONTROL STICK:		
AIL'R'N. MOVEM'T	8" LEFT	8" RIGHT
ELEVATOR "	9" AFT	9" FORWARD
RUDDER PEDAL	3¼" AFT	3¼" FORWARD
• AILERON	16° UP	12° DOWN
ELEVATOR	30° UP	20° DOWN
RUDDER	30° LEFT	30° RIGHT
• FLAPS	60° UP	60° DOWN
• AILERON TAB	5.5 TURNS FOR 8° OF TAB	
ELEVATOR TAB	" " " " " "	
RUDDER TAB	" " " " " "	

- SERVO $\frac{2}{3}$ OF UP OR DOWN (OR SIDEWISE) MOTION PLUS 8° OF TAB (FOR ALL TABS).
- 5 % ADJUSTMENT PERMITTED ON ALL ABOVE.

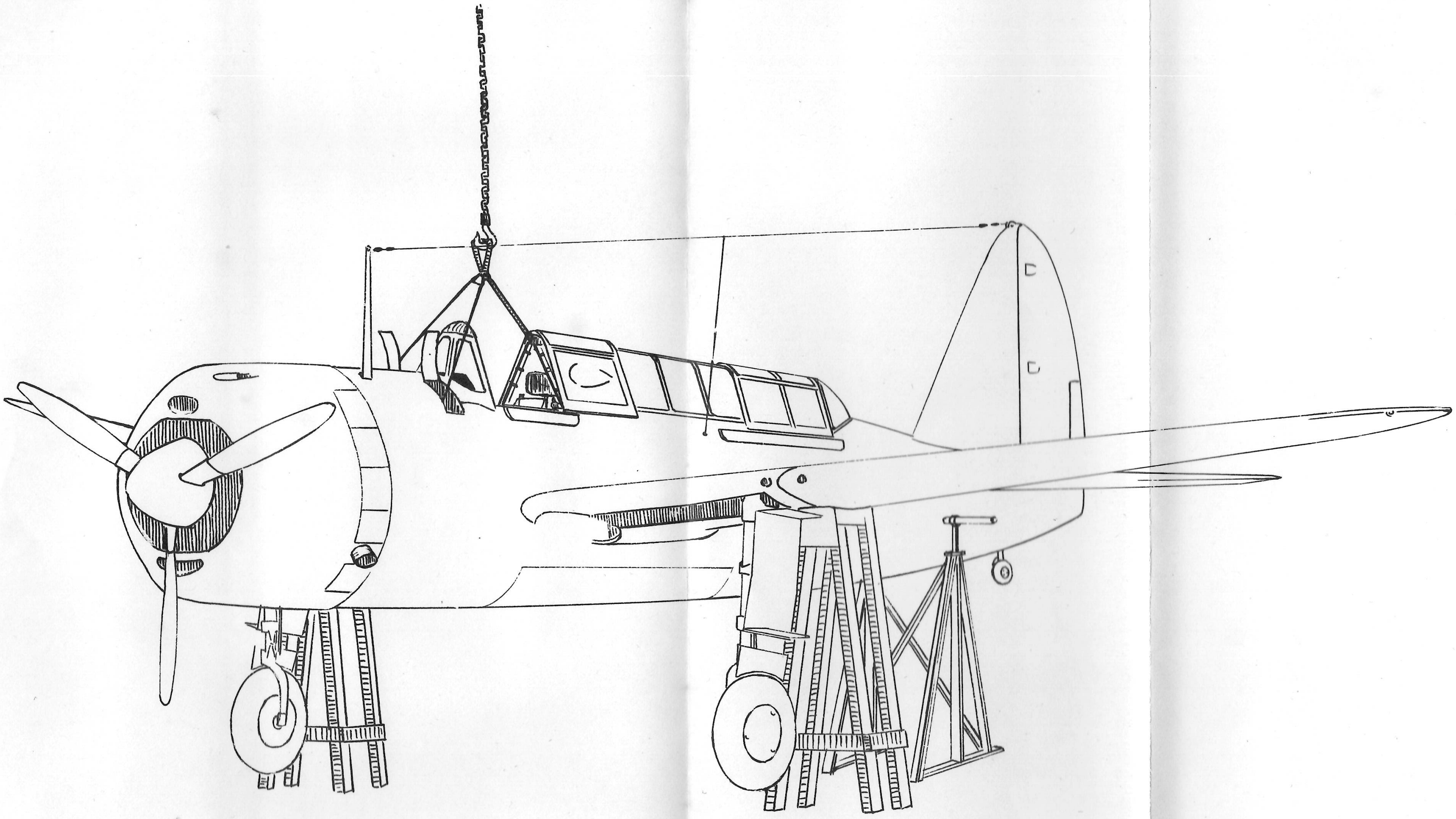




G 12-41

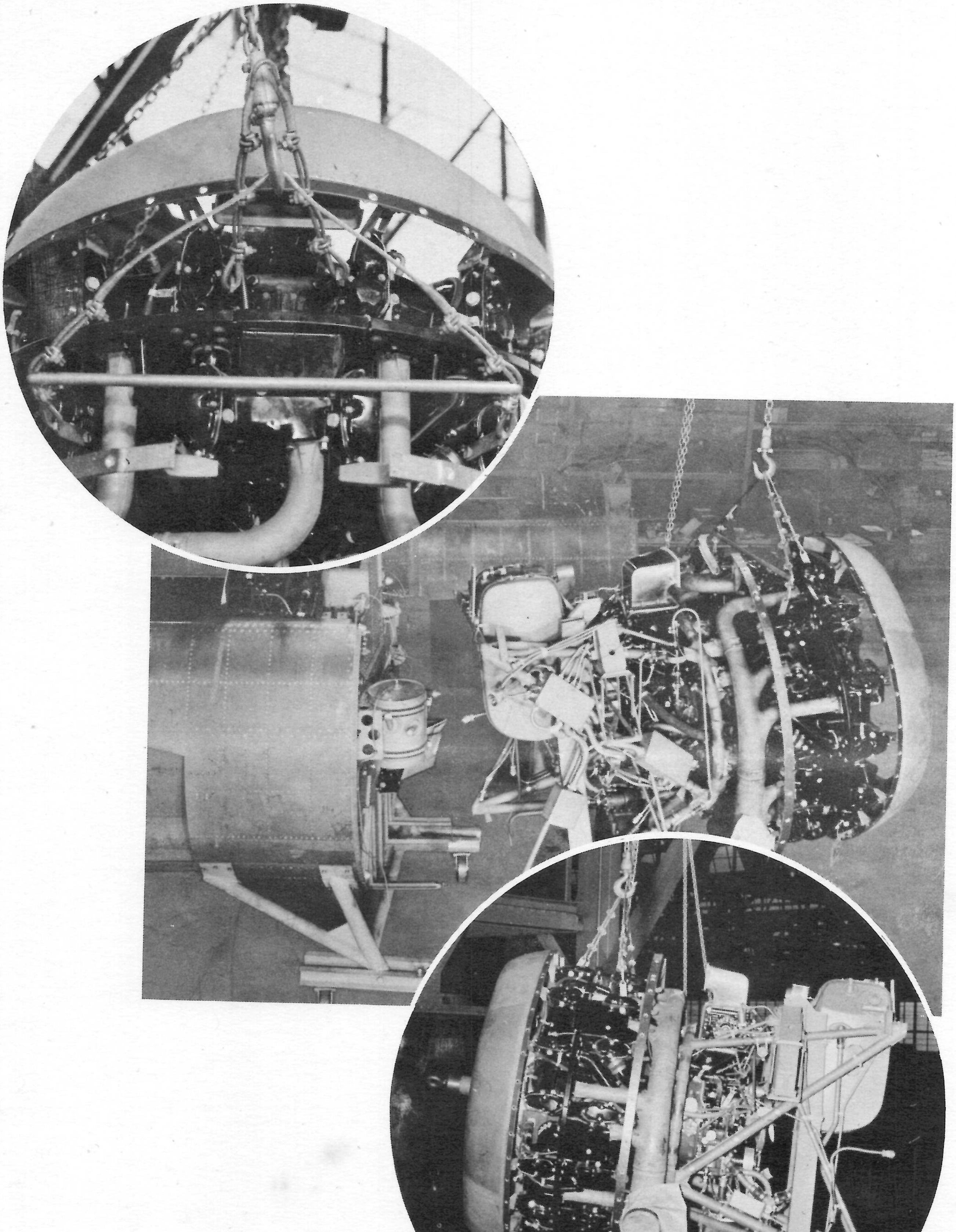


RIGGING DIAGRAM - FIG. 3-1

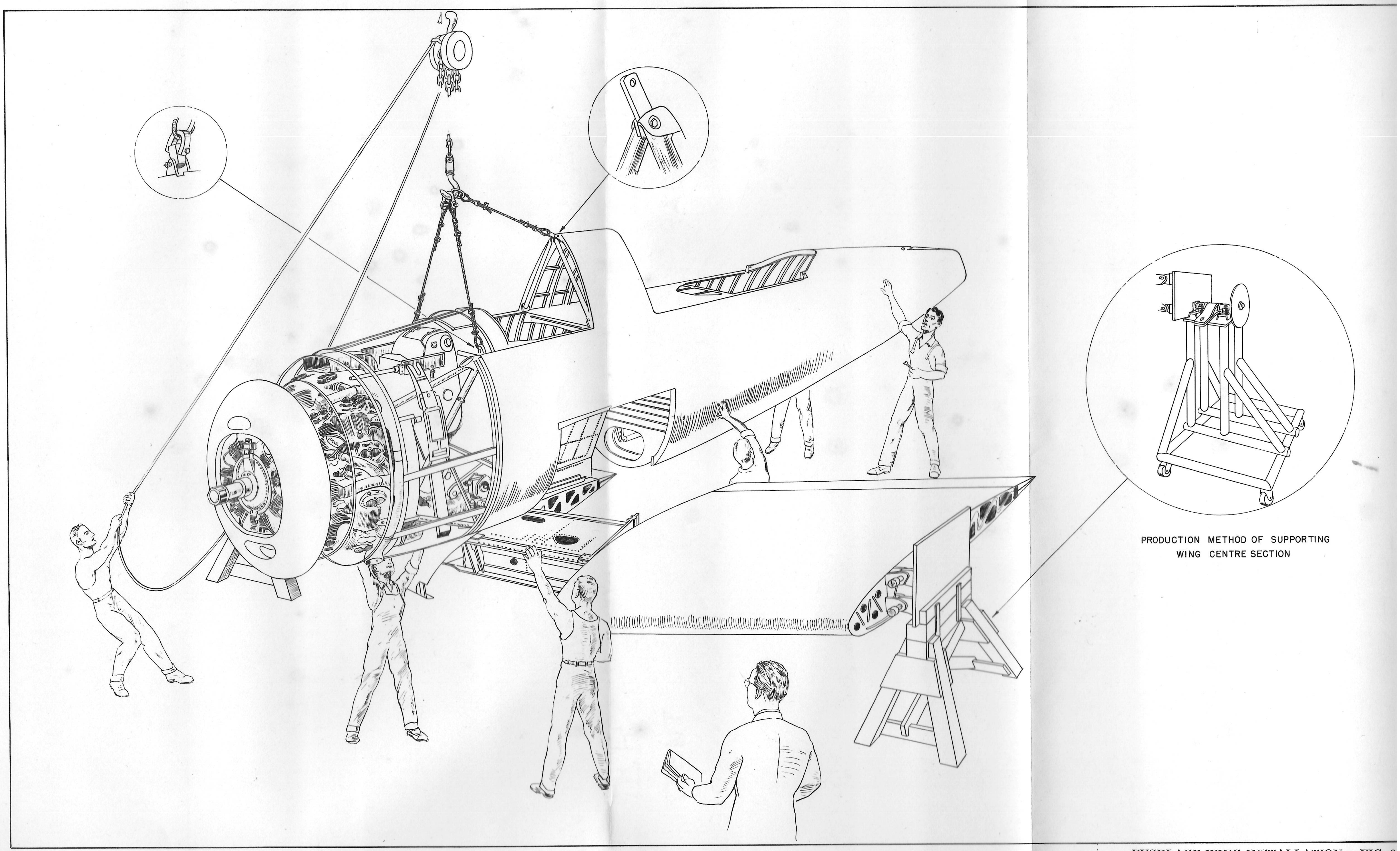


B. Koruz.

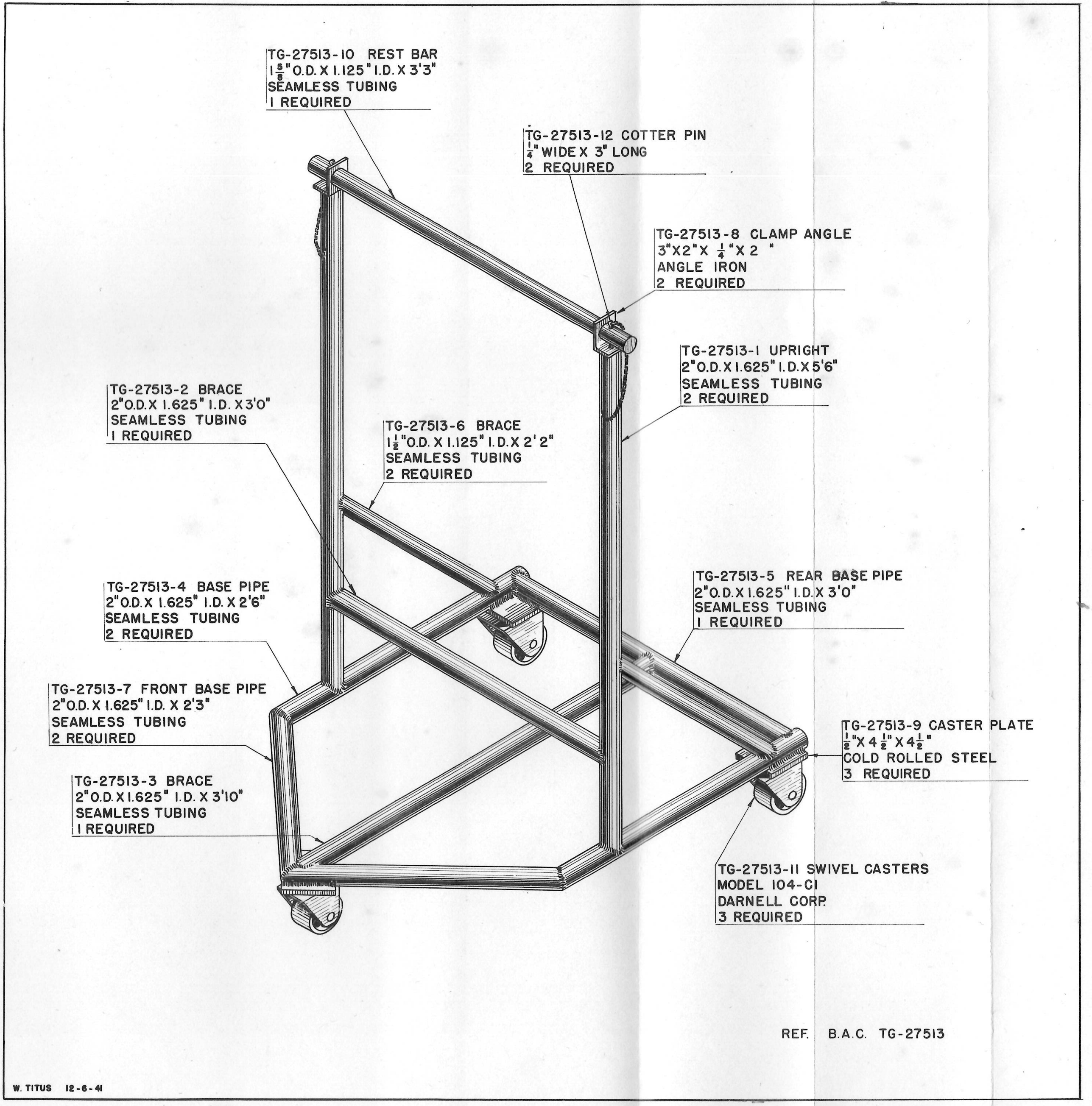
HANDLING DIAGRAM - FIG. 3-2



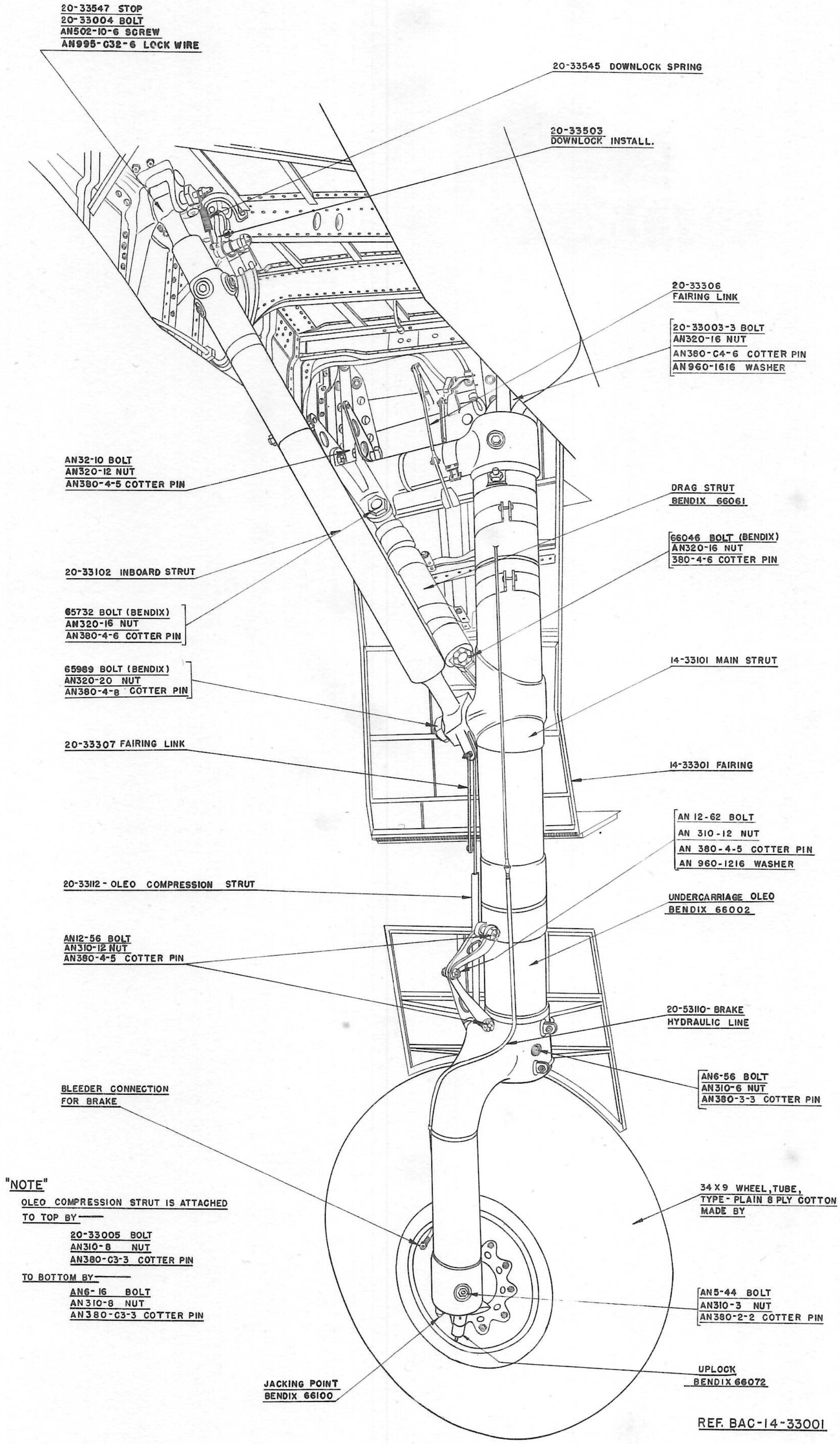
ENGINE HOISTING - FIG. 3-3



FUSELAGE WING INSTALLATION - FIG. 3



TAIL SUPPORT DOLLY - FIG. 3-5



"NOTE"

OLEO COMPRESSION STRUT IS ATTACHED

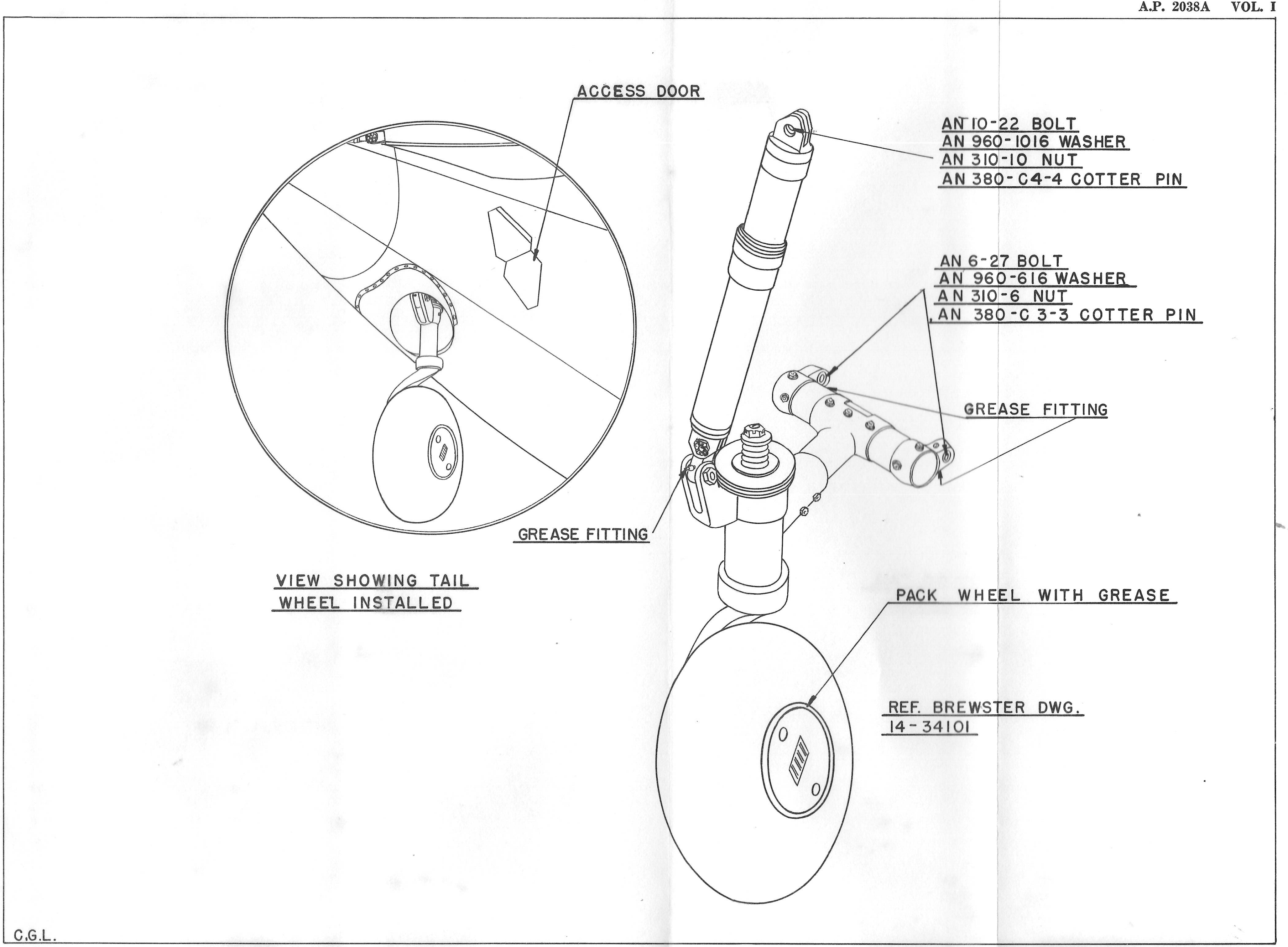
TO TOP BY——

20-33005 BOLT
AN310-8 NUT
AN380-C3-3 COTTER PIN

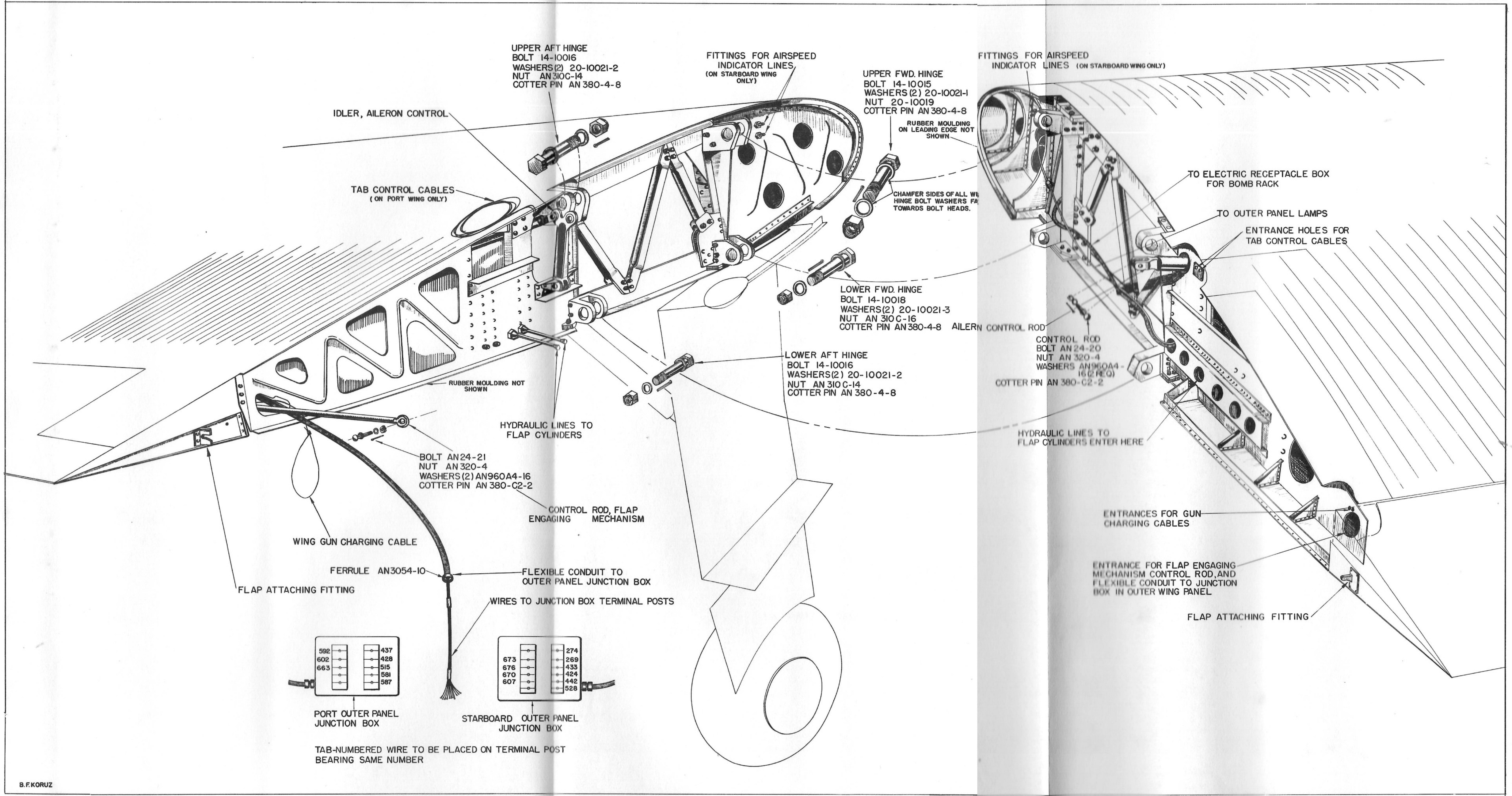
TO BOTTOM BY——

AN6-16 BOLT
AN310-8 NUT
AN380-C3-3 COTTER PIN

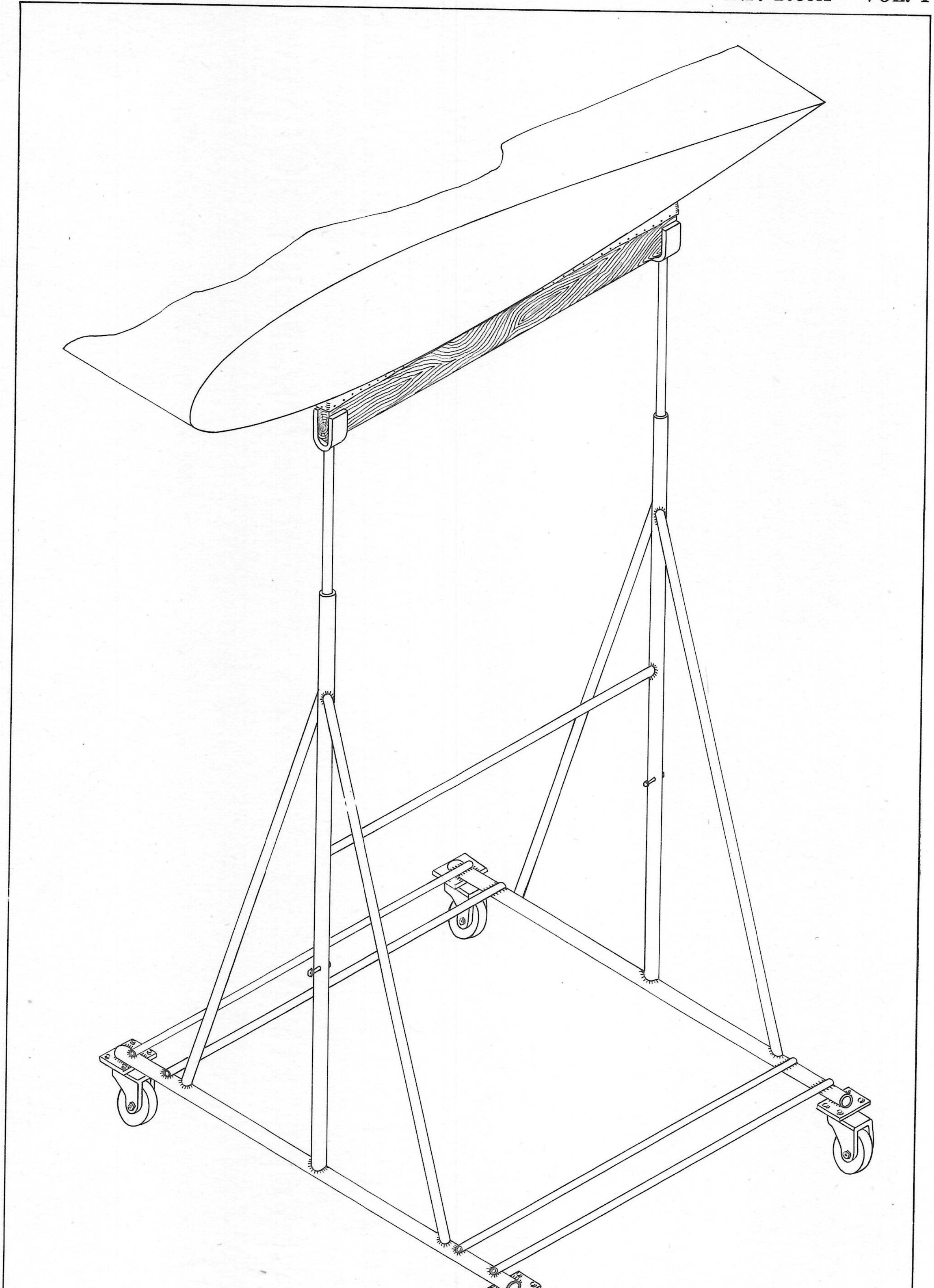
UNDERCARRIAGE INSTALLATION - FIG. 3-6



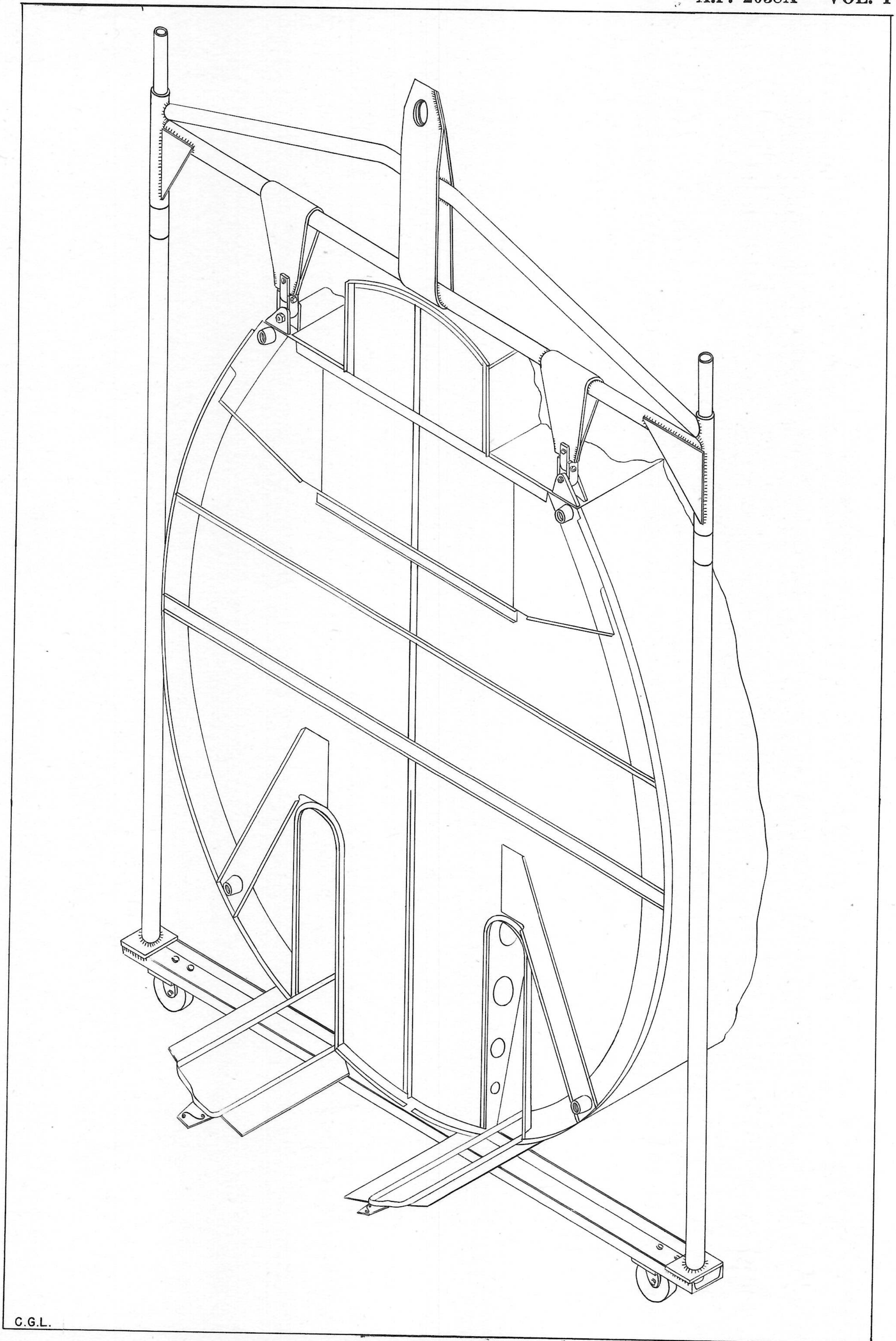
TAIL WHEEL INSTALLATION - FIG. 3-7



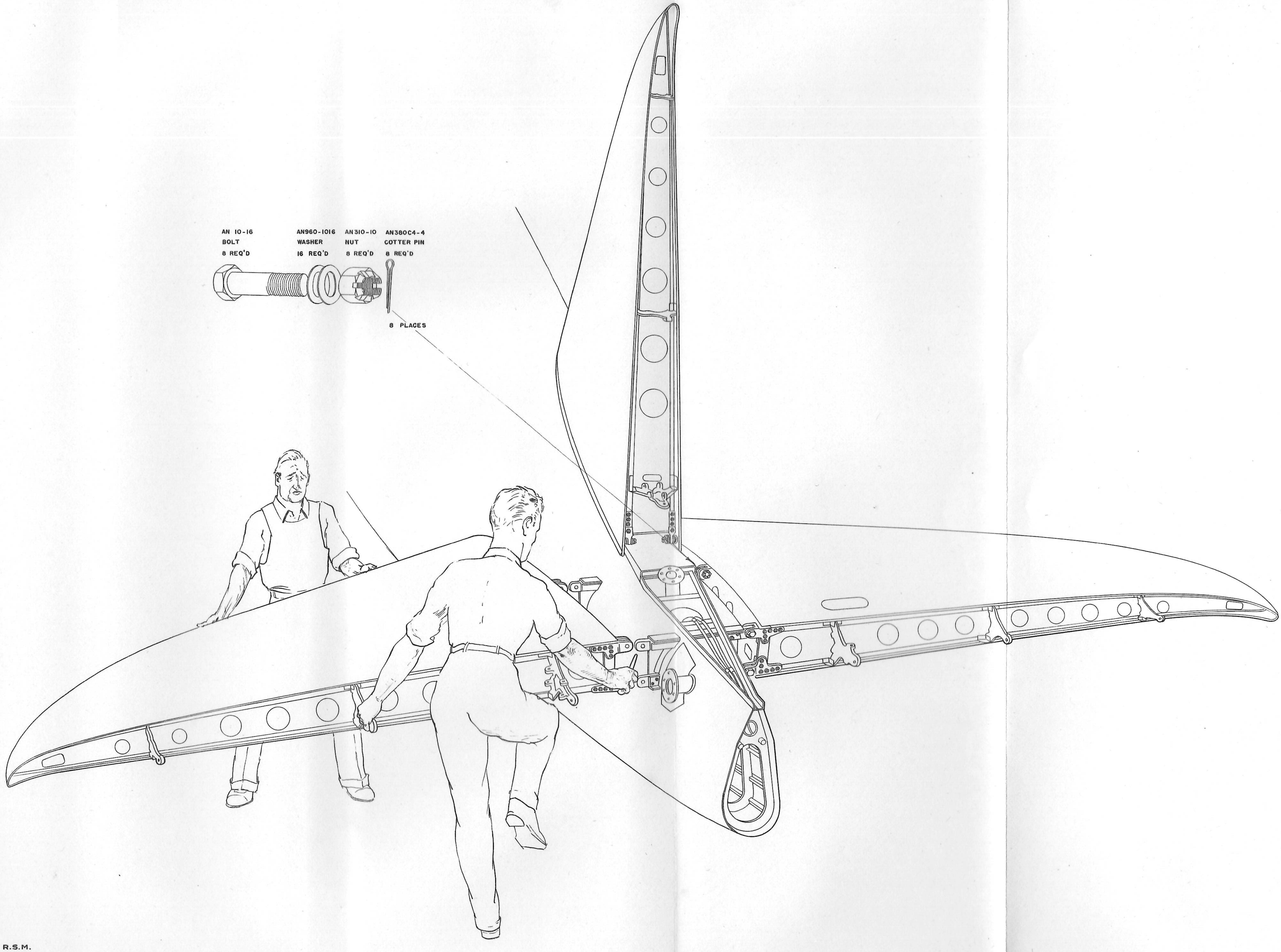
WING-OUTER PANEL INSTALLATION - FIG. 3-8



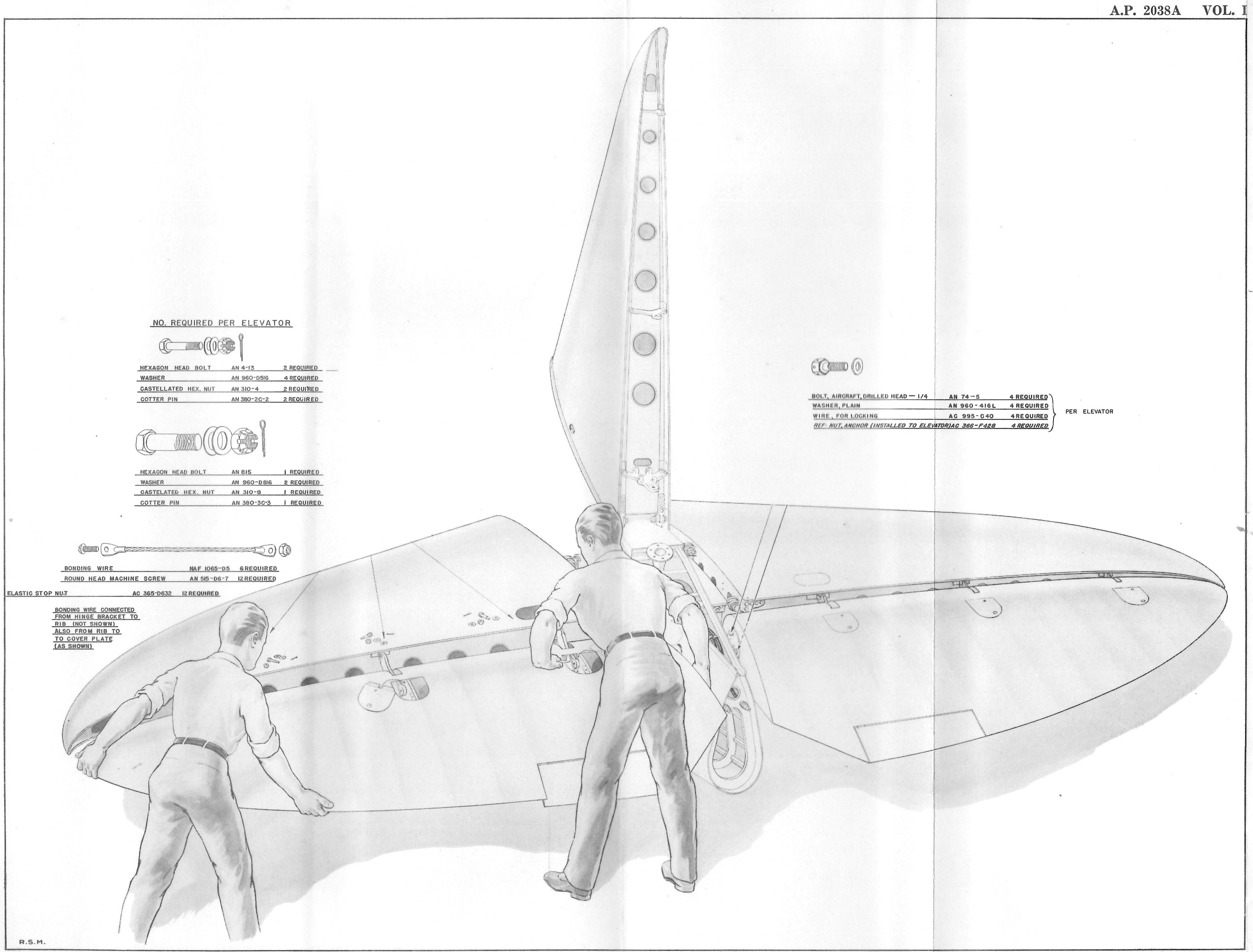
WING SUPPORT DOLLY - FIG. 3-9



FUSELAGE FORWARD END DOLLY - FIG. 3-10



STABILIZER INSTALLATION - FIG. 3-11



NO. REQUIRED PER ELEVATOR

HEXAGON HEAD BOLT	AN 4-13	2 REQUIRED
WASHER	AN 960-D516	4 REQUIRED
CASTELLATED HEX. NUT	AN 310-4	2 REQUIRED
COTTER PIN	AN 380-2C-2	2 REQUIRED

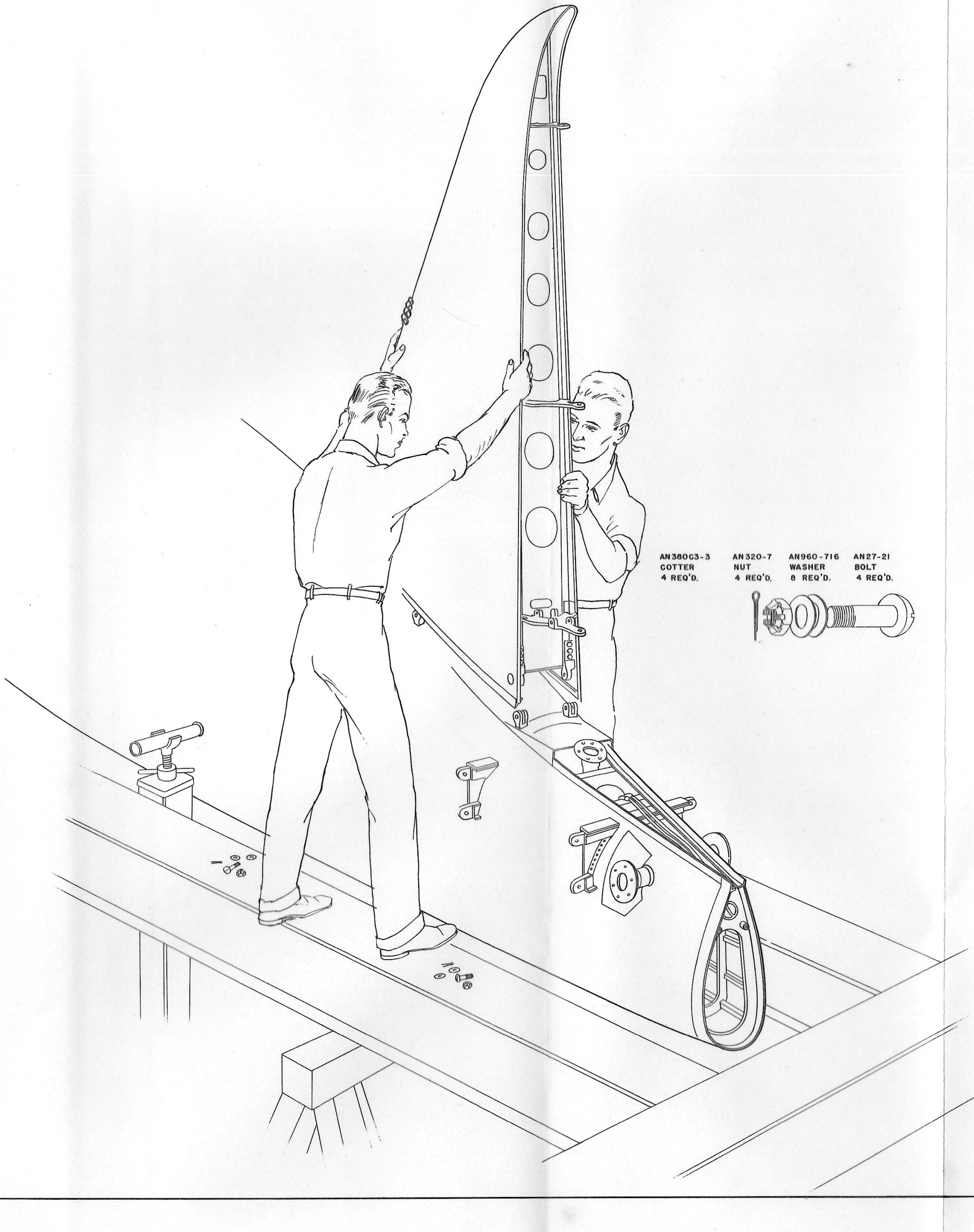
HEXAGON HEAD BOLT	AN 815	1 REQUIRED
WASHER	AN 960-D816	2 REQUIRED
CASTELATED HEX. NUT	AN 310-8	1 REQUIRED
COTTER PIN	AN 380-3C-3	1 REQUIRED

BONDING WIRE	NAF 1065-D5	6 REQUIRED
ROUND HEAD MACHINE SCREW	AN 515-D6-7	12 REQUIRED
ELASTIC STOP NUT	AC 365-D632	12 REQUIRED

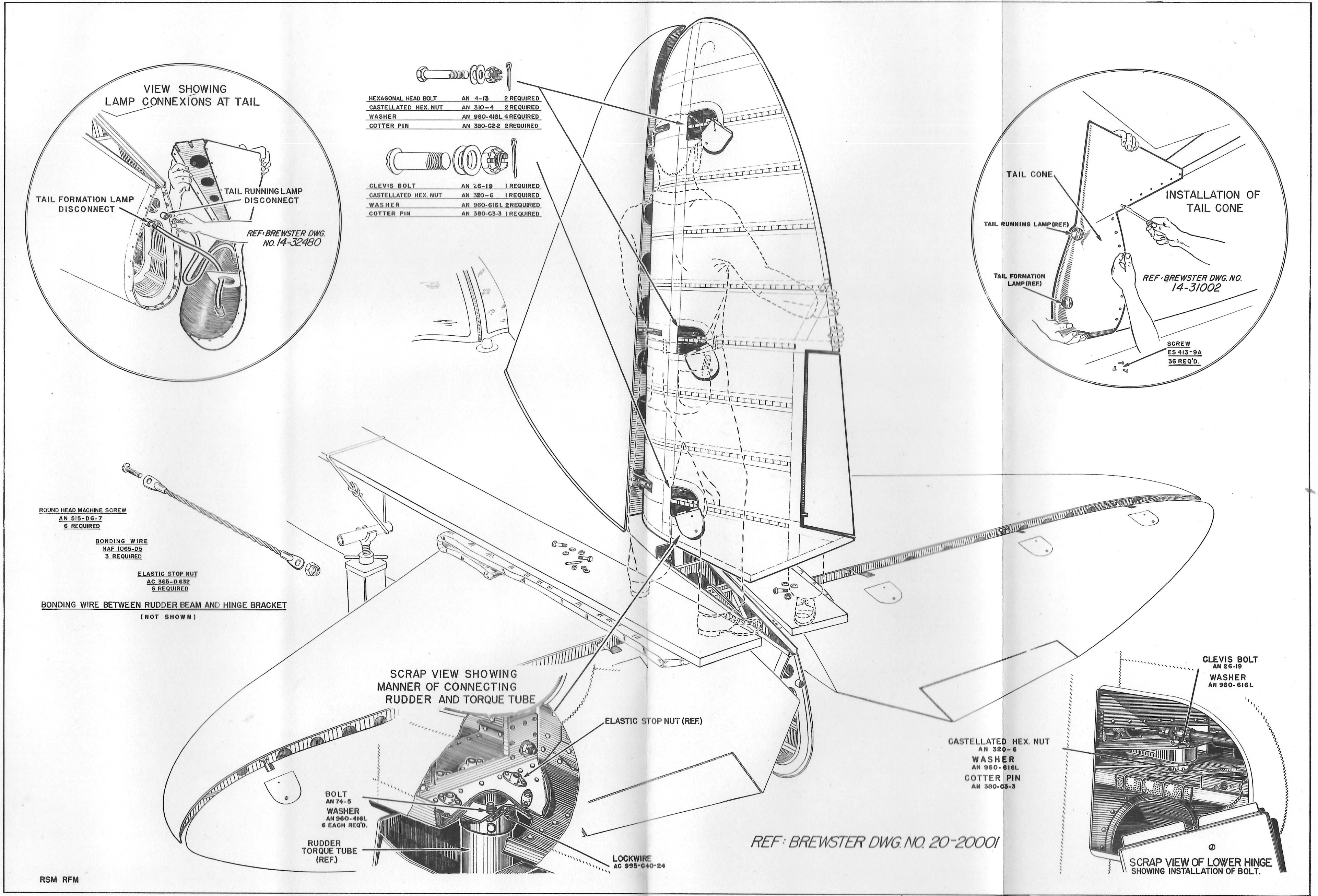
BONDING WIRE CONNECTED FROM HINGE BRACKET TO RIB (NOT SHOWN) ALSO FROM RIB TO TO COVER PLATE (AS SHOWN)

BOLT, AIRCRAFT, DRILLED HEAD — 1/4	AN 74-5	4 REQUIRED	PER ELEVATOR
WASHER, PLAIN	AN 960-416L	4 REQUIRED	
WIRE, FOR LOCKING	AC 995-C40	4 REQUIRED	
REF: NUT, ANCHOR (INSTALLED TO ELEVATOR)	*AC 366-F428*	*4 REQUIRED*	

ELEVATOR INSTALLATION - FIG. 3-12



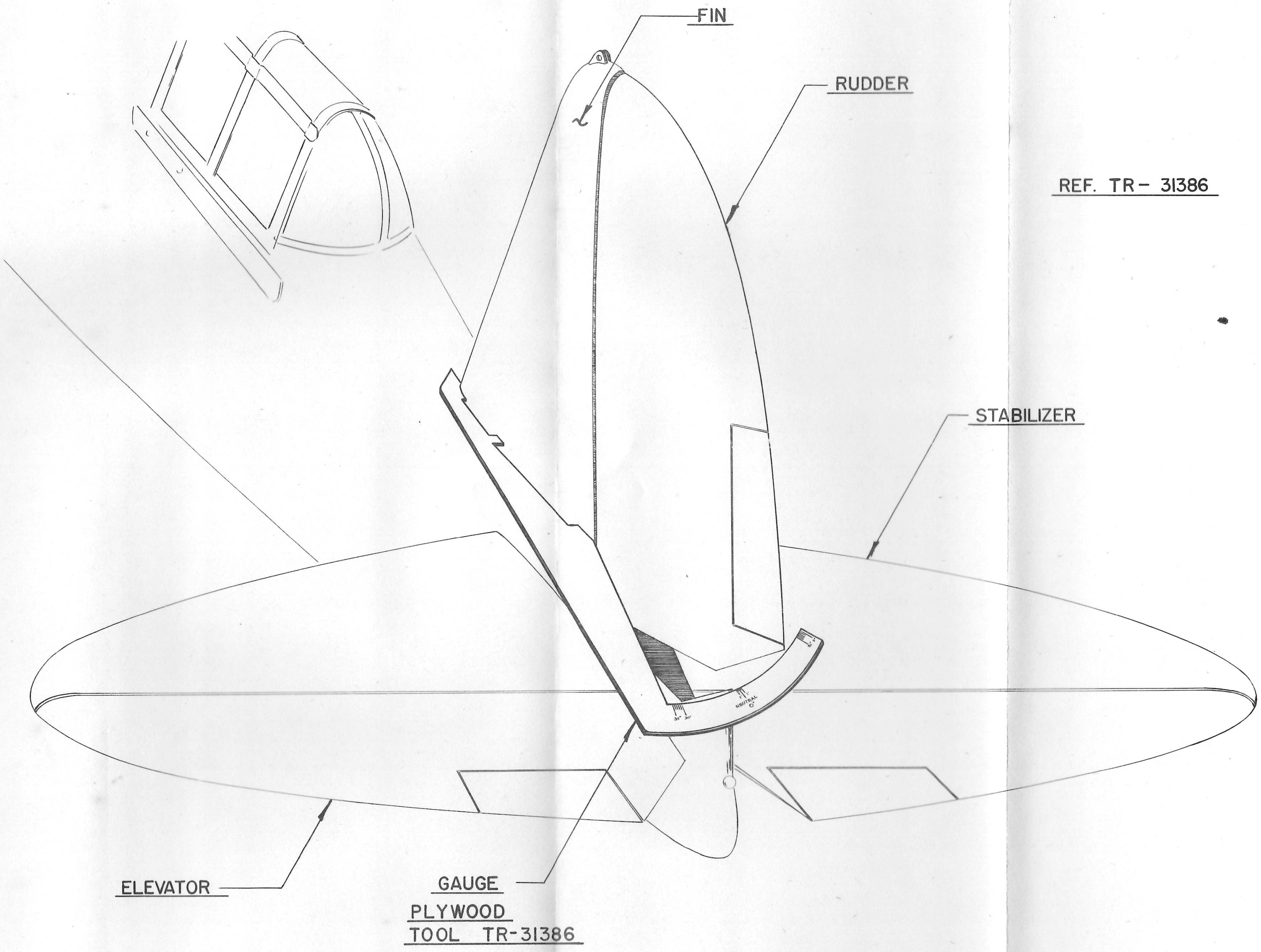
FIN INSTALLATION - FIG. 3-13



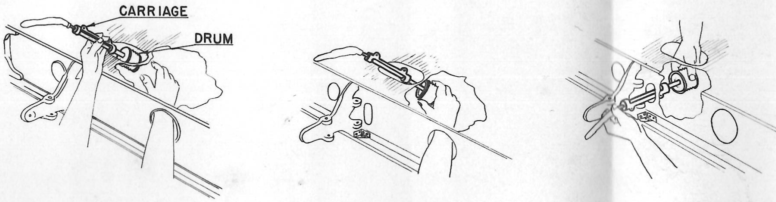
HEXAGONAL HEAD BOLT	AN 4-13	2 REQUIRED
CASTELLATED HEX. NUT	AN 310-4	2 REQUIRED
WASHER	AN 960-416L	4 REQUIRED
COTTER PIN	AN 380-C2-2	2 REQUIRED

CLEVIS BOLT	AN 26-19	1 REQUIRED
CASTELLATED HEX. NUT	AN 320-6	1 REQUIRED
WASHER	AN 960-616L	2 REQUIRED
COTTER PIN	AN 380-C3-3	1 REQUIRED

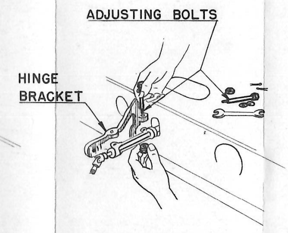
RUDDER INSTALLATION - FIG. 3-14



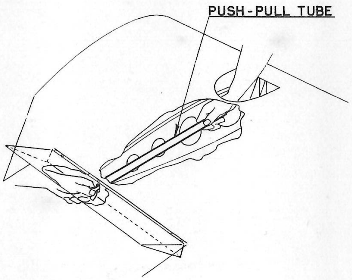
RUDDER SETTING GAUGE - FIG. 3-15



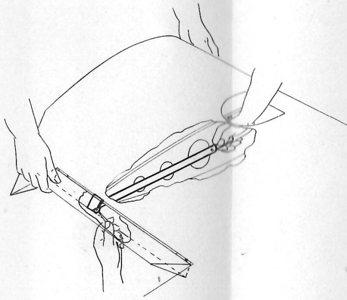
OPERATION 1
INSERTING DRUM AND CARRIAGE ASSEMBLY THROUGH ACCESS DOOR IN FIXED SURFACE.



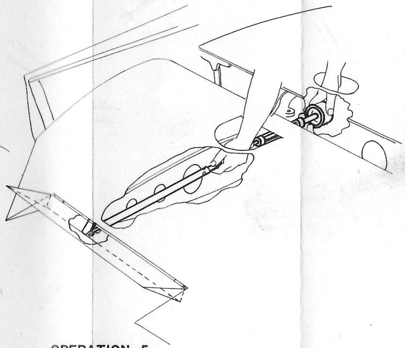
OPERATION 2
INSTALLING ADJUSTING BOLTS CONNECTING CARRIAGE ASSEMBLY TO HINGE BRACKET.



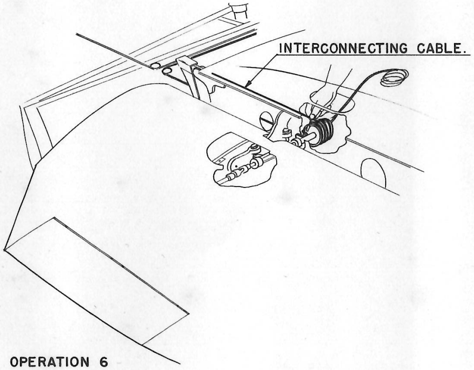
OPERATION 3
INSERTING PUSH-PULL TUBE ASSEMBLY TO MOVABLE SURFACE.



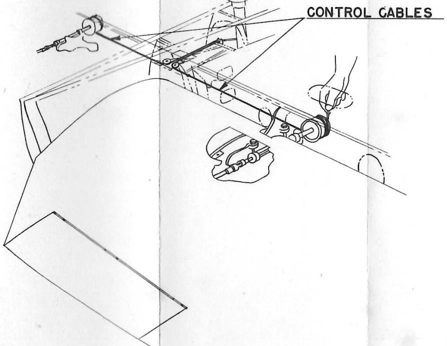
OPERATION 4
ATTACHING PUSH-PULL TUBE ASSEMBLY TO TAB.



OPERATION 5
ADJUSTING PUSH-PULL TUBE ASSEMBLY ON SCREW FOR PROPER LENGTH.

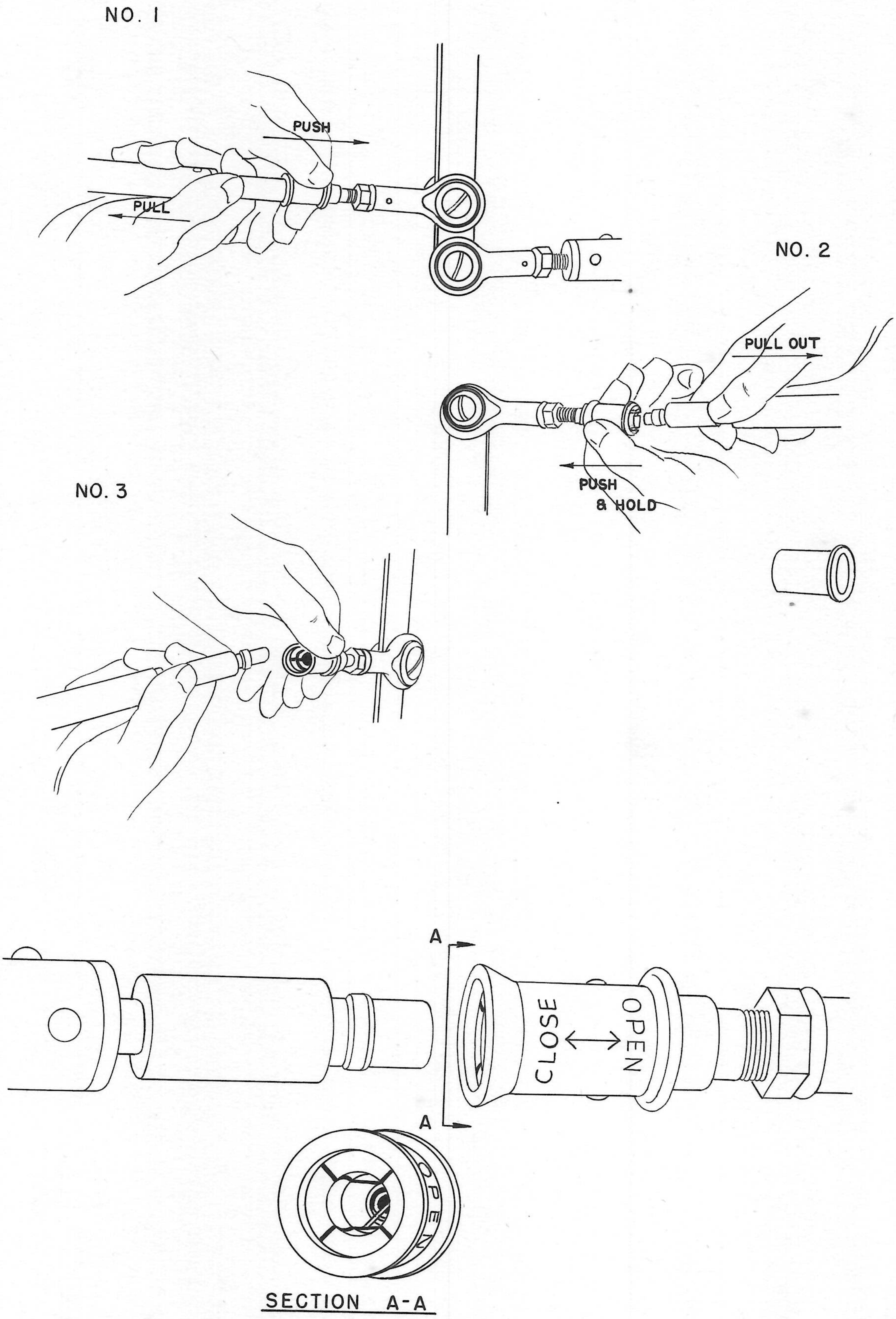


OPERATION 6
LOCKING END OF CABLE INTERCONNECTING ELEVATOR TAB DRUMS.

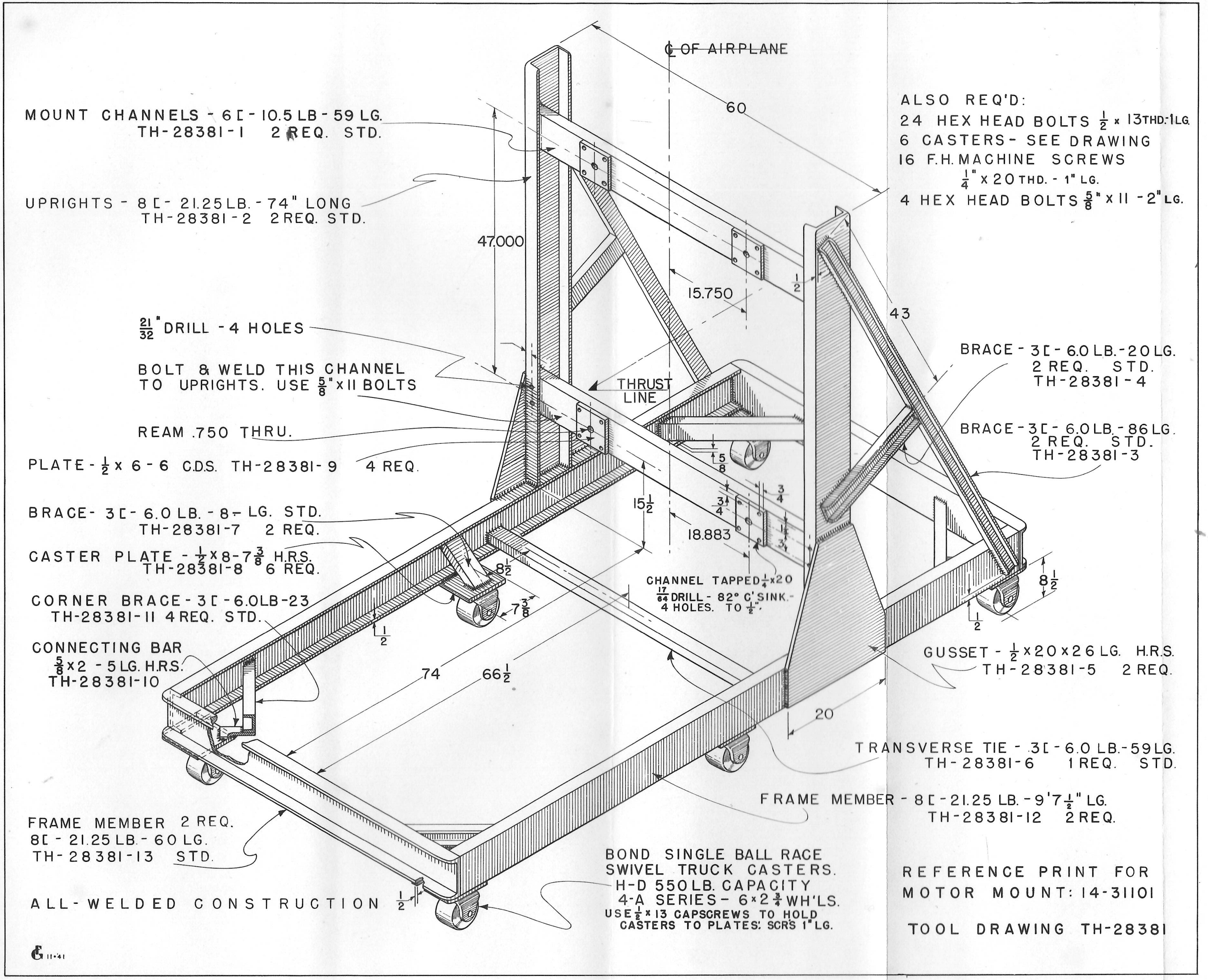


OPERATION 7
TAB CABLES INSTALLED BETWEEN COCKPIT CONTROLS AND MOVABLE SURFACES. CABLE END BEING LOCKED TO DRUM.

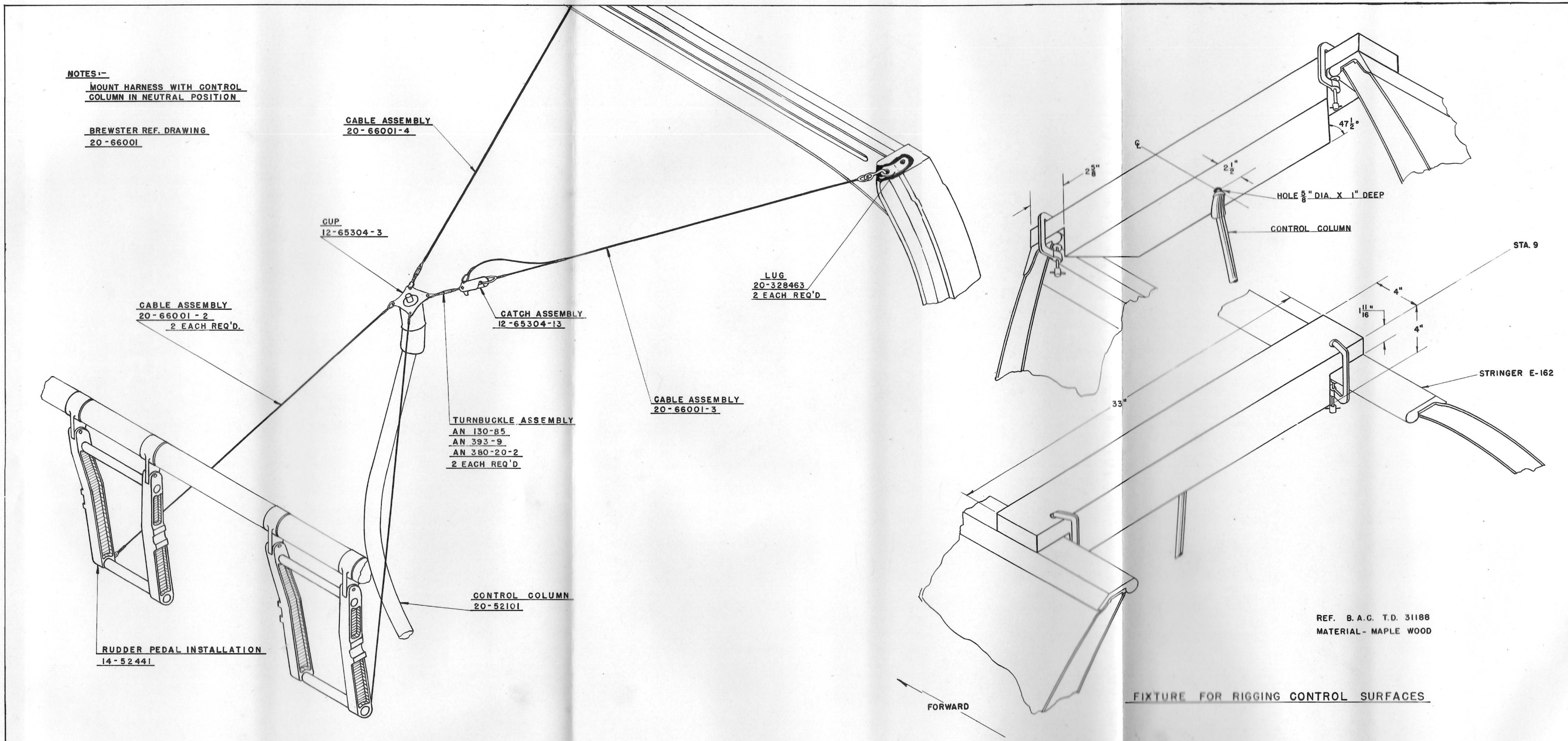
TAB INSTALLATION - FIG. 3-16



PUSH-PULL ROD QUICK DISCONNECT - FIG. 3-18



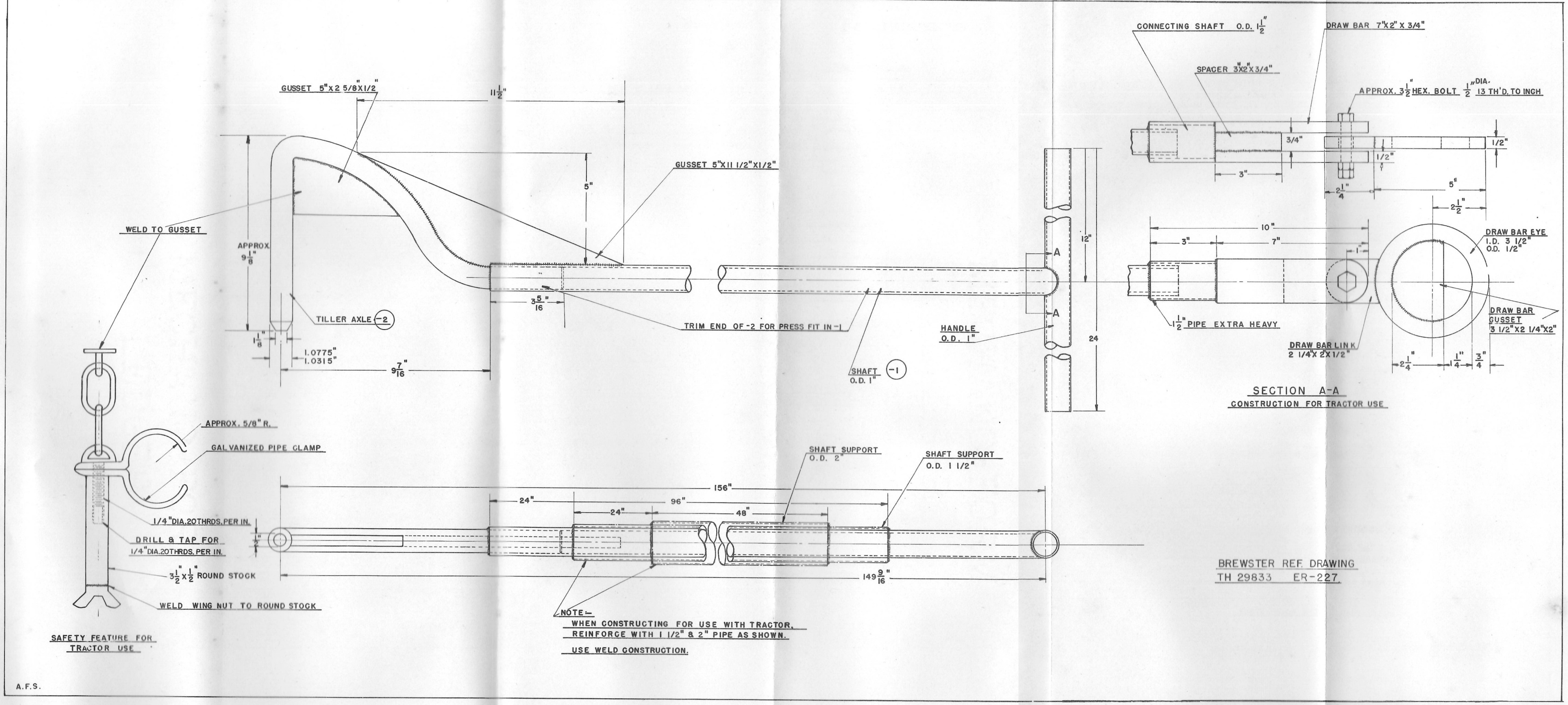
MOTOR MOUNT DOLLY - FIG. 3-19



CONTROL LOCKING HARNESS

FIXTURE FOR RIGGING CONTROL SURFACES

CONTROL COLUMN FIXTURE - FIG. 3-20



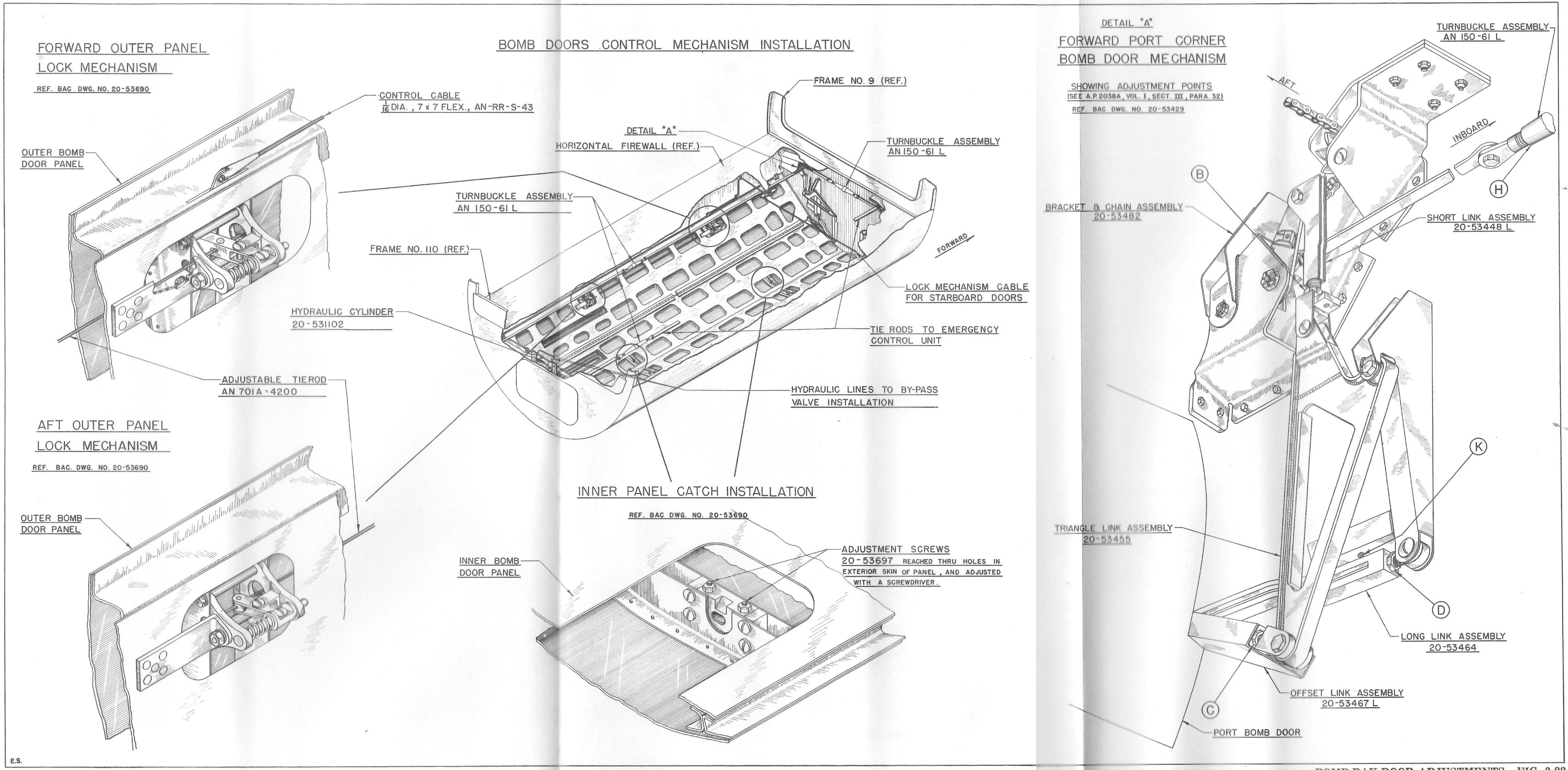
SECTION A-A
CONSTRUCTION FOR TRACTOR USE

SAFETY FEATURE FOR
TRACTOR USE

NOTE:–
WHEN CONSTRUCTING FOR USE WITH TRACTOR,
REINFORCE WITH 1 1/2" & 2" PIPE AS SHOWN.
USE WELD CONSTRUCTION.

BREWSTER REF. DRAWING
TH 29833 ER-227

TAIL WHEEL TILLER - FIG. 3-21



BOMB BAY DOOR ADJUSTMENTS - FIG. 3-22

Section IV—Service Instructions

Paragraph

Instruments

- Description

Hydraulic system

- Description

Figure Index

SECTION IV

Service Instructions

POWER PLANT
AND
POWER PLANT CONTROLS

1 General: This group includes the following items (see figs. 4-1, 4-2, 4-3 and 4-4):

Power plant.
Power plant controls.
Airscrew and airscrew controls.
Starter and starter controls.
Cowl gills and cowl gills controls.
Fire extinguisher and fire extinguisher controls.
Exhaust system.
Engine mount.

Power Plant

2 General: The engine supplied with this aircraft is an air-cooled fourteen (14) cylinder Wright Cyclone, Model R2600A5B-5, manufactured by the Wright Aeronautical Corporation of Paterson, New Jersey, U. S. A.

3 Description: A full description of the engine and specifications thereof is given in the relevant engine handbook.

4 Operation: The operation of the engine, during flight, is explained in detail in the Pilot's Notes, Air Publication 2038A. Operation of the engine on the ground shall be governed by the official operational limitations (see Pilot's Notes or engine operational limitations leaflet), in so far as manifold pressure, R.P.M., oil and fuel pressures, oil and cylinder head temperatures are concerned. The cowl gills must be fully open during all engine ground operation.

5 A satisfactory routine of starting and stopping the engine follows. (See also Pilot's Notes. The instructions in the Pilot's Notes shall be followed if they differ from those given below.)

Starting:

a. Open cowl gills.

b. Airscrew Master Safety Switch "on" and Selector Switch set to "auto."

c. Airscrew governor control lever in aft position marked "increase R.P.M."

d. Supercharger control in "low" blower (aft).

e. Mixture control in "full rich" (forward).

f. Throttle control in a position to develop 800 to 1000 R.P.M. This position will vary slightly with each aeroplane, but should be between $^1/_5$ and $^1/_4$ open from the closed position.

g. Fuel valve in "On-Starboard Reserve" tank.

h. Operate wobble pump to obtain six (6) lbs. per sq. in. on fuel pressure gauge. The wobble pump must be operated continuously during actual priming and starting operations.

i. Prime the engine by depressing the electric primer switch for three to twenty seconds, depending on atmospheric conditions—the amount of prime increases with colder conditions. During the priming operation the airscrew MUST be turned over, by hand, four revolutions to obtain at least two full turns of the engine crankshaft.

j. Turn ignition switch to "both on." The ignition switch in the gunner's cockpit must be in the "both on" position at all times.

k. Energize the electric inertia starter by moving the starter switch upwards for a period of five seconds or until the inertia flywheel has reached its maximum speed—which is indicated when no further change in the sound produced by the starter is noted.

l. The final operation requires that three things be done simultaneously and immediately after the inertia flywheel has reached maximum speed. These three things are:

Snap the starter switch downwards to engage the starter,
Depress the electric primer switch to obtain fuel,
Operate wobble pump to maintain fuel pressure.

Continue this operation until the engine fires regularly or the inertia starter comes to rest. It is important that these primer operations be continued until the engine does fire regularly. The booster coil in the ignition system operates only when the starter is engaged. Without priming, the fuel supply to the engine is inadequate, and fuel pressure can only be obtained with the wobble pump.

m. If the engine fails to start, turn the ignition switch to the "off" position and repeat operations (h) to (l) inclusive.

Stopping:

a. Cowl gills *open*.

b. Supercharger control in "low" blower.

c. Airscrew governor control in "low" pitch.

d. Airscrew master switch in "on" position and selector switch set to "auto" position.

e. Open throttle to position to develop 1000 to 1200 R.P.M.

f. Use the oil dilution system as recommended in the Pilot's Notes.

g. Mixture control valve to "idle cut-off" position.

h. Fuel valve to "off" position.

i. Ignition switch to "off" position.

6 SERVICING AND MAINTENANCE: Information concerning the servicing and maintenance of the Wright R2600A5B-5 engine will be found in the relevant engine handbook.

Power Plant Controls

7 GENERAL: The power plant controls include the throttle, mixture and supercharger controls, primarily. The controls for the starter, airscrew, fire extinguisher system and cowl gills are explained under separate headings in this section of the handbook. The electric primer is discussed in paragraph 111. Two ignition switches are provided, one in each cockpit.

8 DESCRIPTION: The power plant primary control system consists of two engine control quadrants (one in each cockpit), push-pull rods, bell-cranks, levers and cables. A skeleton engine control quadrant is located in the gunner's cockpit which is mechanically interconnected with the engine control quadrant in the pilot's cockpit for the operation of the throttle only.

9 The engine control quadrant in the pilot's cockpit includes levers and knobs for four controls. Starting with the farthest outboard knob and progressing inboard, they are:

Airscrew governor control (marked "P")
Throttle control
Mixture control (marked "M")
Supercharger speed control (marked "SC")

The throttle control does not have a knob, the knob being replaced by a bomb release switch. The quadrant design provides an adjustable throttle stop, a latching device for intermediate settings of the airscrew governor and provisions for automatically resetting the mixture control to "full rich" when the throttle is opened to obtain full power.

10 Push-pull rods are used to transmit motion from the engine control quadrant to bell-cranks and levers supported on the forward side of the fireproof bulkhead for the operation of the throttle, mixture and supercharger controls. Push-pull rods are also used to transmit motion from the fireproof bulkhead to the unit actuating levers, except that two lengths of cable are used in the throttle control system between the fireproof bulkhead and the engine bell-cranks. The push-pull rods are provided with sealed bearings and adjustable (length) ends. The adjustable ends are furnished with jam nuts for securing. The cables are furnished with turnbuckles. Quick disconnection of all control rods may be accomplished at the fireproof bulkhead. Electrical bonding is provided across control connections, where required.

11 OPERATION: The throttle control is operated by moving the throttle lever fore and aft in either the pilot's or gunner's cockpit. The throttle is "closed" when in the rearmost position. Opening the throttle to increase power or speed is accomplished by moving the throttle lever forward. The stop provided in the quadrant should be adjusted to provide the proper combination of R.P.M. and manifold pressure for take-off when the airscrew pitch is properly adjusted.

12 The mixture control lever provides correction for the fuel/air ratio. The mixture control is normally placed in the "full rich" position which is the rearmost position of the lever in the quadrant. Moving the lever forward "leans" (i.e., weakens) the mixture. The extreme forward position of the mixture control lever actuates the idle cut-off valve in the carburetor for stopping the engine. The quadrant design provides automatic return of the mixture control to the "full rich" position when full or near full power is used.

13 The supercharger control is provided with two positions. The rear position is "low" and the forward position is "high." The engine manufacturer recommends that the supercharger speed should not be changed at intervals of less than five minutes. The control should be moved from one setting to another in a period of time of one to two seconds. The control lever should not be left in any intermediate position. The use of "high" blower causes a marked reduction in power at sea level and low altitudes and should only be used at the higher altitudes for which it is intended.

14 Two ignition switches are furnished, one in each cockpit. The switches are connected in a parallel circuit and are not mechanically inter-connected. Both switches must be in the "both on" position when the engine is running. The engine ignition may be cut off from either cockpit.

15 SERVICING AND MAINTENANCE: The general security of all connections should be inspected at each engine check period. Push-pull rod end bearings should be inspected for dents, out-of-rounds or damaged dust plates. Damaged rod-ends must be replaced. Excessive dirt and dust deposits should be removed with a spray cleaner. Never immerse sealed bearings in any fluid. Bonding connections should be inspected at the same time.

16 The adjustment of the cables in the throttle control system shall be inspected at each engine check period. The cables should be adjusted to eliminate any lag in throttle operation, avoiding excessive tightness.

17 Excessive looseness which causes the throttle to creep, or excessive stiffness may be created by maladjustment of the engine control quadrant. Access to the friction adjustment of the quadrant is obtained by removing the side cover plate.

18 The operation of all power plant controls shall be checked before each flight.

Airscrew and Airscrew Controls

19 GENERAL: The airscrew furnished with the

Bermuda Aeroplane (see fig. 4-5) is a Curtiss electric constant speed, Model C5325-C14, manufactured by the Curtiss-Wright Corp., Curtiss Propeller Division, Caldwell, New Jersey, U. S. A. Other units employed in the airscrew control system are as follows:

Governor (Curtiss 100006-c).
Brush housing (Curtiss 104-9302).
Selector switch (Curtiss 102911).
Necessary wiring to connect the system electrically and an Arens control to provide manual control of the governor.

20 DESCRIPTION: The airscrew has a blade diameter of twelve feet. The three blades have a controllable pitch angle of 25° with the low pitch set at 28° and the high pitch set at 53°. The airscrew rotates clockwise (viewed from the cockpit) and its speed is .5625 times the engine speed. The feathering feature of the airscrew is not employed and the feathering limit switch cam is set at 53°, the same as the high pitch limit switch.

21 The governor is of the proportional speed type. The stop on the governor is adjusted to exact take-off R.P.M., when the governor control lever in the pilot's cockpit is in the extreme forward position marked "increase R.P.M." The governor is used to maintain constant speed of the airscrew and engine.

22 Variations of speed are obtained by resetting the governor control in the pilot's cockpit. The governor control functions only when the master switch is in the "on" position and the airscrew selector switch is in the position marked "auto." The governor performs no function except when operating in constant speed.

23 The selector switch (see fig. 4-5) is a four-way toggle switch which functions only when the master safety switch is in the "on" position. When the switch is positioned toward the marking "auto," constant speed operation will result. When the switch lever is positioned vertically the airscrew performs as a controllable fixed pitch airscrew. Variations in pitch are obtained by moving the selector switch lever aft and to one side or the other. Moving the lever aft and outboard will cause the pitch setting to increase, resulting in a decrease in the airscrew R.P.M. Moving the lever aft and inboard produces an opposite effect. The maximum and minimum pitch settings are established by limit-stop switches located in the airscrew motor unit. The limiting pitch setting is indicated by no further change in R.P.M. as the selector switch is held in position. The selector switch is located on a junction box just aft of the engine control quadrant. The master safety switch for the airscrew is located adjacent to the selector switch. The master switch must be in the "on" position at any time that the aeroplane is being operated. The master switch functions as a safety switch in that it returns to the neutral position in the event of an electrical overload in the airscrew or airscrew control system. To reset the master switch it is necessary to return the switch from the neutral (vertical) to the "off' position and then place the switch in the "on" position.

24 A more detailed description of the airscrew and airscrew controls is given in the Curtiss Electric Propeller Handbook.

25 OPERATION: The selection or choice of operating the airscrew at "constant speed" or "fixed pitch" is a matter for the pilot to determine after consideration of all the factors involved. In so far as ground operations are concerned the following will apply: The master switch must be kept in the "on" position. The selector switch except when otherwise necessary, will be in the "auto" position and the governor control lever (marked "P") on the engine control quadrant will be in the position marked "increase R.P.M." It will be necessary to operate in the "fixed pitch" position when making certain minor engine adjustments and when checking the engine R.P.M. to determine whether or not the engine is functioning satisfactorily.

26 The latitude of complete operating instructions is extensive. The phase of these operations is comprehensively discussed in the Curtiss Electric Propeller Handbook and it is recommended that further reference be made to that handbook.

27 SERVICING AND MAINTENANCE: Refer to the Curtiss Electric Propeller Handbook.

Starter and Starter Controls

28 GENERAL: The starter is a combination direct drive and inertia type designated as Series 41. It is manufactured by the Eclipse Aviation Corporation, East Orange, New Jersey, U. S. A. Provision is made to energize the inertia flywheel manually with a hand crank.

29 The starting system also includes the following:

Starter relay solenoid (Eclipse C-53540-2).
Battery booster coil (Eclipse 91662).
Hand crank (Eclipse D-57431-1).
Three position starter control switch and necessary electrical wiring.

30 DESCRIPTION: The starter is provided with an integral solenoid engaging device. A standard six inch mounting flange is furnished and the starter weighs fifty-three and one-half pounds. Operating as a direct drive starter against a torque of four hundred pound feet, the current draw for this twenty-four volt unit is one hundred and forty amperes at eighteen and seven tenths volts with a cranking speed of thirty-one revolutions per minute.

31 Remote control is provided by a three position toggle switch. When the starter system is not being used the toggle switch is placed in the neutral (center) position. This toggle switch is located on the starboard side panel in the pilot's cockpit.

32 The hand crank for the starter is stowed in the baggage compartment.

33 A more complete and detailed description is given in the Eclipse Handbook.

34 OPERATION: Three methods of starter operation are provided, namely: Combination inertia-direct drive, direct drive, and inertia. The first method is accomplished by moving the engine starter switch upwards which closes a circuit to the relay solenoid. The solenoid in turn closes a circuit which operates the starter motor. The starter motor energy is transmitted through gearing to the inertia flywheel. The time required to obtain maximum speed of the inertia flywheel will vary, depending primarily upon the outside air temperature. It is always advantageous to energize the inertia flywheel to maximum speed. The relative speed of the inertia flywheel will be noted by the emitted sound. Maximum speed is indicated when the sound level is stabilized. When maximum speed has been obtained in the inertia flywheel, the engine starter switch is moved downwards. Moving the toggle switch downwards completes three circuits. The three circuits are the battery booster coil, the starter engaging solenoid and the starter relay solenoid. This permits the kinetic energy of the inertia flywheel and the prime energy of the starting motor to be used jointly and the engine ignition system to be aided by the battery booster coil. This method of starter operation is the most efficient and economical.

35 The second method is to use the starter as a direct drive. It is accomplished by moving the starter switch downwards which completes the circuits to the booster coil, starter relay, and starter engagement device. In this instance the starter motor is directly engaged to the engine and is not aided by the inertia flywheel. This method of starter operation should be used only to start an engine which is warmed up by recent operation. Its use, generally, should be discouraged.

36 The third method is the use of the inertia starter (energized by hand crank or external energizer) which is intended to meet emergencies when the required electrical supply is not available. To energize the starter either the hand crank or an external energizer is inserted into the hand crank extension (located on the lower starboard side of the engine accessory compartment) and rotated until maximum speed of the inertia flywheel has been attained. The starter is then engaged. This means of operating the starter is not so effective as the combination direct-drive/inertia starting method; however, it is adequate for emergency starting.

37 SERVICING AND MAINTENANCE: The reliability of starters and starting systems is quite high. Routine inspection and a check for general security, at each engine check period, should include careful inspection of attaching and parting surfaces for loosening. For other information on servicing and maintainance refer to the Eclipse Handbook.

Cowl Gills and Cowl Gills Controls (See fig. 4-6)

38 GENERAL: The necessary additional cooling required by the engine for ground running or high power output at low airspeed is obtained by adjustable cowl gills.

39 DESCRIPTION: Ten cowl gills are located just aft of the engine nose cowl ring, four on each side above the exhaust tail pipe and one on each side below the tail pipe. The cowl gills are made of formed sheet metal with sliding fibre filler plates to maintain an unbroken face area as the circle diameter is expanded by opening. The cowl gills are hinged at the forward end and are actuated by push-pull rods.

40 The actuating system includes a series of bellcranks supported in brackets welded to the outer periphery of the engine mount ring. The bellcranks are inter-connected by push-pull rods. Push-pull rods are also used to connect, individually, the cowl gills to the bellcranks. The motion is obtained from a single hydraulic cylinder which is mounted athwartships on the lower centre portion of the engine mount ring. Fluid under pressure to operate the hydraulic system is obtained from the main hydraulic system of the aeroplane.

41 Remote control of the hydraulic system control valve is provided. The valve is mounted on the forward port side of the fireproof bulkhead just below the thrust line. The remote control system consists of an Arens control operated by a push-pull knob located under the main instrument panel on the starboard side of the pilot's cockpit.

42 The control valve is manufactured by Bendix Co. (No. 400795). The hydraulic cylinder is manufactured by the Aircraft Engineering Products Corp. (20-528146).

43 OPERATION: The cowl gills are fully opened by pulling the push-pull knob to the extreme aft position. Intermediate settings of the cowl gill opening are obtained by returning the knob to the half-way position when the desired opening is reached. The cowl gills are closed by pushing the knob to the extreme forward position. The cowl gills should always be fully open when the engine is operated on the ground.

44 SERVICING AND MAINTENANCE: The general security of all exposed parts of the cowl gills and their controls should be inspected daily.

45 Satisfactory operation of the cowl gills should be checked before each flight.

46 Excessive lubrication results in an accumulation of dirt and dust. Such dirt and dust contain much abrasive matter. The deposits of dirt and dust should be removed regularly. This applies particularly to the sliding surfaces of the cowl gills and sliding filler plates.

47 Minor dents in the cowl gills may be dis-

regarded. Loose rivets shall be replaced immediately. Abraded surfaces shall be recoated with a corrosion preventive finish. Badly damaged cowl gills must be replaced.

48 The hydraulic actuating cylinder for the cowl gills shall be serviced in the same manner as the other units of the main hydraulic system.

Fire Extinguisher and Fire Extinguisher Controls

49 General: The fire extinguishing system is of the compressed carbon dioxide (CO_2) type, operated manually or automatically. The automatic operation is produced either by flame or shock actuators. The hand-operated carbon tetrachloride fire extinguisher supplied with the aeroplane is not considered a part of the fire extinguishing system. The system consists of the following items (see fig. 4-7):

CO_2 cylinder (Kidde 23101).
Cylinder operating head (Kidde 24785).
Four flame actuators (Kidde 23081).
Shock actuator (Kidde 78914).
Electric valve cartridge (Kidde 64062).
Perforated gas discharge ring and necessary wiring and tubing to connect the system.

50 Description: The cylinder is mounted aft of the fireproof bulkhead on the starboard side. It is accessible from the pilot's cockpit. The cylinder has a capacity of five pounds of carbon dioxide (CO_2) which is compressed to an average pressure of 850 lb./sq. in. at 70° F. The pressure increases with elevated temperatures. The maximum allowable storage temperature for a fully charged cylinder is 130° F. A safety disc in the head of the cylinder will rupture at 2350–2400 lb./sq. in. Cylinder charge is determined by weight.

51 The system includes an overboard discharge fitting which is located in the starboard fuselage skin just forward of the cylinder. The opening in the fuselage skin is fitted with a thin cover plate, coloured red. In the event that the pressure safety disc in the head of the cylinder is ruptured, the red coloured cover plate over the discharge fitting will also be ruptured. This provides an external visual means of noting an accidental blow-off of the cylinder. It must be remembered, however, that the red coloured cover plate will not show a depletion of gas charge resulting from a slow leak or operation of the system.

52 The operating head on the cylinder includes provisions for operating either manually or by an electric valve cartridge. The electric valve cartridge is discharged by an electrical impulse from either the shock actuator or one of the flame actuators.

53 A shock actuator is located near the centreline of the aeroplane on the forward side of the fireproof bulkhead. It contains a weight held in place by a spring. The weight may be moved to close a circuit that will energize the electric valve cartridge when a shock load occurs. The actuator is adjustable and is set for 6G when the aircraft is delivered. Adjustment is provided by means of a screw on the starboard side of the actuator. This provides automatic operation of the fire extinguishing system in the event of a crash.

54 Four flame actuators are installed in the engine accessory compartment. A temperature of 300° to 450° F. causes a fusible link to melt and close an electric circuit. The presence of an open flame will cause instantaneous action of the actuator. Either one of the four actuators will energize the electric valve cartridge.

55 A perforated discharge tube is used to obtain distribution of gas to the desired areas. The tube is formed into a large ring which encircles the engine aft of the cylinder row with one end continuing up and around the carburetor air intake. Both ends are plugged and the ring is perforated at two inch intervals with .063 inch diameter holes.

56 Operation: The fire extinguishing system is operated manually by pulling the release handle fully out. The handle is located on the starboard side panel. When the handle is fully pulled out, a lever is tripped in the operating head on the charged cylinder which pierces a disc and releases the gas. The gas flows through a line of tubing to the perforated gas discharge ring where it issues through the perforations.

57 Automatic operation occurs whenever either the shock or flame actuators energize the electric valve cartridge. A piston is moved in the operating head by the explosion of the valve cartridge, tripping the same lever that is actuated by manual operation.

58 Servicing and Maintenance: The condition of the red coloured blow-out plate should be checked before each flight. The cylinder must be recharged or replaced when the blow-out plate is shattered. Also, it must be recharged or replaced after each use.

59 The general security of the fire extinguishing system shall be checked at each engine check period.

60 The cylinder shall be removed and checked for gas charge every 120 flight hours or three months—whichever occurs first. A log tag will be found attached to the top of each cylinder which shows the net and gross weight of the cylinder. The cylinder shall be recharged or replaced when the weight of the gas has diminished by four ounces. The result of each weight check shall be logged on the log card.

Exhaust System

61 General: The exhaust system consists of two collector manifold assemblies shown on Solar drawing 12-818. The manifolds are manufactured by the Solar Aircraft Co., Lindbergh Field, San Diego, California, U. S. A.

62 Description: The manifold assemblies are fabricated of four (4) sections of seam-welded stainless steel sheet. Except for the upper section, each section consists of one integral and one separate exhaust tube. The separate tubes are assembled into the sections with slip joints. The integral tubes furnish the sole support for the exhaust system and are attached to

the exhaust ports of the rear row cylinders, except for the tube leading to No. 14 cylinder which is a front row cylinder. The tube flanges are secured with brass nuts to minimize the breaking of exhaust port studs.

63 Collars are provided at the slip-joints connecting the sections together to complete the assembly.

64 The exhaust system discharges the exhaust gas to the atmosphere just under and forward of the leading edge of the wing.

65 OPERATION: The operation of the exhaust system requires no attention.

66 SERVICING AND MAINTENANCE: Give careful attention to newly installed collector rings for at least the first thirty hours of operation. Keep the tube flange attaching nuts properly tightened. Inspect flanges for cracks. Obtain satisfactory adjustment of the slip-joint collars. These collars should be just barely tight. A light tap with a small hammer should move them. Avoid excessive tightness which may cause the head of the clamp bolts to snap off during engine operation.

67 After the first thirty hours check the general security of the collector manifolds at each engine check. Inspect closely for cracks.

68 Small cracks in the exhaust system may be repaired by gas welding. Much difficulty will be avoided by careful cleaning before attempting to weld stainless steel exhaust system parts.

Engine Mount

69 GENERAL: The engine mount is a conventional tubular ring rigidly attached to the fuselage by eight main brace tubes. The brace tubes converge to four points of attachment. Lord "Dynafocal" suspensions are used to attach the engine to the engine mount ring.

70 DESCRIPTION: The engine mount is fabricated of chrome molybdenum steel tubing joined by gas welding. Secondary brace tubes support the midpoint of the two long diagonal braces and an athwartships brace restrains the secondary braces from sidewise motion. Two brace tubes support the fuselage gun aft mounting posts. Brackets which support the cowl gill actuating bell cranks are welded to the engine mount ring.

71 The Lord "Dynafocal" suspensions are used to dampen out engine vibration which is absorbed by means of shear within the rubber part of these units.

72 OPERATION: The function of the engine mount is to carry the torque, thrust and weight loads from the engine back into the fuselage structure. When the engine mount is in a satisfactory state of repair these functions are maintained without further attention.

73 SERVICING AND MAINTENANCE: At each engine check period the engine mount shall be checked for:

a. General security.

b. Cracks and dents in steel tubing.

c. Decomposition of Dynafocal suspension rubber parts.

d. Tightness of bolts to engine mount ring. Lubricate the bolts attaching the suspension to the brackets on the engine mount ring.

74 Careful attention must be given to the Dynafocal suspension bracket attaching bolts. Should these bolts be too tight, undesirable loads will be imposed on both the bracket and the suspension unit. The life of the rubber parts of the suspension units will be lengthened by avoiding the accumulation of mineral oils and greases.

75 At each engine change period the engine mount should be completely inspected after removal of the finish (preferably by sand blast). Carefully repair or correct all faults noted and completely refinish.

76 Repairs to the engine mount will be made in accordance with Volume II of Air Publication 2038A.

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(ALPHABETICALLY ARRANGED)

POWER PLANT DIAGRAMS

(FIGS. 4-1, 4-2, 4-3 and 4-4)

SYMBOL	FIG. NUMBER	PART NUMBER	NOMENCLATURE
J-19	4-2,-3,-4	NAF-1150-3AB-320	Conduit Assem.; Flexible-Shielded, Standard
J-37	4-4	NAF-1150-4A-58	Conduit Assem.; Flexible-Shielded, Standard
J-K-17	All	NAF-1150-4A-320	Conduit Assem.; Flexible-Shielded, Standard
J-39	All	NAF-1150-6A-112	Conduit Assem.; Flexible-Shielded, Standard
J-26	4-3	NAF-1150-6AC-128	Conduit Assem.; Flexible-Shielded, Standard
J-40	4-4	NAF-1150-8A-72	Conduit Assem.; Flexible-Shielded, Standard
J-23	4-3 4-4	NAF-1150-8AC-31	Conduit Assem.; Flexible-Shielded, Standard
J-41	4-4	NAF-1150-16A-50	Conduit Assem.; Flexible-Shielded, Standard
J-24	4-3	NAF-1150-16A-59	Conduit Assem.; Flexible-Shielded, Standard
J-33	4-1 4-4	NAF-1150-16A-138	Conduit Assem.; Flexible-Shielded, Standard
J-22	4-3	NAF-1150-16AB-72	Conduit Assem.; Flexible-Shielded, Standard
B-4	All	14-43004	Control Assem.; Airscrew Pitch Setting
I-6	4-2	14-43005	Control Assem.; Carburetor Air Control (forward)
I-17	4-2	14-43012	Control Assem.; Carburetor Air Control (rear)
A-20	All	14-43002	Control Assem.; Engine Controls, Front Cockpit
J-34	All	NAF-1161-1	Coupling; Conduit "Y"
D-13	4-2	NAF-213700-8D	Coupling; Tube Tee
H-51	4-1	14-47003	Cradle Assem.; Lubr. System, Oil Tank
C-3	4-3	C-57195-1 Eclipse	Crank—Extension; Hand
I-12	4-2	14-43024	Disconnect—Quick Unit; Carburetor Air Control
I-2	All	14-31582	Duct Assem.; Carburetor Air Door; Aft Section
I-4	4-1,-3,-4	14-31508	Duct—Air; Lubr. System, Eng. Cowl, Oil Cooler
B-13	4-1 4-2	14-315136	Fairlead; Airscrew Pitch Setting Control, Cowl Seal
B-10	4-2	14-315136	Fairlead; Airscrew Pitch Setting Control, Cowl Seal
L-9	4-4	26128 Purolator	Filter; Hydraulic System, Fluid Cleaning
J-10	All	F-79641 Eclipse	Generator
B-3	All	100006-C Curtiss	Governor Assem.; Airscrew Constant Speed Control
A-22	All	14-48184	Handle Assem.; Fuel System, AEL Unit Control
G-20	4-4	M-389-A-4-14	Hose Assem.; Flexible Instrument Connecting (Navy Spec.)
G-K-37	4-4	M-389-B-4-14	Hose Assem.; Flexible Instrument Connecting (Navy Spec.)
L-6	4-4	AN861-8D-18	Hose Assem.; High Pressure, Flared Tube & Swivel Connection
L-3	4-4	AN857-16D-21	Hose Assem.; Medium Pressure, Flared Tube & Swivel Connection
D-7	4-2	24657 Kidde	Hose; Automatic Fire Extinguisher, Flexible-Connecting
G-3	4-3 4-4	14-48001-15	Hose—Self Sealing; Fuel System, AEL Unit to Engine Pump
G-8	4-3	14-48001-14	Hose—Self Sealing; Fuel System, AEL Unit to Selector Valve
G-2	4-3 4-4	14-48001-16	Hose—Self Sealing; Fuel System, Eng. Pump to Carb.
A-M-36	All	14-43011	Jackshaft; Engine Controls, Supercharger
E-1	4-1,-3,-4	Solar 12-818	Manifold Assem.; Power Plant, Engine Exhaust
F-1	All	14-31101	Mount Assem.; Power Plant, Engine
C-G-7	4-1,-2,-3	A.E.L.-3	Pump; Fuel System, Hand
G-1	4-3 4-4	RD-4070-8 Romec	Pump; Power Plant, Engine Driven, Fuel
L-1	4-3 4-4	214VF Pesco	Pump; Power Plant, Engine Driven, Hydraulic
K-1	4-3	548-A Eclipse	Pump; Power Plant, Engine Driven, Vacuum
A-4	4-1,-2,-3	14-43003-13	Rod-Control Assem.; Engine Controls, Mixture
A-27	4-1,-2,-3	14-43003-34	Rod-Control Assem.; Engine Controls, Throttle (rear cockpit)
A-13	All	14-43049-1	Rod-Control Assem.; Engine Controls, Throttle-Mixture
A-17	All	14-43003-1	Rod-Control Assem.; Engine Controls, Throttle-Mixture
A-M-11	All	14-43044-1	Rod-Control Assem.; Engine Controls, Supercharger (fwd.)
A-M-18	All	14-43003-4	Rod-Control Assem.; Engine Controls, Supercharger (rear)
A-3	4-1,-2,-3	14-43003-7	Rod-Control Assem.; Engine Controls, Throttle (carb. to bellcrank)
A-21	4-1,-2,-3	14-43050	Rod-Control Assem.; Engine Controls, Throttle (cockpit interconnecting)
A-19	All	14-43046-1	Rod-Control Assem.; Fuel System, AEL Unit (fwd. cockpit)
A-23	All	14-48173-1	Rod-Control Assem.; Fuel System, AEL Unit (rear cockpit)
I-3	All	14-42002	Scoop-Elbow; Carburetor Air Door
A-24	4-1,-2,-3	49-53074	Seat; Pilot's (North American)
H-1	4-3	563-1 Eclipse	Separator—Oil; Vacuum Pump Discharge
K-2	4-3	AN9205-4	Shaft; Tachometer
J-36	4-4	AC-37D6210	Solenoid; Lubr. System, Oil Dilution Valve
C-J-31	4-1,-3,-4	F-79641 and C-53540-2	Starter; Direct/Inertia, Hand/Electric, Model 447-10, Series 41 (Eclipse)
H-19	4-1	14-47004-2	Strap Assem.; Oil Cooler, Lower Front Support
H-21	4-1	14-47004-4	Strap Assem.; Oil Cooler, Lower Rear Support
H-18	4-1	14-47004-3	Strap Assem.; Oil Cooler, Upper Front Support
H-20	4-1	14-47004-5	Strap Assem.; Oil Cooler, Upper Rear Support
C-2	4-3	14-45002	Support Assem.; Starter System, Inertia Hand Crank
A-26	4-1 4-3	14-43069	Support; Engine Controls, Rear Throttle Rod
G-9	4-3	14-48257	Support; Fuel System, AEL Unit to Selector Valve Hose
L-2	4-4	20-53112	Tank Assem.; Hydraulic System, Fluid
H-15	4-1	14-47002	Tank Assem.; Lubrication System, Oil
D-8	4-2	14-53040-2	Tube Assem.; Automatic Fire Extinguisher
G-10	4-2,-3,-4	14-48001-12	Tube Assem.; Fuel System, Fuel Pump to Carb. Vent
L-23	4-4	14-53102-29	Tube Assem.; Hydraulic System, Cowl Gill Supply
L-22	4-4	14-53102-28	Tube Assem.; Hydraulic System, Cowl Gill Supply
L-8	4-4	14-531397	Tube Assem.; Hydraulic System, Filter to Disconnect Valve
L-7	4-4	14-53102-15	Tube Assem.; Hydraulic System, Pump Pressure
L-4	4-4	14-53102-14	Tube Assem.; Hydraulic System, Pump Supply (lower)
L-5	4-4	14-53102-11	Tube Assem.; Hydraulic System, Pump Supply (upper)
L-16	4-4	14-53102-16	Tube Assem.; Hydraulic System, Tank Drain (center)
L-17	4-4	14-53102-10	Tube Assem.; Hydraulic System, Tank Drain (lower)
L-15	4-4	14-53102-7	Tube Assem.; Hydraulic System, Tank Drain (upper)
L-19	4-4	14-53102-12	Tube Assem.; Hydraulic System, Tank Return
G-K-38	4-4	14-51001-3	Tube Assem.; Instrument, Fuel Pressure Gauge
K-5	4-4	14-51001-1	Tube Assem.; Instrument, Manifold Pressure Gauge
K-21	4-4	14-51001-2	Tube Assem.; Instrument, Oil Pressure Gauge
H-2	4-3	14-42015	Tube Assem.; Instrument, Oil Separator
H-10	4-1	14-47001-5	Tube Assem.; Lubr. System, Engine Crankcase Vent
G-H-11	4-1 4-4	14-47001-9	Tube Assem.; Lubr. System, Oil Dilution Supply
K-3	4-3	14-42013	Tube Assem.; Vacuum Pump, Discharge
K-4	4-3	14-42011	Tube Assem.; Vacuum Pump, Suction
A-7	4-1,-2,-3	14-43003-10	Tube—Control Assem.; Engine Controls, Mixture
N-2	4-2	5-61429	Tube—Impulse Assem.; Synchronized Gun
G-13	4-3	14-48001-20	Tube; Fuel System, Fuel Pump Drain (lower)
G-12	4-3	14-48001-19	Tube; Fuel System, Fuel Pump Drain (upper)
A-M-34	4-4	14-48001-18	Tube; Fuel System, Supercharger Drain (lower)
A-M-33	4-4	14-48001-17	Tube; Fuel System, Supercharger Drain (upper)
L-21	4-4	14-53102-22	Tube; Hydraulic System, Pump Drain (lower)
L-20	4-4	14-53102-21	Tube; Hydraulic System, Pump Drain (upper)
L-14	4-4	20-53102-18	Tube; Hydraulic System, Tank Vent & Overflow
H-24	4-3	14-42003-14	Tube; Instrument, Oil Separator, Oil Return
H-23	4-3	14-42003-4	Tube; Instrument, Oil Separator, Overboard Drain
H-12	4-1 4-4	14-47001-8	Tube; Lubrication System, Oil Drain
H-13	4-1	14-47001-4	Tube; Lubrication System, Return, Cooler to Tank
H-9	4-1	14-47001-3	Tube; Lubrication System, Return, Pump to Cooler
H-14	4-1	14-47001-1	Tube; Lubrication System, Supply
H-16	4-1	14-47001-7	Tube; Lubrication System, Tank Filler Neck Scupper
H-8	4-1 4-4	14-47001-2	Tube; Lubrication System, "Y" Cock to Engine Supply
D-2	All	14-53040-4	Tube—Perforated Assem.; Automatic Fire Extinguisher
D-3	4-2	14-53040-5	Tube—Perforated Assem.; Automatic Fire Extinguisher
D-4	4-2	14-53040-6	Tube—Perforated Assem.; Automatic Fire Extinguisher
C-J-30	All	24V., D.C., Type E	Valve; Electric Primer (Holley)
L-18	4-4	702-HB-6D	Valve; Drain (Parker)
L-12	4-4	2258-A1 Bendix	Valve; Hydraulic System, Four-Way Control
L-11	4-4	20-53106	Valve; Hydraulic System, Relief
L-10	4-4	6D115 Electrol	Valve; Hydraulic System, Unloader
H-7	4-1 4-3	CR-161E Harrison	Valve; Oil Cooler, Thermostat Control

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(ALPHABETICALLY ARRANGED)

POWER PLANT DIAGRAMS

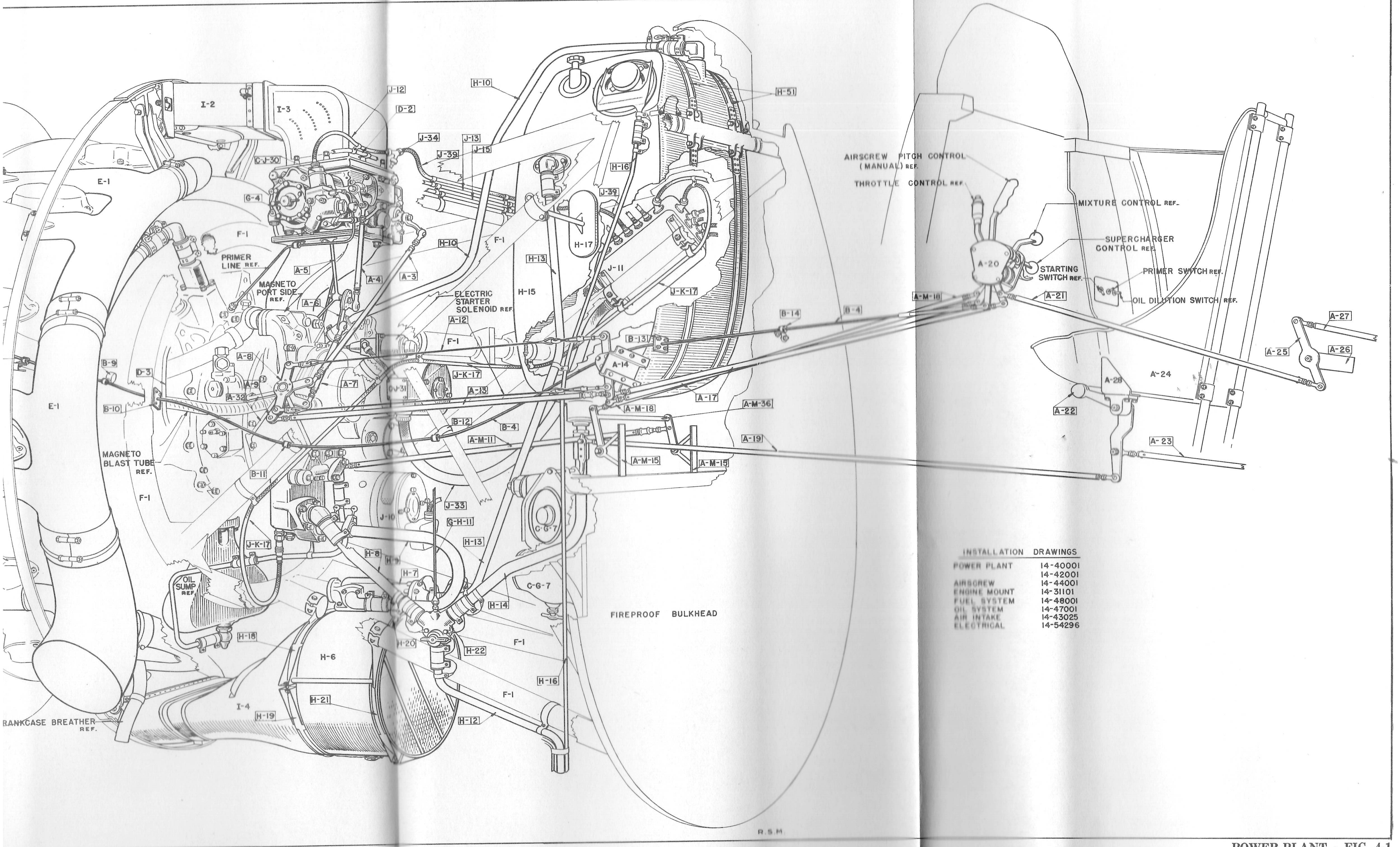
(FIGS. 4-1, 4-2, 4-3 and 4-4)

SYMBOL	FIG. NUMBER	PART NUMBER	NOMENCLATURE
L-13	4-4	HL-107 Simmonds	Accumulator; Hydraulic System
D-1	4-3 4-4	23081 Kidde	Actuator—Flame: Automatic Fire Extinguisher
D-5	4-3	78914 Kidde	Actuator—Impact; Automatic Fire Extinguisher
I-13	4-2	14-43018	Bellcrank Assem.; Carburetor Air Control
A-9	4-1,-2,-3	14-43013-2	Bellcrank Assem.; Engine Controls, Mixture (lower)
A-6	4-1,-2,-3	14-43013-1	Bellcrank Assem.; Engine Controls, Mixture (upper)
A-8	4-1,-2,-3	14-43042	Bellcrank Assem.; Engine Controls, Throttle (lower)
A-25	4-1,-2,-3	14-43013-3	Bellcrank Assem.; Engine Controls, Throttle (upper)
F-2	4-2	14-31116	Bolt; Engine Mount, Attaching
O-1	4-4	14-43055	Boot Assem.; Engine Controls, Firewall Fume Sleeve
O-2	4-4	14-48169	Boot Assem.; Fuel System, AEL Unit Control, Fume Sleeve
J-7	4-3	20-54156	Box—Junction, Assem.; Electrical System, Airscrew Control Relay
J-11	All	14-54028-1	Box—Junction, Assem.; Electrical System, Engine Mount
J-35	4-4	14-54030-1	Box—Junction, Assem.; Electrical System, Generator Control
C-J-32	4-3	14-54258-1	Box—Junction, Assem.; Electrical System, Starter Switch
H-17	4-1	14-47005	Brace Assembly; Lubr. System, Oil Tank Cradle
A-14	All	14-43007	Bracket Assem.; Engine Controls, Bellcrank, Firewall
A-32	4-1,-2,-3	14-43009	Bracket Assem.; Engine Controls, Mixture-Throttle
A-M-15	All	14-43052	Bracket Assem.; Engine Controls, Supercharger Control Jackshaft
I-14	4-2	14-329245	Bracket; Carburetor Air Control
A-5	4-1,-2,-3	14-43010	Bracket; Engine Controls, Mixture
A-28	4-1,-2,-3	14-48186	Bracket; Fuel System, AEL Unit Control Handle
H-30	4-4	14-47028	Bracket; Lubrication System, "Y" Cock
B-J-2	All	104-930-2 Curtiss	Brush Assembly; Airscrew
A-12	All	14-43048	Cable Assembly; Engine Controls, Throttle
G-4	All	1685-F Holley	Carburetor
B-12	4-1 4-2	AC735-16	Clamp; Bonding, $\frac{31}{32}$"
B-11	4-1	AC735-3	Clamp; Bonding, $1\frac{27}{32}$"
B-7	4-1	NAF1051-20	Clamp; Bonding, (Loop Type)
I-8	4-2	NAF1051-20-T	Clamp; Bonding, (Loop Type)
D-9	4-2	20-53417	Clip; Automatic Fire Extinguisher, Inner Seal
I-7,-9,-10,-11 I-15-16	4-2	1-00318-18	Clip; Standard Bonding
B-5-14	4-1 4-2	W91-8	Clip; Standard Bonding, $\frac{5}{16}$"
B-6	4-1	755-5-2-6 Adel	Clip; Support & Bonding
B-8	4-1	755-2-6 Adel	Clip; Support & Bonding
B-9	4-1	735-5-2-6 Adel	Clip; Support & Bonding
D-14	4-2	W-90-73	Clip; Tube Support
H-22	4-1 4-4	AC-37D6114-S	Cock; "Y"
H-6	4-1,-3,-4	B-8504035	Cooler—Oil; Lubrication System (Harrison Mod. CCV20)
C-J-4	4-3	C-31245 Eclipse	Coil—Booster
J-2	4-2,-3,-4	14-54296-14	Conduit Assem.; Flexible-Shielded, Airscrew Control Governor (forward)
J-43	4-3	14-54296-10	Conduit Assem.; Flexible-Shielded, Airscrew Control Governor (rear)
J-1	4-2,-3,-4	14-54296-15	Conduit Assem.; Flexible-Shielded, Airscrew Brush Ring (forward)
J-42	4-3	14-54296-11	Conduit Assem.; Flexible-Shielded, Airscrew Brush Ring (rear)
J-27	4-3	14-54296-12	Conduit Assem.; Flexible-Shielded, Airscrew Junction Box Firewall
J-15	4-1 4-3	14-54296-7	Conduit Assem.; Flexible-Shielded, Auto. Fire Exting., Flame Actuator (aft port)
J-16	4-3 4-4	14-54296-5	Conduit Assem.; Flexible-Shielded, Auto. Fire Exting., Flame Actuator (aft stbd.)
J-13	4-1 4-3	14-54296-9	Conduit Assem.; Flexible-Shielded, Auto. Fire Exting., Flame Actuator (fwd. port)
J-25	4-3	14-54296-3	Conduit Assem.; Flexible-Shielded, Auto. Fire Exting., Flame Actuator (fwd. stbd.)
J-21	4-3	14-54296-6	Conduit Assem.; Flexible-Shielded, Auto. Fire Extinguisher, Impact Actuator
J-14	4-3	14-54296-1	Conduit Assem.; Flexible-Shielded, Booster Coil to Junction Box
J-9	4-3	14-54296-16	Conduit Assem.; Flexible-Shielded, Booster Coil to Stbd. Magneto
J-12	All	14-54296-8	Conduit Assem.; Flexible-Shielded, Electric Priming Valve
J-38	4-4	14-54296-2	Conduit Assem.; Flexible-Shielded, Generator Control
J-8	4-3	14-54296-4	Conduit Assem.; Flexible-Shielded, Magneto Switch
J-20	4-3 4-4	NAF-1150-3AB-180	Conduit Assem.; Flexible-Shielded, Standard
J-18	4-3	NAF-1150-3AB-252	Conduit Assem.; Flexible-Shielded, Standard
J-19	4-2,-3,-4	NAF-1150-3AB-320	Conduit Assem.; Flexible-Shielded, Standard
J-37	4-4	NAF-1150-4A-58	Conduit Assem.; Flexible-Shielded, Standard
J-K-17	All	NAF-1150-4A-320	Conduit Assem.; Flexible-Shielded, Standard
J-39	All	NAF-1150-6A-112	Conduit Assem.; Flexible-Shielded, Standard
J-26	4-3	NAF-1150-6AC-128	Conduit Assem.; Flexible-Shielded, Standard
J-40	4-4	NAF-1150-8A-72	Conduit Assem.; Flexible-Shielded, Standard
J-23	4-3 4-4	NAF-1150-8AC-31	Conduit Assem.; Flexible-Shielded, Standard
J-41	4-4	NAF-1150-16A-50	Conduit Assem.; Flexible-Shielded, Standard
J-24	4-3	NAF-1150-16A-59	Conduit Assem.; Flexible-Shielded, Standard
J-33	4-1 4-4	NAF-1150-16A-138	Conduit Assem.; Flexible-Shielded, Standard
J-22	4-3	NAF-1150-16AB-72	Conduit Assem.; Flexible-Shielded, Standard
B-4	All	14-43004	Control Assem.; Airscrew Pitch Setting
I-6	4-2	14-43005	Control Assem.; Carburetor Air Control (forward)
I-17	4-2	14-43012	Control Assem.; Carburetor Air Control (rear)
A-20	All	14-43002	Control Assem.; Engine Controls, Front Cockpit
J-34	All	NAF-1161-1	Coupling; Conduit "Y"
D-13	4-2	NAF-213700-8D	Coupling; Tube Tee
H-51	4-1	14-47003	Cradle Assem.; Lubr. System, Oil Tank
C-3	4-3	C-57195-1 Eclipse	Crank—Extension; Hand
I-12	4-2	14-43024	Disconnect—Quick Unit; Carburetor Air Control
I-2	All	14-31582	Duct Assem.; Carburetor Air Door; Aft Section
I-4	4-1,-3,-4	14-31508	Duct—Air; Lubr. System, Eng. Cowl, Oil Cooler
B-13	4-1 4-2	14-315136	Fairlead; Airscrew Pitch Setting Control, Cowl Seal
B-10	4-2	14-315136	Fairlead; Airscrew Pitch Setting Control, Cowl Seal
L-9	4-4	26128 Purolator	Filter; Hydraulic System, Fluid Cleaning
J-10	All	F-79641 Eclipse	Generator
B-3	All	100006-C Curtiss	Governor Assem.; Airscrew Constant Speed Control
A-22	All	14-48184	Handle Assem.; Fuel System, AEL Unit Control
G-20	4-4	M-389-A-4-14	Hose Assem.; Flexible Instrument Connecting (Navy Spec.)
G-K-37	4-4	M-389-B-4-14	Hose Assem.; Flexible Instrument Connecting (Navy Spec.)
L-6	4-4	AN861-8D-18	Hose Assem.; High Pressure, Flared Tube & Swivel Connection
L-3	4-4	AN857-16D-21	Hose Assem.; Medium Pressure, Flared Tube & Swivel Connection
D-7	4-2	24657 Kidde	Hose; Automatic Fire Extinguisher, Flexible-Connecting
G-3	4-3 4-4	14-48001-15	Hose—Self Sealing; Fuel System, AEL Unit to Engine Pump
G-8	4-3	14-48001-14	Hose—Self Sealing; Fuel System, AEL Unit to Selector Valve
G-2	4-3 4-4	14-48001-16	Hose—Self Sealing; Fuel System, Eng. Pump to Carb.
A-M-36	All	14-43011	Jackshaft; Engine Controls, Supercharger
E-1	4-1,-3,-4	Solar 12-818	Manifold Assem.; Power Plant, Engine Exhaust
F-1	All	14-31101	Mount Assem.; Power Plant, Engine
C-G-7	4-1,-2,-3	A.E.L.-3	Pump; Fuel System, Hand
G-1	4-3 4-4	RD-4070-8 Romec	Pump; Power Plant, Engine Driven, Fuel
L-1	4-3 4-4	214VF Pesco	Pump; Power Plant, Engine Driven, Hydraulic
K-1	4-3	548-A Eclipse	Pump; Power Plant, Engine Driven, Vacuum
A-4	4-1,-2,-3	14-43003-13	Rod-Control Assem.; Engine Controls, Mixture
A-27	4-1,-2,-3	14-43003-34	Rod-Control Assem.; Engine Controls, Throttle (rear cockpit)
A-13	All	14-43049-1	Rod-Control Assem.; Engine Controls, Throttle-Mixture
A-17	All	14-43003-1	Rod-Control Assem.; Engine Controls, Throttle-Mixture
A-M-11	All	14-43044-1	Rod-Control Assem.; Engine Controls, Supercharger (fwd.)
A-M-18	All	14-43003-4	Rod-Control Assem.; Engine Controls, Supercharger (rear)
A-3	4-1,-2,-3	14-43003-7	Rod-Control Assem.; Engine Controls, Throttle (carb. to bellcrank)
A-21	4-1,-2,-3	14-43050	Rod-Control Assem.; Engine Controls, Throttle (cockpit interconnecting)
A-19	All	14-43046-1	Rod-Control Assem.; Fuel System, AEL Unit (fwd. cockpit)
A-23	All	14-48173-1	Rod-Control Assem.; Fuel System, AEL Unit (rear cockpit)
I-3	All	14-42002	Scoop-Elbow; Carburetor Air Door
A-24	4-1,-2,-3	49-53074	Seat; Pilot's (North American)
H-1	4-3	563-1 Eclipse	Separator—Oil; Vacuum Pump Discharge
K-2	4-3	AN9205-4	Shaft; Tachometer
J-36	4-4	AC-37D6210	Solenoid; Lubr. System, Oil Dilution Valve

INDEX TO FIGURE 4-1

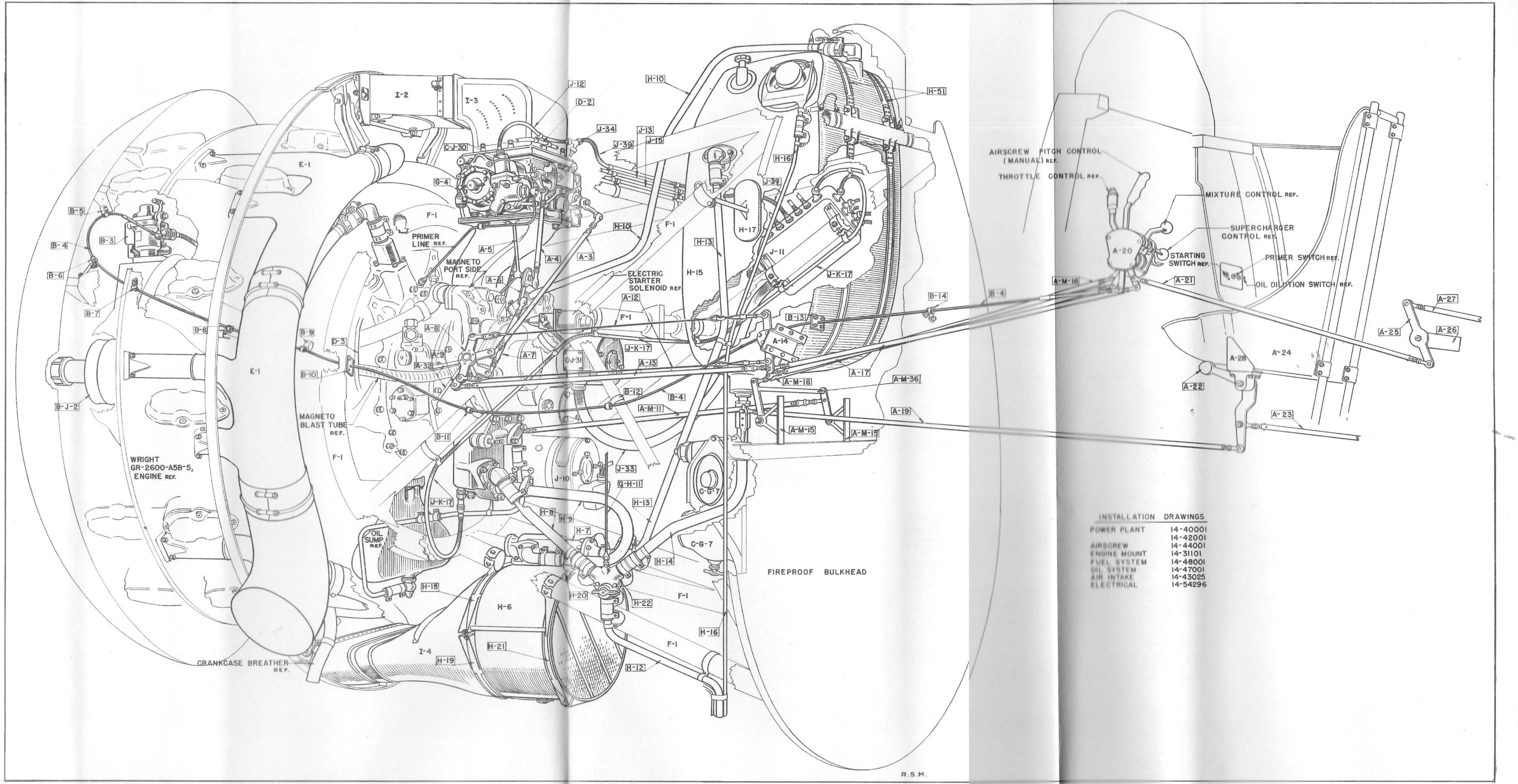
SYMBOL	PART NUMBER	NOMENCLATURE
A-3	14-43007-7	Rod-Control Assem.; Engine Controls, Mixture
A-4	14-43003-13	Rod-Control Assem.; Engine Controls, Mixture
A-5	14-43010	Bracket; Engine Controls, Mixture
A-6	14-43013-1	Bellcrank Assem.; Carburetor Air Control
A-7	14-43003-10	Tube-Control Assem.; Engine Controls, Mixture
A-8	14-43042	Bellcrank Assem.; Engine Controls, Throttle (lower)
A-9	14-43013-2	Bellcrank Assem.; Engine Controls, Mixture (lower)
A-M-11	14-43044-1	Rod-Control Assem.; Engine Controls, Mixture
A-12	14-43048	Cable Assembly; Engine Controls, Throttle
A-13	14-43049-1	Rod-Control Assem.; Engine Controls, Throttle-Mixture
A-14	14-43007	Bracket Assem.; Engine Controls, Bellcrank, Firewall
A-M-15	14-43052	Bracket Assem.; Engine Controls, Supercharger Control Jackshaft
A-17	14-43003-1	Rod-Control Assem.; Engine Controls, Throttle-Mixture
A-M-18	14-43003-4	Rod-Control Assem.; Engine Controls, Supercharger (rear cockpit)
A-19	14-43046-1	Rod-Control Assem.; Fuel System, A.E.L., (fwd. cockpit)
A-20	14-43002	Control Assem.; Engine Controls, Front Cockpit
A-21	14-43050	Rod-Control Assem.; Engine Controls, Throttle (cockpit interconnecting)
A-22	14-48184	Handle Assem.; Fuel System, A.E.L. Control
A-23	14-48173-1	Rod-Control Assem.; Fuel System, A.E.L., (rear cockpit)
A-24	49-53074	Seat; Pilot's (North American)
A-25	14-43013-3	Bellcrank Assem.; Engine Controls, Throttle (upper)
A-26	14-43069	Support; Engine Controls, Rear Throttle Rod
A-27	14-43003-34	Rod-Control Assem.; Engine Controls, Throttle (rear cockpit)
A-28	14-48186	Bracket; Fuel System, A.E.L. Control Handle
A-32	14-43009	Bracket Assem.; Engine Controls, Mixture-Throttle
A-M-36	14-43011	Jackshaft; Engine Controls, Supercharger
B-J-2	104-930-2 Curtiss	Brush Assembly; Airscrew
B-3	100006-C Curtiss	Governor Assem.; Airscrew Constant Speed Control
B-4	14-43004	Control Assem.; Airscrew Pitch Setting
B-5	W91-8	Clip; Standard Bonding, $\frac{5}{16}$″
B-6	755-5-2-6 Adel	Clip; Support & Bonding
B-7	N.A.F. 1051-201	Clamp; Bonding, (Loop Type)
B-8	755-2-6 Adel	Clip; Support & Bonding
B-9	735-5-2-6 Adel	Clip; Support & Bonding
B-10	14-315136	Fairlead; Airscrew Pitch Setting Control, Cowl Seal
B-11	AC-735-30	Clamp; Bonding, 1 27/32″
B-12	AC735-16	Clamp; Bonding, 31/32″
B-13	14315136	Fairlead; Airscrew Pitch Setting Control, Cowl Seal
B-14	W91-8	Clip; Standard Bonding, $\frac{5}{16}$″
C-G-7	A.E.L.-3	Pump; Fuel System, Hand
C-J-30	24V., D.C. Type E	Valve; Electric Primer (Holley)
C-J-31	F-79641, and C-53540-2	Starter; Direct/Inertia, Hand/Electric, Model 447-10 Series 41 (Eclipse)
D-2	14-53040-4	Tube-Perforated Assem.; Automatic Fire Extinguisher
E-1	Solar 12-818	Manifold Assem.; Power Plant, Engine Exhaust

SYMBOL	PART NUMBER	NOMENCLATURE
F-1	14-31101	Mount Assem.; Power Plant, Engine
G-4	1685-F Holley	Carburetor
C-G-7	A.E.L.-3	Pump; Fuel System, Hand
G-H-11	14-47001-9	Tube Assem.; Lubrication System, Engine Compartment
H-6	B-8504035 Harrison	Cooler-Oil; Lubrication System (Harrison Mod. CCV20)
H-7	CR.-161E Harrison	Valve; Oil Cooler, Thermostat Control
H-8	14-47001-2	Tube; Lubrication System, Cock To Engine Supply
H-9	14-47001-3	Tube; Lubrication System, Return, Pump To Cooler
H-10	14-47001-5	Tube Assem.; Lubrication System, Engine Crankcase Vent
G-H-11	14-47001-9	Tube Assem.; Lubrication System, Oil Dilution Supply
H-12	14-47001-8	Tube; Lubrication System, Oil Drain
H-13	14-47001-4	Tube; Lubrication System, Return, Cooler To Tank
H-14	14-47001-1	Tube; Lubrication System, Supply
H-15	14-47002	Tank Assem.; Lubrication System, Oil
H-16	14-47001-7	Tube; Lubrication System, Tank Filler Neck Scupper
H-17	14-47005	Brace Assembly; Lubrication System, Oil Tank Cradle
H-18	14-47004-3	Strap Assem.; Oil Cooler, Upper Front Support
H-19	14-47004-2	Strap Assem.; Oil Cooler, Lower Front Support
H-20	14-47004-5	Strap Assem.; Oil Cooler, Upper Rear Support
H-21	14-47004-4	Strap Assem.; Oil Cooler, Lower Rear Support
H-22	AC 37D6114-S	Cock; "Y"
H-51	14-47003	Cradle Assem.; Lubrication System, Oil Tank
I-2	14-31582	Duct Assem.; Carburetor Air Door, Aft Section
I-3	14-42002	Scoop-Elbow; Carburetor Air Door
I-4	14-31508	Duct-Air; Lubrication System, Eng. Cowl, Oil Cooler
J-10	F-79641 Eclipse	Generator
J-11	14-54028-1	Box-Junction, Assem.; Electric System, Engine Mount
J-12	14-54296-8	Conduit Assem.; Flexible-Shielded, Electric Priming Valve
J-13	14-54296-9	Conduit Assem.; Flexible-Shielded, Auto. Fire Extinguisher, Flame Actuator (fwd. port)
J-15	14-54296-7	Conduit Assem.; Flexible-Shielded, Auto. Fire Extinguisher, Flame Actuator (aft port)
J-K-17	N.A.F. 1150-4A-320	Conduit Assem.; Flexible-Shielded, Standard
C-J-30	24V., D.C., Type E	Valve; Electric Primer (Holley)
C-J-31	F-79641 and C-53540-2	Starter; Direct/Inertia, Hand/Electric, Model 447-10 Series 41 (Eclipse)
J-33	N.A.F. 1150-16A-138	Conduit Assem.; Flexible-Shielded, Standard
J-34	N.A.F. 1161-1	Coupling; Conduit "Y"
J-39	N.A.F. 1150-6A-112	Conduit Assem.; Flexible-Shielded, Standard
J-K-17	N.A.F. 1150-3AB-320	Conduit Assem.; Flexible-Shielded, Standard
A-M-11	14-43044-1	Rod-Control Assem.; Engine Controls, Supercharger (fwd.)
A-M-15	14-43052	Bracket Assem.; Engine Controls, Supercharger Control Jackshaft
A-M-18	14-43003-4	Rod-Control Assem.; Engine Control, Supercharger (rear)
A-M-36	14-43011	Jackshaft; Engine Controls, Supercharger



INSTALLATION	DRAWINGS
POWER PLANT	14-40001 14-42001
AIRSCREW	14-44001
ENGINE MOUNT	14-31101
FUEL SYSTEM	14-48001
OIL SYSTEM	14-47001
AIR INTAKE	14-43025
ELECTRICAL	14-54296

POWER PLANT - FIG. 4-1

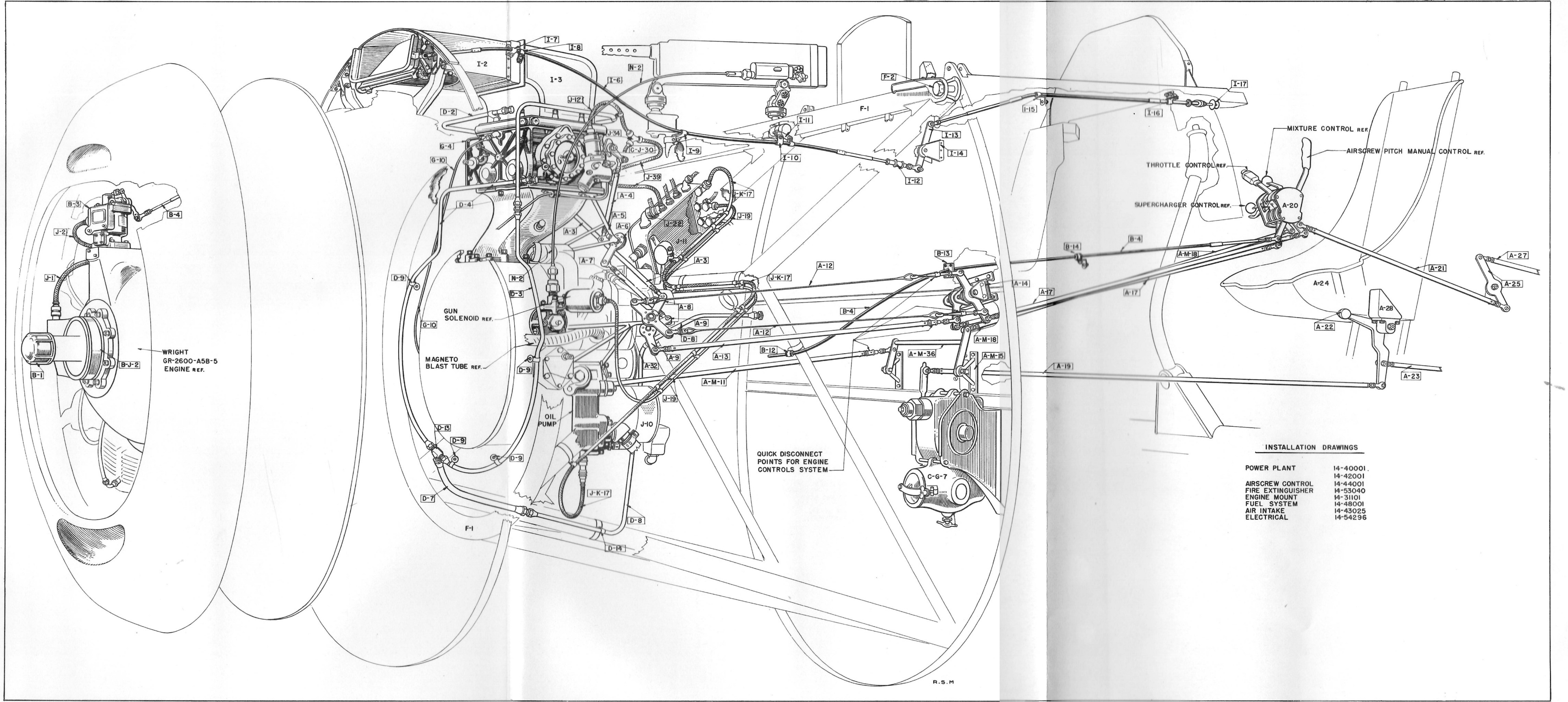


INSTALLATION	DRAWINGS
POWER PLANT	14-40001 14-42001
AIRSCREW	14-44001
ENGINE MOUNT	14-31101
FUEL SYSTEM	14-48001
OIL SYSTEM	14-47001
AIR INTAKE	14-43025
ELECTRICAL	14-54296

POWER PLANT - FIG. 4-1

INDEX TO FIGURE 4-2

SYMBOL	PART NUMBER	NOMENCLATURE
A-3	14-43003-7	Rod-Control Assem.; Engine Controls, Throttle (Carb. To Bellcrank)
A-4	14-43003-13	Rod-Control Assem.; Engine Controls, Mixture
A-5	14-43010	Bracket; Engine Controls, Mixture
A-6	14-43013-1	Bellcrank Assem.; Engine Controls, Mixture (upper)
A-7	14-43003-10	Tube-Control Assem.; Engine Controls, Mixture
A-8	14-43042	Bellcrank Assem.; Engine Controls, Throttle (lower)
A-9	14-43013-2	Bellcrank Assem.; Engine Controls, Mixture (lower)
A-M-11	14-43044-1	Rod-Control Assem,; Engine Controls, Supercharger (fwd.)
A-12	14-43048	Cable Assembly; Engine Controls, Throttle
A-13	14-43049-1	Rod-Control Assem.; Engine Controls, Throttle-Mixture
A-14	14-43007	Bracket Assem.; Engine Controls, Bellcrank, Firewall
A-M-15	14-43052	Bracket Assem.; Engine Controls, Supercharger Control Jackshaft
A-17	14-43003-1	Rod-Control Assem.; Engine Controls, Throttle-Mixture
A-M-18	14-43003-4	Rod-Control Assem.; Engine Controls, Supercharger (rear)
A-19	14-43046-1	Rod-Control Assem.; Fuel System, A.E.L., (fwd. cockpit)
A-20	14-43002	Control Assem.; Engine Controls, front cockpit
A-21	14-43050	Rod-Control Assem.; Engine Controls, Throttle (cockpit interconnecting)
A-22	14-48184	Handle Assem.; Fuel System, A.E.L. Control
A-23	14-48173-1	Rod-Control Assem.; Fuel System, A.E.L., (rear cockpit)
A-24	49-53074	Seat; Pilot's (North American)
A-25	14-43013-3	Bellcrank Assem.; Engine Controls, Throttle (upper)
A-27	14-43003-34	Rod-Control Assem.; Engine Controls, Throttle (rear cockpit)
A-28	14-48186	Bracket; Fuel System, A.E.L. Control Handle
A-32	14-43009	Bracket Assem.; Engine Controls, Mixture & Throttle
A-M-36	14-43011	Jackshaft; Engine Controls, Supercharger
B-J-2	104-930-2	Brush Assembly; Airscrew (Curtiss)
B-3	100006-C	Governor Assem.; Airscrew Constant Speed Control (Curtiss)
B-4	14-43004	Control Assem.; Airscrew Pitch Setting
B-12	AC-735-16	Clamp; Bonding, 31/32"
B-13	14-315136	Fairlead; Airscrew Pitch Setting Control, Cowl Seal
B-14	W-91-8	Clip; Standard Bonding, $\frac{5}{16}$"
C-G-7	A.E.L.-3	Pump; Fuel System, Hand
C-J-30	24V., D.C., Type E	Valve; Electric Primer (Holley)
D-2	14-53040-4	Tube-Perforated Assem.; Automatic Fire Extinguisher
D-3	14-53040-5	Tube-Perforated Assem.; Automatic Fire Extinguisher
D-4	14-53040-6	Tube-Perforated Assem.; Automatic Fire Extinguisher
D-7	Kidde-24657	Hose; Automatic Fire Extinguisher, Flexible-Connecting
D-8	14-53040-2	Tube Assem.; Automatic Fire Extinguisher
D-9	20-53417	Clip; Automatic Fire Extinguisher, Inner Seal
D-13	N.A.F. 213700-8D	Coupling; Tube Tee
D-14	W-90-73	Clip; Tube Support
F-1	14-31101	Mount Assem.; Power Plant, Engine
F-2	14-31116	Bolt; Engine Mount, Attaching
G-4	Holley 1685-F	Carburetor
C-G-7	A.E.L.-3	Pump; Fuel System, Hand
G-10	14-48001-12	Tube Assem.; Fuel System, Fuel Pump to Carb. Vent
I-2	14-31582	Duct Assem.; Carburetor Air Door, aft section
I-3	14-42002	Scoop-Elbow; Carburetor Air Door
I-6	14-43005	Control Assem.; Carburetor Air Control (forward)
I-7	1-00318-18	Clip; Standard Bonding
I-8	N.A.F. 1051-20-T	Clamp; Bonding, (Loop Type)
I-9	1-00318-18	Clip; Standard Bonding
I-10	1-00318-18	Clip; Standard Bonding
I-11	1-00318-18	Clip; Standard Bonding
I-12	14-43024	Disconnect-Quick, Unit; Carburetor Air Control
I-13	14-43018	Bellcrank Assem.; Carburetor Air Control
I-14	14-329245	Bracket; Carburetor Air Control
I-15	W-91-8	Clip; Standard Bonding, $\frac{5}{16}$"
I-16	W-91-8	Clip; Standard Bonding, $\frac{5}{16}$"
I-17	14-43012	Control Assem.; Carburetor Air Control (rear)
J-1	14-54296-15	Conduit Assem.; Flexible-Shielded, Airscrew Brush Ring (forward)
J-2	14-54296-14	Conduit Assem.; Flexible-Shielded, Airscrew Control Governor (forward)
J-10	F-79641	Generator (Eclipse)
J-11	14-54028-1	Box-Junction, Assem.; Electrical System, Engine Mount
J-12	14-54296-8	Conduit Assem.; Flexible-Shielded, Electric Priming Valve
J-K-17	N.A.F. 1150-4A-320	Conduit Assem.; Flexible-Shielded, Standard
J-19	N.A.F. 1150-3AB-320	Conduit Assem.; Flexible-Shielded, Standard
J-22	N.A.F. 1150-16AB-72	Conduit Assem.; Flexible-Shielded, Standard
C-J-30	24V., D.C., Type E	Valve; Electric Primer (Holley)
J-34	N.A.F. 1161-1	Coupling; Conduit "Y"
J-39	N.A.F. 1150-6A-112	Conduit Assem.; Flexible-Shielded, Standard
J-K-17	N.A.F. 1150-4A-320	Conduit Assem.; Flexible-Shielded, Standard
N-2	5-61429	Tube-Impulse Assem.; Synchronized Gun

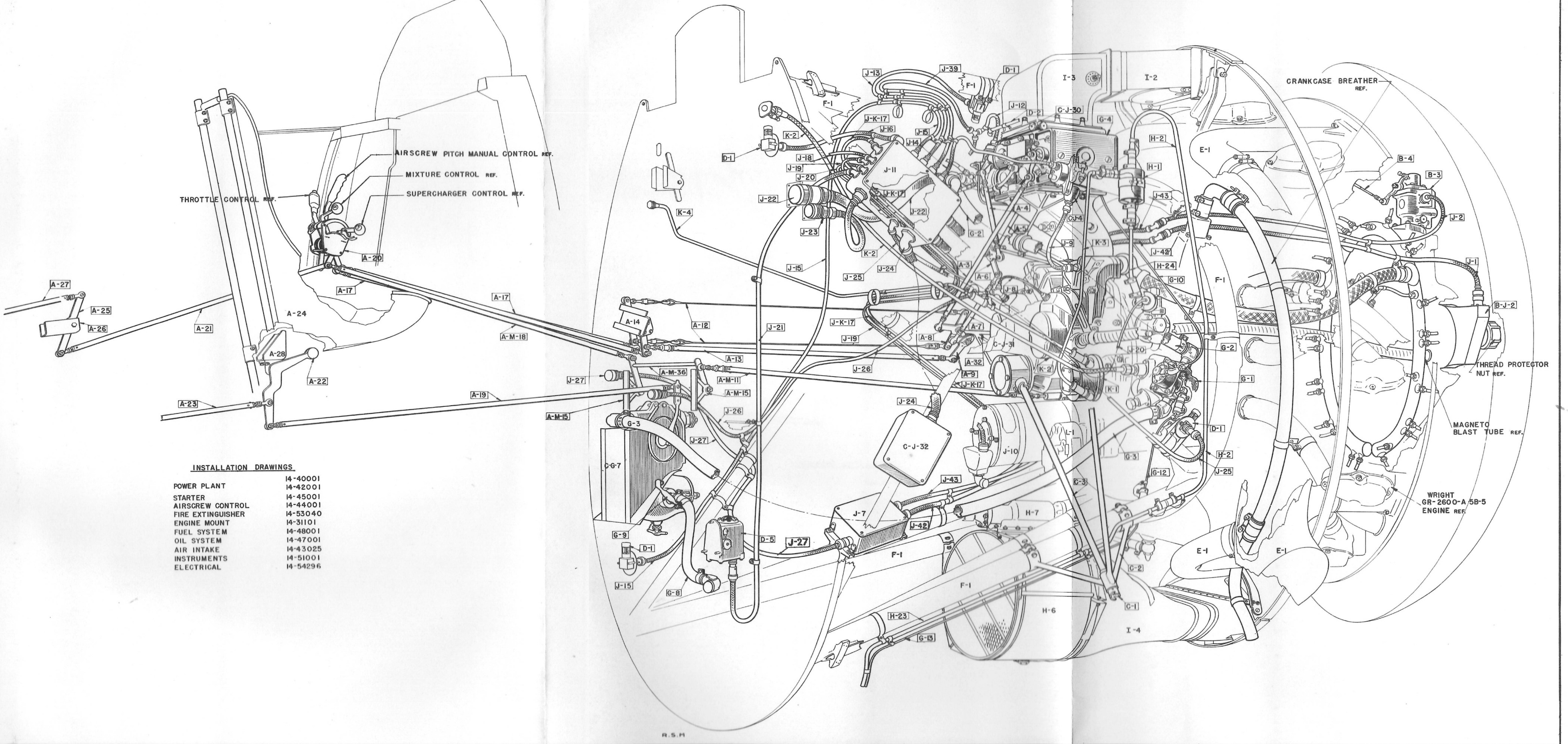


INSTALLATION DRAWINGS

POWER PLANT	14-40001. 14-42001
AIRSCREW CONTROL	14-44001
FIRE EXTINGUISHER	14-53040
ENGINE MOUNT	14-31101
FUEL SYSTEM	14-48001
AIR INTAKE	14-43025
ELECTRICAL	14-54296

INDEX TO FIGURE 4-3

SYMBOL	PART NUMBER	NOMENCLATURE
A-3	14-43003-7	Rod-Control Assem.; Engine Controls, Throttle (carb. to bellcrank)
A-4	14-43003-13	Rod-Control Assem.; Engine Controls, Mixture
A-5	14-43010	Bracket; Engine Controls, Mixture
A-6	14-43013-1	Bellcrank Assem.; Engine Controls, Mixture (upper)
A-7	14-43003-10	Tube-Control Assem.; Engine Controls, Mixture
A-8	14-43042	Bellcrank Assem.; Engine Controls, Throttle (lower)
A-9	14-43013-2	Bellcrank Assem.; Engine Controls, Mixture (lower)
A-M-11	14-43044-1	Rod-Control Assem.; Engine Controls, Supercharger (fwd.)
A-12	14-43048	Cable Assembly; Engine Controls, Throttle
A-13	14-43049-1	Rod-Control Assem.; Engine Controls, Throttle-Mixture
A-14	14-43007	Bracket Assem.; Engine Controls, Bellcrank, Firewall
A-M-15	14-43052	Bracket Assem.; Engine Controls, Supercharger Control Jackshaft
A-17	14-43003-1	Rod-Control Assem.; Engine Controls, Throttle-Mixture
A-M-18	14-43003-4	Rod-Control Assem.; Engine Controls, Supercharger (rear)
A-19	14-43046-1	Rod-Control Assem.; Fuel System, A.E.L. Unit (fwd. cockpit)
A-20	14-43002	Control Assem.; Engine Controls, Front Cockpit
A-21	14-43050	Rod-Control Assem.; Engine Controls, Throttle (cockpit interconnecting)
A-22	14-48184	Handle Assem.; Fuel System, A.E.L. Unit Control
A-23	14-48173-1	Rod-Control Assem.; Fuel System, A.E.L. Unit (rear cockpit)
A-24	49-53074	Seat; Pilot's (North American)
A-25	14-43013-3	Bellcrank Assem.; Engine Controls, Throttle (upper)
A-26	14-43069	Support; Engine Controls, Rear Throttle Rod
A-27	14-43003-34	Rod-Control Assem.; Engine Controls, Throttle (rear cockpit)
A-28	14-48186	Bracket; Fuel System, A.E.L. Unit Control Handle
A-32	14-43009	Bracket Assem.; Engine Controls, Mixture & Throttle
A-M-36	14-43011	Jackshaft; Engine Controls, Supercharger
B-J-2	104-930-2 Curtiss	Brush Assembly; Airscrew
B-3	100006-C Curtiss	Governor Assem.; Airscrew Constant Speed Control
B-4	14-43004	Control Assem.; Airscrew Pitch Setting
C-2	14-45002	Support Assem.; Starter System, Inertia Hand Crank
C-3	C-57195-1 Eclipse	Crank-Extension; Hand
C-J-4	C-31245 Eclipse	Coil-Booster
C-G-7	A.E.L.-3	Pump; Fuel System, Hand
C-J-30	24V., D.C., Type E	Valve; Electric Primer (Holley)
C-J-32	14-54258-1	Box-Junction, Assem.; Electrical System, Starter Switch
D-1	23081 Kidde	Actuator-Flame; Automatic Fire Extinguisher
D-2	14-53040-4	Tube—Perforated Assem.; Automatic Fire Extinguisher
D-5	78914 Kidde	Actuator-Impact; Automatic Fire Extinguisher
E-1	12-818 Solar	Manifold Assem.; Power Plant, Engine Exhaust
F-1	14-31101	Mount Assem.; Power Plant, Engine
G-1	RD-4070-8 Romec	Pump; Power Plant, Engine Driven, Fuel
G-2	14-48001-16	Hose—Self Sealing; Fuel System, Eng. Pump to Carb.
G-3	14-48001-15	Hose—Self Sealing; Fuel System, A.E.L. Unit To Engine Pump
G-4	1685-F Holley	Carburetor
C-G-7	A.E.L.-3	Pump; Fuel System, Hand
G-8	14-48001-14	Hose—Self Sealing; Fuel System, A.E.L. Unit To Selector Valve
G-9	14-48257	Support; Fuel System, A.E.L. Unit To Selector Valve Hose
G-10	14-48001-12	Tube Assem.; Fuel System, Fuel Pump To Carb. Vent
G-12	14-48001-19	Tube; Fuel System, Fuel Pump Drain (upper)
G-13	14-48001-20	Tube; Fuel System, Fuel Pump Drain (lower)
H-1	563-1 Eclipse	Separator-Oil; Vacuum Pump Discharge
H-2	14-42015	Tube Assem.; Instrument, Oil Separator
H-6	B-8504035	Cooler-Oil; Lubrication System (Harrison mod. CCV20)
H-7	CR-161E Harrison	Valve; Oil Cooler, Thermostat Control
H-23	14-42003-4	Tube; Instrument, Oil Separator, Overboard Drain
H-24	14-42003-14	Tube; Instrument, Oil Separator, Oil Return
I-2	14-31582	Duct Assem.; Carburetor Air Door, Aft Section
I-3	14-42002	Scoop-Elbow; Carburetor Air Door
I-4	14-31508	Duct-Air; Lubrication System, Eng. Cowl, Oil Cooler
J-1	14-54296-15	Conduit Assem.; Flexible-Shielded, Airscrew Brush Ring (forward)
J-2	14-54296-14	Conduit Assem.; Flexible-Shielded, Airscrew Control Governor (forward)
J-7	20-54156	Box-Junction, Assem.; Electrical System, Airscrew Control Relay
J-8	14-54296-4	Conduit Assem.; Flexible-Shielded, Magneto Switch
J-9	14-54296-16	Conduit Assem.; Flexible-Shielded, Booster Coil To Stbd. Magneto
J-10	F-79641 Eclipse	Generator
J-11	14-54028-1	Box-Junction, Assem.; Electrical System, Engine Mount
J-12	14-54296-8	Conduit Assem.; Flexible-Shielded, Electric Priming Valve
J-13	14-54296-9	Conduit Assem.; Flexible-Shielded, Auto. Fire Extinguisher, Flame Actuator (fwd. port)
J-14	14-54296-1	Conduit Assem.; Flexible-Shielded, Booster Coil To Junction Box
J-15	14-54296-7	Conduit Assem.; Flexible-Shielded, Auto. Fire Extinguisher, Flame Actuator (aft port)
J-16	14-54296-5	Conduit Assem.; Flexible-Shielded, Auto. Fire Extinguisher, Flame Actuator (aft. stbd.)
J-K-17	N.A.F. 1150-4A-320	Conduit Assem.; Flexible-Shielded, Standard
J-18	N.A.F. 1150-3AB-252	Conduit Assem.; Flexible-Shielded, Standard
J-19	N.A.F. 1150-3AB-320	Conduit Assem.; Flexible-Shielded, Standard
J-20	N.A.F. 1150-3AB-180	Conduit Assem.; Flexible-Shielded, Standard
J-21	14-54296-6	Conduit Assem.; Flexible-Shielded, Auto. Fire Extinguisher, Impact Actuator
J-22	N.A.F. 1150-16AB-72	Conduit Assem.; Flexible-Shielded, Standard
J-23	N.A.F. 1150-8AC-31	Conduit Assem.; Flexible-Shielded, Standard
J-24	N.A.F. 1150-16A-59	Conduit Assem.; Flexible-Shielded, Standard
J-25	14-51296-3	Conduit Assem.; Flexible-Shielded, Auto. Fire Extinguisher, Flame Actuator (fwd. stbd.)
J-26	N.A.F. 1150-6AC-128	Conduit Assem.; Flexible-Shielded, Standard
J-27	14-54296-12	Conduit Assem.; Flexible-Shielded, Airscrew Junction Box, Firewall
C-J-30	24V., D.C., Type E	Valve; Electric Primer (Holley)
C-J-31	F-79641 and C-53540-2	Starter; Direct/Inertia, Hand/Electric, Model 447-10 Series 41 (Eclipse)
C-J-32	14-54258-1	Box-Junction, Assem.; Electrical System, Starter Switch
J-34	N.A.F. 1161-1	Coupling; Conduit "Y"
J-39	N.A.F. 1150-6A-112	Conduit Assem.; Flexible-Shielded, Standard
J-42	14-54296-11	Conduit Assem.; Flexible-Shielded, Airscrew Brush Ring (rear)
J-43	14-54296-10	Conduit Assem.; Flexible-Shielded, Airscrew Control Governor (rear)
K-1	548-A Eclipse	Pump; Power Plant, Engine Driven, Vacuum
K-2	AN-9205-4	Shaft; Tachometer
K-3	14-42013	Tube Assem.; Vacuum Pump, Discharge
K-4	14-42011	Tube Assem.; Vacuum Pump, Suction
J-K-17	N.A.F. 1150-4A-320	Conduit Assem.; Flexible-Shielded, Standard
L-1	214 VF Pesco	Pump; Power Plant, Engine Driven, Hydraulic
A-M-11	14-43044-1	Rod-Control Assem.; Engine Controls, Supercharger (forward)
A-M-15	14-43052	Bracket Assem.; Engine Controls, Supercharger Control Jackshaft
A-M-18	14-43003-4	Rod-Control Assem.; Engine Controls, Supercharger (rear)
A-M-36	14-43011	Jackshaft; Engine Controls, Supercharger



INSTALLATION DRAWINGS

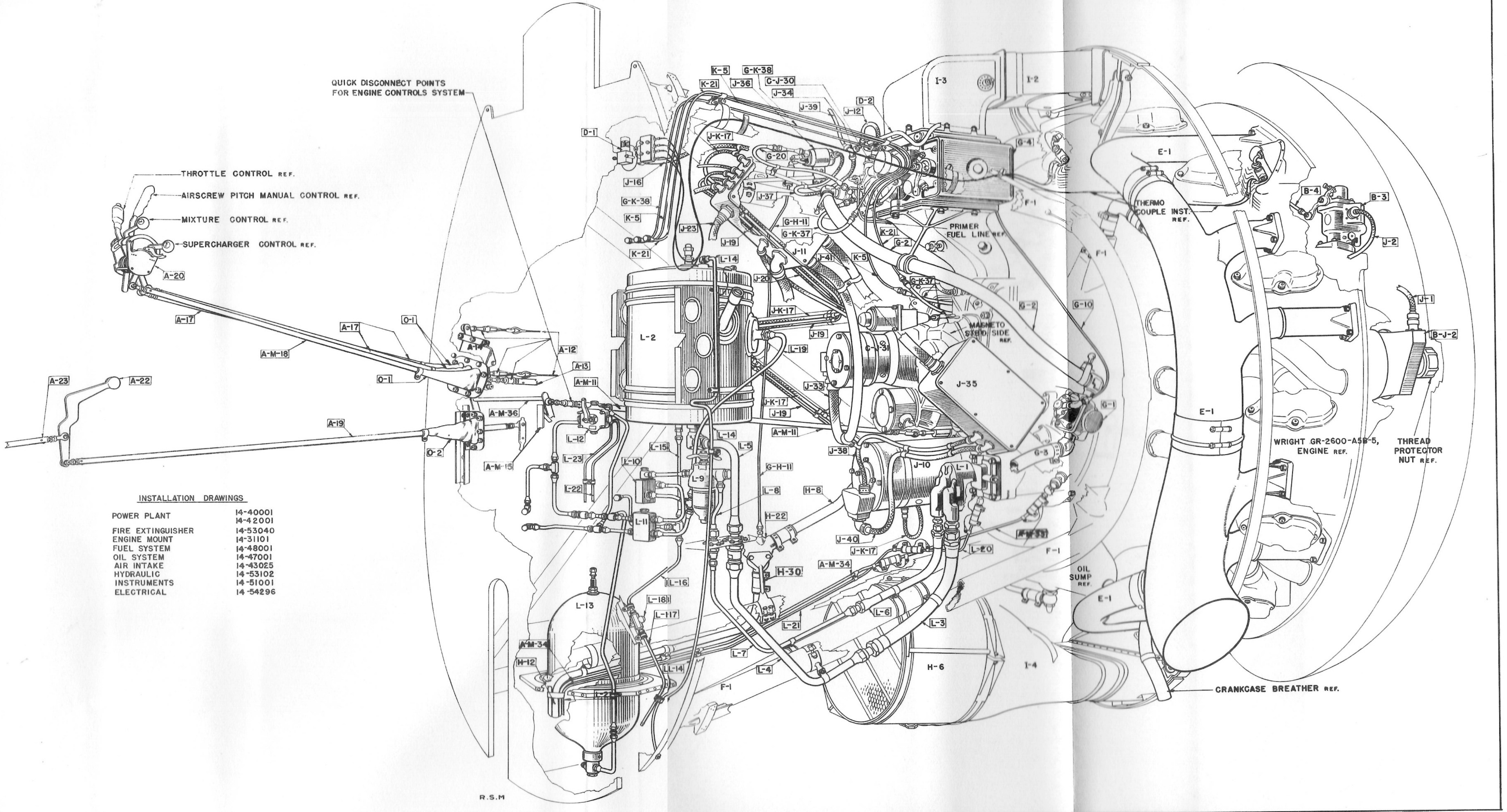
	14-40001
POWER PLANT	14-42001
STARTER	14-45001
AIRSCREW CONTROL	14-44001
FIRE EXTINGUISHER	14-53040
ENGINE MOUNT	14-31101
FUEL SYSTEM	14-48001
OIL SYSTEM	14-47001
AIR INTAKE	14-43025
INSTRUMENTS	14-51001
ELECTRICAL	14-54296

POWER PLANT - FIG. 4-3

INDEX TO FIGURE 4-4

SYMBOL	PART NUMBER	NOMENCLATURE
A-M-11	14-43044-1	Rod-Control Assem.; Engine Controls, Supercharger (fwd.)
A-12	14-43048	Cable Assembly; Engine Controls, Throttle
A-13	14-43049-1	Rod-Control Assem.; Engine Controls, Throttle-Mixture
A-14	14-43007	Bracket Assem.; Engine Controls, Bellcrank, Firewall
A-M-15	14-43052	Bracket Assem.; Engine Controls, Supercharger Control Jackshaft
A-17	14-43003-1	Rod-Control Assem.; Engine Controls, Throttle-Mixture
A-M-18	14-43003-4	Rod-Control Assem.; Engine Controls, Supercharger (rear)
A-19	14-43046-1	Rod-Control Assem.; Fuel System, A.E.L., (fwd. cockpit)
A-20	14-43002	Control Assem.; Engine Controls, Front Cockpit
A-22	14-48184	Handle Assem.; Fuel System, A.E.L. Control
A-23	14-48173-1	Rod-Control Assem.; Fuel System, A.E.L. (rear cockpit)
A-M-33	14-48001-17	Tube; Fuel System, Supercharger Drain (upper)
A-M-34	14-48001-18	Tube; Fuel System, Supercharger Drain (lower)
A-M-36	14-43011	Jackshaft; Engine Controls, Supercharger
B-J-2	104-930-2 Curtiss	Brush Assembly; Airscrew
B-3	100006-C Curtiss	Governor Assem.; Airscrew Constant Speed Control
B-4	14-43004	Control Assem.; Airscrew Pitch Setting
C-J-30	24 V., D.C., Type E	Valve; Electric Primer (Holley)
C-J-31	F-79641 and C-53540-2 Eclipse	Starter; Direct/Inertia, Hand/Electric, Model 447-10 Series 41
D-1	23081 Kidde	Actuator-Flame; Automatic Fire Extinguisher
D-2	14-53040-4	Tube-Perforated Assem.; Automatic Fire Extinguisher
E-1	Solar 12-818	Manifold Assem.; Power Plant, Engine Exhaust
F-1	14-31101	Mount Assem.; Power Plant, Engine
G-1	RD 4070-8 Romec	Pump; Power Plant, Engine Driven, Fuel
G-2	14-48001-16	Hose—Self Sealing; Fuel System, Eng. Pump To Carb.
G-3	14-48001-15	Hose—Self Sealing; Fuel System, A.E.L. Unit To Engine Pump
G-4	1685-F Holley	Carburetor
G-10	14-48001-12	Tube Assem.; Fuel System, Fuel Pump To Carb. Vent
G-H-11	14-47001-9	Tube Assem.; Lubrication System, Oil Dilution Supply
G-20	M-389-A-4-14	Hose Assem.; Flexible Instrument Connecting (Navy Spec.)
G-K-37	M389-B-4-14	Hose Assem.; Flexible Instrument Connecting (Navy Spec.)
G-K-38	14-51001-3	Tube Assem.; Instrument, Fuel Pressure Gauge
H-6	B-8504035	Cooler—Oil; Lubrication System (Harrison Mod. CCV20)
H-8	14-47001-2	Tube; Lubrication System, "Y" Cock To Engine Supply
G-H-11	14-47001-9	Tube Assem.; Lubrication System, Oil Dilution Supply
H-12	14-47001-8	Tube; Lubrication System, Oil Drain
H-30	14-47028	Bracket; Lubrication System, "Y" Cock
H-22	AC 37D6114-S	Cock; "Y"
I-2	14-31582	Duct Assem.; Carburetor Air Door, Aft Section
I-3	14-42002	Scoop-Elbow; Carburetor Air Door
I-4	14-31508	Duct-Air; Lubrication System, Eng. Cowl, Oil Cooler
J-1	14-54296-15	Conduit Assem.; Flexible-Shielded, Airscrew Brush Ring (forward)
J-2	14-54296-14	Conduit Assem.; Flexible-Shielded, Airscrew Control Governor (forward)
J-10	F-79641 Eclipse	Generator
J-11	14-54028-1	Box-Junction, Assem.; Electrical System, Engine Mount
J-12	14-54296-8	Conduit Assem.; Flexible-Shielded, Electric Priming Valve
J-16	14-54296-5	Conduit Assem.; Flexible-Shielded, Auto. Fire Extinguisher Flame Actuator (aft. stbd.)

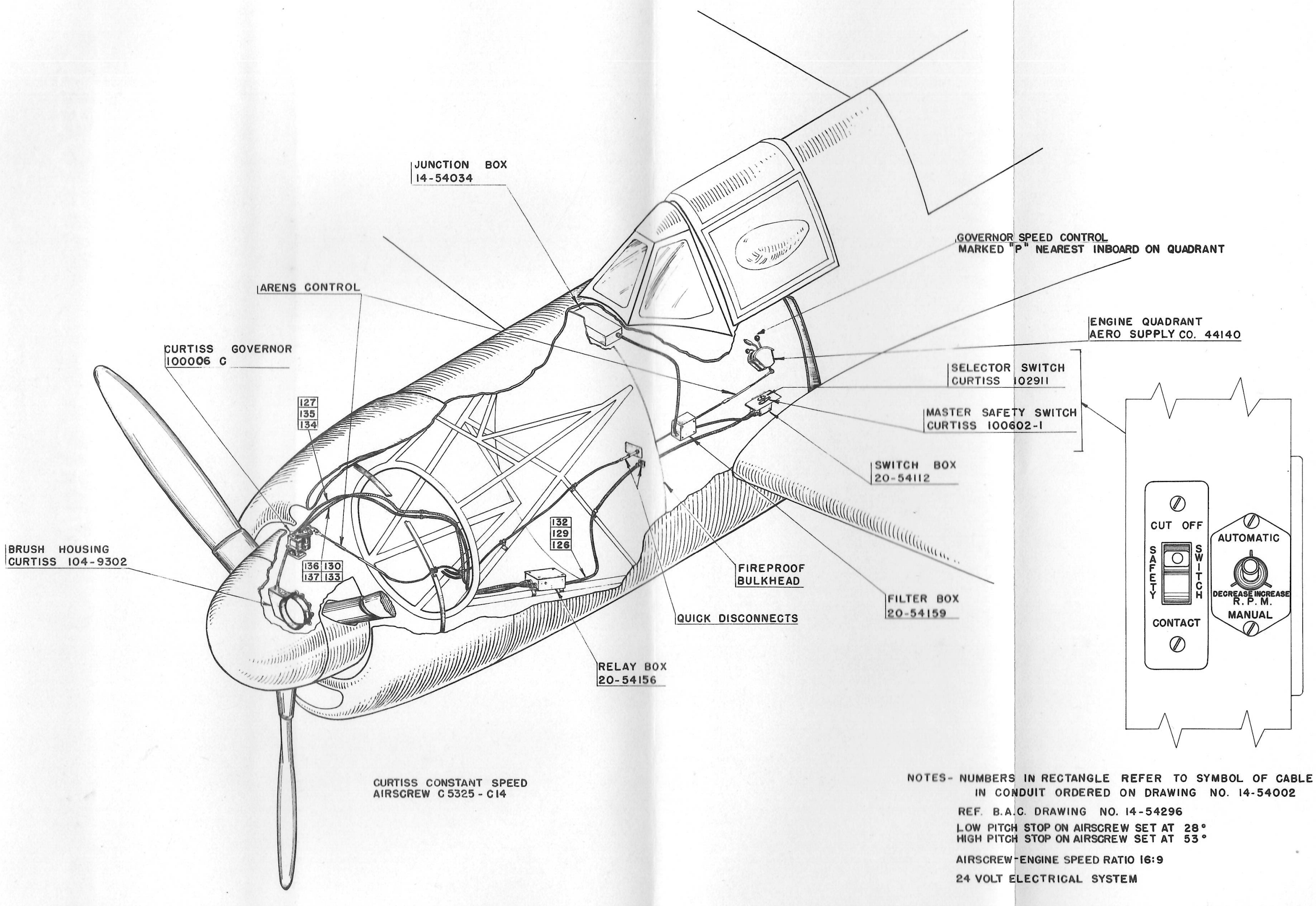
SYMBOL	PART NUMBER	NOMENCLATURE
J-K-17	N.A.F. 1150-4A-320	Conduit Assem.; Flexible-Shielded, Standard
J-19	N.A.F. 1150-3AB-320	Conduit Assem.; Flexible-Shielded, Standard
J-20	N.A.F. 1150-3AB-180	Conduit Assem.; Flexible-Shielded, Standard
J-23	N.A.F. 1150-8AC-31	Conduit Assem.; Flexible-Shielded, Standard
C-J-30	24 V., D.C., Type E	Valve; Electric Primer (Holley)
C-J-31	F-79641 and C-53540-2 Eclipse	Starter; Direct/Inertia, Hand/Electric, Model 447-10 Series 41
J-33	N.A.F. 1150-16A-138	Conduit Assem.; Flexible-Shielded, Standard
J-34	N.A.F. 1161-1	Coupling; Conduit "Y"
J-35	14-54030-1	Box-Junction, Assem.; Electrical System, Generator Control
J-36	AC 37D6210	Solenoid; Lubrication System, Oil Dilution Valve
J-37	N.A.F. 1150-4A-58	Conduit Assem.; Flexible-Shielded, Standard
J-38	14-54296-2	Conduit Assem.; Flexible-Shielded, Generator Control
J-39	N.A.F. 1150-6A-112	Conduit Assem.; Flexible-Shielded, Standard
J-40	N.A.F. 1150-8A-72	Conduit Assem.; Flexible-Shielded, Standard
J-41	N.A.F. 1150-16A-50	Conduit Assem.; Flexible-Shielded, Standard
L-1	Pesco 214VF	Pump; Power Plant, Engine Driven, Hydraulic
L-2	20-53112	Tank Assem.; Hydraulic System, Fluid
L-3	AN 857-16D-21	Hose Assem.; Medium Pressure, Flared Tube & Swivel Connections
L-4	14-53102-14	Tube Assem.; Hydraulic System, Pump Supply (lower)
L-5	14-53102-11	Tube Assem.; Hydraulic System, Pump Supply (upper)
L-6	AN 861-8D-18	Hose Assem.; High Pressure, Flared Tube & Swivel Connection
L-7	14-53102-15	Tube Assem.; Hydraulic System, Pump Pressure
L-8	14-531397	Tube Assem.; Hydraulic System, Filter To Disconnect Valve
L-9	26128 Purolator	Filter; Hydraulic System, Fluid Cleaning
L-10	6D115 Electrol	Valve; Hydraulic System, Unloader
L-11	20-53106	Valve; Hydraulic System, Relief
L-12	Bendix 2258-A1	Valve; Hydraulic System, Four-Way Control
L-13	HL-107 Simmonds	Accumulator; Hydraulic System
L-14	20-53102-18	Tube; Hydraulic System, Tank Vent & Overflow
L-15	14-53102-7	Tube Assem.; Hydraulic System, Tank Drain (upper)
L-16	14-53102-13	Tube Assem.; Hydraulic System, Tank Drain (center)
L-17	14-53102-10	Tube Assem.; Hydraulic System, Tank Drain (lower)
L-18	702-HB-6D Parker	Valve; Drain
L-19	14-53102-12	Tube Assem.; Hydraulic System, Tank Return
L-20	14-53102-21	Tube; Hydraulic System, Pump Drain (upper)
L-21	14-53102-22	Tube; Hydraulic System, Pump Drain (lower)
L-22	14-53102-28	Tube Assem.; Hydraulic System, Cowl Gill Supply
L-23	14-53102-29	Tube Assem.; Hydraulic System, Cowl Gill Supply
A-M-11	14-43044-1	Rod-Control Assem.; Engine Controls, Supercharger (forward)
A-M-15	14-43052	Bracket Assem.; Engine Controls, Supercharger Control Jackshaft
A-M-18	14-43003-4	Rod-Control Assem.; Engine Controls, Supercharger (rear)
A-M-33	14-48001-17	Tube; Fuel System, Supercharger Drain (upper)
A-M-34	14-48001-18	Tube; Fuel System, Supercharger Drain (lower)
A-M-36	14-43011	Jackshaft; Engine Controls, Supercharger
O-1	14-43055	Boot Assem.; Engine Controls, Firewall Fume Sleeve
O-2	14-48169	Boot Assem.; Fuel System, A.E.L. Control, Fume Sleeve
K-5	14-51001-1	Tube Assem.; Manifold Pressure Gauge
J-K-17	N.A.F. 1150-4A-320	Conduit Assem.; Flexible-Shielded, Standard
K-21	14-51001-2	Tube Assem.; Instrument, Oil Pressure Gauge



INSTALLATION DRAWINGS

POWER PLANT	14-40001 14-42001
FIRE EXTINGUISHER	14-53040
ENGINE MOUNT	14-31101
FUEL SYSTEM	14-48001
OIL SYSTEM	14-47001
AIR INTAKE	14-43025
HYDRAULIC	14-53102
INSTRUMENTS	14-51001
ELECTRICAL	14-54296

POWER PLANT - FIG. 4-4



NOTES- NUMBERS IN RECTANGLE REFER TO SYMBOL OF CABLE IN CONDUIT ORDERED ON DRAWING NO. 14-54002

REF. B.A.C. DRAWING NO. 14-54296

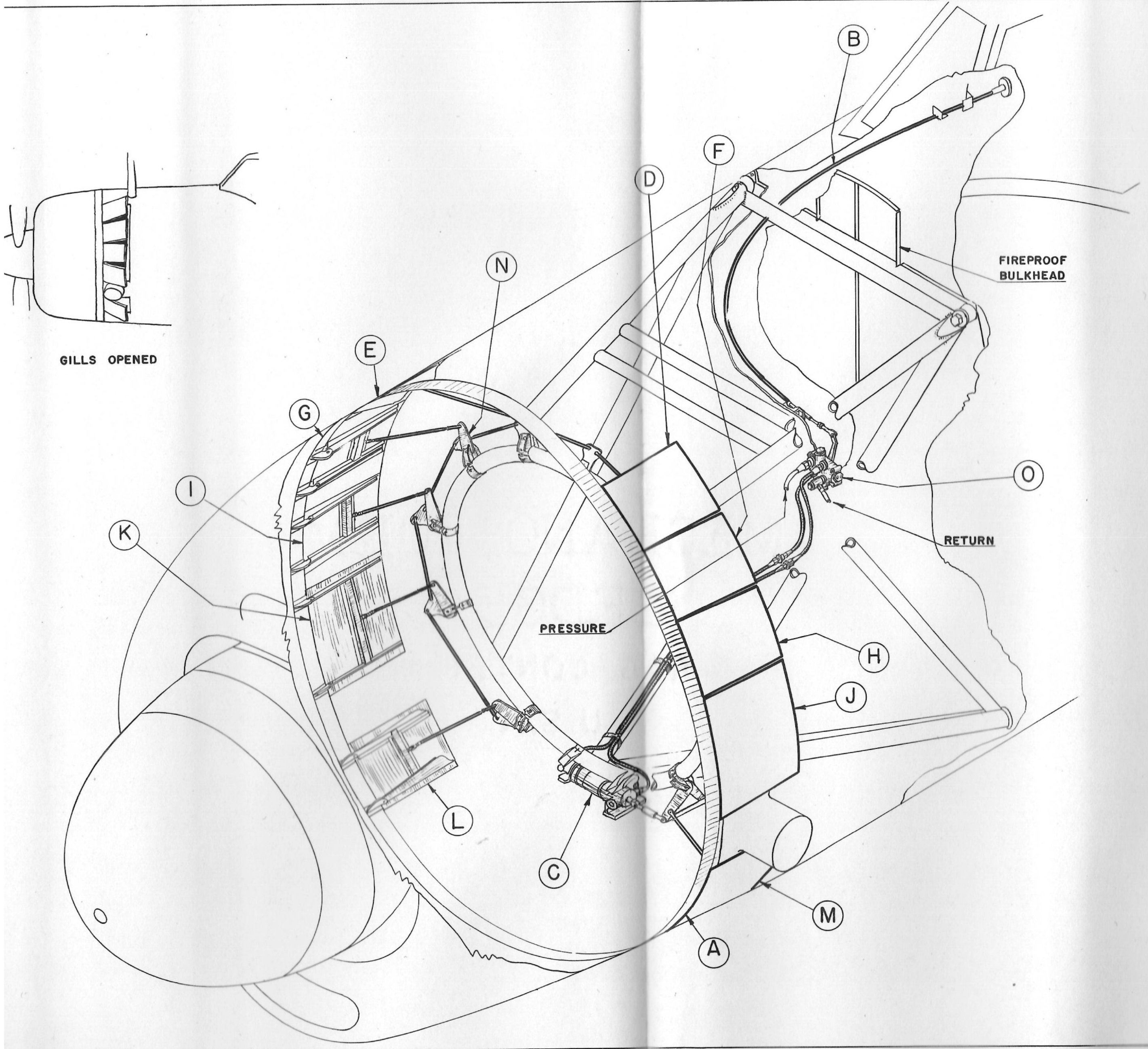
LOW PITCH STOP ON AIRSCREW SET AT 28°
HIGH PITCH STOP ON AIRSCREW SET AT 53°

AIRSCREW-ENGINE SPEED RATIO 16:9

24 VOLT ELECTRICAL SYSTEM

B.F.KORUZ

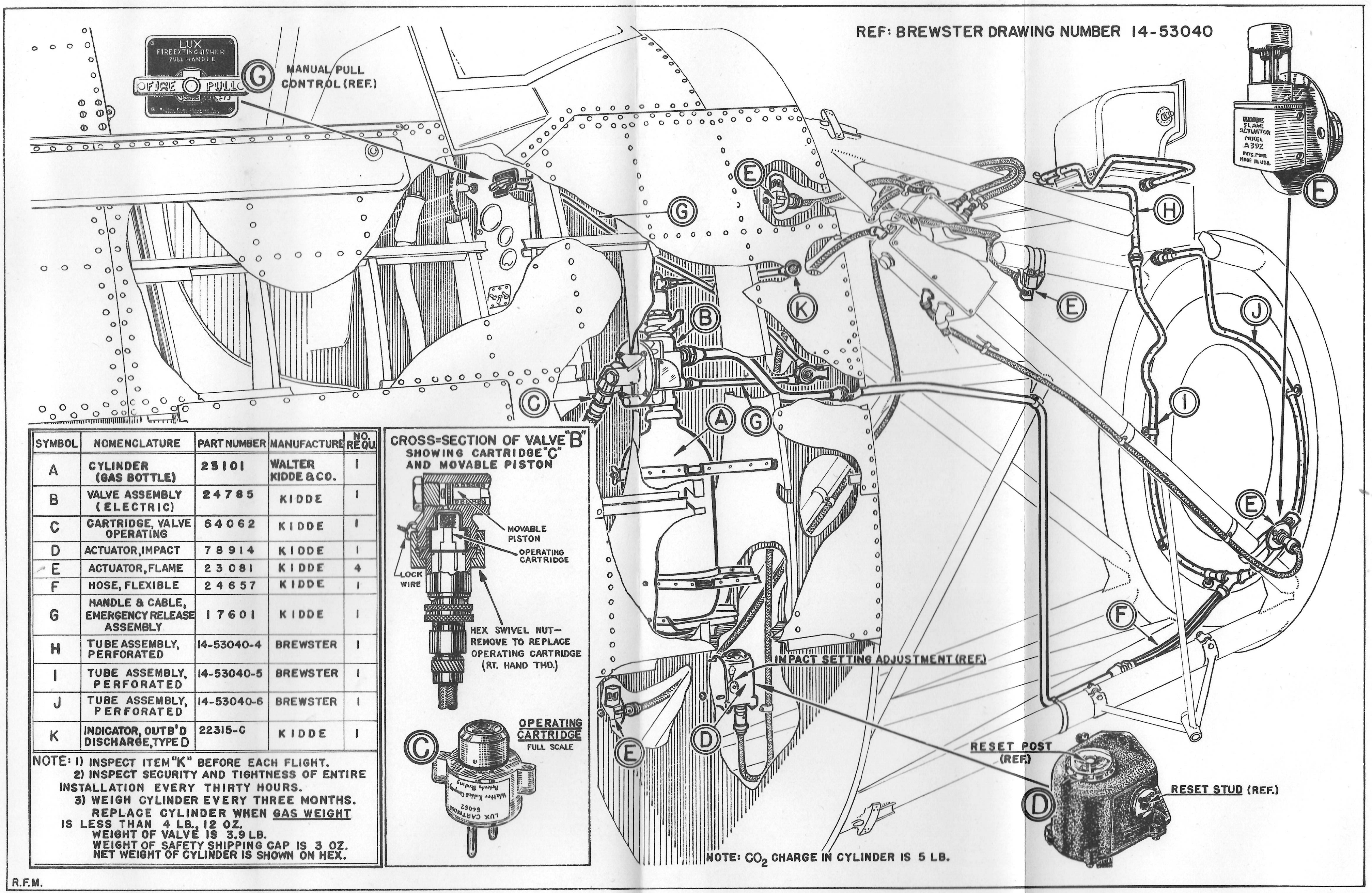
AIRSCREW CONTROL DIAGRAM - FIG. 4-5



SYMBOL	NAME OF PART	BREWSTER PART NO.	NO. REQ'D.
A	BAND ASSEMBLY, ENG. COWL, REAR.	14-31512	1
B	CONTROL ASSEMBLY, COWL GILLS.	20-315023	1
C	CYLINDER, COWL GILLS, ACTUATING.	20-528146	1
D	GILL, 1 COWL, ENG. COMPT.	14-315161 L	1
E	GILL, 1 COWL, ENG. COMPT.	14-315161 R	1
F	GILL, 2 COWL, ENG. COMPT.	14-315162 L	1
G	GILL, 2 COWL, ENG. COMPT.	14-315162 R	1
H	GILL, 3 COWL, ENG. COMPT.	14-315163 L	1
I	GILL, 3 COWL, ENG. COMPT.	14-315163 R	1
J	GILL, 4 COWL, ENG. COMPT.	14-315164 L	1
K	GILL, 4 COWL, ENG. COMPT.	14-315164 R	1
L	GILL, 5 COWL, ENG. COMPT.	14-315165 L	1
M	GILL, 5 COWL, ENG. COMPT.	14-315165 R	1
N	LINKAGE, INSTALL. COWL GILLS, CONTROL MECH.	14-315196	1
O	VALVE, 4-WAY, COWL GILL CONTROL.	BENDIX DRAWING NO. 2258-A1 BENDIX AVIATION LTD.	1

REF. BREWSTER DRAWING NO. 14-31501

COWL GILLS INSTALLATION - FIG. 4-



SYMBOL	NOMENCLATURE	PART NUMBER	MANUFACTURE	NO. REQU.
A	CYLINDER (GAS BOTTLE)	23101	WALTER KIDDE & CO.	1
B	VALVE ASSEMBLY (ELECTRIC)	24785	KIDDE	1
C	CARTRIDGE, VALVE OPERATING	64062	KIDDE	1
D	ACTUATOR, IMPACT	78914	KIDDE	1
E	ACTUATOR, FLAME	23081	KIDDE	4
F	HOSE, FLEXIBLE	24657	KIDDE	1
G	HANDLE & CABLE, EMERGENCY RELEASE ASSEMBLY	17601	KIDDE	1
H	TUBE ASSEMBLY, PERFORATED	14-53040-4	BREWSTER	1
I	TUBE ASSEMBLY, PERFORATED	14-53040-5	BREWSTER	1
J	TUBE ASSEMBLY, PERFORATED	14-53040-6	BREWSTER	1
K	INDICATOR, OUTB'D DISCHARGE, TYPE D	22315-C	KIDDE	1

NOTE: 1) INSPECT ITEM "K" BEFORE EACH FLIGHT.

2) INSPECT SECURITY AND TIGHTNESS OF ENTIRE INSTALLATION EVERY THIRTY HOURS.

3) WEIGH CYLINDER EVERY THREE MONTHS. REPLACE CYLINDER WHEN GAS WEIGHT IS LESS THAN 4 LB., 12 OZ.
WEIGHT OF VALVE IS 3.9 LB.
WEIGHT OF SAFETY SHIPPING CAP IS 3 OZ.
NET WEIGHT OF CYLINDER IS SHOWN ON HEX.

FIRE EXTINGUISHER SYSTEM - FIG. 4-7

FUEL SYSTEM

77 General: The normal capacity of the "Bermuda" fuel system is two hundred and twenty-five (225) Imperial gallons. An auxiliary tank with a capacity of one hundred and twenty-five (125) Imperial gallons may be installed in the bomb bay compartment. This provides a total capacity of three hundred and fifty (350) Imperial gallons of fuel for extended operations as a reconnaisance aeroplane.

78 The engine manufacturer specifies that a fuel with a minimum anti-knock rating of ninety (90) Octane (CFR Method) be used. For latest details of fuel to be used see leaflet A.P. 1464/C.37. The fuel system component parts are (see fig. 4-8):

Main fuel tanks.
Auxiliary fuel tank.
Fuel quantity gauges.
Fuel pumps—engine, hand and primer.
Fuel system pipe lines, controls and fuel pressure gauge.

79 Each of these components will be discussed separately. The operational phase will be treated in a separate sub-chapter following the description of service instructions for the various units.

Main Fuel Tanks

80 General: Two wing tanks and one fuselage tank compose the main tanks. The main tanks are all supplied with internal self-sealing rubber cells (Goodyear Tire & Rubber Co., Type 10) for protection of fuel supply against gun fire.

> Note: If it is desired to omit the rubber cells this may be done provided that the joint between the bottom cover plates and the wing be coated with a layer of zinc chromate paste immediately prior to assembly. The screws used in the cover plate should be dipped in paste before installation.

81 Description: The fuselage tank with a capacity of eighty-one (81) Imperial gallons is located between the pilot's and gunner's cockpits. The tank is fabricated of 52S aluminium alloy sheet, joined by welding, except that the aft bulkhead is bolted up so as to be removable. The removable bulkhead provides a means of installing the self-sealing rubber cell. A single electric fuel quantity gauge transmitter is installed. Two vent lines and two outlet openings are provided. The outlets are located at the extreme fore and aft ends of the bottom of the tank. Both outlets are provided with finger screens to prevent foreign objects from entering the fuel system. The aft outlet includes a sump which may be drained by removing the sump plug to which the finger screen is attached.

82 The filler neck opening is accessible through a small flush type door on the starboard side of the fixed canopy. The filler neck will accommodate a refueling hose with a diameter of 1½ inches, and venting is adequate to permit filling to capacity at not more than forty-two (42) Imperial gallons per minute. A scupper is used to provide overboard discharge of fuel spilled in refueling.

83 The wing tanks are of the integral type; that is, they are formed by the component members of the wing structure. Each wing tank has a capacity of seventy-two (72) Imperial gallons. The starboard tank uses a standpipe discharge to provide an available supply of fuel (25 Imperial gallons) for reserve operation. Each wing tank is provided with two self-sealing rubber cells. The cells are accessible by removing the cover plate from the lower side of wing. The cells of each tank are inter-connected with adequate provisions for equalizing of fuel level by using one large and four small equalizer openings. Each tank is fitted with two fuel gauge transmitters. Two vent line openings are located on the outer bulkhead of each wing tank. Each vent line uses a Kenyon pressure relief valve set at 4½ lb./sq. in. The port wing tank is provided with two outlets with sumps attached. The starboard tank has three outlets of which the two connected to the reserve line are provided with sumps. These four sumps are provided with combination drain plugs and finger strainers. (Potassium Dichromate crystals for absorption of water to prevent corrosion are not required with self-sealing rubber cells.) No sump is required or used with the standpipe outlet which feeds the starboard tank line into the fuel system. Filler necks are located in recessed scuppers accessible through flush type cover doors on the upper side of each wing. The scuppers are provided with drains for overboard discharge of spillage. The filler necks will accommodate a 1½ inch filler hose nozzle with adequate venting for a maximum fuel delivery of forty-two (42) Imperial gallons per minute.

84 The self-sealing rubber cells used in the main tanks of the fuel system consist of successive layers of fuel resistant rubber, raw rubber, cord reinforced rubber, and an outer cover. The primary function of the self-sealing cells is to prevent the loss of the fuel supply in the event of puncture caused by gunfire. Each cell is provided with a large removable inspection opening to facilitate inspection and assembly where two or more cells are joined together to complete a single tank. Two basic forms of attachment are provided. The larger openings contain an integral metal ring which may be supplied with either tapped or through holes. This flange-like form of connection is used to attach sumps, fuel gauge transmitters or to complete cell inter-connections. Hose-like appendages are used when the connection is to be made to tubing or hose fittings, in which case a hose clamp is used exactly as when a conventional hose connection is assembled.

85 Operation: Operating instructions are not applicable to these component parts (refer to paragraphs 127 to 129 for operating instructions covering the fuel system).

86 Servicing and Maintenance: Fuel tanks shall be replenished following any flight operation. Such refueling service prolongs the life of self-sealing cells

by preventing oxidation occurring on their inner surfaces. Further, it offers a substantial means of discovering the existence of a leak in the fuel system which may not otherwise be noted, but does, however, become apparent when the fuel check, which should be conducted prior to each flight, discloses a loss of fuel.

87 Fuel cells which have been supplied in a sloshed condition are identified by a single red line painted around the filler opening and the legend "Sloshed for Aromatic Fuels" and the date stenciled on the cell. In case it is desired to slosh any fuel cell, follow the procedure given in Section VIII.

88 The effects of extreme weather conditions and the use of blended fuels containing benzol or its fractionations (sometimes called "Aromatic fuels") are beyond the knowledge of the cell manufacturer at the present time. It is therefore urged that frequent inspections be conducted with extreme diligence until such time as the experience gained may dictate more exact service instructions. At least one cell should be thoroughly inspected at each engine check period, selected preferably on some rotational system basis to insure definite periodic inspection of all cells. To determine the fuel absorption resulting from inner layer leakage, the removed cell shall be weighed and the weight and date stenciled on the cell adjacent to the original weight stenciling. The access opening of the cell shall be removed and the interior thoroughly inspected. The exterior seams and fittings shall be inspected with particular attention being paid to the joining material. Discovery of deterioration or other unsatisfactory conditions in any one cell would be indicative of the general condition of all cells. Deteriorated cells must be replaced. Damaged cells shall be repaired in accordance with instructions contained in Air Publication 1464. An alternate method is explained in Air Publication 2038A, Vol. II, Part 3, Chapter 3.

89 The daily inspection of wing covering shall give consideration to the external joints and seams of the component parts of the wing structure that forms the wing tanks.

90 The general security of the fuselage fuel tank shall be checked at each engine check period.

91 Damaged tanks shall be repaired in accordance with instructions contained in Vol. II of Air Publication 2038A.

Auxiliary Fuel Tank

92 General: An auxiliary fuel tank with a capacity of one hundred and twenty-five (125) Imperial gallons may be installed in the bomb bay to provide an increase in the normal range of the aeroplane.

93 Description: The auxiliary tank is fabricated of 52S aluminium alloy sheet joined by welding. It is carried in the bomb bay compartment, suspended on a bomb rack located on the fore and aft centreline. This method of attachment reduces the time required to install or remove an auxiliary tank. Access for installation, inspection and refueling is gained by opening the bomb bay cover doors. The filler neck is located on the port side. The tank is not supplied with self-sealing rubber cells. The sump plug contains a capsule of potassium dichromate crystals which combine with the water to form a brown coloured, corrosion inhibitory fluid. A finger screen is also attached to the sump drain plug. A mechanical fuel quantity gauge is installed in the forward end of this tank. The fuel gauge indicator is visible to the pilot through a mirror located forward and below the pilot's seat.

94 Operation: Operational instructions are not applicable to this part, refer to paragraphs 127-129.

95 Servicing and Maintenance: The general security of all attaching parts shall be checked at each refueling period during the time that the auxiliary tank is being employed.

96 The tank sump shall be removed daily, to inspect for water in the fuel. Trapped water will be discoloured to a dark brownish colour so long as the potassium dichromate capsule, in the sump plug, remains active. Replace the capsule when trapped water drainings fail to show discolouration.

97 Particular care must be taken in selecting storage facilities for auxiliary tanks after once being used, to prevent explosion and fire.

98 Damaged tanks shall be repaired in accordance with instructions contained in Vol. II of Air Publication 2038A.

Fuel Quantity Gauges

99 General: Electrical fuel quantity gauges are provided for all main fuel tanks. A mechanical gauge is provided for the auxiliary fuel tank.

100 Description: The quantity indicator for the electrical fuel gauge system is a General Electric direct current Selsyn indicator (GE8DJ3LAF). It is a 3-element instrument with suitably calibrated scales for the fuselage and wing tanks. Five transmitters, each assembled and marked differently are used as follows:

Fuselage tank	GE 8TJ13LCR
Port wing tank (inner)	GE 8TJ13LCL
Port wing tank (outer)	GE 8TJ13LCK
Starboard wing tank (inner)	GE 8TJ13LCN
Starboard wing tank (outer)	GE 8TJ13LCM

101 Each transmitter employs a cork float. The float arm is geared to a magnetic coupling which drives the rotary contact arm of the triple tap resistor. The magnetic coupling provides an effective fuel seal without the use of stuffing boxes or other forms of seals. The current from the triple tap resistor is fed to the indicator gauge which employs a Gramme ring consisting of three coils. The instrument works on the principle that the rotary contact arm serves as a current divider for the current flowing to the three coil Gramme ring. A magnetic flux is established diametrically across the ring, dependent

upon the position of the rotary contact arm with relation to the three taps of the resistor. Therefore the polarized permanent magnet pointer finger of the indicator will align itself with the magnetic flux and give a definite and accurate indication of the transmitter-arm position. This fuel gauge system is not affected by voltage changes that normally occur in aeroplane electrical systems.

102 Two transmitters wired in parallel are required for each wing tank because of the inclined position of the relatively flat tank.

103 OPERATION: The operation of the fuel quantity gauge system is inherently automatic. A direct reading of the fuel quantity in Imperial gallons for the main tanks is shown at all times when the aeroplane electrical system battery switch is in the "on" position.

104 SERVICING AND MAINTENANCE: The operation of the fuel quantity gauges shall be checked prior to each flight.

105 The general security of all connections and attaching parts shall be checked at each engine check period.

106 For further service information see the General Electric Handbook.

Fuel Pumps—engine, hand and primer

107 GENERAL: An engine driven fuel pump normally supplies fuel under pressure to the carburetor. For starting and to supply fuel in the event of engine pump failure, a hand (wobble) pump is provided.

108 DESCRIPTION: The engine driven pump is a Romec RD-4070-8. This pump utilizes a balanced relief valve which maintains a constant fuel pressure to the carburetor through a wide range of inlet fuel pressures. The fuel pump vent line must be connected to the carburetor in the Bermuda aeroplane. The relief valve shall be adjusted to six lb./sq. in. minimum and seven lb./sq. in. maximum pressure. This pump uses an internal by-pass.

109 The hand pump is an integral part of a combination strainer, sump and hand (wobble) pump unit, designated as AEL-3. The AEL unit is located forward of the fireproof bulkhead on the port side. A relief valve of the common spring loaded poppet valve type is used. The relief valve by-passes the excess pressures internally. This pressure is adjusted at seven to nine lb./sq. in.

110 The fuel system master strainer is located in the sump of the AEL unit. It may be readily removed by loosening the one wing nut which holds the access cover door hold-down strap. A screw type draincock is provided for draining the sump of the AEL unit.

111 The priming pump, located on the carburetor fuel inlet fitting, is a Holley Type 18V-DC. In reality it is not a pump, but simply a solenoid operated valve that permits fuel under pressure to enter the priming system.

112 OPERATION: The operation of the engine driven pump is automatic when the engine is running.

113 The hand pump must be operated during starting operations or in the event of the failure of the engine driven pump. Operating handles are conveniently located on the port side of both cockpits. The pump may be operated by either the pilot or gunner. The handles require a reciprocating motion.

114 The primer is operated remotely by a toggle switch located on the starboard side panel. In addition to the operation of the toggle switch, fuel pressure must be maintained by the hand pump to obtain satisfactory engine priming.

115 SERVICING AND MAINTENANCE: The satisfactory operation of the hand and engine driven fuel pumps must be checked during pre-flight engine warm-up.

116 The sump of the AEL unit shall be drained daily. Excessive water drainage would indicate the necessity for draining all fuel tank sumps. Excess dirt or foreign deposits in the sump draining should be immediately investigated to determine their origin.

117 The general security and integrity of the fuel pump installation shall be inspected at each engine check period.

Fuel System Pipe Lines and Controls

118 GENERAL: The plumbing (pipe lines) of the fuel system consists of self-sealing hose and aluminium alloy tubing. The selector valve (cock) to which all fuel tank lines are connected is Type PL-4 manufactured by the Aero Supply Manufacturing Company. Fuel pressure is indicated on the 3-unit engine gauge located on the starboard side of the main instrument panel.

119 DESCRIPTION: The self-sealing hose (U. S. Rubber Co., Type P245) is used for all lines intended to carry the primary fuel supply. All other lines—vent, fuel pressure, oil dilution, priming and overboard discharge drain lines—are formed of aluminium alloy tubing.

120 Conventional hose clamps are employed to complete connections of self-sealing hose. Aluminium alloy tubing lines are connected with tubing fittings of the Weatherhead type.

121 The fuel pressure gauge line is connected to the fuel line at the carburetor inlet fitting.

122 The selector valve is located on the centreline of the aeroplane, below the thrust line and aft of the fireproof bulkhead; remote control is provided by a torque tube arrangement with a control lever mounted on a marked plate located under the centre of the main instrument panel of the pilot's cockpit.

123 OPERATION: Operation of the plumbing, fuel pressure gauge and controls is included under "operation of the fuel system."

124 SERVICING AND MAINTENANCE: Operation of the fuel selector valve and the fuel pressure gauge will be checked prior to each flight.

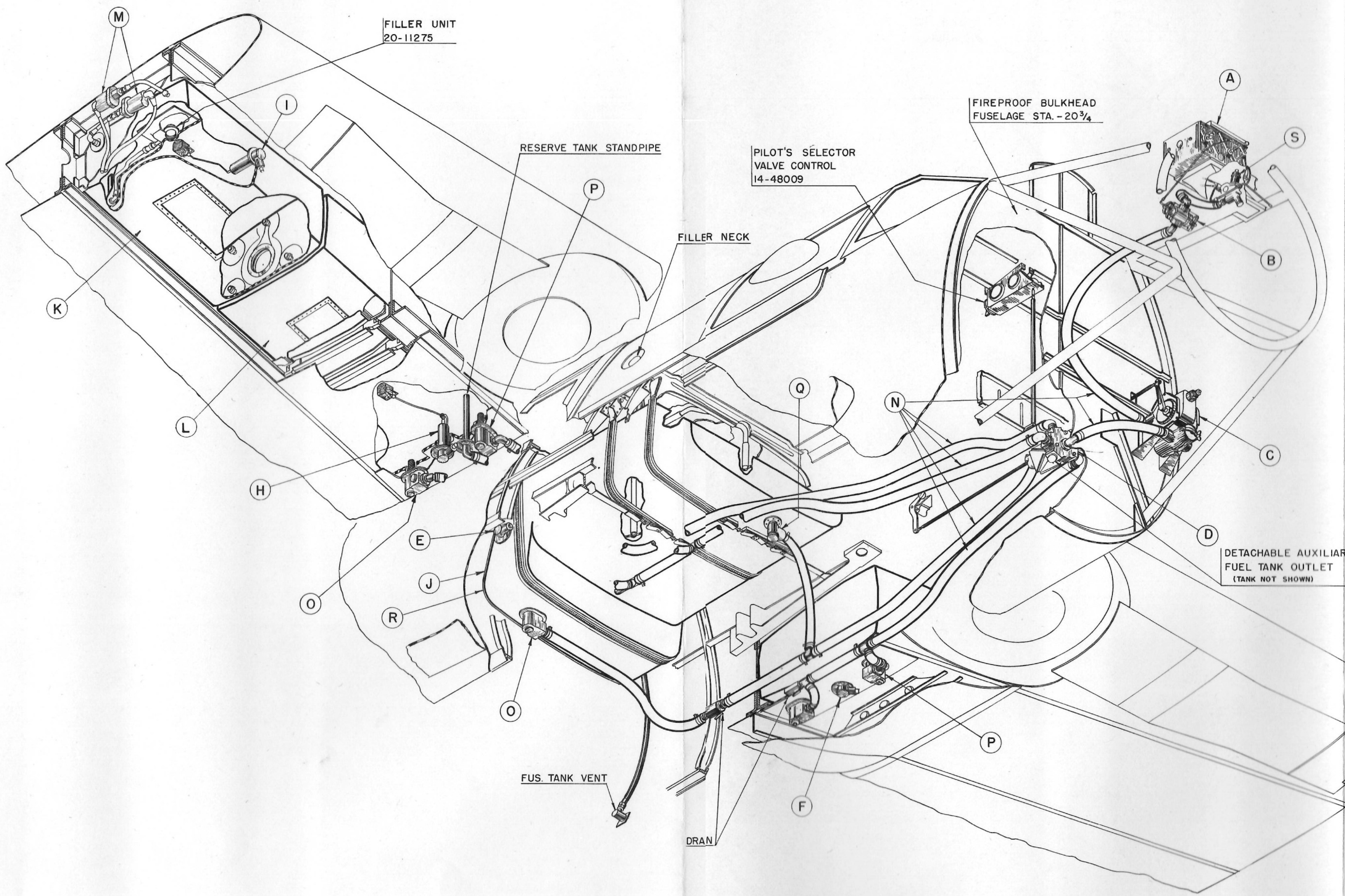
125 The general security of all fuel lines visible, when the AEL-3 unit access and bomb bay doors are open, will be checked daily.

126 All self-sealing lines will be thoroughly checked at each engine check period for damage from rubbing and chafing. Damaged hose may be repaired, in emergencies, by inserting sections of tubing, properly beaded, and adequately secured and bonded to the structure of the aeroplane.

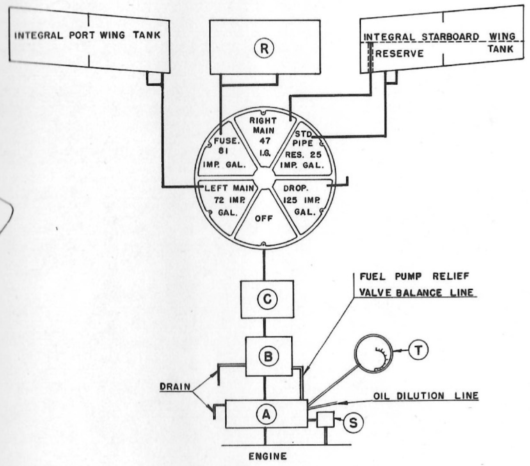
127 **Operation of the Fuel System:** The selector valve permits the pilot to use fuel from the tank of his choice. All warm-up and take-off operations should be conducted from the "Reserve" tank. This eliminates the possibility of the pilot, in error, selecting the starboard tank for take-off. The standpipe opening for that tank may become uncovered during the take-off resulting in a cut-off of the fuel supply. The fuselage tank should never be used because that tank, being intended for use only in certain overload conditions, may not have been fueled.

128 When operating the hand (wobble) pump an effort should be made to maintain the pressure smoothly. This pump must be used to furnish fuel to the engine for priming and starting. The hand (wobble) pump can adequately supply fuel to the engine in the event of an engine driven pump failure.

129 The engine primer will function only when fuel pressure is maintained with the hand pump.



SYMBOL	NAME OF PART	PART REF. NO.	MANUFACTURED BY	NO. REQ'D
A	CARBURETOR	1685 F	HOLLEY CARBURETOR CO.	1
B	PUMP, FUEL, ENGINE DRIVEN.	RD-4070-8	ROMEC PUMP CO.	1
C	PUMP, HAND (WOBBLE) A.E.L. 3-UNIT.	14-48188	UNITED AIRCRAFT PROD. INC.	1
D	VALVE, SELECTOR.	123918	AERO SUPPLY CO.	1
E	TRANSMITTER, FUSELAGE TANK.	8TJ13LCR	GENERAL ELECTRIC CO.	1
F	TRANSMITTER, WING TANK, PORT INBOARD.	8TJ13LCL	GENERAL ELECTRIC CO.	1
G	TRANSMITTER, WING TANK, PORT OUTBOARD.	8TJ13LCK (NOT SHOWN)	GENERAL ELECTRIC CO.	1
H	TRANSMITTER, WING TANK, STARBOARD INBOARD.	8TJ13LCN	GENERAL ELECTRIC CO.	1
I	TRANSMITTER, WING TANK, STARBOARD OUTBOARD.	8TJ13LCM	GENERAL ELECTRIC CO.	1
J	CELL, SELF-SEALING, FUSELAGE TANK.	2FI-5-218-A	GOODYEAR RUBBER CO.	1
K	CELL, SELF-SEALING, OUTBOARD WING TANK.	2FI-6-277A (LEFT) 2FI-6-277A (RIGHT)	GOODYEAR RUBBER CO.	1L & 1R
L	CELL, SELF-SEALING, INBOARD WING TANK.	2FI-6-276A (LEFT) 2FI-6-276A (RIGHT)	GOODYEAR RUBBER CO.	1L & 1R
M	VENT, WING TANK.	4-200-4	KENYON INSTRUMENT CO.	4
N	HOSE, SELF-SEALING	M-497	GENERAL TIRE & RUBBER CO.	AS REQUIRED
O	SUMP, FUEL TANK.	14-48051	BREWSTER AERONAUTICAL CORP.	3
P	SUMP, FUEL TANK, WING, FORWARD. OUTLET.	14-48050	BREWSTER AERONAUTICAL CORP.	2
Q	SUMP.	3-204016	PARKER APPLIANCE CO.	1
R	TANK, FUSELAGE.	14-48092	BREWSTER AERONAUTICAL CORP.	1
S	PRIMER.	A-2346	HOLLEY CARBURETOR CO.	1
T	GAUGE, 3 UNIT ENGINE.	AW. 2-21-C	U. S. GAUGE CO	1



FUEL SYSTEM - FIG. 4-8

OIL SYSTEM

130 General: The oil or lubricating system refers only to the engine oil supply. The system, with the exception of the temperature and pressure gauges, is installed forward of the fireproof bulkhead in the engine accessory compartment. The oil system is comprised of the following parts (see fig. 4-9):

Oil tank.
Oil cooler.
Oil system plumbing, temperature and pressure gauges.
Oil dilution system.

131 The oil pump is a component part of the engine supplied with the aeroplane. For information concerning the proper oil pressure relief valve adjustment and other matters of engine lubrication, refer to handbooks prepared and furnished by the engine manufacturer.

Oil Tank

132 Description: The oil tank fabricated of 52S welded aluminium alloy sheet has a total volume of twenty-two point six (22.6) Imperial gallons which provides an oil capacity of eighteen point six (18.6) Imperial gallons, leaving a volume of four (4.0) Imperial gallons for foaming space. The tank is mounted on the forward side of the fireproof bulkhead. It is suspended on two rubber padded adjustable steel straps attached to the engine mount structure. Side loads are taken through side brace struts attached to the diagonal members of the engine mount. The side brace struts are fitted with felt pads on the face of the large circular strut ends. The tank filler neck is located on the port side. It is accessible through a section of the accessory compartment cowling. A scupper with an overboard drain is provided to drain off any oil spilled during the replenishing operation. A graduated sounding rod indicating the quantity of oil is located on the upper port side of the oil tank forward of the filler neck. It is accessible in the same manner as the tank filler neck. The sounding rod (dip-stick) is graduated in Imperial gallons with the aeroplane in the three-point (grounded) attitude. A threaded end is used to secure the rod in the tank.

133 The tank design provides a hopper arrangement which becomes necessary in conjunction with the "Worth Oil Dilution System." The hopper consists of a 4½ inch tube sitting upright in the tank. The lower end of the hopper tube is connected to the outlet sump. The return oil is fed, through a fitting that is tangent to the tube diameter, into the upper end of the hopper tube. An annular opening in the sump provides a connection between the bodies of oil in the hopper and the tank. This provision results in constant hopper oil level compensation and at the same time limits the quantity of oil that is diluted with fuel when the oil dilution system is employed.

134 Operation: The oil tank operates without attention.

135 Removal and Installation: Removal and installation of the oil tank should not require any additional information. Care must be exercised in the assembly of the support straps to avoid excessive tightness.

136 Servicing and Maintenance: The level of the oil supply shall be checked before each flight.

137 The general security of the filler cap and sounding rod shall be checked before each flight.

138 The general security of the tank installation shall be investigated at each engine check period. The tank shall be removed at each engine change. Remove all fittings (including sump and screen) and thoroughly clean inside and outside.

139 A shake-down inspection shall be conducted at not more than thirty hours after each installation. Re-adjust mounting straps and check tightness of all fittings.

Oil Cooler

140 Description: The oil cooler is a thirteen inch Harrison cooler having an oil temperature regulator. The regulator employs a bimetallic element in the shape of a helical spring which operates a rotary temperature control valve. The rotary valve feeds the oil from the engine to one of four openings, or proportionately to two adjacent openings, as required. This cooler has three openings connecting to the temperature regulator. The openings and their operating temperatures are as follows:

No. 1. Valve by-pass port (through regulator only).
Open up to 70° F.
Starts to close at 70° F.
Full closed at 105° F.

No. 2. Warm-up and core inlet port.
Starts to open at 70° F.
Full open at 105° F.

No. 3. Warm-up outlet port.
Starts to open at 70° F.
Full open at 105° F.
Starts to close at 140° F.
Full closed at 175° F.

No. 4. Core outlet port.
Starts to open at 140° F.
Full open at 175° F.
Full open thereafter.

141 The warm-up ports referred to provide the necessary inlets and outlets for the combination jacket and core heating method which is peculiar to this particular make of oil cooler. The regulator also includes a spring loaded, poppet type, relief valve to minimize the possibility of damage in the event that some form of malfunctioning occurs.

142 The cooler is located on the centreline of the aeroplane in the lower part of the engine accessory compartment. Air for cooling the oil is picked up in an opening in the leading edge on the lower side of the engine nose cowl. It is then fed through an air duct

to the oil cooler. Air from the oil cooler is discharged into the engine accessory compartment where it is spilled overboard through gill openings at the aft end of the accessory compartment cowling.

143 The cooler is suspended from the lower engine mount structure by a support assembly consisting of metal straps clamped to the lower engine mount members.

144 Operation: The operation of the oil cooler is automatic.

145 Removal and Installation: The oil cooler removal and installation should not require any special instructions. It is important that no other make of oil cooler be substituted for the Harrison Model COC-130 with temperature regulator CCV-20.

146 Servicing and Maintenance: Visual inspection of the general security of the oil cooler shall be checked once each day. Looseness of attaching parts and connections shall be corrected.

147 The oil cooler shall be drained at each engine oil change.

148 The oil cooler shall be removed and thoroughly cleaned at each engine change period.

149 Oil cooler temperature regulators shall not be disassembled in the field. The reason for this is that damaged regulator parts cannot be repaired. Methods of repairing damaged Cooler Core Assemblies are described in Air Publication 2038A, Volume II, Part 3.

Oil System Pipe Lines, Temperature and Pressure Gauges

150 Description: All oil system pipe lines are aluminium alloy tubing. The pipe lines, with the exception of the oil pressure gauge line and one fitting in the oil dilution system lines, are all connected or made up with hose clamps. The other connections are made up with aluminium alloy fittings of the Weatherhead type.

151 An individual system of pipe lines related to the oil system is the oil separator. This is used in conjunction with the instrument vacuum pump and is fed into an Eclipse Oil Separator Type 563 Model 1. The oil-saturated air is fed into the separator in a manner so as to cause the oil to be separated. The oil is then fed back into the engine crankcase and the air discharged overboard.

152 The oil pressure and oil temperature are indicated on the 3-unit engine gauge AW 2¾-21-C located on the starboard side of the pilot's main instrument panel. The temperature gauge is an electric remote control type.

153 Operation: Operation of these components is automatic and does not require attention. The desired readings to be obtained on the oil pressure and temperature gauges will be recommended by the engine manufacturer.

154 Removal and Installation: Special instructions for the removal and installation of plumbing and gauges are not necessary. The capillary tube of the temperature gauge requires careful handling to avoid sharp bending and kinks which would destroy the usefulness of the tube.

155 Servicing and Maintenance: Proper functioning of the oil system as indicated on the gauges shall be checked during each engine warm-up.

156 The general security of all fittings, tubing and bonding connections visible through the service platform openings shall be checked daily.

157 All oil system plumbing shall be carefully inspected at each engine check period for signs of wear, rubbing or chafing, loose hose clamps and general security.

158 All oil system plumbing shall be removed and thoroughly cleaned at each engine change period.

159 A shake-down inspection of oil system plumbing shall be conducted not later than twenty-five hours (logged engine operation) following each engine change to establish the tightness and general security of all the component parts and connections.

Oil Dilution System

160 General: The "Worth" oil dilution system was developed to afford means of readily starting engines in extremely cold weather and to provide satisfactory lubrication in the early stages of the engine warm-up under similar climatic conditions. The system merely adds fuel to the lubricating oil. The system comprises a hopper in the oil tank, a remote control solenoid operated valve in the pressure side of the fuel system and the necessary plumbing to connect into the oil system.

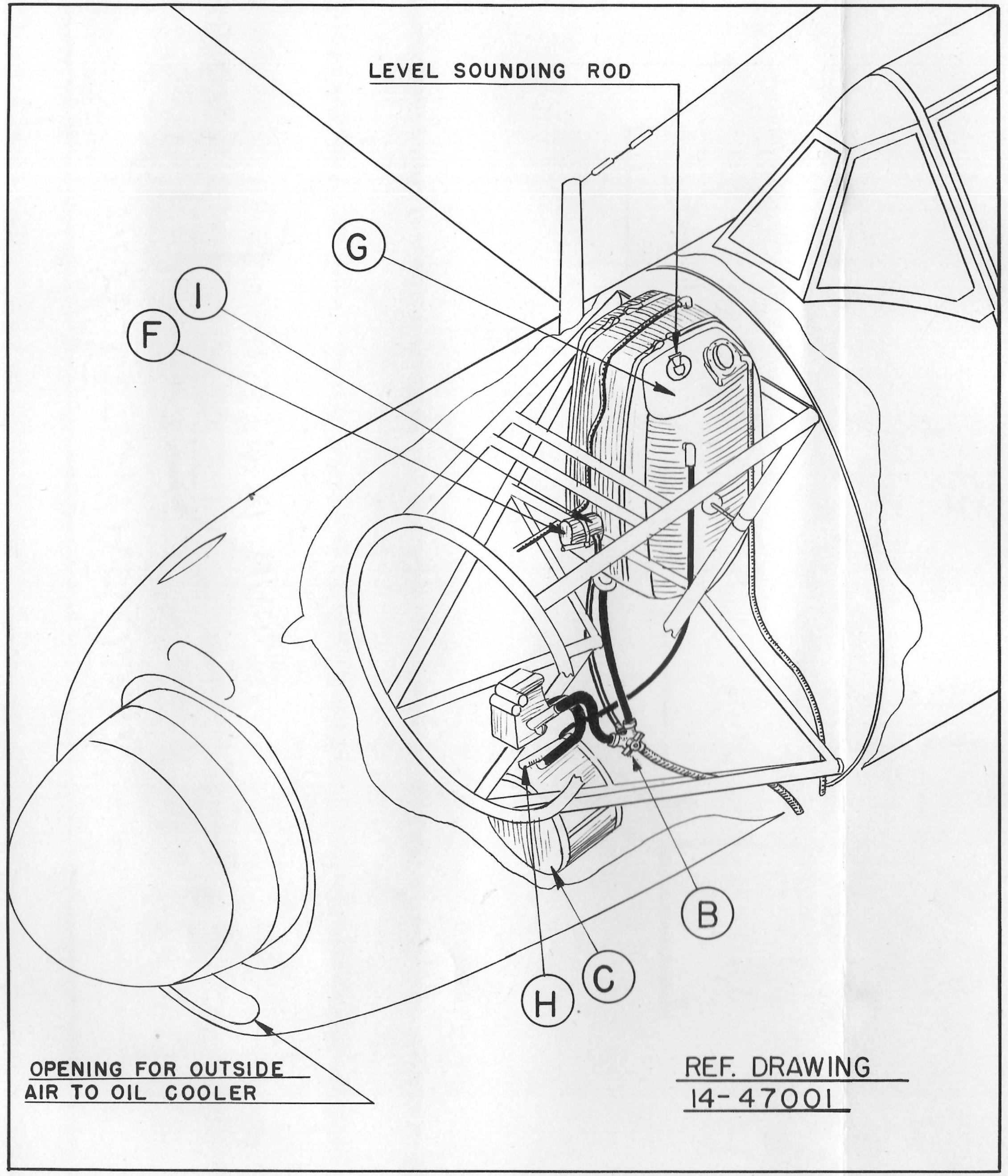
161 Description: The hopper is described in paragraph 133 of this chapter.

162 The oil dilution valve, part No. AC37D6210 is manufactured by the United Aircraft Company of Dayton, Ohio, U. S. A. The valve is installed near the fuel inlet fitting of the carburetor. The valve is connected to the carburetor through a Weatherhead hose M-389-A-4-14 and a fitting (U.A.P. AC37A-3528). The fuel is fed from the valve to a fitting in the "Y" drain cock (U.A.P. 37D6114-5). A toggle switch is located on the starboard side instrument panel. It is the outer switch of a group of three switches and is marked "off" in the upper position and "oil dilution" in the lower position.

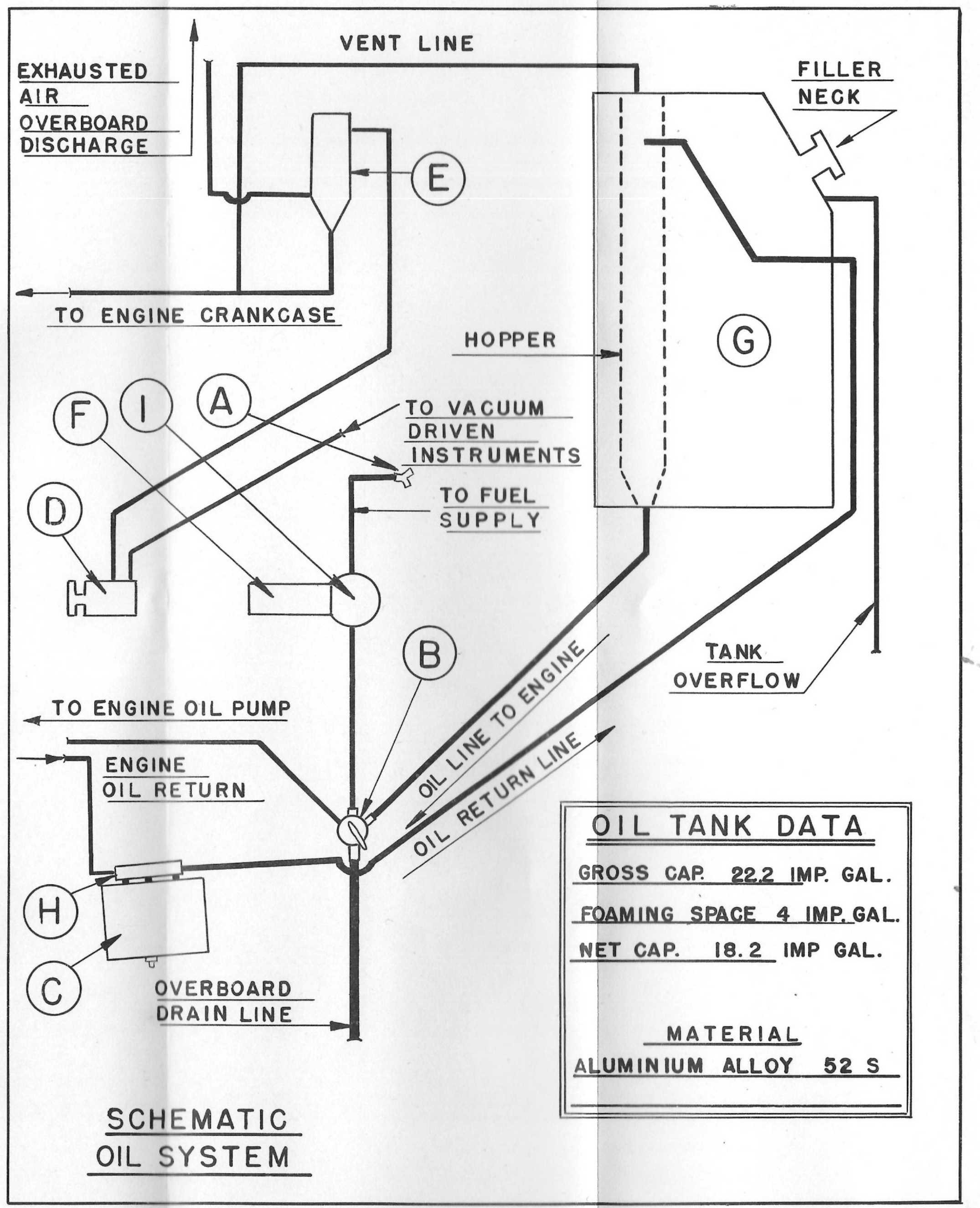
163 Operation: Operation of the oil dilution system is obtained by holding the toggle switch in the downward position while idling the engine. This introduces fuel into the lubricating oil. Specific instructions on the time required to obtain satisfactory dilution of oil will be obtained from the engine manufacturer.

164 The fuel introduced into the lubricating oil is rapidly evaporated when the engine is subsequently warmed up.

165 Servicing and Maintenance: Since the oil dilution system is so closely interrelated with the oil system and is comprised mostly of units in the plumbing of the oil system, the instructions covering service and maintenance of that group shall apply to the oil dilution system.



SYMBOL	PART NO.	PART NAME	MANUFACTURER	NO. PARTS
A	A 2346	ADAPTER, CARBURETOR PRIMER	HOLLEY CARBURETOR CO.	1
B	37D6114-S	COCK, "Y".	UNITED AIRCRAFT PRODUCTS CORP.	1
C	COC-130X9A 8503010	COOLER, OIL.	HARRISON RADIATOR DIVISION GEN. MOTORS CORP.	1
D	TYPE 548 MODEL 5	PUMP, VACUUM.	ECLIPSE AVIATION CORP.	1
E	TYPE 563 MODEL 1	SEPARATOR, OIL.	ECLIPSE AVIATION CORP.	1
F	AC37A3528	SOLENOID, OIL DILUTION.	UNITED AIRCRAFT PRODUCTS CORP.	1
G	14-47002	TANK, OIL	BREWSTER AERO. CORP.	1
H	CR-161E 8504036	VALVE, OIL COOLER THERMOSTAT CONTR.	HARRISON RADIATOR DIVISION GEN. MOTORS CORP.	1
I	AC37D6210	VALVE, OIL DILUTION.	UNITED AIRCRAFT PRODUCTS CORP.	1



OIL TANK DATA

GROSS CAP. 22.2 IMP. GAL.

FOAMING SPACE 4 IMP. GAL.

NET CAP. 18.2 IMP GAL.

MATERIAL

ALUMINIUM ALLOY 52 S

OIL SYSTEM - FIG. 4-9

AIR INTAKE SYSTEM

166 DESCRIPTION: The air intake system (see fig. 4-10) consists of a duct which conducts outside air from an opening in the top of the engine nose cowl to the carburetor air intake on the engine. The duct is provided with a valve installation mounted at the aft cowl band by means of which the flow of external air may be shut off and air taken from within the engine compartment. The purpose of this is to provide a source of relatively dry air during atmospheric conditions which might cause ice formation in the induction system or blocking of the air duct in the nose cowl opening.

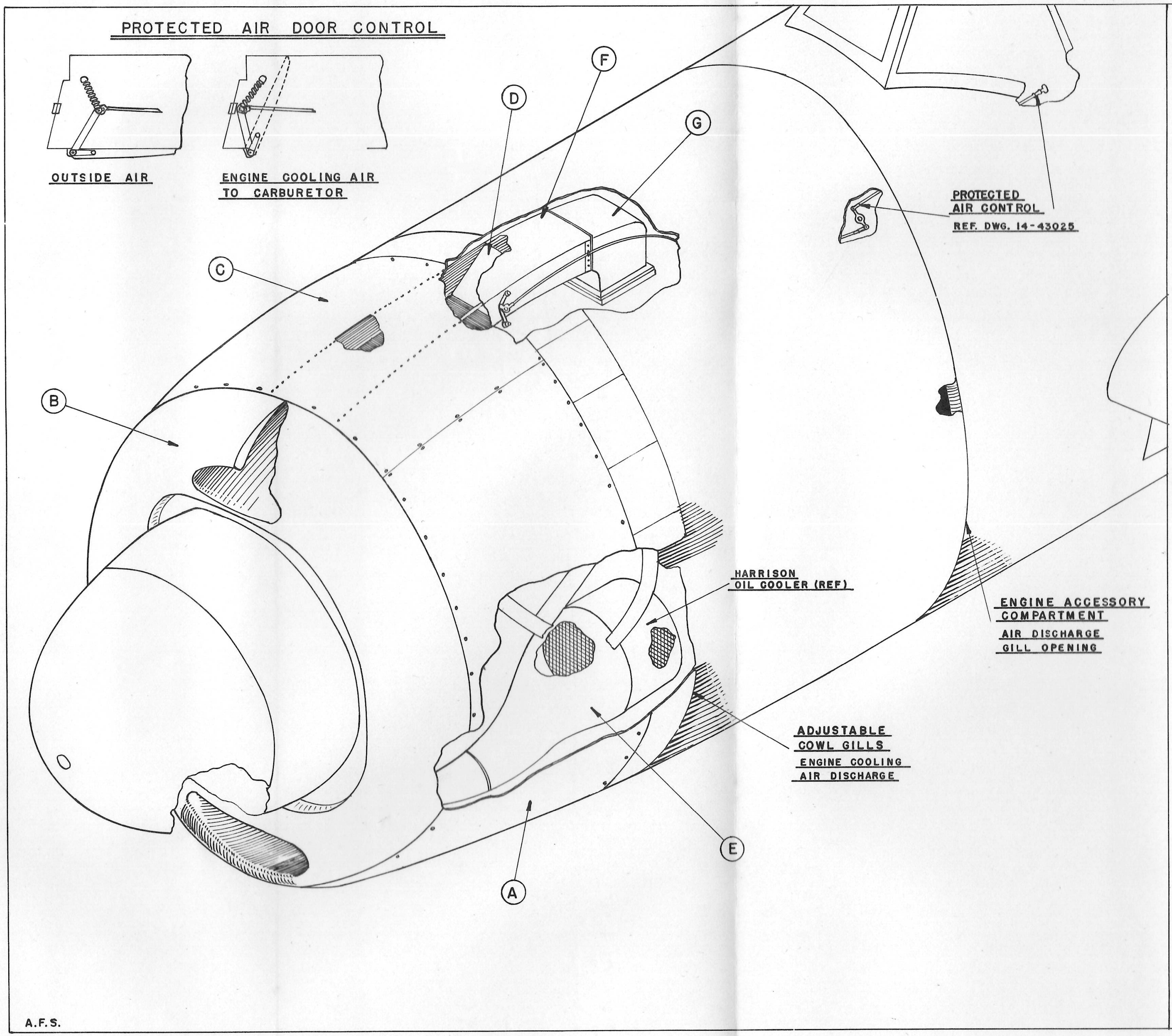
167 OPERATION: The pilot's control for selecting the source of carburetor air is located on the port side of the pilot's cockpit, on a bracket mounted between the main instrument panel and the port side panel. In order to obtain air from within the engine compartment the control is pulled full out (aft) from the panel. A spring loaded lever arm is provided at the valve installation so that the valve may be held only in the full unprotected or full protected air intake position. The action of the pilot's control is transmitted to the spring loaded lever arm by means of a flexible (Arens) control. A short length of push-pull tube is mounted between the pilot's control and a bell crank mounted in a bracket on the forward face of the fireproof bulkhead.

168 SERVICING AND MAINTENANCE: The functioning of the intake air control shall be checked during each pre-flight engine warm-up. A drop-off in manifold pressure will be noted when using protected air.

169 Inspect all air ducts for general conditions of wear (chafing and rubbing), security of assembled connections and condition of controls at each engine check period.

170 Dust sealed self-aligning ball bearings used in the control system must be replaced when damaged. Keep bearings clean by wiping or spray cleaning. Do not immerse in cleaning fluid.

171 The Arens control cable is grease packed. Care should be exercised to avoid this cable becoming kinked. Light oil should be sparingly applied at the points where the push rods enter the cable housing. This cable should not be disassembled by operating personnel.



SYMBOL	NAME OF PART	BAC PART NO.	NO REQ'D
A	COWL ASSEMBLY ENGINE COMPT. LOWER PANEL	14-31526	1
B	COWL ASSEMBLY ENGINE COMPT. NOSE	14-31505	1
C	COWL ASSEMBLY ENGINE COMPT. TOP PANEL	14-31525	1
D	DOOR ASSEMBLY CARB. PROTECTED AIR	14-31572	1
E	DUCT, AIR OIL COOLER	14-315127	1
F	DUCT ASSEMBLY CARB, AIR	14-31582	1
G	ELBOW, SCOOP CARB. AIR DUCT	14-42002	1

AIR INTAKE INSTALLATION - FIG. 4-10

ELECTRICAL SYSTEM

172 GENERAL: The electrical system of the Bermuda is, in general, a 24 volt, single wire, earth return system. All metal parts of the aeroplane are bonded together so that a good electrical circuit is provided. The source of energy is a 24 volt 34 ampere-hour storage battery and a 30 volt 50 ampere Eclipse generator (see figs. 4-11, 4-12, 4-13 and 4-14).

173 The system may be broken down into the following independent circuits, schematic diagrams of which will be found at the end of this section.

a. Battery
b. Generator
c. Ignition
d. Starter
e. Primer
f. Oil dilution
g. Airscrew pitch
h. Lighting system
i. Instruments
j. Anti-icing
k. Gun control
l. Bomb control
m. Fire extinguisher
n. Camera
o. External power receptacle
p. Fuel quantity gauge

174 The individual wires are numbered at each end by means of a one-half inch wide band of tape on which the cable number is marked. The wire numbering corresponds to the numbers indicated on schematic diagrams.

175 All wiring is high quality (aircraft use) single conductor low tension electric cable except wires No. 501 and 502 which are double conductor portable, heavy insulated, 16 × .010 inch cables. Wires No. 501 and 502 run from the bomb switch button on the throttle handle to the bomb release plug on the port side panel.

176 The terminals on all cables are held in place by the clamping action of the terminal itself. The terminals are manufactured by Thomas and Betts, Elizabeth, New Jersey, U. S. A. Care must be used in handling small diameter cables at junction boxes in view of the possibility of breaking the cable where it is clamped to the terminals.

177 Shielded junction boxes are provided at convenient places throughout the aeroplane. See fig. 4-11. In general, rigid aluminium alloy conduit (seamless tubing) is used wherever possible. Flexible conduit is used where it is necessary due to the number of bends, type of attachment fitting and the need of having a certain amount of slack in the cables and conduits at disconnect points. All wiring of the electrical system is shielded and standard fittings are used wherever it is possible. Each junction box is provided with a wiring diagram which will be found attached to the cover lid.

178 Circuit breakers are used to protect wiring from electrical overloads. All of these units are provided with manual re-set switches usually located in the vicinity of the operating switch. Circuit breakers are re-set by momentarily depressing the push button switch for the circuit involved.

179 All aeroplane parts which do not make good electrical contact with the aeroplane structure are bonded to the nearest main metal part of the aeroplane. Bonding braid wires provide an electrical connection, the resistance of which is approximately the same as that which would exist were both the parts being bonded an integral part. The resistance of any bond does not exceed .004 ohm. When bonding braids are installed to any part the part must be free of protective coating or finish (except that of metal plating) before the parts are joined. Standard bonds are made up from braid incorporating 120 strands of number 36 tinned copper wire.

180 DESCRIPTION: *Battery*. The storage battery is located on the centreline of the aeroplane, between stations 115 and 124 and on the floor of the fuselage. It is enclosed in an acid-proof case which is vented to the exterior of the fuselage.

181 The battery container and the surrounding structure (for a distance of ten inches) is painted with acid-proof paint. To clean the battery case use a solution of sodium bicarbonate (baking soda) in the proportions of 1¼ pounds of soda to one gallon of water, then rinse with water and dry. Equally effective alkaline solutions may be made from other ingredients. Do not allow these alkaline solutions to enter the battery cells.

182 The battery may be kept clean and free from corrosive action by the application of a thin coat of vaseline or light grease. The battery should be inspected every thirty hours and distilled water added to the cells if necessary. It is accessible through the bomb bay opening.

183 *Generator*. An Eclipse (F-79641) 28.5 volts 50 amperes generator is mounted on the lower aft face of the engine. The generator is voltage regulated and charges the battery at a current rate proportional to the state of charge of the battery. When the battery is in a discharged condition the charging rate will be high, and when the battery is fully charged (or nearly so) the charging rate will be low. Voltage regulated systems operate automatically to protect from overcharging, thus ensuring longer battery life and efficient operation. Another function of controlling the voltage is to provide a suitable source of electrical energy for the operation of the wireless apparatus. Maintenance information on the generator will be found in publications issued by the manufacturer.

184 An Eclipse voltage regulator (D-84155) is installed on the starboard side brace of the engine mount.

185 When the engine speed decreases to below 1000 R.P.M. (approx.), a cut-out switch located in the generator control box automatically disconnects the battery from the generator circuit, thus preventing the battery from discharging through the generator. The control box also limits the current output of the generator to 50 amperes at 3000 R.P.M., to prevent overheating of the generator which may occur under too great a load.

186 It is very important that no attempt be made to adjust the generator control so that the generator will deliver a definite amount of current. Adjustment should be made for voltage only by turning the adjusting rachet wheel on the generator to increase the voltage. The voltmeter should record a voltage of from 28.4 to 28.6 volts with the engine running at about 1500 R.P.M. Complete instructions pertaining to maintenance and adjustment of the generator voltage regulators are included in publications issued by the manufacturer of the unit.

187 *Ignition.* The pilot's ignition switch is mounted on the port side panel. A cable conduit runs from the switch to the ignition switch junction box (14-54254) which is located on the port side of the cockpit. The gunner's ignition switch is mounted on the port side of the gunner's cockpit at station 110. The switches are not mechanically inter-connected.

188 The low tension leads between the magneto and the ignition switch junction box are separately shielded from the other conductors. A metal shielding is installed over the ignition switch. The starboard magneto lead meets the port magneto lead in a "Y" which is located adjacent to the port magneto. The shielded conductor containing both leads travels to the ignition switch junction box. It is broken by a quick-disconnect at the fireproof bulkhead. The plug is located on and attached to the fireproof bulkhead. The receptacle is attached to the flexible conduit leading to the magneto. The receptacle contains two inner spring clips, so designed that when the receptacle is pulled free from the plug the leads to both magnetos are shorted to the conduit and thus grounded. This is to prevent sparking in case the airscrew should be rotated with the quick disconnect broken, as would be the case when the engine was being set up on the test stand.

189 *Starter.* The starter is an electric direct drive inertia type. The starter switch is mounted on the starboard side panel. It is the furthest inboard toggle switch of the three switches mounted on the lower portion of the panel. A further description of the starter will be found in the power plant section of this volume.

190 The starter circuit includes a relay, located near the starter, to reduce the amount of heavy cable in the system. The relay solenoid is energized by operating the starter switch in either direction. The starter engagement is operated electrically by a solenoid.

191 *Primer.* The engine is primed electrically and this action is controlled by the centre toggle switch of the three toggle switches on the starboard side panel. The wiring circuit from the switch runs to the large junction box which is attached to the port engine mount side brace. A flexible conduit runs from the box to the engine primer. Function and operation are explained in paragraphs 111 and 114 of this section.

192 *Oil Dilution* (see fig. 4-9). The switch for the oil dilution valve is the outboard toggle switch of the three on the starboard side panel. The circuit runs from this switch to the large junction box mounted on the port engine mount side brace. A flexible conduit runs between the box and the oil dilution valve on the engine. The function and operation of the oil dilution system is described under the oil system.

193 *Airscrew* (see fig. 4-5). Flexible conduits lead from the airscrew (Curtiss 100006-C) governor and from the airscrew brush housing (Curtiss 104-9302). They are clipped to the engine and travel to an airscrew control relay box (14-54156), which is attached to the lower port engine mount brace. From here another flexible conduit leads to the airscrew control switch box (20-54112) which is mounted on the port side of the cockpit between the tab controls and the engine controls bracket. The box carries two switches on its top face. The outboard switch is a master safety "on-off" two position switch which controls the supply of current for the airscrew. The forward position is marked "cut-off" and when the switch is in this position no current is supplied to the airscrew. The master switch should always be in the position marked "contact" when the aeroplane is being used.

194 The selector switch (Curtiss 102911) may be placed in four positions: straight up, forward, aft and outboard, and aft and inboard. When in the straight up position the airscrew will operate only in fixed pitch. In case a higher pitch setting is desired, the switch is pulled aft and outboard. It is held in this position until the engine tachometer registers the desired engine speed, then it is returned to neutral. If a lower pitch setting is desired the switch is pulled aft and inboard until the desired R.P.M. is reached, after which it is returned to neutral. An increase or decrease in engine speed is obtained by moving the airscrew governor control lever, located on the engine control quadrant, when operating in the constant speed setting. To place the airscrew in constant speed the switch is placed in the forward position. The airscrew will now maintain the speed at which it was turning when the switch was placed at this position.

195 A filter suppresses the effects of pulsating currents due to the airscrew governor action. This unit is mounted on the port side of the fuselage just aft the fireproof bulkhead.

196 Detailed drawings of the airscrew and airscrew controls will be found in the Curtiss Constant Speed Propeller Manual.

197 *Lighting System.* The lighting system of the Bermuda may be divided into two main subdivisions—the exterior lamps system and the interior lamps system.

198 The exterior lamps system includes the following (see fig. 4-15):

Port navigation lamp, Grimes type P.
Starboard navigation lamp, Grimes type P.
Tail navigation lamp, NAF 1072-4.
Port wing formation lamp NAF 1073-10.
Starboard wing formation lamp, NAF 1073-10.

Tail section formation lamp, NAF 1072-4.
Upper identification lamp, SIS 1583.
Lower identification lamp, SIS 1925.
Port wing landing lamp, ST 2410.
Starboard wing landing lamp, ST 2410.

199 The interior lamps system includes the following:
Pilot's port fluorescent lamp, X205 Electronic Laboratories.
Pilot's starboard fluorescent lamp, X205 Electronic Laboratories.
Spotlight, Grimes A-2277
Gunner's port cockpit lamp, Grimes A-2277.
Gunner's starboard cockpit lamp, Grimes A-2277.

200 The navigation lamps: Port wing, starboard wing and tail are controlled by the switches located on the electrical distribution panel.

201 The navigation lamps are located at each wing tip at wing station 276, just forward of the front spar. The tail running lamp is located on the tail cone, just above the tail section formation lamp.

202 The formation lamps are located on top of each wing tip just inboard of wing station 254 and aft of the rear spar. The tail section formation lamp is located on the tail cone, just below the tail navigation lamp.

203 An identification lamp switch box, provided with two switches and a key, is mounted on the starboard side of the cockpit near the pilot's elbow. The forward switch operates the downward identification lamp and the aft switch operates the upward identification lamp. Each switch may be set to three positions. Starting with the arm in the up position, they are "Morse," "off" and "steady." When turned to "Morse," the lamp may be controlled by the identification switch box tapping key and used as a message transmitter. The downward identification lamp is located on the under side of the fuselage, below the gunner's cockpit. The upward identification lamp is located on the upper side of the fuselage, aft the gunner's canopy.

204 Retractable landing lamps are located on the under surface of each wing, just outboard the undercarriage cut-out. An internal switch located in the lamp assembly turns the lamp on automatically as the lamp is extended by operation of the switches located on the main switch panel.

205 The pilot's cockpit fluorescent lamps are mounted just aft the pilot's seat on the port and starboard overturn structure brace tube. An inverter provides correct current for these lamps. The inverter is mounted below the pilot's seat, just aft the undercarriage warning horn.

206 The pilot's spotlight is mounted on the starboard side of the cockpit just below the longeron on which the movable canopy slides.

207 The gunner's cockpit is provided with two spotlights. One of these lamps is located on the port side of the cockpit near the pilot's shoulder. The other lamp is mounted on the centreline of the aeroplane in the forward portion of the gunner's cockpit. All spotlights are adjustable within a wide angle so that their light may be thrown by the pilot or gunner where required. The illumination system lamp bulb chart is shown in paragraph 208.

LAMP BULB CHART

Bulb	Reference	Description	Candle-Power or Watts	Volts	Manufacturer
Upper Fuselage Identification	105L/40		16 W	24	Customer Furnished
Lower Fuselage Identification	105L/41		16 W	24	Customer Furnished
Port Wing Formation Lamp	105L/39	Mazda 304 Frosted	3 CP	24	Customer Furnished
Starboard Wing Formation Lamp	105L/39	Mazda 304 Frosted	3 CP	24	Customer Furnished
Tail Formation Lamp	105L/3	Mazda 306 Frosted	3 CP	24	Customer Furnished
Starboard Wing Landing Lamp	105L/10	ST. 2410 A	239 CP	24	Grimes Mfg. Co.
Port Wing Landing Lamp	105L/10	ST. 2410 A	239 CP	24	Grimes Mfg. Co.
Starboard Wingtip Running Lamp	105L/46	Mazda 306 c/w silver Reflectors	21 CP	24	Grimes Mfg. Co.
Port Wingtip Running Lamp	105L/46	Mazda 306 c/w silver Reflectors	21 CP	24	Grimes Mfg. Co.
Tail Running Lamp	105L/	T. 3¼ Single Contact	3 CP	24	Grimes Mfg. Co.
Bomb Door Warning Lamp	105L/	T. 3¼ Single Contact	3 CP	24	Aircraft & Marine Specialty Co.
Nose Fusing Indicator Lamp	105L/	T. 3¼ Single Contact	3 CP	24	Aircraft & Marine Specialty Co.
Bomb Release Indicator Lamp	105L/139	T. 3¼ Double Contact, Clear	3 CP	6	Aircraft & Marine Specialty Co.
Tail Fusing Indicator Lamp	105L/	T. 3¼ Single Contact	3 CP	24	Aircraft & Marine Specialty Co.
Front Cockpit:					
Gun Sight	S-8	108B-5	21 CP	24	Star Machine Mfg. Co.
Chartboard	105L/93	G6 Single Contact, Clear	6 CP	24	Grimes Mfg. Co.
Compass	105L/33	Type 1821-2	3 CP	24	Pioneer Instrument Co.
Interior Spotlight		N.A.F. 1068-18	6 CP	24	General Electric Co.
Port Fluorescent Lamp	105C/455	Model X205	4 CP	..	G. E. Electronic Laboratory
Starboard Fluorescent Lamp	105C/455	Model X205	4 CP	..	G. E. Electronic Laboratory
Rear Cockpit:					
Compass	105L/33	Type 1821-2	3 CP	24	Customer Furnished
Port Spotlight	105L/93	G6 Single Contact, Clear	6 CP	24	General Electric Co.
Centre Spotlight	105L/93	G6 Single Contact, Clear	6 CP	24	General Electric Co.

208 The lamp bulbs behind the main instrument panel may be replaced by removing the front of the cover which covers the lamp bulb. The bulbs behind the auxiliary panels may be replaced similarly. Identification and exterior light bulbs in general may be replaced by removing the outer glass cover.

209 *Instruments.* The following instruments are electrically operated:

Wheel and flap position indicator.
Engine tachometer.
Fuel quantity gauge.
Cylinder temperature gauge.
Outside air temperature gauge.
Oil temperature gauge.

Their operation is described in paragraphs 242 et seq, of this section.

210 The pitot head has an electric resistance coil to furnish heat in case of freezing conditions which might clog the head with ice. The heat is controlled by a switch on the electrical distribution panel.

211 The position of each main landing wheel and the position of the landing flaps are shown at all times by an indicator mounted on the port side of the main instrument panel. This indicator also shows whether the lock-down or lock-up mechanisms are in action. A more detailed description of this indicator will be found in paragraph 246 of this section.

212 A micro-switch for the down-lock indication is provided at wing station 82. A micro-switch for the uplock indication is mounted at wing station 32½.

213 A warning horn switch is mounted on the throttle. This switch closes when the engine is throttled to below 1200 R.P.M. If the undercarriage is not in locked-down position at this time, the warning circuit is closed, operating the warning horn (howler) which is mounted under the pilot's seat.

214 The position of each landing gear as well as the position of the landing flaps is continuously indicated by the use of a direct current Autosyn (Pioneer) for each unit. A mechanical linkage drives a transmitter for each landing gear and wing flaps. The varying position of the transmitter causes a corresponding shift in the position of the Autosyn indicator. The two landing gear transmitters are each mounted on the outboard side of the nose rib which carries the main undercarriage oleo hinges. The flap transmitter is mounted on the flap false beam.

215 *Anti-icing Equipment.* The anti-icing fluid (alcohol) for the carburetor and the windscreen is pumped from a 4.4 Imperial gallon capacity tank. This tank is located aft of the pilot's seat inside the canopy. A cut-off valve in the pump supply lines is located on the port side above the camera control. A motor pump (Adel Series J) is mounted on the port forward face of the fireproof bulkhead just above the thrust line. The speed of pumping is governed by a rheostat (Adel 7776-5 or Ohmite No. 0315) which is mounted on the port side of the pilot's cockpit under the camera control. The rheostat includes an "off" and "on" control switch. A selector valve to control fluid to either or both the windscreen and carburetor is located on the port side under the instrument panel. A spray tube located directly in front of the windscreen sprays the fluid over the front of the enclosure. Anti-icer fluid for the engine induction system is fed through tubing which empties into a perforated ring which is installed in the air intake just above the carburetor. The ring is furnished with 16 holes (.030 inch diameter) through which the anti-icing fluid sprays into the intake.

216 The volume of alcohol supplied to the system varies from 20 pounds per hour to 85 pounds per hour depending on the position of the rheostat. For normal icing conditions no anti-icing fluid will be required, the use of air from within the engine accessory cowl being sufficient. For heavy icing conditions, but before ice has formed in the carburetor, a flow of 20 pounds per hour will be all that is required. In case ice forms, a flow of 85 pounds per hour maintained for 30 seconds will clear the carburetor of all ice. It will not be necessary to lean out the engine or to make other operating adjustments during the use of anti-icing fluid.

217 *Fuel Gauges.* The system of gauging the volume of fuel is electric. It consists of fuel gauge transmitters manufactured by the General Electric Company and designated by them as direct current Selsyn type. A Selsyn fuel quantity indicator (General Electric Model 8DJ3LAF) is provided for all the normal fuel tanks. A more complete description of the operation of the gauging system will be found in Section IV, Part F of this manual.

218 *Gun Control.* All fixed guns are fired electrically by the pilot. The four non-synchronized guns in the wing outside the airscrew circle of rotation are operated by a gun firing solenoid which acts as an electrical trigger control. The non-synchronized guns fire a continuous stream of bullets as long as the trigger is pulled aft by the trigger control. The two synchronized guns which fire through the airscrew arc are fired by means of two trigger motors, one of which is mounted on each gun. Each trigger motor is controlled by means of an impulse cable which is actuated by an impulse generator unit. The impulse cable is normally locked in the no-fire position. When the switch on top of the control column is closed a solenoid is actuated, withdrawing a pin which holds the impulse cable in the no-fire position. This allows the cable to follow the movements of the impulse generator unit and to operate the trigger motor.

219 Electrical switches are provided on the distribution panel so that any combination of three pairs of guns may be operated by the control column switch. These three pairs of guns are the two port wing guns, the two starboard wing guns and the two fuselage guns.

220 An illuminated gun sight is mounted on top of the pilot's main instrument panel. When the switch on the electrical distribution panel is turned to "on" the image of a circle of light is projected onto a glass screen at the top of the sight. A rheostat is mounted on the electrical distribution panel in order to control the degree of illumination.

221 The flexible gun in the gunner's cockpit may be swung from one side of the cockpit to the other by withdrawing a locking pin which indexes in a series of holes. The locking pin is normally withdrawn by means of a solenoid which is controlled by a push-button switch located on the gun mount.

222 *Bomb Control.* The bombs are released by individual electrical solenoids which operate to withdraw the locking pin which holds each bomb fixed to its rack. All the solenoid circuits are wired in series with the two fuselage bomb door switches so that no bombs may be dropped before both bomb doors are fully open.

223 The bomb release selector switches are located on the port side panel in the pilot's cockpit. The bomb release switch is located on the pilot's throttle control. Separate switches are provided for the port and starboard fuselage bomb racks as well as for the port and starboard wing bomb racks. A fusing switch is provided for nose or tail fusing. A Mallory sequence release (B-114079) may be used in order to automatically drop the bombs in a definitely fixed predetermined sequence. This sequence is as follows: Port wing, starboard wing, port fuselage and starboard fuselage. The Mallory switch contains four contact points, through each of which the bomb release circuit may be thrown. Individual release of any bomb is accomplished by means of the push-button switch on the pilot's throttle handle after the proper selector switch has been closed. A master bomb release switch on the electrical distribution panel must be closed before operation of any bomb circuits.

224 A 15 ampere master circuit breaker is provided for the bomb panel, a 5 ampere circuit breaker for the nose fusing circuit and a 5 ampere circuit breaker for the tail fusing circuit.

225 The throttle switch is provided with a short length of double conductor portable cable. The free end of the cable plugs into a receptacle on the bomb panel.

226 A bomb door test switch and a bomb door indicator lamp are mounted on the electrical distribution panel.

227 *Fire Extinguisher.* Automatic operation of the fire extinguisher system is accomplished by electrical devices. There are two sets of operating devices, flame and impact actuators. The flame actuators, four in number, are mounted on the engine mount tubes and the fireproof bulkhead. These flame actuators consist of two spring contacts which are held apart by a fusible link. When the temperature in the vicinity of the actuator exceeds a certain limit the link melts, allowing the contacts to close and the fire extinguisher head to operate.

228 An impact actuator is mounted on the centreline of the fireproof bulkhead. This actuator consists of two weighted electrical contacts which are held apart by a spring mechanism. When the aeroplane has a crash landing, inertia throws the weights together against the spring action, making contact and closing the electrical circuit to the bottle operating head.

229 The CO_2 bottle operating head is mounted on top of the fire extinguisher bottle. It consists of a cutter which is held in position by a series of locked levers. When the electrical circuit is closed a powder charge is ignited, driving a piston which in turn releases the train of locked levers. This allows the cutter to be forced downwards under the action of a compressed spring. The cutter pierces the seal on the carbon dioxide bottle, releasing the gas to the system.

230 *Camera.* The F.24 camera is operated from the pilot's cockpit. The control in the pilot's cockpit is located on the port side. A bracket is mounted aft of the tab controls and is designed to carry the normal control box for this camera.

231 *External Power Socket* (Customer supplied). A socket is located inside the lower pilot's step on the starboard side of the aeroplane. This socket may be connected to an external source of power in order to furnish current for starting the engine or operating the radio. When a plug is inserted in the socket the aeroplane's battery is automatically disconnected.

232 The socket is protected by an inner door which is secured in place by two screws. In order to insert a plug in the socket it will be necessary to open the outer door, hold it open and unfasten the screws of the inner door. This door may then be opened and the plug inserted in place.

233 OPERATION: The operation of the electrical system is largely controlled from the electrical distribution panel which is mounted on the starboard wall of the pilot's cockpit. The panel contains switches for operation of the various circuits, and the requisite number of re-sets for circuit breakers. Rheostats for controlling the amount of illumination on the compass and chartboard and in the gun sight are also provided, as well as a volt-ammeter and a receptacle for the pilot's suit heater. The switches are simple on-off toggle switches for the most part, except the controls for the port and starboard landing lamps and the formation lamps. The landing lamps may be retracted or lowered as well as illuminated and the formation lamps may be flash operated by means of the switch on the electrical distribution panel.

234 The circuit breakers are re-set by depressing the buttons on top of the panel. Each re-set button is plainly marked. When a circuit goes dead, the circuit breaker should be immediately re-set. If the breaker opens the circuit again an investigation should be made as soon as possible. The circuit breaker button should not be held down in order to keep the circuit closed, as this may cause serious damage to the system.

235 Servicing and Maintenance: The voltmeter mounted on the electrical distribution panel is combined with an ammeter. The meter normally reads the generator current. Alongside the meter is a spring switch which may be momentarily pressed to read the voltage of the generator. When the switch is released, it automatically returns to the current reading. The voltmeter should read approximately 28.5 volts for normal operation.

236 Care should be exercised when making conduit joints to ensure that the ends of the conduit sections are smooth and even and that all conduit clamps are tight. Rough conduit junctions may injure the insulation of the wires they carry and thus cause short circuits. Conduit dents should be inspected carefully to ensure that no wires are pinched. Before assembly, a light coating of anti-seize compound should be applied between rigid conduit ends and ferrules and on all threaded parts of conduit fittings.

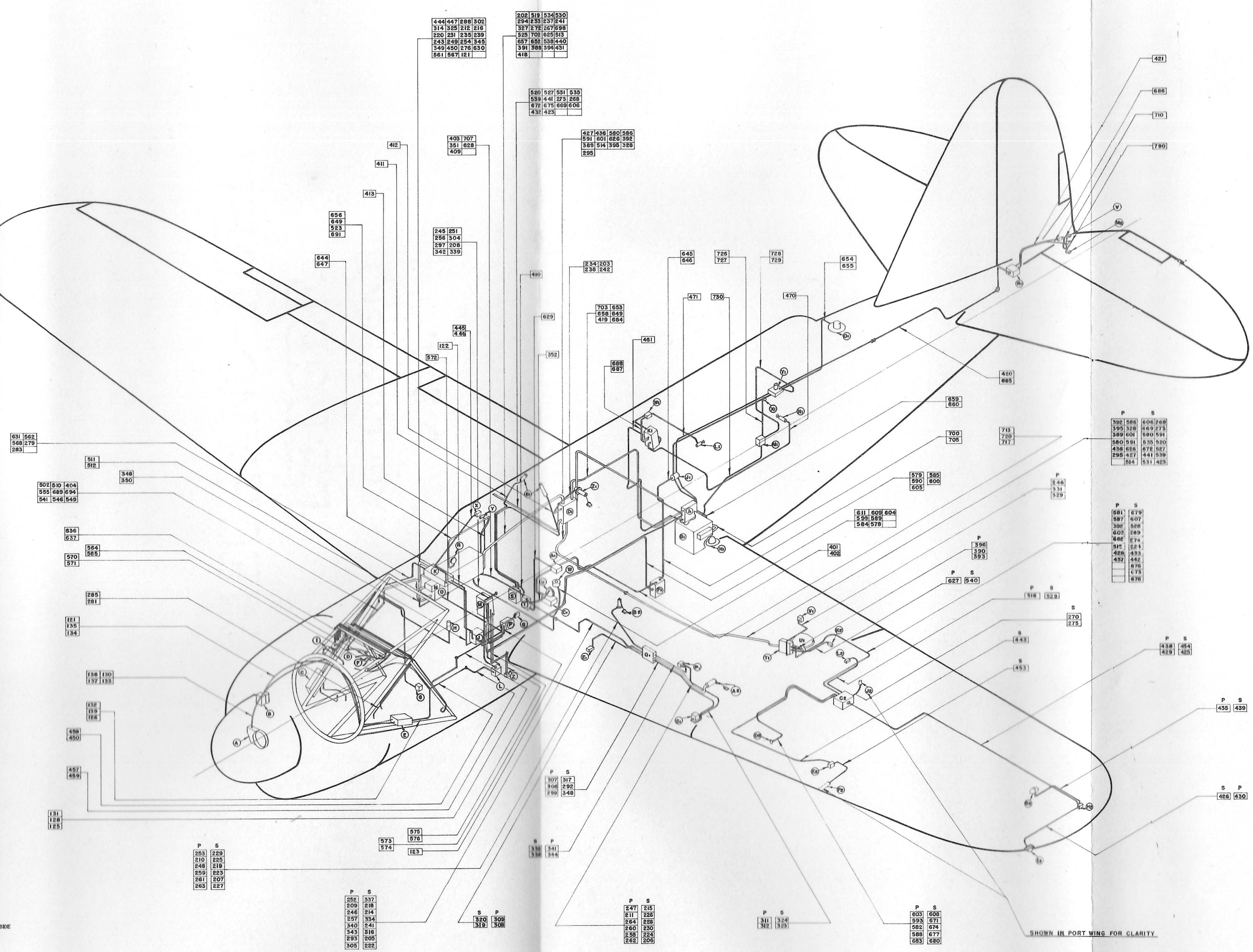
237 Access to the interior of the panel may be had by removing the top lid. It is held in place by eight Dzus fasteners. These fasteners may be unlocked by a counter-clockwise turn of a screw driver. It will be necessary to disconnect the conduit lead to the Bendix radio control, and unlock the two Dzus fasteners holding the identification lamp switch box in order to have enough clearance to lift the panel lid. The radio key may also have to be removed (by unlocking two Dzus fasteners). The lid of the panel (containing the switches) may now be lifted high enough to enable the mechanic to get his hand in and loosen one side of one of the two quick disconnects that are in the box. His other hand may be inserted through the small access door on the inboard side of the box. One disconnect is accessible through the forward and the other through the aft access door. When these two junctions are broken (by twisting counter-clockwise) the panel lid may be lifted free and tipped inboard toward the mechanic. It will then be easily removable from the aeroplane, and the interior of the panel accessible for repair.

238 Electrical items on the port instrument panel, such as bomb switches, are accessible by dismounting the panel from its supports. Items on the main instrument panel are accessible through the top engine compartment cowling.

239 Items in the engine compartment are accessible by removing the cowling nearest the particular item, or by swinging down the port or starboard hinged cowling section. This is unlocked by pushing aft on the metal ring revealed in the skin on the thrust line just forward of the fireproof bulkhead.

240 Items in the bomb bay section are accessible through the bomb bay doors. Items aft of the bomb bay are accessible through the gunner's cockpit and through the bomb bay. The wiring conduit in the tail cone is accessible by removing the cone.

241 Items in the wing panels are accessible through doors in the upper and lower surface of the wing. Refer to the access door diagram, Fig. 6-2.

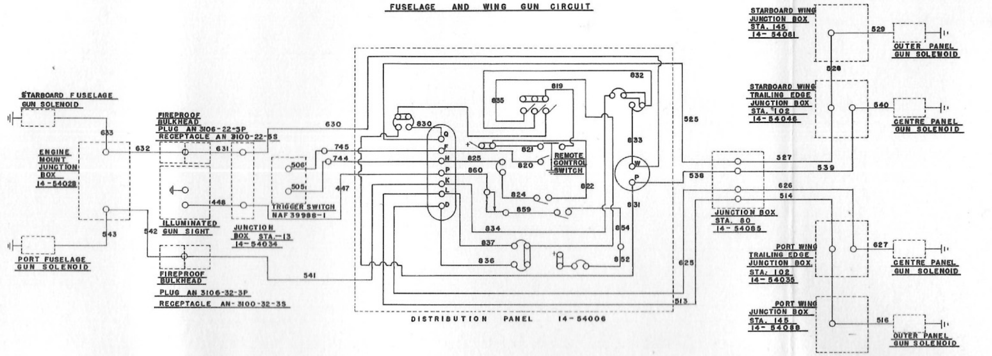


NOTE:
P = PORT SIDE
S = STARBOARD SIDE

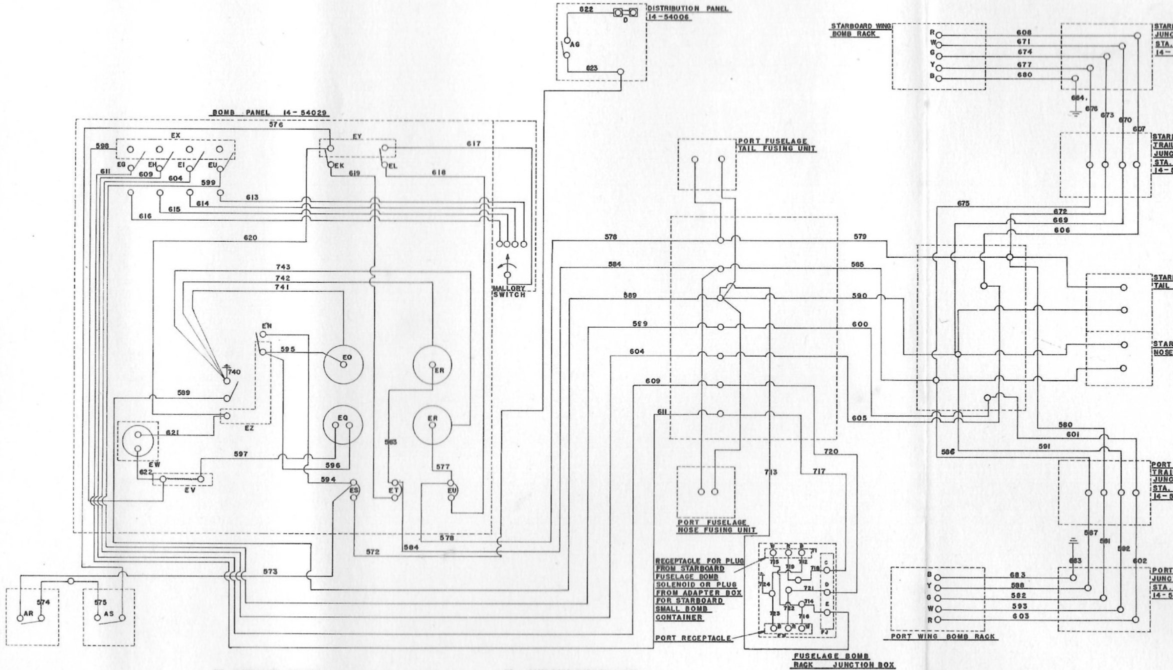
	NAME	PART NO.
A	BRUSH HOUSING	CURTISS 104-9302
B	GOVERNOR	CURTISS 100006C
C	BOX INSTALL. GOVERNOR CONTROL	14-54030
D	BOX INSTALL. ENGINE JUNCTION	14-54028
E	BOX INSTALL. AIRSCREW PITCH CONTROL	20-54156
F	ENGINE STARTER SWITCH BOX INSTALL.	14-54258
G	IMPACT ACTUATOR	KIDDE 78914
H	ANTI-ICING	ADEL J15-24S4 ($7/_{16}$-20)
I	COIL INSTALL. BOOSTER	ECLIPSE 91662
J	BOX INSTALL. AIRSCREW PITCH CONTROL - FILTER	20-54159
K	BOX INSTALL. STA-13 JUNCTION	14-54034
L	BOX INSTALL. IGNITION SWITCH JUNCTION BOX	14-54254
M	BOX INSTALL. BOMB CONTROL SWITCH	14-54029
N	BOX INSTALL. STARBOARD INSTRUMENT PANEL	14-54092
O	PANEL INSTALL. DISTRIBUTION	14-54006
P	BOX INSTALL. AIRSCREW PITCH CONTROL SWITCH	14-54112
Q	SWITCH INSTALL. THROTTLE POSITION MICRO	14-54186
R	SWITCH INSTALL. IDENTIFICATION LAMP	14-54257
S	INVERTER INSTALL. FLUORESCENT LAMPS	20-54098
T	BOX INSTALL. JUNCTION STA. 32½	14-54209
U	HOWLER INSTALL STA. 32½	20-54042
V	TAIL LIGHT	GRIMES NAF 1072-4
W	CONTROL INSTALL. ANTI-ICER	14-54007
X	COMPASS INSTALL.	14-51040
Y	LAMP INSTALL- INTERIOR SPOT	20-54171
Z	SWITCH INSTALL. BOMB DOOR	BZ - R31
A1	BOX INSTALL. F24 CAMERA CONTROL JUNCTION	14-54277
B1	SUPPORT INSTALL. FLUORESCENT LAMP	14-54168
C1	BOX INSTALL. FUSELAGE BOMB RACK JUNCTION	14-54330
D1	BOX INSTALL. STA. 80 JUNCTION	14-54085
E1	UNDERCARRIAGE LOCKUP SWITCH	14-33504
F1	BOX INSTALL. JUNCTION BOX STA. 85	14-54020
G1	BATTERY INSTALL. STA. 110 - 132	14-54177
H1	LAMP INSTALL. DOWNWARD IDENTIFICATION LIGHT	14-54077
I1	BOX INSTALL. BATTERY JUNCTION	14-54227
J1	GUNNER'S COCKPIT IGNITION SWITCH	14-329336
K1	PANEL INSTALL. GUNNER'S COCKPIT	14-54015
L1	LAMP INSTALL. GUNNERS COCKPIT SPOT	14-54326
M1	BOX INSTALL. GUNNERS COCKPIT FLEX. GUN JUNCTION	14-54342
N1	LAMP INSTALL. GUNNERS COCKPIT PORT SIDE	14-54175
O1	LAMP INSTALL. UPWARD IDENTIFICATION LIGHT	14-54087
P1	UNDERCARRIAGE LOCKDOWN SWITCH AND WARNING SWITCH	14-33503
Q1	BOX INSTALL. STA. 60 PORT AND STARBOARD WING JUNCTION	14-54090
R1	BOX INSTALL. TAIL SECTION JUNCTION	14-54151
S1	UNDERCARRIAGE POSITION TRANSMITTER	14-33523
T1	BOX INSTALL. STA. 120 PORT AND STARBOARD WING JUNCTION	14 34035 14 34046
U1	LANDING LAMP	GRIMES ST 2410
V1	FLAP POSITION TRANSMITTER-PORT WING	PIONEER 6615-2A
W1	TO BE FURNISHED BY CUSTOMER	
X1	TO BE FURNISHED BY CUSTOMER	
Y1	TO BE FURNISHED BY CUSTOMER	
Z1	FUSELAGE TANK FUEL GAUGE TRANSMITTER	GENERAL ELECTRIC ATJLCR
A2	FUEL GAUGE TRANSMITTER PORT WING TANK OUTER STARBOARD WING TANK INNER	GENERAL ELECTRIC 8TJLCK GENERAL ELECTRIC 8TJLCN
B2	FUEL GAUGE TRANSMITTER PORT WING TANK INNER STARBOARD WING TANK OUTER	GENERAL ELECTRIC 8TJLCL GENERAL ELECTRIC 8TJLCM
C2	JUNCTION BOX INSTALL. STARBOARD WING PORT WING	20-54081 20-54088
D2	BOMB RACK RECEPTACLE	14-54299
E2	JUNCTION BOX INSTALL. STARBOARD WING	14-54266
F2	PITOT TUBE - STARBOARD WING	20-51009
G2	FORMATION LIGHT	20-54025
H2	WING TIP JUNCT. BOX INSTALL.	20-54024
I2	WING RUNNING LIGHT INSTALL.	20-54037
J2	THERMOMETER INSTALL. STARBOARD WING	14-54033
K2	GUN SOLENOID WING CENTRE SECTION	MAGNAVOX G-9
L2	GUN SOLENOID OUTER PANFL	MAGNAVOX G-9
M2	FORMATION LIGHT	GRIMES NAF 1073-10

ELECTRICAL CONDUIT DIAGRAM - FIG. 4-11

FUSELAGE AND WING GUN CIRCUIT



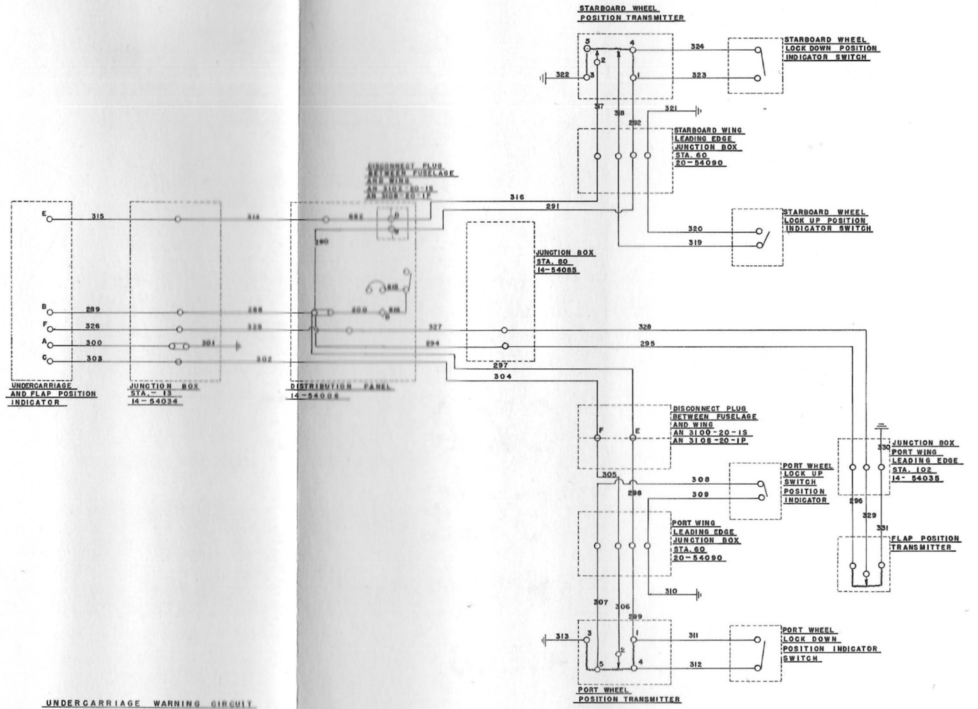
BOMB CIRCUIT



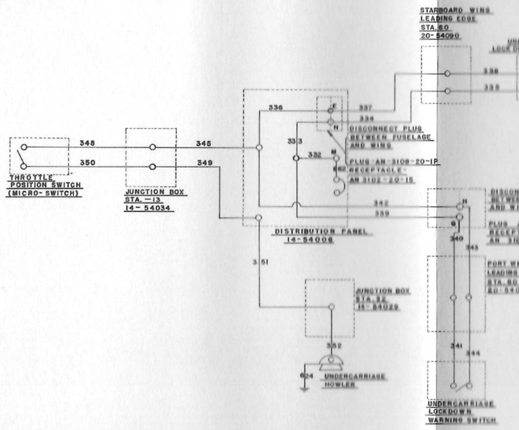
EX	BOMB PANEL BUS BAR
EG	STARBOARD FUSELAGE BOMB RACK SWITCH
EH	PORT FUSELAGE BOMB RACK SWITCH
EI	STARBOARD WING BOMB RACK SWITCH
EU	TAIL FUSING CIRCUIT BREAKER
EY	BOMB PANEL BUS BAR
EK	NOSE FUSING SWITCH
EL	TAIL FUSING SWITCH
FA	BOMB SWITCH RELEASE
EW	BOMB PANEL RECEPTACLE
EZ	BOMB PANEL BUS BAR
EV	BOMB PANEL RESISTOR
EN	BOMB DOOR TEST SWITCH
EO	BOMB DOOR WARNING LIGHT
EQ	BOMB RELEASE INDICATOR LIGHT
EP	NOSE FUSING INDICATOR LIGHT
ER	BOMB RELEASE INDICATOR LIGHT
ES	MASTER BOMB PANEL CIRCUIT BREAKER
ET	NOSE FUSING CIRCUIT BREAKER
EV	BOMB PANEL RESISTOR
AS	PORT BOMB DOOR SWITCH
AR	STARBOARD BOMB DOOR SWITCH
AT	BOMB RELEASE PLUG
AV	BOMB RELEASE SWITCH
AG	THROTTLE POSITION SWITCH
D	ENGINE GAUGE TRANSMITTER

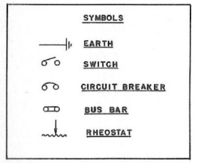
A.F.S.

UNDERCARRIAGE & FLAP POSITION INDICATOR CIRCUIT



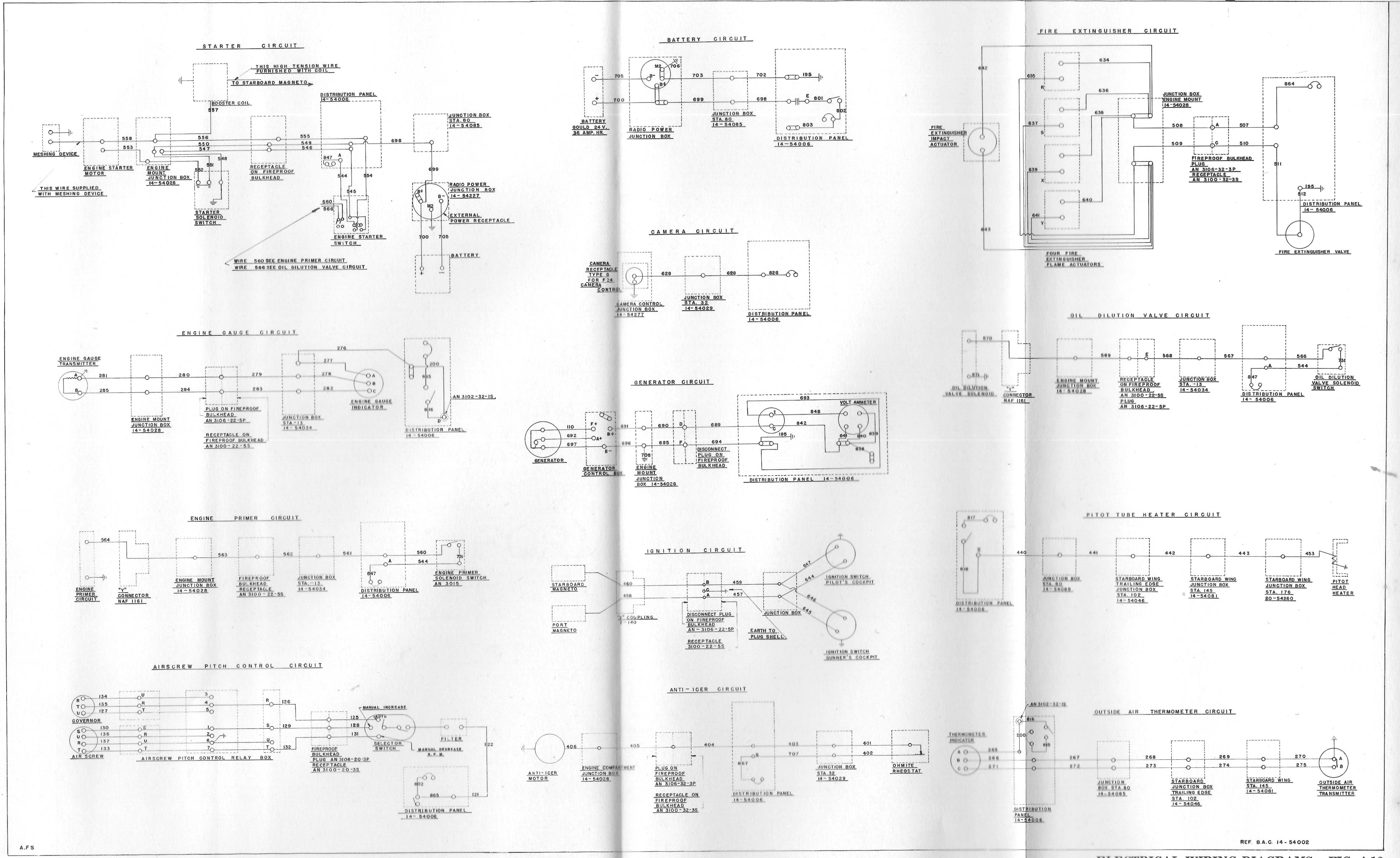
UNDERCARRIAGE WARNING CIRCUIT



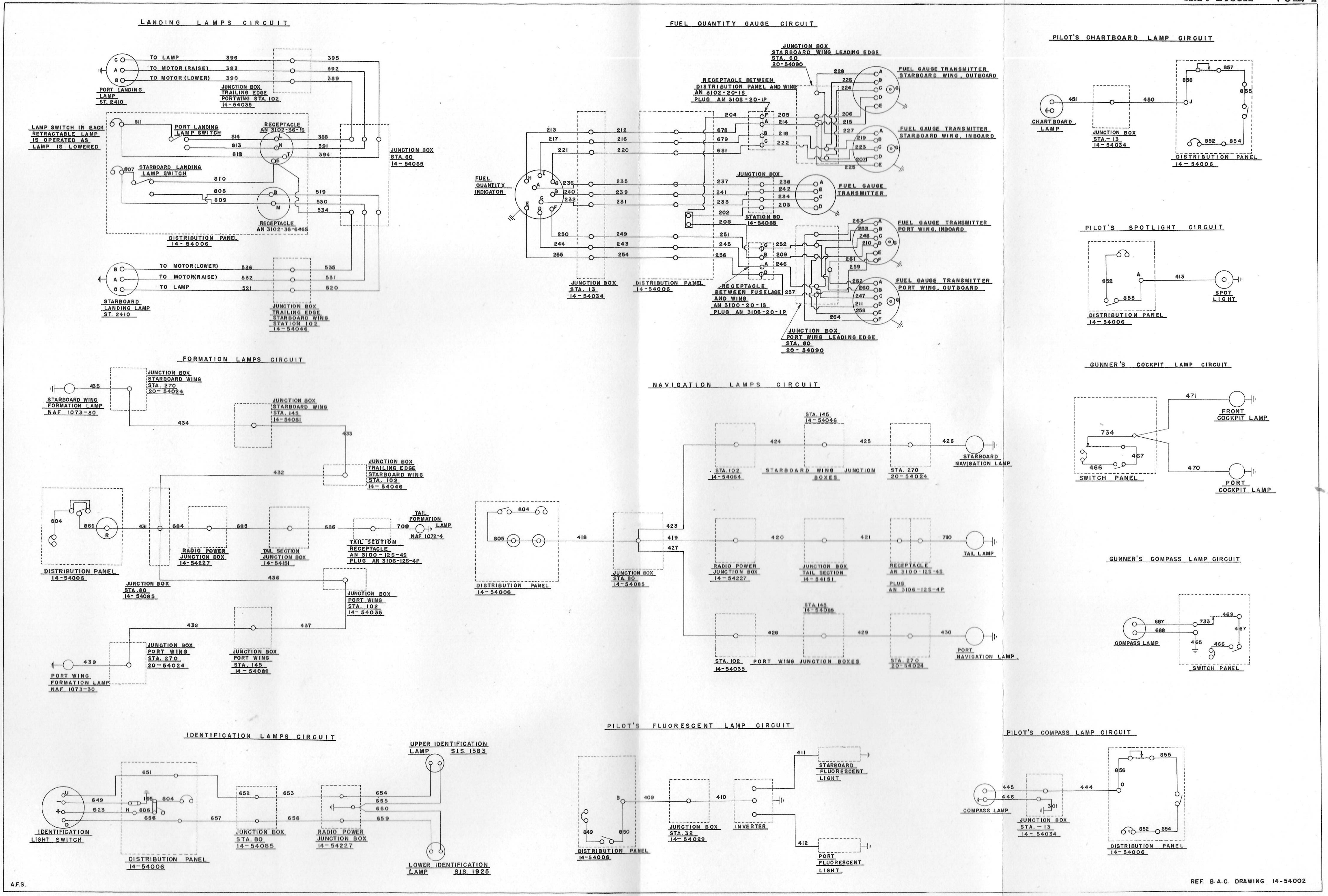


REF. B.A.C. DRAWING 14-54002

ELECTRICAL WIRING DIAGRAMS - FIG. 4-12



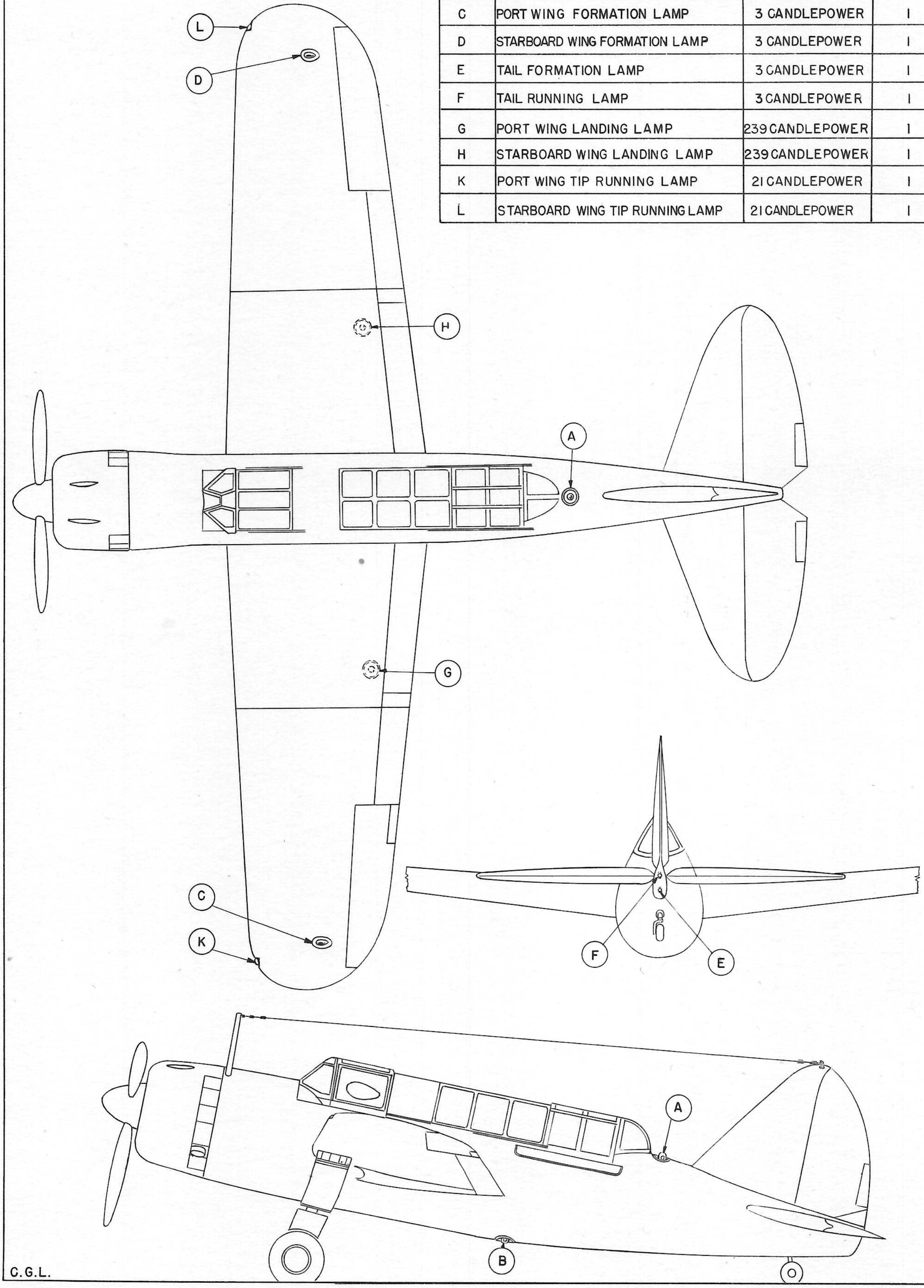
ELECTRICAL WIRING DIAGRAMS - FIG. 4-13



REF. B.A.C. DRAWING 14-54002

ELECTRICAL WIRING DIAGRAMS - FIG. 4-14

SYMBOL	NOMENCLATURE	POWER OF LAMP BULB (FILAMENT)	NO. REQUIRED
A	UPPER FUSELAGE IDENTIFICATION LAMP	16 WATT	1
B	LOWER FUSELAGE IDENTIFICATION LAMP	16 WATT	1
C	PORT WING FORMATION LAMP	3 CANDLEPOWER	1
D	STARBOARD WING FORMATION LAMP	3 CANDLEPOWER	1
E	TAIL FORMATION LAMP	3 CANDLEPOWER	1
F	TAIL RUNNING LAMP	3 CANDLEPOWER	1
G	PORT WING LANDING LAMP	239 CANDLEPOWER	1
H	STARBOARD WING LANDING LAMP	239 CANDLEPOWER	1
K	PORT WING TIP RUNNING LAMP	21 CANDLEPOWER	1
L	STARBOARD WING TIP RUNNING LAMP	21 CANDLEPOWER	1



EXTERIOR LAMPS DIAGRAM - FIG. 4-15

INSTRUMENTS

242 General: The instrument panels and the compass are shock-mounted by means of rubber shear supports (Lord Mounts). Instruments in the pilot's cockpit are located on the main instrument panel and the starboard side panel and in the gunner's cockpit on the main panel. The instruments on the pilot's main panel (see figs. 4-16, 4-17 and 4-18) are as follows:

a. Clock.
b. Altimeter.
c. Undercarriage position indicator.
d. Directional gyroscope (direction indicator).
e. Airspeed indicator.
f. Manifold pressure gauge (boost gauge).
g. Turn and bank indicator.
h. Gyro artificial horizon.
i. Rate of climb indicator.
j. Engine gauge unit.
k. Engine tachometer (engine speed indicator).
l. Fuel quantity gauge.

The instruments on the pilot's starboard side panel are as follows:

m. Cylinder temperature gauge.
n. Hydraulic pressure gauge.
o. Air temperature gauge.
p. A compass is mounted above the main instrument panel, in the windscreen cap.

The instruments on the gunner's main instrument panel (see figs. 4-19 and 4-20) are as follows:

q. Air speed indicator.
r. Turn and bank indicator.
s. Altimeter.
t. Compass.

243 Description: *Clock*—Jaeger 1650. The clock is mounted on the left hand side of the main instrument panel. It is an eight day clock with a winding and set knob below the dial. Hour, minute and sweep-second hands are provided. The dial has luminous numerals and graduations on a dull black background. Adjustments may be made by means of a regulator plug on the upper back face of the case.

244 *Altimeter*—Pioneer 1546-2G (Bendix Aviation). The sensitive altimeter registers from sea level to 35,000 feet. Two dials are provided; an outer and an inner. The outer dial registers in hundreds of feet, from 0 to 10. The centre small dial registers 0, 10, 20 and 30, in thousands of feet. The hands and the principal graduations are in radium paint and fluorescent lacquer. The instrument may be used as a barometer by turning the knob until the main hands are at 0. The millibar recording (small dial in lower centre of dial) will then indicate the barometric pressure at sea level. Or, when coming into a field, the pilot may set the millibar recording to the barometric pressure at the field he is approaching. The altimeter will then indicate the true height of the aeroplane above the field.

245 The static line from the pitot head is connected to the altimeter to provide outside atmospheric pressure rather than the pressure of the cockpit.

246 *Undercarriage Position Indicator*—Pioneer wheel and flap position indicator 6532-1J-A. The indicator is of the direct current Autosyn type which is controlled by the action of a transmitter. There is a separate transmitter for each undercarriage wheel (port and starboard) located in the wheel wells, attached to the wing structure and mechanically connected to the undercarriage struts. The transmitters are wired in series with the undercarriage position lock switches. A continuous indication of the position of the main undercarriage and landing flaps is provided. The indicating instrument is mounted on the port side of the main instrument panel. In the upper half of the dial is an outline of a twin-engined aeroplane. In the lower half of the dial is a cross-sectional outline of an aeroplane wing and in appropriate position is mounted a small pointer shaped to represent a flap.

247 When the wheels are in raised and locked position nothing is indicated below the wing. As each wheel is unlocked a red tab appears. As the wheel descends the red tab is pushed downwards. When the wheel is locked in the down position the red tab is pushed down out of sight and only the wheel remains visible. The red tab is always revealed until the up or down locks operate, then it quickly snaps out of sight. This is caused by the action of the micro-switches mounted on the up and down locks.

248 As the flaps are opened the indicator pointer moves to indicate exact angular position of the flaps. The landing flaps alone are indicated, as the dive flaps are visible to the pilot. The relative motion of the dive flaps when in use is the same as the landing flaps. If for any reason the power supply is shut off, the landing wheel markers drop out of sight leaving a flag marked "off" exposed. The flap pointer also moves off its normal scale and hangs straight downwards. These actions are entirely mechanical. A simple linkage is provided between the undercarriage and flaps and their respective indicator transmitters, so that rapid adjustment of the system is possible. For additional description and information on the 6532-1J wheel and flap position indicator, the 6615-2A-A flap position transmitter and the 6613-2A-A and 6613-1A-A wheel position transmitters reference is made to the Pioneer Instrument Manual.

249 *Directional Gyroscope*—Sperry 640,370. The directional gyro (direction indicator) is mounted on the left hand side of the pilot's main instrument panel. The instrument may be manually set by pushing the caging knob (at the bottom of the instrument) in and rotating it to the desired setting. The instrument will now record any deviation of the aeroplane from this course setting. The gyroscope contained in the instrument will precess from any given course setting over a period of time. Therefore the instrument must be checked and re-set, if necessary, to agree with the magnetic compass every fifteen minutes. The gyro-

scope is air driven by the Eclipse vacuum pump which is mounted on the engine.

250 *Airspeed Indicator*—United States Gauge Company AW 2¾-16-Z. This instrument is mounted on the left hand side of the main instrument panel. It registers the airspeed of the aeroplane in "miles per hour." The dial is dull black with raised aluminium markings, and is marked from 50 to 500 miles per hour in increments of 50. The instrument operates by measuring the pressure difference between the impact and static air pressure. The instrument is connected to a pitot head (Kollsman 519-62) which projects from the starboard wing. The static line of the pitot head faces at right angles to the pressure line which faces the direction of flight.

251 To test the functioning of this instrument slip a rubber tube over the pressure inlet of the pitot head and, starting at the free end of the tube, coil it up, compressing the tube flat. The resulting increase in pressure will be shown on the airspeed indicator.

252 *Manifold Pressure Gauge*—Manning, Maxwell and Moore 6744-103. Located in the upper centre portion of the main instrument panel. It is calibrated in absolute inches of mercury and the dial is graduated from 10 to 50, in increments of 5. The pressure line to the instrument is connected to the engine supercharger housing near the starboard magneto. For additional description and information on this gauge reference is made to a Manning, Maxwell and Moore Bulletin on the subject.

253 *Turn and Bank Indicator*—Pioneer 1700-1AG. Located in the lower centre portion of the main instrument panel. The instrument contains a dial, a moving pointer and a curve spirit level. For zero (0°) turn, the hand on the dial points vertically up. When the aeroplane is making a port turn the pointer moves to the left and when making a starboard turn the pointer moves to the right. When the bubble in the spirit level is centered in the level, the aeroplane is either flying level or else is making the correct bank for that turn. The dial face is dull black, with radium paint on the pointer and on the left, right and centre markings. Fluorescent lacquer is added to the lettering "Turn" and "Bank." The instrument is air driven by the engine driven vacuum pump. The air supply line is connected to the port marked T of the suction regulating valve by a ¼ inch diameter line. For additional description and information reference is made to the Pioneer Manual.

254 *Gyro-Artificial Horizon*—Sperry 643,710. Located on the right hand side of the main instrument panel. This gyro instrument dial contains a miniature aeroplane and an angular scale with a cut-out to provide a view of a horizontal white bar and the movable background. A pointer at the top of the moving background moves in accordance with the bank of the aeroplane and records on an outer indicator ring the amount of bank. The figures 3 and 6 are placed on the outer ring of the dial to indicate the number of degrees, e.g., if the pointer points to 3 the aeroplane is in a 30° bank. The relation of the horizontal white bar to the miniature aeroplane outline indicates whether the aeroplane is flying level, climbing or diving. (If the aeroplane is above the bar, it is climbing.) The instrument is connected through a ⅜ inch line to the port marked "H" on the suction regulating valve. The suction regulating valve is connected to the engine driven vacuum pump. Additional descriptive information is given in the Sperry Handbook.

255 *Rate of Climb Indicator*—Pioneer 1633-4L. Mounted on the right hand side of the main instrument panel. This instrument reads the rate of climb of the aeroplane in thousands of feet per minute. The dial is graduated from 0 to 4, and reads from 0 (indicator pointer horizontal) to 4000 feet per minute climb (pointer above horizontal) and to 4000 feet per minute dive (pointer below horizontal). A re-set knob is provided so that the pilot may re-set the instrument to 0 if necessary. The dial has a dull black background with raised frosted aluminium characters. Radium paint is applied to all numerals and graduations, and fluorescent lacquer to the lettering "Climb," "Up," "Down," to the arrow and to all 400 foot graduations. The instrument is attached to the static line of the pitot head. For additional description and information reference is made to the Pioneer Manual.

256 *Engine Gauge Unit*—United States Gauge Company AW2¾-21-C. This unit is located on the right hand side of the main instrument panel. This instrument carries three dials, one above and two below. The dial above records engine temperature in degrees Centigrade and is marked from −10° to +120°. Connection is made to the engine electrically and a thermometer bulb (Edison ES33100) is mounted in a sump on the bottom of the oil pump.

257 The left hand bottom dial registers the oil pressure in pounds per square inch and runs from 0 to 200 in 50 pound increments. Connection is made to the discharge side of the oil pump on the engine through a ¼ inch aluminium alloy tube.

258 The right hand bottom dial registers the fuel pressure in pounds per square inch and is marked 0, 5 and 10. Connection is made to the fuel pump connection on the carburetor through a ¼ inch aluminium alloy tube.

259 *Engine Tachometer*—Kollsman 170-01. This instrument is mounted on the right hand side of the main instrument panel. This instrument registers revolutions per minute, and is marked in hundreds from 5 to 35, in steps of 5. The arc from 25 to 35 is marked in red, to indicate the over-speed range of the engine. For additional description and information on the tachometer reference is made to the Kollsman Manual.

260 *Fuel Quantity Gauge*—General Electric Company 8DJ3-LAF. The gauge is mounted on the right hand side of the pilot's main instrument panel. This gauge contains three dials, two of which record the fuel vol-

ume in the port and starboard wing beam tanks and the third of which gauges the fuselage tank. Two General Electric Company transmitters are mounted in each wing beam tank. These are required to compensate for the angle of the wing. When the transmitter rotary contact rotates (with variation in the fuel level), the indicator pointer will rotate in synchronism, thus directly indicating the fuel level which is translated to quantity on the calibrated dial of the indicator. A transmitter for the fuselage tank is provided. For additional description and information on the 8DJ3-LAF type indicator gauge and the 8TJ13-LCL, -LCM, -LCN and -LCR type transmitters reference should be made to the General Electric Handbook.

261 The gauge for the removable fuel tank which is installed in the bomb bay is a mechanical liquid level indicator mounted on the tank. A mirror is placed in the forward end of the bomb bay so that the pilot may see this gauge which is calibrated to indicate the fuel quantity directly in Imperial gallons.

262 *Cylinder Temperature Gauge*—Lewis 17ATS-3D. This gauge is mounted at the top of the starboard side panel. It registers from 0° to 350° Centigrade, in 50° increments. The temperature at two places on the engine may be measured. These are as follows:

(i) Head of No. 1 cylinder.
(ii) Head of No. 2 cylinder.

263 A two position switch is located in the lower left corner of the instrument so that either thermocouple may be cut into the circuit. When the instrument is being taken in or out of the aeroplane the two terminals on the back of the case (marked + and −), should be shorted with a copper wire. The effect of this short is to damp the swing of the needle, thus lessening the effect of jarring. For additional description and information on the Lewis thermocouple (8-T-200) and the Lewis thermocouple indicator (17-ATS-3D) reference is made to Lewis bulletins on the subject.

264 *Hydraulic Pressure Gauge*—Manning, Maxwell and Moore 6737-03. This gauge is mounted on the starboard side panel. It is marked 0, 10 and 20, and registers in hundreds of pounds per square inch.

265 *Air Temperature Gauge*—Lewis 47AC-5G. This gauge is mounted on the starboard side panel, at the bottom of the panel. It ranges from −50° C. to +50° C. and is marked −40, −20, 0, +20, +40. For additional description and information on the air temperature gauge reference is made to a Lewis bulletin on this subject.

266 *Compass*—Pioneer 1820-2. This instrument is mounted in the upper cap of the windscreen. For additional information reference is made to a Pioneer bulletin on the subject.

267 This covers the instruments located in the pilot's cockpit. A description of the instruments in the gunner's cockpit is as follows:

268 *Airspeed Indicator* (*Gunner*)—United States Gauge Company AW2¾-16-Z. Provision is made for mounting an airspeed indicator on the instrument panel in the gunner's cockpit. Tees are inserted in the pressure and static lines to the pitot head and lines run aft from these tees.

269 *Turn and Bank Indicator* (*Gunner*)—Pioneer 1700-1AG. Provision is made for mounting a turn and bank indicator on the instrument panel in the gunner's cockpit. A ¼ inch line runs from a tee in the ¼ inch line just forward of the Pesco 200B regulating valve. A needle valve is provided to adjust the suction at the instrument to 2 inches of mercury. The regulating valve is connected to the engine driven vacuum pump.

270 *Altimeter* (*Gunner*)—Pioneer 1546-2G. Provision is made for mounting an altimeter on the instrument panel in the gunner's cockpit. This instrument is connected to the static pressure line of the pitot head.

271 *Compass* (*Gunner*)—Pioneer 1821-2. The compass is mounted in the forward cap of the gunner's cockpit.

272 *Vacuum Pump.* The source of vacuum for those instruments which use it is the vacuum pump (Pesco B-2A-194) which is mounted on the lower starboard side of the engine. This pump is being continuously lubricated under pressure from the engine oil system. Some oil continually works its way through the pump packings and, as it does so, it is caught up in the air passing through the pump and is carried out through the air exhaust. To prevent losing this oil the exhaust is passed through an air separator (Eclipse 563-1) which is mounted on the starboard engine mount brace just aft the engine ring. The separator condenses the oil vapor in the line and by-passes it back into the crankcase by way of the oil vent connection located on the upper starboard side of the crankcase. The exhausted air from the vacuum system is discharged overboard on the starboard side of the engine cowling near the engine mount ring (see fig. 4-21).

273 *Suction Regulating Valve.* Control of suction is provided by the regulating valve (Pesco 200B) which is mounted on the port side of the aeroplane just forward of and at the level of the pilot's main instrument panel. It is accessible through the top accessory compartment cowling. The valve has four ports marked P, G, T and H. The half inch line from the pump connects to port P. Ports G, T and H are connected to the directional gyro, turn and bank indicator and the gyro-artificial horizon, as heretofore mentioned. For additional information reference is made to the Pump Engineering Service Company's Handbook.

274 *Pitot Head.* The pitot head installation (Kollsman 519-02) is located at wing station 184 in the starboard wing. The pressure line from this head runs to the airspeed indicator in the pilot's cockpit. A tee is

inserted in this line and connection made to the airspeed indicator in the gunner' cockpit. The altimeter, airspeed indicator and rate of climb indicator lines to the pilot's cockpit are taken off the static line from the pitot head. A tee is inserted in the static line and a line routed to the airspeed indicator and the altimeter in the gunner's cockpit. Drain fittings are provided at low points in both pitot head lines. They are located on the starboard side of the fuselage and are accessible through the wheel well. For additional information on the pitot head reference is made to the Kollsman Handbook.

275 *Illumination.* The instrument dials may be illuminated by direct light. If this is not desired the direct lights may be shut off and invisible, or ultraviolet, light supplied. (See Electrical Section.) The ultra-violet light causes the fluorescent paint on the instrument dials to become activated, making them glow with a soft light. Radium markings are also supplied on some instruments so that the chief instruments may be read even if the electrical power to the lamps fails.

276 OPERATION: Generally, instruments do not require operating instructions. Instructions for the use of instruments in connection with the operation of the various parts of the aeroplane will be found under the sub-heading of "Operation" for that part.

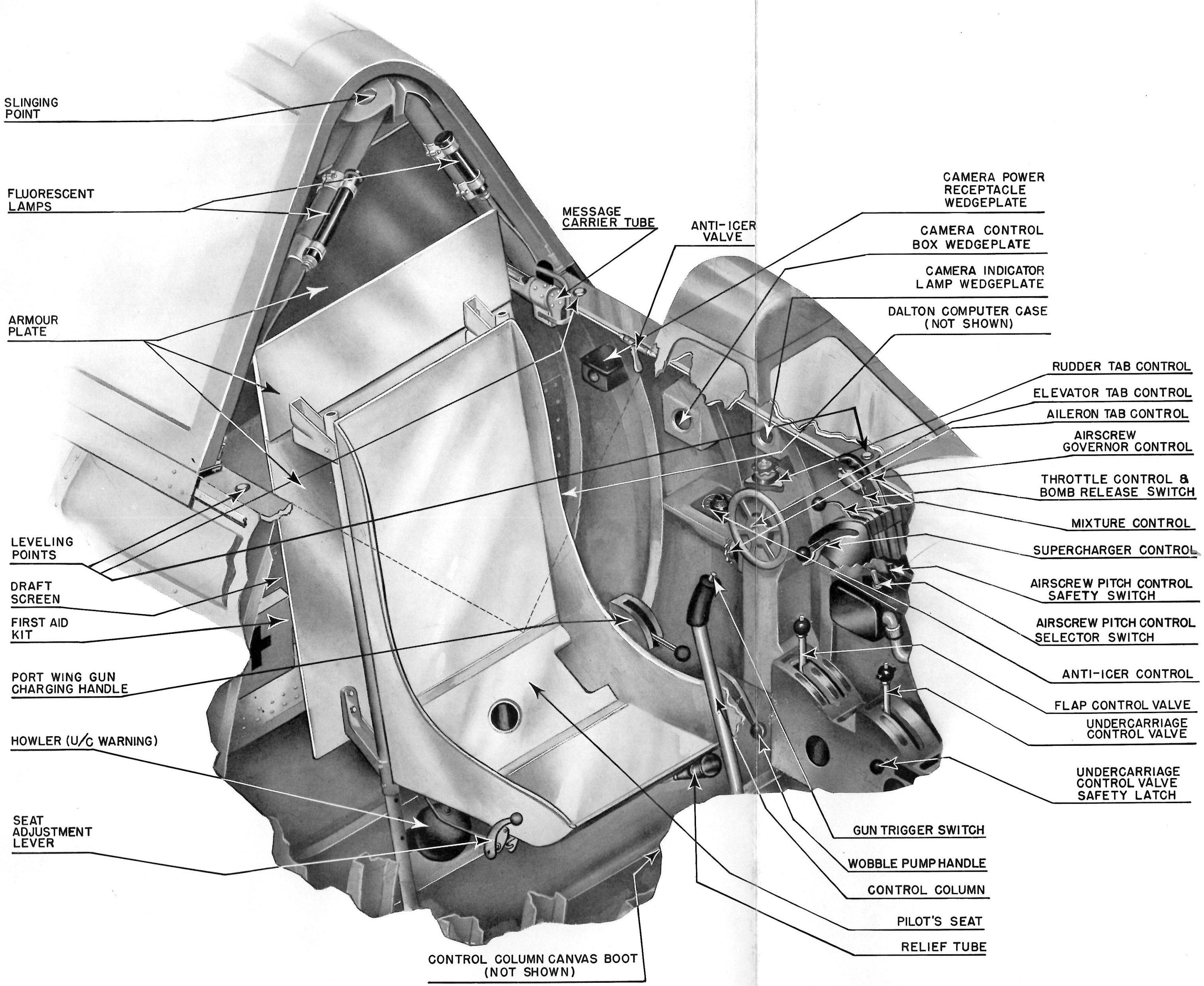
277 SERVICING AND MAINTENANCE: The removal and installation of all instruments is accomplished in the usual manner since all installations follow conventional practice.

278 Instrument manufacturers indicate that it is not advisable for field or operating personnel to undertake the disassembly and repair of instruments. It is recommended that unsatisfactory instruments be replaced. The faulty instrument may then be returned to overhaul bases where trained personnel and shop facilities are available to undertake the overhaul of instruments. The information necessary to properly re-condition the various instruments may be obtained from the manufacturer of the particular instrument.

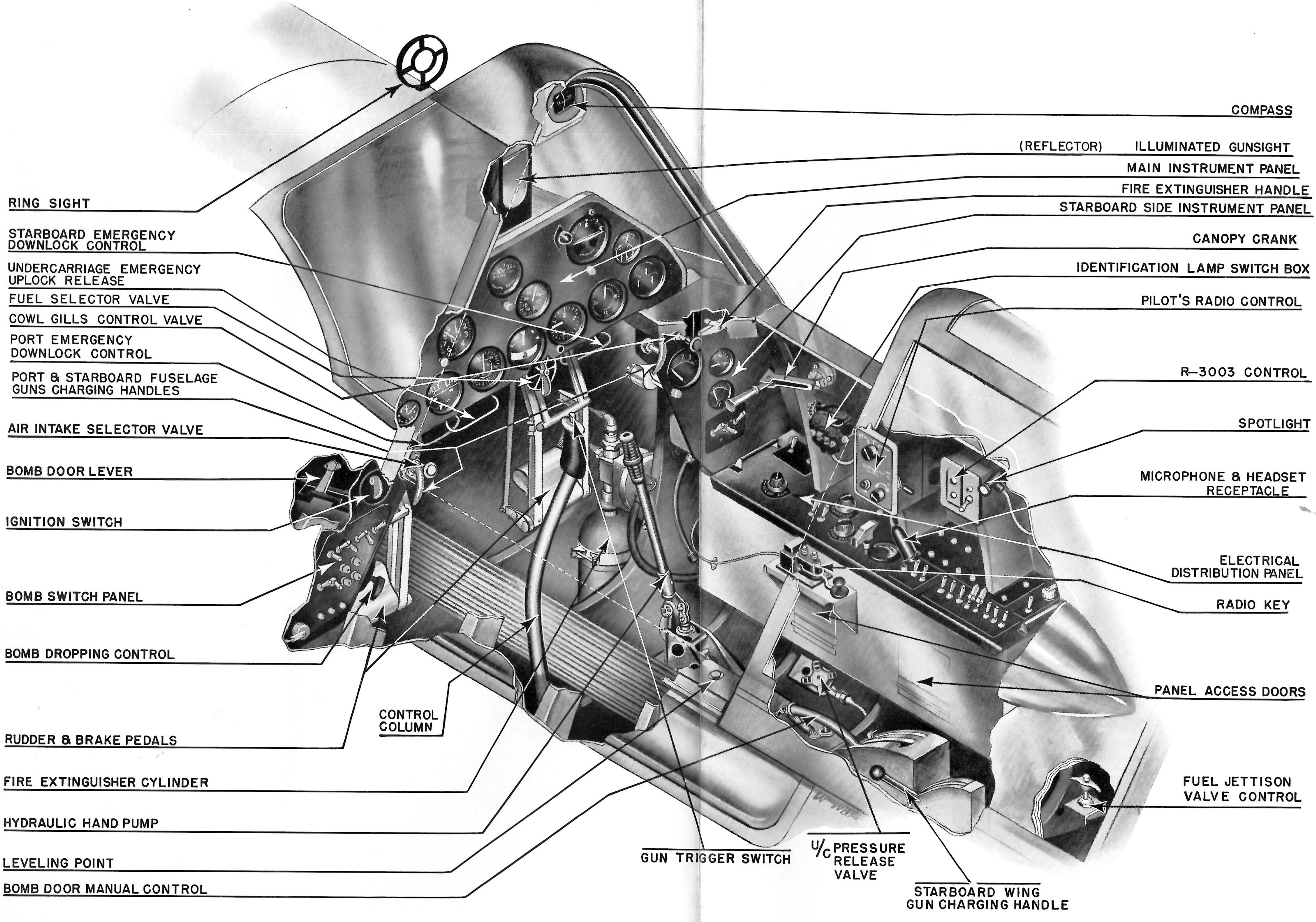
279 All instruments, except flight, shall be checked for satisfactory operation during each pre-flight engine warm-up period.

280 Flight instruments will be inspected and serviced according to instructions in the maintenance schedule (Vol. II, Part 2).

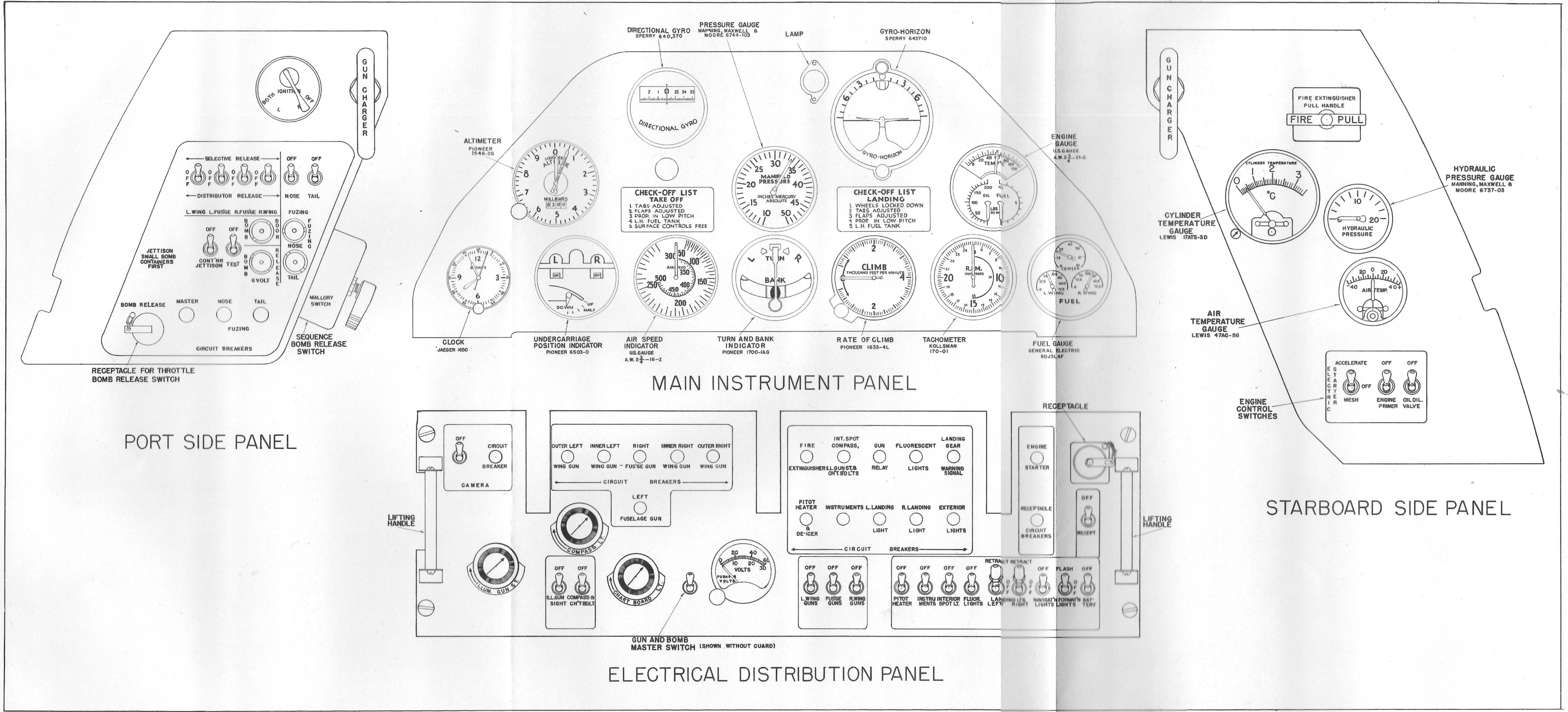
281 All instruments shall be inspected for general security at each engine shake-down inspection and at each engine check period.



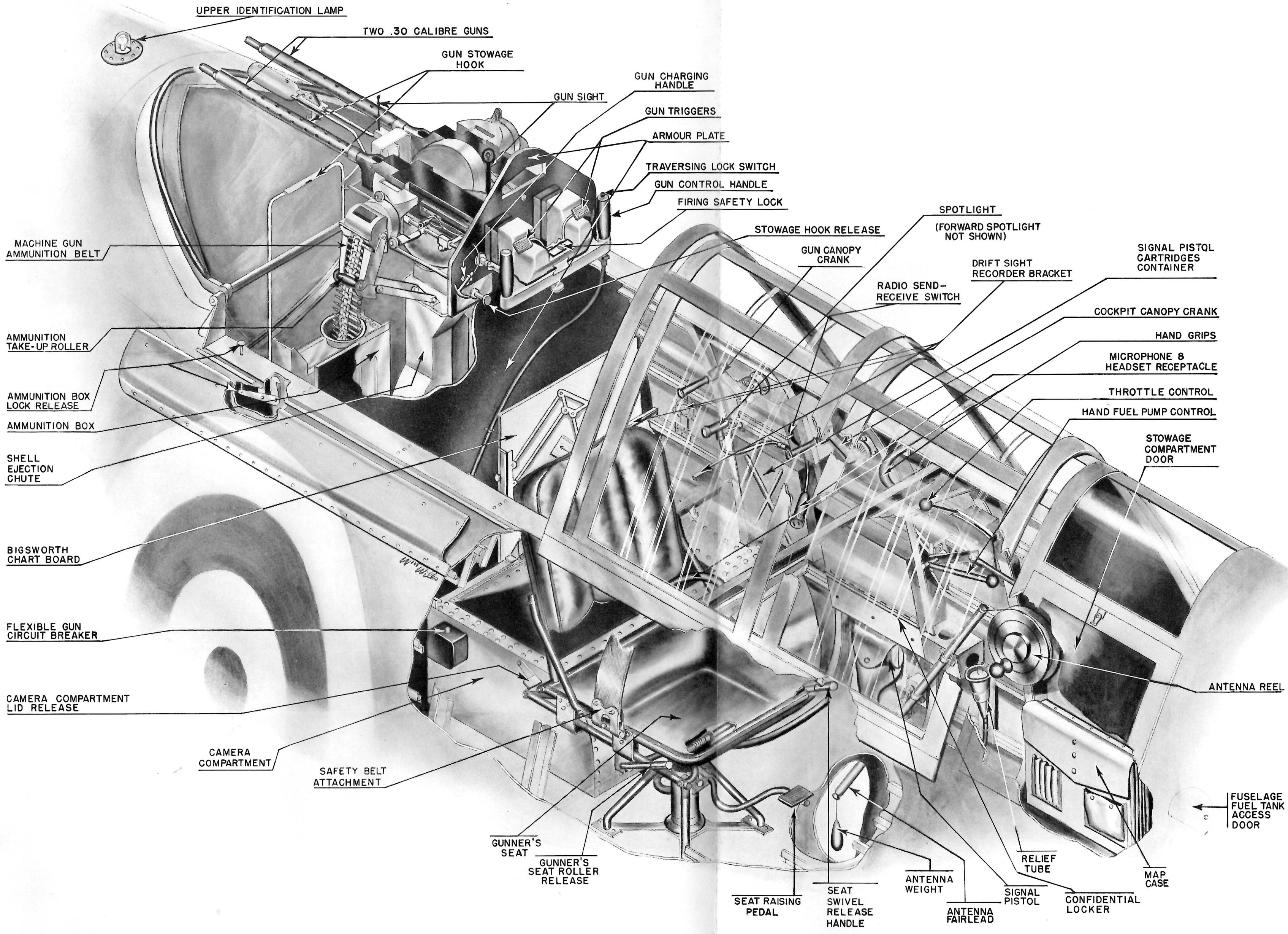
PORT SIDE PILOT'S COCKPIT - FIG. 4-16



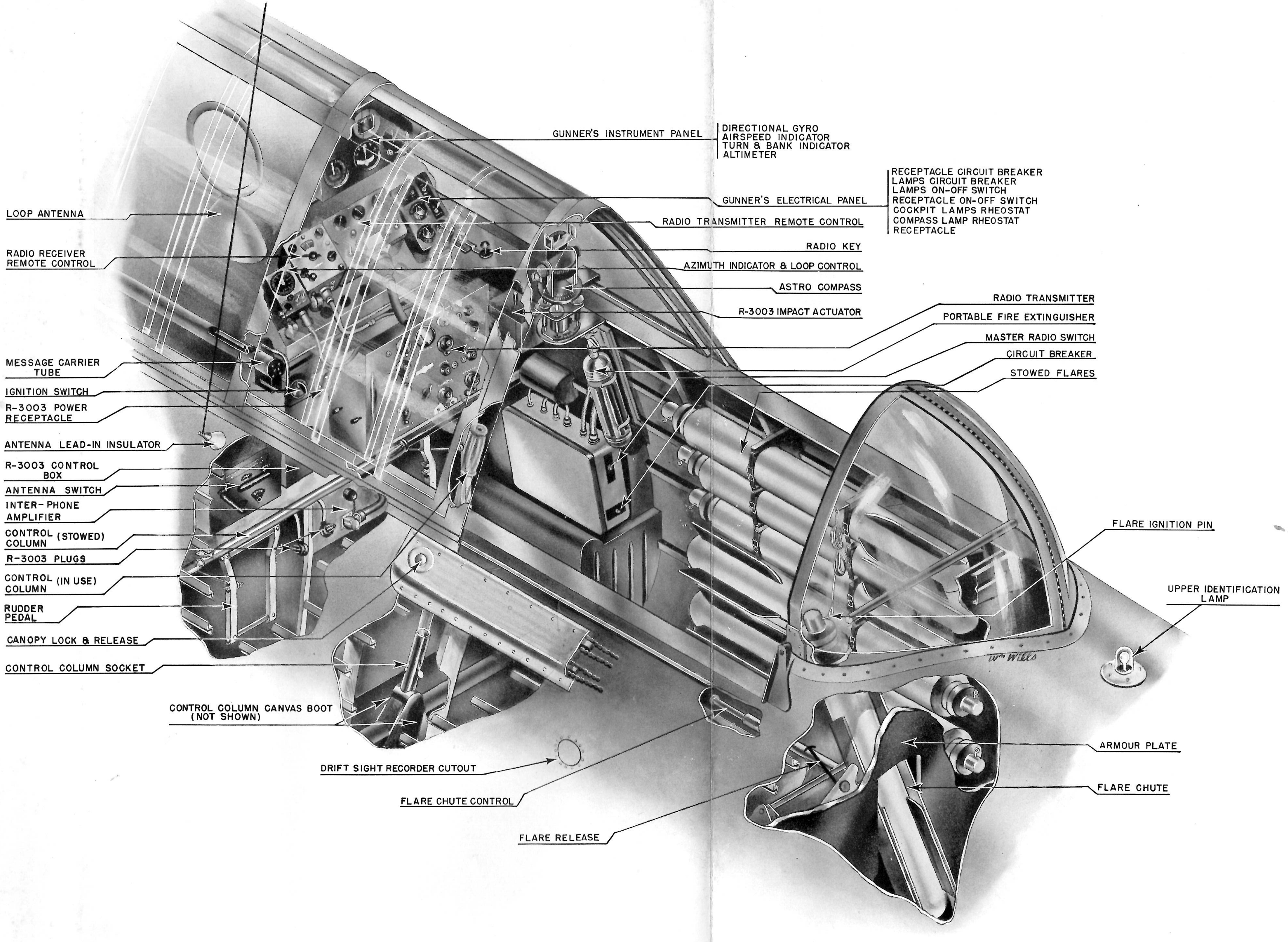
STARBOARD SIDE PILOT'S COCKPIT - FIG. 4-17



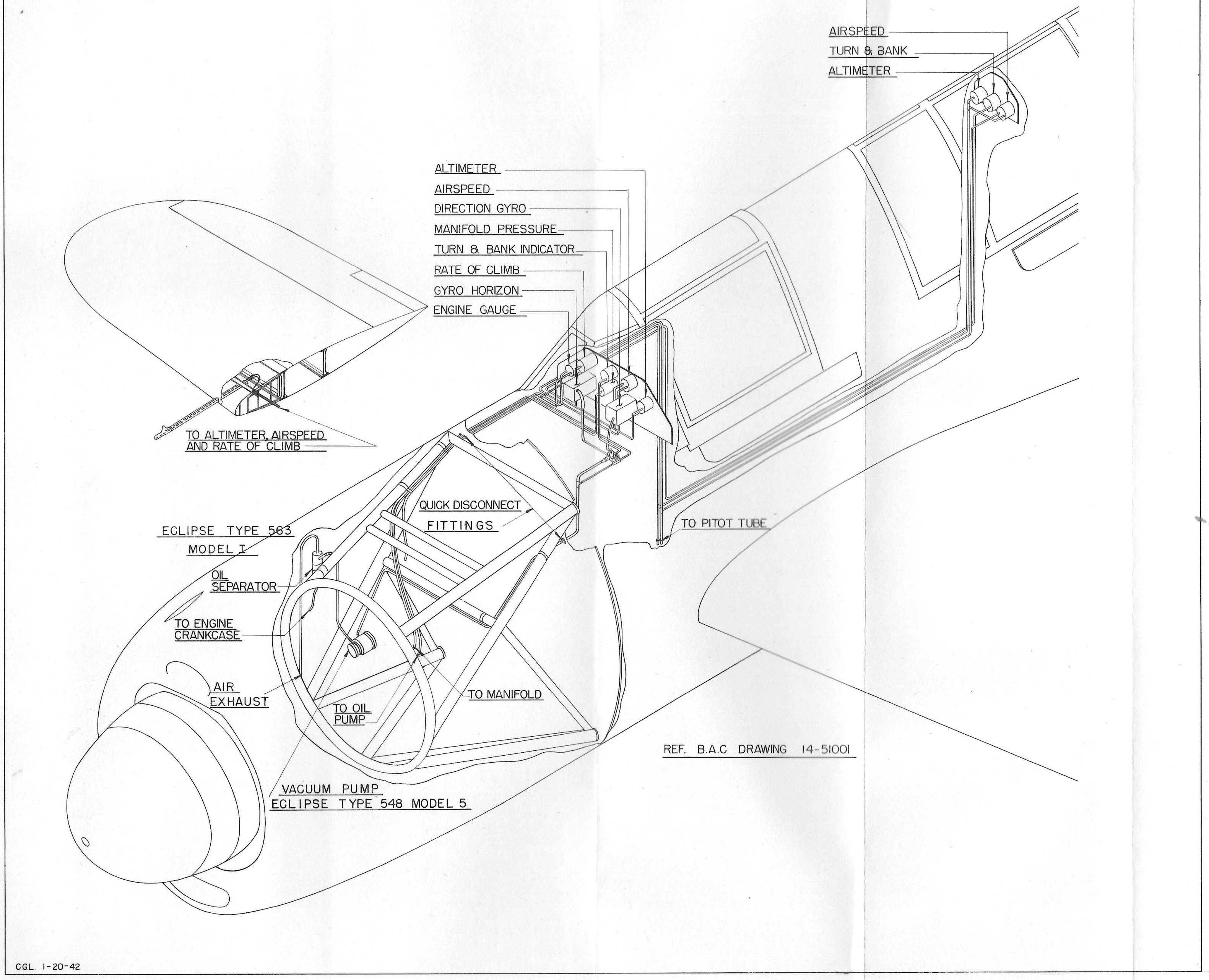
CLOSE-UP OF INSTRUMENT PANELS - FIG. 4-18



PORT SIDE GUNNER'S COCKPIT - FIG. 4-19



STARBOARD SIDE GUNNER'S COCKPIT - FIG. 4-20



INSTRUMENT PIPING SYSTEM - FIG. 4-21

HYDRAULIC SYSTEM

283 General: A hydraulic system provides a means of operating the retractable undercarriage, the landing flaps, the split-diving flaps, the bomb bay doors, the engine cowl gills and the undercarriage wheel brakes. Remote control of the hydraulic operation of the various units is provided by means of control valves, located in the pilot's cockpit, which govern the direction of flow of the fluid under pressure created normally by the engine driven hydraulic pump.

284 The hydraulic system (see fig. 4-22) may be more easily understood when it is considered to contain two separate groups. The first group is that part of the system leading from the fluid tank to the various control valves. This is shown in fig. 4-23 for the primary hydraulic system. The second group is that part of the system leading from (but not including) the control valves to the operating cylinders. This is shown in fig. 4-24 for the secondary hydraulic system.

285 The first group contains, in addition to the necessary tubing and other accessories to complete the installation, the following items:

a. Hydraulic system fluid tank, Brewster 20-53113.
b. Engine driven hydraulic pump, Pump Engineering Service Co. 214-VF.
c. Disconnect valves, Aeroquip Corp. 106-8, 106-16.
d. Filter, Purolator Products Co. 25661.
e. Unloading valve, Electrol, Inc. 6D115.
f. Relief valve, Brewster 20-53106.
g. Accumulator, Simmonds Aerocessories HL-107.
h. Directional check valves, Aircraft Engineering Products Company 2 each 1000, 2 each 993.
i. Hand pump, Aircraft Engineering Products Company 1301.
j. Control valves, Bendix Aviation, Inc. 2258-A1.
k. Brake control valve, Vickers AA-13004.
l. Relief valve, Brewster 20-53107 (3 reqd.)
m. Pressure gauge, Manning, Maxwell & Moore 6737-03.

Note: Items c, d, e, and f are assembled into a major sub-assembly to provide ease of removal for maintenance operations.

286 The second group contains, in addition to the necessary tubing and other accessories to complete the installation, the following listed items:

n. Cowl gills operating cylinder, Brewster 20-528146.
o. Brake cylinder (2 required), Bendix Products 57661.
p. Undercarriage actuating cylinder (2 required), Brewster 20-33501.
q. Undercarriage up-lock cylinder, Brewster 20-33502.
r. Bomb bay door actuating cylinder, Brewster 20-531102.
s. One-way restrictor valve, Bendix Products Inc. 400020.
t. Flow equalizer, Pump Engineering Service Co. 397.
u. Inboard flap cylinder (2 required), Brewster 20-56803.
v. Outboard flap cylinder (2 required), Brewster 20-52804.
w. Dive flap engaging cylinder, Brewster 20-52819.
x. Dive flap engaging system timing valve, Electrol, Inc. (4 reqd.)

287 The first group may be called the primary or pressure group of the hydraulic system. The second group is the secondary or operating group. The reference letters after each part name listed below correspond to the index letters in paragraphs 285 and 286.

Description

288 Fluid Tank (a): The fluid tank is fabricated of formed 52S aluminium alloy sheet joined by welding. The tank is cylindrical in shape and is provided with six openings. The filler neck opening is located in the side of the tank in a position to supply sufficient space for foaming of fluid and to prevent overfilling. The filler neck is fitted with a finger screen to prevent the introduction of foreign bodies into the tank. The filler neck cap is threaded, a slot being provided in the cap to afford easy removal and installation. A dip stick is attached to the filler cap. The tank has two outlets at the bottom. One is connected to the engine driven pump and is provided with a standpipe within the tank (so that all the fluid will not be lost if that line should be broken). The other does not have a standpipe and is connected to the hand pump. The tank can be drained completely through the latter opening. The return line opening is located on the side of the tank and is tangential to the circumference of the tank to form a centrifuge. In this manner any air which may have entered the fluid column will be separated, and foaming caused by agitation will be held to a minimum. A vent line opening in the top of the tank is connected by a line to a point outside of the aeroplane. This ensures that the tank will not be subjected to pressures greater than atmospheric. A second opening in the top of the tank has no use in the Bermuda aeroplane, and a plug is inserted.

289 The tank has a total volume of 1190 cubic inches. The maximum fluid capacity is 960 cubic inches of which 310 cubic inches are below the standpipe opening and therefore not available to the engine driven pump. The fluid below the standpipe opening provides fluid for hand pump operation of the hydraulic system in the event of a line failure anywhere between

the fluid tank (through items b to h, inclusive) and the directional check (non-return) valve located between the accumulator and the remainder of the primary system.

290 The tank is mounted in a bracket located on the starboard side of the forward face of the fireproof bulkhead. The bracket is made of formed sheet metal and is attached to the aeroplane structure with rivets. The tank, standing upright, is held to the bracket by two metal straps. The straps are riveted to the bracket and are covered with a moulded shaped rubber pad to protect the tank. The tank is removed by disconnecting all lines after draining and loosening the two support straps.

291 ENGINE DRIVEN HYDRAULIC PUMP (b): This pump is the product of the Pump Engineering Service Co. of Cleveland, Ohio, and is designated as model number 214-VF. It is of the spur gear type. It is mounted on the rear face of the engine on the starboard side and is accessible through the engine accessory compartment. The pump is driven at a ratio of 1.5 times the engine speed and has a displacement of .447 cubic inch of fluid per revolution of the pump.

292 The pump may be removed from the engine by removing the nuts on the mounting flange studs. The lines may be removed without draining the system provided that the lines are first disconnected at the disconnect valves on the fireproof bulkhead.

293 DISCONNECT VALVES (c) (see fig. 4-25): An Aeroquip disconnect valve type 106-16 is connected in the line between the fluid tank and the engine driven pump. This type of disconnect valve consists of two major parts which are joined by an internally shouldered nut. Each of the two major units is fitted with a spring-loaded mechanism which serves as a cut-off valve when the units are separated, permitting parting of the lines without draining the system. This valve is designed to be used in a one inch line. The valve is mounted on the hydraulic panel which is located on the starboard side of the forward face of the fireproof bulkhead.

294 Another Aeroquip disconnect valve 106-8 is connected in the line between the engine driven pump and the Purolator fluid filter. This 106-8 valve is the same as the 106-16 valve (see preceding paragraph) except that it is for use in a one-half inch line. The two valves are mounted adjacent to each other.

295 FILTER (d): A Purolator fluid filter 25661 is installed in the engine driven pump pressure line between the disconnect valve (106-8) and the unloading valve. The filter is mounted on the removable hydraulic panel on the fireproof bulkhead.

296 The Purolator consists essentially of a main body, a filter element and a removable bowl. The main body is provided with an inlet and outlet opening. The outlet opening is provided with a directional check (non-return) valve. The filter element is composed of a skeleton cylinder covered by closely wound wire. The element is attached to the main body of the filter, covering the check valves and filtering the fluid as it passes into the inner portion of the cylinder element. A wiping blade for the removal of dirt from the outer face of the filter element is moved by a handle located on the top of the main body. A ratchet is incorporated in the wiper operating handle so that the wiping blade may be rotated in only one direction. Material wiped from the filter element is allowed to accumulate in the removable bowl which serves as a sump. The removable bowl is provided with a drain plug for easy removal of accumulated dirt. The bowl must be removed to thoroughly clean the filter element.

297 UNLOADING VALVE (e) (see fig. 4-26): An unloading valve (type 6D115 of the Electrol Company) is mounted on the removable hydraulic panel. The unloading valve functions as a pressure regulator for the output of the engine driven pump. The valve includes a means for reducing the pressure in the engine driven pump during periods when the system is not performing work and the fluid has reached a state of static equilibrium at the pressures determined by the valve settings of the unloading valve.

298 The unloading valve consists essentially of a housing which contains a ball check (non-return) valve, a poppet pressure relief valve and a poppet system control valve. The directional check valve (non-return) is located in the port opening of the housing which is connected to the primary system. Fluid which has passed the directional check valve is in a column which is directly connected to the poppet pressure relief valve. The poppet pressure relief valve is adjusted to 1000 lb./sq. in. and the fluid which is permitted to pass at that pressure is led to a chamber which houses the operating piston for the poppet control valve. The poppet control valve, when opened, allows the total output of the engine driven hydraulic pump to return to the fluid tank at a pressure not exceeding 100 lb./sq. in. When the pressure of the fluid in the system beyond the directional check valve drops to 800 lb./sq. in. the poppet relief valve closes and the operating piston for the poppet control valve is unable to hold the valve open any longer. When delivered, the poppet relief valve setting of the unloading valve is set and sealed. Without adequate testing facilities the unit should not be disturbed.

299 The unit is easily removed from the removable control panel, being supported by three bolts which may be removed after disconnecting the lines.

300 RELIEF VALVE (f) (see fig. 4-25): A relief valve, Brewster part 20-53106, is mounted on the removable hydraulic panel and is connected in the line between the unloading valve and the fluid tank and the accumulator. This relief valve is set at 1200 lb./sq. in. and serves to protect the accumulator from excessive pressures due either to a failure of the unloading valve or a pressure rise due to thermal expansion Pressures originating in the hand pump or from the balance of the system not heretofore described cannot reach this relief valve due to a directional check valve in the line just ahead of the accumulator.

301 This relief valve consists of a body with two through openings. One of these openings is connected to the return line and the other opening to the pressure line. A third opening through the valve interconnects the pressure and return opening and is fitted with a spring-loaded relief valve. This permits fluid to pass from the pressure openings to the return opening when the relief valve is opened. The valve is adjusted by a threaded spring housing cap. The threaded cap is secured in place with a jamb nut.

302 Accumulator (g): A cylindrical balloon bag type of accumulator manufactured by the Simmonds Aerocessories Co. is mounted on the lower forward face of the fireproof bulkhead. The accumulator consists essentially of a steel cylinder and a rubber (synthetic) bag or envelope. The bag is fitted into the cylinder and held in position by a collar which provides the seal between the two parts. This collar also provides a connection for the rubber bag air valve. The opening on the bottom end of the cylinder is threaded to receive a tubing fitting for connecting into the hydraulic system. A mounting flange is attached to the cylinder of the accumulator to afford simple mounting.

303 The accumulator serves to store energy produced by the engine driven pump during periods when the engine is running and no hydraulically operated units are being used. This is accomplished by inflating the bag in the accumulator and then introducing fluid under pressure which compresses the bag. The total amount of fluid stored under pressure in the accumulator depends on the initial inflation pressure of the bag and the fluid pressure available from the engine driven pump as determined by the unloading valve. In the Bermuda aeroplane this accumulator with a displacement of 515 cubic inches is pre-loaded with air to 500 lb./sq. in. and the unloading valve is adjusted to 1000 lb./sq. in. When the accumulator is charged to the above condition the total fluid stored is approximately 257 cubic inches. The engine driven pump will then develop only a very low pressure (see paragraph 297) until the pressure in the accumulator has dropped to 800 lb./sq. in. which occurs with the discharge of approximately 64 cubic inches of fluid. In the event of a failure of the engine driven pump after the accumulator has been fully charged, approximately 257 cubic inches would be available to extend the undercarriage and the landing flaps which require approximately 241 cubic inches.

304 In addition to providing for the storage of fluid under pressure the accumulator functions as a dampener for the engine driven hydraulic pump, eliminating objectionable fluid "knock" which causes vibration.

305 Extreme caution and careful handling must be observed in all work connected with the accumulator. Before removing the accumulator from the aeroplane, all of the fluid must be exhausted by operating some units and bleeding *all* of the air through the air valve.

306 Pre-loading the accumulator with an initial air charge in the Bermuda aeroplane can be accomplished by several different methods. The pressure may be obtained from either air or inert gas storage cylinders (bottles) or by using a high pressure hand pump. Any method of determining the value of the initial air load pressure by reading the hydraulic pressure gauge in the aeroplane must take into consideration the fact that the system includes a directional ball check valve between the pressure gauge and the accumulator. One simple method of determining the initial air load value is to fully discharge the fluid in the accumulator by operating some unit, then replace the above-mentioned check valve with a short jumper line, and observe the pressure gauge while slowly operating the hand pump. The first pressure indicated will be the initial air load value which must be adjusted by either bleeding or adding air to obtain 500 lb./sq. in.

307 Directional Check Valves (h): Directional check (non-return) valves consist essentially of a two-piece body which houses a steel ball and a spring. The steel ball is held against a seat by the spring. Fluid can pass through the check valve only when it lifts the steel ball off the seat and only in the direction opposite to the compressing force of the spring.

308 Four directional check valves are used in the Bermuda hydraulic system. Two different sizes are used, size 993 being provided for use in ⅜ inch diameter lines and size 1000 being provided for use in ½ inch diameter lines. Schematically, these valves are located in the system as follows:

One 1000 in the line between the accumulator and the balance of the system not heretofore described.

Another 1000 in the line between the relief valve 20-53107 (not yet described) and the balance of the system heretofore described.

One 993 in the line between the brake control valves and the balance of the primary system.

Another 993 in the line between the emergency hand pump and the balance of the primary system.

309 These valves are located in the aeroplane and are accessible as follows:

The first 1000 is located in the line leading from the accumulator to the fireproof bulkhead and is accessible through the engine accessory compartment cowling.

The second 1000 is located in the line leading to the landing flap control valve just ahead of the relief valve 20-53107, aft of fuselage station 9 and on the floor below the pilot's seat. This valve is accessible through the pilot's bombing window.

The first 993 is located in the line leading to the wheel brake control valves, on the aft face of the fireproof bulkhead near the thrust line of aeroplane. This valve is accessible through the pilot's bombing window.

The second 993 is located in the line leading from the emergency hand pump, forward of station 2$\frac{5}{16}$ on the starboard side of the aeroplane below the thrust line. This valve is accessible through the pilot's bombing window.

310 EMERGENCY HAND PUMP (i): The emergency hand pump is mounted on the right side of the pilot's cockpit. The pump has a rated capacity of one and and one half cubic inches per cycle and is capable of producing a pressure of 1500 lb./sq. in. with the application of approximately fifty-five (55) pounds of force on the end of the telescoping operating handle when extended.

311 This pump is intended to provide fluid for the operation of the hydraulically operated units in the event of a failure in the engine driven pump. A reserve of fluid below the standpipe opening in the fluid tank also makes the hand pump available in the event of loss of fluid. Further, the higher pressure available in the hand pump may be necessary in the event of a partial line stoppage which cannot be overcome with pressure developed by the engine driven pump. The pump is connected into the system in a manner that eliminates the possibility of fluid being diverted into the accumulator.

312 SYSTEM CONTROL VALVES (j) (see fig. 4-27): Five control valves of the same design are used in the Bermuda aeroplane. These valves consist essentially of a body, four poppet valves and a poppet valve operating cam. Four equally spaced ports are provided, two ports for lines leading to the operating cylinder of the unit involved, a pressure inlet port and a return port. The two latter ports are diametrically opposed to one another. In the case of the pressure port, the fluid of the primary system is above the poppet valves and can only pass through a poppet valve opening when the cam lifts the valve off the seat; however, fluid from either operating line will lift the valve off of the seat when the pressure becomes greater in the operating line than it is in the primary system. The return line port passageway is below the poppet valve and therefore fluid from the operating cylinder lines can enter the return line only when the poppet valve is opened. When a pressure rise occurs in either cylinder operating line, due to thermal expansion or external force, the pressure is relieved through the pressure port of the four-way valve acting as a directional check.

313 One of these valves is mounted on the forward face of the fireproof bulkhead above the centreline of the aeroplane. This valve is for the control of the cowl gills operating cylinder. A push-pull remote control unit for the operation of this valve is mounted on the right side of the pilot's cockpit just below the instrument panel. The cowl gills may be held in any desired position by returning the remote control handle to a point mid-way in the range of motion as the cowl gills are being operated.

314 The valve for the operation of the undercarriage retraction cylinders is located on the left side of the fuselage between stations 2$\frac{5}{16}$ and 9. The operating handle for this valve is mounted on a pedestal which is somewhat higher than the valve. The handle quadrant is provided with only two positions. A safety arrangement is included in the handle quadrant to prevent inadvertent operation. This mechanism consists of a spring loaded pin which permits the handle to move only toward the extended position. Before moving the handle to the retracted position it is necessary to lift the pin by pulling the small knob inboard at which time a plate is allowed to rotate to a position which will hold the safety pin until the gear has been operated. The rotating plate releases the handle and makes it possible to operate the gear with one hand.

315 The valve for controlling the landing flaps is located on the port side of the pilot's cockpit and is operated by a handle mounted on an elevated pedestal directly aft of the undercarriage control valve handle. The handle quadrant is provided with a position marked "Neutral" for retaining the flaps in any intermediate position. A fore and aft motion of the handle controls the landing flap.

316 The valve for controlling the dive flap engaging mechanism is mounted directly above the landing flap valve and is operated by the same handle which controls the landing flap valve. The dive flap engaging mechanism valve is controlled by moving the handle from inboard to outboard to engage the diving flaps. The dive flaps operate jointly with the landing flaps when the control handle for the landing flaps is moved (see fig. 4-46) fore and aft through the outboard slot of the handle quadrant.

317 The control valve for operating the bomb bay doors is located on the left side of the pilot's cockpit, under and further forward than the main instrument panel. The control valve handle is provided with two positions. Moving the handle to the forward position opens the bomb bay doors.

318 BRAKE CONTROL VALVES (k) (see fig. 4-28): A Vickers brake control valve for each wheel brake is mounted on the aft face of the fireproof bulkhead. The brake control valves are mechanically connected to the rudder bar toe pedals. The control valves are accessible through the pilot's cockpit.

319 The Vickers valve consists essentially of a three piece body, a plunger and spring assembly, and a spool and sleeve assembly. The body is provided with three ports, a primary system pressure line, a line to the brake cylinder and a return line to the fluid tank.

320 The plunger spring controls the amount of pressure delivered to the brakes. As the plunger is displaced the plunger spring moves a steel ball which displaces the sleeve in the spool and sleeve assembly. The end of the spool and sleeve assembly opposite the steel ball functions as a poppet valve. Fluid from the primary system enters through the centre port of the main body, then passes through the openings in the necked portion of the spool and on through the open

poppet valve (on the sleeve). As the fluid pressure increases in the brake line it also increases under the steel ball since there is an opening through the sleeve to the opening covered by the steel ball. The diameter of the opening covered by the steel ball is $\frac{15}{32}$ inch. When the fluid pressure equals the load applied on the plunger spring, the poppet valve will close and maintain the pressure. When the load on the plunger is reduced the steel ball will uncover the valve seat and fluid will be returned to the tank.

321 The valve as assembled for use with the Bermuda aeroplane is furnished with a plunger spring designed to produce 700 lb./sq. in. in the brake lines when the plunger is totally depressed $\frac{7}{8}$ inch. This pressure is obtained by adjusting the plunger spring length with shim spacers in the plunger rod housing. The total force required to displace the plunger rod $\frac{7}{8}$ inch should not exceed 145 pounds.

322 The brake control valve should not be considered as a brake master cylinder since it can produce no pressure; it can only regulate the pressure required to operate the brake as supplied from a source of equal or higher pressures.

323 In the event of an engine pump failure the necessary pressure required to operate the brakes may be obtained from the emergency hand pump by operating the pump while the brake operating toe pedals are depressed.

324 Relief Valve (l): A relief valve set at 1500 lb./sq. in. is located in the primary system just ahead of the landing flap control valve. It is mounted on the forward face of the fuselage frame at station $16\frac{3}{4}$ below the pilot's seat and on the port side of the aeroplane.

325 Two relief valves, one on each side of the aeroplane, are mounted in the undercarriage wheel wells. The valves are connected to the lines leading to the undercarriage retracting cylinder and are intended to relieve excessive pressures in those lines due to pull-out loads in the event of a failure of the up-lock mechanism.

326 These valves are similar in design to the items explained in paragraphs 298 and 299. These valves will also provide protection in the system against a pressure rise due to thermal expansion of the fluid when the four-way control valves are in the neutral position.

327 Pressure Gauge (m): A pressure gauge is included in the primary hydraulic system. It is mounted on the starboard auxiliary instrument panel in the pilot's cockpit. The gauge dial is marked 0–20 to read in hundreds of pounds pressure per square inch. The gauge will show the pressure on the primary hydraulic system except that the pressure on the primary system ahead of the check (non-return) valve nearest the accumulator will not be directly indicated.

328 Cowl Gills Operating Cylinder (n) (see fig. 4-29): The cowl gills operating cylinder is mounted on the bottom of the engine mount ring. The cowl gills are opened when the cylinder is extended. The cylinder requires seven and three-quarter cubic inches of fluid to obtain full extension and five cubic inches to fully close.

329 Brake Operating Cylinder (o): The brake operating cylinders are integral with the brake assembly spider support. The cylinders are single-ended and single acting, being dependent on the brake shoe return springs for closing. There is a brake cylinder in each main undercarriage wheel.

330 Undercarriage Actuating Cylinder (p) (see fig. 4-30): An undercarriage actuating cylinder is located in each wheel well. The cylinders are of the conventional double acting single piston rod type with a displacement to retract of 92.7 cubic inches and 49.5 cubic inches to extend the undercarriage.

331 Undercarriage Up-Lock Cylinder (q) (see fig. 4-31): A hydraulic cylinder is used to unlatch the undercarriage up-lock. One cylinder is used for each undercarriage strut. The cylinder unlatches the lock when retracted, requiring .44 cubic inch of fluid. One-half cubic inch of fluid is required to extend the cylinder.

332 Bomb Bay Door Actuating Cylinder (r) (see fig. 4-32): The cylinder used to actuate the bomb bay door is double-ended, with a piston rod extending from both ends. The cylinder is mounted on fuselage frame No. 110 and is accessible through the bomb bay doors.

333 One Way Restrictor (s): The one way restrictor valve in the landing flap "down" line reduces the speed of the flap closing. The valve consists essentially of a body which houses an adjustable orifice. The orifice adjustment is obtained by a needle valve.

334 The restrictor valve is mounted between fuselage stations $16\frac{3}{4}$ and $24\frac{1}{2}$ and under the pilot's seat. It is accessible through the pilot's bombing window.

335 Flow Equalizer (t) (see fig. 4-33): Two flow equalizers are used in the lines between the flap cylinders and the landing flap four-way control valve. The equalizers are mounted on the rear face of the aft wing beam. The units are accessible through the bomb bay compartment.

336 Each flow equalizer consists essentially of a three-piece body, two sets of spur gears and two restrictor valve assemblies. The two sets of spur gears are mechanically interconnected. One inlet and two outlet ports are provided in the body. The inlet port is connected through a common passage to both sets of gears. Fluid is distributed equally to both outlet ports as governed by the mechanically interconnected sets of gears. The restrictor valves further tend to equalize flow since they are seated into a common column of fluid. The restrictor valves are also provided with means of increasing the restriction of the flow of the fluid being returned from the outlet to the inlet port.

337 The flow equalizer is provided with a relief valve (thermal expansion) which is connected into the

passageway between the two restrictor valves. This relief valve has been plugged in the Bermuda aeroplane.

338 INBOARD FLAP CYLINDER (u) (see fig. 4-34): The two inboard flap cylinders are of the conventional single-ended and double-acting type. Each cylinder has a bore of 3⅞ inches and requires 48.7 cubic inches of fluid to fully extend. The flaps are open when the cylinders are extended. 43.7 cubic inches of fluid are required to close each cylinder. One of these cylinders is mounted on each side of the fuselage in the wing centre section. The cylinders are accessible through cover plates in the upper skin of the wing.

339 OUTBOARD FLAP CYLINDER (v) (see fig. 4-35): The two outboard flap cylinders are of the conventional single-ended, double-acting type. Each cylinder has a bore of three inches and requires 22.1 cubic inches of fluid to obtain full extension and 18.7 cubic inches of fluid to fully close. One of these cylinders is mounted in each outer wing panel. They are accessible through cover plates in the upper skin of the wing.

340 DIVE FLAP ENGAGING CYLINDER (w) (see fig. 4-36): The dive flaps are operated by the landing flap cylinders when the dive flap actuating mechanism is engaged (see fig. 4-47). The actuating mechanism is engaged hydraulically by the dive flap engaging cylinder which is located between fuselage stations 67 and 72½. It is accessible through the bomb bay compartment.

341 The dive flap engaging cylinder is of the conventional single-ended, double-acting type. The cylinder is extended to engage the diving flaps, which requires 2.43 cubic inches. 2.12 cubic inches of fluid are required to close the cylinder which disengages the diving flaps.

342 FLAP SYSTEM TIMING VALVE (x) (see fig. 4-37): Timing control valves (2) are mounted in the wing centre section (one on each side) in a manner so as to be actuated by the inboard flap. The purpose of the valves are to limit the operation of the dive flap engaging system to the time when the landing flaps are fully closed. The valves are located in the lines between the four-way control valve and the operating cylinder in the engaging system; one in each line.

343 Two timing valves are mounted on the aft face of the rear beam in the port side of the wing centre section. These valves are actuated by brackets attached to the engaging system push-pull tubes. They are connected in parallel to the down line of the flap operating cylinders and limit the motion to the time when the engaging system is completely engaged or disengaged.

344 The timing control valve consists essentially of a body which houses a plunger operated poppet valve and a poppet valve return spring. Two ports are provided in the body. The valve allows fluid to pass through when the plunger lifts the poppet valve off its seat.

Operation

345 GENERAL: The hydraulic system operates at a pressure of 800 to 1000 lb./sq. in., which is maintained by the unloading valve and is protected by two relief valves. One valve is set at 1200 lb./sq. in., preventing an overload on the system derived from an unloading valve failure, and the second is set at 1500 lb./sq. in., providing protection against excessive pressures resulting from hand pump operation, thermal expansion, or from back pressure created in the system by an air overload on the flaps.

346 UNDERCARRIAGE: The hydraulic retraction of the undercarriage of the Bermuda aeroplane is controlled from the pilot's cockpit by operating the four-way control valve for that unit as described in paragraph 312. When the valve is operated the fluid is permitted to flow from the primary part of the system to the cylinders, retracting the undercarriage. As soon as the strut has started to move upwards the wheel position indicator on the pilot's instrument panel will show a red flag. As the wheels are moved upwards their relative position will be shown on the indicator by the position of the simulated white wheel. When the wheels are fully retracted and the up-lock has successfully operated, both the wheel and the red flag will be out of sight on the wheel position indicator. The undercarriage control valve will be left in the "up" position until the pilot desires to extend the wheels. During this time the fluid pressure of the primary system will be present in the undercarriage retracting system. To extend the undercarriage wheels, it will be necessary to move the four-way control valve to the "down" position. The fluid will then be passed from the primary system through the lines to the up-lock cylinder, releasing the lock; and fluid entering the retracting cylinders will extend the undercarriage. The positions of the undercarriage during this operation will be in the reverse order of retraction, the relative position of the undercarriage being indicated on the position indicator as the undercarriage is extended. The wheel position indicator will first show a red flag indicating that the up-lock has been unlatched and as the undercarriage moves downward a pair of white wheels will show followed by a red flag at the end of the wheel motion. The red flag will disappear when the undercarriage is locked in the down position.

347 An emergency means of lowering the undercarriage has been provided. The emergency means of operation includes a mechanical means for releasing the up-lock and a valve in the hydraulic system which permits the fluid in the system to be discharged overboard. The emergency pressure release valve is located on the lower right-hand side of the cockpit just forward of the emergency bomb bay door operating valve. The landing gear up-lock is unlatched mechanically by operating the pull ring which is located under the left side of the instrument panel. To extend the undercarriage in an emergency, first open the valve and then pull the up-lock release.

348 DIVE BRAKING AND LANDING FLAPS: The hydraulic operation of the dive brake and landing flaps is controlled by the operation of the respective four-way control valve located in the pilot's cockpit. The operation of these valves is described in paragraphs 313 and 314. The flap operating system consists of four operating cylinders. Fluid from the landing flap four-way control valve passes through to a flow equalizer, where it is divided into two columns and then transmitted to the port and starboard side of the aeroplane. The lines to the port and starboard side are then divided with one line going to an inboard cylinder and one to an outboard cylinder for the respective flaps. This set of four cylinders operates either the dive brakes or the landing flaps depending upon the position of the mechanical engaging mechanism. Separate mechanical engagement is provided for each operating cylinder. The mechanical engaging system is operated by a hydraulically operated mechanical control system. During the operation of the landing flaps the mechanical engagement for the dive brake flap is disengaged.

349 To extend the landing flaps move the landing flap four-way control valve to the position marked "open." With the control valve left in the open position, primary system pressure will be maintained in the affected lines and cylinders until the four-way valve is moved. Should an intermediate setting be desired this can be obtained by returning the four-way control valve handle to the position marked "Neutral" on the quadrant when the flaps have reached the desired setting.

350 The mechanical arrangement provided for the operation of the dive brake flap four-way control valve is so arranged that it is impossible to move that valve except when the landing flap four-way control valve is in the fully closed position. The hydraulic control for the dive brake flap engaging mechanism is further protected by the inclusion of two timing valves. The timing valves will not permit fluid to enter the mechanical engaging system actuating cylinder except when the landing flaps are in the fully closed position.

351 The flap operating cylinders and lines are protected against excessive pressures which may arise either from thermal expansion or air loads on the flaps. This is accomplished by the four-way valve and a relief valve with a setting of 1500 lb./sq. in. in the hydraulic primary system lines just ahead of the four-way control valve. A one-way restrictor valve is included in the flap "up" line between the four-way valve and the flow equalizer to limit the speed at which the flaps can open. The purpose of this valve is to avoid too sharp a change in the "trim" of the aeroplane occurring with the opening of the flaps.

352 BOMB BAY DOORS: The bomb bay doors are operated by the four-way control valve described in paragraph 317. The doors are opened by moving the control valve handle to the forward position which permits fluid to pass through lines to the operating cylinder. A single cylinder in the aft end of the bomb bay compartment is mechanically connected to both ends of the bomb bay doors to maintain equal movement. The mechanical indicator system is comprised of pull-rods and chains. Sprockets are used where it is necessary to change the direction of the chains and to operate the position indicator. The position indicator will move from the position marked "closed" to the position marked "open" as the bomb bay doors open. The control valve will be left in the "open" position until the pilot desires to close the bomb bay doors.

353 COWL GILLS: The cowl gills are opened by moving the control rod to its rearmost position. The control rod is located on the starboard side of the pilot's cockpit just below the main instrument panel. The control rod forms a remote control system for operating the four-way control valve which is mounted on the fireproof bulkhead.

354 An intermediate setting of the cowl gills can be obtained by moving the control valve to a position midway between the open and closed position when the desired setting has been reached. A midway position of the control valve may be determined by observing the four-way valve control operating arm which is located on the aft face of the fireproof bulkhead near the centreline of the airplane and just ahead of the rudder pedal heel trough. The operating arm stands vertically when the four-way valve is in the neutral position.

355 No emergency means of operating the cowl gills in the event of failure of the hydraulic system is provided.

356 WHEEL BRAKES: The wheel brakes are operated separately by moving the respective toe pedals which are a part of the individual rudder pedals. The toe pedals are adjustable for the convenience of the pilot. As the toe pedals are depressed the brake control valve is opened. The pressure on the brakes is dependent upon the amount of motion and load delivered to the brake valve. The maximum pressure available to the brakes is 700 lb./sq. in. providing that the pressure in the primary hydraulic system is equal to or greater than this figure. The pressure in the brake system cannot exceed the pressure of the primary hydraulic system. The brakes are released by allowing the toe pedals to return to their static position.

357 In the event of a failure of the primary hydraulic system the hand pump may be used to operate the brakes. In this case it will be necessary to operate the hand pump and toe pedals simultaneously. No provision is made to operate the brakes in an emergency where the hydraulic system has completely failed.

Servicing and Maintenance

358 GENERAL: The hydraulic system on the Bermuda aeroplane requires approximately six Imperial gallons of fluid to fill the entire system. The

fluid used shall be a mineral base oil. Recommended fluids are:

1. Sperry Servo No. 9.
2. Univis No. 40.
3. Intava Servo Fluid.

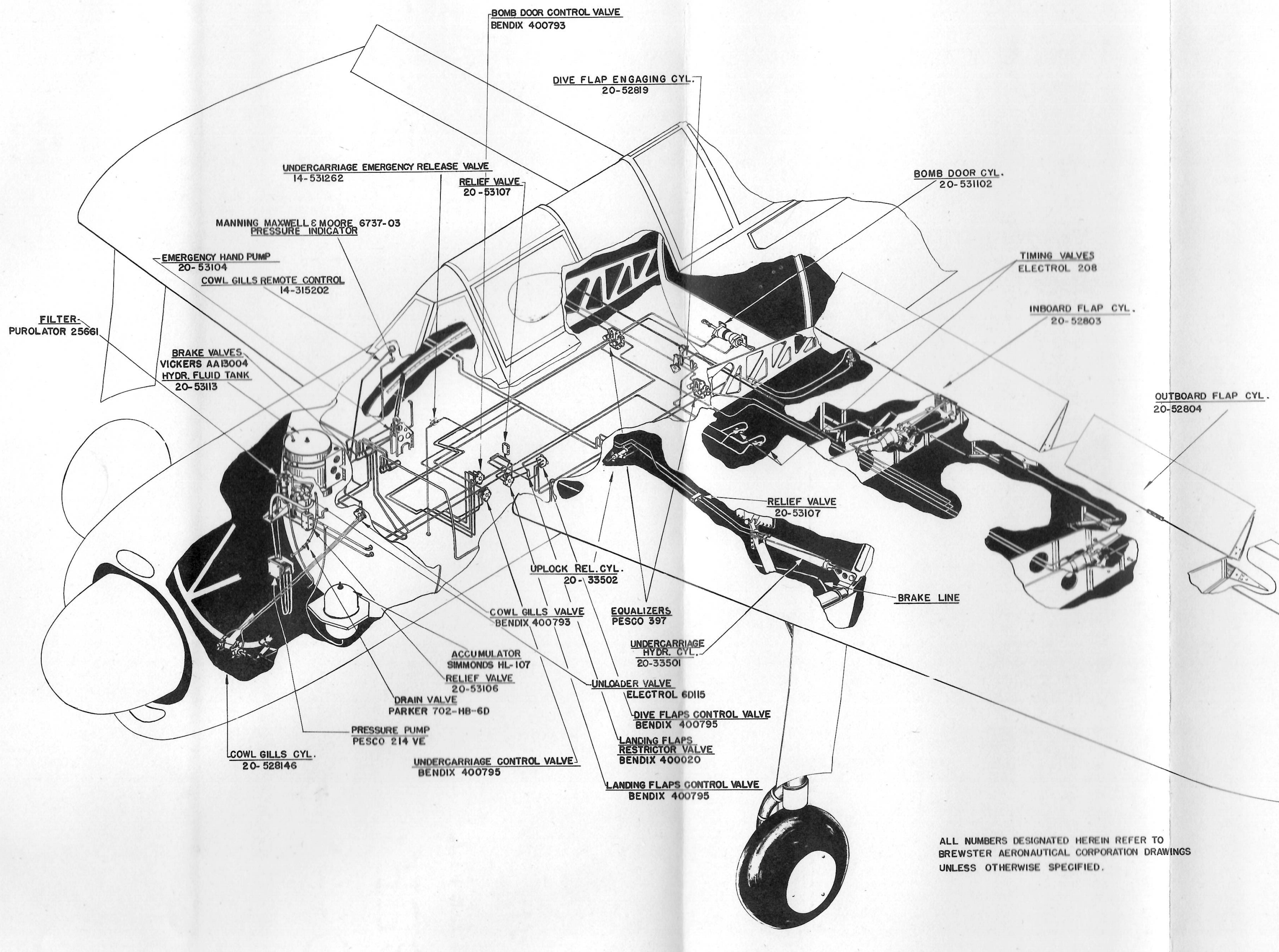
The fluid level in the tank should be checked daily. The level should be checked with the undercarriage extended, the landing flaps closed, and the accumulator fully charged with the pressure gauge showing 1000 lb./sq. in. In this condition the proper fluid level in the fluid tank is level with the bottom of the threaded portion of the tank filler neck.

359 The functioning of all hydraulic units shall be checked daily during the preflight engine warm-up. This does not include the operation of the undercarriage which must be checked by the pilot during flight.

360 At each 30-hour inspection all units in the hydraulic system shall be inspected for looseness of attaching parts, fluid line connections, and packing joints which may leak. Security of attaching parts shall be checked. All fluid deposits resulting from leaks shall be removed and the exposed portions of the hydraulic system units cleaned of dirt. The Purolator filter shall be cleaned by rotating the operating handle at least two full revolutions.

361 It is recommended that no hydraulic units be disassembled unless a full set of packing cups, piston gaskets and other such material is available for replacement. This is based on the experience that very frequently such items cannot be reused after having been removed.

362 BLEEDING: A description of this operation will be found in Section III, paragraph 16.

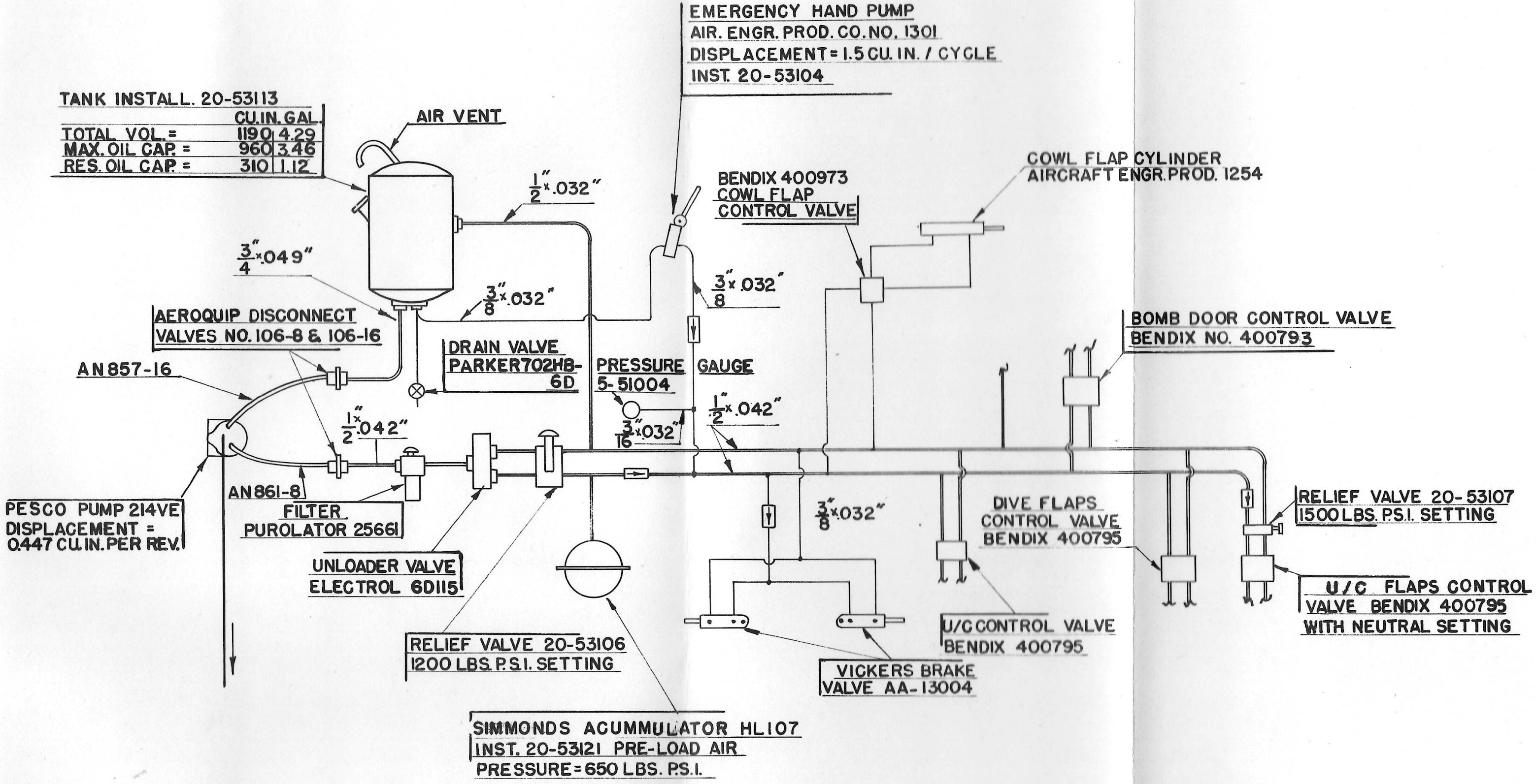


ALL NUMBERS DESIGNATED HEREIN REFER TO
BREWSTER AERONAUTICAL CORPORATION DRAWINGS
UNLESS OTHERWISE SPECIFIED.

B.F. KORUZ

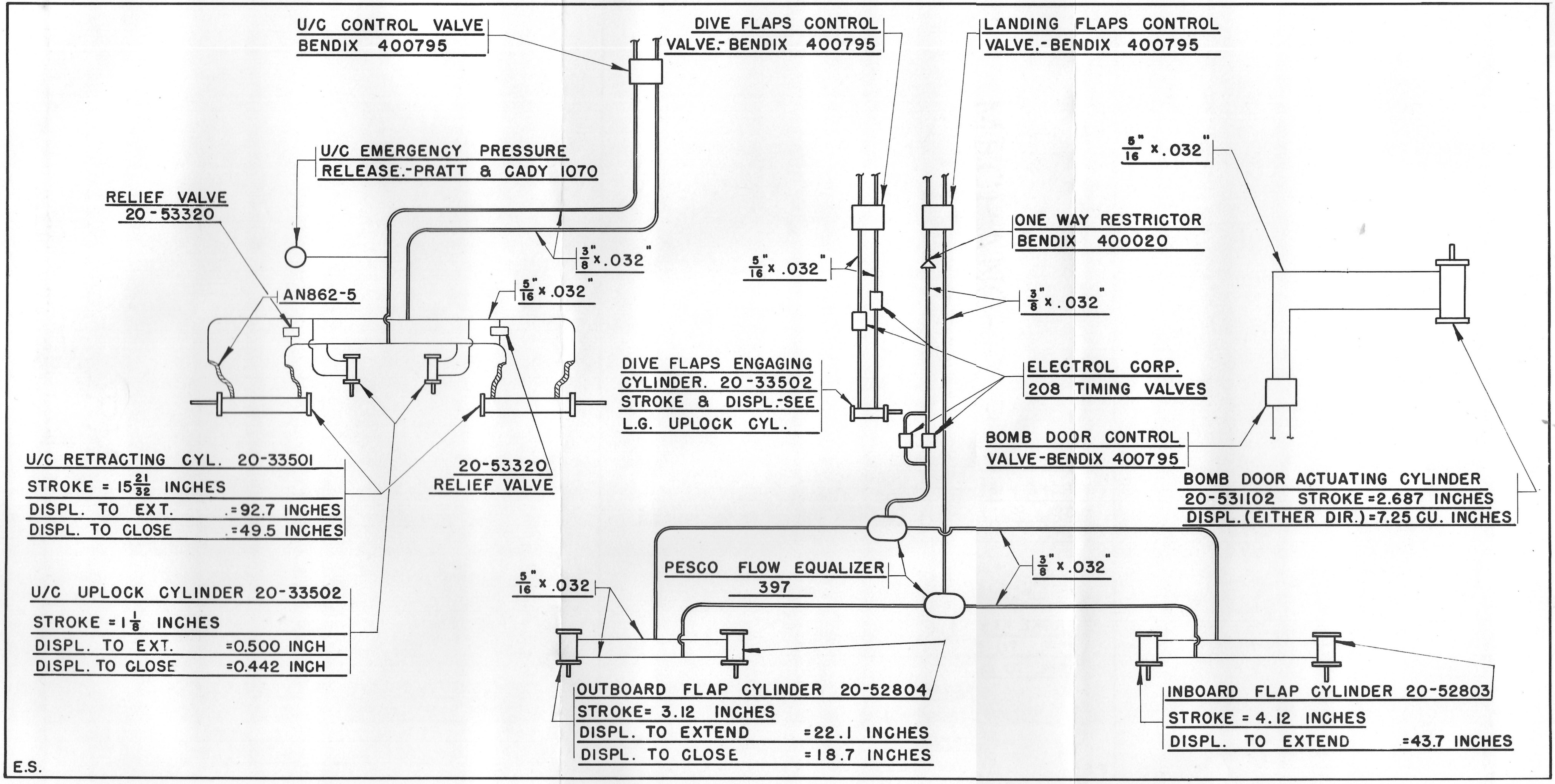
HYDRAULIC SYSTEM - FIG. 4-22

FLUID:
SPERRY SERVO NO. 9
UNIVIS NO. 40
INTAVA SERVO

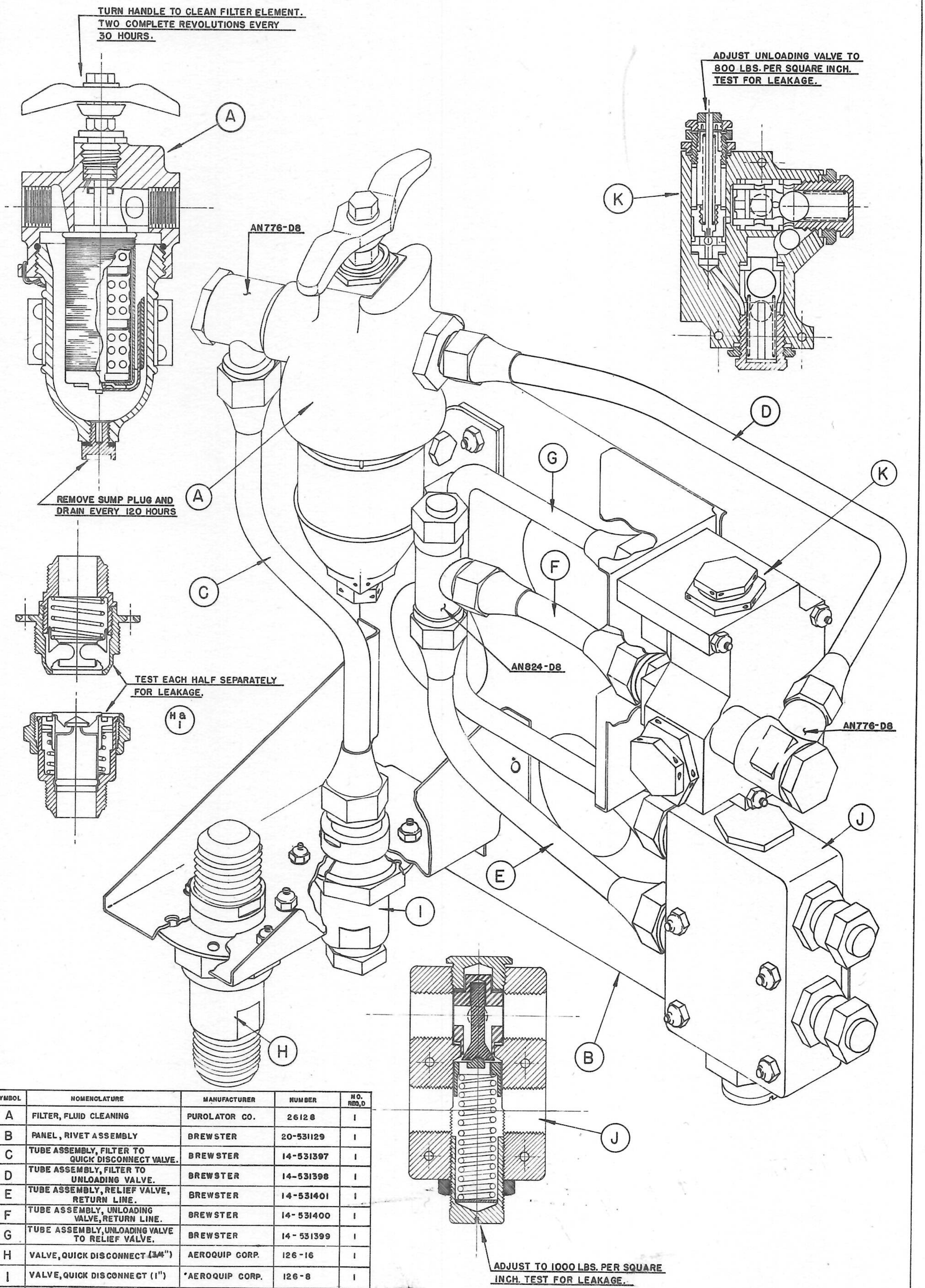


NOTES:
1. OPERATING PRESSURE RANGE 800 - 1000 LBS. P.S.I.
2. OIL CAPACITY ACCUMULATOR AT PRE-LOAD PRESSURE = 650 LBS. P.S.I. IS 173 CU. IN.
3. CHECK VALVE = NON-RETURN VALVE
4. ALL AL. ALLOY TUBING

PRIMARY HYDRAULIC SYSTEM DIAGRAM - FIG. 4-23



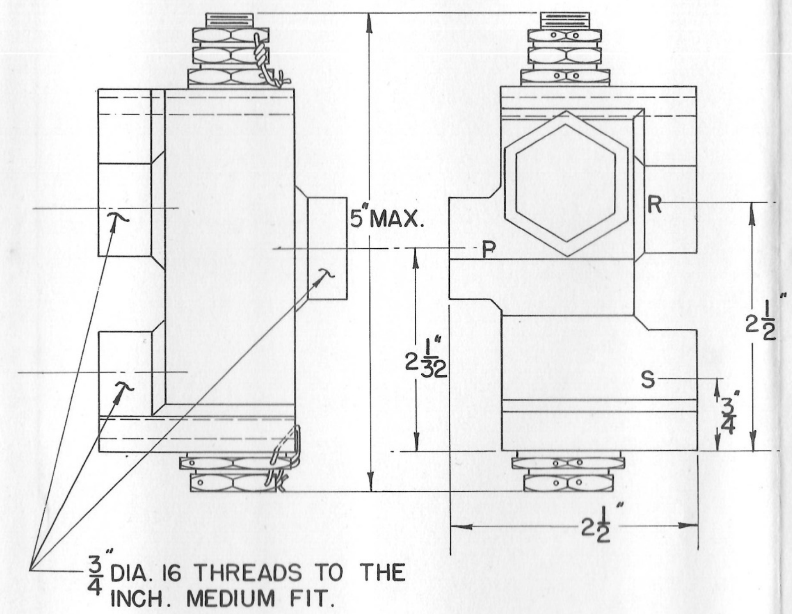
SECONDARY HYDRAULIC SYSTEM DIAGRAM - FIG. 4-24

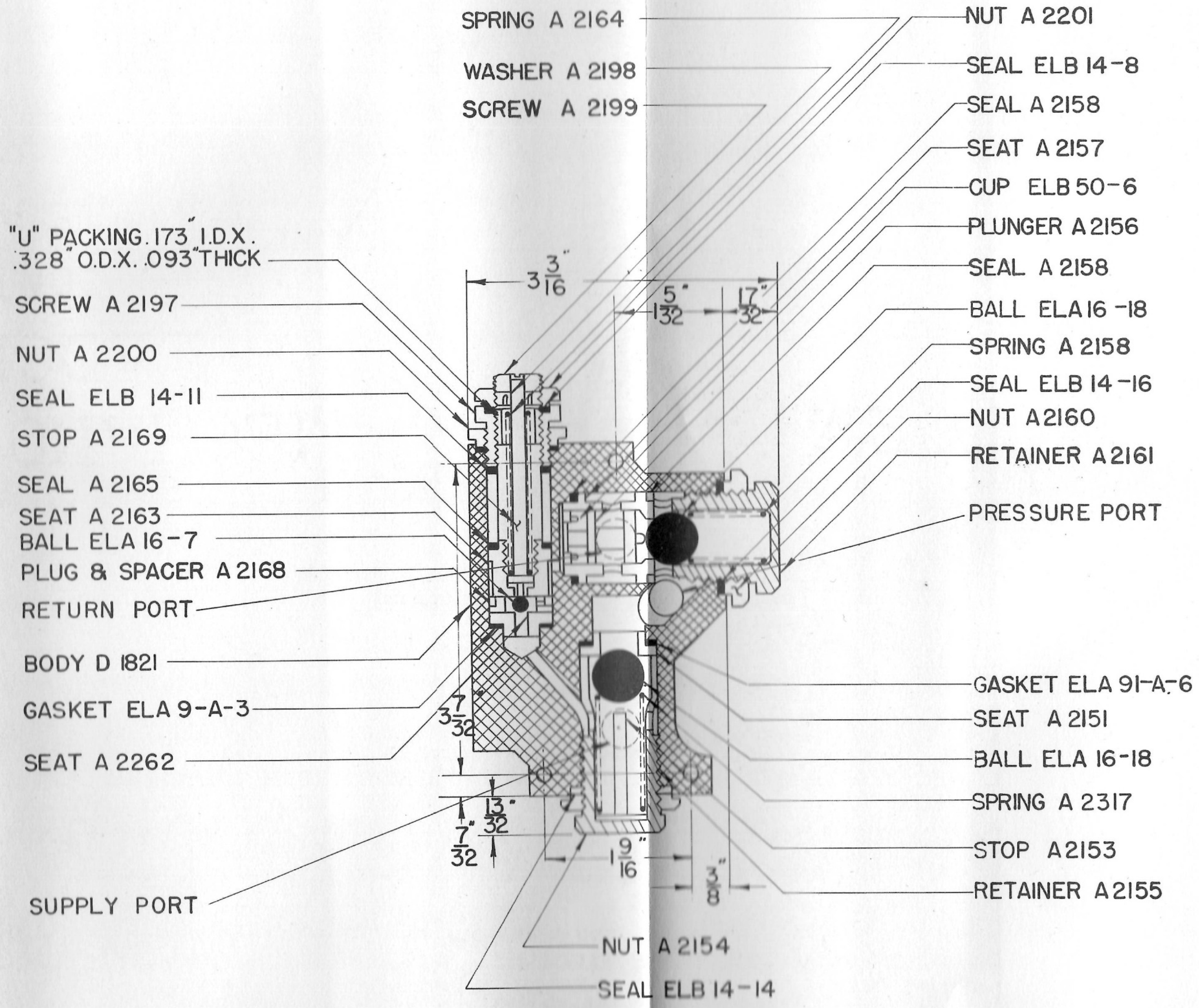


SYMBOL	NOMENCLATURE	MANUFACTURER	NUMBER	NO. REQ,D
A	FILTER, FLUID CLEANING	PUROLATOR CO.	26128	1
B	PANEL, RIVET ASSEMBLY	BREWSTER	20-531129	1
C	TUBE ASSEMBLY, FILTER TO QUICK DISCONNECT VALVE.	BREWSTER	14-531397	1
D	TUBE ASSEMBLY, FILTER TO UNLOADING VALVE.	BREWSTER	14-531398	1
E	TUBE ASSEMBLY, RELIEF VALVE, RETURN LINE.	BREWSTER	14-531401	1
F	TUBE ASSEMBLY, UNLOADING VALVE, RETURN LINE.	BREWSTER	14-531400	1
G	TUBE ASSEMBLY, UNLOADING VALVE TO RELIEF VALVE.	BREWSTER	14-531399	1
H	VALVE, QUICK DISCONNECT (3/4")	AEROQUIP CORP.	126-16	1
I	VALVE, QUICK DISCONNECT (1")	AEROQUIP CORP.	126-8	1
J	VALVE, RELIEF.	BREWSTER	20-53106	1
K	VALVE, UNLOADING.	ELECTROL INC.	6D115	1

GEAM

HYDRAULIC DISCONNECT PANEL ASSEMBLY - FIG. 4-25





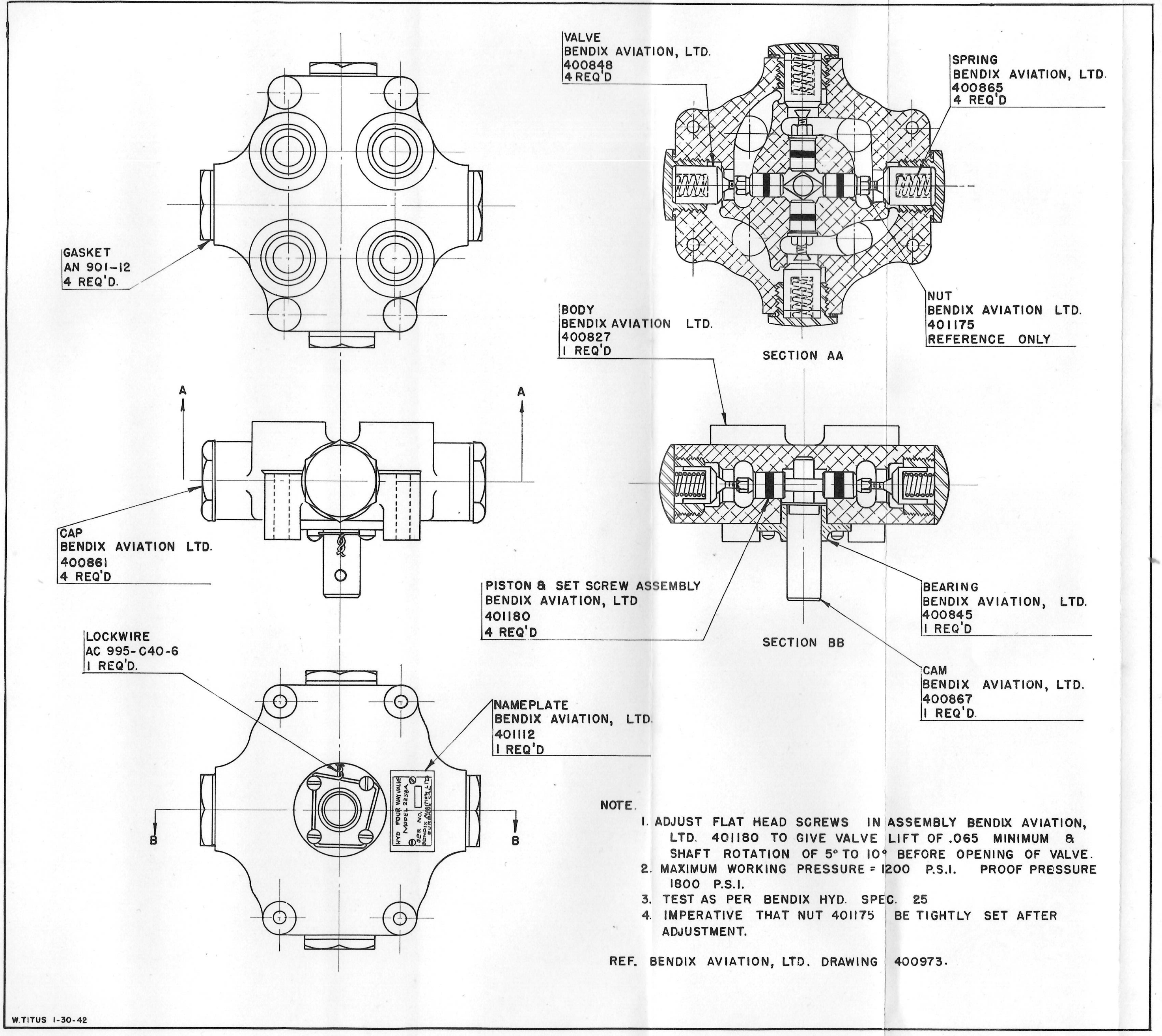
NOTE :—

UNLOADING PRESSURE TO BE ADJUSTABLE 1000 – 1200 P.S.I.. SET VALVE TO UNLOAD AT 1000 P.S.I. ± 25 LB. PRESSURE DIFFERENTIAL = 150 P.S.I. ± 25 LB. TEST PRESSURE = 1500 P.S.I. BURST PRESSURE TO EXCEED 2500 P.S.I.

UNLOADING VALVE
ELECTROL INC.
AIRCRAFT DIVISION
85 GRAND STREET
KINGSTON, N.Y.

E.A.PEARSON

UNLOADING VALVE - FIG. 4-26

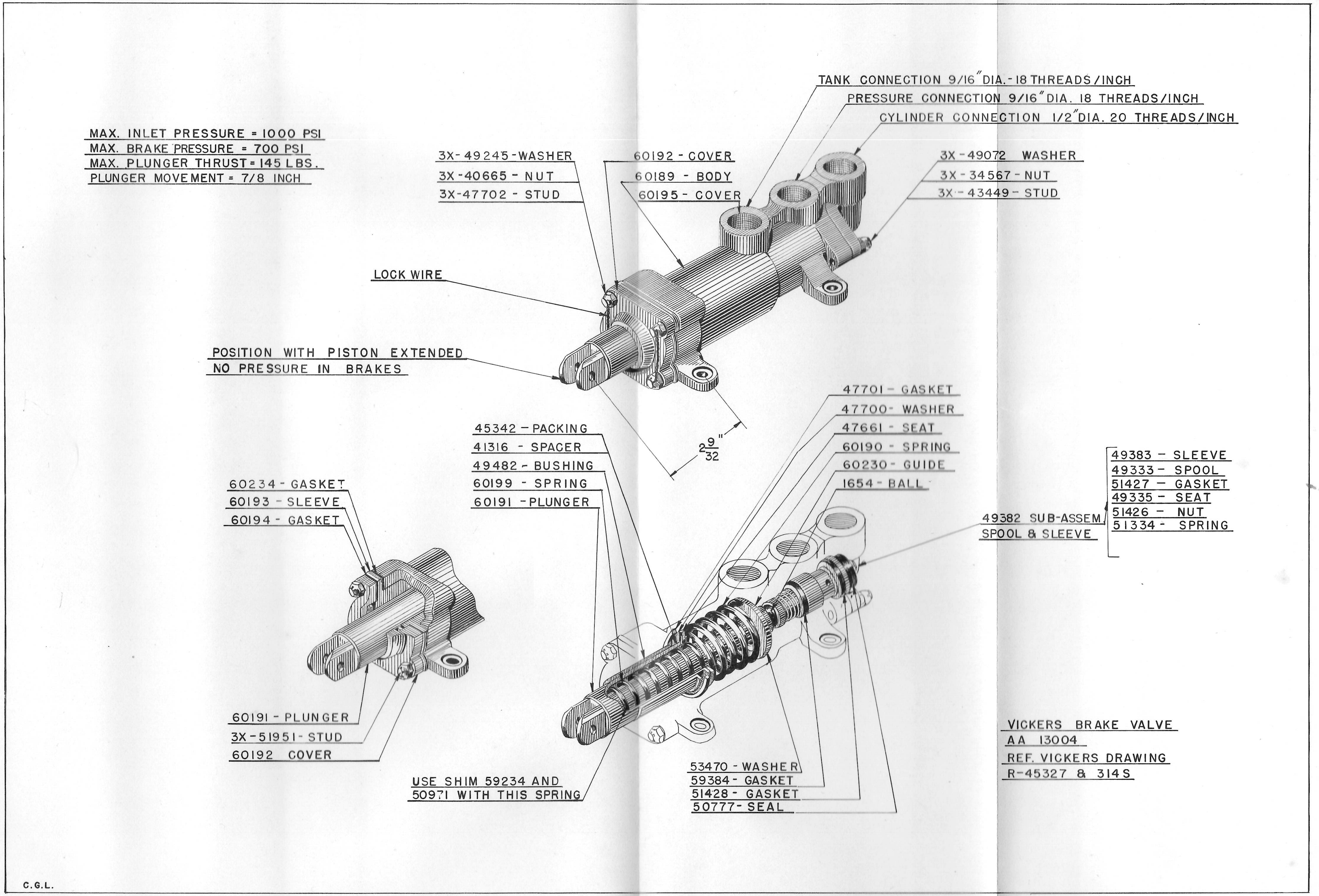


NOTE.

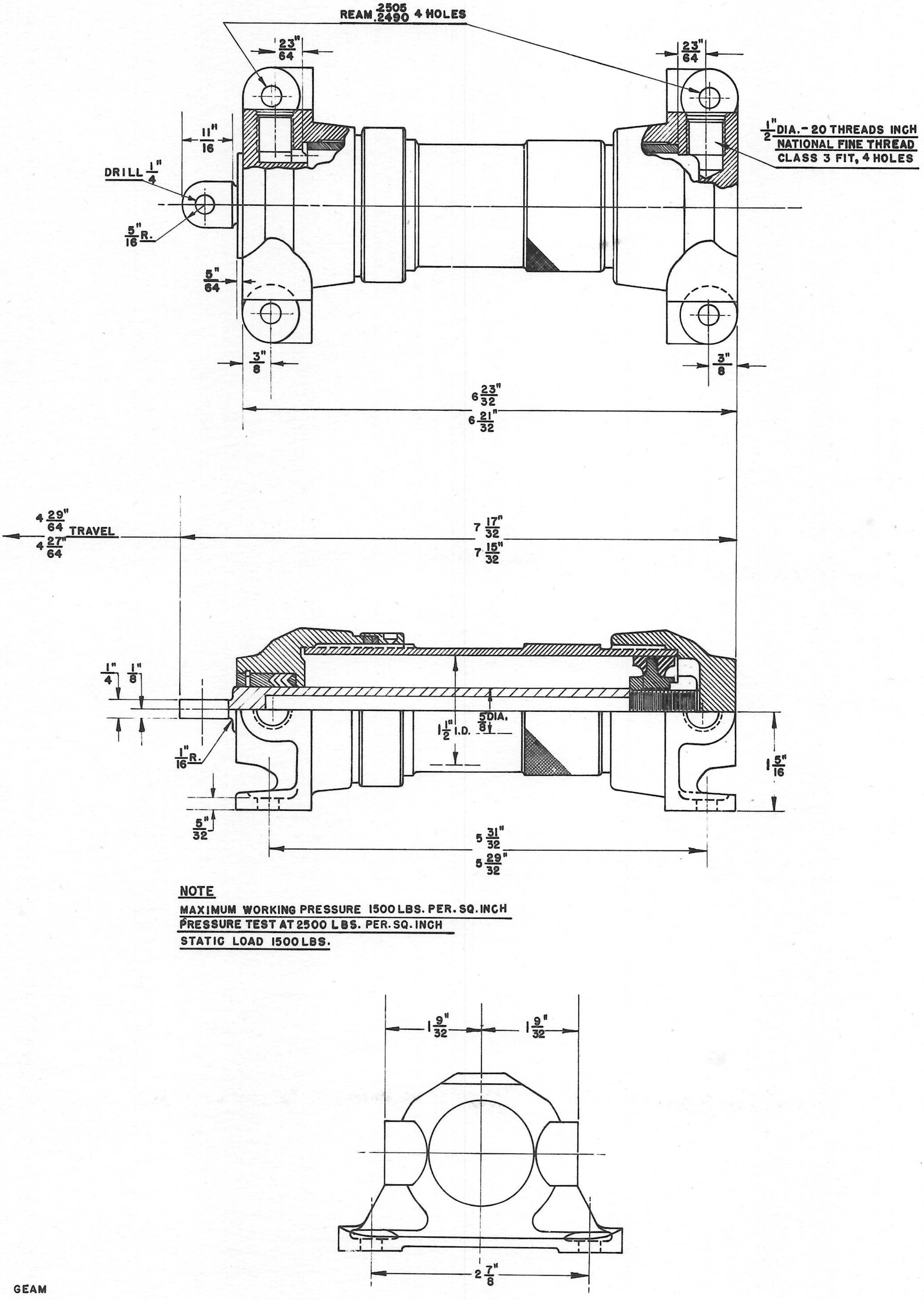
1. ADJUST FLAT HEAD SCREWS IN ASSEMBLY BENDIX AVIATION, LTD. 401180 TO GIVE VALVE LIFT OF .065 MINIMUM & SHAFT ROTATION OF 5° TO 10° BEFORE OPENING OF VALVE.
2. MAXIMUM WORKING PRESSURE = 1200 P.S.I. PROOF PRESSURE 1800 P.S.I.
3. TEST AS PER BENDIX HYD. SPEC. 25
4. IMPERATIVE THAT NUT 401175 BE TIGHTLY SET AFTER ADJUSTMENT.

REF. BENDIX AVIATION, LTD. DRAWING 400973.

FOUR WAY VALVE - FIG. 4-27



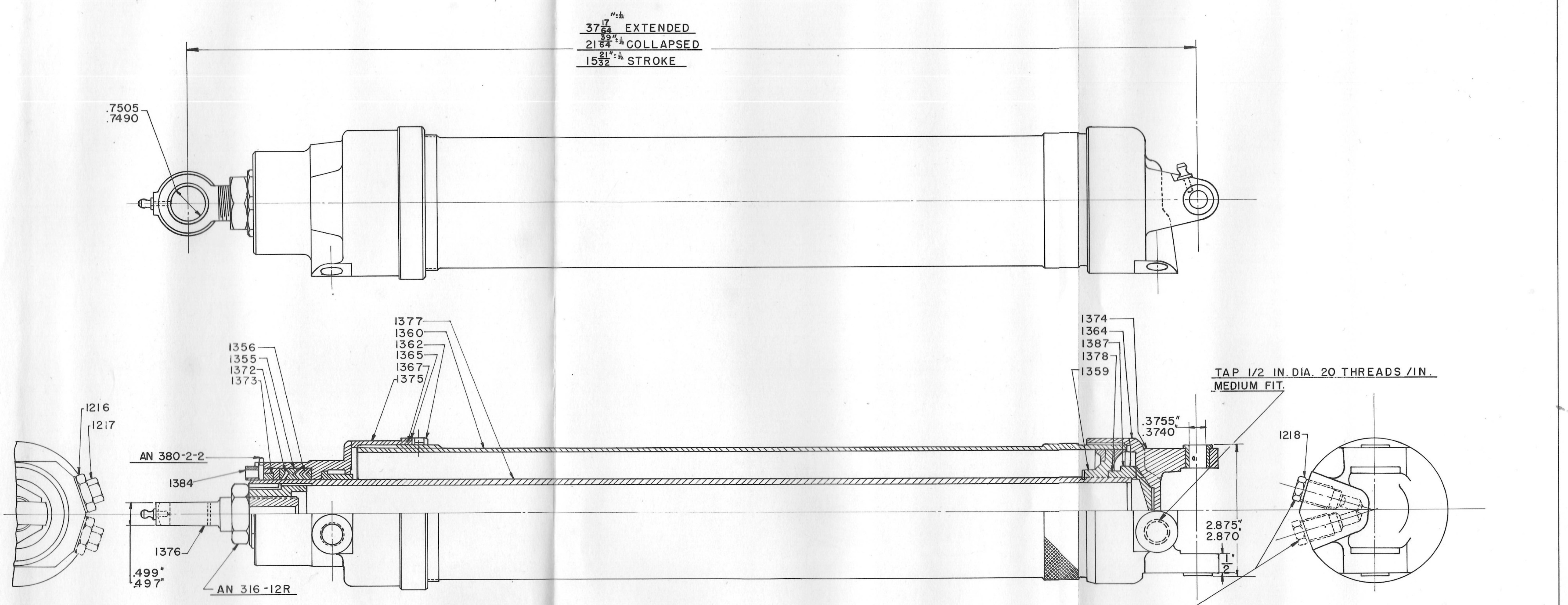
BRAKE CONTROL VALVE - FIG. 4-28



NOTE

MAXIMUM WORKING PRESSURE 1500 LBS. PER. SQ. INCH
PRESSURE TEST AT 2500 LBS. PER. SQ. INCH
STATIC LOAD 1500 LBS.

COWL GILLS OPERATING CYLINDER - FIG. 4-29



NOTE:-

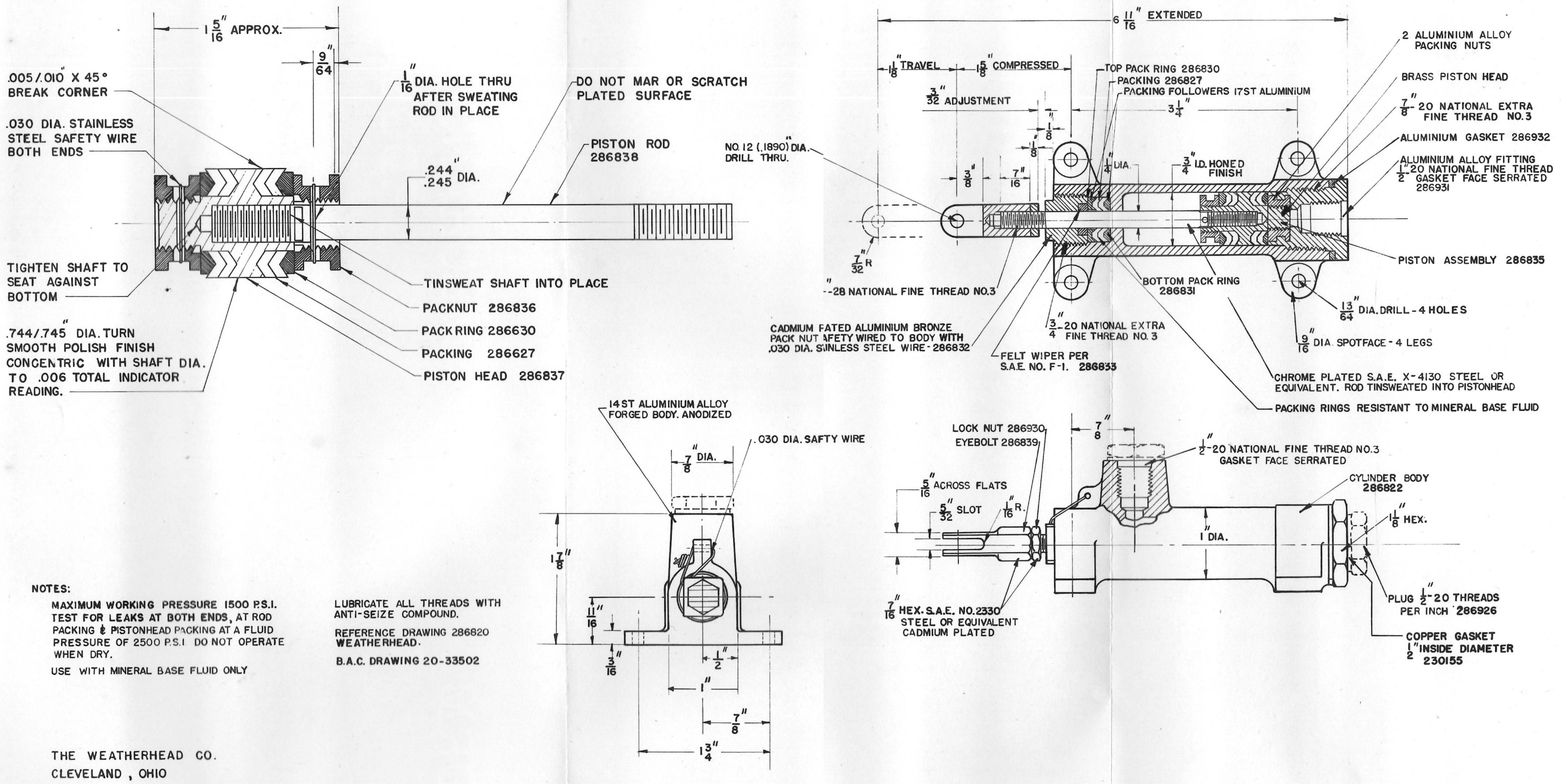
1. MAXIMUM OPERATING PRESSURE 1500 LB./SQ. IN.
2. TEST PRESSURE 3000 LB./SQ. IN.
3. PACKING TO BE SUCH AS TO PREVENT AIR LEAKAGE INTO CYLINDER AT A DIFFERENTIAL PRESSURE OF 15 LB./SQ. IN.
4. TAPPED HOLES FOR IN AND OUTLET TO BE IN LINE WITH EACH OTHER

NOTE:-
ASSEMBLE AS SHOWN BY SOLID LINES FOR R.H. CYLINDER
ASSEMBLE AS SHOWN BY DASH LINES FOR L.H. CYLINDER
BOTH ENDS.

AIRCRAFT ENGINEERING PRODUCTS, INC.
NO. 1253 CLIFTON N.J.

A.F.S.

UNDERCARRIAGE ACTUATING CYLINDER - FIG. 4-30



NOTES:

MAXIMUM WORKING PRESSURE 1500 P.S.I.
TEST FOR LEAKS AT BOTH ENDS, AT ROD PACKING & PISTONHEAD PACKING AT A FLUID PRESSURE OF 2500 P.S.I DO NOT OPERATE WHEN DRY.

USE WITH MINERAL BASE FLUID ONLY

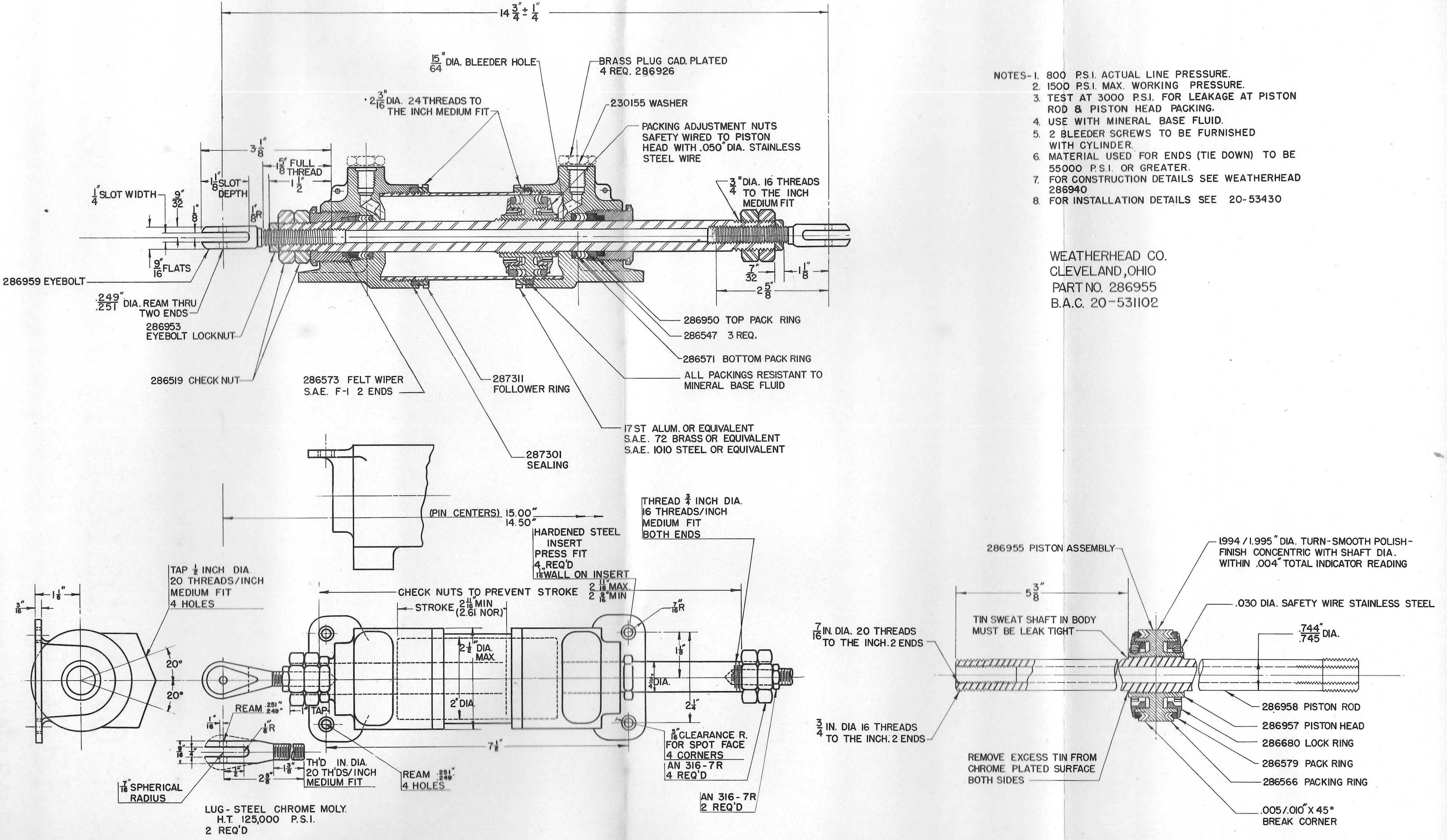
LUBRICATE ALL THREADS WITH ANTI-SEIZE COMPOUND.

REFERENCE DRAWING 286820 WEATHERHEAD.

B.A.C. DRAWING 20-33502

THE WEATHERHEAD CO.
CLEVELAND, OHIO

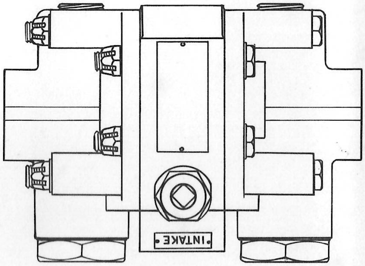
UPLOCK CYLINDER - FIG. 4-31



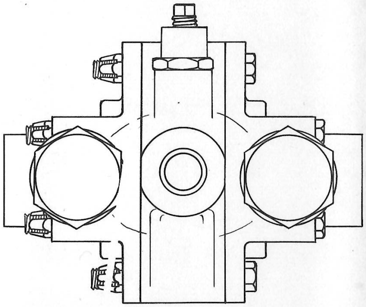
NOTES-
1. 800 P.S.I. ACTUAL LINE PRESSURE.
2. 1500 P.S.I. MAX. WORKING PRESSURE.
3. TEST AT 3000 P.S.I. FOR LEAKAGE AT PISTON ROD & PISTON HEAD PACKING.
4. USE WITH MINERAL BASE FLUID.
5. 2 BLEEDER SCREWS TO BE FURNISHED WITH CYLINDER.
6. MATERIAL USED FOR ENDS (TIE DOWN) TO BE 55000 P.S.I. OR GREATER.
7. FOR CONSTRUCTION DETAILS SEE WEATHERHEAD 286940
8. FOR INSTALLATION DETAILS SEE 20-53430

WEATHERHEAD CO.
CLEVELAND, OHIO
PART NO. 286955
B.A.C. 20-531102

BOMB BAY DOOR ACTUATING CYLINDER - FIG. 4-32



TOP VIEW

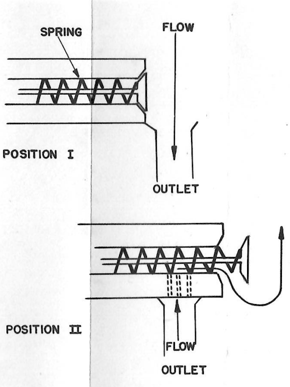


AFT VIEW

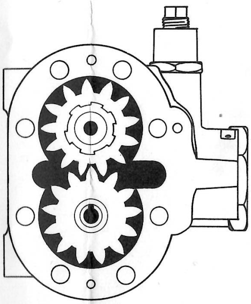
NOTES:

22 NEEDLE BEARINGS UNDER EACH END OF SPLINE SHAFT, ACTUATING DRIVE GEAR.

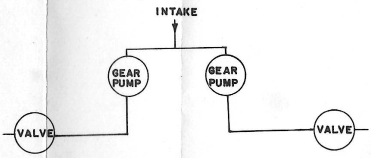
MADE BY PUMP ENGINEERING SERVICE CORPORATION, MANUFACTURER'S NUMBER 397-G.



VALVE ACTION



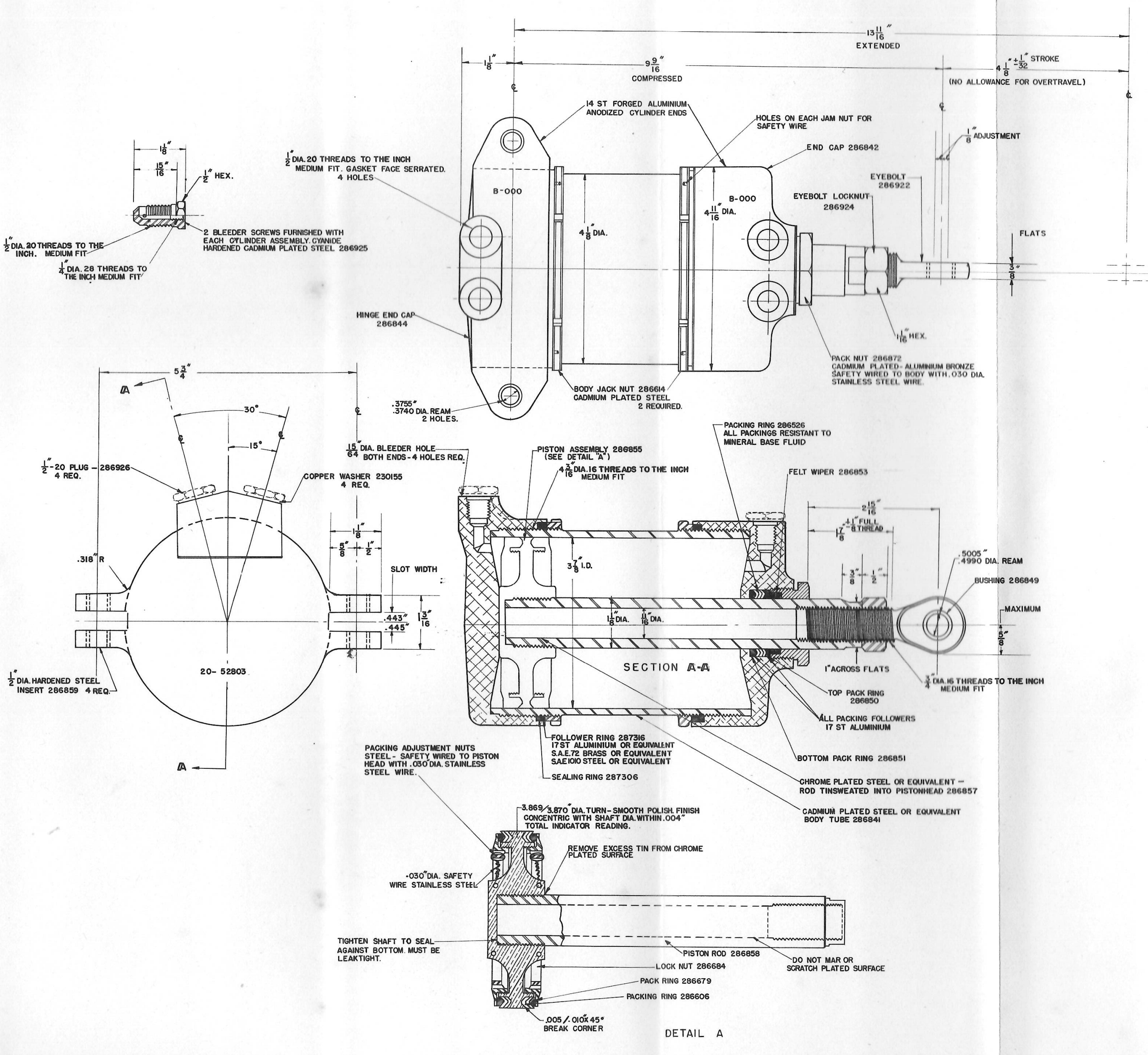
STARBOARD VIEW, COVER REMOVED



FLOW DIAGRAM

B.F. KORUZ.

FLOW EQUALIZER DIAGRAM - FIG. 4-33



NOTES:

800 PSI ACTUAL LINE PRESSURE
1500 PSI MAXIMUM WORKING PRESSURE

DO NOT OPERATE WHEN DRY

USE WITH MINERAL BASE FLUID

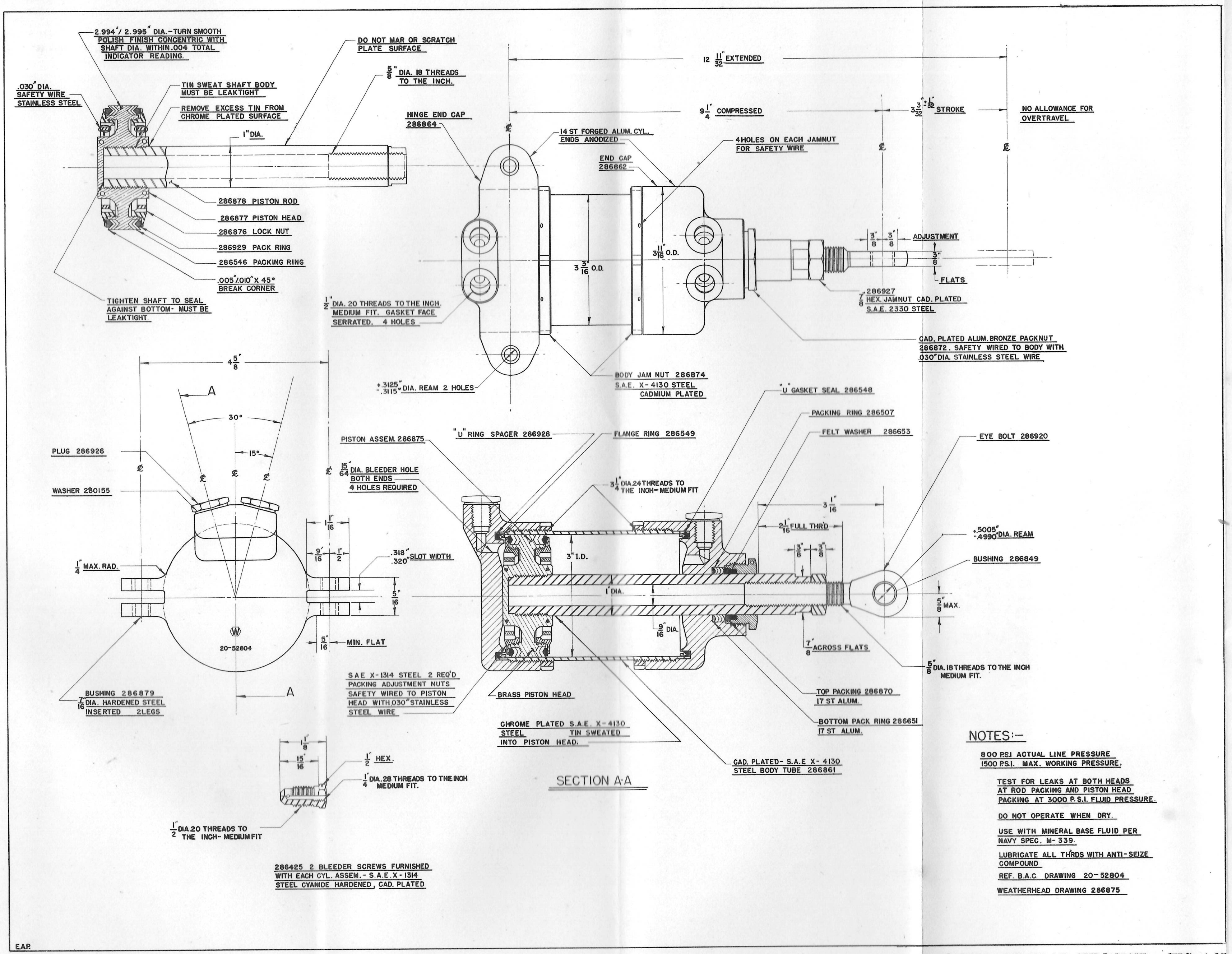
LUBRICATE ALL THREADS WITH ANTI-SEIZE COMPOUND

STAMP BOTH END CAPS WITH NUMBER TO DESIGNATE MODEL "B" AND SERIAL NO. - AS "B-000"- CONSECUTIVELY NUMBERED FROM 1 TO —— .

REFERENCE B.A.C. DRAWING 20-52803

WEATHERHEAD DRAWING 286824

INBOARD FLAP CYLINDER - FIG. 4-34



NOTES:—

800 P.S.I ACTUAL LINE PRESSURE
1500 P.S.I. MAX. WORKING PRESSURE.

TEST FOR LEAKS AT BOTH HEADS AT ROD PACKING AND PISTON HEAD PACKING AT 3000 P.S.I. FLUID PRESSURE.

DO NOT OPERATE WHEN DRY.

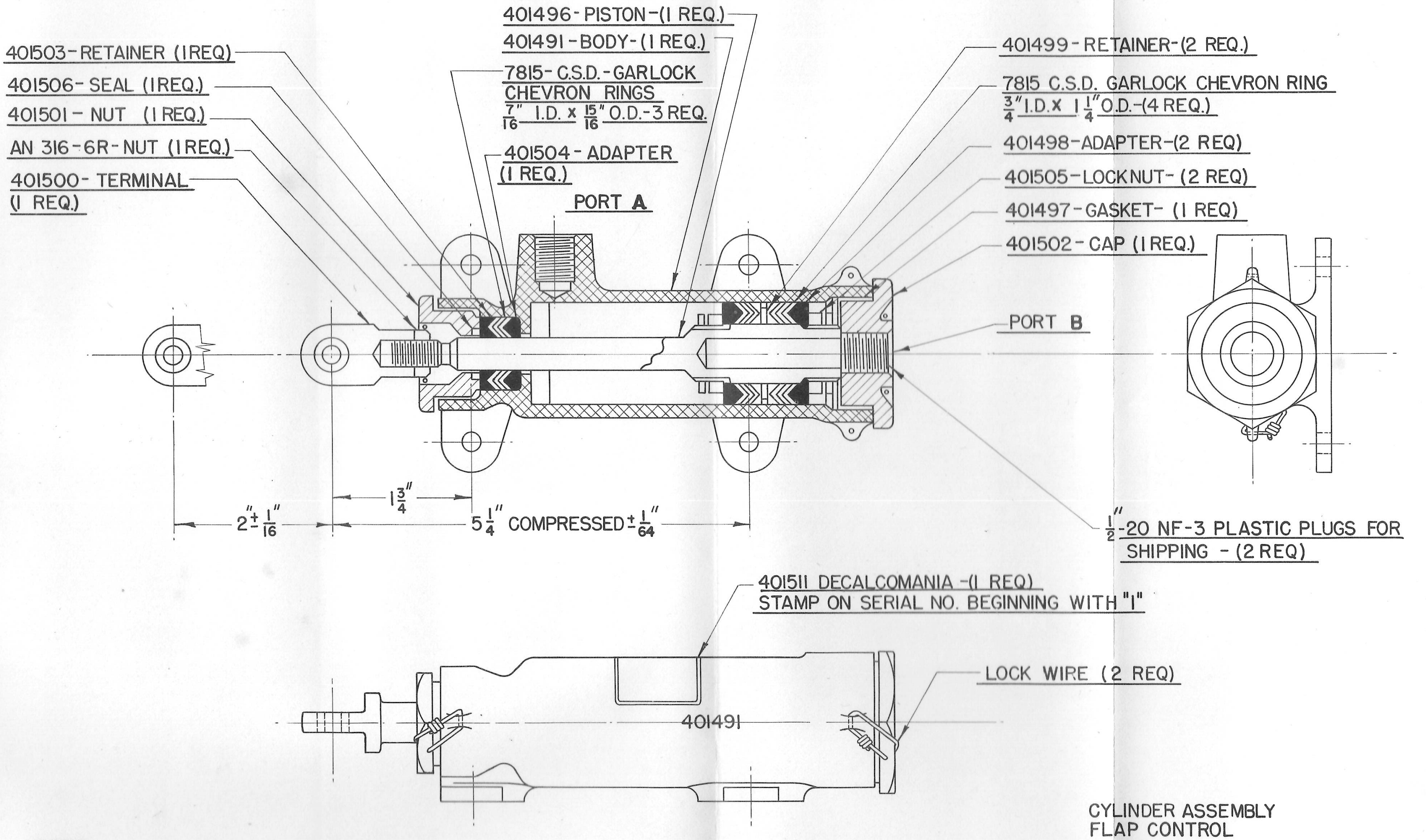
USE WITH MINERAL BASE FLUID PER NAVY SPEC. M-339.

LUBRICATE ALL THRDS WITH ANTI-SEIZE COMPOUND

REF. B.A.C. DRAWING 20-52804

WEATHERHEAD DRAWING 286875

OUTBOARD FLAP CYLINDER - FIG. 4-35



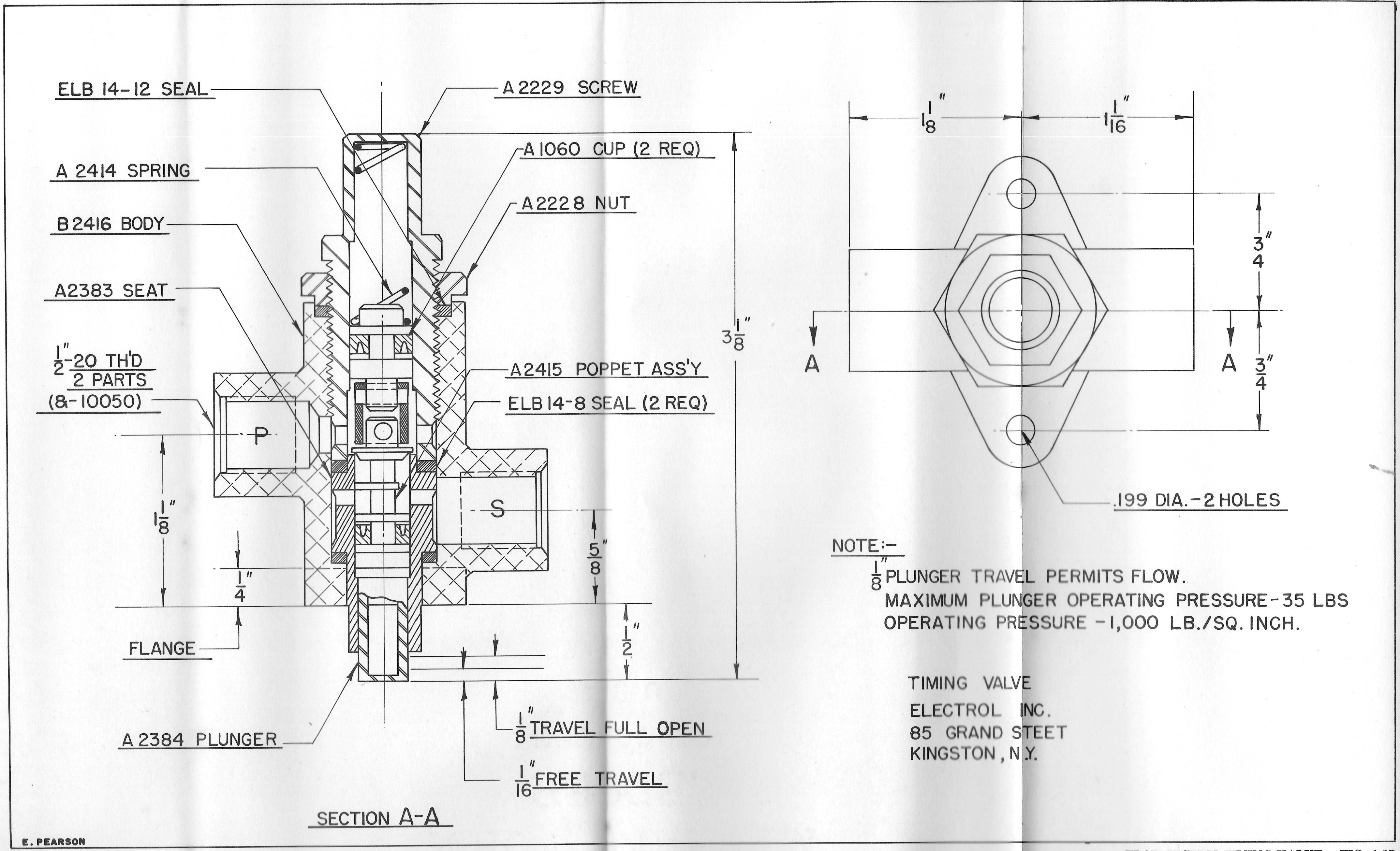
CYLINDER ASSEMBLY
FLAP CONTROL
DRAWING NO. 401493
BENDIX AVIATION
BURBANK CAL.

NOTES:

2500 P.S.I. TEST PRESSURE SHALL BE APPLIED FOR FIVE MINUTES TWO SUCCESSIVE TIMES AT EACH PORT, WITH AN ACTION OF THE UNIT AFTER EACH APPLICATION. NO DISTORTION, PERMANENT SET OR LEAKAGE SHALL OCCUR.

E A PEARSON.

DIVE FLAP ENGAGING CYLINDER - FIG. 4-36



NOTE:-
1/8" PLUNGER TRAVEL PERMITS FLOW.
MAXIMUM PLUNGER OPERATING PRESSURE-35 LBS
OPERATING PRESSURE -1,000 LB./SQ. INCH.

TIMING VALVE
ELECTROL INC.
85 GRAND STEET
KINGSTON, N.Y.

FLAP SYSTEM TIMING VALVE - FIG. 4-37

ALIGHTING GEAR

363 General: The wide track main undercarriage comprises two oleo shock-absorber struts which fully retract inboard into a recess in the side of the fuselage and the bottom of the wing forward of the front spar structure. The extending and raising of the undercarriage is carried out hydraulically (see paragraph 376). The "down" position lock is mechanically unlatched by a cable which extends between the lock and the hydraulic system undercarriage control valve handle. The "up" lock is automatically unlatched by a small hydraulic cylinder. An auxiliary emergency mechanical release is also provided. Electrical indicating devices include a visual position indicator operated by a rheostat follower which is directly connected to the undercarriage and an audible warning buzzer which is controlled by switches on the undercarriage and engine throttle, operating when the undercarriage is not fully extended and the throttle is closed to less than one-third open. A wheel with pneumatic tyre is carried on a stub axle on the outboard side of each oleo shock strut. Each wheel is fitted with a hydraulically operated brake (see paragraph 356). The brakes are controlled by toe pedals which are a component part of the rudder pedal assemblies.

364 The tail wheel unit is of the fixed (non-retracting) full castoring type. The assembly is fitted with an oleo shock absorber strut. The wheel fork and stub axle is of cantilever design. The wheel is fitted with a pneumatic self-earthing tyre.

Description

365 Undercarriage Oleo Struts (see fig. 4-38): The undercarriage oleo struts are of the oil and air type. The struts are comprised of an inverted open cylinder into which slides a cylindrical piston rod carrying the wheel axle stub at its lower end; the piston rod is prevented from turning by a scissors mechanism connected to the two parts. Compressed air in the upper portion of the oleo strut provides a means for absorbing the light or taxying shock loads, the necessary dampening from heavier shock loads being obtained by progressive hydraulic loading which forces oil through an orifice that decreases in area as the piston rod moves upwards. At its upper closed end the cylinder is fitted to a trunnion to provide a means of attaching it to the aeroplane; a gland for the piston rod is fitted at the lower end. Chevron type packings are used in the packing gland which is provided with an externally threaded adjusting nut. The piston rod upper end is fitted with chevron type packings to form an oil seal. The struts are to be filled to overflowing with hydraulic fluid when fully compressed. The initial air load is approximately 100 lb./sq. in. with the oleo strut extended. The oleo strut is attached by the upper end trunnion to the wing centre section structure and is braced fore-and-aft and athwartships from a point appproximately one-third down the oleo strut. The fore-and-aft bracing is provided by an aft brace strut connected from a fitting on the oleo strut to the trunnion to form a triangle. The athwartships bracing is provided by a hinged inboard strut which is connected to a fitting on the oleo strut and to a fitting on the front spar of the wing centre section. The oleo strut has freedom of motion only in the inboard direction, this being provided by the hinged inboard strut. The oleo strut must be compressed when the undercarriage is retracted; this is accomplished by an oleo compression strut which is connected to the lower end of the piston rod of the main oleo and to a fitting on the hinged inboard strut.

366 Undercarriage Wheels: The wheel (Bendix No. 57583) contains the brake drum and provides the rim for the pneumatic tyre. It is attached to the axle by means of a castellated nut. To provide free rotation about the axle the wheel is mounted on two roller bearings.

367 Undercarriage Wheel Tyres: The tyre (Goodyear 34 × 9) is a heavy tread unit to be inflated to a pressure of 50 lb./sq. in.

368 Undercarriage Wheel Brakes (see fig. 4-39): The brake (Bendix No. 57619) is the duo servo type. The brake shoe mechanism is floating and is held in place by means of three springs. The action on the brake shoes is provided by a hydraulic cylinder connected to a brake control valve (see paragraph 318) on the corresponding rudder pedal. As the cylinder has two pistons acting at 180° and in the same cylinder the piston with the least pressure on it will move first. This uneven motion on the ends of the cylinder is caused by the direction of rotation of the wheel. As the piston moves outwards the entire brake shoe revolves until equal pressure on both pistons is reached and then the cylinders expand together producing full braking action. The floating arrangement on the duo servo brake assures that there will be equal pressure at all points between the brake drum on the wheel and the brake shoes.

369 Tail Wheel Assembly (see fig. 4-40): In addition to the retractable main undercarriage the aeroplane is equipped with a non-retractable tail wheel installation, provided with a 14.5 inch, 6 ply cotton, smooth contour, pneumatic, self-earthing tail wheel tyre (Goodyear). The shock absorbing unit (Cleveland No. 7802) consists of an air-oil strut, suspended from a fitting affixed to the uppermost aft side of fuselage frame 273. The lower end of the shock strut is bolted to the upper aft end of the tail wheel chassis assembly which in turn is bolted at its forward end to a fitting fastened to the lower aft side of fuselage frame 273. One bolt at each point of attachment facilitates rapid removal.

370 Tail Wheel Shock Strut: The tail wheel shock strut is the conventional type utilizing the passing of oil through an orifice to absorb the energy of impact; air being the elastic medium for taxying and restoring the parts to their extended position. The

filler plug is located at the top of the strut piston; the strut should be kept full to the level of the filler plug.

371 Tail Wheel Chassis Assembly: The tail wheel drag truss or chassis assembly consists of a cast unit fitted with a knuckle assembly which is free swiveling within the drag truss housing. The lower end of the knuckle assembly comprises the axle about which the tail wheel (Bendix 57457) rotates, while the upper end passes into the housing which forms the bearing point for the swiveling of the knuckle assembly. A lug, integral with the housing and located on the upper aft portion, is the attachment point for the lower end of the shock absorber strut, which in turn is fastened to a fitting on the upper part of the fuselage at frame 273. The housing itself is cylindrical and fitted at its forward end with a tubular "T" which is in turn fitted with a lug at each end, through which two bolts, one for each lug, fasten the drag truss unit to the two fittings affixed to the lower aft side of fuselage frame 273.

> Note: Both the housing bearings and the knuckle housing should be swabbed periodically with "Essoleum B" or "Intava 629" or an equivalent grease. Operate through motion and then wipe dry to prevent accumulation of dirt.

Operation

372 Undercarriage: The main undercarriage is retracted or extended by a hydraulic cylinder which is connected on one end to the main oleo strut trunnion and on the other end to a fitting on the hinged inboard strut. When the hydraulic cylinder is extended a rotational component is delivered to the oleo strut by the hinged inboard strut.

373 To retain the undercarriage in the retracted position, "up-lock" latches are bracketed to the wing structure in the wheel well. The latches are spring-loaded and are automatically engaged as the undercarriage is raised. Disengagement of the latches is normally accomplished by a hydraulic cylinder (see paragraph 331). An emergency means of disengaging the "up-lock" latches is provided (see fig. 4-41).

374 The "down-lock" mechanism automatically engages a pin on the hinged inboard struts when the undercarriage is extended. Disengagement of the "down-locks" is obtained by mechanical means. The "down-lock" latches are interconnected by cables with the hydraulic undercarriage four-way control valve handle (see fig. 4-42). An emergency means of causing complete extension of the undercarriage is provided. A cable is attached to the centre joint of the inboard strut on both undercarriage oleos. A pull may be exerted on either cable by means of handles which are located under the main instrument panel.

375 The operation of the wheel position indicator, which shows the relative position of the main wheels when being operated in addition to indicating the operation of the "up" and "down" lock latches, is described in paragraphs 246 to 248.

376 Should both main undercarriage units not be locked "down" at any time when the throttle lever is less than one-third open, the pilot will immediately be reminded of the potential danger of his position by the sounding of a warning buzzer which is situated under the pilot's seat on the decking of the cockpit floor.

377 Undercarriage Wheel Brakes: Operation of the brakes is discussed in paragraphs 318 to 323 of the hydraulic section.

378 Tail Wheel Assembly: The operation of the tail wheel assembly is automatic and requires no attention during operation of the aeroplane.

Servicing and Maintenance

379 Undercarriage, main wheels:

Inspect daily:

a. Oleo extension to $2\frac{3}{16}$ inches.
b. Tyre pressure to 50 lb./sq. in.
c. All exposed attaching bolts for tightness and security.
d. "Up" and "down" lock latches and operating mechanism for satisfactory working order.
e. Fairing for general security.
f. Tyre wear and damage.
g. All hydraulic connections and oleo struts at packing glands for leaks.

Inspect each 60 hours:

h. Oleo fluid level.
i. Wheel bearings for wear and lubrication.
j. Wheel brakes for wear and adjustment.

380 Fluid: Bendix fluid 54160 is supplied in the oleo struts for both the main and tail wheels. A satisfactory substitute for this fluid would be one of the following:

Sperry Servo No. 9.
Univis No. 40.
Intava Servo Fluid.

381 No harmful effect will result from mixing any of these four fluids in any proportion in any strut.

382 Undercarriage, Tail Wheel:

Inspect daily:

k. Oleo extension to 4 inches.
l. Tyre pressure to 45 lb./sq. in.
m. Exposed attaching bolts for tightness and security.
n. Tyre wear and damage.

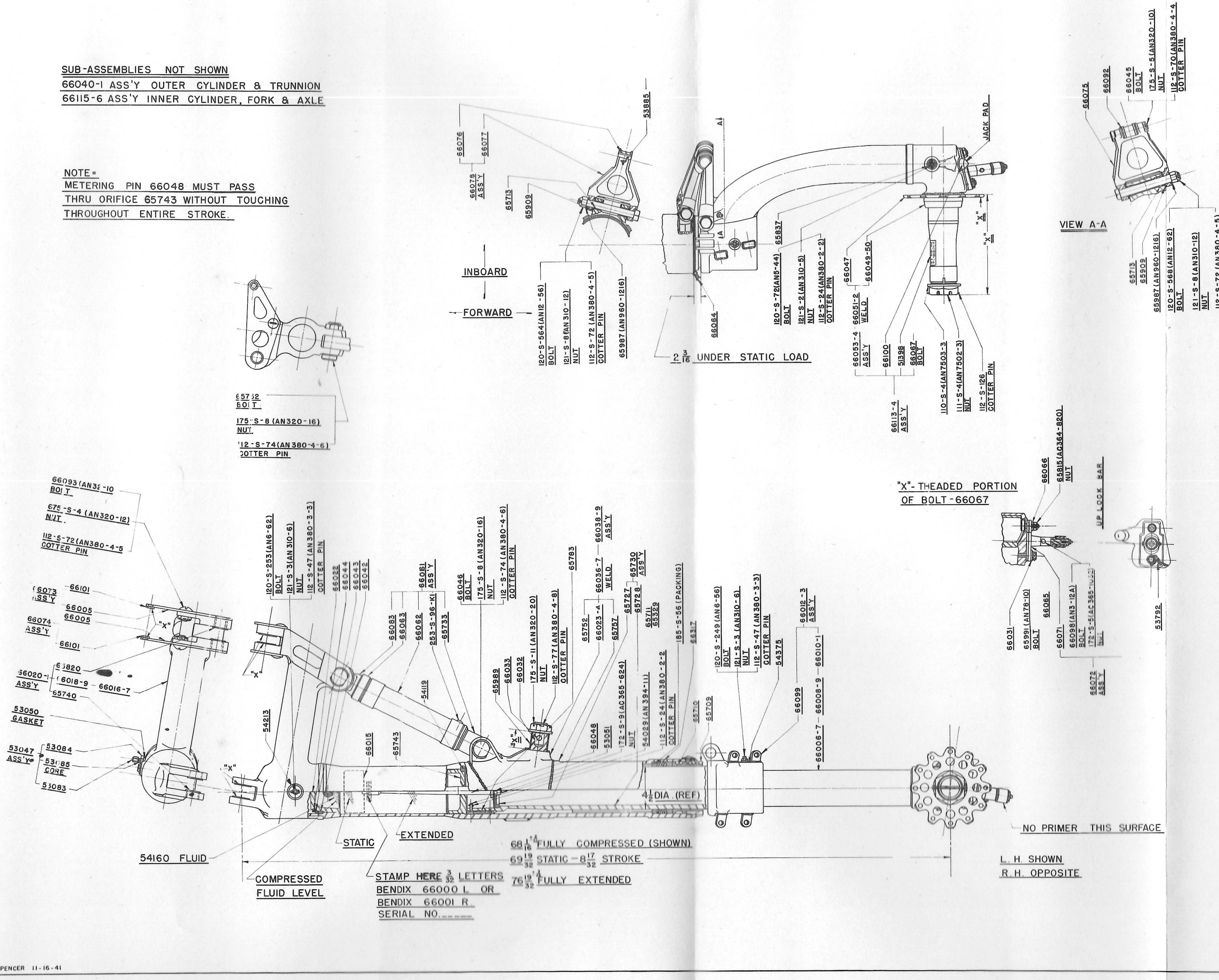
Inspect each 60 hours:

o. Oleo strut fluid level.
p. Wheel and axle fork bearing for wear, adjustment and lubrication.

SUB-ASSEMBLIES NOT SHOWN
66040-1 ASS'Y OUTER CYLINDER & TRUNNION
66115-6 ASS'Y INNER CYLINDER, FORK & AXLE

NOTE =
METERING PIN 66048 MUST PASS THRU ORIFICE 65743 WITHOUT TOUCHING THROUGHOUT ENTIRE STROKE.

FLUID REQ'D FOR COMPLETE FILLING = 9 PTS-13 OZ.
APPROX. AIR PRESSURE WITH STRUT FULLY EXTENDED = 98 LBS PER SQ. IN.

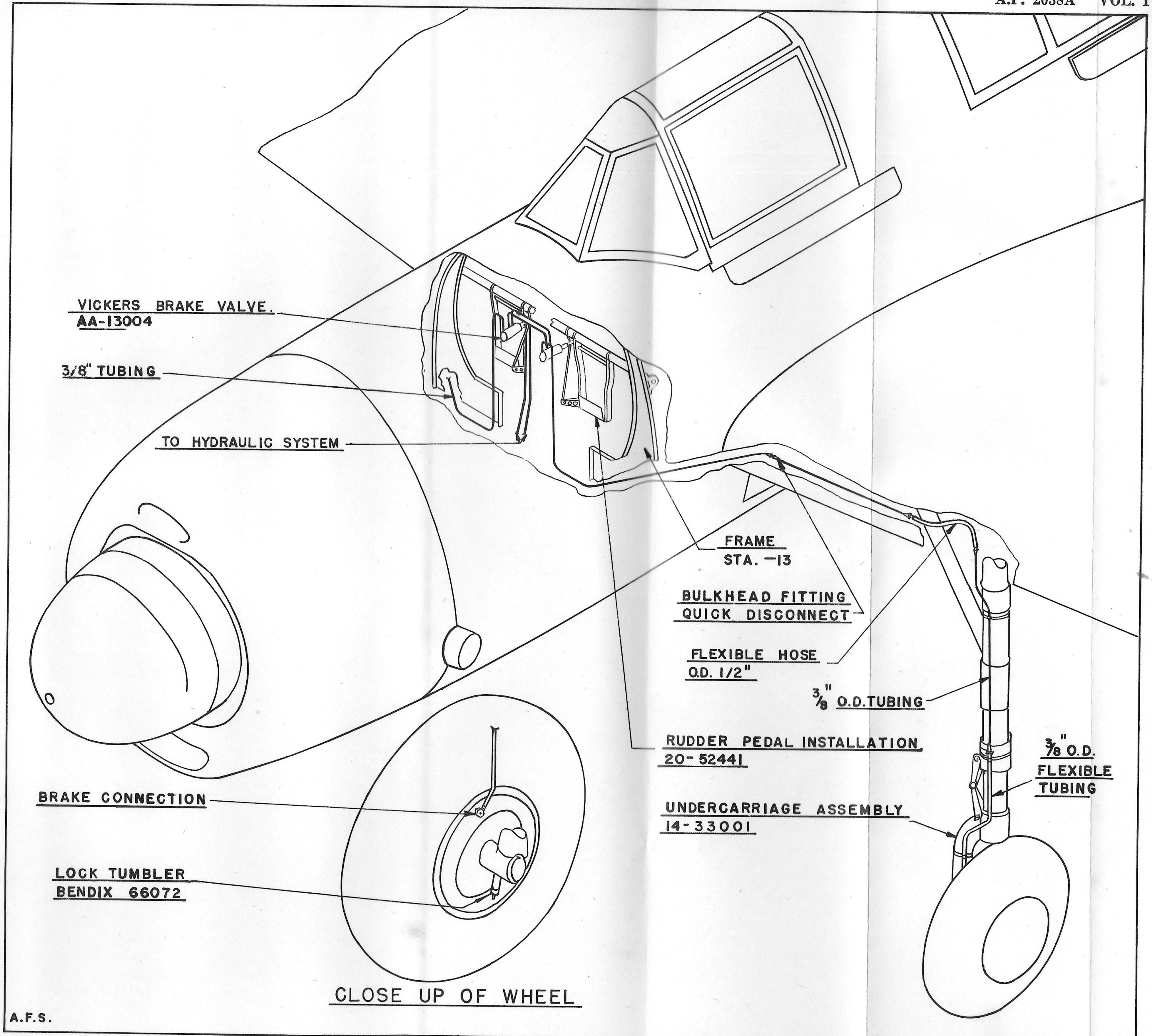


FINISH SPECIFICATIONS =
ONE COAT OF ZINC CHROMATE PRIMER 53089 (NAVY) AERONAUTICAL SPEC. P-27)
COAT ALL EXTERNAL SURFACES EXCEPT CHROME PLATED SURFACES, I. D. OF HOLES, AND SURFACES MARKED "X", 7 PLACES,
BEFORE ASSEMBLY OF =

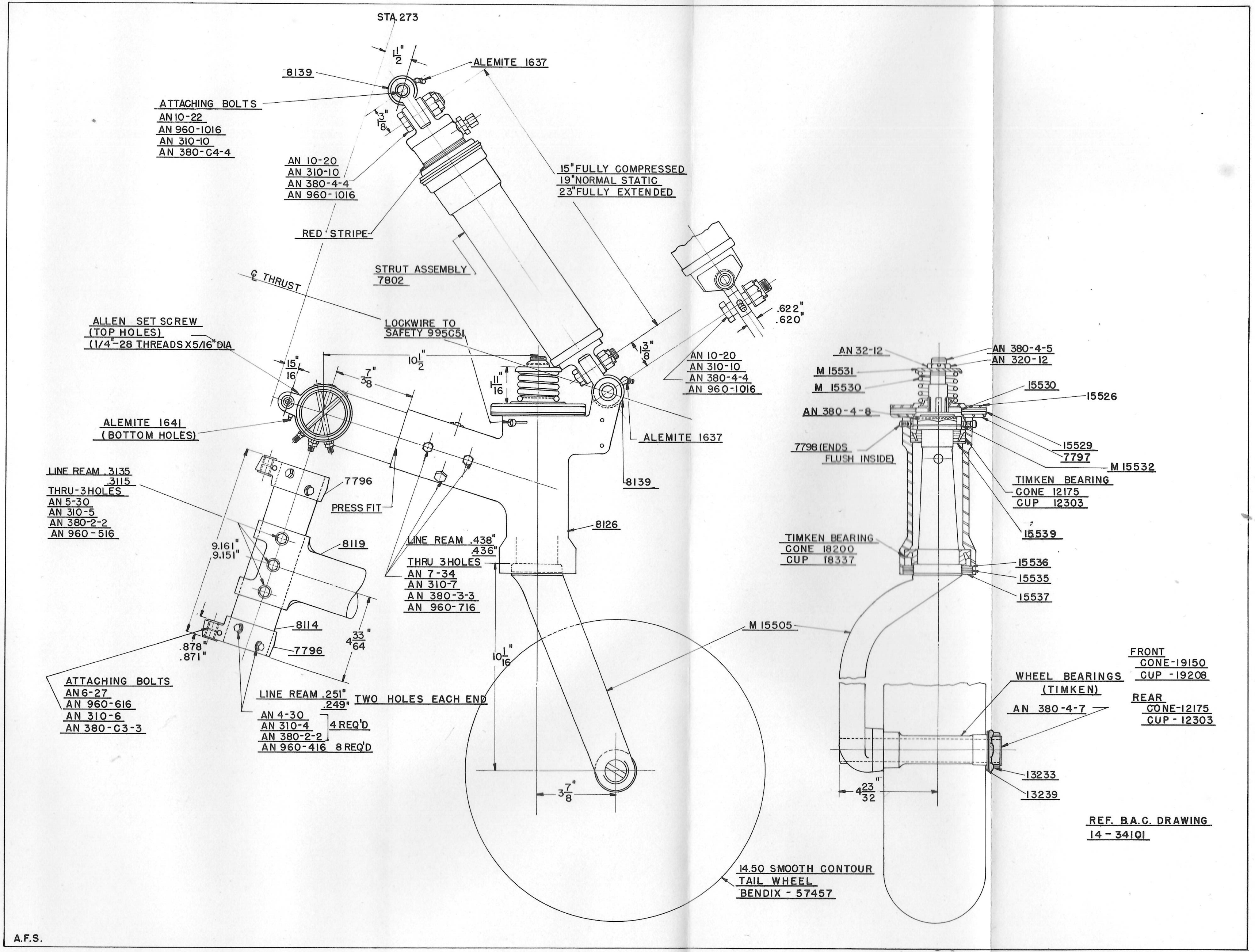
66031-WASHER	66072-ASS'Y-RETRACTING LOCK ROLLER
65991-BOLT	
66095-PLATE	65815-NUT
	66066-WASHER

EXPOSED SURFACES OF WHICH SHOULD RECEIVE ONE COAT OF PRIMER, EXCEPT OUTSIDE OF 66068-ROLLER.

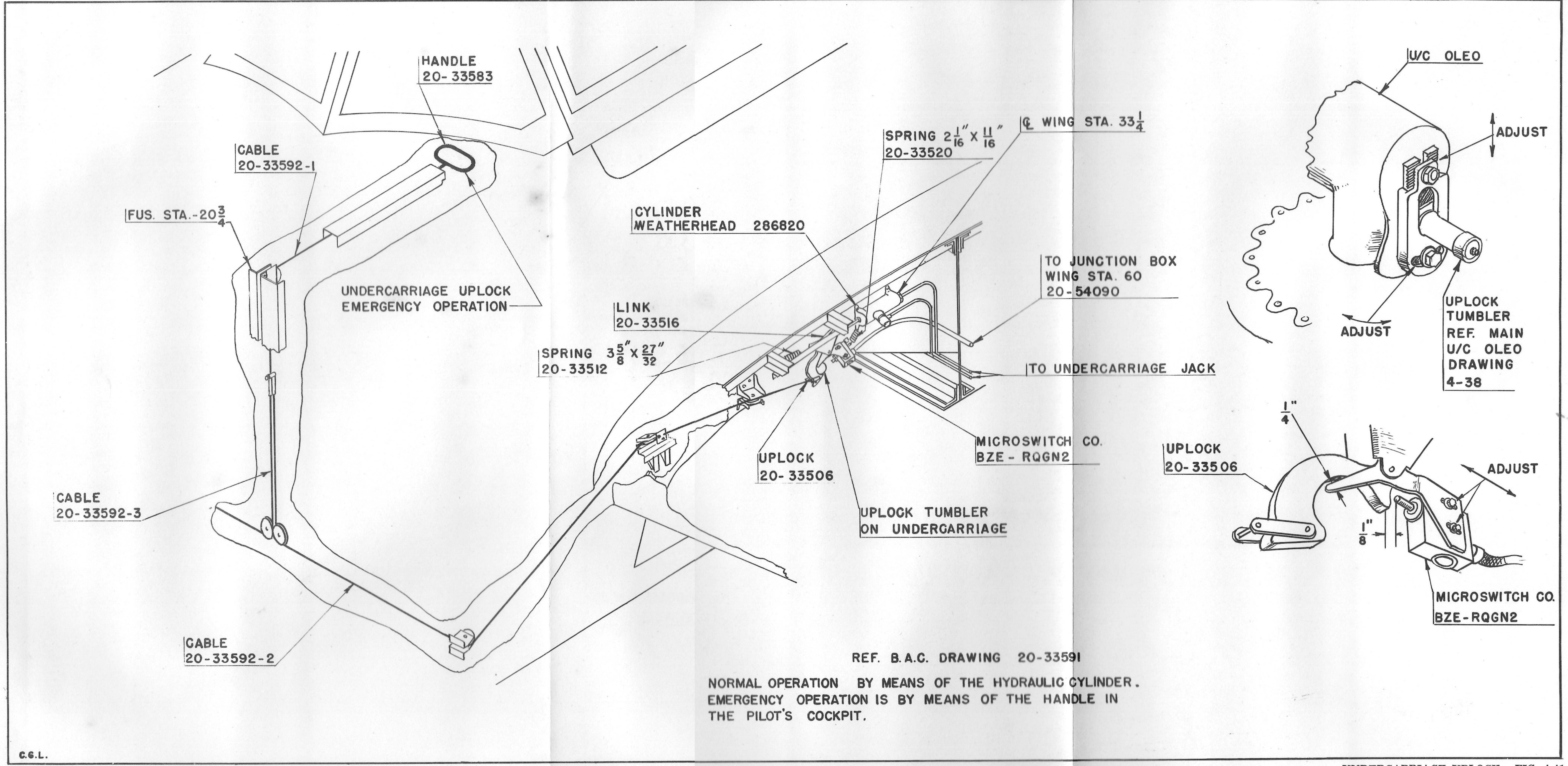
MAIN UNDERCARRIAGE OLEO - FIG. 4-38



BRAKE ASSEMBLY - FIG. 4-39



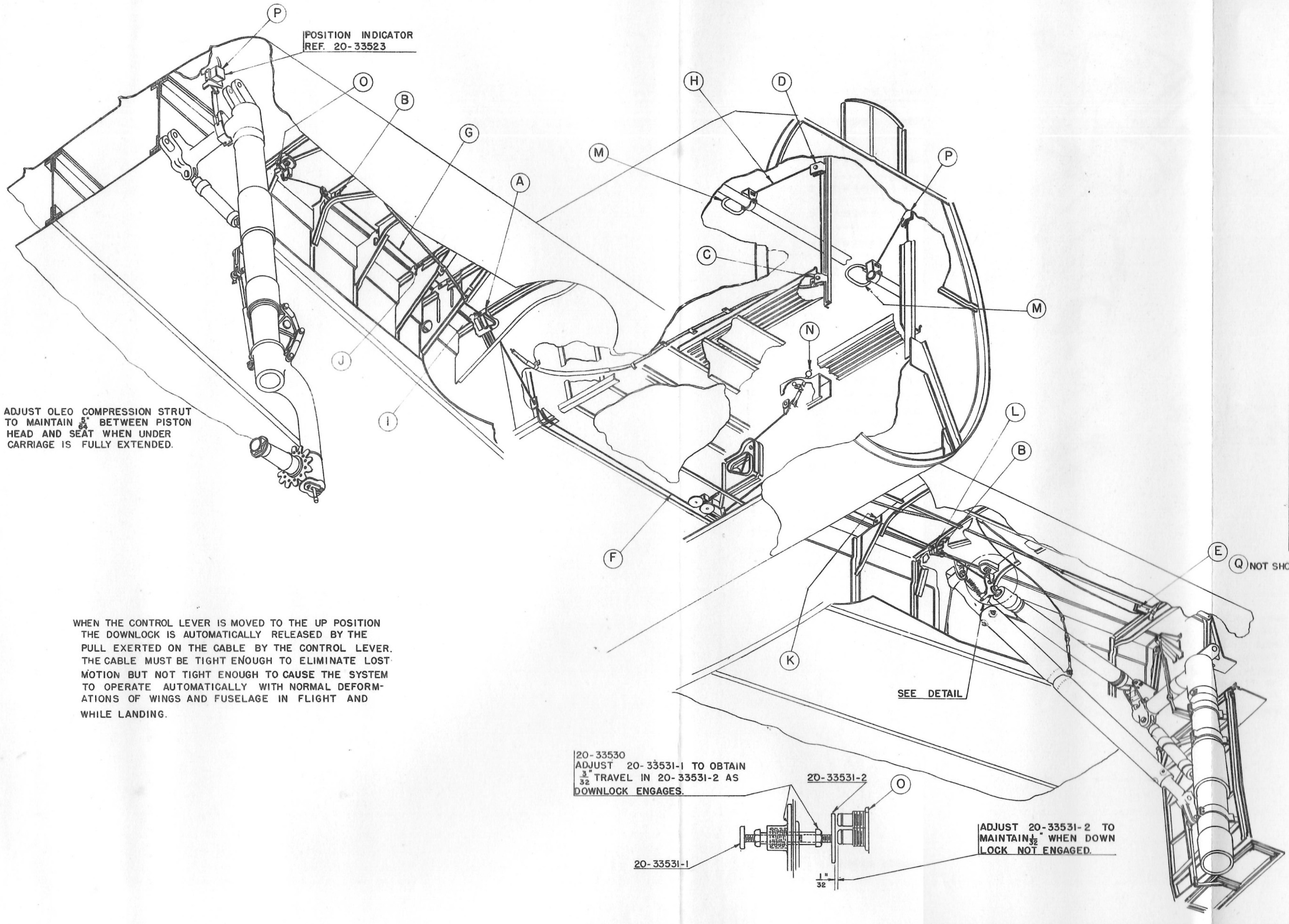
TAIL WHEEL ASSEMBLY - FIG. 4-40



REF. B.A.C. DRAWING 20-33591

NORMAL OPERATION BY MEANS OF THE HYDRAULIC CYLINDER.
EMERGENCY OPERATION IS BY MEANS OF THE HANDLE IN THE PILOT'S COCKPIT.

UNDERCARRIAGE UPLOCK - FIG. 4-41



ADJUST OLEO COMPRESSION STRUT TO MAINTAIN $\frac{5}{64}$" BETWEEN PISTON HEAD AND SEAT WHEN UNDER CARRIAGE IS FULLY EXTENDED.

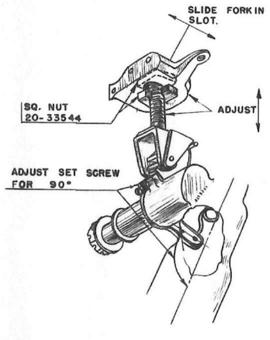
WHEN THE CONTROL LEVER IS MOVED TO THE UP POSITION THE DOWNLOCK IS AUTOMATICALLY RELEASED BY THE PULL EXERTED ON THE CABLE BY THE CONTROL LEVER. THE CABLE MUST BE TIGHT ENOUGH TO ELIMINATE LOST MOTION BUT NOT TIGHT ENOUGH TO CAUSE THE SYSTEM TO OPERATE AUTOMATICALLY WITH NORMAL DEFORMATIONS OF WINGS AND FUSELAGE IN FLIGHT AND WHILE LANDING.

20-33530
ADJUST 20-33531-1 TO OBTAIN $\frac{3}{32}$" TRAVEL IN 20-33531-2 AS DOWNLOCK ENGAGES.

ADJUST 20-33531-2 TO MAINTAIN $\frac{1}{32}$" WHEN DOWN LOCK NOT ENGAGED.

SYMBOL	NOMENCLATURE	PART NUMBER	MANUFACTURER	NO. REQ'D
A	BRACKET, PULLEY *(STA. 32 1/2)* DOWNLOCK RELEASE	20-33579	BREWSTER	IL-IR
B	BRACKET, PULLEY *(STA. 70)* DOWNLOCK RELEASE	20-33561	BREWSTER	IL-IR
C	BRACKET, PULLEY EMERGENCY DOWNLOCK *(FIREPROOF BULKHEAD, LOWER)*	14-335184	BREWSTER	IL-IR
D	BRACKET, PULLEY EMERGENCY DOWNLOCK *(FIREPROOF BULKHEAD, UPPER)*	14-335183	BREWSTER	IL-IR
E	BRACKET, PULLEY, INST. EMERGENCY DOWNLOCK *(STA. 104)*	14-335185	BREWSTER	IL-IR
F	CABLE, *(FUSELAGE)* DOWNLOCK RELEASE	20-33575	BREWSTER	1
G	CABLE, *(WING)* DOWNLOCK RELEASE	14-33553	BREWSTER	2
H	CABLE, EMERGENCY DOWNLOCK RELEASE	14-335180	BREWSTER	2
I	FAIRLEAD, *(STA. 32 1/2 & 48)* DOWNLOCK RELEASE CABLE	20-33559	BREWSTER	4
J	FAIRLEAD, *(STA. 42)* DOWNLOCK RELEASE CABLE	20-33563	BREWSTER	2
K	FAIRLEAD, *(STA. 59)* DOWNLOCK RELEASE CABLE	20-33562	BREWSTER	2
L	FAIRLEAD, *(STA. 70)* DOWNLOCK RELEASE CABLE	20-33558	BREWSTER	2
M	HANDLE, EMERGENCY DOWNLOCK	14-335181	BREWSTER	2
N	LEVER, DOWNLOCK RELEASE	20-53160	BREWSTER	1
O	MICROSWITCH	BZE-RQ6N-1	MICROSWITCH CORP.	2
P	TRANSMITTER, *(RIGHT HAND)*, UNDERCARRIAGE POSITION INDICATOR	6613-1A-A	PIONEER INSTRUMENT CO.	1
Q	TRANSMITTER, *(LEFT HAND)*, UNDERCARRIAGE POSITION INDICATOR *(NOT SHOWN)*	6613-1A-A	PIONEER INSTRUMENT CO.	1

NOTE: ALL STATIONS NOTED ARE WING STATIONS.



DETAIL OF DOWNLOCK ASSEMBLY
20-33505

UNDERCARRIAGE DOWN-LOCK DIAGRAM - FIG. 4-42

FLYING CONTROLS

383 GENERAL: The primary flight control system comprises a set of ailerons, a set of elevators and a rudder controlled by a "stick" and rudder pedals. A dual set of controls are included. The primary flight controls are fitted with combination servo and trim tabs which are adjustable for trim only from the pilot's cockpit. Landing flaps and dive brake flaps attached to the wing trailing edge are operated hydraulically by remote controls located in the pilot's cockpit.

Description

384 All primary flight control structures are fabricated from formed aluminium alloy sheet covered with fabric. The frame structure is composed of a single beam to which is attached the leading edge nose cover skin to form a torsion box. Trailing edge ribs aft of the single beam provide the form for the fabric cover. Vents are provided in the underside of the fabric cover. These controls are all statically and dynamically balanced by lead weights installed in the leading edge under the nose cover skin. Three hinge supports are provided for each control surface. All hinge bearings are of the dust-sealed pre-lubricated type. Access doors are provided for each hinge.

385 AILERONS: The ailerons are symmetrical with one another but are not interchangeable. They are attached to the wing trailing edge and extend from wing station 176 to 270. The total aileron area is 37.56 square feet. A differential movement of 16 degrees up and 12 degrees down is provided. The control system includes a mechanical interconnection between the port and starboard wing ailerons.

386 ELEVATORS: The elevators are symmetrical with one another but are not interchangeable. They are attached to the aft end of the stabilizers and each elevator has an area of 21.1 square feet. The elevators may be controlled through a movement of 30 degrees up and 20 degrees down. The elevators are attached to the same torque tube to ensure equal movement.

387 RUDDER: The rudder is attached to the aft end of the vertical fin and has a total area of 16.4 square feet. The rudder has a movement of 30 degrees to either side.

388 AILERON CONTROL SYSTEM: The aileron control movement is obtained by a sidewise movement of the "stick" in either the pilot's or gunner's cockpit. The two control sticks are connected by cables to the aileron control spider assembly located on the aft face of the wing centre section rear beam at fuselage station 78⅙. The cable systems connecting the pilot's and gunner's control sticks to the spider assembly are independent of each other. A set of six push-pull rods transmits motion from the spider assembly to each aileron. The push-pull rods are interconnected by idlers at wing stations (port and starboard) 40, 80, 120, 140 and a bell-crank at station 184. The differential in up and down movement of the aileron is obtained by the bell-crank located at wing station 184. All movable connections in the aileron control system are fitted with sealed pre-lubricated ball bearings. (See fig. 4-43.)

389 ELEVATOR CONTROL SYSTEM: The elevator control movement is obtained by a fore and aft motion of either control stick, the motion of the stick being transmitted to torque tubes. Mechanical interconnection of the two sticks is obtained by two push-pull rods and an idler torque tube which is located at fuselage station 78⅙. An arm on the gunner's control stick torque tube is attached to the first of a series of four push-pull tubes which attach to an arm on the torque tube to which the elevators are attached. The push-pull tubes are interconnected by idler levers located at fuselage stations 162½, 230 and 273. All movable connections in the elevator control system are fitted with sealed pre-lubricated ball bearings. (See fig. 4-43.)

390 RUDDER CONTROL SYSTEM: The rudder movement is obtained by moving the rudder pedals in either the pilot's or gunner's cockpit. The rudder pedals in the pilot's cockpit are provided with five adjustments in length. The adjustments are obtained by operating a small lever on the outboard side of each rudder pedal which disengages a spring loaded pin. The pedals are spring loaded to move to this shortest position. A check cable holds the pilot's rudder pedals tight against the balance of the rudder control system. The rudder pedals of the two cockpits are interconnected by cables. Cables attached to the gunner's rudder pedals are routed aft through eight pulleys to lever arms on the rudder torque tube. (See fig. 4-44.)

391 TRIMMING TAB CONTROL SYSTEM: The servo tabs on all control surfaces with the exception of the starboard aileron are controllable for trim balance from the pilot's cockpit. The servo tab on the starboard aileron functions only to self-energize the aileron motion; decreasing the force required to operate the controls. The servo tabs are fabricated from aluminium alloy sheet. The tabs are attached to the respective controls with three hinges which use bolts for hinge pins. (See fig. 4-45.)

392 The tab actuating mechanisms which are mounted forward of the hinge line for the respective controls are provided with two adjustments. The adjustment which determines the ratio of servo action relative to control surface displacement consists of a mounting support with two long threaded bolts in which the actuating mechanism is bedded; the position of the actuating mechanisms may be varied with relation to the centreline of the respective control. The variation of position of the mechanism changes one leg of a parallelogram which thereafter will affect the position of the opposite leg with displacement of the control surface. The second adjustment of the actuating mechanism is controlled from the pilot's

cockpit and affects, primarily, the trim of the airplane. This adjustment varies the length of a push-pull rod to which the tabs are connected. A universal joint is used to provide for hinging of the push-pull rod with displacement of the control rod.

393 The actuating mechanism controls are located on the port side of the pilot's cockpit. Controls for aileron, elevator and rudder servo tabs are all mounted on the same housing. Separate knobs and wheels are provided for each set of tabs. The control knobs are all provided with marked scales to indirectly indicate the position of respective tabs. Motion of the control knobs is transmitted by sprockets and chains to cables. These cables are wound over a drum on the respective control actuating mechanisms.

394 FLAPS: The landing and diving brake flaps (see figs. 4-46, 4-47) are comprised of six sections of trailing edge flaps which extend inboard from the ailerons to the fuselage. The lower trailing edge flaps are employed as landing and diving brake flaps while the upper trailing edge flaps function only as diving brakes. The flaps are similar to one another in shape and are fabricated of aluminium alloy sheet. The covering is perforated to avoid tail buffeting when the flaps are being used.

395 The flaps are actuated hydraulically with the actuation of the diving brake flaps being secondary; a separate mechanism affords the engagement with the landing flaps. (See paragraph 316.)

Operation

396 The operation of primary and secondary flight controls in the Bermuda are conventional. The operation of the landing and diving brake flaps are described in the hydraulic section of this hand book.

Servicing and Maintenance

397 Service information on the hydraulic units of the flight control system is discussed in the hydraulics section.

398 Daily inspection shall be made of all exposed parts of the flight controls.

399 Preflight inspection shall be made on all fabric covered surfaces. The operation of all primary and secondary flight controls shall be conducted prior to every flight; during this inspection all tab controls shall be operated through their range and reset to zero on the indicating scale of the respective controls.

400 At each sixty hour period the following shall be inspected or checked for tightness, security and wear.

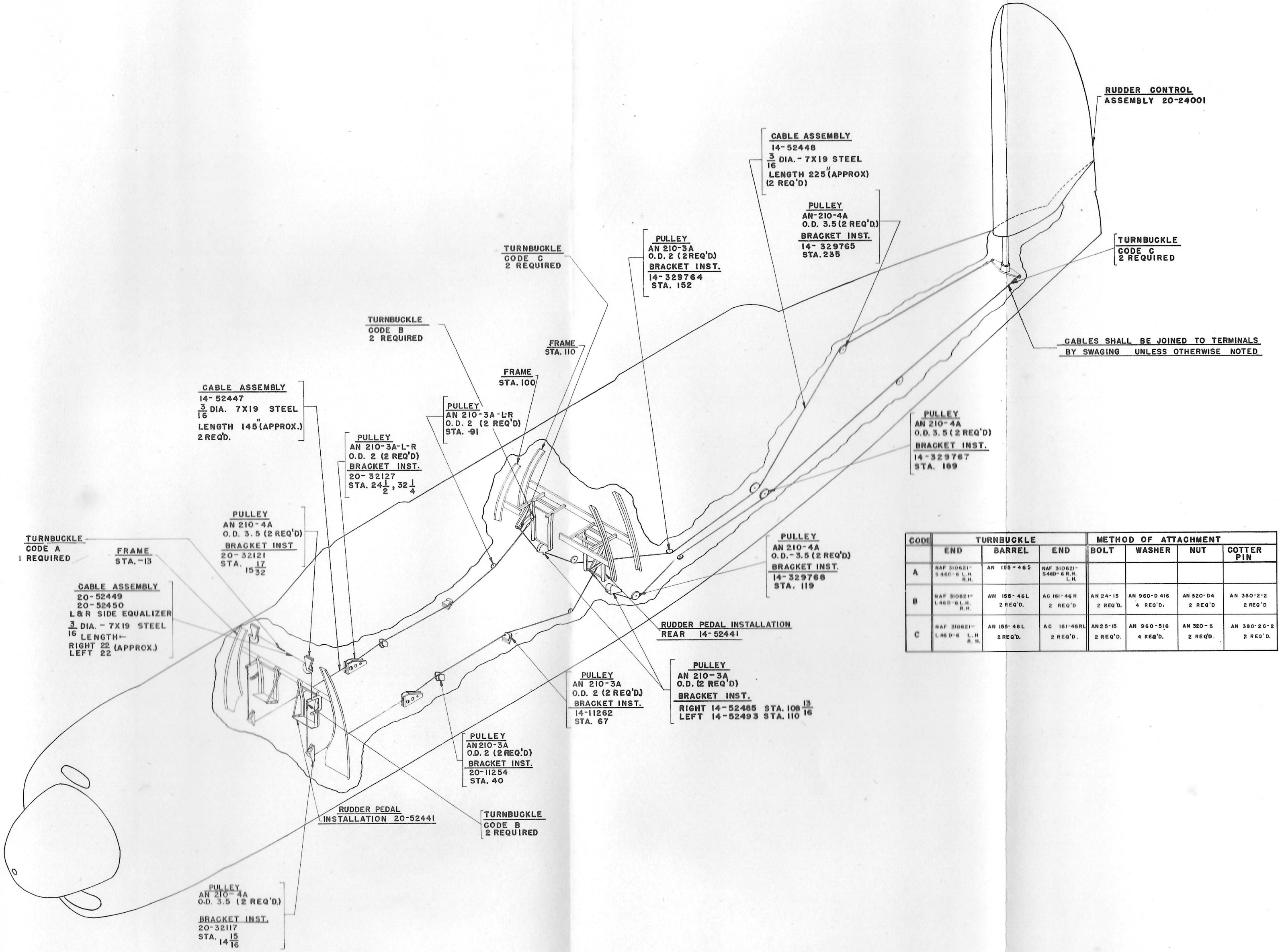
All control surfaces and attachments.
All control system connections.
All control operating mechanism.

401 Bearings used in the control system are of the dust-sealed pre-lubricated type which must be replaced in the case of damage. Avoid excessive use of grease solvents in cleaning, do not immerse the bearings.

402 Cables should be coated and wiped dry with corrosion-resistant lubricant. Chains and screw thread connections should be lubricated with a good quality of graphite base grease, wiping excessive deposits off the parts. Servo tab and landing flap hinges shall be lubricated with a light grade of oil. Apply sufficient oil to ensure complete penetration of the hinges and then wipe the exterior dry.

403 Cable tensions for the aileron dual control and the rudder pedal interconnection shall be checked in the bomb bay compartment. The tensions shall be adjusted as follows:

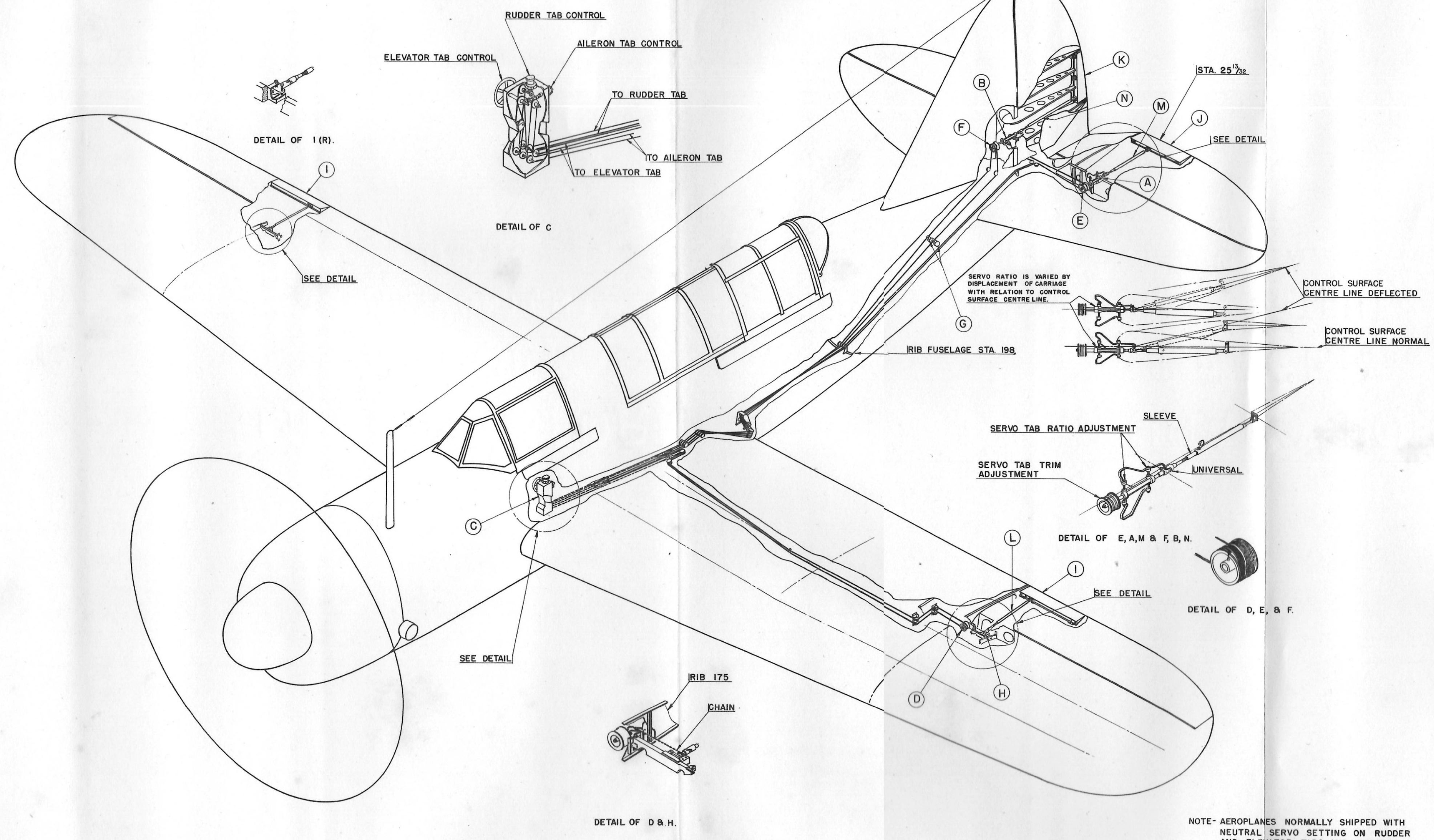
Rudder cables, 70 pounds.
Aileron cable, 95 pounds.
Tab cables, 25 pounds.



CODE	TURNBUCKLE			METHOD OF ATTACHMENT			
	END	BARREL	END	BOLT	WASHER	NUT	COTTER PIN
A	NAF 310621-S46D-6 L.H. R.H.	AN 155-46S	NAF 310621-S46D-6 R.H. L.H.				
B	NAF 310621-L46D-6 L.H. R.H.	AN 155-46L 2 REQ'D.	AC 161-46R 2 REQ'D	AN 24-15 2 REQ'D.	AN 960-D416 4 REQ'D.	AN 320-D4 2 REQ'D	AN 380-2-2 2 REQ'D
C	NAF 310621-L46D-6 L.H. R.H.	AN 155-46L 2 REQ'D.	AC 161-46RL 2 REQ'D.	AN 25-15 2 REQ'D.	AN 960-516 4 REQ'D.	AN 320-5 2 REQ'D.	AN 380-2C-2 2 REQ'D.

A.SCHWENK 10-29-41

RUDDER CONTROL DIAGRAM - FIG. 4-44



SYMBOL	NAME OF PART	B.A.C. PART NO.	NO. REQ'D.
A	CARRIAGE ASSEMBLY, ELEVATOR TAB CONTROL.	14-52575	2
B	CARRIAGE ASSEMBLY, RUDDER TAB CONTROL.	14-52574	1
C	CONTROL UNIT, TAB.	20-52504	1
D	DRUM, AILERON TAB CONTROL.	20-52571	1
E	DRUM, ELEVATOR TAB CONTROL.	20-52572-2	2
F	DRUM, RUDDER TAB CONTROL.	20-52572-1	1
G	FAIRLEAD. RUDDER TAB CONTROL CABLE.	20-52669	2
H	SPROCKET, AILERON TAB CONTROL.	20-52550	1
I	TAB, AILERON CONTROL.	20-13406	1L & 1R
J	TAB, ELEVATOR CONTROL	14-22009 L	1L & 1R
K	TAB, RUDDER CONTROL.	14-24007	1
L	TUBE ASSEMBLY, AILERON TAB CONTROL.	20-52554	2
M	TUBE ASSEMBLY, ELEVATOR TAB CONTROL.	20-52533	2
N	TUBE ASSEMBLY, RUDDER TAB CONTROL.	20-52532	1

TAB-STOP-DIAL ADJUSTMENTS

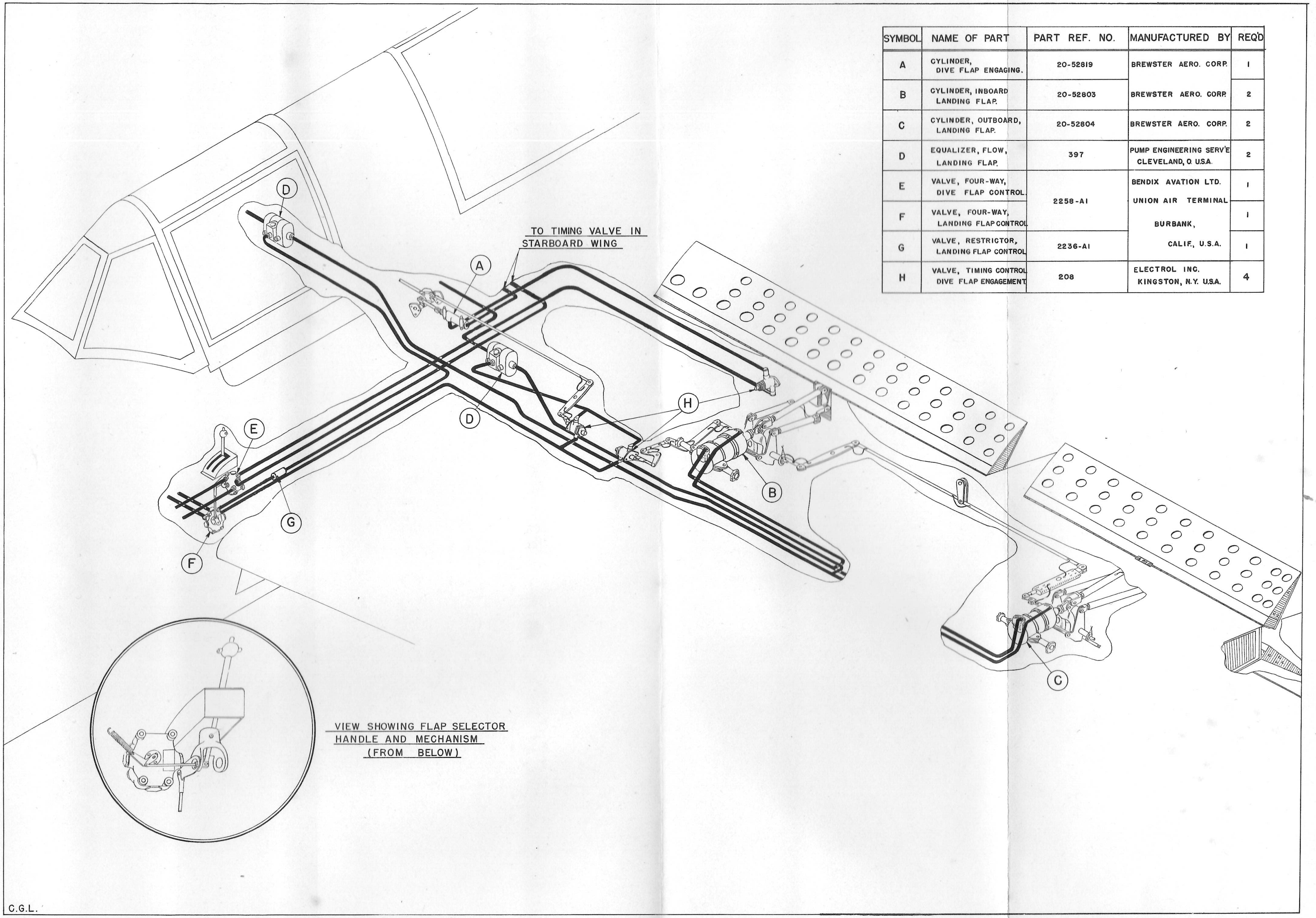
	DIAL SETTING	STOP LOCATION	TAB POSITION
ELEVATOR			
EXTREME NOSE DOWN POSITION	TURN CLOCKWISE TO 3.5	AGAINST 20-329815 STA. 89	8° ABOVE STABILIZER & ELEVATOR CHORD LINE.
NEUTRAL	AT 0.	———	ALONG CHORD LINE
EXTREME NOSE UP POSITION	TURN COUNTERCLOCKWISE TO. 6.5	AGAINST 20-329815 STA. 89	17° BELOW STABILIZER & ELEVATOR CHORD LINE
RUDDER			
EXTREME NOSE RIGHT POSITION	TURN CLOCKWISE TO 5.5	AGAINST 20-329815 STA. 89	8° TO LEFT OF FIN & RUDDER CHORD LINE
NEUTRAL	AT 0	———	ALONG CHORD LINE
EXTREME NOSE LEFT POSITION	TURN COUNTERCLOCKWISE TO 5.5	AGAINST 20-329815 STA. 89	8° TO RIGHT OF FIN & RUDDER CHORD LINE
AILERON			
EXTREME RIGHT WING DOWN POS	TURN CLOCKWISE TO 5.5	AGAINST 20-52671 STA. 89	8° ABOVE CHORD LINE
NEUTRAL	AT 0	———	ALONG CHORD LINE
EXTREME LEFT WING DOWN POS	TURN COUNTERCLOCKWISE TO 5.5	AGAINST 20-52671 STA. 89	8° BELOW CHORD LINE

NOTE- AEROPLANES NORMALLY SHIPPED WITH NEUTRAL SERVO SETTING ON RUDDER AND ELEVATOR TABS, AND MAXIMUM SERVO SETTING ON AILERON TAB.

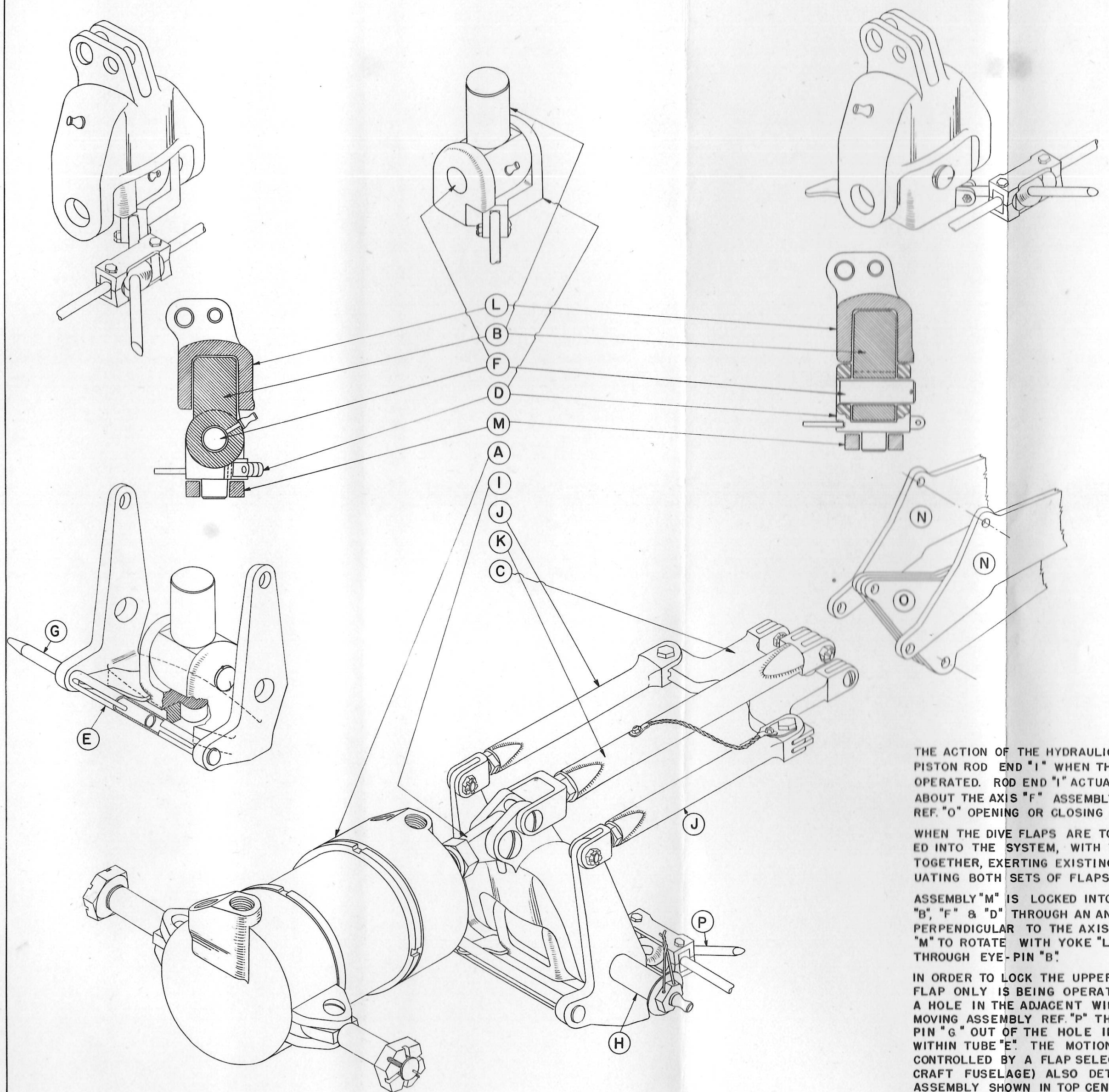
W. TITUS

TAB CONTROL DIAGRAM - FIG. 4-45

SYMBOL	NAME OF PART	PART REF. NO.	MANUFACTURED BY	REQ'D
A	CYLINDER, DIVE FLAP ENGAGING.	20-52819	BREWSTER AERO. CORP.	1
B	CYLINDER, INBOARD LANDING FLAP.	20-52803	BREWSTER AERO. CORP.	2
C	CYLINDER, OUTBOARD, LANDING FLAP.	20-52804	BREWSTER AERO. CORP.	2
D	EQUALIZER, FLOW, LANDING FLAP.	397	PUMP ENGINEERING SERV'E CLEVELAND, O. U.S.A.	2
E	VALVE, FOUR-WAY, DIVE FLAP CONTROL.	2258-AI	BENDIX AVATION LTD. UNION AIR TERMINAL BURBANK, CALIF., U.S.A.	1
F	VALVE, FOUR-WAY, LANDING FLAP CONTROL			1
G	VALVE, RESTRICTOR, LANDING FLAP CONTROL	2236-AI		1
H	VALVE, TIMING CONTROL DIVE FLAP ENGAGEMENT	208	ELECTROL INC. KINGSTON, N.Y. U.S.A.	4



FLAP INSTALLATION - FIG. 4-46



SYM	NAME OF PART.	B.A.C. PART NO.		NO. REQ'D.
		INBOARD	OUTBOARD	
A	CYLINDER ASSEMBLY, FLAP CONTROL.	20-52803	20-52804	2 2
B	EYE PIN, BOLT ASSEMBLY.	20-52811		4
C	FORK, ROD ASSEMBLY DIVING FLAPS.	20-52827		4
D	FORK, YOKE BOLT SUPPORT	20-52809		2L 2R
E	HOUSING ASSEMBLY, PIN LOCK. F.C. WELD.	20-52835		4
F	PIN, EYEBOLT CLEVIS.	20-52854		4
G	PIN, LOCKING FLAP CONTROL.	20-52832		4
H	PIN ASSEMBLY, FLAP CONTROL	20-528111	20-528111 20-528111-1	6 2
I	ROD, CYLINDER ASSEM.	286858 REF. 20-52803	286878 REF. 20-52804	2 2
J	ROD ASSEMBLY, DIVING FLAPS.	20-52831	20-52869	4 4
K	ROD ASSEMBLY, LANDING FLAPS.	20-52820	20-52873	2 2
L	YOKE, CENTRAL. FLAP CONTROL.	20-52807		4
M	YOKE ASSEMBLY, MAIN SUPPORTING.	20-52805		4

THE ACTION OF THE HYDRAULIC CYLINDER "A" TAKES EFFECT ON THE PISTON ROD END "I" WHEN THE LANDING FLAPS ONLY ARE BEING OPERATED. ROD END "I" ACTUATES ASSEMBLY "K", ROTATING YOKE "L" ABOUT THE AXIS "F" ASSEMBLY "K" EXERTS A FORCE ON LEVER ARM REF. "O" OPENING OR CLOSING THE LANDING (LOWER) FLAP.

WHEN THE DIVE FLAPS ARE TO BE ACTUATED ASSEMBLY "M" IS LOCKED INTO THE SYSTEM, WITH THE RESULT THAT "K" AND "J" OPERATE TOGETHER, EXERTING EXISTING FORCES ON "N" AND "O" AND THUS ACTUATING BOTH SETS OF FLAPS.

ASSEMBLY "M" IS LOCKED INTO THE SYSTEM BY ROTATING ITEMS "B", "F" & "D" THROUGH AN ANGLE OF 90°. THIS PLACES PIN "F" PERPENDICULAR TO THE AXIS OF ROTATION "G" AND CAUSES YOKE "M" TO ROTATE WITH YOKE "L", THE MOTION BEING TRANSLATED THROUGH EYE-PIN "B".

IN ORDER TO LOCK THE UPPER FLAP CLOSED WHEN THE LANDING FLAP ONLY IS BEING OPERATED THE PIN "G" IS MADE TO ENGAGE A HOLE IN THE ADJACENT WING RIB. THE PIN IS UNLOCKED BY MOVING ASSEMBLY REF. "P" THROUGH 90° ANGLE. THIS SLIDES PIN "G" OUT OF THE HOLE IN THE RIB AND PARTIALLY HOUSES "G" WITHIN TUBE "E". THE MOTION OF ASSEMBLY "P" (REF.) (WHICH IS CONTROLLED BY A FLAP SELECTOR CYLINDER MOUNTED IN THE AIRCRAFT FUSELAGE) ALSO DETERMINES THE POSITION OF THE ASSEMBLY SHOWN IN TOP CENTRE OF SHEET, AND AS STATED, DETERMINES WHETHER THE LOWER FLAPS ONLY, OR THE LOWER AND UPPER FLAPS ARE ACTUATED.

REF. B.A.C. DRAWING 14-52801.

C.G.L.

FLAP ACTUATING MECHANISM - FIG. 4-47

Section V—Weight Data and Military Equipment

Figure Index

SECTION V

Weight Data and Military Equipment

C.G. LOCATION

1 The location of the centre of gravity of the Bermuda aeroplane may be determined in two ways, by the Loading and C.G. Diagram or by the Index Numbers Chart.

2 *Loading and C.G. Diagram.* The Loading and C.G. Diagram is shown on fig. 5-1. The weights, lever arms from an arbitrary axis of reference and the moments are given for every removable item of military load. The addition or removal of any of these items changes the centre of gravity location and the new location may be determined by computation. The axis of reference is taken at a point 150 inches forward of fuselage station 0. Station 0 is the intersection of the leading edge of the wing with the centreline of the fuselage.

3 *Index Numbers Chart.* The Index Numbers Chart is shown on fig. 5-2. The centre of gravity may be located by obtaining the intersection of the weight line and the index line. The centre of gravity location, in percent of the mean aerodynamic chord, is directly given by the diagonal line.

4 An example of the use of this chart would be as follows: Determine the total gross weight and the total index from the tables given later in this section, viz.—

	Weight	*Index Unit*
Weight Empty	9,697.0	16,956
Pilot	200.0	341
Gunner	200.0	574
Fuel (Wing Tanks 144.8 Imp. Gal.)	1,044.0	2,067
Oil (10.0 Imp. Gal.)	90.0	108
Armament		
Fuselage Guns (Total)	149.0	160
Wing Guns (Total)	267.5	580
Flexible Guns (Total)	179.0	572
Bomb Installation	1,111.5	2,192
Pyrotechnics	156.0	466
Communicating		
Type TA-12D & RA-10FB (Total)	159.0	398
Type R3003 (Total)	38.0	84
Navigating (Total)	7.0	19
Miscellaneous (Total)	67.0	109
	13,365.0	24,626

5 From the chart the centre of gravity is at 28.8% M.A.C. If it is desired to add 80.8 (Imperial gallons) of fuel by utilizing the fuselage fuel tank, obtain the weight and index unit of the fuel and oil to be added.

Fuel—(80.8 Imp. Gal.)	582.0	1,263
Oil—(4.2 Imp. Gal.)	127.5	153
	709.5	1,416

Add the total weight and index unit to the figure determined above:

	13,365.0	24,626
	709.5	1,416
Total	14,074.5	26,042

From the chart the centre of gravity for this loading is 29.5% M.A.C.

> NOTE: The index unit for any fuel load may be calculated from the small chart included in the left upper corner of the Index Numbers Chart.

Weight and Index Units

Item	*Weight* *Item*	*Weight* *Total*	*Index Unit* *Item*	*Index Unit* *Total*
Weight Empty (Including Armour & Protected Fuel Tanks)		9697.0		16,956
Normal Bomber Useful Load				
PILOT		200.0		341
GUNNER		200.0		574
FUEL (WING TANKS) (144.8 IMP. GAL.)		1044.0		2067
OIL (10.0 IMP. GAL.)		90.0		108
ARMAMENT				
Fuselage Guns (Total)		149.0		160
2—.30 Cal. Guns, MG 40-2 (M-2)	44.0		47.2	
2—Trigger Motors, Type E-3	1.9		2.2	
2—Impulse Generator Units, Type E-4	4.0		3.6	
2—Solenoids, D-Z-100	7.7		7.0	
2—Impulse Cable Assemblies	2.0		2.0	
2—Front Trunnion Bolt Assemblies	2.4		2.5	
2—Rear Mounting Post Assemblies	2.8		3.2	

Item	*Weight* *Item*	*Weight* *Total*	*Index Unit* *Item*	*Index Unit* *Total*
Weight Empty (Including Armour & Protected Fuel Tanks)		9697.0		16,956
Normal Bomber Useful Load				
ARMAMENT				
1200 Rds. .30 Cal. Ammo. & Links	79.5		85.5	
1—Trigger Switch, Type NA-2	.7		1.2	
1—Reflector Gun Sight, Type N2A	3.0		4.4	
1—Ring & Bead Sight	1.0		1.2	
Wing Guns (Total)		267.5		580
4—.30 Cal. Guns, MG 40-2 (M-2)	88.1		190.2	
4—Solenoids, Type G-9	10.0		22.2	
4—Front Trunnion Bolt Assemblies	4.8		10.1	
4—Rear Mounting Post Assemblies	5.6		12.5	
2400 Rds. .30 Cal. Ammo. and Links	159.0		345.0	
Flexible Guns (Total)		179.0		572
2—.30 Cal. Guns, MG 40-2 (M-2)	44.0		138.2	
1—Bell Twin Adaptor, GM 749-800	30.5		97.0	
2—Bell Ammunition Feeds, GM 749-540	4.2		13.3	
1500 Rds. .30 Cal. Ammo. and Links	99.5		321.0	
1—Ring & Bead Sight	.8		2.5	
Bomb Installation		1111.5		2192
2—Fuselage Bomb Carriers	13.3		26.6	
2 Sets—Displacing Gear	90.4		129.9	
2 Sets—Bomb Chocks	4.6		9.2	
4—Fusing Units, Type B	1.9		3.9	
2—Box Adapters, Type A	1.3		2.4	
2—Bombs (500 Lb.)	1000.0		2020.0	
Pyrotechnics		156.0		466
1—Signal Pistol, No. 2 MK I	3.2		9.6	
12 Rds. Signal Cartridges 1½″	2.8		8.5	
6—Reconnaissance Flares, 4.5″ Mk. III or Mk. V	150.0		447.9	
EQUIPMENT				
Communicating (Type TA-12D and RA-10FB) (Total)		159.0		398
Transmitter, C/W Shock Mount, Type TA-12D	35.5		91.1	
Dynamotor C/W Shock Mount, Type MP-28B	26.0		63.4	
Antenna Reel, C/W 200 Ft. Wire & Weight, Type MT-5E	6.5		17.6	
Strain Insulators (2) Type MT-48A	.5		1.3	
Antenna Fairlead, A.L. 4639	1.1		3.1	
Antenna Switch and Box, 3939	3.6		9.2	
Receiver C/W Shock Mount, Type RA-10FB	32.0		78.1	
Remote Control, Type MR-9F	2.1		5.4	
Loop Antenna, Type MN20C	4.9		12.0	
Loop Antenna Transmission Line	.6		1.5	
Intercommunicating Amplifier Model 3611	9.5		24.2	
Mechanical Cable, 17½″ Length	.2		.5	
Mechanical Cable, 24¾″ Length	.3		.8	
Control Unit, Type MN-52B	.9		2.3	
Radio Operators Control Box, 3616	3.9		10.1	
Radio Operators Interphone Box, 3615	.8		2.3	
Pilot's Station Interphone Box, 3612	1.5		2.5	
Junction Box, Bendix Type 3503	4.0		10.6	
Telegraph Keys C/W Cord & Plug, Type MT-11B	.9		1.9	
Antenna and Lead-In	.8		2.1	
Connecting Cables	23.4		58.0	
Communicating (Model R3003) (Total)		38.0		84
Receiver Type R3003	25.8		52.6	

Item	*Weight* *Item*	*Weight* *Total*	*Index Unit* *Item*	*Index Unit* *Total*
Weight Empty (Including Armour & Protected Fuel Tanks)		9697.0		16,956
EQUIPMENT				
Control Unit, Type 18	3.7		9.6	
Receiver Mounting, Type 39	2.0		4.1	
Control Unit Mounting, Type 40	.3		.8	
Plug, Type 48, 3-Point	....		....	
Plugs (2), Type 172, 5-Point	.1		.2	
Plug, Type 174, 7-Point	.1		.2	
Sockets (2), Type 199	.6		1.4	
Socket, Type 105	.1		.3	
Socket (2), Type 107	.2		.5	
Socket, Type 108	.1		.3	
Socket, Type 185	.1		.3	
F.E. Crash Switch—Inertia	1.3		3.3	
Switch Box	.3		.5	
Connecting Cables	1.8		4.9	
R3003 Antenna	1.5		5.0	
Navigating (Total)		7.0		19
Chart Board, Type B., Mk. II	4.2		13.3	
Dalton Navigational Computor, Model G	2.2		4.2	
Mathematical Dividers	.2		.6	
Writing Pads (2)	.4		.9	
Miscellaneous (Total)		67.0		109
Balloon Barrage Wire Cutter Equipment	60.0		93.0	
Vacuum Flasks (2)	7.0		16.0	
Total Normal Bomber Useful Load		3668.0		7670

Overload Bomber Useful Load

Normal Bomber Useful Load	3668.0	7670
Plus Fuel (80.8 Imp. Gal. in Fuselage Tank)	582.0	1263
Plus Oil (4.2 Imp. Gal.)	127.5	153
Total Overload Bomber Useful Load	4377.5	9086

Other Useful Load Items

Desert Equipment	55.5	121.0
F. 24 Camera	40.0	124.0
2 Bomb Carriers and Box Adapters—Wing	28.5	55.0
2 Bombs (250 Lb.) Wing	500.0	958.0
2 Bombs (250 Lb.) Fuselage	500.0	1010.0
Fuel per Imp. Gal. (Droppable Tank—125.7 Imp. Gal.)	7.2	14.7
Droppable Fuel Tank	80.0	164.0
Oil per Imp. Gal.	9.1	10.9

Special Equipment Items
(Not Included in Weight Empty of 9697 Lb.)

Control Locking Mechanism	5.0	13
Hoisting Sling	8.0	13
Astro Compass	2.2	6
Standard for Astro Compass	.6	2
Adaptor for Astro Compass	.3	1
Drift Recorder	3.4	11
Bomb Hoisting Mechanism	21.7	38

NOTE: The index unit for any special equipment item may be calculated as indicated below. The effect on aeroplane balance is accounted for by including the weight and index unit in the respective totals of weight and index units. When weight is removed the weight and index units are subtracted from the totals.

$$\text{Index Unit} = \frac{\text{Weight in Pounds} \times \text{Lever Arm}}{100}$$

The lever arm is the distance that the weight is located aft of a line 150 inches forward of the leading edge of the wing at the fuselage centreline. For example, the index unit for a 20 pound weight located in the gunner's seat is

$$\frac{20 \times 287}{100} = 57.4$$

NOTE: The C.G. datum plate is located 10 inches forward of station O.

WEIGHT AND BALANCE

6 The gross weight and centre of gravity location for all the specified load conditions are tabulated on the loading and C.G. diagram. The allowable range of the centre of gravity and the length and location of the main aerodynamic chord will be found on this diagram.

7 Items that must be ballasted for when not carried are as follows:

Fuselage guns
Wing guns
Flexible guns
Bomb installation
Reconnaissance flares
Camera
Balloon barrage cutting equipment

8 If any heavy radio items are omitted, a calculation should be made of their effect on the C.G. location.

ARMAMENT—GUNS

Guns—General

9 The gun armament consists of the following:

(i) Two fixed synchronized .30 M.G. 40-2 (M-2) guns, mounted one on each side of the fuselage.

(ii) Four fixed, .30 M.G. 40-2 (M-2) wing guns. One is mounted in each outer plane near the root and one is mounted in the centre section near each outboard end.

(iii) Two flexible, .30 M.G. 40-2 (M-2) guns mounted on a Bell twin-gun adaptor (serial GM-19H) in the rear cockpit.

Fixed Gun Adjustment

10 The fixed guns are adjustable in plan view for fire-line convergence between 150 and 400 yards ahead. In side view, the inboard wing guns are set by specification to fire parallel to the line of flight with the aeroplane in the maximum velocity attitude at critical altitude. The outboard wings and the fuselage guns are set to converge on the fire line of the inboard wing gun.

Fuselage Guns Installation (see fig. 5-3)

11 The installation of the two .30 machine guns located in the fuselage forward of the fireproof bulkhead (one on the upper port side and one on the upper starboard side) consists of fore and aft mounting post assemblies facilitating quick removal to which the gun trunnions are bolted. Graduations on the aft post index the vertical adjustments while transversal adjustments may be made on the bolt on the aft gun trunnion. One mil is equal to a vertical distance of .001 inch per inch of boresighting distance. In other words, if the guns are being sighted in to converge on a target 150 yards distant, one mil change on the aft mounting post would change the elevation of the gun 150 × 36 × .001 inches, or 5.4 inches. Each graduation on the aft mounting post equals 5 mils, so a change in gun elevation of one graduation would change the point of impact of the bullet 5 × 5.4 or 27 inches. (See figs. 5-5, 5-6 and 5-7.)

12 *Blast Tubes.* A blast tube is provided for each gun to protect the cowling and accessories within the vicinity of the gun barrel. Essentially the blast tube consists of a spring-loaded tube installed within a fairing tube which terminates at its forward end in the nose cowling. This tube is flanged at its forward end, thus preventing it from moving forward. The gun barrel engages the spring-loaded tube at the tube's aft extremity and forces the tube forward, thereby firmly holding the blast tube in place. A special hook arrangement is located on the outside surface of the forward, larger tube, and is designed to prevent the sliding tube from being pressed its complete travel forward. However, this hook may be pulled aft, thus allowing the spring-loaded tube to be pressed forward far enough to allow for the removal of the entire gun from the aeroplane when necessary for servicing, etc.

13 *Synchronizing Gear.* A gun synchronizer is installed. From the trigger motor of the gun an impulse tube and wire assembly is connected to the impulse generator and solenoid which is actuated by a one lobe cam rotating with the gun synchronizing drive unit, which (in turn) is geared to the magneto drive shaft, integral with the engine.

14 *Ammunition Boxes.* An ammunition box is located directly below each gun, accessible through an access door provided in the side of the fuselage. Each box has a capacity of 600 rounds. A support installation, upon which both ammunition boxes slide, is suspended from the engine mount structure and extends from one side of the fuselage entirely across to the other side. A small access door directly above the ammunition box facilitates rapid loading of the

gun. The inboard, inside bottom of the ammunition box is stenciled "START HERE."

15 *Chutes*. An ejection chute for each gun, supported by brackets from the engine mount structure, provides for the discharge of the spent cases and links through the bottom fuselage skin directly below the gun.

16 *Charging*. Each fuselage gun is mechanically charged by a pull handle located on the inboard side of each instrument side panel. A cable extending forward from each handle is directed over pulleys to the charging pin located on the inboard side of the gun.

Wing Guns Installation (see fig. 5-4)

17 The installation of the four .30 machine guns one located in each outer wing and one on each side of the fuselage in the centre panel, consists of the following:

18 *Mounting Posts*. The front gun trunnion is mounted upon a support assembly affixed to wing stations 110 and 120, for the inboard centre panel gun, and wing stations 124 and 134 for the outboard outer panel gun. The rear trunnions are supported by an assembly bolted to wing stations 110 for the inboard gun and 124 for the outboard gun. The horizontal through bolt located immediately below the gun barrel, fastening the holder assembly to the gun, affords transversal adjustments of the gun, while the inverted trunnion post passing through the inboard end of the holder assembly, is the conventional graduated (in mils) type, for the vertical adjustment of the gun.

19 *Blast Tubes*. The wing gun blast tube assemblies consist of two telescoping tubes; the larger tube is fitted at one end with a smaller spring-loaded tube which is flanged to butt up against the gun barrel when the gun is in place. The tube is slotted at the other end to engage a pin designed to retain the assembly in a fixed position when the gun is in place. To install a blast tube it is necessary to insert the assembly through the gun fire hole provided in the leading edge of the wing, push the tube aft until it engages the gun barrel and continue to push, thus compressing the spring, until the slot in the forward end of the tube can be engaged by the locking pin. The locking pin is engaged by rotating the tube until the pin enters the slot.

20 *Ammunition Boxes*. One ammunition box (capacity 600 rounds) is provided for each gun. The outboard gun is supplied ammunition from the forward ammunition box, which is fitted with an extended feed chute provided to carry the ammunition over the top of the inboard gun to the breech of the gun in the outer panel. Both boxes are easily removable through an access door in the wing upper skin.

21 *Chutes*. The spent cases and links are discharged through the wing lower skin; the links through a chute located on the outboard side of each gun, and the cases through a chute located beneath the gun.

22 *Charging*. The wing gun charging handles are located on the floor of the pilot's cockpit to the left and right of the seat. Cables run outboard from the handle on the left to control the charging pin located on the inboard side of each gun in the port wing. A similar arrangement of cables connected to the handle installed on the starboard side of the cockpit is provided for charging the starboard wing guns.

Gun Firing Switch

23 All forward firing guns are controlled by the press type button switch, fitted upon the top of the pilot's control column, in conjunction with the selectivity toggle switches located on the pilot's main electrical distribution panel. The following switches are provided: one toggle switch for each pair of port wing guns, one toggle for each pair of starboard wing guns, and one switch for the pair of fuselage guns.

Gun Sights

24 An illuminated gun sight is mounted on the centreline of the aeroplane or the main instrument panel. The degree of illumination in the sight may be controlled by a rheostat on the electrical panel. A ring and bead sight assembly is mounted on the starboard side of the fuselage above the engine compartment. Both ring and bead sights are adjustable in a vertical direction by means of screw threads. This affords the pilot an auxiliary sight in case the power supply to the illuminated gun sight fails.

Flexible Gun Installation (see fig. 5-8)

25 The two .30 machine guns installed in the gunner's cockpit are mounted upon a Bell adaptor GM 749-800 (see Bell adaptor manual for mounting details). The guns are fired simultaneously by pushing forward the trigger assembly located at the aft end of the guns. The firing mechanism of each gun is actuated by this trigger assembly which is an integral part of the removable aft portion of the flexible gun assembly and consists of two levers interconnected by a cast trigger extending laterally across the aft end of the guns.

26 *Ammunition Boxes*. Two boxes (capacity 750 rounds each) installed vertically, directly aft and below the flexible gun on each side of the centreline of the fuselage, may be removed by pressing downwards on the spring-loaded locking plunger, located on each side of the fuselage adjacent to the ammunition box, thus releasing the latch arrangement from the outboard side of the box.

27 *Chute*. An ejection chute for the disposal of spent cases and links is installed vertically on the centreline of the aeroplane directly below the gun. A spherically shaped funnel type chute is fitted to the under side of the gun to conduct the cases down to the chute in which the cases pass from the aeroplane

With a bomb installed the sway braces (crutches) are adjusted to firmly engage the upper side surfaces of the bomb by rotating the wheel installed on each sway brace for this purpose, and which is easily accessible from beneath the wing. The wing bomb carrier release mechanism is operated by a solenoid integral with the rack and interconnected with the bomb release switches located on the armament panel. The arming is also accomplished electrically by the fuzing unit which is an integral part of the bomb rack.

Selective Bomb Release

42 The bombs are released selectively by the three-position "Selective Release" switches located on the armament panel. The bomb rack release mechanism is actuated with the respective switch in the up or "Selective Release" position, only after the master toggle switch located on the main electrical distribution panel is in the inboard, "On" position. In addition to the main master switch which controls the entire armament electrical system (Gun and Bombs) is the bomb release master switch located on the armament panel at the lower edge, between the nose and tail fuzing circuit breakers and the bomb release receptacle, for the "Plug-In" of the throttle button bomb switch. This secondary master switch is used in conjunction with the previously discussed "Selective Release" switches. The actual release of the desired bomb is accomplished by depressing the button type switch located on top of the throttle control lever after the secondary master switch and the desired "Selective Release" switch are "On."

Bomb Distributing Release

43 A bomb distributor (Mallory Intervalometer Part No. B-114079) is installed on the inboard side of the armament panel for the consecutive dropping of the entire bomb load. For this operation the "Selective Release" switches are in the down or "Distributor Release" position, thus bringing the intervalometer into the bomb release circuit. With the throttle release button switch depressed, the bombs are released in the following sequence: (i) port wing, (ii) starboard wing, (iii) port fuselage, (iv) starboard fuselage. It is obvious that designated bombs may be retained by the position of the respective "Selective Release" switches (either in neutral or up position) but the sequence will remain unchanged.

Bomb Loading (see fig. 5-10)

44 The two 500 lb. bombs are loaded in the bomb bay by means of a cable and winch arrangement which hoists the bombs into position for attachment to the bomb racks. Each bomb is hoisted by means of two cables which attach to a hoisting sling which passes under the bomb to support it. Each cable runs upward from either side of the bomb sling to an open-sheaved pulley suspended from the bottom of the wing beam in the top of the bomb bay, thence forward to the two box assemblies located on the bottom of the horizontal bulkhead at fuselage station 16¾. In the boxes the cables pass over rollers and directly down through the shafts of the hand-operated hoisting winches where they are secured to the winch drums.

45 On the hoisting winch is a handcrank which operates a 10-to-1 gear assembly which revolves the winch drum. Attached to the gear box is a vertical shaft through which the cable runs from the drum to the fitting on the upper end of the shaft. A ball and socket arrangement between the shaft and the fitting allows limited sway in operation. The fitting will fit loosely into the hole in the bottom of the box on the horizontal bulkhead of the aeroplane, and presses snugly against the face of the box. In operation the hoisting winch is supported chiefly by the tension of the cable, although the operator steadies the winch by means of a handgrip on the bottom of the gear box frame.

46 In operation two hand hoisting winches are used, and two men operate them simultaneously. The cables are drawn from the shafts, threaded over the rollers in the box assemblies, thence aft to their respective inboard and outboard pulleys above one bomb, and down to the fittings on either side of the bomb sling. The hoisting winches are placed in their sockets in the boxes and secured by making the cables taut by operating the winches. By turning the hand cranks the men hoist the bomb into place to engage the bomb lug with the bomb rack latch. When the latch is locked and the bomb secure, the dogs on the winch gear are released, and the cables are slacked off to permit removing the sling from the bomb. The cables are then transferred from the one side to their respective pulleys on the other side of the bomb bay, ready to repeat the process in hoisting the second bomb.

47 Upon completion of the hoisting operations the cables are slipped out of the pulley sheaves, pulled through the box assemblies, wound up on the winch drums, and the winches removed from the aeroplane.

ARMOUR PLATE

(See fig. 5-12)

48 The aeroplane is equipped with armour plate providing protection, for both the front and rear cockpits, from gunfire directed from forward, aft or underneath the aircraft. In addition, the oil tank is protected by plating designed to obstruct gunfire originating forward of the aeroplane and directed diagonally downward from above.

49 *Oil Tank Protection.* The ¼ inch armour plate mounted upon the two upper engine mount cross members directly forward of the oil tank is rigidly supported from the cross trusses by a welded assembly consisting of two vertical brackets each fitted with an attachment plate at the upper end, through which three bolts (3 to each plate) affix the welded assembly to the forward face of the armour plate. This forms approximately a 22° angle be-

tween the bracket and the plate, from which the brackets (one to each side of the aeroplane centreline) extend downward and forward to the forward engine mount cross member. The lower end of each bracket is fitted with a clamp, firmly held in place about the cross member by four bolts. The armour plating extends downward between the port and starboard fuselage machine guns to the upper structure of the engine mount where the lower portion of the plating passes just aft of the second cross member, and to which the plating is clamped at four points of attachment, along the cross truss. The protected area aft of the armour plate is approximately 15 square inches in cross section.

> NOTE: The aft face of the protective plate is painted in yellow roundels.

50 *Front Cockpit Protection.* The installation of armour plate for the protection of the front cockpit from gunfire originating forward of the aeroplane consists of three sections of non-magnetic, ¼ inch plates, vertically installed at, and parallel to, fuselage station 13. The centre section armour plating is attached to the top assembly of frame 13 by four bolts, while the adjacent port and starboard plates are fastened with two Dzus fasteners each. The plates are hinged along the inboard edge to facilitate rapid removal or access to the forward side of the instrument panel.

> NOTE: Access doors are provided in the fuselage skin directly above and forward of the armour plate installation. Piano type hinges along the inboard edges facilitate opening the doors inboard and upward exposing the armour plate installation, etc.

The windscreen assembly also provides protection for the forward cockpit. The front windscreen glass is composed of 1½ inch bullet proof glass, with the side glass being constructed of ⅝ inch shatterproof glass. The front cockpit is further protected from gunfire resulting from an underneath attack, by the installation of a ⅛ inch aluminium alloy sheet extending horizontally between fuselage stations 20¾ to 36, approximately 12 inches below the thrust line.

51 The front cockpit is protected from gunfire originating from the rear of the aeroplane by three sections of armour plate installed directly to the rear of the pilot's seat. The lower section consists of a ¼ inch, homogeneous plate approximately 22 by 30 inches, supported at the lower edge by two forgings, one fastened to each port and starboard seat tube assembly by two bolts. The upper portion of the lower section of armour plate is bolted to two bracket assemblies consisting of a fore and aft bracket; the forward bracket is attached to each port and starboard seat tube assembly by one bolt passing through the bracket and the seat tube, thus also supporting the seat tube assemblies at its upper extremities. The aft bracket is bolted to the forward end of the fuselage seat upper support assembly. Two bolts pass through both the brackets at the junction with the armour plate which is bolted between the brackets, thus attaching the brackets or bracket assembly to the protective plate and in turn supporting the plating. The lower bolt passes through the upper edge of the lower section armour, while the upper bolt passes through the lower edge of the ⅜ inch armour plate which comprises the centre section armour and which is supported at its upper port and starboard corners by a clamp assembly attached to the port and starboard quadrupods. The lower edge of the centre section armour plate is located immediately above water line 24, and the upper edge of the ¼ inch armour plate.

52 The upper section of armour plating is also ⅜ inches in thickness, but differs in that it is of the face hardened type. The 15½ × 27 inch plate is located directly aft of the pilot's head rest and is fixed in place by three clamps spaced equidistantly and vertically along each port and starboard quadrupod, and attached to the port and starboard edges of the armour plate by bolts at each respective place.

53 *Rear Cockpit Protection.* The rear cockpit is protected from gunfire originating aft of the aeroplane by ¼ inch armour plate consisting of two units of homogeneous plating, one approximately 22 × 36 inches, and the other approximately 22 × 29 inches, installed vertically within the fuselage at station 165, and joined by a splice plate at the junction of the inboard edges. The port and starboard edges are attached to the fuselage frame by bolts facilitating rapid removal. A ¼ inch plate, mounted upon the flexible guns (see also paragraph 25), affords additional protection from gunfire during the training and firing of the two rear .30 calibre machine guns. Attachment to the gun is made at three points. An eye bolt is passed through the upper centre of the armour plate to a link assembly bolted to the deflector assembly thus fixing the upper portion of the plate, while the lower portion is bolted to circular brackets, one bracket attached to each bearer tube assembly. The armour plate has a sighting slit approximately 1 × 6 inches in the upper centre.

RADIO COMMUNICATING EQUIPMENT

(SEE FIG. 5-13)

54 *General.* The following are the major items of radio equipment carried by this aircraft:

Transmitter TA-12D (Bendix)
Receiver RA-10FB (Bendix)
Interphone amplifier (Model 3611—Bendix)
Remote controls MR-9B (Bendix)
R3003

A more detailed list is given in the subsequent paragraphs and the lay-out of the equipment is shown in fig. 5-13. Reference should be made to the relevant Bendix operating and instruction manual for complete details of the Bendix radio equipment.

55 *Bendix Radio.* The aeroplane is equipped with the following items of Bendix radio equipment:

(i) TA-12D Transmitter with tubes and shock mounting base assembly, installed facing aft on the lower radio shelf in the gunner's cockpit to the right of the aeroplane centreline.

(ii) MP-28B Dynamotor modulator unit and mounting plate, located directly aft of station 89 on the lower radio shelf on the port side of the aeroplane.

(iii) RA-10FB Receiver and loop relay with tubes and mounting base located directly forward of the TA-12D radio transmitter unit on the lower radio shelf.

(iv) MR-9B Remote control unit is mounted on the upper radio shelf within the fixed canopy, between the azimuth indicator and the radio operator's control box.

(v) AA-15410-1 Mechanical cable-drive unit 24¾ inches in length, interconnecting the receiver with the remote control.

(vi) MN-20C Loop antenna (aerial) installed immediately aft of station 89 on the centreline of the aeroplane on the upper radio shelf forward of the remote control unit and the radio operator's control box.

(vii) AC55966-1 Loop transmission line-cable assembly -R11 extending from the receiver and loop relay (RA-10FB) to the loop antenna (MN-20C). Length of loop must not be altered. Coil any excess and fix in place.

(viii) MN-52B Azimuth indicator, directly connected to the loop antenna and installed on the upper radio shelf to the left of the remote control box.

(ix) AA-15410-1 Mechanical cable-drive unit 17½ inches in length, interconnecting the loop antenna to the azimuth indicator.

(x) MT-5E Antenna reel, equipped with 200 feet wire and weight, and mounted upon a bracket assembly bolted to the port side of the fuselage at station 121.

(xi) MT-48A Antenna strain insulator; 2 required.

(xii) MT-11B Telegraph key, one located on the inboard side of the main electrical distribution panel assembly, just aft of fuselage station 9 and connected to the pilot's station box 3612, and one located on the starboard side of the upper radio shelf within the fixed canopy, directly above the outboard edge of the transmitter unit at station 110.

(xiii) A29500 Copper clad steel antenna wire.

(xiv) 3503 Junction box—box installation 14-65159, located on the starboard side of the gunner's cockpit between fuselage stations 110 and 121. This box also contains Bendix Equipment master switch and R3003 circuit breaker.

(xv) 3611 Interphone amplifier unit with tubes, mounted upon a special shelf suspended by four brackets from the underside of the lower radio shelf on the centreline of the aeroplane, directly below the inboard end of the transmitter unit.

(xvi) 3612 Pilot's interphone station box installed on the starboard side of the pilot's cockpit aft of station 16.

(xvii) 3615 Radio operator's interphone auxiliary position box, located on the port side of the gunner's cockpit forward of station 143 directly above the confidential locker.

(xviii) 3616 Radio operator's interphone control box located on the starboard side of the upper radio shelf, adjacent to the remote control unit.

(xix) 3939 Antenna switch (Box assembly 14-65177) installed on the port side of the lower radio shelf to the left of the receiver control unit.

(xx) AL-4639 Antenna fairlead assembly, bracketed to the port side of the gunner's cockpit and extending diagonally downward and aft from the antenna reel through the fuselage skin just aft of fuselage station 132.

(xxi) Set of electrical interconnecting cables.

56 *R3003 Radio.* Provision is made for the installation of this equipment but the main units are not fitted at the time the aircraft leaves the manufacturer's factory. Before leaving the factory all the necessary attachment cabling and push button controls are installed. The following are further details:

(i) The provision for the R3003 unit is made in the luggage compartment aft of the anti-icer tank and is accessible through the door located in the starboard side of the fixed canopy.

(ii) The R3003 control unit mounting is located to the left of the Bendix transmitter and to the right of the antenna switch control unit.

(iii) The gravity switch location is just above the floor of the rear cockpit on the starboard side.

(iv) The pilot's switchbox control is installed on the starboard side of the cockpit directly aft of the Bendix control box (3612) immediately below the longeron.

(v) The fixed triangular antenna for the R3003 radio equipment is fixed to the leading edge of the port and starboard horizontal stabilizers and the fuselage just aft of the gunner's cockpit. Two ceramic insulators form the attachment point at the fuselage, while no insulators are used at the stabilizer connection.

PARACHUTE FLARE INSTALLATION

(SEE FIG. 5-14)

57 The gunner's cockpit is equipped to discharge parachute flares Mark III or V. Six flares may be carried in racks located on the right-hand side of the cockpit. The flare discharge chute is located in the starboard aft corner of the cockpit. Two operating

handles are provided; one for opening the flare discharge door in the bottom of the fuselage skin, and one for releasing the flare after it is placed in the chute. The propellor on the nose of the flare is safetied in place by means of a pin. The pin is pulled out, after the flare has left the chute, by a cord which is attached to the pin and to a bracket located over the flare chute. An aluminium alloy plate, .065 inch thick, is placed on the exterior of the starboard fuselage side skin for flare protection.

CAMERA INSTALLATION

(SEE FIG. 5-15)

58 A F.24 camera may be mounted in a compartment aft of the gunner's cockpit. It may be directed vertically or at an oblique angle and two apertures are provided in the fuselage skin for this purpose. The camera may be operated from the pilot's cockpit by remote control.

ANTI-ICING SYSTEM

(SEE FIG. 5-16)

59 Anti-icing fluid may be supplied to the carburetor air intake or windscreen by means of controls located in the pilot's cockpit. The anti-icing system consists of:

a.	fluid tank	14–53310	Brewster
b.	filter	7979	Adel
c.	valves (2)	NAF 1076–1	Parker
d.	rheostat	7776–5	Adel
e.	fluid pump	J15–24S4	Adel

60 The main fluid line extends along stringer No. 1 on the port side of the aeroplane from the anti-icing tank which is located directly aft of the pilot's seat, to the fluid pump which is mounted on the forward port side of the fireproof bulkhead.

61 A filter and a main shut-off valve are provided in the main line within the cockpit. Two lines extend from the pump, one to the carburetor air intake duct which subdivides into two channels and enters the duct from two sides; and the other to the windscreen. A rheostat is provided on the port side of the cockpit for controlling the speed of the pump; and a secondary shut-off valve is located near the main instrument panel thus affording a control for the windscreen line.

62 The anti-icing tank is constructed of 52S aluminium alloy and has a capacity of $4^{1}/_{4}$ Imperial gallons. All the anti-icing piping is $^{1}/_{4}$ O.D. × .032 aluminium alloy. A filler neck ($^{13}/_{16}$ I.D.) for the anti-icing tank is provided in the fuselage skin on the port side of the aeroplane and directly aft of the pilot's seat. A suitable fluid for this tank is ethyl alcohol.

NAVIGATING EQUIPMENT

63 Provision is made for installing a Mark II Astro-Compass in the gunner's cockpit. Wedge plates are mounted to both sides of the cockpit forward of the gunner's seat. The compass may be readily changed from one location to the other.

64 Provision is made for the installation of a Mark II Drift Recorder on the left-hand side of the gunner's cockpit near the seat.

65 Provision is made for installing a type B, Mark II chart board in the gunner's cockpit just aft the seat.

66 A map case is located on the lower left-hand side of the gunner's cockpit forward of the antenna reel.

67 A map case is located in the pilot's cockpit, accessible to the pilot.

68 A canvas case for stowage of a Dalton Computor is mounted to the left-hand side of the pilot's cockpit, aft the seat.

69 Mathematical dividers and writing pads may be stowed in the gunner's map case.

MISCELLANEOUS EQUIPMENT

70 Sockets for the installation of balloon barrage cutting equipment are provided.

71 Two hand electric torches may be stowed in the aircraft, one in the pilot's map case and one in the gunner's map case.

72 Stowage for two water tanks (desert equipment) is provided in the luggage compartment. The luggage compartment is located in the canopy between the two cockpits. An access door is provided on the starboard side of the aeroplane.

73 Two vacuum flasks (one pint capacity) may be stowed in the luggage compartment.

74 A hand fire extinguisher (Pyrene Manufacturing Co. number C-21-P) filled with one quart of carbon tetrachloride may be mounted on the right-hand side of the gunner's cockpit forward of the seat.

75 A first aid kit may be placed in the box located on the right-hand side of the pilot's cockpit, aft the seat.

76 Covers for both cockpits, the airscrew and the engine may be stowed in the luggage compartment.

77 Sun blinds are provided in the pilot's cockpit on top of the sliding canopy.

78 A pilot's chart board is mounted under the main instrument panel.

79 A roller shade is provided so that the shade may be pulled aft over the bomb bay window.

80 A mechanically operated message carrier is provided for the transmission of messages between the pilot's and gunner's cockpits. The carrier is located on the port side of the fuselage and runs the length of the fixed canopy. The installation consists of a tube within which a small car runs. When the handle is pulled, the message carrier car is forced to the other end of the tube.

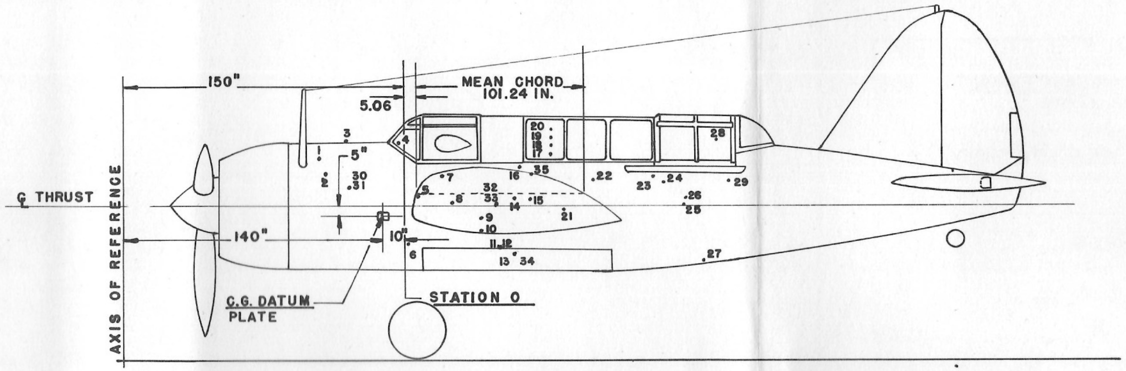
81 *Gunner's Seat Operation.* The gunner's seat may be adjusted vertically by stepping on either foot lever at the base of the seat. The seat will now move down under the weight of the occupant. The seat

may be raised by removing the weight of the occupant. A spring will then raise the seat. A lever on the left hand forward side of the seat releases the seat so that it may swivel. A control on the right hand forward side of the seat releases it so that it may slide fore and aft. The seat may latch into any one of five fore and aft positions.

82 *Gunner's Canopy Operation.* Two crank handles are provided for operating the gunner's sliding canopy and the canopy covering the flexible gun mount. The handles are located on the left-hand side of the gunner's cockpit. The forward handle controls the sliding canopy. When the handle is cranked in a counter-clockwise direction the canopy is forced aft into a closed position. The canopy may be pushed fore or aft by hand if the crank handle is pulled inboard, releasing the crank gear. The same effect may be produced by pushing the button exposed in the port skin of the aeroplane just forward of the gunner's canopy and at the level of the longeron. The aft handle controls the gun canopy. When the handle is cranked in a counter-clockwise direction the canopy is rotated down into a recess in the fuselage. All canopies will move in the direction that the crank is rotated.

83 *Pilot's Canopy Operation.* The pilot's canopy may be cranked forward or back by means of a crank handle located on the right-hand side of the pilot's cockpit above the electrical distribution panel. The handle is cranked clockwise to open the canopy (e.g., slide the canopy aft). The canopy may be slid fore or aft by hand if the crank assembly is unlatched by pulling inboard on the handle. The same effect may be produced from the outside of the aeroplane by pressing the button revealed in the fuselage skin at the lower forward starboard corner of the sliding canopy.

84 *Destruction of Aircraft.* The aeroplane may be destroyed by flooding the bomb bay with fuel and then igniting it with a discharge from the Verey pistol. A drain line from the starboard wing tank leads to the bomb bay near the end of the bomb displacing gear. This drain is normally closed by means of a valve. A soft copper safety wire maintains the valve in this condition. The valve may be opened by means of a handle located on the floor on the right-hand side of the pilot's seat. When the handle is pulled upward enough force is exerted on the valve handle to break the safety wire. A similar drain line and valve is provided for both the port wing tanks and the fuselage tank. In order to operate these two valves, however, the stainless steel safety wire must be cut and the valves opened by hand in the bomb bay. No means of remote control is provided for these two latter valves. When replacing the safety wire on the starboard tank valve, use a copper wire .032 inch in diameter.



ITEM NO.	REMOVABLE ITEMS OF MILITARY LOAD	GENERAL (A) RECONNAISSANCE			BOMBER (B) (1000 LB. BOMBS)			OVERLOAD (C) (1500 LB. BOMBS)			REINFORCING (D) LOAD		
		WEIGHT (LB)	ARM (IN.)	MOMENT (LB.IN.)	WEIGHT (LB.)	ARM (IN.)	MOMENT (LB.IN.)	WEIGHT (LB.)	ARM (IN.)	MOMENT (LB. IN.)	WEIGHT (LB.)	ARM (IN.)	MOMENT (LB.IN.)
1	2-.30 CALIBER FUSELAGE GUNS (AS WEIGHED)	59.0	104.5	6,166	59.0	104.5	6,166	59.0	104.5	6,166	59.0	104.5	6,166
2	1200 ROUNDS OF AMMUNITION (FUSELAGE GUN)	79.5	107.5	8,546	79.5	107.5	8,546	79.5	107.5	8,546	79.5	107.5	8,546
3	RING AND BEAD SIGHT	1.0	118.0	118	1.0	118.0	118	1.0	118.0	118	1.0	118.0	118
4	REFLECTOR GUNSIGHT	3.0	146.0	438	3.0	146.0	438	3.0	146.0	438	3.0	146.0	438
5	BALLOON BARRAGE CABLE CUTTERS	21.0	156.0	3,276	21.0	156.0	3,276	21.0	156.0	3,276	21.0	156.0	3,276
6	BOMB CARRIERS AND ACCESSORIES -FUSELAGE	105.0	152.0	15,960	105.0	152.0	15,960	105.0	152.0	15,960	105.0	152.0	15,960
7	PILOT AND PARACHUTE	200.0	170.5	34,100	200.0	170.5	34,100	200.0	170.5	34,100	200.0	170.5	34,100
8	MACHINE AT TARE WEIGHT-WHEELS UP	9,807.0	175.3	1,719,167	9807.0	175.3	1,719,167	9807.0	175.3	1,719,167	9807.0	175.3	1,719,167
9	2-250 LB. BOMBS - WING							500.0	191.5	95,750			
10	BOMB CARRIERS AND ACCESSORIES-WING							28.5	191.5	5,458	28.5	191.5	5,458
11	2-250 LB. BOMBS- FUSELAGE	500.0	202.0	101,000									
12	2-500 LB.BOMBS- FUSELAGE				1000.0	202.0	202,000	1000.0	202.0	202,000			
13	DROPPABLE FUEL TANK										103.0	204.0	21,012
14	4-.30 CALIBER WING GUNS (AS WEIGHED)	138.5	209.0	28,947	138.5	209.0	28,947	138.5	209.0	28,947	138.5	209.0	28,947
15	2400 ROUNDS OF AMMUNITION (WING GUNS)	159.0	217.0	34,503	159.0	217.0	34,503	159.0	217.0	34,503	159.0	217.0	34,503
16	R 3003 RADIO	29.5	211.0	6,225	29.5	211.0	6,225	29.5	211.0	6,225	29.5	211.0	6,225
17	2 WATER TANKS- FULL										32.0	228.0	7,296
18	2 WATER BOTTLES-FULL										8.0	228.0	1,824
19	2 ORDINARY FLYING RATIONS										12.0	228.0	2,736
20	2 EMERGENCY FLYING RATIONS										3.5	228.0	798
SEE NOTE I 21	MISCELLANEOUS (SUNDRY)	14.5	235.0	3,408	14.5	235.0	3,408	14.5	235.0	3,408	14.5	235.0	3,408
22	W/T TA-12D AND-RA-10FB	68.5	250.5	17,159	68.5	250.5	17,159	68.5	250.5	17,159	68.5	250.5	17,159
SEE NOTE 2 23	NAVIGATIONAL INSTRUMENTS	13.5	282.0	3,807	13.5	282.0	3,807	13.5	282.0	13,807	13.5	282.0	3,807
24	GUNNER AND PARACHUTE	200.0	287.0	57,400	200.0	287.0	57,400	200.0	287.0	57,400	200.0	287.0	57,400
25	SIGNAL PISTOL AND 12 CARTRIDGES	7.5	298.0	2,235	7.5	298.0	2,235	7.5	298.0	2,235	7.5	298.0	2,235
26	6 RECONNAISSANCE FLARES	150.0	298.5	44,775				150.0	298.5	44,775	150.0	298.5	44,775
27	F-24 CAMERA	39.5	309.5	12,225	39.5	309.5	12,225	39.5	309.5	12,225	39.5	309.5	12,225
28	2-.30 CALIBER FLEXIBLE GUNS (AS WEIGHED)	90.0	316.0	28,440	90.0	316.0	28,440	90.0	316.0	28,440	90.0	316.0	28,440
29	1500 ROUNDS OF AMMUNITION (FLEXIBLE GUNS)	99.5	322.5	32,089	99.5	322.5	32,089	99.5	322.5	32,089	99.5	322.5	32,089
	TOTAL WEIGHTS AND MOMENTS OF REMOVABLE ITEMS OF MILITARY LOAD	11,785.5	183.3	2,159,984	12,135.5	182.6	2,216,209	12814.0	184.3	2,362,192	11,472.5	182.9	2,098,108
30	OIL 14.1 IMP. GAL. @ 9.07 LB./GAL.	127.5	120.0	15,300	127.5	120.0	15,300	127.5	120.0	15,300			
31	OIL 18.2 IMP. GAL. @ 9.07 LB./GAL.										165.0	120.0	19,800
32	PETROL PORT WING 72.4 IMP. GAL@ 7.21 LB./GAL.	522.0	198.5	103,617	522.0	198.5	103,617	522.0	198.5	103,617	522.0	198.5	103,617
33	PETROL STARBOARD WING 72.4 IMP. GAL.@ 7.21 LB./GAL.	522.0	198.5	103,617	522.0	198.5	103,617	522.0	198.5	103,617	522.0	198.5	103,617
34	PETROL DROPPABLE TANK 125.7 IMP. GAL.@ 7.21 LB/GAL.										906.0	204.5	185,277
35	PETROL FUSELAGE TANK 80.7 IMP. GAL@ 7.21 LB/GAL.	582.0	217.0	126,294	582.0	217.0	126,294	582.0	217.0	126,294	582.0	217.0	126,294
	TOTAL ALL- UP WEIGHTS AND MOMENTS	13,539.0	185.3	2,508,812	13,889.0	184.7	2,565,037	14567.5	186.1	2,711,020	14,169.5	186.1	2,636,713

NOTE: I. ITEM 21, MISCELLANEOUS (SUNDRY) CONSISTS OF CONTROL LOCKING DEVICE, FIRST AID KIT AND VACUUM FLASKS.

2 ITEM 23, NAVIGATIONAL INSTRUMENTS CONSIST OF CHARTBOARD, DALTON COMPUTOR, MATHEMATICAL DIVIDER, WRITING PADS, ASTRO COMPASS, 0.5 STANDARD ADAPTOR AND DRIFT RECORDER.

A.F.S.

TARE WEIGHT 9816 LB. INCLUDES THE FOLLOWING ITEMS	WEIGHT (LB)
FIXED PART OF FUSELAGE AND WING GUN INSTALLATION	90.0
FIXED PART OF FLEXIBLE GUN INSTALLATION	114.5
FIXED BOMB AND FUSING GEAR	6.5
FIXED EQUIPMENT FOR PYROTECHNICS	21.0
FIXED PART OF BALLOON BARRAGE WIRE CUTTING EQUIP.	39.0
BULLET PROOF GLASS	18.0
PILOTS ARMOUR	104.0
GUNNERS ARMOUR	116.0
PYROTECHNIC ARMOUR	21.7
FUSELAGE FUEL TANK SELF SEALING CELL	78.5
WING TANKS SELF SEALING CELLS	216.0
ELECTRICAL EQUIPMENT	282.0
FIXED PART OF INSTRUMENT EQUIPMENT	40.0
FIXED PART OF RADIO EQUIPMENT	98.5
FIXED PART OF CAMERA EQUIPMENT	0.5

MAXIMUM ALL-UP WEIGHT AT WHICH THIS AIRPLANE HAS BEEN TESTED FOR ALL FORMS OF FLYING. ________
LENGTH OF MEAN CHORD________________ 101.24"
I PERCENT OF LENGTH OF MEAN CHORD ____________ 1.012"

PERMISSIBLE C.G. LIMITS

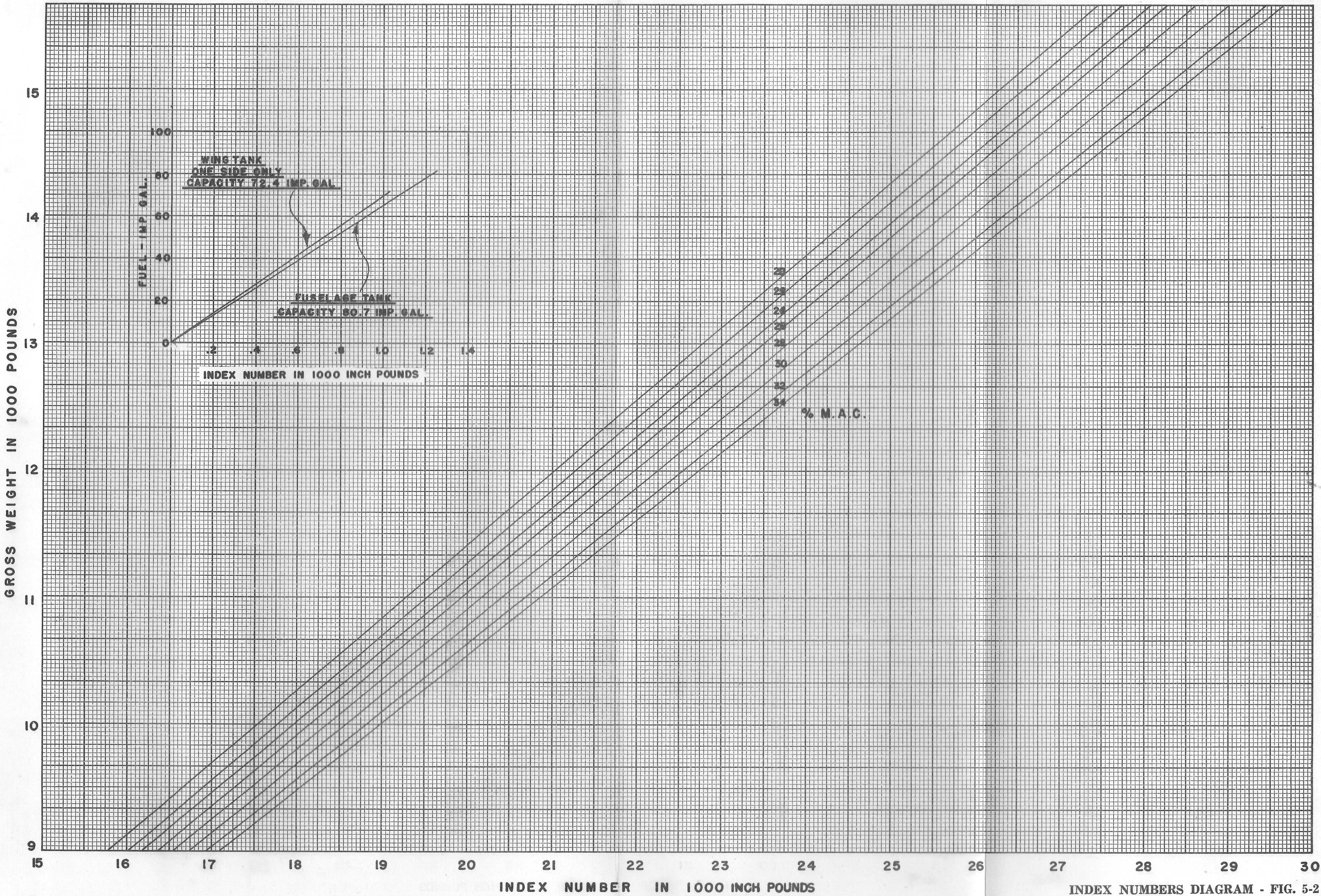
THE MOST AFT C.G. POSITION AT WHICH ALL FORMS OF FLYING ARE PERMISSABLE IS______ INCHES AFT OF THE AXIS OF REFERENCE OR __ % MEAN CHORD. IN EMERGENCY OR EXCEPTIONAL CIRCUMSTANCES THE AIRCRAFT MAY BE LOADED TO A C.G. POSITION OF _____ INCHES AFT OF THE AXIS OF REFERENCE OR ___ % MEAN CHORD, BUT CARE MUST BE TAKEN WHEN OPERATING IN THIS CONDITION. THE MOST FORWARD C.G. POSITION AT WHICH ALL FORMS OF FLYING ARE PERMISSABLE IS______ INCHES AFT OF THE AXIS OF REFERENCE OR __ % MEAN CHORD.

CONDITION	DIST. FROM AXIS OF REF. TO C.G. (IN)	$\% \text{M.A.C} = \left(\frac{\text{HORIZONTAL ARM} - 155.1}{101.24}\right) 100$
A	185.6	$\% \text{M.A.C} = \left(\frac{185.3 - 155.1}{101.24}\right) 100 = \frac{30.2}{101.24} = 29.8$
B	186.3	$\% \text{M.A.C} = \left(\frac{184.7 - 155.1}{101.24}\right) 100 = \frac{29.6}{101.24} = 29.2$
C	186.4	$\% \text{M.A.C} = \left(\frac{186.1 - 155.1}{101.24}\right) 100 = \frac{31.0}{101.24} = 30.6$
D	186.3	$\% \text{M.A.C} = \left(\frac{186.1 - 155.1}{101.24}\right) 100 = \frac{31.0}{101.24} = 30.6$

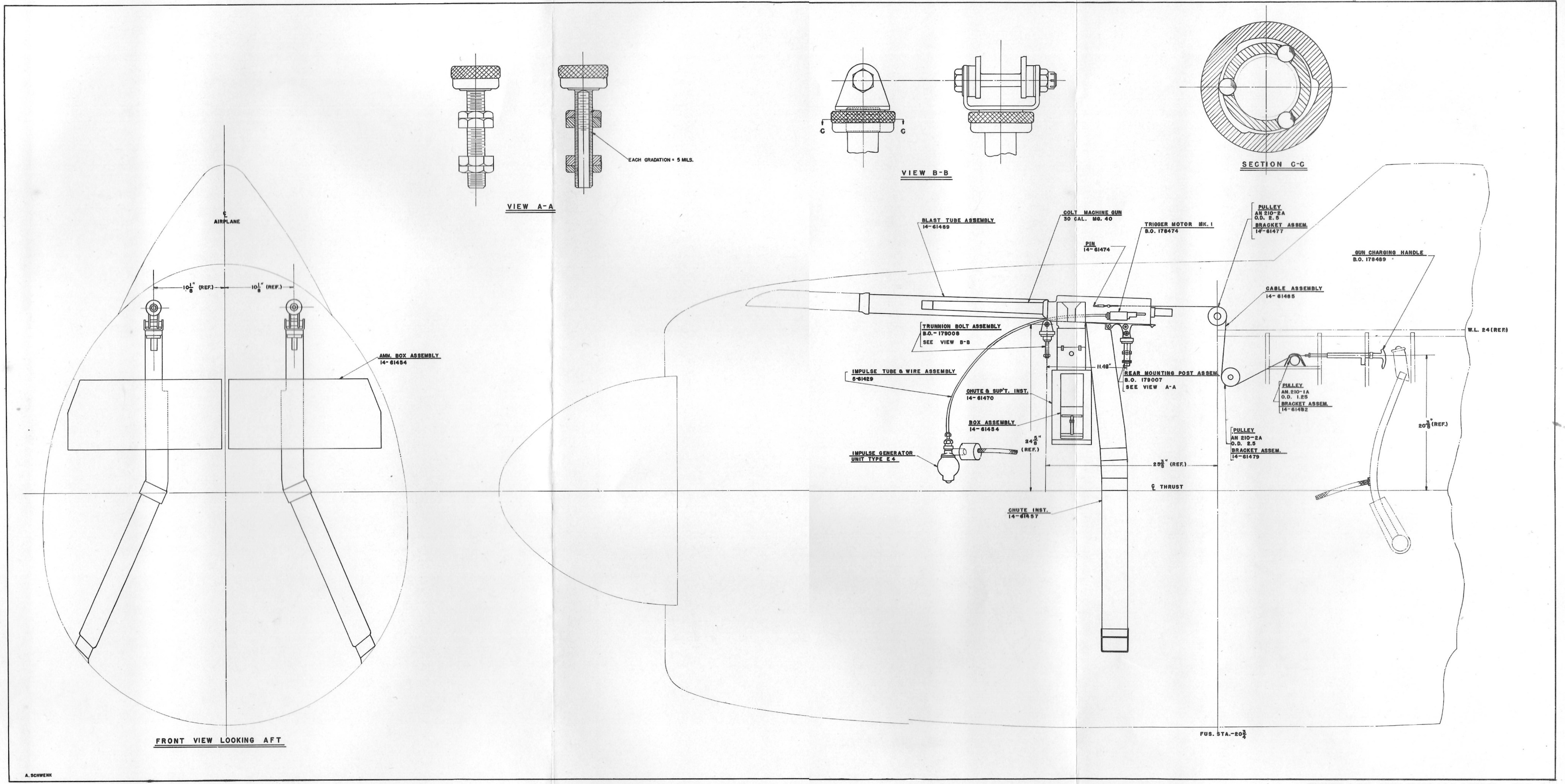
REMOVABLE ITEMS OF MILITARY LOAD NOT INCLUDED IN TYPICAL LOADINGS	WEIGHT (LBS)	ARM (IN)	MOMENT (LB.IN)
CARBURETOR CLEANER INSTALLATION	18.0	110.0	1,980

MISCELLANEOUS DATA	MOMENT (LB. IN)
U/C UP	+ 6,976
U/C DOWN	− 6,976

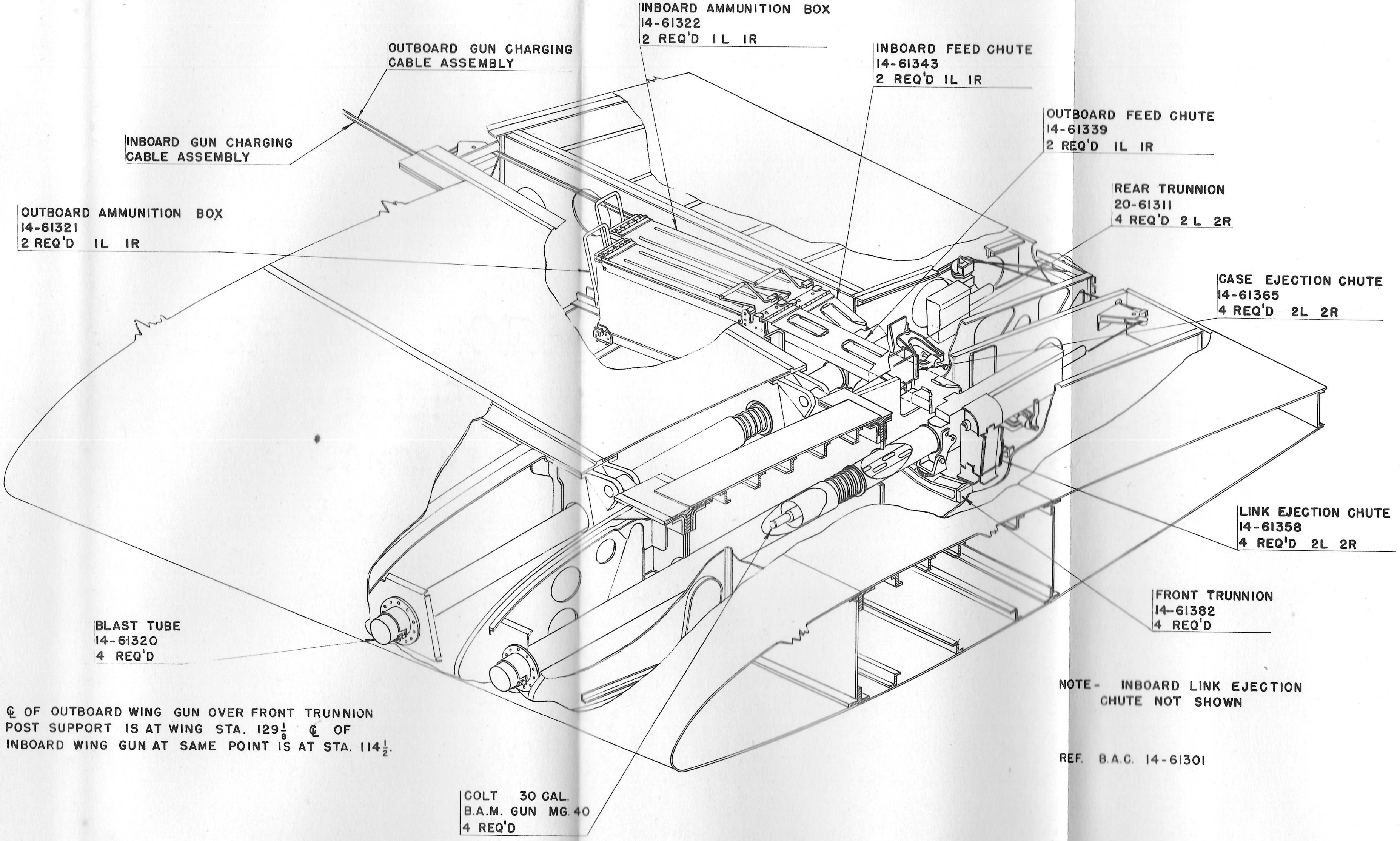
LOADING AND C. G. DIAGRAM - FIG. 5-1



INDEX NUMBERS DIAGRAM - FIG. 5-2



FUSELAGE GUN INSTALLATION - FIG. 5-3



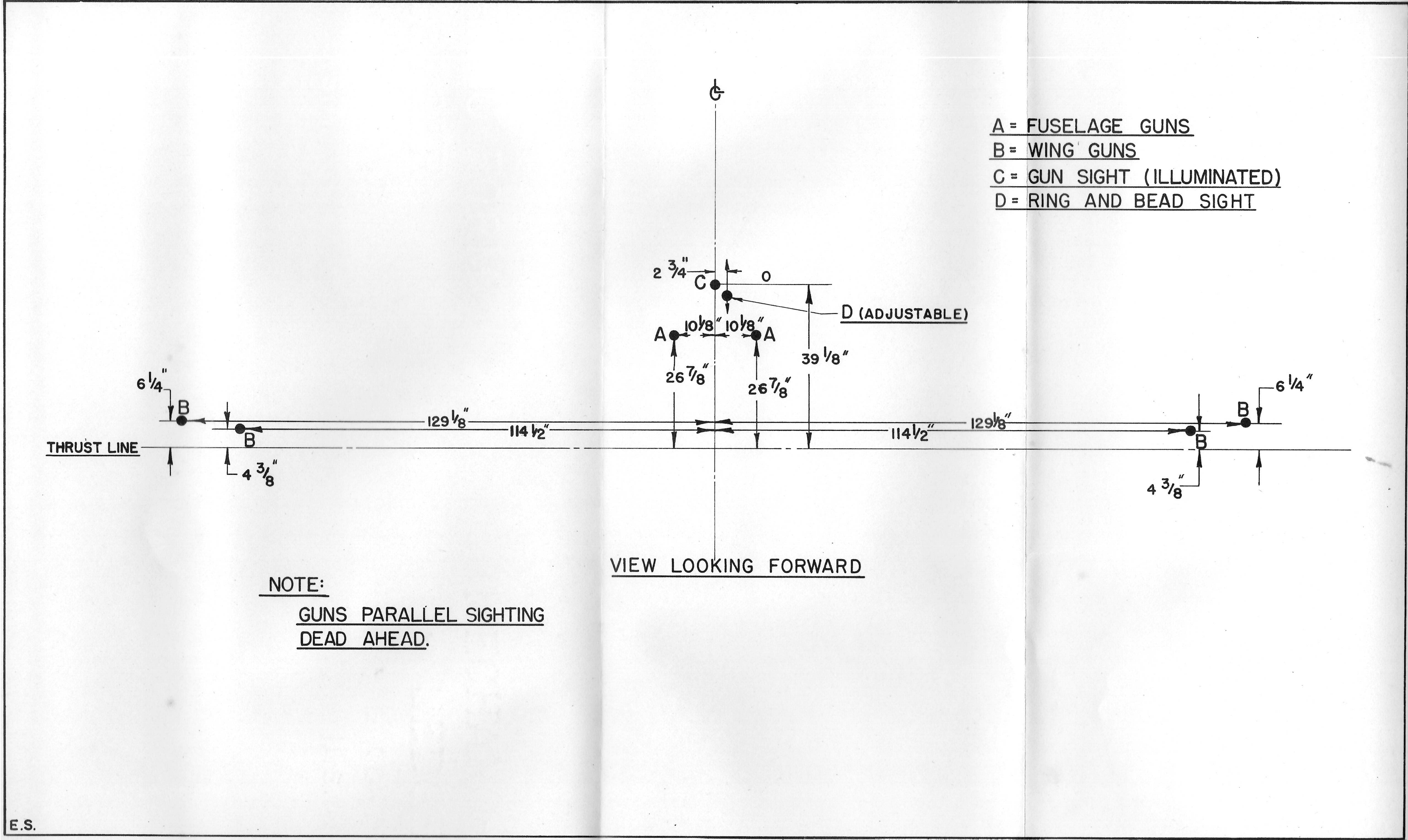
NOTE- ℄ OF OUTBOARD WING GUN OVER FRONT TRUNNION POST SUPPORT IS AT WING STA. $129\frac{1}{8}$ ℄ OF INBOARD WING GUN AT SAME POINT IS AT STA. $114\frac{1}{2}$.

NOTE- INBOARD LINK EJECTION CHUTE NOT SHOWN

REF. B.A.C. 14-61301

W. TITUS

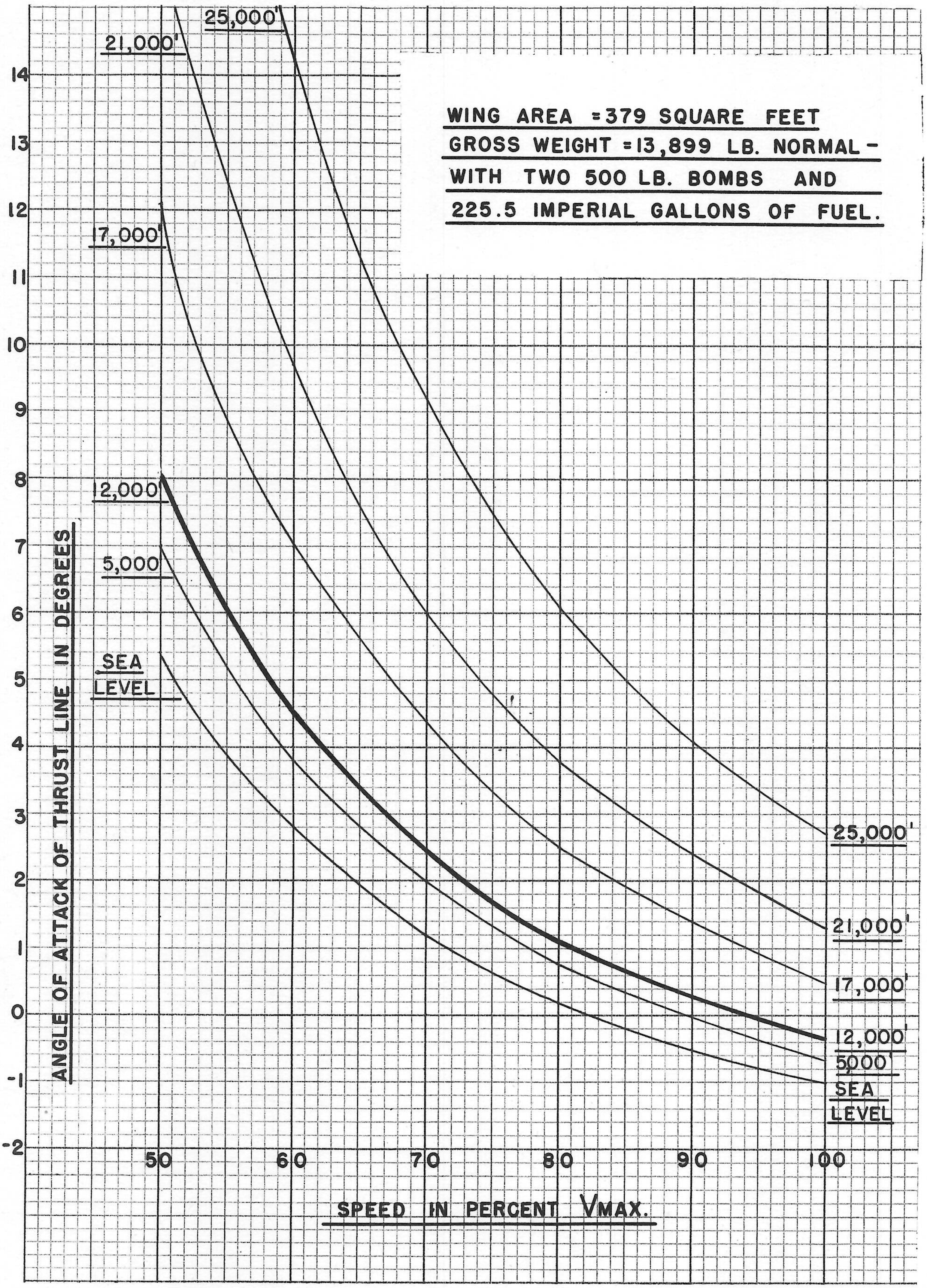
WING GUN INSTALLATION - FIG. 5-4

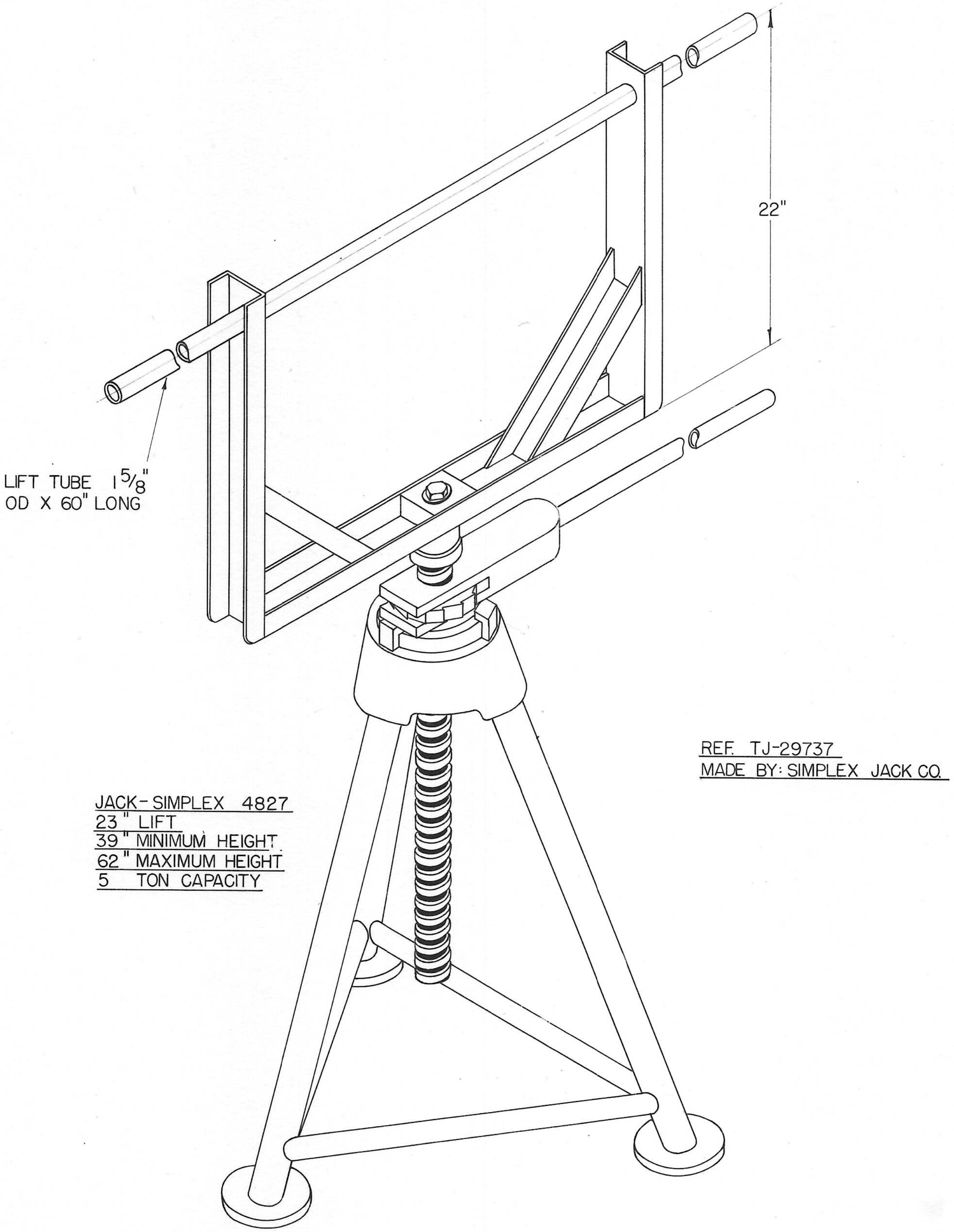


BORE-SIGHTING DIAGRAM - FIG. 5-5

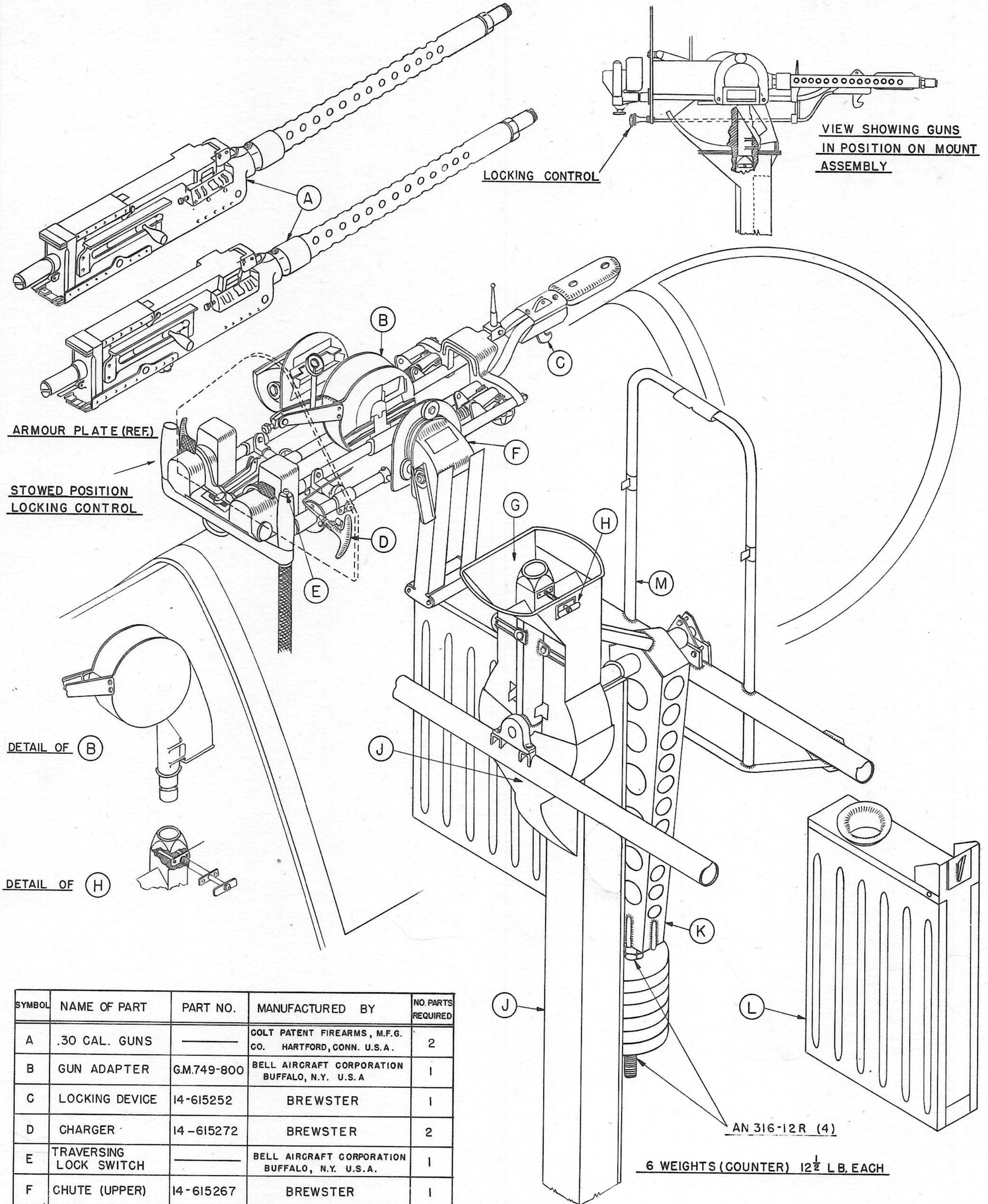
BERMUDA AEROPLANE

ANGLE OF ATTACK OF THRUST LINE PLOTTED AGAINST PERCENT VMAX.





ADJUSTABLE TAIL SUPPORT - FIG. 5-7

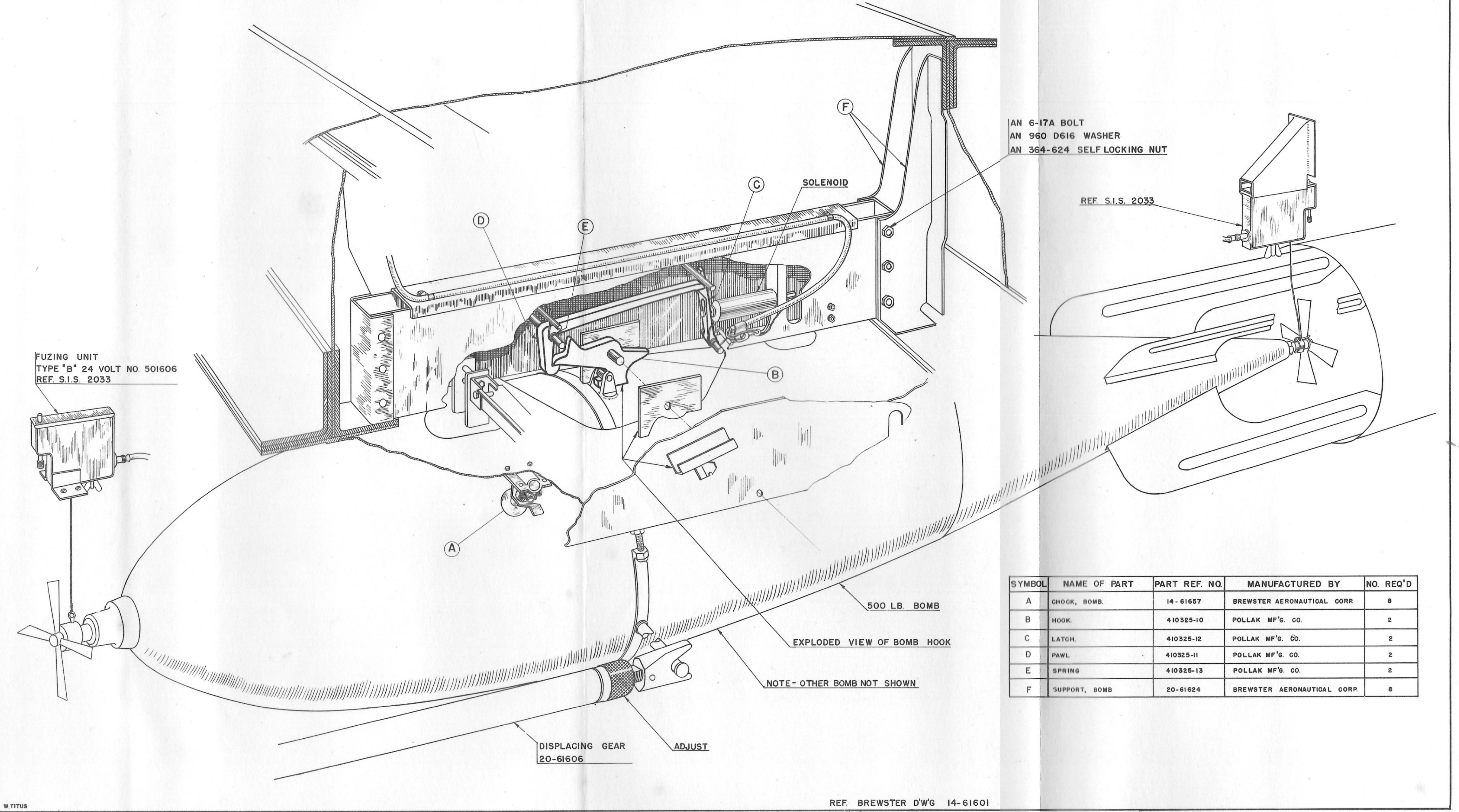


SYMBOL	NAME OF PART	PART NO.	MANUFACTURED BY	NO. PARTS REQUIRED
A	.30 CAL. GUNS	———	COLT PATENT FIREARMS, M.F.G. CO. HARTFORD, CONN. U.S.A.	2
B	GUN ADAPTER	G.M.749-800	BELL AIRCRAFT CORPORATION BUFFALO, N.Y. U.S.A	1
C	LOCKING DEVICE	14-615252	BREWSTER	1
D	CHARGER	14-615272	BREWSTER	2
E	TRAVERSING LOCK SWITCH	———	BELL AIRCRAFT CORPORATION BUFFALO, N.Y. U.S.A.	1
F	CHUTE (UPPER)	14-615267	BREWSTER	1
G	CHUTE (CENTRE)	14-615192	BREWSTER	1
H	ROD ASSEMBLY	14-615152	BREWSTER	1
J	CHUTE (LOWER)	14-615214	BREWSTER	1
K	ROCKING POST	14-615101	BREWSTER	1
L	AMMO. BOX	14-615160	BREWSTER	2
M	LOCK SUPPORT	14-615264	BREWSTER	1

C.G.L.

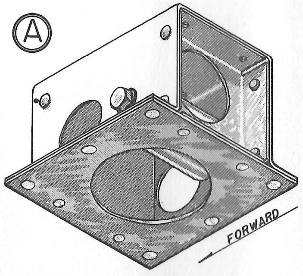
REF. DRAWING 14-615100

FLEXIBLE GUN INSTALLATION - FIG. 5-8

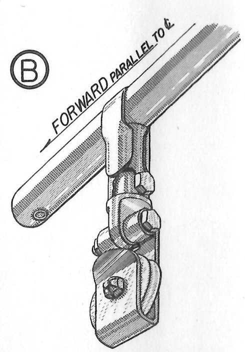


SYMBOL	NAME OF PART	PART REF. NO.	MANUFACTURED BY	NO. REQ'D
A	CHOCK, BOMB.	14-61657	BREWSTER AERONAUTICAL CORP.	8
B	HOOK.	410325-10	POLLAK MF'G. CO.	2
C	LATCH.	410325-12	POLLAK MF'G. CO.	2
D	PAWL	410325-11	POLLAK MF'G. CO.	2
E	SPRING	410325-13	POLLAK MF'G. CO.	2
F	SUPPORT, BOMB	20-61624	BREWSTER AERONAUTICAL CORP.	8

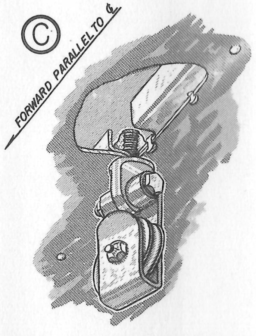
FUSELAGE BOMB INSTALLATION - FIG. 5-9



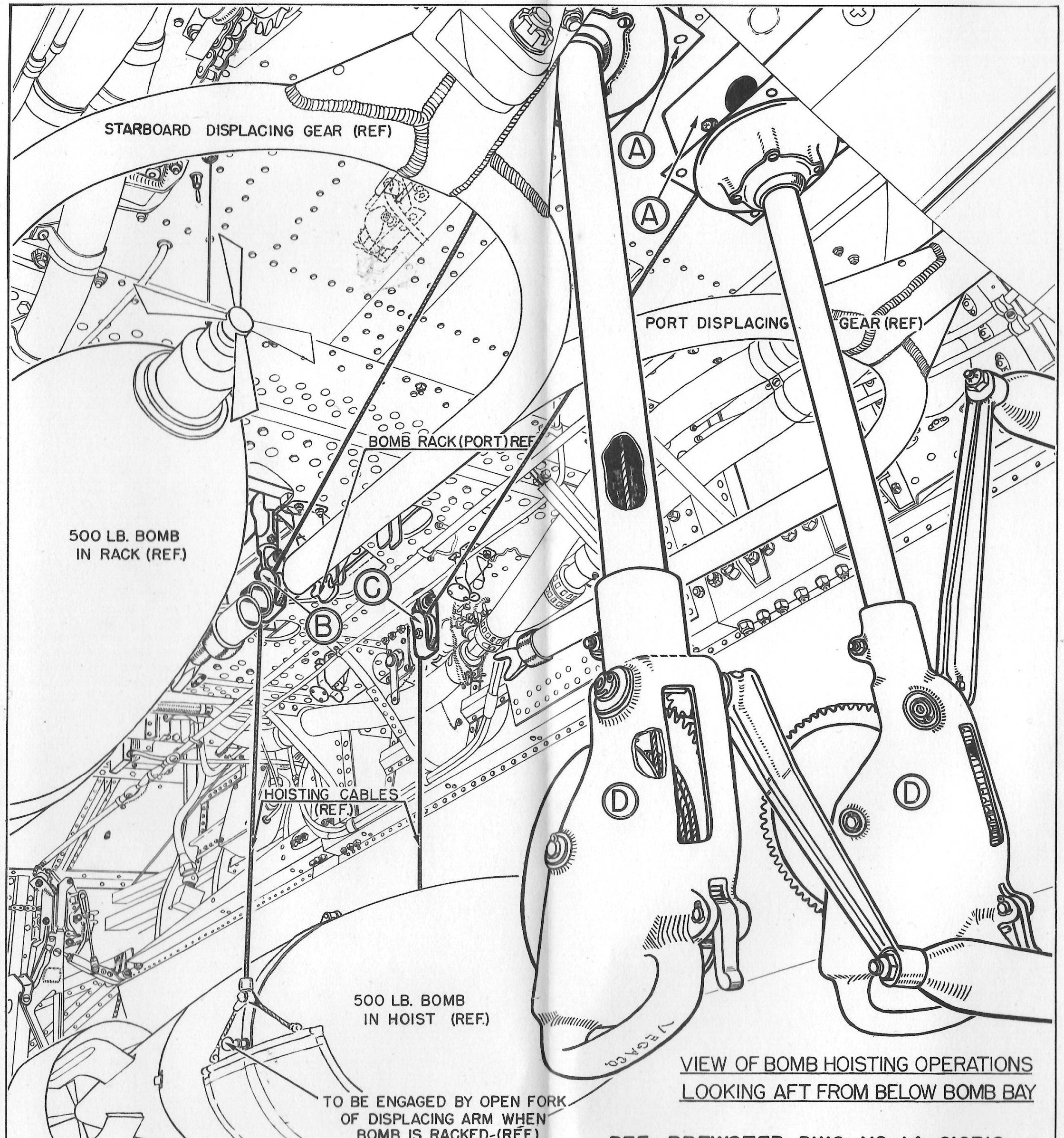
DETAIL OF BOX



DETAIL OF INBOARD PULLEY
(STARBOARD SHOWN)
PULLEY ROTATED TO ALIGN WITH BOX

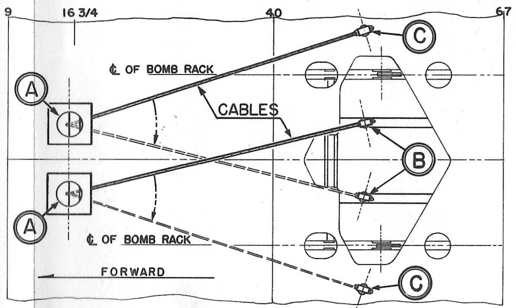


DETAIL OF OUTBOARD PULLEY
(STARBOARD SHOWN)
PULLEY ROTATED TO ALIGN WITH BOX
REF: BREWSTER DWG. NO. 14-616310



VIEW OF BOMB HOISTING OPERATIONS
LOOKING AFT FROM BELOW BOMB BAY

REF: BREWSTER DWG. NO. 14-616310

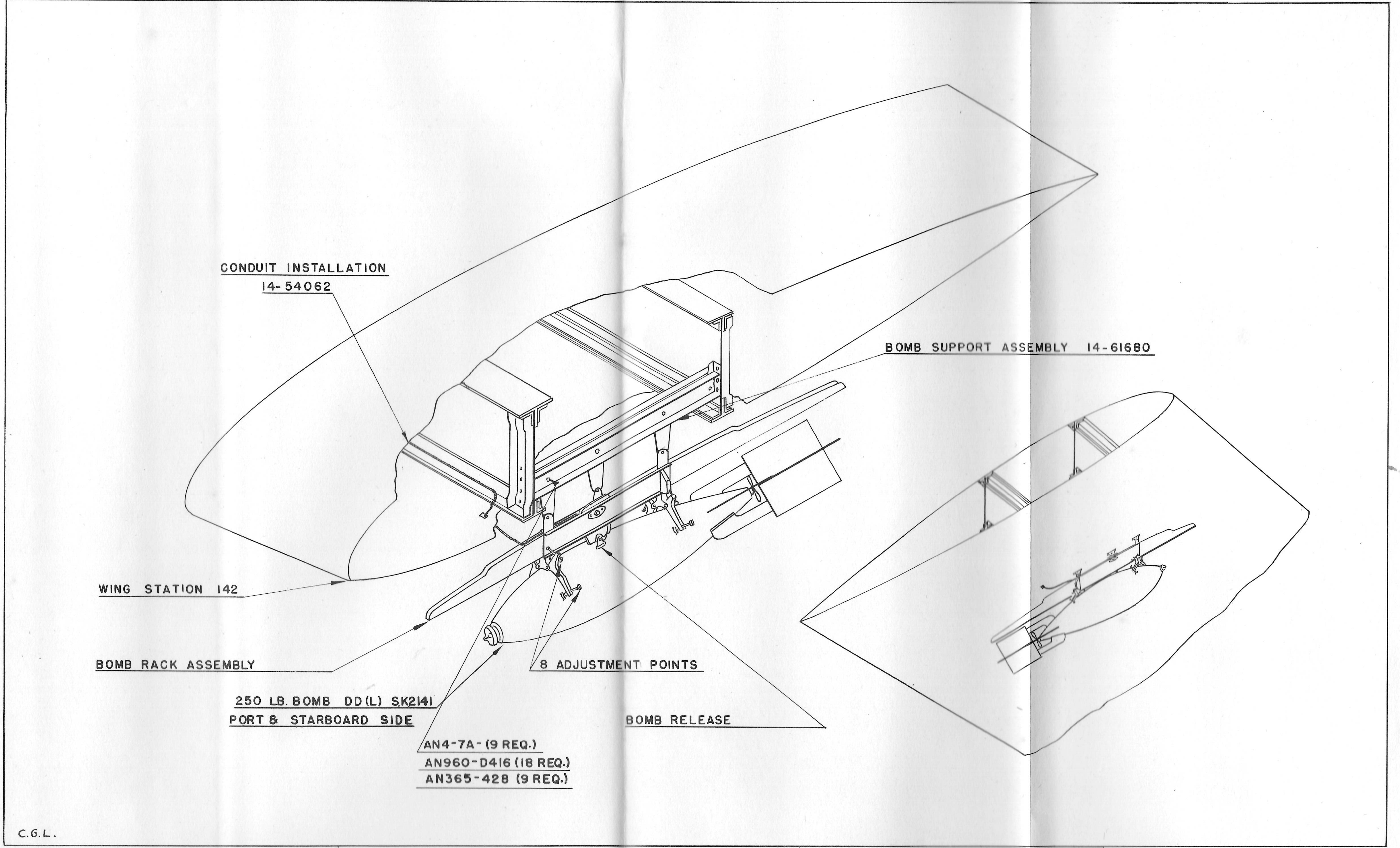


BOMB HOIST RIGGING DIAGRAM
VIEWED FROM BENEATH AEROPLANE

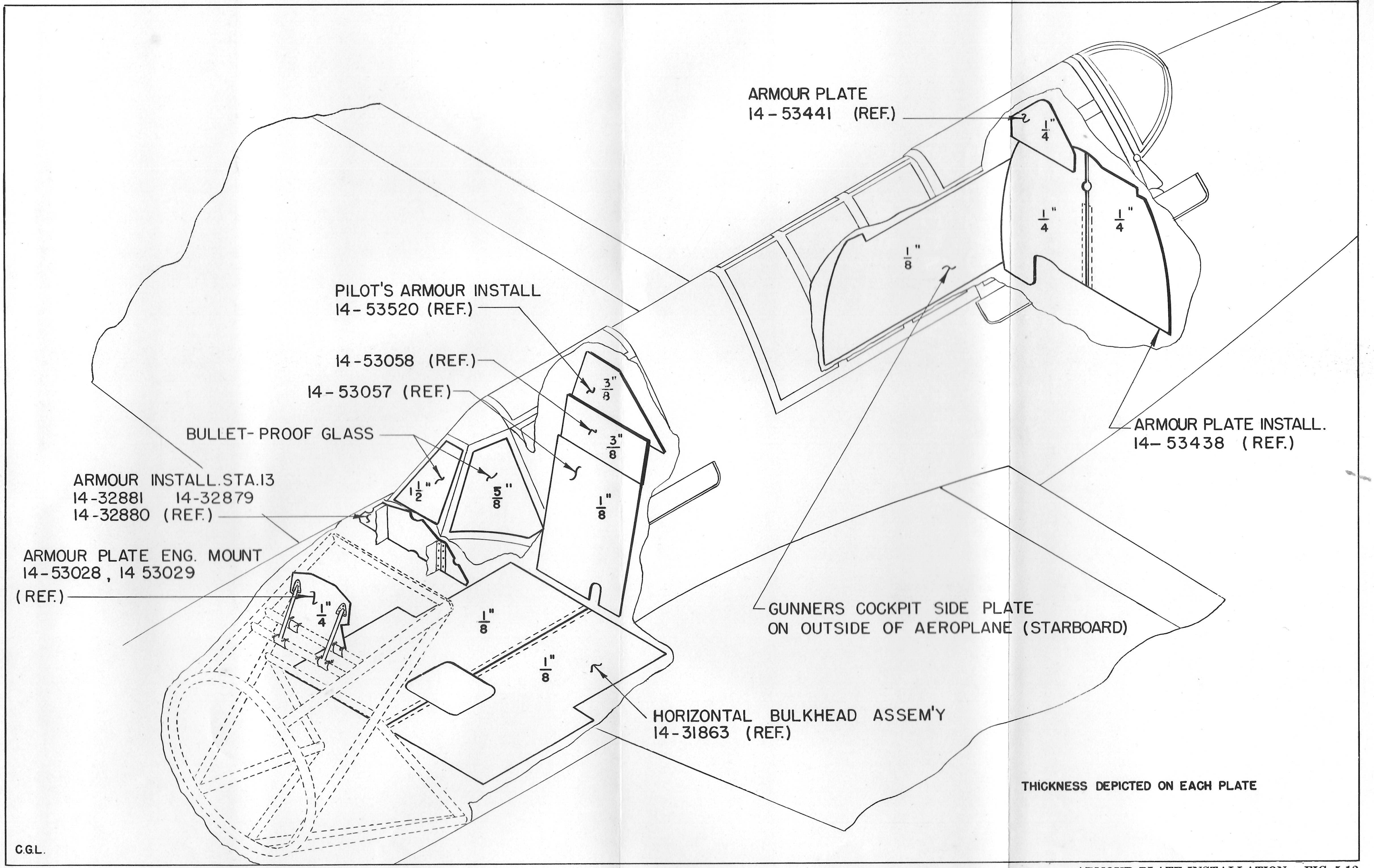
SYMBOL	NOMENCLATURE	PART NUMBER	MANUFACTURER	NO. REQU.
A	BOX	14-616312	BREWSTER	2
B	PULLEY INSTALL.	14-616311	BREWSTER	2
C	PULLEY & SWIVEL ASS'Y. CONSISTING OF: 1 EA. BOLT 1 EA. NUT, CAST'D. HEX. 1 EA. PIN, COTTER 1 EA. SPACER 1 EA. EYEBOLT 1 EA. NUT, CAST'D. HEX. 1 EA. PIN, COTTER 1 EA. SPACER 1 EA. PULLEY ASS'Y	 AN 5-17 AN 310-5 AN380-2C-3 W11-5-125 AN 48-10 AN 310-8 AN380-3C-5 W 11-8-19 14-616316	BREWSTER	2
D	WINCH, HOISTING	CUSTOMER SUPPLIED	VEGA AIR.CO.	2

R.F.M.

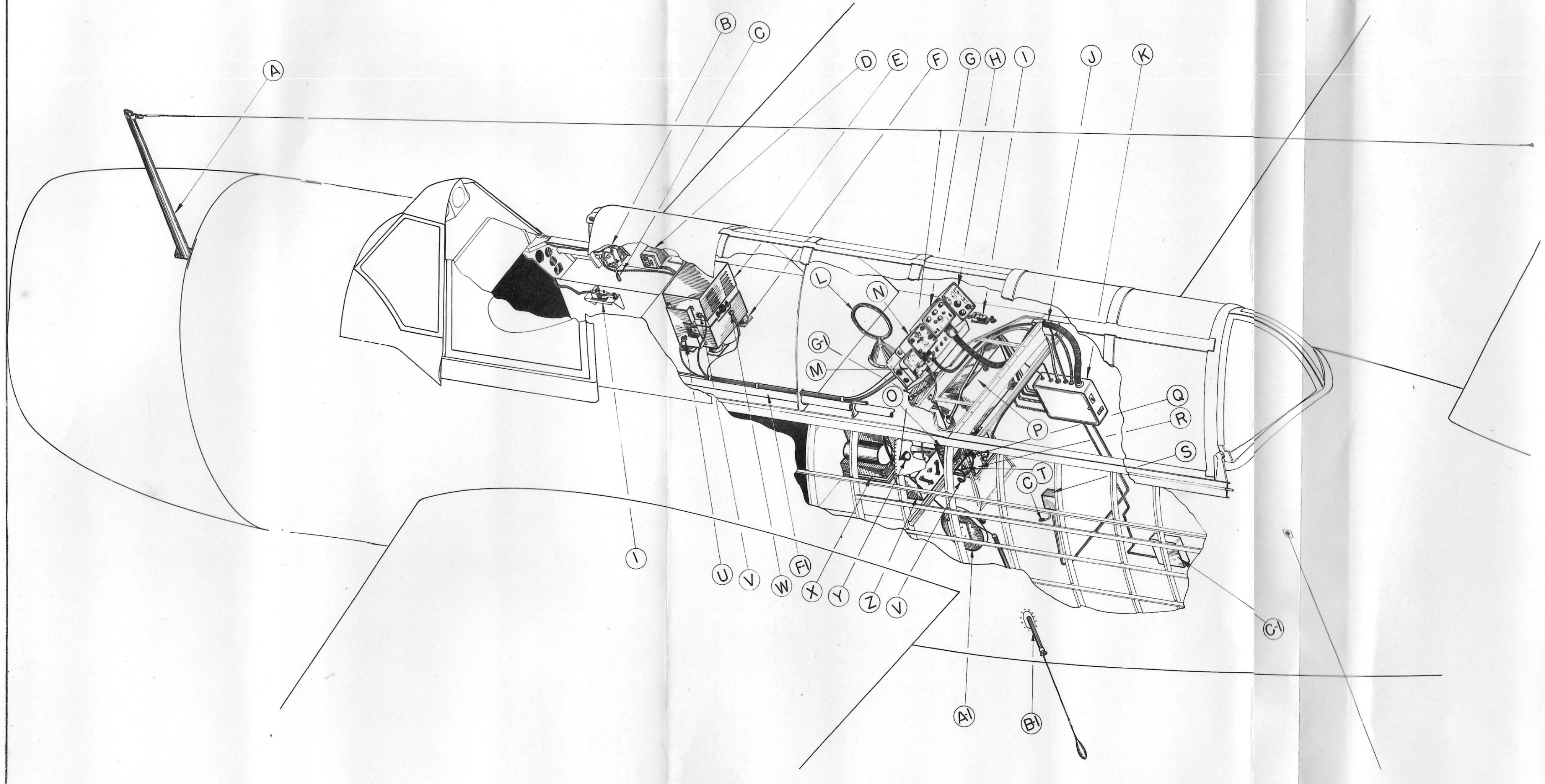
BOMB HOIST DIAGRAM - FIG. 5-10



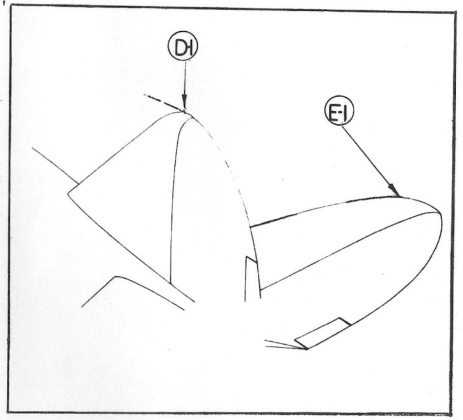
WING BOMB INSTALLATION - FIG. 5-11



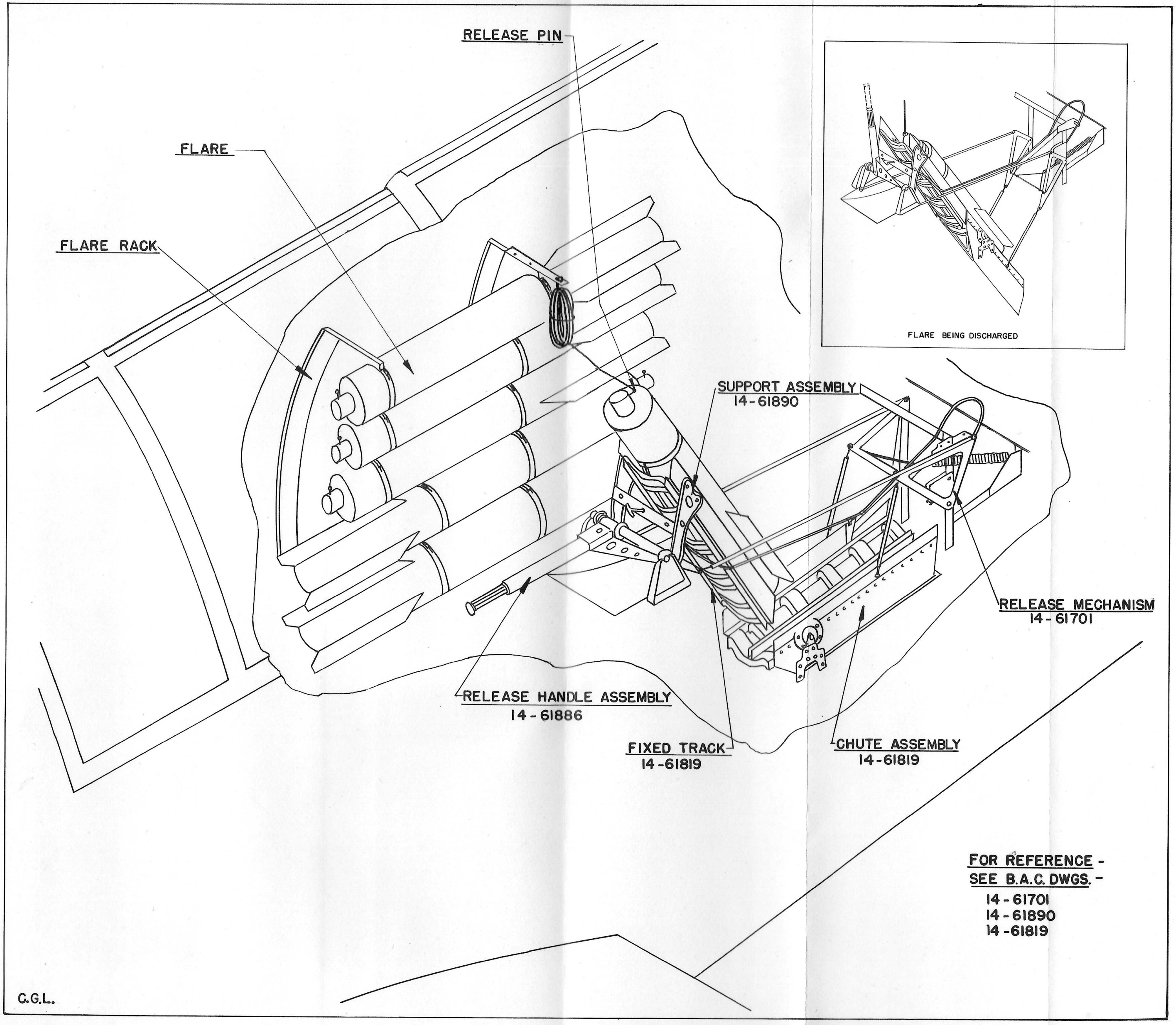
ARMOUR PLATE INSTALLATION - FIG. 5-12



SYMBOL	NAME OF PART	PART REF. NO.	MANUFACTURED BY	NO. REQ.
A	ANTENNA MAST, FUSELAGE	14-65179	TAYLOR FIBRE COMPANY	1
B	PILOT'S STATION BOX	3612	BENDIX RADIO CORP.	1
C	MICROPHONE-TELEPHONE SOCKET	10H/625	MESSRS. BELLING & LEE	2
D	PILOT'S CONTROL BOX	14-65165	BREWSTER	1
E	R-3003 RECEIVER UNIT	10H/DB2	CUSTOMER SUPPLIED	1
F	RECEIVER SHOCKMOUNTING	10A/12222	CUSTOMER SUPPLIED	1
G	WIRELESS OPERATOR'S CONTROL BOX	3616	BENDIX RADIO CORP.	1
H	SWITCH PANEL, REAR COCKPIT	14-54015	BREWSTER	1
I	TELEGRAPH KEY, FRONT & REAR COCKPITS	MT-11B	BENDIX RADIO CORP.	2
J	IMPACT ACTUATOR, RADIO	21F/374	CUSTOMER SUPPLIED	1
K	JUNCTION BOX	14-65159	BREWSTER	1
L	LOOP ANTENNA	MN-20C	BENDIX RADIO CORP.	1
M	AZIMUTH INDICATOR	MN-52 B	BENDIX RADIO CORP.	1
N	REMOTE CONTROL BOX	MR-9B	BENDIX RADIO CORP	1
O	RECEIVER CONTROL UNIT	10LB/4	CUSTOMER SUPPLIED	1
P	TRANSMITTER & SHOCKMOUNTING	TA-12D	BENDIX RADIO CORP.	1
Q	PLUG	10H/258	MESSRS. BELLING & LEE	1
R	INTERPHONE AMPLIFIER & SHOCKMOUNTING	3611	BENDIX RADIO CORP.	1
S	WIRELESS OPERATOR'S AUXILIARY POSITION BOX	14-65181	BREWSTER	1
T	PLUG	10H/7383	CUSTOMER SUPPLIED	1
U	SOCKET	10H/256	MESSRS. BELLING & LEE	1
V	PLUG	10H/254	MESSRS. BELLING & LEE	2
W	SOCKET	10H/460	MESSRS. FERRANTI, LTD.	1
X	DYNAMOTOR-MODULATOR UNIT & SHOCKMOUNTING	MP-28-B	BENDIX RADIO CORP.	1
Y	LEAD-IN INSULATOR	14-65107	NAVAL AIRCRAFT FACTORY	1
Z	ANTENNA SWITCH BOX	14-65177	BENDIX RADIO CORP.	1
A-1	ANTENNA REEL	MT-5E	BENDIX RADIO CORP.	1
B-1	ANTENNA FAIRLEAD	AL-4639	BENDIX RADIO CORP.	1
C-1	BATTERY JUNCTION BOX	14-54227	BREWSTER	1
D-1	ATTACHMENT, FIN, ANTENNA	20-23018	BREWSTER	1
E-1	ANTENNA ATTACHMENT, STABILIZER		BREWSTER	2
F-1	MESSAGE CARRIER TUBE	20-53099	BREWSTER	1
G-1	RECEIVER & SHOCKMOUNTING	RA-10F B	BENDIX RADIO CORP.	1



RADIO INSTALLATION - FIG. 5-13



FOR REFERENCE -
SEE B.A.C. DWGS. -
14-61701
14-61890
14-61819

PARACHUTE FLARE INSTALLATION - FIG. 5-14

INSTRUCTIONS FOR SETTING CAMERA AND RAILS IN POSITION

VERTICAL PHOTOGRAPHY

LENS	HOLE NO.	RAILS	
		FRONT	REAR
5"	9	B	B
8"	8	B	B
14"	2	A	A

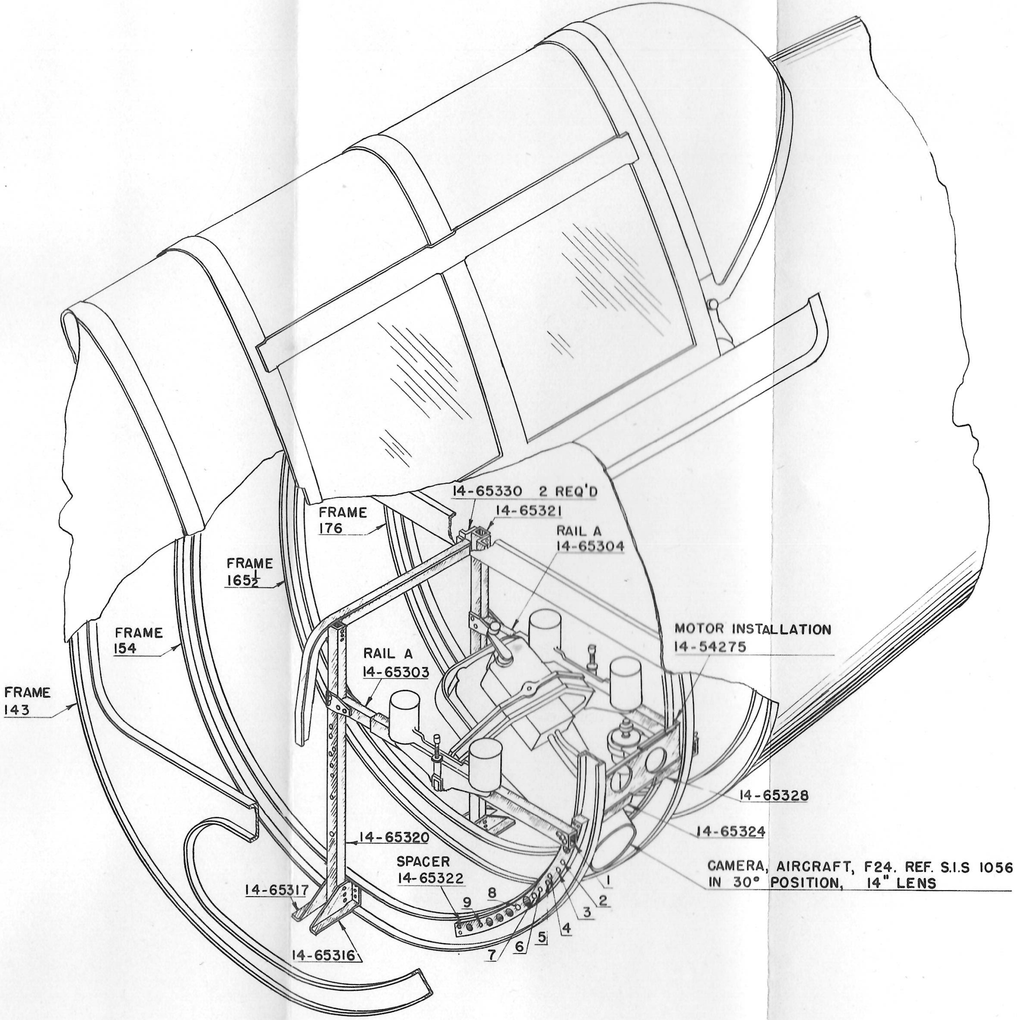
OBLIQUE PHOTOGRAPHY

8" LENS			
DEGREES	HOLE NO.	RAILS	
		FRONT	REAR
30°	3	A	A
20°	5	A	A
15°	6	B	B
10°	7	B	B
14" LENS			
30°	1	A	A
20°	2	A	A
15°	4	A	A
10°	5	A	A

NOTE-

FOR 15° POSITION & 14" LENS USE INNER HOLE ON RAIL ENDS "A" FRONT & "A" REAR. ON OTHER POSITIONS USE OUTER HOLE

CAMERA LENS 1" MINIMUM FROM SKIN.

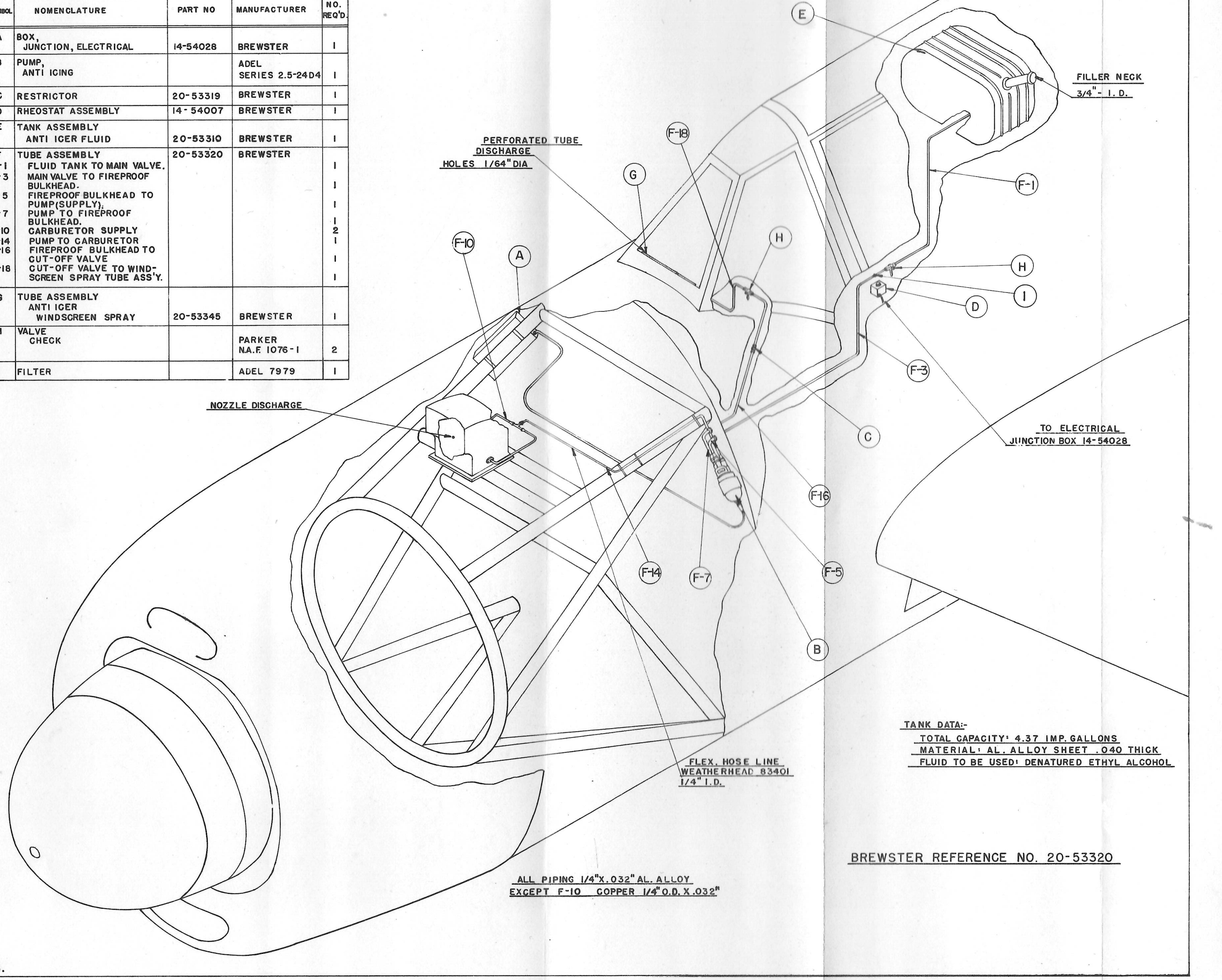


REF. B.A.C. DRAWING 14-65301

W. TITUS

CAMERA INSTALLATION - FIG. 5-15

SYMBOL	NOMENCLATURE	PART NO	MANUFACTURER	NO. REQ'D.
A	BOX, JUNCTION, ELECTRICAL	14-54028	BREWSTER	1
B	PUMP, ANTI ICING		ADEL SERIES 2.5-24D4	1
C	RESTRICTOR	20-53319	BREWSTER	1
D	RHEOSTAT ASSEMBLY	14-54007	BREWSTER	1
E	TANK ASSEMBLY ANTI ICER FLUID	20-53310	BREWSTER	1
F	TUBE ASSEMBLY	20-53320	BREWSTER	
-1	FLUID TANK TO MAIN VALVE.			1
-3	MAIN VALVE TO FIREPROOF BULKHEAD.			1
-5	FIREPROOF BULKHEAD TO PUMP(SUPPLY).			1
-7	PUMP TO FIREPROOF BULKHEAD.			1
-10	CARBURETOR SUPPLY			2
-14	PUMP TO CARBURETOR			1
-16	FIREPROOF BULKHEAD TO CUT-OFF VALVE			1
-18	CUT-OFF VALVE TO WIND-SCREEN SPRAY TUBE ASS'Y.			1
G	TUBE ASSEMBLY ANTI ICER WINDSCREEN SPRAY	20-53345	BREWSTER	1
H	VALVE CHECK		PARKER N.A.F. 1076-1	2
I	FILTER		ADEL 7979	1



TANK DATA:-
TOTAL CAPACITY: 4.37 IMP. GALLONS
MATERIAL: AL. ALLOY SHEET .040 THICK
FLUID TO BE USED: DENATURED ETHYL ALCOHOL

BREWSTER REFERENCE NO. 20-53320

ALL PIPING 1/4"X.032" AL. ALLOY
EXCEPT F-10 COPPER 1/4" O.D. X.032"

A.F.S.

ANTI-ICING SYSTEM - FIG. 5-16

Section VI—Lubrication and Inspection

Figure Index

SECTION VI

Lubrication and Inspection

LUBRICATION

1 The aeroplane, exclusive of the engine and airscrew, shall be lubricated as indicated on the lubrication chart, fig. 6-1. The grease recommended for use is 1344 made by the Black Bear Company of Long Island City, New York, and the aeroplane as supplied is lubricated with this grease. This is a graphited lubricant, developed especially for aircraft use, and leaves a film of colloidal graphite on the bearing surfaces. Marfak No. 3 grease made by the Texas Company is used in the landing wheel hubs. It is a fibre grease and must be used in this location to ensure proper lubricant retention. The oil recommended for use is Black Bear Chain Lubricant No. 1. This is a graphited oil with good penetrating qualities.

2 If these lubricants cannot be obtained, an approximate substitute may be made as follows:

For the 1344 grease: Intava graphited soft grease E (Stores Ref. 34A/49), Intava graphited medium grease 642 (Stores Ref. 34A/65, 95) or Intava graphited hard grease 643 (Stores Ref. 34A/65, 95).

For the Marfak fibre grease No. 3: D.T.D. 419 (Stores Ref. 34A/66, 105).

For the Chain Lubricant No. 1: Intava Servo fluid with from 5% to 10% of colloidal graphite (Stores Ref. 34A/92).

> NOTE: These substitute lubricants cannot be recommended by the manufacturer of this aircraft as no service experience is available on their use.

INSPECTION

3 GENERAL: The following routine of inspection is recommended. The time limits given are those recommended by the manufacturer on the basis of experience in this country on similar types of aircraft. The check periods may be made at more frequent intervals (particularly in the case of the first few inspections) but in no case should they be extended until sufficient operating experience has been collected to warrant the change. It is also the opinion of the manufacturer that the time limits noted should not be materially lowered, except in exceptional circumstances. Service units are to be cautioned against the disassembly of any unit for inspection purposes without an adequate supply of replacement parts (such as gaskets) on hand. *This schedule should only be used as an interim measure until the issuance of Vol. II, Part 2.*

4 **Pre-Flight Inspection:**

See that chocks are under wheels.

Warm up and check proper functioning of engine.

Check engine controls for proper functioning and lost motion.

Check operation of airscrew.

Open cowl gills during warm up.

Check operation of carburetor mixture control.

Check operation of vacuum pump at speed sufficient to operate instruments.

Check radio equipment for proper functioning.

Remove all surface control locks.

5 **Daily Inspection:**

Airscrew:

Inspect blades for pits, cracks and nicks.

Inspect hubs and attaching parts for looseness, defects and proper safetying.

Inspect airscrew.

Engine:

Inspect engine cowling.

Inspect engine ring cowl and flaps for cracks and adjustments.

Check exhaust stacks and collector ring for cracks and security.

Check spark plugs for tightness and terminal assemblies for cleanliness and tightness.

Inspect accessible ignition wiring and harness for security of mounting.

Clean main fuel line strainers.

Drain small quantity of fuel from bottom drains of all tanks and inspect for presence of water and foreign matter.

Check fuel and oil supply (do not rely on gauges).

Check operation of vacuum pump at speed sufficient to operate instruments.

Warm up and check proper functioning of engine.

Check engine controls for proper functioning and lost motion.

Open engine flaps during warm up.

Check operation of carburetor air control.

Check operation of carburetor mixture control.

Electrical System:

Check level of battery electrolyte and add distilled water if necessary.

Inspect gun firing and bomb release circuits.

Inspect airscrew pitch circuit.

Radio:

Check operation of tuning controls.

Check operation of transmitter and receiver.

Check operation of interphone.

Armament:

Inspect condition of gun mounts.

Inspect condition of ammunition boxes.

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Inspect condition of shell ejection chutes.

Inspect condition of link boxes.

Inspect condition of bomb racks and bomb release cables and fittings.

Inspect condition of gun camera and check security.

Fuselage:

Inspect all bays for loose articles.

Inspect control column assembly and accessible parts of control system for freedom of movement, lost motion, security of attachments and proper lubrication.

Inspect rudder pedal assembly and control system as above.

Inspect fire extinguisher bottle indicator for fully charged condition.

Inspect all removable cowling, fairing and inspection doors for security.

Check proper functioning of lamps system.

Check security of safety belts.

Check proper functioning of cockpit enclosures and adjustable seat mechanism.

Check hydraulic system reservoir and anti-icing system reservoir for proper quantity of fluid.

Wings:

Inspect covering and structure for damage.

Inspect attachment fittings for security.

Check aileron hinges, horns and tabs for security of sealed bearings and position. Outer housing of sealed ball bearings must not be dented.

Inspect and check operation of landing and diving flaps.

Inspect accessible control cable tubes and pulleys for security and for lubrication.

Remove all surface control locks before flight.

Inspect all access doors for security.

Inspect wing-tip attachment screws for security.

Undercarriage:

Inspect tyres for defects and proper inflation (45–50 lb./sq. in.).

Inspect wheels for cracks and distortion.

Inspect hub caps for security.

Inspect oleo units and brake gear.

Inspect strut fittings and bolts.

Inspect retracting mechanism.

Tail:

Inspect covering and structure for damage.

Check control surface hinges, horns and tabs for security of attachments, proper lubrication and position.

Inspect control cables, tubes, rods and pulleys for security and proper lubrication.

Remove all surface control locks before flight.

6 **30 Hour Inspection** (include daily inspection and the following):

Airscrew:

Remove airscrew, inspect engine shaft and cores for cracks and galling.

Thoroughly clean airscrew with soap and fresh water or kerosene.

Check all lock wires and cotters after reinstalling airscrew.

Inspect hub for tightness on shaft.

Check blade-setting field marks.

Check controllable and constant speed operating mechanism.

Track airscrew.

Check action of limit switches.

Inspect brushes for wear.

Clean oil and carbon dust from brush holder and brushes.

Check brush springs.

Wipe slip rings.

Check electrical circuits through brushes.

Check relay points for pitting; dress points if necessary.

Check operation of brakes.

Engine:

Clean engine.

Check thrust bearing nut for tightness.

Clean out rocker boxes and check intake and exhaust clearances.

Inspect push rods where excess valve clearances indicate necessity.

Check oil-tightness of push-rod housing.

Drain and renew oil as per current engine instructions.

Inspect ignition cable in spark plug elbows for burned or damaged insulation.

Check engine hold-down nuts for tightness.

Inspect engine mount for cracks, distortion, security of bolts and correct adjustment of rubber mounts.

Inspect generator for security of mounting.

Check magnetos for tightness of hold-down bolts, nuts and mounting screws.

Inspect magneto distributor rotor for burned spots and cracks.

Clean oil strainer.

Check operation of power plant controls and remove lost motion.

Inspect and service fire extinguisher equipment as necessary.

Fuel System:

Check tightness and safety of nuts attaching carburetor to scoop adapter.

Check carburetor controls and functioning of corresponding carburetor parts.

Check all fuel lines and connections for sharp bends, cracks, leaks and security of mounting.

Inspect all tank caps and connections for leaks and security of mounting; see that vents are clear of obstructions.

Inspect control valves and hand pump for leaks, tightness and proper functioning.

Inspect primer pump, valves and lines for leaks and security.

Remove carburetor at intervals not to exceed 120 hours and inspect in accordance with manufacturer's instructions.

Clean all strainers and flush all fuel lines.

Check fuel quantity gauges.

Inspect carburetor and fuel lines for leaks with pressure up.

Inspect fuel tanks for signs of leaks and security of mounting.

Lubricating System:

Check all oil lines and connections for leaks and security.

Clean strainers, note condition, and replace if necessary.

Inspect oil tanks, caps and connections for leaks and security of mounting. Make sure that vents are clear of obstructions.

Check oil cooler connections and operating controls.

Electrical System:

Inspect conduits and quick-disconnect plugs for tightness of all fittings and bonding clamps.

Inspect ignition switch and connections.

Inspect battery hold-down bolts for tightness.

Inspect all accessible wiring connections.

Test all lamp circuits.

Check action of undercarriage signal, make sure that switches are correctly adjusted.

Inspect generator control box.

Radio:

Test indicator lights.

Armament:

Oil exterior of guns sparingly.

Fuselage:

Thoroughly clean all interior structure spaces.

Inspect accessible structure for cracks, bent supports, faulty welding and corrosion.

Inspect cockpit enclosures and adjustable seat mechanism for fouling.

Inspect safety-belt fastenings for security.

Inspect and service fire extinguisher equipment.

Inspect security of all removable cowling, fairing and inspection plates.

Wing:

Inspect air-speed line for condition and drain.

Inspect attachment fittings for cracks, displacement, elongation, play and security.

Inspect tabs for security of attachment and position.

Inspect flaps and check operating controls.

Controls:

Inspect all control tubes and horns for distortion, preservation and security of attachments.

Trace all control wires, wipe off all accessible parts with oily rag and check for frays, rust and proper tension and adjustment.

Rudder cables should be tightened not to exceed 70 pounds tension, aileron cable not to exceed 95 pounds, tab cables not to exceed 25 pounds.

Inspect safety wiring of all control turnbuckles.

Inspect, clean and lubricate all fairleads.

Inspect pulleys.

Inspect control column assembly for freedom of movement, cleanliness, preservation and lubrication.

Inspect rudder assembly as above.

Inspect all control surface hinges for cleanliness, lost motion, security of attachments and condition of sealed bearings. Outer housings of any sealed ball bearings must not be dented.

Undercarriage:

Remove wheels, clean, inspect and lubricate as necessary.

Adjust brakes.

Service oleo units.

Inspect rubber hose lines (hydraulic) for signs of deterioration and chafing.

Adjust turnbuckles in down-lock cable to take up all slack.

Check uplock operating mechanism.

Inspect shock absorber units and service as necessary.

Tail:

Inspect attachment fittings for security.

Check tail wheel assembly for condition and lubrication.

7 **60 Hour Inspection** (include 30 hour inspection and the following):

Engine:

Remove spark plugs.

Install reconditioned plugs if available—otherwise new plugs.

Electrical System:

Check generator for loose connections and worn or binding brushes.

Radio:

Inspect dynamotor for loose connections, worn or binding brushes.

8 **120 Hour Inspection** (include 30 and 60 hour inspections and the following):

Engine:

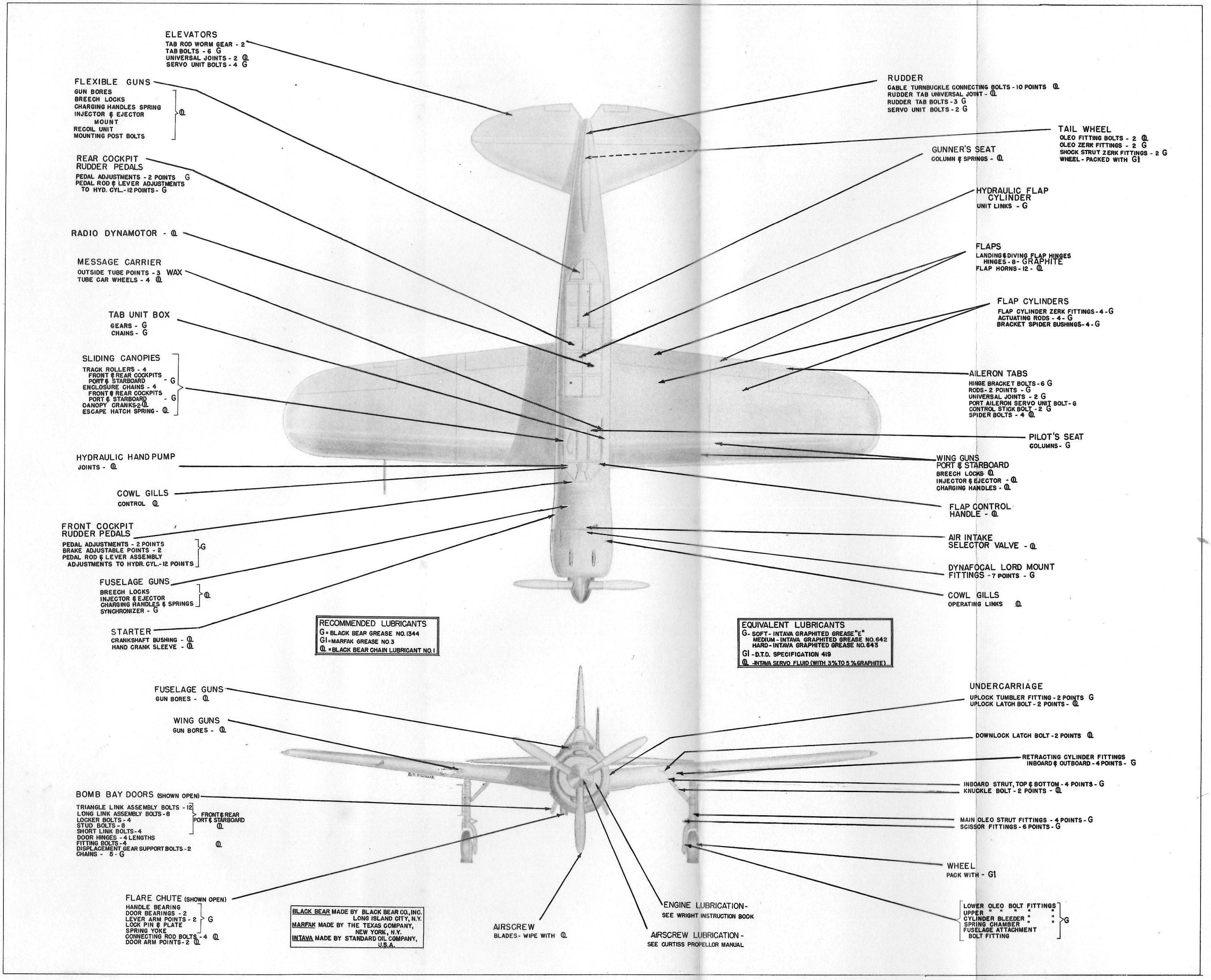
Inspect magneto breaker points for burning, weak springs, proper clearance and synchronization.

Undercarriage:

Check emergency landing gear lowering procedure.

Hydraulic System:

Remove sump plug on filter and drain filter.

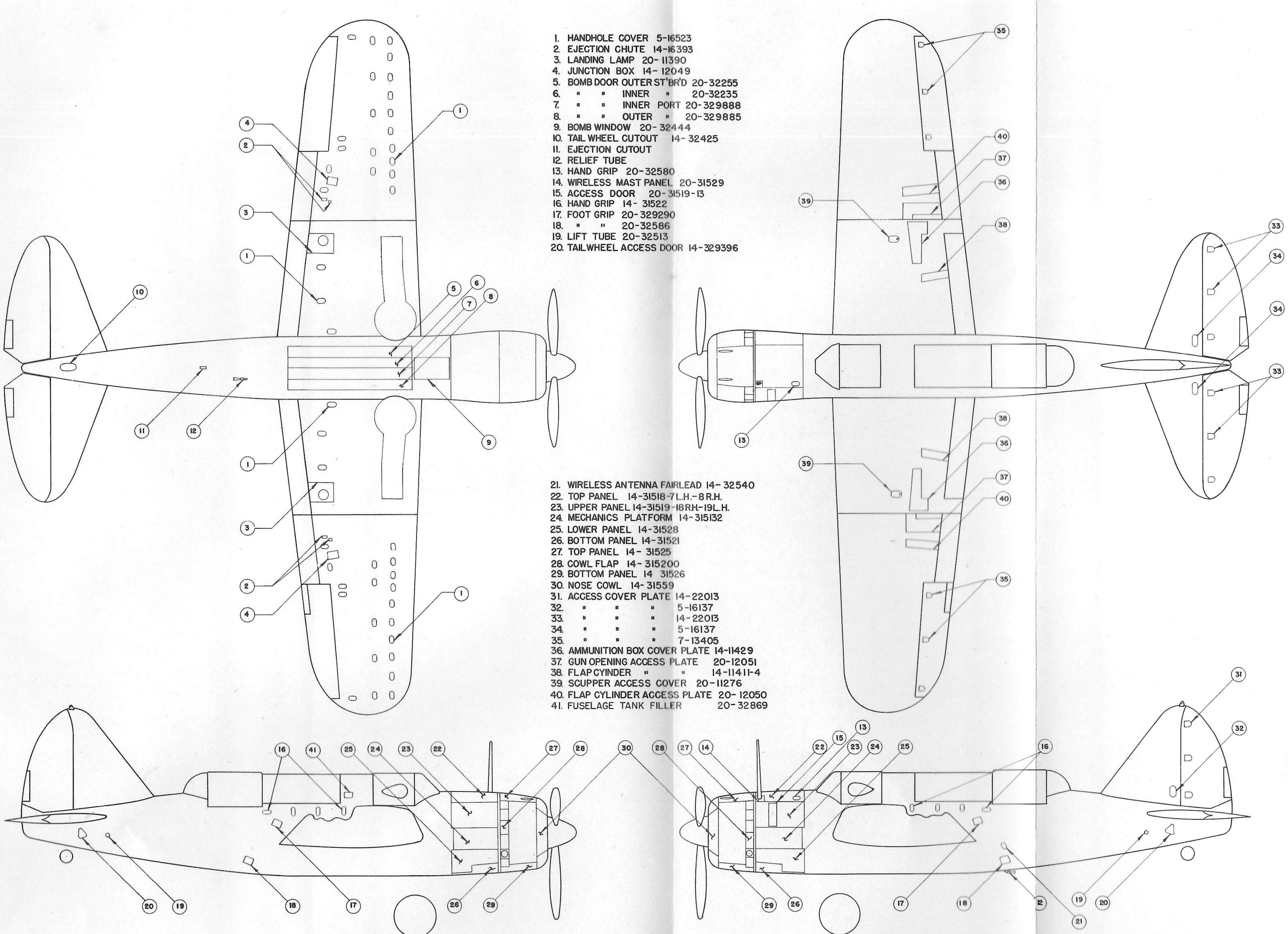


RECOMMENDED LUBRICANTS
G = BLACK BEAR GREASE NO. 1344
GI = MARFAK GREASE NO. 3
CL = BLACK BEAR CHAIN LUBRICANT NO. 1

EQUIVALENT LUBRICANTS
G - SOFT - INTAVA GRAPHITED GREASE "E"
MEDIUM - INTAVA GRAPHITED GREASE NO. 642
HARD - INTAVA GRAPHITED GREASE NO. 643
GI - D.T.D. SPECIFICATION 419
CL - INTAVA SERVO FLUID (WITH 3% TO 5% GRAPHITE)

BLACK BEAR MADE BY BLACK BEAR CO., INC. LONG ISLAND CITY, N.Y.
MARFAK MADE BY THE TEXAS COMPANY, NEW YORK, N.Y.
INTAVA MADE BY STANDARD OIL COMPANY, U.S.A.

LUBRICATION CHART - FIG. 6-1



1. HANDHOLE COVER 5-16523
2. EJECTION CHUTE 14-16393
3. LANDING LAMP 20- 11390
4. JUNCTION BOX 14- 12049
5. BOMB DOOR OUTER ST'BR'D 20-32255
6. " " INNER " 20-32235
7. " " INNER PORT 20-329888
8. " " OUTER " 20-329885
9. BOMB WINDOW 20- 32444
10. TAIL WHEEL CUTOUT 14- 32425
11. EJECTION CUTOUT
12. RELIEF TUBE
13. HAND GRIP 20-32580
14. WIRELESS MAST PANEL 20-31529
15. ACCESS DOOR 20-31519-13
16. HAND GRIP 14- 31522
17. FOOT GRIP 20-329290
18. " " 20-32586
19. LIFT TUBE 20-32513
20. TAILWHEEL ACCESS DOOR 14-329396

21. WIRELESS ANTENNA FAIRLEAD 14- 32540
22. TOP PANEL 14-31518-7 L.H.-8 R.H.
23. UPPER PANEL 14-31519-18 R.H.-19 L.H.
24. MECHANICS PLATFORM 14-315132
25. LOWER PANEL 14-31528
26. BOTTOM PANEL 14-31521
27. TOP PANEL 14- 31525
28. COWL FLAP 14- 315200
29. BOTTOM PANEL 14 31526
30. NOSE COWL 14- 31559
31. ACCESS COVER PLATE 14-22013
32. " " " 5-16137
33. " " " 14-22013
34. " " " 5-16137
35. " " " 7-13405
36. AMMUNITION BOX COVER PLATE 14-11429
37. GUN OPENING ACCESS PLATE 20-12051
38. FLAP CYINDER " " 14-11411-4
39. SCUPPER ACCESS COVER 20-11276
40. FLAP CYLINDER ACCESS PLATE 20- 12050
41. FUSELAGE TANK FILLER 20-32869

ACCESS DOOR DIAGRAM - FIG. 6-2

Section VII—Materials of Construction

SECTION VII

Materials of Construction

The following tables list the physical properties of the metals used in the Bermuda aeroplane together with the prescribed heat treatment. More complete details as to the location of these metals in the aeroplane may be found in Vol. II, Section 3.

Aluminium Alloys

Material				Physical Properties							
Navy Spec.	Commercial Designation	Form	Condition or Temper*	U.T.S. 1000 Lb./Sq. In.	Yield Strength (Tension) 1000 Lb./Sq. In.	Compression Strength 1000 Lb./Sq. In.	Shear Strength 1000 Lb./Sq. In.	Bearing Strength 1000 Lb./Sq. In.	Modulus of Elasticity (Tension) 1,000,000 Lb./Sq. In.	Modulus of Rigidity 1,000,000 Lb./Sq. In.	Elongation % in 2 Inches
44T19	2S	Tubing	Soft ½ Hard Hard	15.5 16 22	5 14 ...	... ...	9.5 11 13	... ...	... ...	... ...	35 9 5
47A2		Sheet & Strip	Soft	15.5	5	...	9.5	...	...	...	35
46A3		Bar & Rod	Soft	15	5	...	9.5	...	...	...	45
44T20	3S	Tubing	Soft ½ Hard	14.5 19.5	6 18	... ...	11 14	... ...	... ...	... ...	30 8
47A4		Sheet	Soft ½ Hard Hard	14.5 19.5 27	6 18 25	... ...	11 14 16	... ...	... ...	... ...	30 8 4
46A6		Bar & Rod	Hard	29	25	...	...	...	...	...	10
46A7	14ST	Forging	Grade 5	65	50	65	39	93	10.3	3.8	10
46A4	17S	Bar & Rod	Heat-Treated	50	30	50	30	75	10.3	3.8	16
44T28	24S	Tubing	Annealed Heat-Treated	35 62	... 40	... 62	... 37	... 90	10.3 10.3	3.8 3.8	... ...
46A9		Bar & Rod	Annealed Heat-Treated	35 62	... 40	... 62	... 37	... 90	10.3 10.3	3.8 3.8	... ...
		Shapes	Heat-Treated	57	38	57	34	83	10.3	3.8	...
47A10		Sheet	Annealed Heat-Treated	35 62	... 40	... 62	... 37	... 90	10.3 10.3	3.8 3.8	... 11
47A8	Alclad 24S	Sheet	Heat-Treated Heat-Treated and Rolled	56 58	37 46	56 58	34 35	82 83	10.3 10.3	3.8 3.8	12 ...
44T32	52S	Tubing	Soft	32	16	...	...	...	10.3	3.8	15
46A11		Bar & Rod	Soft ½ Hard Hard	29 37 41	14 29 36	... 37 41	... ...	... ...	10.3 10.3 10.3	3.8 3.8 3.8	30 14 8
47A11		Sheet	Soft ½ Hard Hard	29 34 39	14 24 33	... 34 39	... 20 23	... 61 70	10.3 10.3 10.3	3.8 3.8 3.8	15 4 4
46A10	53S	Bar & Rod	Heat-Treated	32	25	...	...	...	...	...	14
46A1	Alcoa 43	Casting	Class 2	17	9	...	...	...	...	...	...
	Alcoa 195-T4		Class 4	29	16	45	25	45	10	...	6
M-186	Alcoa 220-T4			42	22	70	31	68	10.3	3.8	12
M-212	Alcoa 355		Class 10 Heat-Treated	32	20	...	...	...	...	...	2

Steel

Material				Physical Properties							
Navy Spec.	Commercial Designation	Form	Condition or Temper*	U.T.S. 1000 Lb./Sq. In.	Yield Strength (Tension) 1000 Lb./Sq. In.	Compression Strength 1000 Lb./Sq. In.	Shear Strength 1000 Lb./Sq. In.	Bearing Strength 1000 Lb./Sq. In.	Modulus of Elasticity 1,000,000 Lb./Sq. In.	Modulus of Rigidity 1,000,000 Lb./Sq. In.	Elongation % in 2 Inches
44T18	SAE X4130	Tubing	Normalized	90	70	90	55	140	29	11	15
			Heat-Treated	125	100	125	75	175	29	11	...
			Heat-Treated	150	135	150	90	190	29	11	...
			Heat-Treated	180	165	180	105	200	29	11	...
46S23		Bar & Rod	Normalized	90	70	90	55	140	29	11	15
			Heat-Treated	125	100	125	75	175	29	11	...
			Heat-Treated	150	135	150	90	190	29	11	...
			Heat-Treated	180	165	180	105	200	29	11	...
47S14		Sheet	Normalized	90	70	90	...	...	29	11	10
			Heat-Treated	150	135	150	...	...	29	11	...
			Heat-Treated	180	165	180	...	...	29	11	...
46S28	SAE X4340	Bars & Billets	Heat-Treated	215	...	215	...	...	30	...	...
46S21	SAE 2330	Bar & Rod	Heat-Treated	100	80	100	65	140	29	11	...
			Heat-Treated	125	100	125	75	175	29	11	...
			Heat-Treated	150	135	150	90	190	29	11	...
46S22	SAE 1020	Bar	Annealed	55	36	55	35	90	28	10	22
AN-QQ-S-651	SAE 1025	Sheet & Strip	Annealed	55	36	55	35	90	28	10	22
47S15	SAE 1095	Sheet & Strip	Heat-Treated	220	...	220	...	...	...	...	...
22W11		Wire	Hardened	225 to 350	...	...	...	...	...	...	...
44T25	Corrosion-Resistant 18-8 Type 321	Tubing	Annealed	80	30	80	70	...	26	...	40
44T26			Annealed	80	30	80	70	...	26	...	40
46S18 GR.1 Type C		Bars, Rods, and Forgings	¼ Hard	125	75	125	90	...	26	...	12
			Hard	185	140	185	125	...	26	...	...
47S19		Sheet	Annealed	80	35	80	70	...	26	...	40
47S20	Type 304	Sheet	½ Hard	150	110	150	...	...	25	...	10
47S21	Type 302	Sheet	Annealed	80	30	80	...	...	26	...	40
			¼ Hard	125	75	125	...	...	26	...	...
			½ Hard	150	110	150	...	...	26	...	...
46S25	SAE 6135	Bars & Billets	Heat-Treated	125	100	125	65	140	29	11	16
22W13	Corrosion Resistant 18-8 Type 304	Wire	Annealed	85	...	85	...	...	...	...	...
			Heat-Treated	265	...	265	...	...	...	...	...
49S1		Casting	Hard	80	40	...	...	...	...	...	17

Miscellaneous Metals

Material				Physical Properties							
Navy Spec.	Commercial Designation	Form	Condition or Temper*	U.T.S. 1000 Lb./Sq. In.	Yield Strength (Tension) 1000 Lb./Sq. In.	Compression Strength 1000 Lb./Sq. In.	Shear Strength 1000 Lb./Sq. In.	Bearing Strength 1000 Lb./Sq. In.	Modulus of Elasticity (Tension) 1,000,000 Lb./Sq. In.	Modulus of Rigidity 1,000,000 Lb./Sq. In.	Elongation % in 2 Inches
46B14	Phosphor Bronze	Bar & Rod	Up to ½" thick	80	60	...	...	...	...	...	12
			½" to 1" thick	60	40	...	...	...	...	...	20
		Sheet	Medium	50	25	...	...	...	...	...	25
47C2	Copper	Sheet	Hard	35	...	...	...	...	...	...	...
49B3	Bronze	Casting		65	...	...	...	...	...	...	...
46B15	Manganese Bronze	Rod	Class A	80	56	...	...	...	...	...	10
M-112	Magnesium Alloy	Casting	Class 4 Heat-Treated	32	10	...	...	...	6	...	7

* NOTE:

(i) The condition or temper column indicates the condition or temper of the metal or alloy as it exists within the finished aeroplane with the corresponding physical properties wherever these are available.

(ii) For those alloys which are heat treatable the strength after heat treatment is indicated in the U.T.S. (ultimate tensile strength) column.

(iii) Chrome molybdenum steel [X4130] in addition to being used in the normalized condition is also used in the following heat-treated conditions:
125,000 lb./sq. in.
150,000 lb./sq. in.
180,000 lb./sq. in.

(iv) All other metals are hardened by cold working.

High-Strength Bolts and Screws

Note:

All hexagon head bolts and countersunk head screws which are heat treated are provided with special head markings. The markings are as follows:

Strength After Heat Treatment	Head Markings
125,000 lb./sq. in.	X
150,000 lb./sq. in.	●X●
180,000 lb./sq. in.	X●

Section VIII—Finish Specification

SECTION VIII

Finish Specification

1 Applicable Specifications and Instructions

The requirements of Specification SR-15c will be followed only so far as they are specified herein.

1.1 The latest issue of specifications in effect at the date of contract, and which are recorded in Appendix I of this specification, forms a part of this specification unless otherwise specified.

2 General Instructions

2.1 The plant equipment and process control as applied to this specification are essentially the same as approved for previous contracts. In the event that the plant equipment or process controls are changed during the life of this specification, they shall be submitted to the inspector for proper approval.

2.2 This specification covers the protective treatment of each section of the subject aeroplane in detail. The omission of any requirement listed in Specification SR-15c without specific approval will not exempt the contractor from carrying out the provisions thereof.

2.3 PRECEDENCE: In the case of conflict between the requirements of Specification SR-15c and the contractors approved specification, the latter shall prevail subject to the limitations imposed by paragraph 2.2 above.

2.4 DRAWINGS: The protective coating system shall be denoted on all contractors' drawings in such a manner as not to require reference to additional specifications, and so that the finished information will be available when parts are reordered after completion of the contract.

2.5 DISCREPANCIES: In the case of discrepancies between the above information shown in drawings and the requirements of applicable specifications, the latter shall prevail.

3 Material and Workmanship

3.1 QUALITY OF MATERIALS: The materials used in the finishing of all aircraft parts shall be subject at any time to such tests as the inspector may prescribe to determine compliance with the specifications.

3.2 WORK DONE PRIOR TO MATERIAL INSPECTION: Any finishing done prior to the approval of material by the inspector shall be at the risk of the contractor. If tests indicate that the material fails to meet the approved requirements, the lot of material from which the samples were taken shall be rejected and any work done using such materials shall be refinished to the satisfaction of the inspector.

4 Design Considerations of Protection

4.1 FREE DRAINAGE: Designers shall give the utmost attention to the elimination of moisture, particularly from places where it may be readily retained, by every possible method and device. Special attention shall be given to sub-assemblies and assemblies toward providing every possible means of dryness, free drainage and the elimination of water pockets.

4.2 SEAMS: This type of assembly presents a most difficult part of the aeroplane to keep permanently dry. Design shall be considered from this standpoint as well as structural considerations. Faying surfaces shall lend themselves to assembly in the most intimate contact through their entire areas. A minimum of buckling and bulging between adjacent rivets shall be allowed. Edge distances shall not exceed the minimum required by structural considerations in order that a minimum of parting at the edges may be insured.

4.3 DISSIMILAR METALS: Designers shall give this subject most careful and detailed consideration; first, toward eliminating the use of dissimilar contacts wherever possible and, second, by taking every precaution to ensure that a permanently dry contact will result from production methods of assembly.

4.4 HEAT TREATMENT: Designers shall consider the cold water quenching requirements of aluminium alloys (Specification SR-53b) and should not develop shapes or sections which do not lend themselves to rapid quenching in cold water without excessive warping.

4.5 EXHAUST GASES: Designers shall consider the aerodynamic path of exhaust gases and take every precaution to ensure that openings are not provided around areas of negative pressure through which the gases might enter.

5 General Requirements

5.1 The processes and equipment, as applied to this specification, have been approved under previous contracts and comply with the requirements of Specification SR-15c.

5.2 INORGANIC SURFACE TREATMENT

5.21 *Electroplating:* All steel parts, except as herein indicated, shall be cadmium plated. All welding shall be done prior to plating. Brass, bronze and copper parts in contact with dissimilar metals shall be similarly plated. This process, as described below, is in accordance with Specification AN-QQ-P-421.

5.211 All steel parts to be cadmium plated shall be cleaned and pickled in either a five (5) to ten (10) percent solution of sulphuric acid by volume, or a fifteen (15) to thirty (30) percent solution of muriatic acid by volume. If the size and tolerances of the parts will permit, they may be cleaned instead by sandblasting.

All parts shall be thoroughly rinsed in clean water and dried after the cleaning and pickling operation. Parts to be plated immediately after pickling and cleaning need not be dried.

5.212 After the pickling operation, paragraph **5.211**, the removal of grease and oxide films required in the preparation of the surface for plating shall be accomplished without interruption immediately before plating, and the parts shall not be allowed to become dry at any stage once the operations have commenced. The grease film shall be removed by treatment in a hot alkaline cleaning solution, in a hot electrolytic cleaner, or in an organic solvent degreaser, followed by a light duty electrolytic cleaner. Upon rinsing, the parts shall show no water break. The oxide film is then removed by dipping the parts in hydrochloric acid or in a ten percent (10%) solution of sulphuric acid at 50° C. (122° F.).

5.213 Immediately before plating all parts shall be given a cyanide dip by immersing for at least thirty (30) seconds in a two (2) ounce per gallon solution of sodium cyanide. If the cyanide dip solution is reasonably fresh, the parts may be transferred directly into the plating tank without water rinsing.

5.214 The parts to be plated shall be suspended in an electrolytic solution of sodium cyanide, cadmium oxide and caustic soda. A brightener of either hide glue or molasses shall be used as required. The voltage maintained will depend on the class of work and on the distance between the anodes and cathodes. This should be between 4 to 6 volts in still plating. The parts shall be suspended in the electrolyte from the cathode bus bar by means of suitable racks or hooks. The operating temperature shall be from normal room temperature to 95° F. The time required for plating will depend on the thickness of the deposit desired and upon the current density. The latter shall be so regulated as to obtain a hard deposit having a fine grain and a good appearance. In order to maintain the production of satisfactory coatings, it is necessary that the composition of the plating solution be maintained within the limits specified by additions to compensate for materials consumed.

5.215 On completion of the plating operation the plated parts shall be rinsed in clean warm or hot water immediately after removal from the tank. Following this, parts to be painted shall be immersed for one to two minutes in a 5% chromic acid solution at room temperature.

5.216 *Embrittlement Relief of Springs:* All electroplated springs, or other articles subject to flexure, made of steel containing more than .40% carbon and with a final diameter or thickness of less than ¼ inch shall be baked to relieve acid brittleness. The baking process shall consist of heating at a temperature of 375° ± 25° F. for three hours. The springs shall be given this treatment as soon after electroplating as practicable and before any performance tests are made. Plated springs shall not be flexed before the baking specified. The baking treatment shall also be given to springs which are pickled (springs should not be sandblasted) and not subsequently electroplated.

5.217 Thickness of the plating shall be not less than .0005 inch except for threaded articles for which the thickness of plating shall be not less than .0002 inch on any external part of the article. It shall be uniform in thickness, possess good adhesion and the quality shall be such as to withstand a continuous 250 hour 20% salt spray test without signs of rust appearing. The drop test, as specified in AN-QQ-P-421, may be used to determine the thickness of the plating.

5.218 Brass, bronze and copper parts shall be plated according to the same procedure as steel parts with the exception that for oxide film removal, the brass, bronze and copper parts shall be dipped for a few seconds in a solution of approximately the following composition by volume: forty-three and five-tenths percent (43.5) of sulphuric acid, seven and two tenths (7.2) percent of nitric acid, two tenths (.2) percent hydrochloric acid, and forty-nine and one-tenth (49.1) percent water.

5.219 Parts that are not to be cadmium plated are as follows:

a. Parts manufactured of corrosion resistant steel.

b. Parts which are welded to unplated structures such as cowling supports, etc.

c. Welded structures such as fuselages, and hollow parts which cannot be thoroughly cleaned to ensure removal of the plating solution.

d. Cable and parts fabricated from wire.

e. Portions of members which act as bearings or journals.

5.3 CLEANING AFTER SURFACE TREATMENT OR PRIOR TO PAINT PRIMING: After inorganic surface treatment the priming coats shall be applied immediately. In cases where delay has been unavoidable, the material shall be cleaned and dried to ensure against contamination resulting from the delay. If alkaline solutions are used at this stage, the pH value will not exceed 8.5. A preferred method of cleaning at this stage is by the use of a synthetic soap compound such as RM-70. It shall be ensured that all cleaners used at this stage have definite full rinsing properties.

5.4 CLEANING PRIMED SURFACES AFTER FABRICATION AND PRIOR TO APPLICATION OF FINISH COATS: After fabrication of sub-assemblies and assemblies of previously primed material, these surfaces shall be cleaned in such manner as to be thoroughly cleaned and degreased, without leaving a residue of cleaning material, while at the same time removing a minimum amount of the original primer. A warm synthetic soap solution or synthetic soap compound such as RM-70 is most suitable for this purpose. If hydrocarbon solvents are used at this stage, they should be aliphatic petroleum having the lowest solvency values obtainable in order that a minimum amount of the original primer will be removed. An excess of clean rags shall be employed. Care shall be taken to keep cleaning materials out of crevices.

Applicable Specifications

Chromic Acid	AN-O-A-81
Pickling of Steel	PT-4
Sandblasting	PS-5
Embrittlement Relief	PH-4a
Plating, Cadmium	AN-QQ-P-421
Oakite Aviation Cleaner	
Oakite 14	
Embrittlement Relief of Springs	Ph-4a

6 Application of Organic Materials

6.1 Condition of Surfaces: All surfaces shall be thoroughly cleaned and dry at the time of application of any organic coating. They shall not have been handled by dirty or greasy hands after the final cleaning operation. They shall have been conditioned in an atmosphere of reasonable dryness so that the surfaces are free from even the slightest traces of moisture.

6.2 Air or Weather Conditions: Organic coatings shall be applied in an air-conditioned room. The temperature shall be between 80° F. and 90° F. with a maximum relative humidity of 60%.

6.3 Preparation of Materials: Mixing shall be done under controlled conditions and may be either by weight or by volume in such a manner as to ensure a high degree of uniformity of all materials prepared for use.

6.31 *Mixing Aluminium Pigment:* The pigment shall first be wet with a small amount of thinner such that the first operation provides a free flowing paste which may then be gradually reduced by additional small increments of thinner.

7 Detail Finish Schedule

7.1 Shop Primer Coat Required: After the inorganic surface treatment, all metal surfaces and parts shall receive a shop coat of zinc chromate primer and one coat of aluminized zinc chromate unless specified otherwise. After shop fabrication is complete, these coats shall be thoroughly cleaned as specified under paragraph 5.4, retouched where necessary and then serve as the first two coats of the following schedules.

7.2 General Instructions: All finishes shall be applied by the spray gun method except the application of clear dope to fabric, which shall be applied by brushing. Each coat of paint shall be thoroughly dry before the application of another coat.

7.21 *Fuselage Interior:* All surfaces and parts shall receive one coat of zinc chromate primer and one coat of aluminized zinc chromate in detail before assembly, unless otherwise specified. After assembly all grease, dirt, etc., shall be cleaned from the original coats, care being taken that a minimum of these coats are removed. All abraded or scratched portions of the original coats shall then be touched up with aluminized zinc chromate. When the repaired surface has thoroughly dried a final coat of aluminized zinc chromate shall be applied.

7.22 *Cockpits Fore and Aft—Interior:* The forward cockpit shall be that portion of the interior of the aeroplane extending from the firewall to station 40. The rear cockpit shall be that portion of the interior of the aeroplane starting at station 100 and terminating at station 168½.

7.23 *Cockpits—Detail:* In addition to the finish schedule of paragraph 7.21, the interior cockpit enclosures, as defined in paragraph 7.22, and all the brackets, supports, reinforcements used for structural purposes, control handle shafts, containers and flooring included in this section shall receive a coat of dull green lacquer unless specified otherwise.

> Note: The control handle shaft is the rod connecting the handle to the control cable or other transmitting apparatus and does not include the handle or knob.

7.24 *Canopy and Windshield:* The metal interior of the canopy and windshield shall receive two coats of zinc chromate primer and one coat of dull green lacquer.

7.25 *Pilot and Gunner Seats:* The pilot and gunner seats shall receive two coats of zinc chromate primer and one coat of dull green lacquer.

7.26 *Instrument Panels:* The instrument panels shall receive one coat of zinc chromate primer and two coats of black enamel.

7.27 *Wings, Flaps and Ailerons—Interior:* The interior of the wings, flaps and ailerons shall receive one coat of zinc chromate primer and one coat of aluminized zinc chromate in detail before assembly. After assembly they shall receive another coat of aluminized zinc chromate.

7.28 *Struts and Open Structural Tubing—Interior:* Struts and open structural tubing shall receive one coat of zinc chromate primer and one coat of aluminized zinc chromate in detail before assembly unless specified otherwise.

7.29 *Interior of Non-Structural Tubing—Open:* The interior of open non-structural tubing shall receive one coat of zinc chromate primer with the exception of the airspeed meter tubing which shall not be painted.

7.30 *Tail Surfaces—Interior:* The interior of the tail surfaces shall receive one coat of zinc chromate primer and one coat of aluminized zinc chromate in detail before assembly. After assembly these surfaces shall receive another coat of aluminized zinc chromate.

7.31 *Cowling—Interior:* The interior of the cowling shall receive one coat of zinc chromate primer and one coat of aluminized zinc chromate in detail before assembly. After assembly it shall receive another coat of aluminized zinc chromate.

7.32 *Fabric Surfaces:* Successive coats of clear dope shall be applied on fabric covered parts until a film is obtained to produce a uniformly taut, smooth and rigid surface. Under normal conditions this should be accomplished with at least four coats of dope. This process shall be in accordance with Specification SR-70. (Ref. TN 8-41—Deterioration of Fabric Covered Surfaces.)

7.33 *General Exterior Finish:* The entire exterior surface (which includes the fuselage, wings, tail surfaces, ailerons, flaps, cowling, tail wheel, main undercarriage, the metal section of the canopy, etc.) shall receive one coat of zinc chromate primer in detail before assembly. After assembly these exterior surfaces shall be camouflaged according to Brewster Aeronautical Corporation drawing 14L-401.

7.34 *Marking System for the Aeroplane*

7.341 *Piping System:* The pipe lines in the following groups shall have colored bands located near the flared ends as specified below.

For pipes up to and including 7/16 inch diameter:

Broad Band	3/8 inch wide
Narrow Band	1/8 inch wide
Distance between Bands	1/8 inch

For pipes 1/2 inch diameter and greater:

Broad Bands	3/4 inch wide
Narrow Bands	1/4 inch wide
Distance between Bands	1/4 inch

The bands shall be of the following sizes and colours to identify the purpose of the pipes and the liquid or gas being conveyed thereby.

Fuel System	One Broad Red Band
Lubricating System	One Broad Black Band
Hydraulic System	One Broad White Band
Oxygen System	One Narrow White Band— One Narrow Blue Band
Anti-Icer System (Carburetor and windscreen)	One Narrow Yellow Band— One Broad White Band— One Narrow Yellow Band
Vacuum Lines (for Instruments)	One Narrow White Band— One Narrow Black Band

7.343 *Armour Plate Identification:* All armour plate shall be painted yellow or have yellow roundels for the purpose of identification.

7.344 *Lift Points:* All lift points of aeroplanes shall be indicated by the words "Lift Here" painted in letters one inch high above the lift point.

7.345 *Electrical Connections:* The following instructions shall be painted at points where necessary to break electrical connections when folding back or removing wings, or removing tail surfaces or struts: "Disconnect electrical wiring before removing (part)."

Applicable Specifications

Zinc Chromate Primer	P-27-b
Aluminized Zinc Chromate	PF-9b
Dull Green Lacquer	L-12b
Aluminium Powder or Paste	RM-137-1
Clear Lacquer	L-12b
Black Enamel	E-6E
Aluminium Lacquer	L-12b
Clear Dope	D-15d
Thinner	T-25e
Thinner, Toluene Substitute	T-62b

8 Special Requirements for Corrosion Prevention

8.1 *Free Drainage:* A special inspection shall be made of the aeroplane primarily from the standpoint of its attitude at rest, but also considering its attitude in flight, to determine that every possible pocket, large and small, is provided with a means of complete drainage. This inspection shall be made at such times during the process of construction and repeated as necessary to ensure that its purpose is being effectively accomplished. When necessary, holes shall be drilled of sufficient size that they may be adequately painted without endangering subsequent stoppage. Where drain holes cannot be provided for minor pockets, the affected area shall be filled with wax or wax-grease mixtures, or other suitable compounds, such as to ensure the elimination of moisture concentration by this method.

8.2 FAYING SURFACES AND SEAMS:

8.21 *Faying Surfaces:* A faying surface is defined as the area of contact between either similar or dissimilar metals. It does not include bearing surfaces or any metal contacts which are not permanently fixed. Faying surfaces shall all be painted with a minimum of one coat of zinc chromate primer and one coat of aluminized zinc chromate on each surface regardless of the class of protective schedule used on adjacent surfaces. Where dissimilar metals are involved, additional coats as specified under paragraph 8.3 shall be required.

8.22 *Seams—General:* A minimum of non-meeting area shall be provided. Where full caulking is not required organic coatings shall be applied in such a manner as to provide caulking and filleting of the edges. Rivet spacing closer than that required for structural considerations may be required by the inspector if considered desirable.

8.23 *Seams—Watertight:* Seams shall be caulked in such a manner as to prevent seepage of moisture into any part of the seam. The caulking compound shall be applied to one side of the seam in ribbon form such that an excess will be squeezed out during the process of riveting the assembly. The caulking compounds shall be Fuller's zinc chromate compound types 1 and 2, or Vellutex gasket in combination with the Fuller's caulking compounds. The finished seams shall comply with paragraph 8.22.

8.24 *Seams—Fuel Tanks:* Seams shall be caulked with Fuller's zinc chromate compound of either type 1 or 2. The finished seams shall comply with paragraph 8.22.

8.3 DISSIMILAR METALS—INSULATION OF: An additional coat of zinc chromate primer shall be applied to ferrous and copper alloy surfaces. They shall also be insulated with Fuller's zinc chromate compound types 1 or 2 in such a manner that when assembled the compound shall be squeezed out at all boundaries and the excess removed so as to leave a complete fillet all around the boundary. Where the plastic compound cannot be used two additional coats of zinc chromate primer shall be applied, and a complete fillet using the plastic compound made after assembly.

8.4 HEAT TREATMENT OF ALUMINIUM ALLOYS: The following requirements shall be strictly adhered to so that the maximum corrosion resistance of aluminium alloy parts is obtained. Where, through unanticipated design limitations it is found to be impracticable to provide rapid quenching in cold water, parts shall be redesigned or production processes so altered as to make full compliance with this specification possible. Any deviations from the procedure specified herein, necessary to accomplish the desired results, shall be brought to the attention of the inspector.

8.41 The aluminium alloys which are subject to the heat treatment described herein are: sheet and plate of alloys 17S, alclad 17S, 24S and alclad 24S; bar, rod, shapes, wire, tubing, rivets and rivet wire of alloys 17S and 24S; machine screws, bolts and nuts of alloy 24S. The aluminium alloys 2S, 3S and 52S are not to be heat-treated. The following process is in accordance with SR-53.

8.42 The metal shall be heat-treated in a salt bath containing 50% sodium nitrate and 50% potassium nitrate. The temperature of the salt bath shall be maintained at 930° to 950° F. for alloys 17S and alclad 17S and at 910° to 930° F. for 24S and alclad 24S. The size of the charge shall be so regulated as to avoid undue cooling of the salt bath when the charge is introduced. The charge shall be arranged in such a way that the parts are not nested except where it is composed of multiple small parts such as spacers, washers, clips, etc.; contact between parts is permissible under these conditions. In general, charges of alclad 17S and alclad 24S involving different thicknesses of material should be avoided as much as possible due to the danger of excessive diffusion in the coating of thinner parts. The molten mixture of sodium nitrate and potassium nitrate shall be maintained so that the pH value of a 1% solution of a sample of the bath is between 6.0 and 7.5.

8.43 The time of soaking for any alloy will in general depend upon the type of alloy, the prior thermal or mechanical treatment to which the alloy has been subject, and the size and shape of the part or parts being treated. Reference should be made to specification SR-53 for the recommended periods of time required for the particular size, type of alloy and condition of heat treatment concerned.

8.44 All parts shall be quenched from the heat-treating temperature by immediate immersion in cold water. The quenching water shall not exceed 85° F. at the time the charge is introduced or 100° F. at any time during the quenching operation. The time consumed in transferring the heated parts from the salt bath furnace shall be as short as possible in all cases. Any delay whatever is detrimental to the effectiveness of the heat treatment. The quenching operation shall be systematized in such a manner as to eliminate delays due to lack of coordination and to assure uniform consumption for all loads. After quenching, the parts shall be dipped into a cold water solution containing six (6) ounces of Oakite 31W per gallon of water to remove the salts adhering to the parts from the solution heat treatment. This shall be followed by a thorough rinsing in cold water. Heat-treated parts shall be considered to have developed their maximum physical properties in four days of natural aging at room temperature. Aging of these alloys shall not be accelerated by additional heating of any kind.

8.45 Alloys 17S and 24S may be re-heat-treated repeatedly without injury, provided the treatment is carefully and properly performed. For the re-heat treatment of aluminium coated alloys, reference should be made to Specification SR-53.

8.46 *Annealing:* The purpose of annealing is to increase the formability of the alloys as an aid in fabrication. It is not a final heat treatment and all parts which have been annealed shall be heat-treated prior to acceptance for service. Alloys alclad 17S and alclad 24S shall not be fully annealed for relief of hardness caused by previous heat treatment. If this material is required in the annealed condition, it shall be purchased annealed. The aluminium alloys 2S, 3S and 52S are not to be annealed.

8.461 The annealing procedure to be followed in any case will depend upon prior treatment of the material and the degree of softness desired. The degree of annealing desired may be either a partial annealing or full annealing. For full anneal for the purpose of relief of hardness caused by cold work (material not previously heat-treated) the parts are to be heated to a uniform temperature by means of a salt bath similar to that described in paragraph 8.42 within a range 640° to 670° F. and then allowed to cool slowly in air. Under no condition should the parts be quenched in water. To obtain a partial anneal for relief of hardness caused by previous heat treatment the same procedure is to be followed as described above. In order to obtain a full anneal for relief of hardness caused by previous heat treatment, the parts shall be heated to a uniform temperature within the range 790° to 810° F., soaked for two hours, and cooled slowly (approximately 50° F. decrease per hour) to 450° F., after which more rapid cooling is permissible.

8.47 *Heat Treatment of Rivets:* The requirements specified above for the heat treatment of general parts are applicable to the heat treatment of rivets except for the details of temperature, soaking time, equipment especially adapted to handling rivets and elimination of direct contact between the rivets and the molten salt in salt baths.

8.471 All rivets shall be anodized before re-heat treatment in order to prevent intergranular oxidation. Since rivets are purchased in the heat-treated condition, the first heat treatment performed by the fabricator is a re-heat treatment and prior anodizing is required. The minimum soaking period for rivets shall be forty (40) minutes, and the temperature shall be maintained from 930° to 950° F. for alloy 17S, and from 910° to 930° F. for alloy 24S. At no time should the rivets be allowed to come in direct contact with the solution in the salt bath, and a suitable container should be supplied to avoid the contact and to facilitate handling during the operation. After the rivets have soaked for the specified time, the container shall be removed from the bath and the rivets poured immediately into circulating cold water. The volume of the quenching water shall be sufficient to avoid appreciable rise in temperature during quenching.

8.472 Rivets of alloy 17S allowed to age at room temperature (less than 85° F.) shall be considered unfit for use one (1) hour after quenching, and shall be returned for re-heat treatment. Rivets of alloy 24S shall be returned for re-heat treatment twenty (20) minutes after quenching. If, after quenching, rivets of either alloy are maintained continuously at a temperature not higher than 32° F. they may be used without re-heat treatment for periods up to forty-eight (48) hours maximum if the material is properly workable when it is removed from refrigeration storage. Rivets shall not be re-heat-treated more than fifteen (15) times.

8.5 SURFACES EXPOSED TO EXHAUST GASES: Additional protection shall be applied to any surfaces that are exposed to exhaust gases.

Applicable Specifications

Preparation of Faying Surfaces and Fastening	PF-2-2
Zinc Chromate Primer	P-27b
Heat Treatment of Wrought Aluminium Alloy	SR-53b

9 Electrical Bonding

9.1 ELECTRICAL BONDING: Aluminium alloy bonding jumpers shall be used where either part that is to be bonded is made of aluminium, aluminium alloy, magnesium base alloy or steel. An exception is made in the case of corrosion-resistant steel. This bonding jumper shall be of copper. All bonding jumpers other than in the cases specified above are to be made of copper.

9.2 DISSIMILAR METAL CONNECTIONS: Where dissimilar metal connections are required by bonding, such connections shall not be made to any structural part of the aeroplane. The design of structures should provide for integral tabs to which bonding connections may be made. If not provided, similar metal tabs shall first be attached to a structural member such that when and as corrosion of dissimilar contacts takes place the main structure will not be affected.

9.3 ELECTRICAL CONDUIT: Electrical conduit need not be painted prior to installation. After installation, the conduit and boxes shall receive one coat of zinc chromate primer and one coat of aluminized zinc chromate.

9.4 PROTECTION OF BONDING CONNECTIONS: Bonding connections shall receive one coat of zinc chromate primer and two coats of aluminized zinc chromate after installation. They shall also be coated with Par-al-ketone.

Applicable Specification

Electrical Bonding of Aeroplanes	SR-16e

10 General Precautions

10.1 METAL PARTICLES: Precautions shall be taken in the fabrication and assembly of materials, particularly relatively inaccessible sections, to ensure that metal particles, particularly of dissimilar character, do not remain lodged behind frames or stringers by becoming partially imbedded in organic coatings. A vacuum cleaner providing strong suction shall be employed for frequent cleaning operations in such areas.

10.2 STEEL WOOL, USE OF: The use of steel wool on aluminium and magnesium alloy surfaces is prohibited. Where used on steel surfaces, it shall be handled with caution and all the particles arising from such use shall be carefully disposed of.

10.3 LEATHER, USE OF: Leather shall not be used in the construction of this aeroplane.

10.4 TIE RODS: There are no tie rods on the subject aeroplane.

10.5 WRAPPING: There shall be no wrapped structural members on the subject aeroplane.

10.6 WELDING AND SOLDERING: Welded aluminium alloy parts shall be cleaned in the manner described herein as soon as practicable after welding so as to ensure complete removal of the welding flux. Complete and prompt removal of welding flux is necessary in order to prevent serious corrosive attack. The following process is in accordance with Specification PT-5.

10.61 All excess flux shall be removed from the part by washing with water. The part shall then be immersed in a 10% solution (by weight) of sulphuric acid for a period of 1 hour or less or a sufficient length of time to remove all traces of flux, making sure that all relatively inaccessible surfaces are in contact with the solution. A fresh solution should be prepared when loss of effectiveness in removing flux is noted. After removing from the acid, the part should be washed in fresh, running water for a sufficient length of time to thoroughly remove the acid.

10.62 Welding, soldering or filing shall not be permitted on an assembly after it has been painted without prior approval of the inspector.

10.7 WORKING SURFACES: Special care shall be exercised to ascertain that paint is not applied to working surfaces or to adjustable screw threads, oil holes, etc. Paint shall not be applied to fittings in such a manner as may cause bearings to freeze.

10.8 RUBBER: Rubber shall not be painted, greased or oiled.

10.9 FIREPROOF BULKHEAD AND ENGINE STRUCTURES: The forward surface of the fireproof bulkhead and all parts of the engine structure shall receive one coat of zinc chromate primer and one coat of aluminized zinc chromate.

Applicable Specifications

Removing of welding flux from aluminium fuel and oil tanks	PT-5

11 Fabric Surfaces

11.1 GENERAL: See fabric doping under paragraph 7.32 of this report.

11.2 DOPE PROOFING: The metal surfaces in contact with doped fabric do not require dope proofing when finished as herein specified.

11.3 FIRE PROOFING: There are no doped surfaces exposed to hot particles from exhaust manifolds.

12 Miscellaneous Items and Requirements

12.1 ACID PROOFING: Surfaces within at least 12 inches of storage batteries or parts further removed which are subject to acid spillage or spray shall be given two additional coats of bituminous paint, Navy Spec. P-22.

12.2 STANDARD PARTS: Standard parts such as bolts, nuts, etc., shall be painted with zinc chromate primer prior to assembly wherever practicable. After assembly, they shall be thoroughly coated with primer in such a manner as to provide an organic film around all boundaries. Where a bolt forms a part of a dissimilar metal assembly, an aluminium alloy AN-960 series washer shall be placed under both the head of the bolt and the nut. Threads of adjustable parts such as tie rods, turnbuckles, etc., shall be lubricated and protected both before and after assembly with Par-al-ketone. Where properly protected by this material, seizure will be eliminated.

12.3 CONTROL CABLES: Control cables shall be protected by immersing in Par-al-ketone prior to installation. After installation, they shall be lightly coated with the same material.

12.4 TANKS

12.41 *Fuel Tanks—Integral:* The interior of the fuel tanks shall receive one coat of zinc chromate primer. The primer shall be allowed to dry at least two weeks prior to filling with fuel or, if a shorter drying time is required, it shall be accomplished by continuous circulation of hot air for a period of at least 24 hours.

12.42 *Oil and Hydraulic Tanks:* The exterior surface of all oil and hydraulic tanks shall receive one coat of zinc chromate primer and two coats of aluminized zinc chromate. The interiors of oil and hydraulic tanks require no organic protection. However, when these tanks are going to be stored as spares, the interior surfaces shall receive a coating of S.A.E. 20 oil.

12.43 *Tank Supports:* Tank supports shall receive one coat of zinc chromate primer and two coats of aluminized zinc chromate. The supports shall be insulated from the tanks with Adelite pads.

12.5 TUBING

12.51 *Structural:* All structural tubing except as otherwise specified shall be protected on the interior in the same manner as the exterior. In the case of bent-up sections or sections in which the three coat system is impractical, this requirement may be modified by the Inspector as may be required to provide for adequate protection. The use of steel fittings in conjunction with aluminium alloy tubing shall not be employed where a suitable design can provide otherwise. End fittings used with open tubing shall be designed or drained so they do not form pockets for the collection of moisture.

12.52 *Sealed Steel—Structural:* Shall be sealed by welding to exclude the entrance of moisture. After all welding and brazing operations have been completed, the interiors shall be protected with Par-al-ketone "B" reduced with not more than equal parts of toluene, mineral spirits or lead-free petrol to consistency desired. A small hole is to be drilled into the side of the tubing at each end. The Par-al-ketone mixture is introduced at one end of the tubing and after thoroughly covering the interior surfaces it is drawn from the opposite end. The holes are sealed using self-tapping screws. When self-tapping screws are used in structural members, care shall be exercised to place them in the regions of the lowest fibre stress and in carefully selected locations to prevent structural weakness. The diameter of the hole shall be so related to the pitch diameter of the screw that tightness is obtained without stretching, scratching, or splitting the surrounding metal.

12.521 Structures of this type shall be sandblasted and immediately thereafter protected with a shop coat of zinc chromate primer with minimum handling or contamination of the sandblasted surface. After the primer has dried a coat of aluminized zinc chromate shall be applied. When such parts have been installed or assembled in the aeroplane they shall receive a final finish in accordance with adjacent surfaces.

12.53 *Non-Structural Tubing:* Tubing of this type shall receive suitable organic protection depending upon the size, type of material and function, and whether open or closed. 2S, 3S, 52S and 53S require less protection than 17S and 24S. Closed systems of the former materials normally require no protection.

Open systems of the material shall receive a minimum of one coat of zinc chromate primer. Open systems of the latter materials shall receive two coats of zinc chromate primer.

12.531 *Oil Lines, Fuel Lines and Hydraulic Lines:* Any tubing used in the oil lines, fuel lines and hydraulic lines shall not be painted on the interior, but shall be finished on the exterior with one coat of zinc chromate primer in detail before assembly and one coat of aluminized zinc chromate after assembly.

12.6 POTASSIUM DICHROMATE, USE OF: Potassium dichromate crystals or preferably a mixture of two (2) parts of these crystals with one (1) part of zinc chromate pigment, shall be supplied in small fabric sacks or in aluminium tea balls, and employed in the sumps of all fuel tanks. Provision shall be made that inspection and replenishment of these materials may be easily accomplished.

12.7 RIVETS: Rivet heads shall be thoroughly cleaned and neatly touched or sprayed with zinc chromate primer as soon as practicable after the driving operation. Where dissimilar metals are involved zinc chromate primer shall be applied to the surface of the rivet holes before application of the rivets in such a manner that the primer coat is still wet during the driving operation.

12.8 FASTENINGS, STRUT ENDS AND OTHER SIMILAR PARTS: Shall be coated with an equal mixture of Par-al-ketone "B" and one of the following: toluene, mineral spirits or lead-free petrol.

12.9 CORROSION-RESISTANT STEEL PARTS: Shall receive no organic surface treatment unless otherwise specified.

12.10 ARMOUR PLATE: All armour plate which is unexposed shall receive one coat of zinc chromate primer and one coat of aluminized zinc chromate. Armour plate located in the cockpit enclosures as defined in paragraph 7.22 shall receive one coat of zinc chromate primer and two coats of dull dark green lacquer. (Navy specification L-12b.)

12.101 A light sandblast may be used in preparing armour plate for organic finish coats, but in no instance shall the acid pickling process be used. Also, care should be taken to avoid heating or subjecting armour plate to temperatures in excess of 212° F. as this may seriously decrease the effectiveness of the armour.

Applicable Specifications

Par-al-ketone	RM-61c Tech. Note 33-38
Potassium Dichromate	Tech. Note 41-38
Zinc Chromate Primer	P-27b
Toluene	RM-111c
Mineral Spirits	TT-T-291

13 Colour System

13.1 INSIGNIA AND MARKING: The insignia and marking of the subject aeroplane shall be according to British Specifications.

14 Specifications for Protective Coatings

Compound, Dope, Enamel, Lacquer, Paint, Primer, Solvent, Thinner and Varnish

Specification Number	Title
C-47c	Compound, Soya Bean Oil
C-71-1	Compound, Liquid Wax, Self-Polishing, Waterproof
D-15d	Dope, Nitrocellulose, Clear
D-16d	Dope, Nitrocellulose, Pigmented
E-5e	Enamel, Glyceryl Phthalate, Aircraft
E-6e	Enamel, Black, Glyceryl Phthalate
L-12b	Lacquer, High Resin, Phthalate
P-27b	Primer, Zinc Chromate, Naval Aircraft
P-37	Paint, Dope-Proof
RM-61c	Par-al-ketone
T-25e	Thinner, Nitrocellulose Dopes and Lacquers
T-62b	Thinner, Toluene Substitute
V-10e	Varnish, Naval Aircraft Spar
ST-15e	Inspection of Organic Protective Coatings for Aircraft

15 Specifications for Cleaning Materials

Specification Number	Title
M-354	Metal Cleaner, Silicate Soap
M-355	Stripping Agent, Phenolic Amine Base
RM-70	Ether, Alkylated, Phenolic
AN-O-T-631	Trichlorethylene, Stabilized

16 Specifications for Ingredient Materials

Specification Number	Title
C-55	Cadmium Oxide
AN-O-A-81	Acid, Chromic
AN-O-A-361	Zinc Cyanide
AN-QQ-A-671	Anodes, Cadmium
AN-QQ-A-686	Anodes, Zinc
52B4c	Beeswax
RM-1d	Cellulose Nitrate
RM-11b	Oil, Linseed, Raw
RM-31-1a	Resin, Glyceryl Phthalate
RM-32-1a	Resin, Phenol-Formaldehyde
RM-61c	Par-al-ketone
TT-T-291	Mineral Spirits
RM-111c	Toluene (Toluol)
RM-112d	Xylene (Xylol)
RM-131-1b	Carbon Black
RM-133-2b	Toluidene Red
RM-135-1b	Lead Chromate
RM-135-5c	Zinc Chromate
RM-135-6	Cadmium Lithopone
RM-136-2b	Chrome Green, Extra Light
RM-137-1	Aluminium Pigment
RM-151a	Creosol

RM-160	Potassium Nitrate
P-22	Bituminous Paint

17 Specifications for Processes

Specification Number	Title
AN-QQ-P-421	Plating, Cadmium
PD-2	Application of Series D-12 and D-13 Dopes to Fabric Surfaces
PF-2	Preparation of Faying Surfaces and Fastenings
PF-6	Painting of Special Aircraft
PF-9b	Use of Zinc Chromate Primer
PR-2	Rejuvenation of Doped Fabric Surfaces
PS-5	Sandblasting Metal Parts
SR-19d	Protective Treatment of Aluminium and Aluminium Alloys by Anodic Oxidation Process
SR-70b	Application of Protective Coatings to Fabric Surfaces of Aircraft
ST-15e	Inspection of Organic Protective Coatings for Aircraft
AN-QQ-S-91	Salt Spray Corrosion Test; Process for
M-364	Compound Phosphate Coating

18 Slosh Coating Cell Interiors of Self-Sealing Fuel Tanks with Fuller's TL-284 for Protection against the Effects of Aromatic Fuels

Materials

Fuller's TL-284 Compound	Mfd. by W. P. Fuller & Co., 135 North Los Angeles Street, Los Angeles, Calif.
Acryloid Resin 9524	Mfd. by Pratt and Lambert Inc.
Ethyl Acetate	Commercial
Oil	S.A.E. No. 60

General Requirements

All self-sealing fuel tanks that are not manufactured with an inner layer that is resistant to the effects of aromatic fuels shall be sloshed. Tanks manufactured with an inner layer that is resistant to the effects of aromatic fuels and which, therefore, do not need to be sloshed are identified by a solid red line painted around the filler opening and are stenciled "Suitable for use with aromatic fuels"—and the date.

Equipment

The equipment shall consist of a container suitable for thinning the Fuller's compound, and containers, funnel, etc., suitable for pouring and draining. Facilities shall be provided for the circulation of air through the cell for drying purposes.

Procedure

The method to be used in applying the protective coatings to tanks shall be as follows:

If the cell has had fuel in it, precautions shall be taken to drain the cell completely of the fuel, making certain that no fuel remains in depressions. Circulate air through the cell for about eight hours or until the odour of fuel has disappeared.

Scuff the interior surface of the cell at the sump with sandpaper or abrasive cloth in order to obtain satisfactory adhesion in this area. Clean the interior of the cell by wiping the entire surface with ethyl acetate.

Reduce the sloshing compound TL-284 by the addition of one part thinner (ethyl acetate) to three parts compound. It is important to control the viscosity at all times in order to obtain uniform results. One simple method for controlling viscosity is to check by means of a hydrometer at least twice daily.

Disconnect all fuel lines, gauge lines, etc. Remove fuel quantity gauges and any other interior fittings. Seal all openings except the filler openings.

Before the application of the sloshing compound mask the upper and lower surfaces of the cell with which the float will come in contact. This area shall be a square of approximately five inch side.

After all masking has been completed fill the cell with compound TL-284 reduced in accordance with instructions given above. In order to avoid pinholes in the finished coating pour compound into the cell through a tube or down the side of a rod or tube until the cell is completely filled. If the cell is not installed in the aeroplane slosh the cell by using 15 to 20% of the tank volume of the sloshing compound reduced as noted. Seal the filler opening and rotate the cell into all positions to assure complete coating of the cell interior and non-metallic fittings. When the cell interior has been completely coated, turn the cell on one corner and allow all excess sloshing compound to drain into this corner for a period of five to ten minutes. The corner selected for this drainage should be one that gives the best flow from all surfaces of the cell and should be near an opening for final drainage. After the final draining process and as long as the compound remains fluid, it is important to shift the position of the cell at approximately 20 minute intervals in order to prevent the formation of pools or puddles of the compound. It is highly important that the interior of all non-metallic cell fittings be thoroughly coated as well as the cell interior.

Dry the coating compound by a slow stream of air. The air movement should be no faster than necessary to accomplish a complete air change every two or three minutes. The air should be circulated through the cell for 18 to 24 hours, or until all odour of ethyl acetate has disappeared.

When the cell interior has been dried apply a second coat, following the procedure set forth for the initial coat. After the second coat has been thoroughly dried swab the cell interior with oil S.A.E. No. 60, making sure that all areas of the slosh coat are covered by the oil film. This treatment will prevent the slosh coat from adhering to itself on installation.

After the second coat has been thoroughly dried, and before the float has been installed into the cell and before the application of the lubricating oil, remove the masking. Apply to this protected area two or three coats of acryloid resin by means of a brush. A drying period of about two hours shall be allowed between coats. After the interior of the cell is completely dried the float shall be installed.

Cells that have been delivered already sloshed and in which no provisions were made for the application of the acryloid resin shall be treated as follows:

Remove the sloshing compound from the areas that would ordinarily be masked by swabbing with a cloth saturated with ethyl acetate. Precautions must be taken to restrict the flow of ethyl acetate to within the 5 inch square and not to flow freely about the cell. When the cleaned surfaces have been thoroughly dried apply the acryloid resin.

All cork floats shall also be protected against the action of aromatic fuels. This is accomplished by applying at least two coats of acryloid resin to the surface of the float with a suitable drying period between coats.

The sloshed tank shall be identified by a single broken red line painted around the filler opening and "Sloshed for Aromatic Fuels" and the date stenciled on the cell.

Should it be necessary to slosh a fuel cell without removing it from the aeroplane, fill cell with sloshing compound. Agitate compound by rocking aeroplane by wing tips until complete coverage is assured. Then drain cell and dry by blowing air through cell as previously described.

19. Inorganic Finish Treatments for the Bermuda Aeroplane

U. S. Navy Spec.→	Cleaning Prior to Anodizing	Anodizing SR-19	Electroplating PP-1B	Embrittlement Relief of Springs PH-4A	Heat-Treating SR-53B	Annealing SR-53b	Cyanide Dip PP-1B	Cleaning and Pickling PT-4	NOTES
Aluminium and Aluminium Alloy Parts and Tubing	Oakite aviation cleaner				Alloys 17S and 24S, alclad 17S and alclad 24S	Alloys 17S and 24S			
Steel Parts			After welding immediately after plating rinse in clean hot water				Immediately before plating	Yes—see notes 1 and 2	1. If size and tolerances of parts permit, they may be cleaned by sandblasting (PS-5) 2. Grease and oxide films removed by treatment in a hot alkaline solution
Springs—or Other Parts Subject to Flexure				All containing more than .40% carbon and thickness or final diameter less than 1/4 in.					
Brass, Bronze and Copper Parts			Only when in contact with dissimilar metals						Remove oxide film by dipping for a few seconds in a solution of approximately 43.5% sulphuric acid, 7.2% nitric acid, .2% hydrochloric acid and 49.1% water (by volume)
Aluminium Bar, Rod, Shapes, Wire, Tubing, Rivets and Rivet Wire					Alloys 17S and 24S				
Machine Screws — Bolts and Nuts					Alloys 24S				
Rivets		All rivets must be anodized prior to re-heat treatment			All rivets of alloys 17S and 24S before using				Rivets are generally purchased in a heat-treated and anodized condition. When such is not the case, rivets must be anodized before heat treatment

20. Organic Finish Treatments for the Bermuda Aeroplane

	Each item to be finished as specified under the item heading without reference to any other item	Shop Coat Primer Zinc Chromate Before Assembly	One or More Additional Prime Coats	Aluminized Zinc Chromate Before Assembly	Aluminized Zinc Chromate After Assembly	Dull Green Lacquer	Black Enamel Type 3	Clear Dope	Camouflage Finish	Caulking Compound	Par-al-Ketone	NOTES
	U. S. Navy Specifications →	P-27b-2		PF-9b		L-12b	E-6e-2	SR-70b	M-485		RM-61c	
1	Fuselage Interior	One coat	Touch up after cleaning	One coat	One coat							
2	Cockpits Fore and Aft—Interior Detail	One coat	Touch up after cleaning	One coat	One coat	One coat						Forward cockpit—fireproof bulkhead to station 40. Rear cockpit—station 100 to station $168^1/_2$
3	Canopy, Windshield and Gun Turret	Two coats				One coat						
4	Pilot and Gunner's Seat	Two coats				One coat						
5	Instrument Panels	One coat					Two coats					
6	Wings, Flaps and Aileron—Interiors	One coat		One coat	One coat							
7	Struts and Open Structural Tubing—Interior	One coat		One coat								
8	Open Non-Structural Tubing—Interior, Except Air Speed Meter Tube	One coat										Interior surfaces of airspeed meter tubing shall receive no finish
9	Tail Surfaces—Interior	One coat		One coat	One coat							
10	Cowling—Interior	One coat		One coat	One coat							
11	Fabric Surfaces							At least 4 coats				The final finish shall be camouflage paint
12	General Exterior after Assembly	One coat							Two coats			
13	Faying Surfaces											When the parts are finished under this schedule they will have received two coats on each faying surface
14	Seams—Watertight	One coat								Zinc chromate compound		
15	Seams—Fuel Tanks	One coat								Zinc chromate compound		
16	Dissimilar Metals, Insulation of	One coat	One coat							Zinc chromate compound		Where plastic compound cannot be used, two additional coats of primer shall be used
17	Electrical Conduit and Junction Boxes—Exterior	One coat			Two coats							
18	Electrical Conduit and Junction Boxes—Interior											No finish shall be applied
19	Bonding Connections		One coat		Two coats						One coat	The finish shall be applied after installation
20	Fireproof Bulkhead and Engine Structure—Forward Surface	One coat			One coat							

(Continued on next page)

(Continued from preceding page)

21	Surfaces within 12 Inches of Storage Batteries				Two additional coats							
22	Standard Parts—Bolts, Nuts, Etc.	One coat										Where a bolt forms a part of a dissimilar metal assembly, an aluminium alloy washer (AN 960) shall be placed under both head and nut of the bolt
23	Threads of Adjustable Parts, Such as Turnbuckles, Etc.										Before and after assembly	These threads shall receive no finish. Masking or other suitable means may be used to protect these areas
24	Control Cables										Before and after assembly	
25	Fuel Tanks Integral—Interior	One coat										The primer must be allowed to dry two weeks prior to filling with fuel
26	Fuel Tanks Non-Integral—Exterior	One coat		Two coats								See note under modifications for finishing welded assemblies
27	Oil and Hydraulic—Exterior (Tanks)	One coat		Two coats								See note under modifications for finishing welded assemblies
28	Oil Tanks—Interior Stored as Spares											A coat of SAE No. 20 oil shall be applied to the interior surfaces
29	Tank Supports	One coat		One coat	One coat							Tank supports shall be insulated from the tanks with adelite pads
30	Non-Structural Tubing Open—2S, 3S, 52S, 53S	One coat										
31	Non-Structural Tubing, Open—17S, 24S	Two coats										
32	Oil, Fuel and Hydraulic Lines—Exterior Only	One coat			One coat							
33	Rivet Holes	One coat										Primer coat shall be still wet during the driving operation
34	Rivet Head—Not Later than 12 Hours after Driving	One coat										
35	Fastenings—Strut Ends, Etc.											Coated with a mixture of Par-alketone "B" and one of the following: toluene, mineral spirits (TT-T-291) or lead-free petrol
36	Sealed Steel—Structural (Interior)										Yes—Interior	Coated with a mixture of Par-alketone "B" and one of the following: toluene, mineral spirits (TT-T-291) or lead-free petrol
37	Sealed Steel—Structural (Exterior)	One coat		One coat	One coat							See note under modifications for finishing of welded parts
38	Bearing Surfaces and Reamed Holes											Bearing surfaces and surfaces of reamed holes shall receive no finish. Masking or other suitable means may be used to protect these areas

Before assembly indicates the piece to be in its primary stage, i.e., before assembly into a sub-assembly.

The term after assembly indicates the complete assembly of a section of the aircraft, i.e., fuselage, wings, etc., but does not include sub-assemblies.

Modifications—parts or sections that are inaccessible, or rendered impractical to finish after assembly by ordinary shop procedure, shall be coated at such intermediate steps during assembly as may be practical. However, under all circumstances every coat of finish called for in the schedule must be applied. Parts of welded assemblies shall receive no organic coating of any kind prior to welding operations.

Section IX—Special Tools

Figure Index

SECTION IX

Special Tools

1 **General.** The Bermuda aeroplane is supplied with a set of special tools required for assembling and maintenance. These tools are in addition to the engine tool kit. The special tools are herewith listed:

See Fig. 9-1

Adapter—Socket wrench $\frac{1}{2} \times \frac{3}{4}$ male
Bar—Airscrew nut
Key—Dzus fastener
Screwdriver—(Set of four) Phillips recess head
Wrench—Axle nut

See Fig. 9-2

Wrench—Crowfoot, starter and generator
Wrench—Crowfoot, $\frac{5}{8}$ inch tubing coupling nut, type A
Wrench—Crowfoot, $\frac{5}{8}$ inch tubing coupling nut, type B
Wrench—Crowfoot, $\frac{11}{16}$ inch tubing coupling nut, type A
Wrench—Crowfoot, $\frac{11}{16}$ inch tubing coupling nut, type B
Wrench—Open end, quick disconnect valve, $1\frac{7}{16}$ inch opening
Wrench—Open end, quick disconnect valve, $1\frac{3}{4}$ inch opening

See Fig. 9-3

Wrench—Pin, Bomb bay door actuating cylinder
Wrench—Pin, Cowl gill actuating cylinder
Wrench—Pin, Flap actuating cylinder
Wrench—Socket, Engine mount attaching bolt $1\frac{1}{16}$ inch opening
Wrench—Socket, Wing hinge bolt, $1\frac{5}{16}$ inch opening
Wrench—Socket, Wing hinge bolt, $1\frac{1}{2}$ inch opening
Wrench—Socket, Wing hinge bolt, $1\frac{11}{16}$ inch opening
Wrench—Spanner, adjustable

See Fig. 9-4

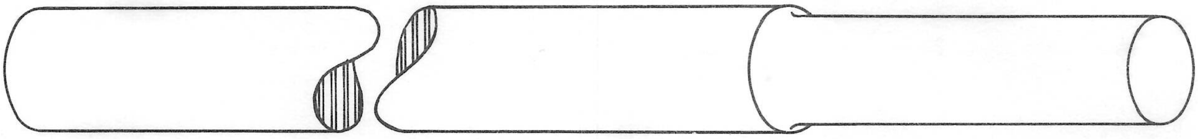
Wrench—Spanner, Bomb bay door actuating cylinder
Wrench—Spanner, Flap actuating cylinder (inner)
Wrench—Spanner, Flap actuating cylinder (outer)
Wrench—Spanner, Flap engaging cylinder
Wrench—Spanner, Hydraulic hand pump
Wrench—Spanner, Undercarriage retracting cylinder
Wrench—Torque, 0 to 200 foot pound range

2 **Torque Wrench.** The socket wrench adapter is required to attach the wing hinge socket wrenches to the torque wrench. Three sizes of sockets are provided for the wing hinge bolts which shall be tightened to 35 foot pounds. The torque wrench must be used to avoid introducing excessive bending in the wing hinges. The engine mount attaching bolts shall be tightened to 165 foot pounds. Proper torque loads for critical bolts are mentioned in the appropriate text.

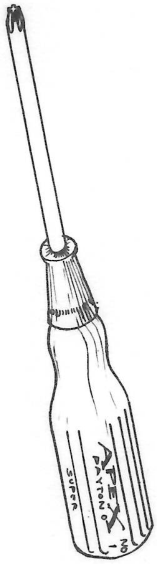
3 **Airscrew Nut Bar.** The airscrew nut bar is used to tighten or remove the airscrew nut on the engine. The airscrew nut shall be tightened by applying a force of 225 pounds on the end of the bar. This develops a force of 900 foot pounds.

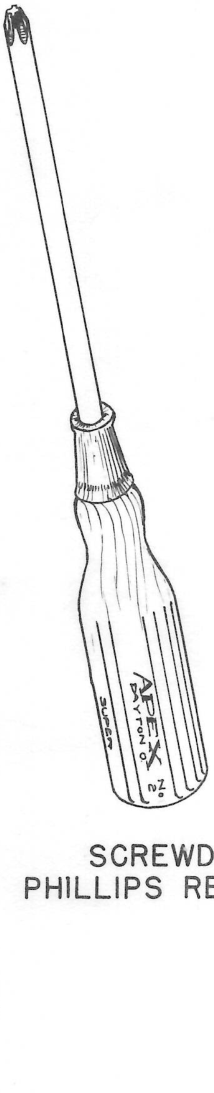
4 **Tubing Coupling Wrenches.** Special designs of crowfoot wrenches are supplied for tubing coupling nuts. These wrenches can be used with any combination of standard $\frac{3}{8}$ inch standard socket wrench handles. This provides suitable wrenches for tubing coupling nuts in crowded locations. The special wrench provides a better purchase than ordinary open end wrenches which frequently cause damage to tubing fittings. The slot permits the wrench to be passed over the tubing for removal or installation.

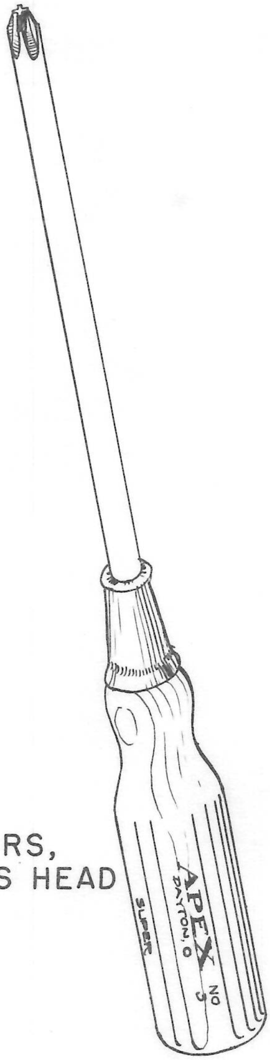
5 **Pin and Spanner Wrenches.** The pin and spanner wrenches are conventional, being designed for particular items as indicated. Extreme care must be exercised in holding cylinders during the removal of packing glands and cylinder ends; it is recommended that the cylinder be gripped in formed hardwood blocks held between the jaws of a bench vise.

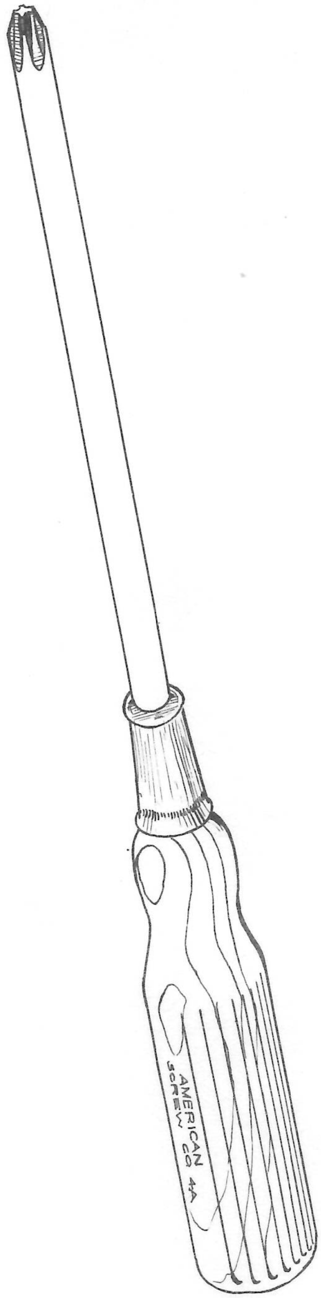


BAR-AIRSCREW NUT

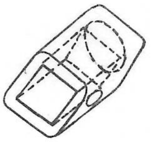






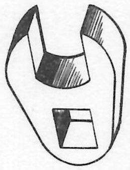


SCREWDRIVERS,
PHILLIPS RECESS HEAD

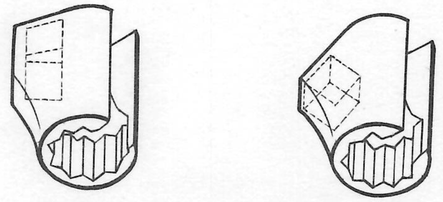


ADAPTER-SOCKET WRENCH

KEY-DZUS FASTNER

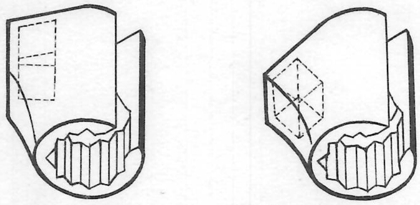


WRENCH-CROWFOOT,
STARTER & GENERATOR



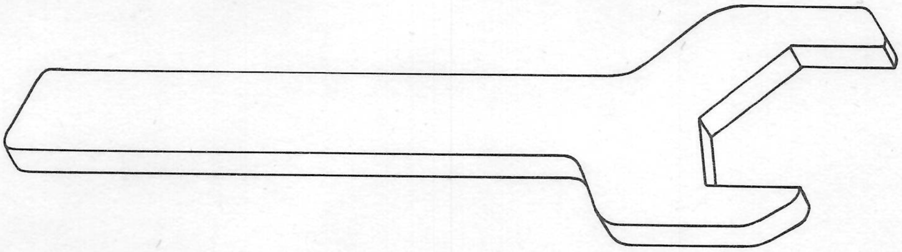
TYPE A TYPE B

WRENCH-CROWFOOT,
5/8 INCH TUBING COUPLING NUT

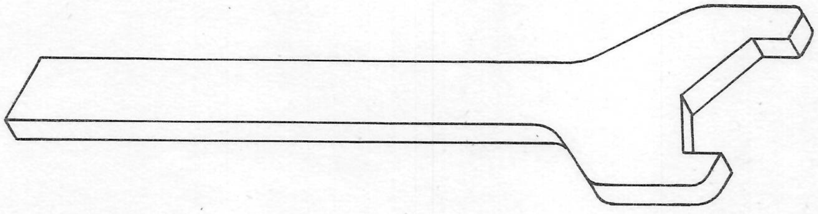


TYPE A TYPE B

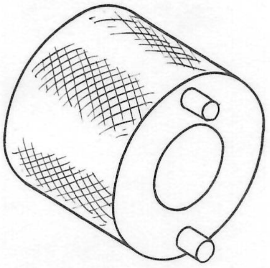
WRENCH-CROWFOOT,
11/16 INCH TUBING COUPLING NUT



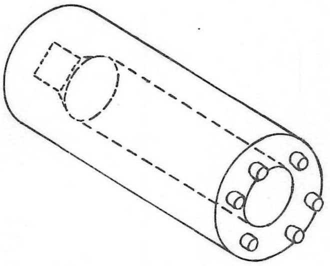
WRENCH-OPEN END, QUICK DISCONNECT VALVE
1 3/4 INCH OPENING



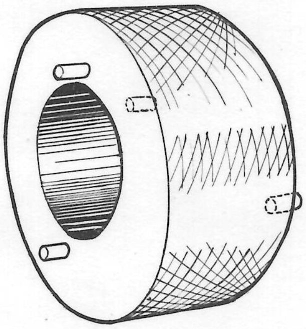
WRENCH-OPEN END, QUICK DISCONNECT VALVE
1 7/16 INCH OPENING



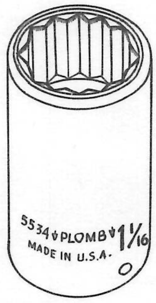
WRENCH-PIN,
BOMB BAY DOOR ACTUATING CYLINDER



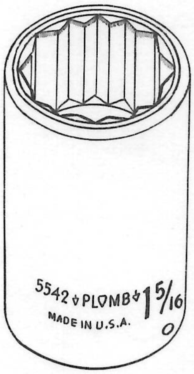
WRENCH-PIN
COWL GILL ACTUATING CYLINDER



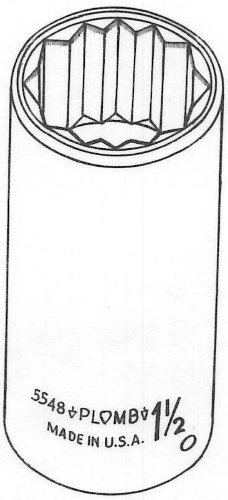
WRENCH-PIN,
FLAP ACTUATING CYLINDER



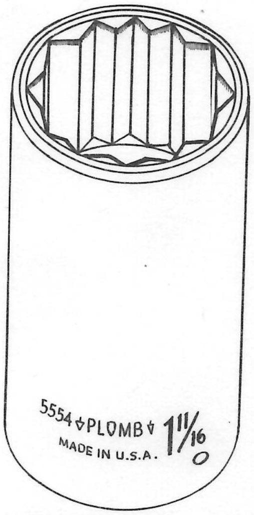
WRENCH-SOCKET,
ENGINE MOUNT ATTACHING BOLT
1 1/16 INCH OPENING



WRENCH-SOCKET,
WING HINGE BOLT,
1 5/16 INCH OPENING

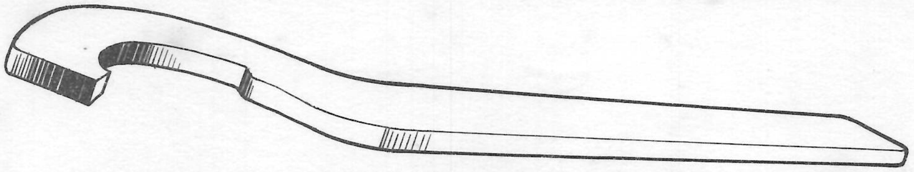


WRENCH-SOCKET,
WING HINGE BOLT,
1 1/2 INCH OPENING

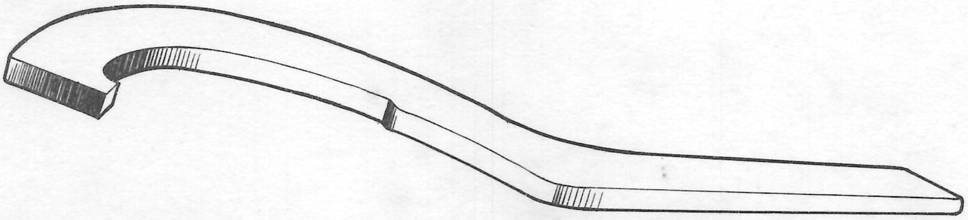


WRENCH-SOCKET,
WING HINGE BOLT,
1 11/16 INCH OPENING

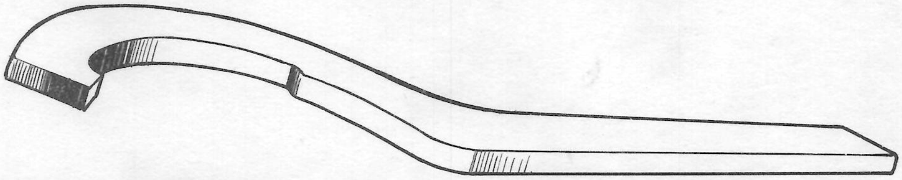
SPECIAL TOOLS - FIG. 9-3



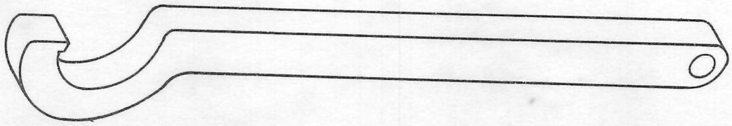
WRENCH-SPANNER, BOMB BAY DOOR ACTUATING CYLINDER.



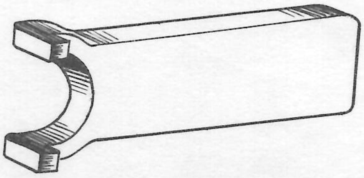
WRENCH-SPANNER, FLAP ACTUATING CYLINDER (INNER).



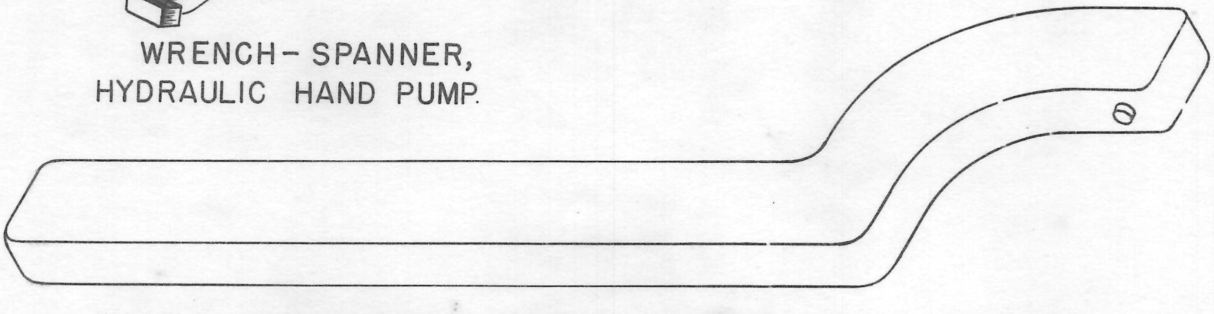
WRENCH-SPANNER, FLAP ACTUATING CYLINDER (OUTER).



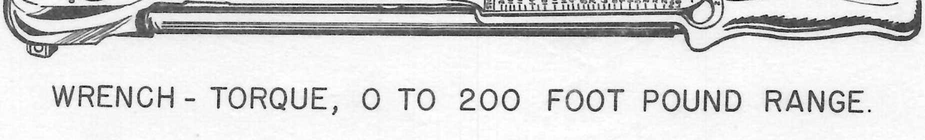
WRENCH-SPANNER, FLAP ENGAGING CYLINDER.



WRENCH-SPANNER, HYDRAULIC HAND PUMP.



WRENCH-SPANNER, UNDERCARRIAGE RETRACTING CYLINDER



WRENCH-TORQUE, 0 TO 200 FOOT POUND RANGE.