LIBERATOR JOB SHEET MANUAL

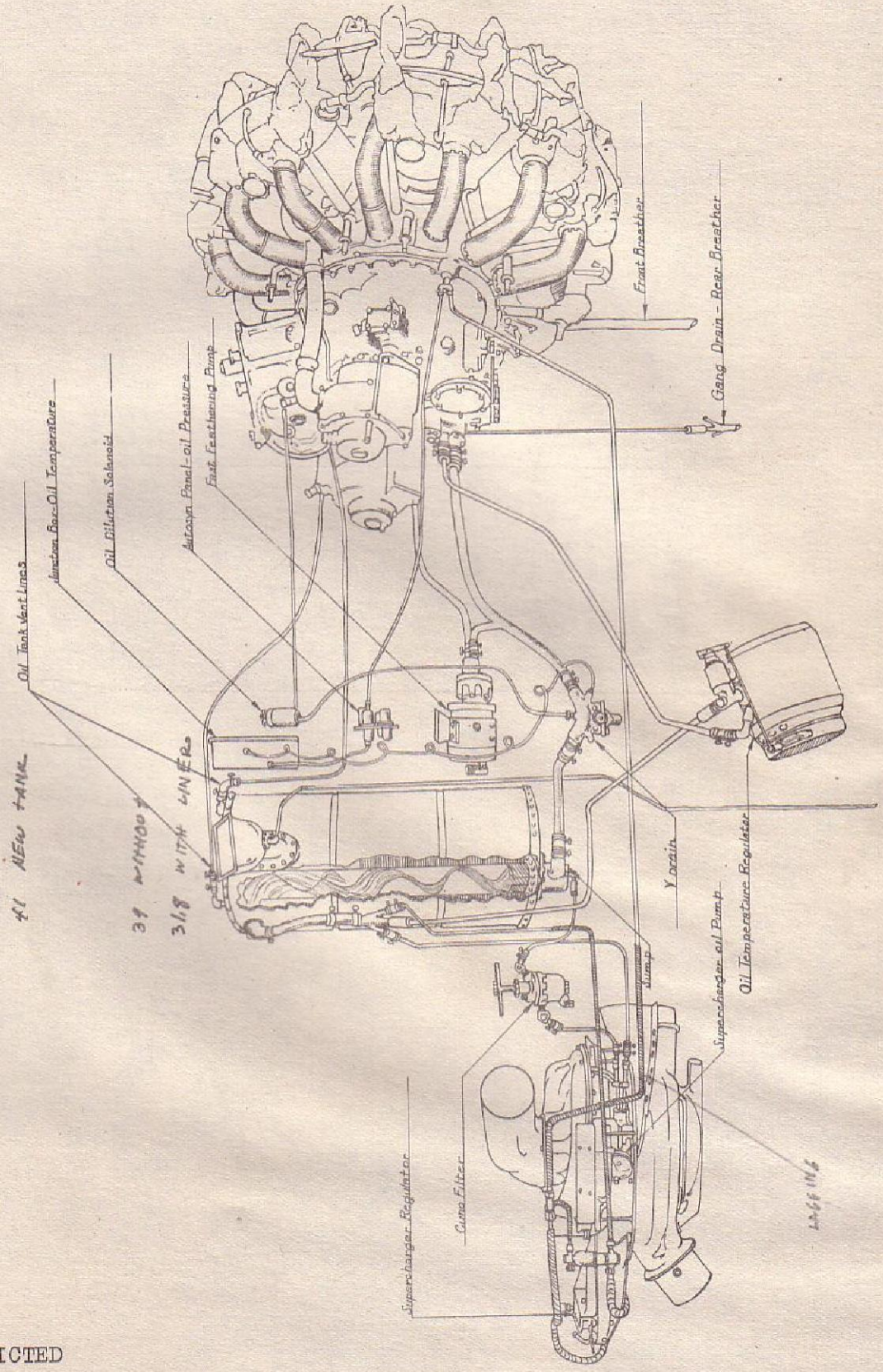
3509th AAF BASE UNIT (F.S.)

AIRPLANE & ENGINE MECHANIC COURSE

(SPECIAL B-24)

FORD AIRPLANE SCHOOL

WILLOW RUN *YPSILANTI, MICHIGAN*



NACELLE OIL SYSTEM

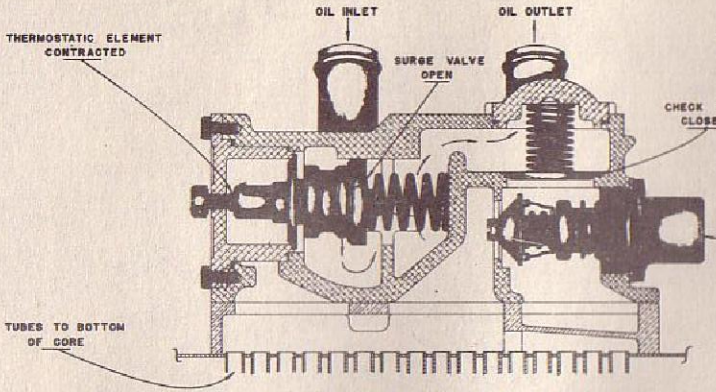


FIG. 1 COLD INCOMING OIL

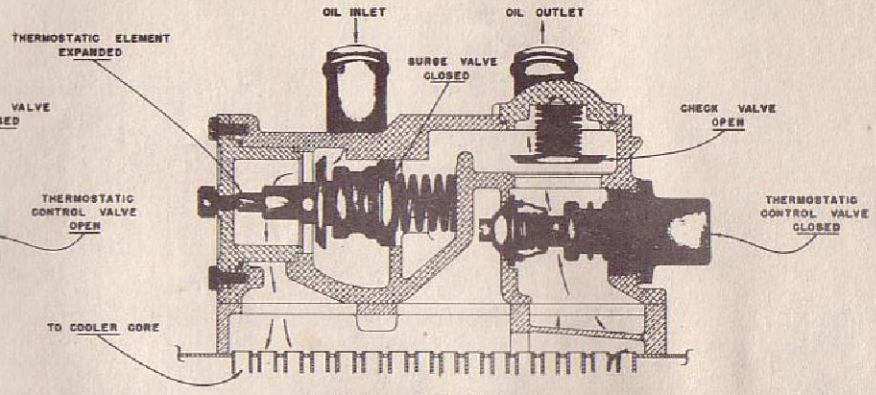


FIG. 2 WARM INCOMING OIL

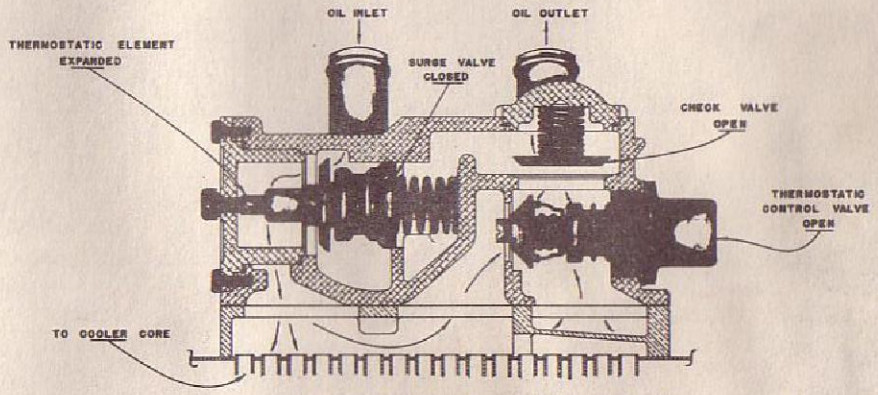
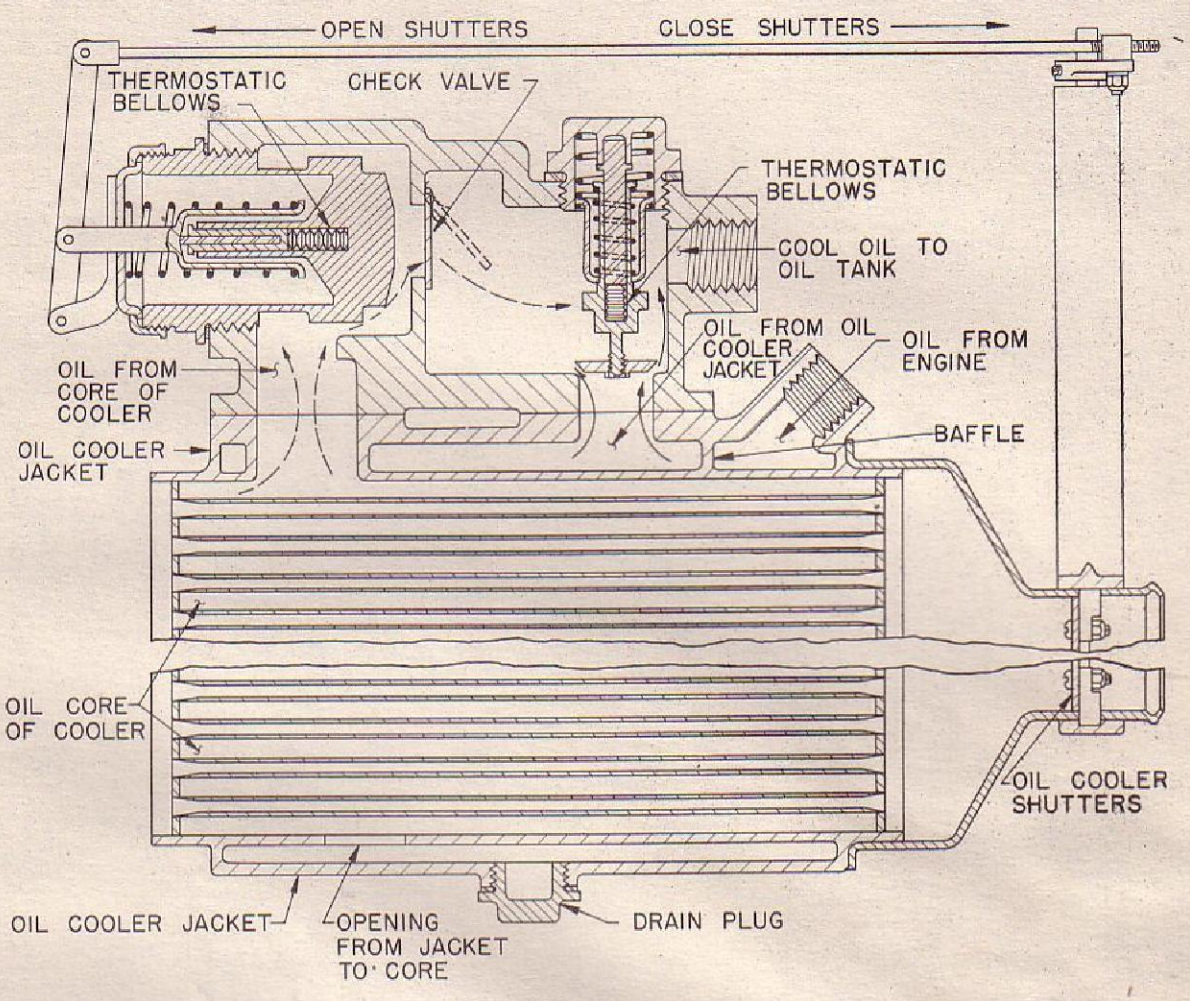


FIG. 3 TEMPERATURE CONTROLLED OIL

OIL SURGE VALVE AND OIL TEMPERATURE REGULATOR VALVE



SCHEMATIC DIAGRAM OF OIL TEMPERATURE REGULATOR

Figure 48B

RESTRICTED

ENGINE MECHANICS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

OIL SYSTEM INSPECTION SHEETS

Location and Function

Locate each unit listed below and be able to state its function.

1. Oil tank
   a. Filler cap
   b. Scupper and Drain
   c. Inspection Plate
   d. Vent necks.
   e. Oil-in Connection
   f. Hold down clamps
   g. Strap
   h. Padding
   i. Sump
   j. Oil-out Connections
2. Y-drain
   a. Drain cock
   b. Oil dilution inlet
   c. Oil temperature bulb connection
3. Fast feathering pump
   a. Relief Valve
   b. Inlet and Outlet lines
4. Oil inlet line to engine
5. Oil pressure pump
6. Main oil screen
7. By-pass valve
8. Alternate oil temp. Connection
9. Thermostatic time delay control ass'y.
10. Compensating oil pressure relief valve
11. Oil pressure-gage connection
    a. Oil press. gage line to autosyn
12. Oil pressure autosyn transmitter
13. External oil pressure line to front power section
14. Main Sump
    a. Drain plug
    b. Screen
15. Rocker Box sump
16. Rocker sump scavenge and breather pipes
17. Nose section scavenge pump
18. External scavenge pipe from nose scavenge pump
19. Front breather
20. Rear breather
21. Oil tank lines and connections
22. Fast feathering line, pump to governor
23. Auxiliary high pressure oil outlet
24. Auxiliary low pressure oil outlet
25. Accessory section drain plug and screen
26. Oil out-line to oil temp. regulator
27. Oil temperature regulator
28. D-8 thermostatic valve
29. Turbo-supercharger Cuno
30. Oil inlet connection to turbo
31. Oil outlet line from turbo
32. Line from turbo to oil tank
33. Pressure line to turbo regulator
34. Turbo regulator relief valve
35. Turbo regulator inlets
36. Turbo regulator outlet
37. Turbo regulator return line to tank
38. Oil dilution solenoid
39. Fast feathering solenoid
40. Inter-cylinder rocker box oil drain
41. Inter-ear cylinder rocker box oil drain.

3.8
3.8
4
3 (10.6)
3.5

RESTRICTED

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

ENGINE MECHANIC

OIL SYSTEM INSPECTION SHEETS

1	2	3	4	5
Column No. Form 41B.	Interval	Inspections Required	Symbols	Remarks pertaining to defects, replacements, or adjustments.
	50	1. Inspect oil tank for: (T.O. 01-5EC-2) a. Security of mounting b. Signs of leakage c. Condition and proper location of padding. d. Proper tension of supporting straps. e. Proper anchorage of oil lines leading to and from the tank.	D	
	PF	2. Check for evidence of deterioration of self sealing oil tank. (01-5EC-2)	D	
	PF	3. Check the amount of oil in the tank using a dip stick and allow 1" = 1 gal. (If oil is added, on an installation, the quantity is entered, in quarts, on the Airplane Flight Report, Form No. 1A).	D	
	PF	4. Secure the tank cap and safety.	D	
	D	5. Inspect the oil tank drain cock for tightness and proper safetying.	D	
	25	6. Inspect all the oil lines for leaks, security of anchorage, wear due to chafing or vibration, dents or cracks, and general condition, from: a. Tank to Y-drain. b. Y-drain to engine and fast feathering pump. c. Right front of blower section to front of power section. d. Rocker sump to nose pump. e. Nose pump to forward left hand side of blower section. f. Fast feathering pump to prop governor. g. Main oil pump to oil temp. regulator. h. Oil temp. regulator to tank. i. Engine to turbo regulator. j. Turbo regulator to tank. k. Oil pressure gage connection to autosyn l. Tank to Cuno. m. Cuno to turbo. n. Turbo to tank.	/	OIL LINES LEAK

ENGINE MECHANICS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

OIL SYSTEM INSPECTION SHEETS

1 Column No. Form 41B.	2 Interval	3 Inspections Required	4 Symbols	5 Remarks pertaining to defects, replacements, or adjustments.
	25	7. Inspect all connections for leaks, wear due to chafing, proper tightness of clamps (T.O. 03-1-29), tightness of nuts, condition at: a. Tank. b. Y-drain. c. Engine "in" and "out" d. Feathering pump "in" and "out" and connection at prop governor. e. Oil pressure gage connection. f. Other oil line connections on engine. g. Oil temperature regulator. h. Turbosupercharger. i. Turbosupercharger regulator. j. Oil pressure autosyn k. Turbo supercharger Cuno. l. Inter-cylinder drains. m. Line from oil temp regulator to tank.	D	
	25	8. Inspect for leakage, condition of gaskets, and tightness of nuts on: a. Compensating oil pressure relief valve b. Oil pump. c. Rocker box covers. d. Sumps. e. Main oil screen cover.	D	
	25	9. Inspect for dents, security of anchorage, clogging, tightness of connections, kinks, and general condition of: a. Front breather. b. Rear breather. c. Scupper drain.	/	SCUPPER DRAIN HAS DENTS
	25	10. Inspect the Y-drain for: a. Security of mounting. b. Evidence of leakage. c. Proper safetying. d. Proper connections.	/	EVIDENCE OF LEAKAGE

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich. ENGINE MECHANICS
B-24 Airplane School

OIL SYSTEM INSPECTION SHEETS

1 Column No. Form 41B.	2 Inter.	3 Inspections Required	4 Symbols	5 Remarks pertaining to defects, replacements, or adjustments.
	25	11. Inspect main oil screen. Drain oil from main screen chamber by removing plug from cover. Remove and clean main oil screen. a. Inspect for breaks, tear, condition of check valve and tension of spring b. Inspect neoprene seal for condition also gasket on cover plate. c. Check by-pass valve for tension of spring by inserting hand into screen chamber and pressing on valve with finger. d. Replace drain plug in cover and safety before installing. Check with instructor for proper installation of screen, retaining, and cover. Also see T.O. 02-10CB-2, page 38. Instructor initial	/	MAIN OIL SCREEN HAS BEEN UNDER HEAVY PRESSURE AND PLACED IN UPSIDE DOWN.
	D	12. Turn the handle of the Cuno Filter, in each supercharger oil line, one complete revolution.	D	
	25	13. Remove and clean oil Cuno filter in turbo line. Check for leakage and security after replacement. Instructor's Initial.	D	
	D	14. Inspect compensating relief valve for leakage at connection and proper safetying.	D	
	25	15. Sumps a. Check main and rocker box sumps for leaks, cracks, security, and proper safetying. b. Drain main and rocker sumps by removing drain plugs. Inspect main sump plug for accumulation of metal particles. Pass finger over screen to check for metal particles. Insert finger into drain hole of rocker sump and feel on each side of suction pipe for sludge and foreign particles. Show plugs to instructor before installing and safetying.	D	

RESTRICTED
AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

OIL SYSTEM INSPECTION SHEETS

1	2	3	4	5
Column No. Form 41B.	Interval	Inspections Required	Symbol	Remarks pertaining to defects, replacements, or adjustments.
	D	16. Oil temperature regulator. T.O. 03-15-9 a. Inpsect mounting and valve attaching bolts for tightness. Check all connections, including drain plug, for tightness. b. Inspect for clogging of cores, dents and leaks. (In shutterless coolers, do not mistake dummy plugs in cores for a clogged condition.)	D	
	D	17. Check the turbo regulator for attachment of oil pressure and drain lines, tightness of external connections, faulty gaskets and oil seals which could permit oil leakage.	D	
	D	18. Inspect the fast feathering pump for security of mounting and evidence of leakage at connections. Check for proper safetying at connections and at the relief valve.	D	
	S	19. Fill the oil pressure gage line with hydraulic fluid. T.O. 05-70-6.	D	

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich ENGINE MECHANICS

B-24 Airplane School

PRE-OILING OF AIRCRAFT ENGINES
(Taken from T.O. 02-1-22)

A. Service activities will pre-oil engines, before operation, at times specified below:

1. After engine change.
2. After each oil change.
3. After engine has been idle seven days or more.

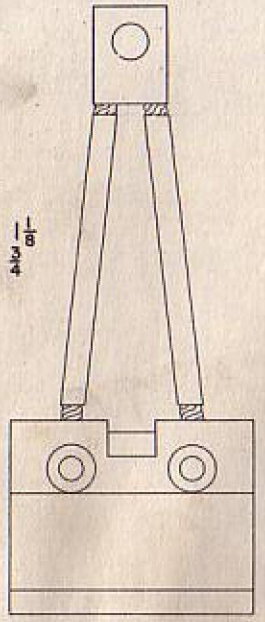
B. Procedure:

1. Make sure that the oil level in the tank is high enough to furnish oil to the pump.
2. Remove the front spark plug from each cylinder and spray a quantity of oil into the cylinders above the horizontal line. The plugs should be left out to facilitate later turning of the engine.
3. Place one-half (½) pint of oil in the exhaust rocker box of each cylinder which has no inter-cylinder rocker box connection. The remaining rocker boxes will be lubricated by placing a sufficient quantity of oil in the first rocker box on each side of the engine above the horizontal center line. This quantity should total approximately one-half (½) pint per cylinder. This is accomplished by the following procedure:

   a. Remove the following rocker box covers:
      1. Exhaust of cylinders #1,2,3,4, and 14.
      2. Intake of cylinder #12 and 13.
   b. Place engine oil, grade 1120, in the rocker boxes of the designated cylinders.
      1. ½ pint in the exhaust of #1,2, and 14.
      2. ~~1 pint in intake of #12.~~
      3. 1½ pints in exhaust of #3 and 4; also in intake of #13.

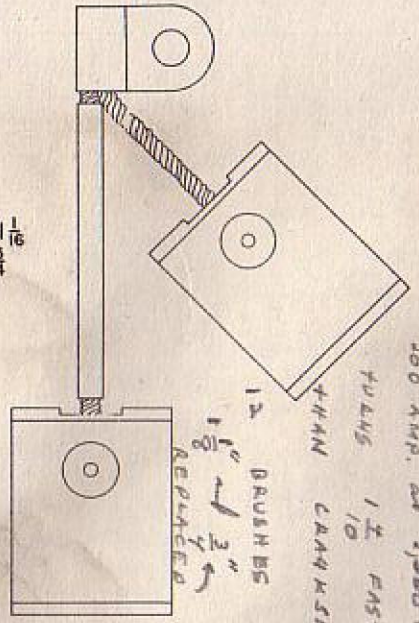
4. Replace rocker box covers. Torque 70 to 85 inch pounds.
5. Make sure ignition is "grounded out."
6. Place mixture control in Idle Cut-Off.
7. On an installation, it is necessary to remove the plug from the propeller dome and pour in enough oil to bring the oil to the level of the plug hole.
8. Remove the compensating oil pressure relief valve and turn the engine through until a steady flow of oil is discharged at the connection. This assures a flow of oil to the pump. If oil fails to reach the relief valve connection, check to see that oil reaches the pump. This may be done by disconnecting the oil inlet line to bleed out air trapped in the line.
9. Replace the compensating oil pressure relief valve. Check the condition of the crush gasket. A new gasket should be used every time the relief valve is removed and replaced.
10. Turn the propeller shaft through at least thirty (30) revolutions.
11. Replace the spark plugs. Torque 300 to 360 inch pounds.

① 8 BRUSHES
NEW LENGTH $1\frac{1}{8}$
REPLACE AT $\frac{3}{4}$



① WESTINGHOUSE

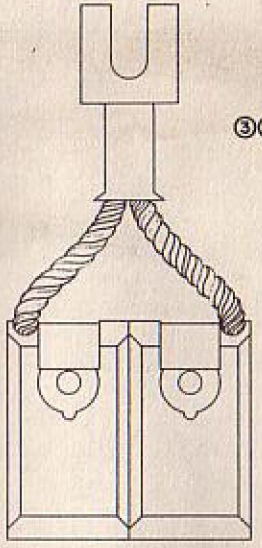
② 6pr. BRUSHES
NEW LENGTH $1\frac{1}{16}$
REPLACE AT $\frac{3}{4}$



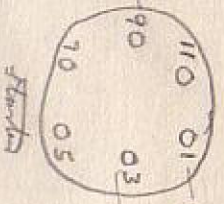
② DELCO REMY

(GENERATOR BRUSHES)

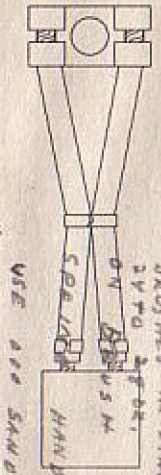
③④ 6pr. BRUSHES
NEW LENGTH $1\frac{1}{8}$
REPLACE AT $\frac{3}{4}$



③ FORD
④ GENERAL ELECTRIC



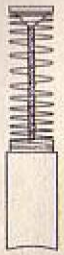
⑤ 4 BRUSHES
NEW LENGTH $1\frac{25}{32}$
REPLACE AT $\frac{15}{16}$



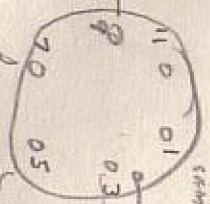
⑤ STARTER
⑥ FAST FEATHERING

⑥ 4 BRUSHES
NEW LENGTH $\frac{1}{2}$
REPLACE AT $\frac{11}{32}$

⑦ INTERCOOLER SHUTTER
2 BRUSHES
NEW LENGTH $\frac{1}{4}$
REPLACE AT $\frac{1}{8}$

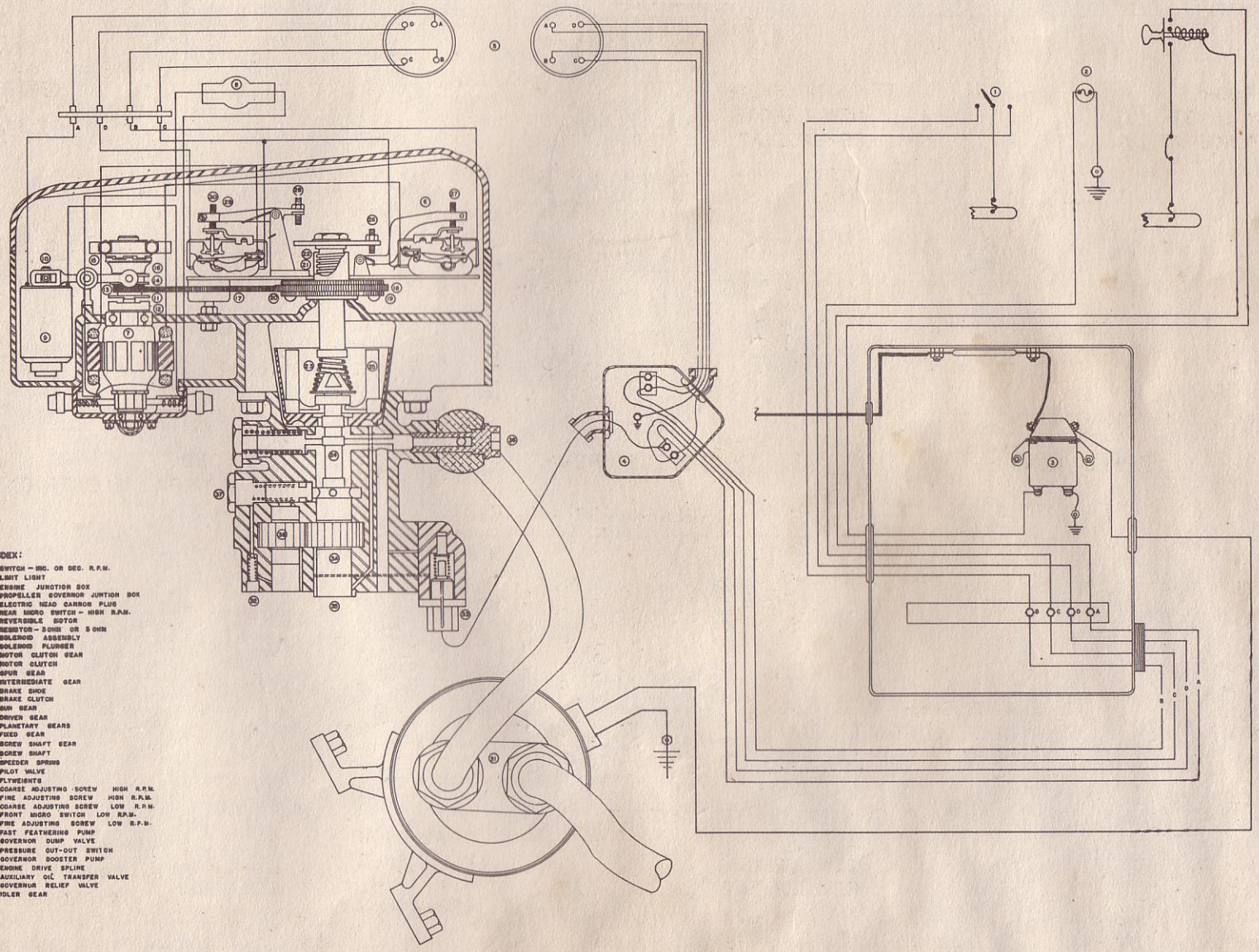


⑧ COWL FLAP
2 BRUSHES
NEW LENGTH
REPLACE AT $\frac{23}{32}$



⑨ PROP. GOVERNOR
2 BRUSHES
NEW LENGTH $\frac{19}{32}$
REPLACE AT $\frac{11}{32}$

MOTOR & GENERATOR BRUSH DATA - A.A.F. TECHNICAL SCHOOL



INDEX:

1. SWITCH – INC. OR DEC. R.P.M.
2. LIMIT LIGHT
3. ENGINE JUNCTION BOX
4. PROPELLER GOVERNOR JUNTION BOX
5. ELECTRIC HEAD CANNON PLUG
6. REAR MICRO SWITCH – HIGH R.P.M.
7. REVERSIBLE MOTOR
8. RESISTOR – 3 OHM OR 5 OHM
9. SOLENOID ASSEMBLY
10. SOLENOID PLUNGER
11. MOTOR CLUTCH GEAR
12. MOTOR CLUTCH
13. SPUR GEAR
14. INTERMEDIATE GEAR
15. BRAKE SHOE
16. BRAKE CLUTCH
17. SUN GEAR
18. DRIVEN GEAR
19. PLANETARY GEARS
20. FIXED GEAR
21. SCREW SHAFT GEAR
22. SCREW SHAFT
23. SPEEDER SPRING
24. PILOT VALVE
25. FLYWEIGHTS
26. COARSE ADJUSTING SCREW HIGH R.P.M.
27. FINE ADJUSTING SCREW HIGH R.P.M.
28. COARSE ADJUSTING SCREW LOW R.P.M.
29. FRONT MICRO SWITCH LOW R.P.M.
30. FINE ADJUSTING SCREW LOW R.P.M.
31. FAST FEATHERING PUMP
32. GOVERNOR DUMP VALVE
33. PRESSURE CUT-OUT SWITCH
34. GOVERNOR BOOSTER PUMP
35. ENGINE DRIVE SPLINE
36. AUXILIARY OIL TRANSFER VALVE
37. GOVERNOR RELIEF VALVE
38. IDLER GEAR

NOMENCLATURE - PROPELLER GOVERNOR ASSEMBLY

(T.O. 03-1-6, chpt. 11; T.O. 01-5EC-2, pg. 246B; T.O. 03-20CA-1)

ALLMAN 8-6-44

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

ELECTRICAL SYSTEM

A. Location and Function: (Parts followed by * to be located after removal of accessory.)

1. Generator.
   a. Air blast cover and blast tube.
   b. Mounting flange.
   c. Terminal box.
   d. Brush rigging assembly.*
   e. Field assembly frame.
   f. Cable. generator to wing.
2. Starter.
   a. Starter jaw, baffle plate, oil seal.*
   b. Mounting glange.
   c. Reduction gear housing.
   d. Motor and flywheel housing.
   e. Meshing solenoid and poppet.
   f. Meshing bell crank.
   g. Hand crankshaft extension and support bearing.
   h. Brush assembly spring release button.
      1. "OFF" and "ON" positions.
   i. Meshing cable.
   j. Hand meshing rod and bell crank.
3. Electric wire or cable from Engine Junction Box to:
   a. Engine instruments cannon plug in wing.
   b. Electric cable connection in Wing. (Hot line for starter, etc.)
   c. Fast feathering pump motor.
   d. Intercooler shutter motor.
   e. Cowl flap motor.
   f. Energizing solenoid to starter.
   g. Starter meshing solenoid.
   h. Induction vibrator or Booster coil.
   i. Primer solenoid.
   j. Oil dilution solenoid.
   k. Autosyn panel units.
   l. Oil temperature bulb.
   m. Heater solenoid
   n. Propeller governor.
4. Thermocouple cable.
5. Four(4) bonding connectors, engine to mount.
6. One (1) bonding connector, autosyn panel.
7. Fast feathering solenoid.
8. Starter energizing solenoid.
9. Current limiter and spare, (slow-blow fuse).
10. Propeller cut-out switch.
11. Carburetor air thermometer connection.
12. Battery
    a. Filler and Vent Cap.
    b. Cell positive and negative terminals.
    c. Cell connectors.
    d. Case vents.
13. Cowl flap motor and brushes.
14. Cowl flap control box, limit switches, and cams.

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School.

Time: not to exceed _____ hours.

ENGINE MECHANICS
(Continued)

ELECTRICAL SYSTEM

1	2	3	4	5
Column No. Form 41B	Interval	Inspection Required	Symbol	Remarks Pertaining to defects, replacements or adj.
	PF	1. Verify that all ignition switches are off.	D	
	S	2. Removal of generator. (Do not remove Oil compensating relief valve).	D	
	S	3. Removal of starter. a. Disconnect external electrical connections. b. Disconnect meshing cable at bell crank. c. Loosen, but do not remove, one of the upper nuts on the starter flange. d. Remove the other 5 nuts on the flange and then remove the top nut. e. Carefully remove starter from right side of engine.	D	
	25	4. Make following inspections on generator a. Check housing and mounting flange for cracks and other visible defects b. Using a wire hook, remove one set of brushes. Check for condition and proper length. Max. Length is 1-1/16", min. length 3/4". T.O. 03-5AE-1. Record inspection, length, _____. c. Check the tension of brush springs, which should be 20-26 oz. per brush. (03-5AE-1.) d. Check for tightness of connections at brush terminals. e. Check commutator for loose dirt, oil, wear, glazed condition, roughness, out of round, and blackened edges. Commutator should have an even dark-brown color. f. Check armature for play. g. Replace brushes and check for binding. h. Check brushes for seat. When necessary, reseating is done with No. 000 sandpaper. i. Check connector assembly and terminal box for cracks and other failures.	D	

ENGINE MECHANICS

(Continued)

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

Time: Not to exceed _____ hours.

ELECTRICAL SYSTEM

1 Column No. Form 41B	2 Interval	3 Inspection Required	4 Symbols.	5 Remarks Pertaining to defects, replacements or adj.
	S	5. Make the following inspections on the starter. T.O. 03-1-6, Ch. 43, Parts A and	D	
		a. Check the starter dog for meshing and retraction by pulling meshing cable.		
		b. Check clearance between bell crank and solenoid poppet. A max. of 1/32" or .031" is recommended. Adjust if necessary.	D	
	50	c. Remove one brush and check for length and condition. Max. wear of brushes is 3/16" from new length of ½". Record inspection length, _____. When reseating is necessary, use No.0000 sandpaper between brush and commutator with sanded side next to brush and pull in direction of rotation.	D	
	50	d. Inspect brush leads for proper covering and attachment.	D	
	50	e. Check brush spring tension, making sure brush spring release is "ON" position. Raise spring 1/8" above brush box. Spring tension should be 24-28 oz. per brush. If necessary to adjust spring tension, remove cotter pin and rotate adjusting sleeve clockwise to increase, and counterclockwise to decrease spring tension.	D	
	50	f. Check commutator; if dirty or rough, smooth and polish with No. 0000 sandpaper. Check armature for play. None allowed.	D	
	50	g. Replace brush and check for free fit in holder, without excessive side play or binding.	D	
	S	h. Inspect lowest point of flywheel housing for presence of 3/16" diameter oil drain hole. If not present, remove flywheel housing and drill 3/16" diameter drain hole. Make certain no chips remain in flywheel housing when reassembling.	D	
	D	i. Inspect entire starter for: 1. Cracked housing and flange. 2. Tightness of bolts and nuts. 3. Proper safetying. 4. Evidence of oil leaking at parting surfaces of housing sections.	D	

ENGINE MECHANICS

(Continued)

ELECTRICAL SYSTEM

1 Column No. Form 41B	2 Interval	3 Inspection Required	4 Symbol	5 Remarks Pertaining to defects, replacements or adjustments
		6. Install starter and hand meshing rod. Make necessary electrical connections and then perform the following:	D	
	S	a. Check hand meshing cable for proper play. There must be 1" free movement at right angles to cable when hand meshing rod is in clip flange on top of clip. Adjust be lengthening the rod or moving meshing rod bell crank on engine mount.		
		b. Check to see that you cannot insert a wire through the inspection hole in meshing connections.		
		c. Check starter for security of mounting and security of electrical connections		
	D	7. Replace generator and perform the following:	D	
		a. Check for security of mounting.		
		b. Check cable for looseness, chafing, and safety. Read T.O. 01-1-48. Instructor initial		
		8. Replace hand crank extension.	D	
		a. Inspect hand crank extension brackets and supports for security of mounting and general condition.		
	50	b. Lubricate hand crank extension support bearing with engine oil		
		c. Energize starter for about 10 seconds and mesh with meshing switch.		
		d. Check to see if starter dog has retracted. If not, rock the propeller back and forth until the dog has retracted.		
	50	9. Inspect all the folllwing electric lines for tightness and condition of connections; breaks; scuffed, burnt, or frayed insulation; and tightness of all cannon plugs, 1/8 to 1/4 turn beyond finger tight; from Engine Junction Box to:	D	
		a. Engine instruments cannon plug in wing.		
		b. Electric cable connection in wing (Not line for starter, etc.		
		c. Fast feathering pump motor.		

Column No. Form 41B	Interval	Inspection Required	Symbol	Remarks Pertaining to defects, replacements or adjustments
		d. Intercooler shutter motor.	D	
		e. Cowl flap motor.		
		f. Energizing solenoid to starter.		
		g. Starter meshing solenoid.		
		h. Induction vibrator or Booster coil.		
		i. Primer solenoid.		
		J. Oil dilution solenoid.		
		k. Autosyn panel units.		
		l. Oil temperature bulb.		
		m. Heater solenoid.		
		n. Propeller Governor.		
	10.	Check the following for operation:	D	
PF		a. Fast feathering pump.		
PF		b. Intercooler shutter motor, open and closed positions.		
PF		c. Cowl flap motor, operation of flaps up and down.		
PF		d. Primer solenoid.		
PF		e. Induction Vibrator or Booster co91.		
50		f. Oil dilution solenoid.		
50		g. Heater solenoid.		
PF		h. Propeller governor. Check both increase and decrease rpm lights. Observe limit lights if present. Time between limit lights approximately 12-19 seconds. Instructor will explain theory of electric head and adjustment of limit switches during laboratory.		
	11.	Inspect bonding--engine to mount, and at autosyn panel--for:	D	
		a. Breaks, tears, and kinks.		
		b. Contact or rubbing with other parts.		
		c. Security of bonding connections.		
	12.	Cowl flap motor. T.O. 03-5CE-2. Inspect for the following:	D	
100		a. Mounting bolts and elastic stop nuts for tightness.		
100		b. Tightness of ring nut holding connector ppug in place.		
100		c. Cracks or breaks in the casting.		

ENGINE MECHANICS

(Continued)

ELECTRICAL SYSTEM

Col. No. Form 41B	Interval	Inspection Required		Remarks Pertaining to defects, replacements or adj.
	100	d. Tightness of safety wires, screws, and nuts. Note: Brushes and commutator of the motor are to be inspected every 100 flying hours. Brushes are to be replaced if necessary. The maximum permissible brush wear is reached when brushes have worn to a length of 3/16" on the long side. When removing brushes note the position of the brush and replace it in the same position at installation. If necessary to clean the commutator, use No. 0000 sandpaper. Remove particles of metal with a dry air stream.	D	
	S	e. Set the position of the cowl flaps as directed by the instructor.		
	100	13. Intercooler shutter motor. T.O. 03-5CE-1. Inspect for the following: a. Mounting bolts, nuts, and cotter pins for condition and security. b. Ring nut holding connector plug to see it is in place and tight. c. Casting for cracks or breaks. d. Safety wire, screws, and nuts for tightness. Note: Brushes and commutator of the motor are to be inspected every 500 flying hours. Brushes are to be replaced if necessary. The maximum permissible brush wear is reached when brushes have worn to a length of 3/16" on the long side. When removing brushes, note the position of the brush and replace it in the same position at installation. If necessary to clean the commutator, use No. 0000 sandpaper. Remove particles of metal with dry air stream.	D	
	50	14. Fast feathering pump. T.O. 03-30CA-2. a. Check for security of mounting. Tighten all loose connections.		

1	2	3	4	5
Col. No. Form 41B	Interval	Inspection Required		Remarks Pertaining to defects, replacements or adj.
	50	b. Check brushes for free fit in boxes without excessive side play. Binding brushes and boxes should be cleaned with undoped gasoling saturated cloth. Max. brush wear is 5/32" from new length of ½".	D	
		c. Seat new brushes with No. 000 sandpaper. Note: The generator will be removed and checked for freedom of rotating parts at the 100 hr. inspection. Pumps will be removed for overhaul at engine change or as specified in T.O. 03-1-4.		
	50	15. Inspect the following for security of attachment, condition, and evidences of corrosion.	D	
		a. Primer solenoid		
		b. Oil dilution solenoid,		
		c. Starter relay solenoid.		
		d. Fast feathering solenoid.		
		e. Heater solenoid.		
		f. Oil temperature bulb.		
	D	16. Battery—Use extreme caution in performing the following inspections. (T.O. 03-5B-1). Battery acid will cause severe burns if it comes in contact with skin.	D	
		a. Check the specific gravity of any 2 cells of the battery with a hydrometer. Use a temperature corrected hydrometer and make readings at eye level. Just enough electrolyte (acid) should be drawn up to raise the float. Always return the acid to the cell from which it was withdrawn.		
		STATE OF CHARGE — SPECIFIC GRAVITY		
		a. Fully charged. — 1.275 to 1.300		
		b. 1/3 Discharged, replace fully charged if below this reading. — 1:240		
		c. 2/3 Discharged. Not sufficient capacity for satisfactory operation. — 1.200		

R E S T R I C T E D

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

ENGINE MECHANICS

A. Questions:

1. What damage will oil on the generator armature do? Short & out
2. What is the voltage rating of the generators? 28.5 volts
3. How many brushes are used in the Ford Generator? 12 General Electric? 12 Westinghouse? 8
4. What is the minimum and maximum length of generator brushes allowed? NEW 1 1/2 REPLACE 3/4
5. How are generator brushes seated? BY USING 000 SAND PAPER
6. Why do brushes tend to flake at high altitudes and not at low altitudes? LOW PRESSURE MAKES THEM HOTED
7. What is the gear reduction of the starter? 14-1
8. What is the rated speed of the motor? 1600 The dog? 107
9. Where is a 3/16" hole drilled in the starter and why? FOR SWEAT
10. What is the purpose of the clutch? FRICTON TYPE - TO PROTECT STARTER
11. What type clutch is used? FRICTIN TYPE
12. Trace electrical circuit from battery to starter.
13. Suppose the starter started smoking when energized, what might the trouble be? SHORT
14. How many brushes are used in the Eclipse starter? 4 brushes
15. Where is the meshing solenoid located? On the side of starter
16. What is the outcome of the seal in the starter leaking? oil back brush
17. What is the torque on the starter clutch? 725 ft lbs.
18. What is the minimum and maximum length of starter brushes allowed? 1/2" to 5/16"
19. What is the purpose of the button on the rear of the starter? Lift brushes for hand cranking
20. If clearance between meshing solenoid and arm is too little, what is the result? .031
21. What is the clearance between the meshing arm and solenoid?
22. Why should precaution be taken to insure proper length of the hand meshing cable? Hold drive retracting and allowing oil to leak back
23. What is the difference between G-6 and F-2 starters and why are G-6 starters better? G-6 accurate and neat F-2 carb.
24. How can the oil dilution solenoid, if leaking, be remedied? Carb. in idle cut off and turn on booster pump and
25. How may the cowl flap motor brushes be replaced incorrectly? They must be placed at 90° to be commutated.
26. How is it permissible to shorten a thermocouple wire to make it fit into a nacelle? Can't cut up.

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

VACUUM SYSTEM

A. Location and Function:

1. Line from wing to backfire check valve.
2. Backfire check valve.
3. Suction relief valve.
4. Suction line to "IN" side of pump.
5. Vacuum pump.
6. Pressure line from "OUT" side of pump to oil separator.
7. Oil Separator.
8. Oil return line from separator to accessory section.
9. Line from separator to safety (pressure relief) valve.
10. Pressure relief valve.
11. Pressure Check Valve.
12. Pressure line in wing leading to fuselage.

B. Questions and Related Information:

1. At preflight, suction gage should read $4\frac{1}{2}$ inches Hg.
2. The safety (pressure relief valve) opens at about 24 inches Hg. and then maintains a pressure of from 15 inches to 19 inches Hg.
3. The suction relief valve is mounted with the screen facing downward or to one side but never upward.
4. To check for correct lubrication of the vacuum pump, run the engine at 1000 RPM for 10 minutes; the oil discharge at the oil separator oil outlet should be at least 4 cubic centmeters, or at least 4 drops per minute.
5. Could this pump be lubricated from an external source on the engine if necessary? Where is this external source?
6. In which direction would you turn the adjusting screw on the suction relief valve to increase the amount of suction? To decrease the amount of suction?
7. Does the pressure from vacuum pumps 1 and 2 enter the fuselage in one or two tubes? Look in region of wing firewall, #2 engine.
8. Does the vacuum from pumps 1 and 2 enter the fuselage in one or two pipes?
9. How does oil normally flow from the top to the bottom bearing?
10. What precaution regarding the gasket is taken when installing a pump?
11. In what position is the separator mounted? Why?
12. Would pressure relief valve, stuck in the open position, interfer with the vacuum developed?

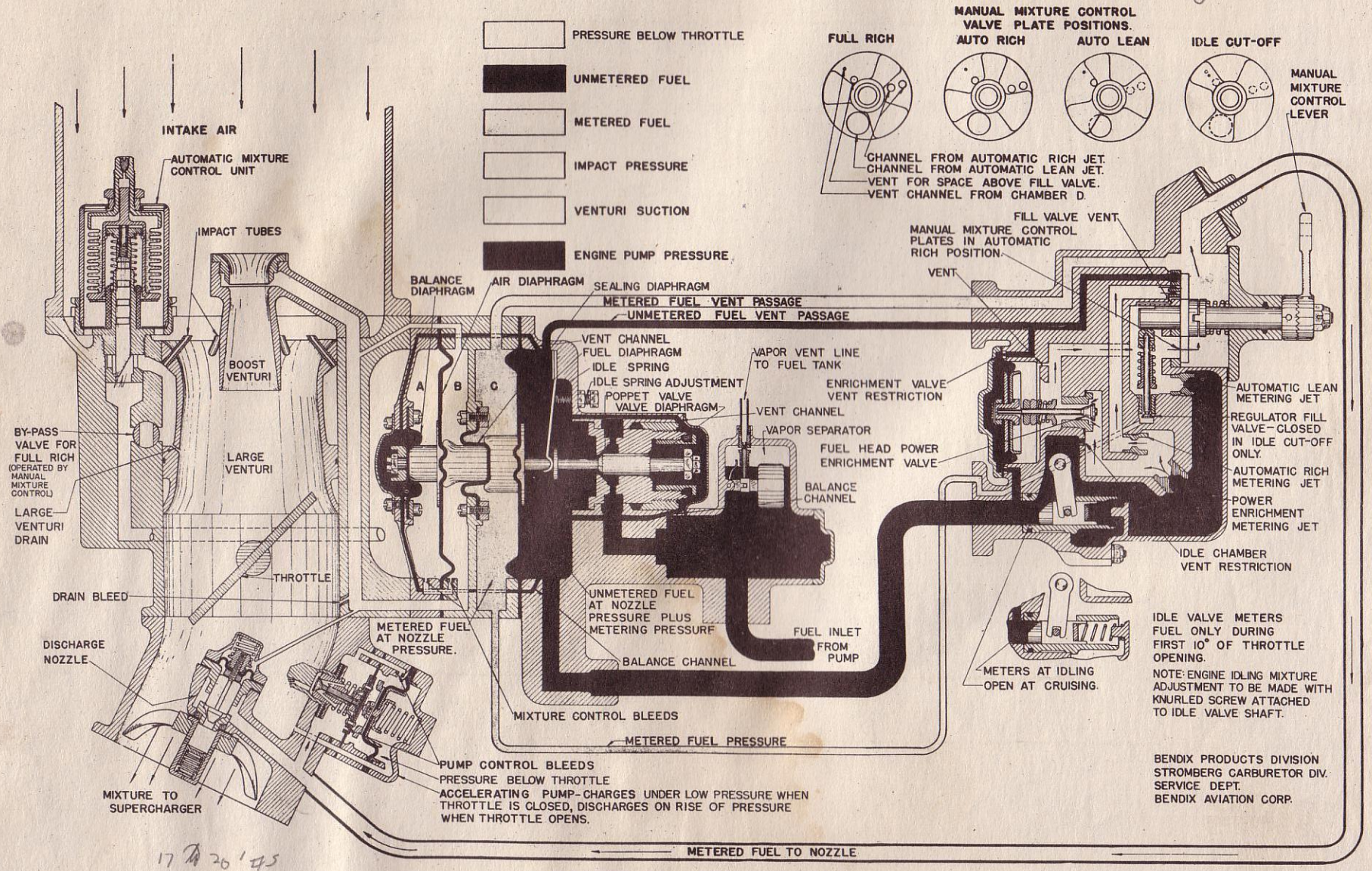
AAF TECHNICAL SCHOOL
W[illegible] Ann, Ypsilanti, Mich
[illegible]24 Airplane School

ENGINE SYSTEMS

VACUUM SYSTEM

Col.No. Form 41B Interval		Inspections Required	Symbol	Remarks
	D	1. Inspect the following lines for proper indentification, mounting, loose or broken tubing, tightness of hose clamps. (03-1-20,-29), and chafing. a. Wing to backfire check valve b. Backfire check valve to suction relief valve. c. Suction relief valve to pump d. Pump to oil separator. e. Oil separator to accessory section. f. Oil separator to pressure safety valve. g. Pressure safety valve to check valve.		
	100	2. Inspect vacuum pump for: a. Security of mounting and proper safetying. (03-30AA-1). b. Evidence of oil leaks and condition of gasket at mounting flange.		
	100	3. Inspect the backfire check valve for proper installation and security.		
	100	4. Inspect the suction relief valve for security of mounting and general condition.		
	100	5. Inspect the suction relief valve screen and, if dirty, remove the valve and loosen the screen The screen is cleaned in gasoline and then replaced. (03-30AA-1).		
	100	6. Inspect oil separator for security and condition of rubber mounting, and proper installation.		
	100	7. Remove and clean oil outlet fitting and screen of oil separator. Replace. (03-30AA-1).		
	100	8. Inspect safety (pressure relief) valve for security and proper attachment.		
	100	9. Remove the valve guide from the safety valve and wash in a suitable cleaning fluid. If the valve disc is worn, dress it carefully with a flat oilstone, (03-30AA-1).		
	100	10. Check the pressure check valve for proper attachment and general condition.		

SCHEMATIC DIAGRAM OF STROMBERG INJECTION CARBURETOR WITH FUEL HEAD ENRICHMENT VALVE.



CARBURETOR MODELS PDI2F2, PDI2F3, PDI2HI

PRINTED IN U.S.A.

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

FUEL SYSTEM

INSPECTION AND WORK SHEET

Locate each unit listed below and be able to state its function:

1. Nacelle fuel inlet line.
2. C-4 Strainer.
   a. Inlet
   b. Outlet
   c. Drain Cock
   d. Strongback.
3. Fuel pump
   a. Inlet Port
   b. Drain Line.
   c. Lubricating Port(s)
   d. Pressure Adjustment.
   e. Regulator Section.
   f. Vent Line.
   g. Outlet Port
   h. Instruction Plate.
4. Gang Drain.
5. Internal Supercharger
   a. Drain Line
   b. Drain Valve.
6. Carburetor.
   a. Inlet Line.
   b. Two vapor eliminator chambers.
   c. Vent Line.
   d. Fuel Screen Cover.
   e. Metered fuel line to discharge nozzle.
   f. Drain Plugs in Chambers C, D, and B.
   g. Adapter Section.
   h. Idle speed Adjustment Screw.
   i. Idle Mixture adjustment Screw.
   j. Throttle Control.
   k. Mixture Control.
   l. Idle Cut-Off Position.
   m. 65% safety Throttle.
   n. Primter Take-Off.
   o. Pressure Take-Off.
   p. Throttle Section.
   q. Fuel Control Section.
   r. Regulator Section.
7. Primer
   a. Solenoid.
   b. Main Line.
   c. Spider Distributor.
   d. Lines to Cylinder.
   e. Lowest Cylinder Primed.
8. Oil Dilution System:
   a. Fuel Inlet Line to Solenoid from Carburetor.
   b. Solenoid.
   d. "Y" or "T" Junction in Line at Oil Dilution Solenoid.
   d. Line to "Y" Drain
   e. Solenoid Drain Plug.
9. Fuel Pressure Autosyn.
   a. Fuel Inlet Line.
   b. Vent Line.
10. Heater Lines.
   a. Fuel-air Mixture Take-Off.
   b. Solenoid.
   c. Exhaust Fitting.

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

I 7

FUEL SYSTEM INSPECTION AND WORK SHEET

Interval		Symbols	Remarks:
D	1. Check main fuel line into nacelle to C-4 strainer for chafing and clamps for tightness. All hose clamps are checked for tightness daily until hose ceases to "cold-flow" and the hose clamps remain tight; and then hose clamps are inspected at the 50 hour period (T.O. 03-1-29: 03-1-20).	D	
25	2. Inspect all fuel lines for the following: a. Insecurity of Line Anchorage. b. Wear due to vibration or chafing. c. Condition of hose connection. d. Tightness of hose connection. e. Chafing or cutting into lines by clamps, screws, bolts, etc. (T.O. 01-5EC-2 p. 86.)	D	
PF	3. Drain sufficient fuel from the C-4 strainer to insure the removal of any water in the fuel system (note that this strainer is the lowest point in the fuel system, hence any water would collect here). Close drain cock (normally it would also be necessary to safety drain cock to wing nut at this time).	D	
25	4. Remove and clean the screen in the C-4 strainer. Inspect screen for breaks and tears. Check for evidence of self-sealing tank or line failure indicated by rubber particles. Clean strainer body. Replace strainer, be sure right side of strainer is up and recessed at top of the body. Safety cover properly with braid of wire diagonally across the strongback from one hinge pin to the other, and wing nut to drain cock. Instructor's Check_____.	D	
D	5. Check fuel pump for security of mounting and proper safetying. Check hose to pump for tightness and for chafing.	D	

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

Interval		Symbol	Remarks:
25	6. Lubricate Pesco fuel pump by filling seal chamber half full with cup grease Spec-VV-G681 (this is also done when new pump is instal'led). Apply a Zerk or Alemite fitting in one of the pipe tapped connections next to the mount ing pad (T.O. 01-5EC-2 p.86).	D	
D	7. Check fuel line from pump to carburetor for security of clamps and for tightness. Check all safety wiring on carburetor and see that it is installed where necessary.	D	
25	8. Check carburetor attachment bolts and air scoop nuts for tightness (T.O. 03-10BA-2 Sec. IV).	D	
25	9. Remove and clean carburetor fuel screen. Use air blast to clean screen. Replace screen properly by putting, flanged end in first, the tension spring in the cup end of the strainer. Install cover, and safety bolt to eye on carburetor. Instructor's Check_____	D	
50	11. Drain carburetor by removing plugs in the bottom of the regulator unit, air chamber, fuel chambers, and fuel control unit (T.O. 03-10BA-2). The purpose of this is to remove any accumulation of moisture in the air chambers, and any sediment in the other compartments. Replace plugs and safety them properly with .020 wire. Instructor's Check_____	D	
50	11. Lubricate throttle shaft bushings, if available use machine oil Spec. "2-27. (Note: The mixture control latch mechanism is NOT greased on this type of carburetor, see T.O. 03-10BA-2 Sec. IV).	D	

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

P

Interval		Symbol	Remarks:
50	12. Nacelle heater system - check fuel air and exhaust gas tubing lines and fitting from take-off to rear firewall connection, for security of mounting and tightness of clamps and connections (T.O. 01-5#C-2 p. 102).	D	
	To approximate actual conditions, build up pressure in the nacelle fuel system with the simulated booster pump on the side of the wing mock-up. Consider the fuel pump on the wing as engine driven, and make any necessary adjustments on it. To simulate the gage on the cockpit panel, connect protable pressure gage to fuel line at fuel pressure autosyn. Provide clean containers for fuel leakage and return fuel to can. (NOTE - the following work would normally be done concurrently with that already done at the respective inspection periods.)	P	
25	13. Since you have already removed and replaced the carburetor fuel screen, now complete the rest of that inspection: while carburetor strainer is filled with air, disconnect flexible hose at the vent line and observe the action of the vapor eliminator. It should be possible to notice the rush of air being expelled and then cease when the fuel level raises the float and shuts off the vent passage. On this type of carburetor a seepage of 40 to 60 cc. per minute is normal (T.O. 03-10BA-2 Sec. IV., 1).	D	
50	14. Refill carburetor - the following procedure is carried out whenever the carburetor has been drained, the carburetor has been replaced, or a new carburetor installed: a. Set mixture control to automatic rich. b. Move throttle to halfway open position. c. Turn on booster pump. d. Continue to supply fuel until a small amount flows from the supercharger drain valve through the gang drain.	D	

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

Interval		Symbols	Remarks
D	15. With carburetor in IDLE CUTOFF and fuel pressure built up by the booster pump inspect the following for leakage: a. Line to C-4 Strainer. b. Line to fuel pump. c. Line to carburetor. d. Carburetor Drain Plugs, parting surfaces of body casting. e. Primer Lines. f. Oil dilution line. g. Fuel pressure Autosyn Line.	D	
D	16. With carburetor in IDLE CUTOFF and fuel pressure built up by booster pump, remove flexible line at primer solenoid and check solenoid when in the OFF position for leakage. No leakage at all is permitted. (A leaking primer would cause engine to gallop, smoke, and fail to idle; a serious leak would be indicated by a loss of 2 or 3 lbs. Fuel pressure.)	D	
25	17. With carburetor in IDLE CUTOFF and fuel pressure built up by booster pump, check fuel pump for leakage. Also remove drain line to gang drain and check for leakage. Any drive shaft seal leakage in excess of 10 drops per minute is cause for rejection (T.O. 03-5EA-1 Sec. V.). If necessary, adjust pressure to deliver 14 to 16 lbs., resafety adjusting screw	D	
25	18. With carburetor in IDLE CUTOFF and fuel pressure built up, inspect oil dilution solenoid for leakage by removing plug at the bottom. Maximum allowable leakage is 10 drops per minute. If leakage exceeds this, reinstall plug, turn oil dilution switch "on" and "off" for ten 5 second periods while pressure is built up. Remove plug and again check for leakage, if still excessive push end of plunger up and down several times with a steel rod or finger to produce beater seating of the valve. Recheck, and if leakage is still excessive, the solenoid is replaced (T.O. 03-15-3).	D	

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

ENGINE SYSTEMS

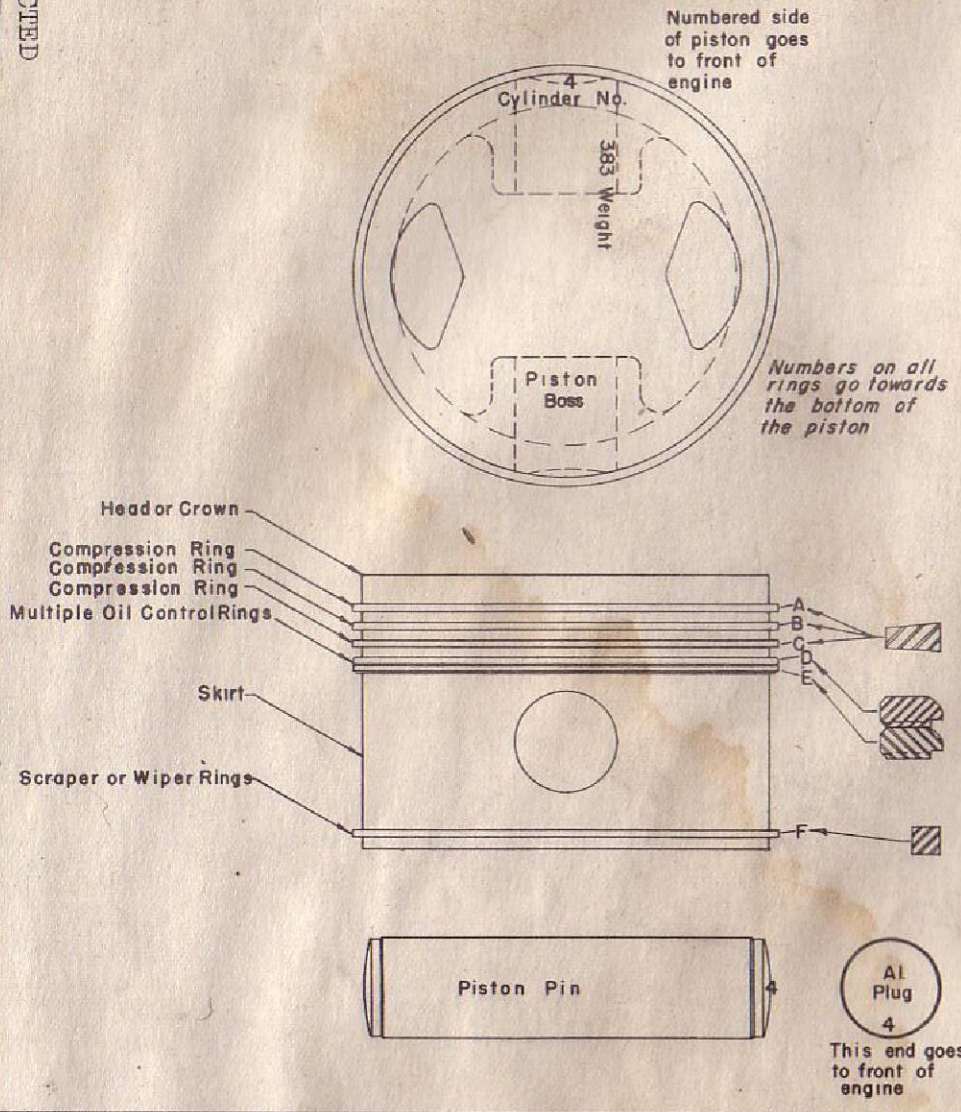
The instructor may ask you the following questions:

1. If rubber particles are found when draining and /or cleaning the C-4 strainer, what trouble would you look for?
2. Does draining the C-4 strainer drain any part of the carburetor?
3. How is the fuel pump safetied to the engine? To what are the regulator housing screws and the adjustment screw safetied?
4. What type and make (s) of fuel pump are used on the B-24?
5. When installing a new pump, why must precaution be taken to insure that the regulator housing is properly installed?
6. What is the purpose of the flexible line from the fuel pump to the carburetor air scoop? (T.O. 03-10EA-1 Sec. IV, 2).
7. How and where is adjustment for fuel pressure made?
8. How and where is adjustment made for idling speed? For idling mixture?
9. Where does the internal supercharger drain go overboard? How does the internal supercharger drain valve work? (T.M. 1-407 p.7).
10. Where does the fuel passed by the vapor eliminator return?
11. Where does the fuel for oil dilution come from? Specifically from what part or section?
12. Where is the other place that a primer solenoid may be located in B-24 nacelles?
13. What connection, if any, is there between an oil dilution solenoid stuck in "open" position and engine breathers throwing oil? (T.O. 02-1-29, 19E.)
14. What is the purpose of the vent line to the fuel pressure autosyn?
15. From where does the fuel leaking from the gang drain come the moment the engine is stopped?
16. What is the purpose of the 65% safety throttle?
17. Describe the flow of fuel from C-4 Strainer to intake ports during priming.
18. Whence do the fuselage heaters get their fuel? Why is, or is not, the heater exhaust vented overboard?
19. What are the identification markings for self-sealing aromatic resistant hose, non-self-sealing aromatic resistant hose, non-self-sealing and non-aromatic resistant hose? (T.O. 04-5-12)
20. When, if ever, would the air pressure in the scoop be at pressure other than sea level?
21. Why will more air through the carburetor draw more fuel into the induction system?
22. Why isn't #5 cylinder primed?
23. How many lines take fuel from the carburetor? What are they?
24. What seal, if any, is used between the carburetor and the engine? (T.O. 01-5EC-2 p. 216).
25. Why aren't hose clamps on self-sealing hose safetied?
26. What torque is applied to hose clamps? (T.O. 03-1-29)
27. How long should a new carburetor diaphragm soak before it will be efficient? (T.O. 01-5EC-2 p. 212).
28. What is the procedure for diluting oil? (T.O. 01-5EC-2 p. 50; 02-1-29 Sec.IV,17)
29. What procedure would you follow to prepare a carburetor for storage? (T.O. 01-5EC-2 pp. 211-2).
20. What torque is applied to the mounting screws when installing the carburetor? (T.O. 01-5EC-2 p. 217).

Technical Order References:

02-1-7 Detonation
02-1-29 Ground Operation Instructions.

RING CLEARANCES



Side Clearance – Piston – Piston Ring

	Min.	Max.
(A) 1st Groove	.003	.005
(B) 2nd Groove	.003	.005
(C) 3rd Groove	.003	.005
(D) 4th Groove	.004	.007
(E) 4th Groove	.004	.007
(F) 5th Groove	.003	.005

END CLEARANCE – PISTON RING

(A) 1st Groove	.0595	.0665
(B) 2nd Groove	.0595	.0665
(C) 3rd Groove	.0595	.0665
(D) 4th Groove	.0565	.0635
(E) 4th Groove	.0565	.0635
(F) 5th Groove	.0135	.0205

(50% over maximum allowed before replacement)
5th Groove – With Chrome Moly. Barrels uses compression ring in place of scraper ring.

Clearance Between Barrel and Piston .021 – .025

Engines equipped with Nitralloy (#139) or CHROMIUM Plated Barrels (# Yellow & Red band & etched Chrome Plated use following numbered rings in grooves
(A) – 31406, (B) – 31406, (C) – 31406, (D) – 19667, (E) – 19667, (F) – 39711 or 17004

Engines equipped with Chrome Moly Barrels (#185)
(A) – 50512, (B) – 31406, (C) – 31406, (D) – 19667, (E) – 19667, (F) – 39711 or 17004
(When 17004 is used in "F" 39711 must be used in #1, #2, #8 cylinders others can use 17004.

Wedge Type Compression Ring, must be used in wedge type groove.

Oil Control Ring, must be placed with flutes down.

Plain square type compression ring.

Oil Scraper ring similar to "D" or "E" can be used in this groove in certain barrels as given above.

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

ENGINE REPAIR AND MAINTENANCE

A. Location:

1. Nose Section.
2. Power section or crankcase (3 pieces).
3. Supercharger and mounting section
4. Intermediate section.
5. Accessory section.
6. Cylinders 5 and 12.
7. Cylinder baffles.
8. Push rod housing packing nuts.
9. Flared end of push rod housing.
10. Numbered end of push rod.
11. Numbered end of piston and pin.
12. Piston.
    a. Head
    b. Skirt.
    c. Boss.
    d. Lands.
    e. Ring grooves.
13. Weight of piston.
14. Compression, oil control, and oil scraper rings.
15. Numbered side of piston rings.
16. Intake and exhaust valves.
17. Valve safety circlet.
18. Valve tip, stem, neck or fillet, face, margin, head.
19. Valve seats and guides.
20. Split cone valve keepers, intake and exhaust.
21. Cylinder head, barrel, and mounting flange.
22. Tappets, tappet guides, tappet housing.
23. Engine shock mount brackets.
24. Shock mounts.

B. Questions:

1. Why must rocker box covers be removed in pairs when interconnected? For convenience sake.
2. When removing push rods why must piston be set at T.D.C. compression? To allow valve to be lapped
3. Can push rod and cover be installed incorrectly? How? Yes number four and from end to
4. Why is there a hole in the push rods? For lubrication.
5. Why is it necessary to be positive of valve clearance when the push rods have been replaced. To insure closing and opening properly.
6. Why is the exhaust valve larger and heavier than the intake? greater heat.
7. Should the valve springs be tested for tension and if so, why?
8. How is the valve seat checked for seating? Prussian blue paint gauge, chrome
9. What is the value of the safety circlet? To relieve from fully stem grinder
10. What type of locking device is used for cylinder hold down nuts? Bolt nut
11. What torque is used on spark plugs? 300 to 360 lbs.
12. What torque is used on cylinder hold down nuts? 325 to 350
13. Are the push rods all of the same length and why? No length of the cyle they are
14. Why must rings be placed with numbers towards the bottom of the piston?
15. What provision is made to keep the piston pin from scoring the cylinder wall
16. Are all cylinder barrels made of the same material, how can you tell? test

T.O. 02-1-39
T.O. 02-1-40

They have different numbers stamped on them.

155 - Chrome Molybdenum
134 - Nitrided

ENGINE MECHANICS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

B. Questions (Continued)

21. How do you check the valve face for seating?
22. How many valve springs are used per cylinder and why?
23. What torque is used on rocker box cover nuts? (T.O. 02-1-19)
24. How is the stellite face checked for coating?
25. What size propeller shaft is used on the R-1830-43 engine?
26. What damage might result if the wrong rocker arms are depressed while adjusting valve clearances when using the positive method?
27. What disposition must be made of sodium filled valves? (T.O. 02-1-67)
28. What is the minimum clearance between the rocker arm and valve spring washer? If the clearance is less than the minimum, how is connection made? See T.O. 02-10CB-3, P. 93

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

ENGINE REPAIR AND MAINTENANCE

D	1. Inspect the engine mount for general condition and security of attachment. Check for cracks particularly at the welds. Check mounting bolts for condition and safetying.	D
D	2. Inspect engine shock mount brackets for evidence of deterioration, cracks, and proper safetying.	D
D	3. Inspect the following engine sections for cracks and general condition: a. Nose b. Crankcase c. Supercharger and mounting d. Intermediate e. Accessory	D
D	4. Check for broken, damaged, or clogged cylinder baffles, also inspect cylinder for general condition and particularly for damaged or broken fins.	D
25	5. Check intake pipe tacking nuts for tightness at the first 25 hour inspection after engine overhaul: tighten if evidence of leakage is found. If leakage is still found during subsequent inspections, put in a new packing gland. (T.O. 02-1-28)	D
50	6. Inspect for tightness of cylinder stud nuts on one cylinder, Remove, replace and properly torque r nuts. Torque in inch pounds: 325 minimum, and 350 maximum.	D
50	7. Check rocker box covers for tightness, 70 to 85 inch pounds torque. Check also for condition of the gaskets. Caution: Slightly damaged gaskets will cause leakage of oil.	D
50	8. Check for leakage of oil at the propeller thrust bearing retaining nut.	D
D	9. Inspect for tightness of engine data plate. If loose, refer to T.O. 02-10-39A for maintenance procedure.	D
S	10. Remove the push rods and valve springs from a cylinder designated by your instructor. a. Remove the rocker box covers, in pairs if interconnected. Handle gaskets carefully. b. Remove front spark plug on subject cylinder. c. Set piston at T.D.C. compression stroke. d. Loosen push rod cover packing nuts. e. Depress rocker arm with rocker arm depressor, and remove push rods and covers. DO NOT DROP PUSH RODS. f. Inspection. 1. Check ball ends for excessive wear and cracks. 2. Check push rods for straightness. 3. See that oil passage is open	D D

RESTRICTED
AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

ENGINE REPAIR AND MAINTENANCE

Interval		Symbol	Remarks
	4. Check push rod cover tube and packing for condition. (See T.O. 01-5EC-2 p.204, (2) (e), p. 206. (4) (b)	D	
	g. Remove valve spring by compressing with PWA valve spring compressor. Remove split cone keepers and upper washer. Ask instructor for replacements.		
	h. Replacement	P	
	1. Lubricate ball ends of push rods.		
	2. Replace push rod by depressing rocker arm. Locate numbered end of rod and flared end of Housing toward CRANKCASE and install. Make certain that the push rod is properly seated by lifting the housing and spinning the rod freely. Also double-check by checking the rocker arms for valve clearance.	D	
	3. Tighten and safety cover packing nuts, tappet end first.	D	
	4. Adjust valve clearances as directed on a following sheet. See T.O. 02-10CB-3 p. 92, 01-5EC-2 p. 209.	D	
	5. Replace rocker box cover. Torque nuts 70 to 85 in. lbs.	D	
	6. Replace and torque spark plug to 300 to 360 inch lbs.	D	
	7. Replace connector and elbow. Caution: Do not tighten excessively. See T.O. 01-5EC-2p.220)		
S	11. Valves, use spare cylinder on the bench.		
	a. Place cylinder on wooden block, (cylinder tree).		
	b. Compress valve springs using PWA valve spring compressor, remove the split cone keepers, upper washer, and valve springs, removing the inner spring first.		
	c. Remove safety circlet from the valve stems, and holding the valve stems lift the cylinder from the tree, remove the valves using care not to drop them.		
	d. Inspection. (T.O. 02-1-6.Gives Valve Inspections)		
	1. Check valve stem, fillet, facr, margin, and head for signs of failure.		
	2. Check springs for breaks and other signs of weakness.		
	3. Inspect valve guides and seats for evidence of failures.		
	e. Replacement		
	1. Oil galve guides and insert valves.		
	2. Place cylinder on tree to hold valves in place.		

ENGINE MECHANICS (Continued)

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

ENGINE REPAIR AND MAINTENANCE

Interval		Symbol	Remarks
	3. Replace safety circlets in grooves on valve stems.		
	4. Insert valve springs and upper washer.		
	5. Compress valve springs, using PWA compressor and install keepers. Be sure all serrations and grooves inter-lock on exhaust valve keeper. Have instructor initial here approving installation		
S 12.	Piston and Piston Rings.		
	a. Inspect the general condition of the piston by looking for signs of excessive wear, cracks, distortion of ring lands, and scratches.	D	
	b. Check the piston for "dishing" by placing a straight edge across the top of the piston and measuring the clearance if any is found. The maximum allowable clearance is .008 inch. T.O. 02-10CB-3, p. 58.	D	
	c. Have instructor demonstrate removal and replacement of rings.	D	
	d. Inspect all rings for general condition.		
	e. Measure the side clearance of each ring and list. Measurements T.O. 02-10CB-3, p. 59 Groove 1: .0052 .0053 .0054 .0045 .003	D	
	f. Measure the end clearance of each ring and list measurements. Groove 1: .0592 .0068 .0064 .0595 .0015		
	g. Replacement: Place numbered or marked end of rings toward the bottom of the piston. Stagger the ring gap around the piston. Cover piston sides with oil. Using a piston ring compressor, install the piston in the cylinder and place cylinder on the mandril or block.	D	
25	13. The propeller shaft thrust bearing retaining nut is checked for tightness at the first 25-hour inspection period after the engine has been installed in the airplane, and subsequent tightening is accomplished at the discretion of the Engineering Officer in charge.		
	Such tightening on R-1830 engines is done by means of a proper wrench (40J3909) and adapter (40J3909-16). The nut is torqued to 600 foot pounds (T.O. 02-10CB-2, 02-1-34).	D	

ENGINE MECHANCS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

ADJUSTMENT OF VALVE CLEARANCES by the POSITIVE method as given in T.O. 03-10CB-2, pp46-7; T.O. 02-10-CB-3 pp.92-3; T.O. 01-5EC-2, pp 209-10

Valve clearances should be checked after the first 25 hours of engine operation and at 300-hour periods thereafter. The clearances are adjusted in a sequence which conforms to the firing order of the cylinders. The following method places the cam in the same relative position on its bearing for the setting of each pair of valves and permits a positive setting with all the push rods in position.

1. Back off the valve clearance adjusting screws several turn to insure that the clearances are loose. Refer to the table listed below and place the piston of the first designated cylinder (No. 1) on top center of its compression stroke. The crankshaft should be turned in the normal direction of rotation for all operations.

2. Momentarily relieve the valve spring load on the two specified tappets (No. 9 intake and 7 exhaust), using two rocker arm depressors. The two tappets should be relieved, then slowly released simultaneously. This will allow the cam to slide over so that it is in contact with the bearing adjacent to the cylinder whose valve clearances are being set. Adjust the valve clearances of the specified valves (No. 1 inlet and No. 1 exhaust), setting each to .020 inch with the valve clearance gage.

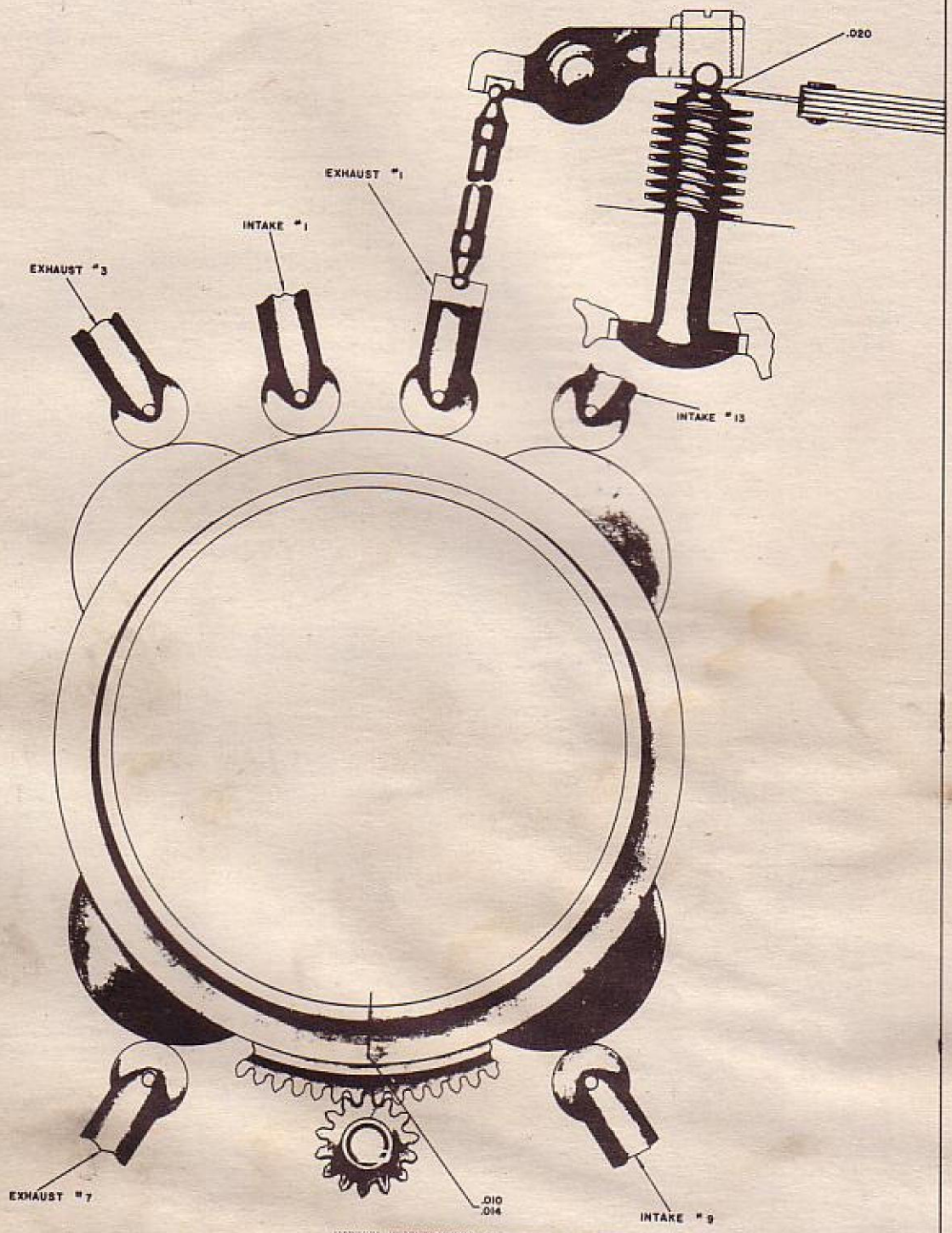
CAUTION: Particular care must be exercised to make sure that the proper valves are depressed else a push rod may drop out of place and cause damage before it is discovered.

3. Adjust the clearance of all other valves in the same manner following the order shown in the table below. After setting all the valve clearances, turn the crankshaft two revolutions in the normal direction of rotation; then check each valve clearance with the proper piston at top center on the compression stroke again following the order shown in the table below. If, on this check, clearance are found which vary more than .005 inch from the specified clearance of .020 inch (in other words, if less than.015" or more than .025"), these clearances should be reset to the correct specified clearance of .020".

Adjust Valves .020 clearance		Set Piston TDC Compression	*Depress Valves	
Intake	Exhaust		Intake	Exhaust
1	1	1	9	7
10	10	10	4	2
5	5	5	13	11
14	14	14	8	6
9	9	9	3	1
4	4	4	12	10
13	13	13	7	5
8	8	8	2	14
3	3	3	11	9
12	12	12	6	4
7	7	7	1	13
2	2	2	10	8
11	11	11	5	3
6	6	6	14	12

*Depress these two valves simultaneously, then release slowly, before proceeding with adjustment of the valve clearances at the cylinder which has the piston on TDC of compression stroke.

LOCATION OF VALVE LIFTER ROLLER ON CAM



MAXIMUM UNCENTRALIZED CAM FLOAT CLEARANCE

(CENTRALIZED CAM FLOAT CLEARANCE IS .005 TO .007)

NO.1 CYLINDER TOP DEAD CENTER COMPRESSION STROKE

PHASE IV
P. 37

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

4. If excessive valve clearances are found (.025 inch or more), the following procedure will be followed:

a. Remove and clean the necessary push rods and push rods covers.
b. Inspect push rods for straightness, wear on ball ends, and security of ball ends.
c. Inspect condition of packing in push rod cover nuts. Replace if necessary.
d. Re-assemble all parts and ascertain that both ends of the push rod covers fit properly in packings.
e. Recheck valve clearances and make proper adjustment thereof in accordance with the above instructions.

Explanation for Adjusting Valve Clearance by the Positive Method

On the R-1830-43 and -65, the twin rows of cam lobes are an integral part of the cam rim. The cam rim is driven by a gear which revolves the cam rim upon a cam bearing. If the clearance between the cam rim and the cam bearing were centralized (as it is when the engine is running), this centralized clearance would average from .005" to .007". This centralized clearance is commonly called cam float.

When the crankshaft is turned slowly during the valve clearance adjustment procedure, there is a very strong likelihood that the cam float clearance does NOT stay centralized. In fact this cam float clearance may vary from almost .000" to as high as .014".

Thus the older method of valve clearance adjustment created a likely possibility of considerable error between the valve clearance set at .010" and the greatly variable cam float clearance of .000" to .014".

To take the extreme cases that could occur when using the older method - If one were setting the valve clearance at .010" on #1 cylinder and if the cam float clearance at the moment happened to be .000" at the point where the cam followers for the valves of this cylinder touch the cam rim, then later the running engine with its centralized average float clearance of .005" to .007" would reduce the actual valve clearance so that it would be .003" to .005" (cold). To take the opposite extreme, if one were to go on to #10 cylinder and set the valve clearance at .010" and if the cam float clearance at that moment happened to be maximum of .014" at the point where the cam followers for the valves of #10 cylinder contact the cam rim, then later the running engine with its centralized average float clearance of .005" to .007" would increase the actual valve clearance so that it would be .017" to .019" (cold).

This possibility of error in valve clearance adjustment due to cam float is eliminated by using the Positive Method.

By depressing the outer valves of the opposite two cylinders in the same row, the cam rim is forced away from the valves on which the adjustment is going to be made: in other words, at that point the cam rim is forced against the cam bearing so that there is no cam float clearance at all at this point. The clearance on the valves is then set at .020" so that when the cam float clearance becomes centralized while the engine is running, the actual valve clearance will be .013" to .015"(cold)

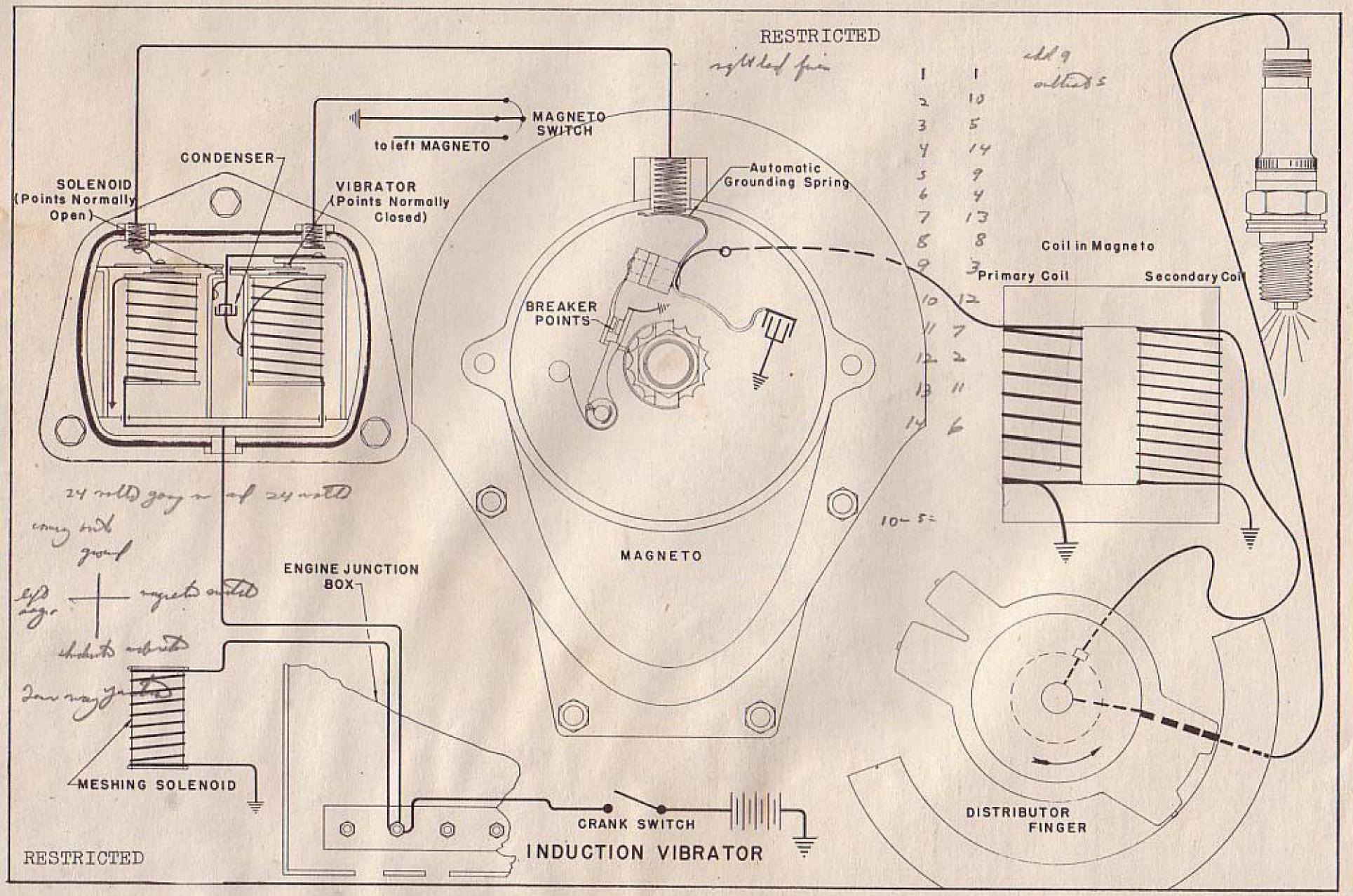
AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

To take a specific example: Suppose one were going to adjust the valve clearance on #1 cylinder. When #1 cylinder has been set on top center of the compression stroke, the cam followers for #1 Cylinder will be between two of the cam lobes: at the same time the cam followers for #3 and #7 exhaust and for #9 and #13 intake will be on the four cam lobes. Thus when #7 exhaust and #9 intake valves are simultaneously depressed, the pressure, (Which the springs of these valves exerted on the lobes and thus also on the cam rim) is relieved: at this instant the pressure exerted by the springs of #3 exhaust and #13 intake valves on the other two (the upper) camlobes forces the cam rim on to the cam bearing. As the result, the cam rim rests directly on the cam bearing at the point where the cam followers for the valves of #1 cylinders are, and the cam float clearance has shifted to the opposite side, away from the valves to be adjusted. The cam rim will remain in this same position IF #7 exhaust and #9 intake valves are slowly released at the same time (that is, simultaneously), because the springs of #3 exhaust and #13 intake valves are continuing to exert pressure on the upper two cam lobes (however, if the two depressed valves are allowed to snap back quickly or unequally, there will most likely be some change in the cam float clearance - hence release must be SLOW and SIMULTANEOUS).

Similar action occurs when this positive method is used to adjust the valve clearance on the remaining cylinders in the engine firing order.

- Adapted from Buick's P & W Instructional Manual

RESTRICTED



RESTRICTED

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

IGNITION SYSTEM

Parts followed by * to be located after removal of accessory or cover.

A. Location and Function

1. Magneto.
   a. Mounting flange.
   b. Gear housing.
   c. Drive coupling.*
   d. Breaker cover.
   e. Dust cover
   f. Radio shield.
   g. Radio shield elbow.
   h. Ground switch connection (P-lead)
   i. Red dot on compensating cam.*
   j. Primary condenser.*
   k. Breaker points.*
   l. Coil assembly.*
   m. Distributor block.*
   n. Timing collar.*
   o. Distributor rotor.*
   p. Cam follower and spring.*
   q. Safety, short circuiting spring.*
   r. Primary cable.*
   s. Secondary, high tension terminal.*
   t. Booster coil connection.
   u. Breaker point adjusting screws.*
   v. Cable piercing screws in dist. block.*

2. Ignition Control Cable.
   a. Lead, left mag. to ignition cross.
   b. Lead, induction vibrator to ignition cross
   c. Lead, from ignition cross to ground.
   d. Cable, from ignition cross to wing firewall.
   e. Safety grounding cannon plug at wing firewall.

3. Induction Vibrator
   a. Mount, housing, and cover.
   b. Grounding plate.
   c. Positive outlet.
   d. Ignition switch outlet.
   e. Magneto outlet.
   f. Slotted nut and lock spring.
   g. Positive cable, post, clip, and screw.*
   h. Relay coil.*
   i. Vibrator coil.*
   j. Relay points.*
   k. Vibrator points.*
   l. Condenser.*
   m. Terminal nut (Spring contact)*
   n. Terminal strip.

3. Ignition Harness.
   a. Flexible conduit, mag. to pipe conduit.
   b. Pipe conduit.
   c. Flexible conduit, pipe to manifold.
   d. Ignition manifold.
   e. Braided conduit, manifold to plugs.
   f. Elbows.
   g. Conduit clamps.
   h. Braided conduit clamps.

4. Spark Plugs.
   a. Shielding barrel assembly.
   b. Shell assembly.
   c. Core assembly.*
   d. Core contact point.*
   e. Center electrode.*
   f. Ceramic core insulator.
   g. Ground electrode.*
   h. Bushing, (cylinder head).

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

ENGINE SYSTEMS

Col. No.
Form 41B

IGNITION SYSTEM

Interval	Inspection Required	Symbol	Remarks
PF	1. Verify that ignition switches are off.	D	
D	2. Check magneto for:		
	a. Cracked housing and mounting flange.		
	b. Security of mounting.		
	c. Proper safetying.		
	d. Conduit for tightness and condition.		
50	3. Remove breaker cover and clean breaker housing.		
50	4. Check cam lubrication. Wipe off excess oil. Lack of lubrication is indicated when cam follower has a grayish-white color instead of reddish-brown, moist appearing surface, or if reddish color appears on cam.	D	
50	5. Inspect breaker points. A small amount of pitting and burning is permissible, but dressing or replacement is necessary in event of excessive pitting or burning. Never use a file, sandpaper or emery cloth to dress these points. (T.O. 01-5EC-2, p212*	b	
50	6. Check magneto timing and synchronizing. T.O. 02-10CB-2 and 03-5DC-1. (Refer to end of these inspection sheets for instructions).		
	7. Induction Vibrator. T.O. 03-5-2.		
PF	a. Check for operation by engaging the meshing switch. A buzzing sound should be heard.	D	
	b. Check for security of mounting and condition of leads.		
100	c. Check for security of lock springs securing slotted outlet nuts on ignition switch and magneto outlets.	D	
	d. Remove top cover and inspect condition of gasket. Gasket is shellacked to cover.		
	e. Check terminal nut assemblies for contact with terminal strip within the unit. If loose, tighten slotted nuts.		
	f. Check tightness of screws securing the positive cable to the unit. Tighten if necessary.	D	
	g. Check contact points for general condition and cleanliness.	b	
	8. Ignition Harness.		
50	a. Inspect harness for security of mounting to rear section and to power section.		
	b. Inspect for tightness of ring nuts between pipe and flexible conduit.	D	
	c. Inspect for evidence of kinks and cracks in pipe conduit and manifold.		
	d. Inspect braided leads to plugs and elbows for tightness at connections and evidence of failure.		
	e. Replace ignition wire. Refer to end of these inspection sheets for instructions.		

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

IGNITION SYSTEM

Col.No. Form 41B	Interval	Inspections Required	Symbol	Remarks:
	D	9. Spark Plugs.	D	
		a. Check spark plugs and connections for general condition and evidences of failure.	b	
		b. Remove plugs from No. 1 and 10 cylinders.		
		1. Inspect plugs and bushing threads for nicks burrs, and cross threads.	b	
		2. Inspect gap between electrodes. Clearance should be .011" to .014".	D	
		3. Inspect plugs for cracks, carbon, oil, or fouling		
		4. Install plugs, using thread lubrication and torque 300 to 360 inch lbs.	b	
		5. Install elbows. Caution: Excessive tightening will change the gap setting.*		
	100	Note: On the 100 hour inspection, all spark plugs will be removed and replaced with new or reconditioned plugs.	D	

* This caution is especially applicable to mica spark plugs.

So much trouble is being encountered in the removal and replacement of spark plug elbows that further cautions are added here to help remedy the situation:

1. It is recommended that the nut on the high tension lead be loosened a few turns BEFORE the nut on the spark plug elbow is loosened - this will greatly lessen the danger of cross-threading the elbow nut when re-installing the elbow.

2. When loosening or tightening the spark plug elbow nut, use one hand to hold the elbow - This precaution is to insure the prevention of twisting the elbow itself or damage to the lead and its shielding which might result if the elbow twisted.

3. The high tension lead connector (or cigarette) should be removed from or inserted in the spark plug terminal well with great care. When removing, pull carefully, DO NOT JERK, the connector straight out from the plug, and likewise when inserting; avoid tilting the connector and avoid applying a side load on the plug barrel - This is to prevent damaging either the insulator or the lead connector or both (T.O. 03-5E-1. Sec. II, para. 4,5).

4. When removing the lead connector (or cigarette) from the lead, remember that the wire projecting through the connector must first be

IGNITION SYSTEM (Continued)

straightened before it can be removed.

5. After the connector has been inserted in the spark plug, start the elbow nut by hand and screw on finger-tight. Then with a wrench torque ONLY sufficiently to insure a snug fit.

6. Exercise care to prevent scratching and/or marring the elbows.

7. Be sure that you use the proper angled elbow:

a. 110° elbows on both front and rear spark plugs in the rear row of cylinders:

b. 110° elbows on the rear spark plugs in the front row of cylinders (except on #8 cylinder).

c. 70° elbows on the front spark plugs in the front row of cylinders and on the rear plug of #8 cylinder.

8. REMEMBER that:

a. Use of the right type and side of wrench is of greatest importance to prevent damage to internal plug parts.

b. Excessive tightening of the spark plug itself may make it hard to remove for the next servicing; such excessive torque may also compress the gasket out of shape thus losing the gas-tight seal besides imposing an overload which stretches the threads and results in dangerous loosening of plug parts; furthermore, the excessive torque may distort and stretch the plug to such a degree that breakage of the shell would result when the plug is subsequently removed or installed, or the plug shell damage may be such that it ultimately results in a "blown out" center electrode or core insulator.

c. Experience in the field indicates that the damage which makes ceramic plugs inoperative, has usually occured in the handling, installation, removal, or servicing operations. Only rarely does a spark plug become inoperative because of failure of some plug part. Normally the only wearing part of the spark plug is the electrodes; with proper servicing ceramic plugs can operate efficiently for 300 hours. (Buick's P&W Instruction Manual, p. 291).

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

REPLACING ITNITION WIRE (T.O. 02-10CB-2)

If there are indications that an ignition wire is defective, the wire will be located and replaced as follows. The instructor may wish to add or omit certain steps.

1. Determine which wire is to be replaced, and obtain a new wire of the correct length. See T.O. 02-10CB-3, p. 100 for proper lengths.
2. Remove spark plug connection from the end of the wire.
3. Remove braided conduit and spark plug elbow from wire by unscrewing the union nuts at each end of the conduit.
4. Disconnect the one or all the wires from the distributor block. CAUTION: Be careful that identification bands are not lost from the wires.
   a. Remove radio shield elbow and conduit if all the wires are removed from the distributor block.
5. Unscrew the union nut which fastens the pipe assembly to the manifold and slip the assembly back toward the distributor block after doing step 7.
6. Remove the four cap screws that fasten the manifold to the front of the power section.
7. Remove as many elbows from spark plugs as is necessary to allow manifold to be pulled forward enough to locate wire where union nut fastened to pipe assembly. Pull the wire out enough here to form a small loop.
8. Determine in which direction the old wire will move more easily and splice and/ or solder an end of the new wire to that end of the old wire.
9. Dust the new wire with talc or soapstone to prevent it from binding or seizing when being installed in the manifold.
10. Pull the old wire out and at the same time feed the new wire into the manifold. Be sure to maintain a loop at the union nut so that the wire will be pulled straight and not around corners. CAUTION: It is necessary to perform this operation carefully so as not to injure the protective coating of the new wire.
11. When the new wire has been pulled through the manifold far enough, cut off to proper length at each end.
12. Replace conduit and radio shield elbow, if removed. Place clip on distributor end of wire and then insert the wire into the block.
13. Fasten the pipe assembly to the manifold, manifold to front of power section, replace braided conduit and elbow to new wire, and then connect all the loosened elbows to their respective plugs. (The spark plug elbows should be tightened only enough to insure a snug fit. These elbows tend to turn when the attaching nuts are tightened. This may cause damage to the elbows, particularly on the front mounted type haraess, as well as possible failure of ignition lead insulation. Therefore, particular care must be taken to hold elbows to prevent them turning while tightening the attaching nuts. Furthermore, on at least some types of spark plugs, excessive tightening of the elbow may change the gap setting of the spark plug.)

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

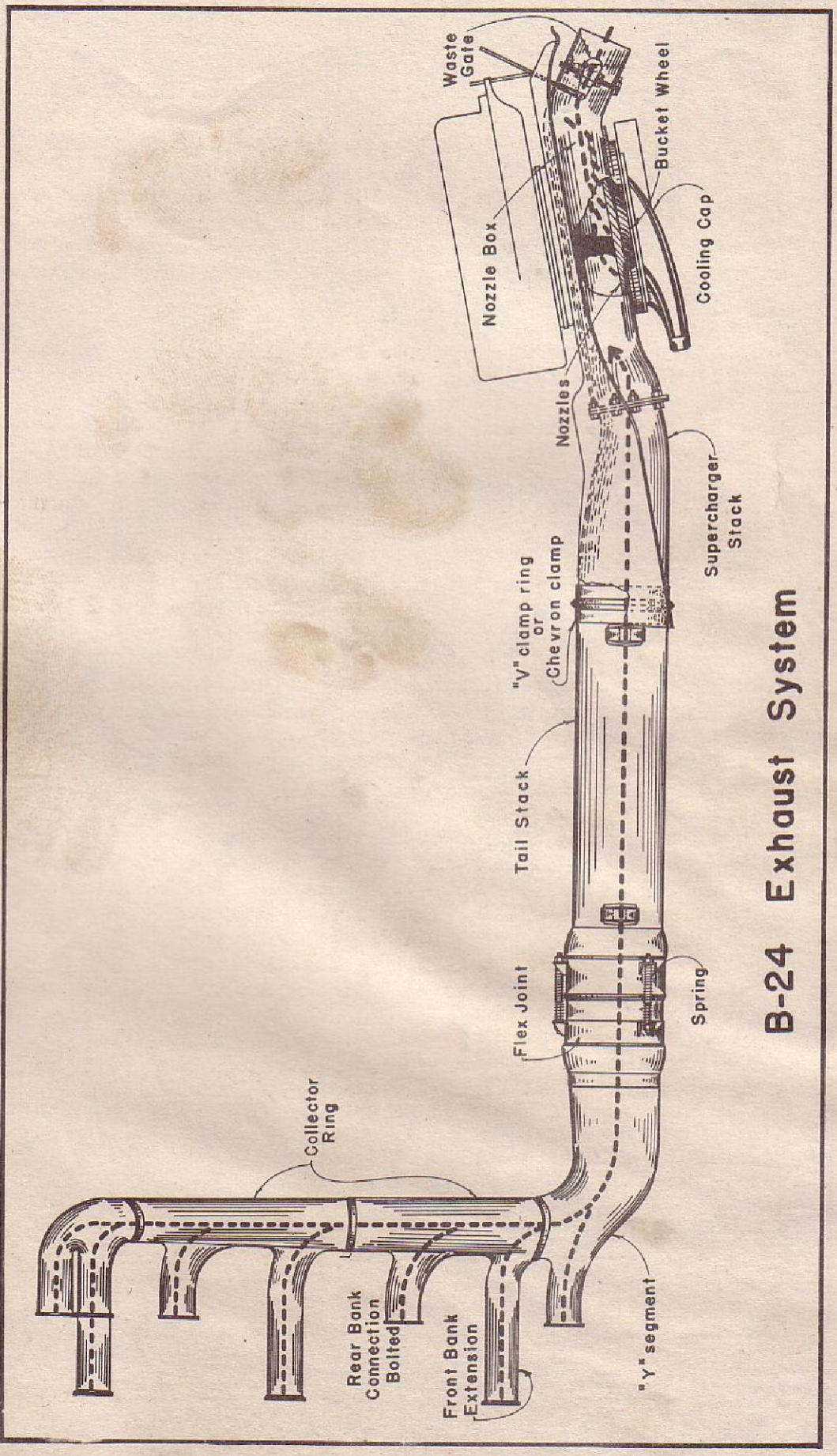
ENGINE SYSTEMS

IGNITION SYSTEM

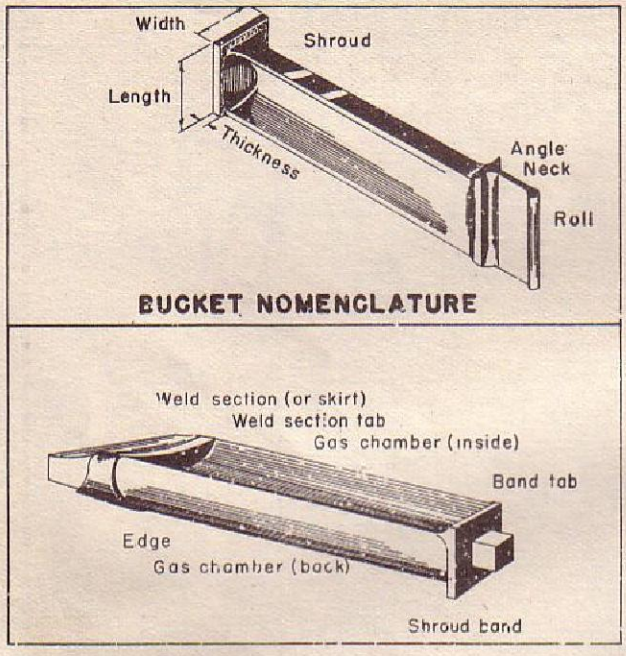
Questions

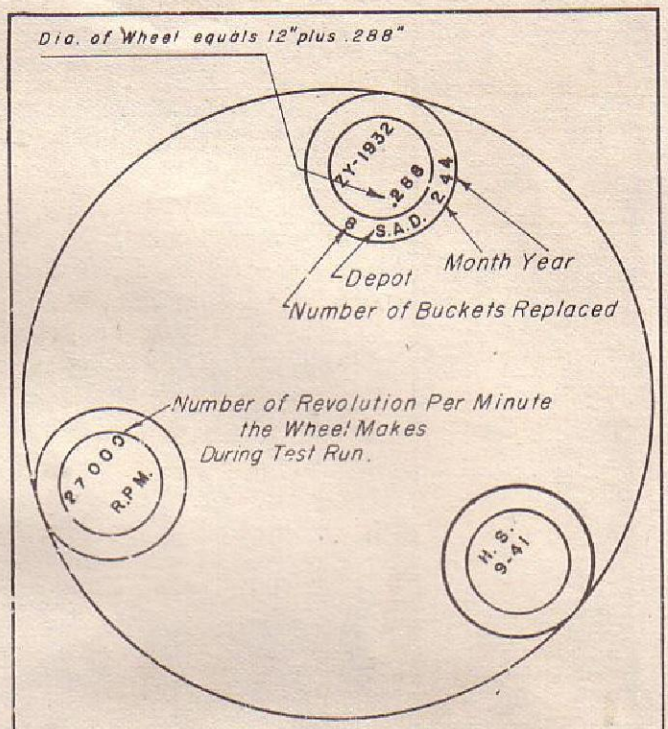
1. What is the purpose of the red dot on the compensated cam?
2. What is meant by synchronized timing?
3. Are the magnets in the Bosch magneto stationary or rotating?
4. What is the main function of the induction rotor?
5. Suppose you replaced a magneto, but it is not in step, or the stud are not in approximate center in the slots--what would you do to correct the situation?
6. In synchronizing magnetos, why is it so important to have both lights going out at the same time, rather than coming on at the same time when using the "home-made" timing light?
7. Right magneto fires which plugs?
8. What type plugs are used? (T.O. 03-5E-3)
9. What is the spark advance on this engine?
10. Are these plugs cleaned with sand blast? (T.O. 03-5E-1)
11. What is meant by compensated magnetos?
12. Where are the magnetos grounded, when switches are "Off"?
13. Are the magnetos "on" if the "P" lead is removed from magneto?
14. Are the magnetos "on" if the cannon plug is removed or opened at the firewall? (T.O. 01-5EC-2, p.37, bottom col.)
15. Where is the booster "in" connection on the magneto?
16. Where is the induction vibrator "in" connection on the magneto?
17. What is the speed of the distributor of the induction rotor?
18. When should the mechanic readjust the breaker plate?
19. Is it possible to change the timing of the distributor $\frac{1}{4}$ tooth?
20. When mounting a magneto, how many timing settings are available?
21. What spark plug gap tolerance is allowed?
22. What torque is used to tighten plugs?
23. What torque is used to tighten spark plug elbows?
24. What inspection is made on spark plugs?
25. What is done to spark plugs on 100 Hr. Inspection?
26. What advantage has the induction vibrator over the booster coil?
27. If relay coil or points fail to operate, what might the trouble be?
28. If vibrator coil or points fail to operate, what might the trouble be?
29. Which magneto is the induction vibrator attached?
30. Which plugs does the induction vibrator fire?
31. How is the induction vibrator turned off?
32. Why doesn't the vibrator ground out the magneto when the meshing switch is released?
33. How many ignition wires are housed in ignition harness?
34. Are all the wires the same length?
35. What material is used for a lubricant when replacing ignition wires?
36. Will a plug fire if there is an open in the wire? Would altitude make any difference?
37. How would you check for an open in an ignition wire?
38. Should you splice an ignition wire?
39. Is the ignition wire soldered to the cigarette? (T.O. 02-10CB-3, p.102).
40. Between which cylinders does the ignition harness pass?
41. Is it necessary to remove any cylinders in order to replace the ignition harness?
42. How is the wire fastened into the distributor block?
43. Can the lead assembly be replaced at the harness?
44. How is harness attached to engine?
45. Is the harness supercharged?

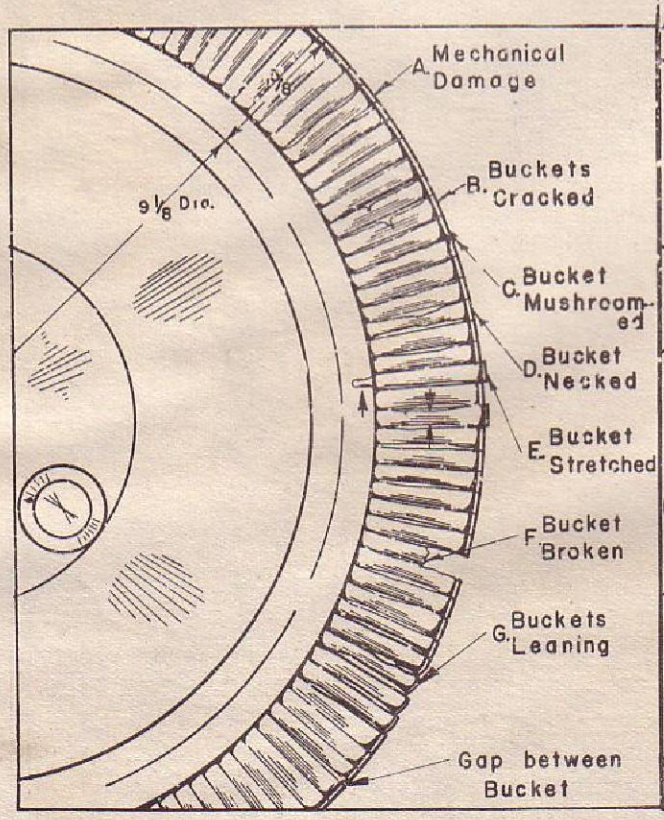
580TH TECHNICAL SCHOOL SQUADRON
Willow Run Airport
Willow Run, Michigan

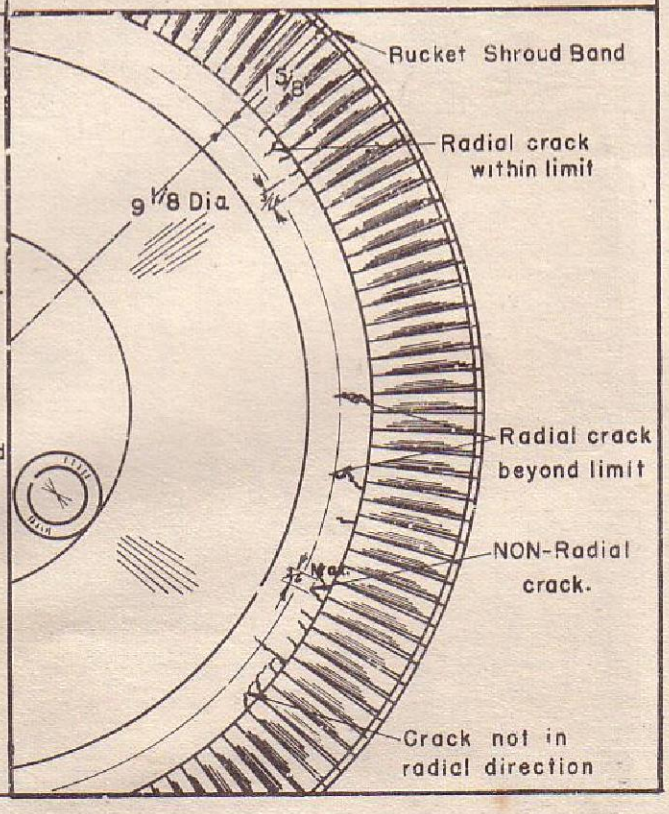


AAF TECHNICAL SCHOOL
WILLOW RUN, YPSILANTI, MICH.
B-24 AIRPLANE SCHOOL









ENGINE SYSTEMS.

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School.

EXHAUST AND TURBOSUPERCHARGER SYSTEMS

A. Location and Function

Locate each unit listed below and be able to state its function.

1. Exhaust extensions on cylinders.
2. V-clamp (chevron clamp) on front bank extensions.
3. Exhaust collector ring, 7 sections.
   a. Half clamp and nipple.
4. Short stacks attached to front cylinders.
5. Adapter flanges on collector ring, for rear row of cylinders.
6. Expansion joints on exhaust collector ring.
7. Exhaust collector ring shroud.
8. Diaphragm or engine firewall.
9. Tail stack shroud.
10. Ball joint assembly, spring loaded (Flex joint in tail stack assembly.)
11. Tail stack forward section.
12. Tail stack V-clamp.
13. Tail stack aft section.
14. Turbo compressor casing.
15. Baffle ring.
16. Supercharger shroud.
17. Turbo tachometer connection.
18. Turbo oil pump.
19. Bearing and pump casing.
20. Nozzle boxes.
21. Bucket wheel and buckets.
22. Cooling cap.
23. Waste gate pipe and waste gate.
24. Supercharger regulator and mounting bracket.
25. Supercharger regulator exhaust balance line.
26. Turbo-supercharger mounting brackets.
27. Pressuretrol.
28. Turbo governor
29. Waste gate motor.
30. Nacelle junction box

ENGINE SYSTEMS
T-50

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School.

EXHAUST AND TURBOSUPERCHARGER

Col. No. Form 41B Interval	Inspections Required	Symbol	Remarks:
50	1. Inspect V-clamp bolts on front bank extensions for proper installation, tightness, and safetying.	D	
S	2. Remove one of the V-clamps, check its condition and re-install applying a torque of 35 to 50 in.-lbs., safety with cotter key. The correct part no. on the clamp should be 55470. See T.O. 02-10-38.	D	
50	3. Inspect rear row adapter flange bolts for proper safetying and general condition.	D	
S	4. Remove the flange bolts on one cylinder, inspect, replace if defective, retighten to 50 in. lbs. (If cotter pin holes do not line up, back off the nut as required for proper alignment.) Resafety nuts with .032 inch wire. T.O. 01-5-63 & 01-5-15	D	
50	5. Inspect for cracks and evidence of leakage at: a. Short stacks. b. Collector ring. c. Exhaust extensions.	D	
25	6. Inspect the spring loaded ball joint assembly for the proper installation and general condition. Note the arrow on the male portion. Turn the joint by hand to make sure it is free and adjusted evenly.		CANNOT TURN JOINT FREELY
D	7. Inspect the forward tail stack for proper anchorage and general condition. (Anchored to tail stack shroud brackets by four bolts.)	D	
50	8. Inspect V-clamp on tail stack for safetying and general condition.	D	
D	9. Inspect aft tail stack for proper anchorage and general condition. Note 12 bolts which fasten stack to supercharger.	D	
D	10. Check the turbosupercharger for security of mounting, (2 side brackets and 1 rear bracket) and for evidence of failure	D	
PF	11. Inspect the waste gate for: a. Evidence of warping. b. Corrosion c. Freedom of movement--laterally and from the open to the closed position. Note: Disconnect waste gate linkage before attempting to open or close waste gate on electronic regulator installation. d. Proper clearance between waste gate and waste pipe when gate is closed should be from .020 to .045 inches. T.O. 01-5EC-2, page 231.	D D	

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

EXHAUST AND TURBOSUPERCHARGER SYSTEMS

Col. No. Form 41B. Interval	Inspections Required	Symbol	Remarks:
D	12. Inspect turbo for oil leaks at bearings and oil lines. Repair leaking condition. Note: Oil seepage from the turbo oil seal onto the bucket wheel and cooling cap is permissible when the turbo is idle. T.O. 03-10DA-1	D	
PF	13. Inspect bucket wheel:		
	a. Rotate wheel for freedom of operation Listen for unusual noises of internal rubbing or indication of bearing failure.	D	
	b. Check the turbine wheel for cracked or defective buckets. (See diagram)	X	CRACKED BUCKETS
	c. Check for bucket looseness by applying a slight pressure to the bucket tip at a right angle to the face of the wheel. T.O. 01-5EC-2, page 52	D	
D	14. Inspect the bucket wheel disk directly above the cooling cap rim for run-out by revolving the bucket wheel slowly by hand. If run-out appears, it should be measured by placing a feeler gage between one point on the cooling cap and a point on the bucket wheel rim just inside the point where the buckets are attached to the wheel. Maximum run-out is .005 inches. T.O. 01-5EC-2 and 03-10DA-1.	D	
PF	15. Check nozzle box clearance in 4 equally spaced places by inserting a feeler gage between bucket wheel and nozzle box. Allowable clearance is from .070 to .160 inches. T.O. 03-10DA-1.	D	
PF	16. Measure the clearance between the cooling cap and turbine wheel. If the maximum clearance is greater than .190 inches or if the minimum clearance is less than .090 inches, rearrange the shims supporting the cooling cap until the clearance is within these limits around the entire rim of the cooling cap. T.O. 03-10DA-1	D	
100	17. Inspect the total side play (radial play) of the turbo roter for bearing wear. A dial indicator is used for the best results, but an approximation may be obtained with a screw driver and feeler gage in the following manner. Hold the screwdriver in a vertical position so that the end of the blade is against the nozzle boxes and the face of the blade tip rests against the end of one of the buckets. Push the bucket wheel horizontally in a direction away from the screwdriver and measure the clearance between the screwdriver and bucket. The maximum		

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School.

EXHAUST AND TURBO-SUPERCHARGER SYSTEMS.

Col. No. Form 41B. Interval.		Inspections Required	Symbol	Remarks:
		allowable side play is .003 inches, T.O. 03-10DA-1 .012 inches, T.O. 01-5EC-2.	D	
100	18.	Inspect the total end play (Axial play) of the turbo rotor for bearing wear. A dial indicator is used for best results but an approximation may be obtained with the use of only a feeler gage in the following manner. Make a mark on the rim of the bucket wheel and a mark on the nozzle box so that the two marks are in line. Measure the nozzle box clearance at this point. Then, move the bucket wheel up and measure the clearance again at the same point. The difference between the two readings gives the end play. The maximum allowable end play is .009 inches, T.O. 03-10DA-1.	D	
D	19.	Inspect the turbine wheel buckets for: See diagrams for details.		
		a. Mechanical damage as nicks, dents or gouges.	X	HAVE DENTS IN TURBINE WHEEL
		b. Cracks.		
		c. Mushrooming or upsetting.		
		d. Necking		
		e. Stretching		
		f. Breaks.		
		g. Back-lean.		
		h. Caps between adjacent buckets.		
D	20.	Inspect for cracks in welded wheels. See diagram for details.	D	
D	21.	Inspect the nozzle box for cracks, especially in the weld. Inspect the inside of the nozzle diaphragm and the bucket wheel and look through the space between the buckets. Cracks over 1 inch in length or of such condition to permit leakage are cause for removal of the turbo	X	DENTS IN NIZZLE BOX
D	22.	Inspect the nozzle blades for buckling by looking between the buckets of the turbine wheel and the nozzle diaphragm.	D	
PF	23.	Inspect the nozzle box and cooling cap for loose bolts and broken safety wire. Replace any stretched bolts and make repairs that are necessary. Inspect condition of cooling cap.	D	
D	24.	Check the balance line, making sure it cannot chafe where it passes through the shroud and that it has no low spots or dips to accumulate moisture where it might freeze. See T.O. 01-5-30 for rerouting exhaust balance line.	D	

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

EXHAUST AND TURBOSUPERCHARGER SYSTEMS.

Col. No. Form 41B. Interval	Inspections Required	Symbol	Remarks:
50	25. Inspect the turbo regulator control bracket for cracks in the webs. See T.O. 01-5E-53 for repair procedures and diagrams.	D	
50	26. Check the turbo regulator for: a. Proper mounting and security of attachment. b. Proper attachment of oil pressure and drain lines. c. Faulty gaskets and excessive oil leakage at servo piston rod. Note: A leakage of one drop per minute at 71°C and pressure of 50 p.s.i. is permitted.	D	
D	27. Inspect the following for security of attachment and general condition: a. Engine firewall. b. Collector ring shroud. c. Tail stack shroud. d. Supercharger shroud.	D	

ENGINE SYSTEMS

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich
B-24 Airplane School

ELECTRONIC TURBO SUPERCHARGER CONTROL SYSTEM (AN-03-10D-6)

I. General Location of Units in the System:

a. Located in fuselage of plane:
1. Manifold Pressure Selector.
2. Amplifiers for all four engines.
3. Main Junction Box.
4. Inverter.

b. Located in each engine nacelle:
1. Pressuretrol.
2. Governor.
3. Waste Gate Motor.
4. Nacelle Junction Box.

II. Detailed Location and General Function of Individual Control Units:

1. Manifold Pressure Selector:
   a. Installation: Located on the control pedestal adjacent to the throttle quadrant, replacing former installation of turbo control levers.
   b. Connections: The Pressuretrol, Governor, Waste Gate Motor, and Nacelle Junction Box of each engine are connected in series with a Calibrator on the Manifold Pressure Selector. The Calibrator of each engine is then shunted into the main control quadrant.
   c. Function: Controls increase or decrease of manifold pressure by movement of main control knob over control quadrant.

2. Amplifiers:
   a. Installation: In some installations, they are located beneath the floor of the radio room between stations 2.0 and 4.0, or they may be mounted on one platform at station 4.0.
   b. Connections: Wired in series between signal system and waste gate motor field winding.
   c. Function: Amplifier contains four tubes: one (7Y4) rectifier supplies a high d-c voltage to the two plates of the (7F7) tube; one (7F7) amplifier which increases the strength of the bridge signals and then transmits them to the grids of the (7C5) tubes; and two (7C5) discriminator or detector tubes, one of which detects signals calling for the waste gate to open whereas the other detects signals calling for the waste gate to close.

3. Main Junction Box:
   a. Installation: On some models it is located beneath the floor of the radio room at station 3.2, approximately in the center of the airplane in front of the hatchway; on others, at at station 4.0-several inches above radio room floor, on atarboard side behind radio operator.
   b. Connections: Wire harnesses of Manifold Pressure Selector, regulator units from the four engines, and all four Amplifiers join in this box with the inverter circuit.

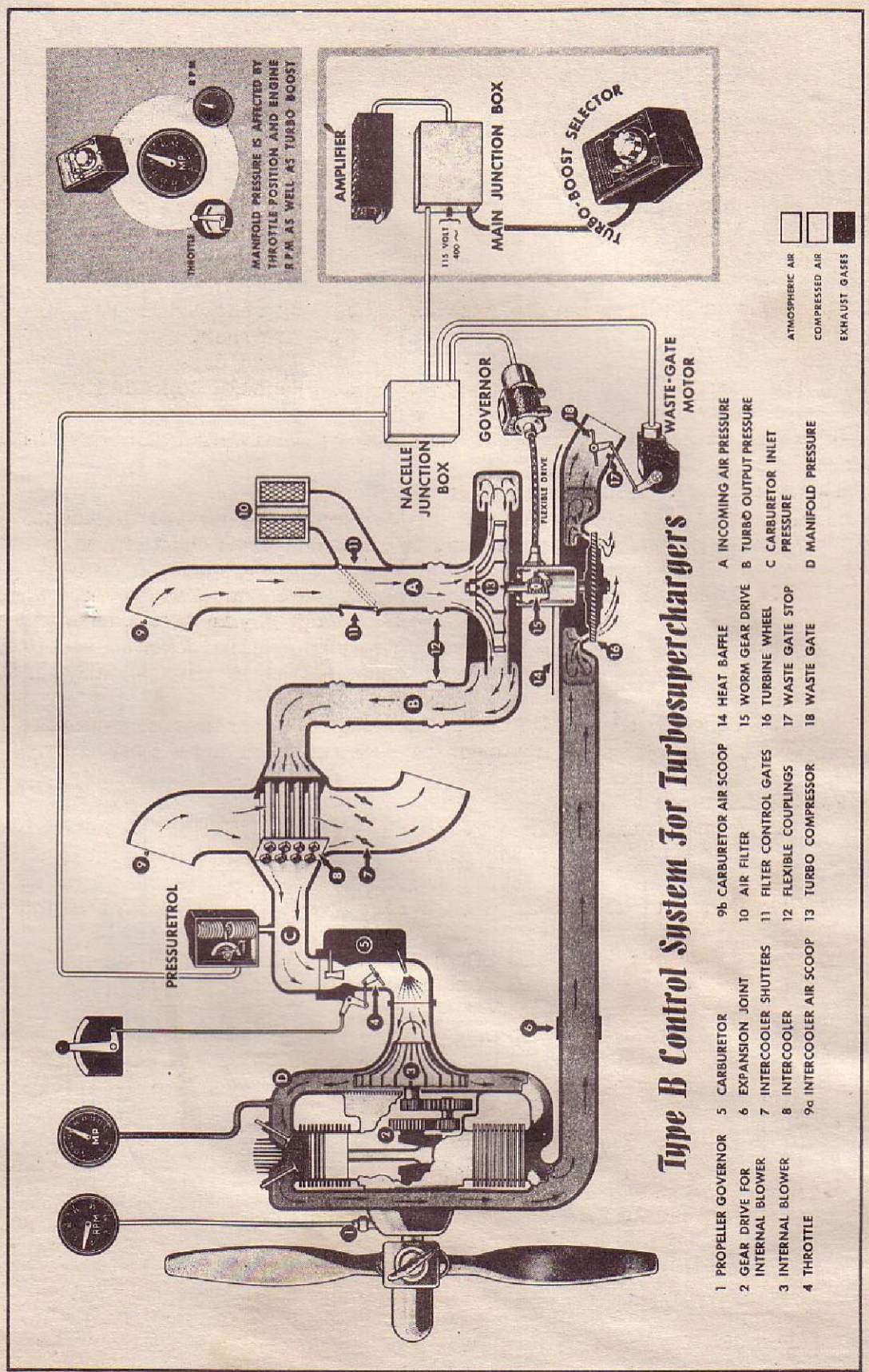
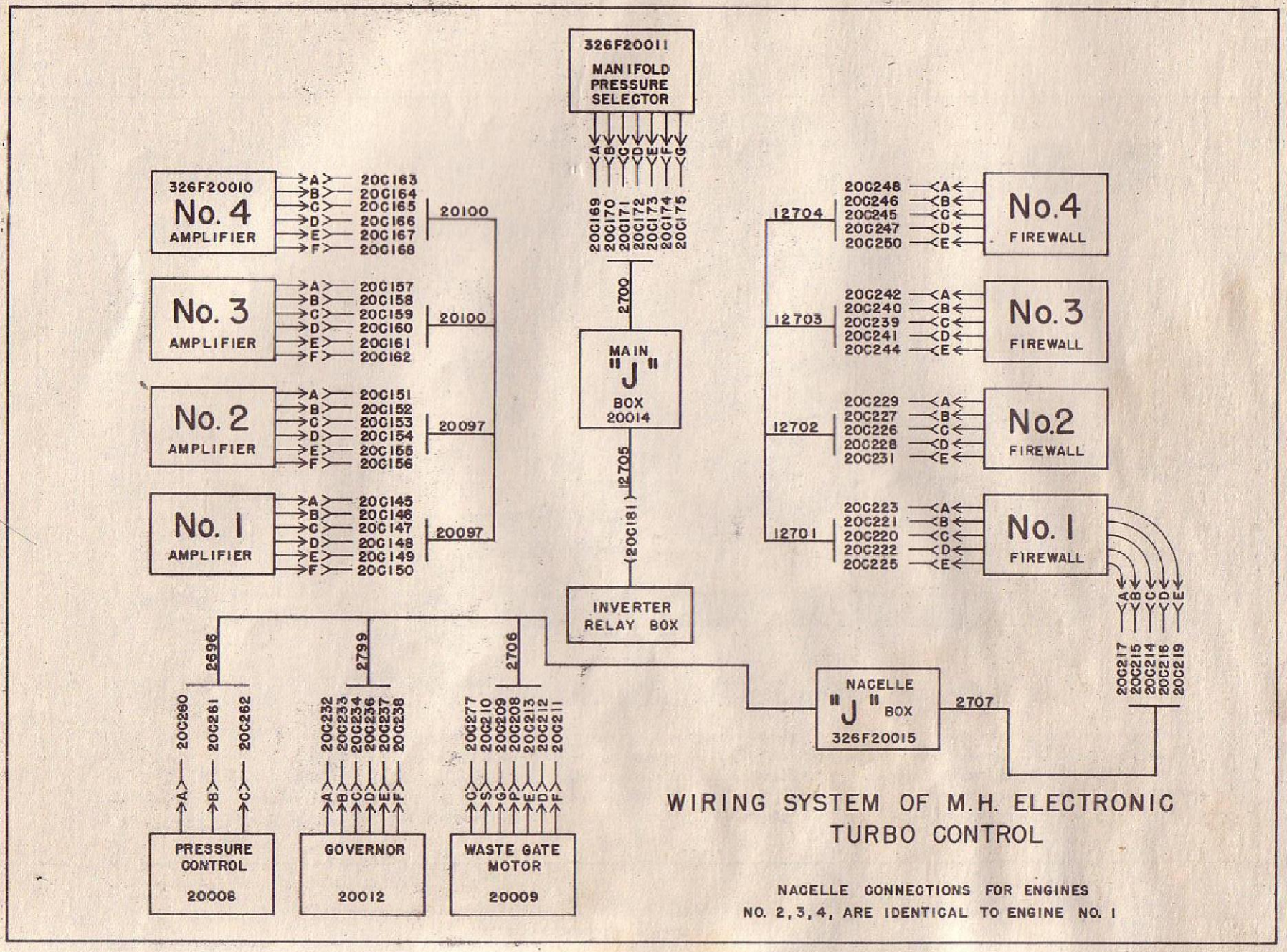


Figure 121—Schematic Drawing of Induction and Exhaust System of an Engine Equipped With Type B Control System for Turbosuperchargers

RESTRICTED



WIRING SYSTEM OF M.H. ELECTRONIC TURBO CONTROL

NACELLE CONNECTIONS FOR ENGINES NO. 2, 3, 4, ARE IDENTICAL TO ENGINE NO. 1

RESTRICTED

(Continued)

c. Function: To provide a means of interconnecting the various units of the control system and act as a central checking point for circuit-failures.

4. Inverters:
   a. Installation: Two inverters are located in the nosewheel compartment.
   b. Connections & Function: The power for the complete control system is taken from one of the two 400-cycle, 115 volt inverters. The main power connection is made at the inverter fuse in the co-pilot's fuse box. In some ships, an additional fuse is used in the main power output line of each inverter. These fuses are installed in the inverter fuse box, located beneath the floor of the radio room a short distance to the left of the inverter.

5. Pressuretrol:
   a. Installation: Located on the engine mount on the left side of the carburetor intake duct, slightly forward and above the left magneto.
   b. Connections: Rubber tube from Pressuretrol bellows to carburetor air scoop. Wired in series between Manifold Pressure Selector and Governor.
   c. Function: Registers air pressure from carburetor air scoop, the action of which actuates wiper arm over control quadrant when bellows contracts or expands.

6. Governor:
   a. Installation: Located at right rear side of turbo, just above the shroud between the impeller housing and nozzle box.
   b. Connections: Driven through a flexible drive taken off the tachometer connection of the turbo oil pump. Wired in series between Pressuretrol and Waste Gate Motor control quadrant.
   c. Functions: 1. Overspeed---prevents overspeeding of turbo by use of flyweights which throw out at approximately 24,000 RPM turbo speed thereby engaging clutch which causes wiper arm to move over control quadrant sending signal for "open" waste gate action.
      2. Accelerometer---Prevents overshooting of manifold pressure, yet allows very rapid acceleration of the turbo by use of inertia wheel which floats on shaft connected to drive shaft by torque spring. Sudden torque of shaft transmits energy to inertia wheel through spring causing wheel to slide along shaft and operate push pin. Push pin moves wiper arm over control quadrant sending signal for "open" waste gate action.

7. Waste Gate Motor:
   a. Installation: Located at rear of turbo about 10 inches above the waste gate.
   b. Connections: Connected by mechanical linkage from motor operated arm to waste gate shaft. Wired in series between governor and amplifier and between amplifier and ground.
   c. Function: Opens or closes waste gate according to direction of motor rotation in response to control signals. It also operates a balancing potientiometer which produces a signal opposed to the original control signal.

ENGINE SYSTEMS

(Continued)

When the rotation of the motor is enough to make the two signals exactly neutralize each other, the power from the amplifier is cut off and the waste gate motor stops.

8. Nacelle Junction Box:
   a. Installation:
      Mounted on the supercharger mounting brackets just above the heat baffle (shroud) on all four engines. All four "J" boxes are located on the left side of their respective turbos.
   b. Connections:
      Wire harnesses of Pressuretrol, Governor, and Waste Gate Motor join at this box and are connected to Main Junction Box through a single harness.
   c. Function: Acts as a checking point for circuit and unit failures at the nacelle.

The Manifold Pressure Selector, Pressuretrol, Governor, Waste Gate Motor, and Amplifier are all wired in series thus composing a bridge control unit. A failure occuring in any one of the nacelle units will result in failure of operation of the entire control system for that engine only.

III Operating Instructions for Ground Run-up of Electronic Control System.

The control system is wired directly to the 115 volt 400 cycle inverter and is therefore automatically energized whenever the inverter is running. Allow two minutes for amplifiers to warm up before attempting to check response of units to action of Manifold Pressure Selector. At low altitudes, no pressure can be expected until dial position of "5" or higher has been reached.

If inverter voltage does not come within the 105 volt to 120 volt limits, unsatisfactory results will not be obtained from the test.

Providing that all waste gates respond to Manifold Pressure Selector before engines are started, it is inadvisable to blame turbo control system for any malfunctioning until each engine has been first checked at high RPM for normal value of manifold pressure without turbo boost.

The turbo control system should be calibrated to take-off manifold pressure during ground run-up following any change of calibrator settings, or when necessary following replacement of any unit in the system. It should not be necessary to recalibrate when changing grade of gasoline. The calibration should be made so that take-off pressures for 100-octane gasoline will be obtained with a dial setting of "8"; the lower manifold pressures used for 91-octane gasoline will then be obtained by stopping the dial at a point below "8".

It should not be necessary to change the calibrator settings during regular engine run-up or preflight checks. If initial calibration is made carefully, variations in manifold pressure in regular run-up tests will then indicate malfunctions in the engine or turbo control system. To permit a more accurate check during engine run-up, avoid changing calibration settings in flight.

(1) Turn on inverter switch.
(2) Turn on filters.
(3) Start engines and turn on generators at proper RPM.
(4) Check d-c voltage. For proper calibration, the d-c voltage must be between 26 and 28.5 volts, and a-c voltage must be between 105 and 120 volts. Check a-c voltage with voltmeter attached to proper terminals in turbo control main "J" box.

INSPECTION OF ELECTRONIC TURBO SUPERCHARGER CONTROL SYSTEM
(AN-03-10DC-6)

1	2	3	4	5
Col. No. Form 41B	Int	INSPECTION	Sym.	Remarks pertaining to defects, replacements, or adjustments.
		NOTE: ONLY THOSE INSPECTIONS PRECEDED BY AN ASTERISK* WILL BE PERFORMED IN THIS PHASE. The others are included as information to acquaint the student with the maintenance requirements of this system.		
10 *	PF	1. Check waste gate for warpage, bending, or binding. (Do not try to open or close waste gate while linkage is connected to the waste gate motor.)	D	
	PF	2. With engines off, connect external power source. Turn inverter on and turn selector to "10". Inspect all waste gates for uniformity of positions. Departures indicate calibrator setting has been changed to compensate for power defects. After correcting engine or accessories trouble, recalibrate the control.	D	
	PF	3. See that amplifier cases in the system are not covered by clothing, etc., preventing ventilation.	D	
*	PF	4. Turn dial clockwise to stop on selector. When stop is reached, arrow should point to "8". Press dial stop latch and turn dial to "0". The dial-stop latch should work freely. Turn dial counterclockwise to a point below "8" and check to see that dial stop re-engages. Return dial to "0" before starting the engine.	D	
	PF	5. When the airplane is flying combat missions, inspect the induction system and exhaust stacks for bullet holes before each flight.	D	
19 *	D	6. Jiggle waste-gate linkage to make sure there is no binding in linkage hearings. Also inspect linkage rod for shiny spots or wear, which would indicate it had been scraping against the fairing or other airplane structures.		
*	D	7. In very dusty or sandy areas, check cleanliness of carburetor air filters daily.	S	
27 *	25	8. Inspect exhaust stack for loose expansion joints and other leaks.	D	
*	25	9. Check waste gate for warpage, bending, or binding. To do this, disconnect linkage from gate arm and move gate from fully open to fully closed position.	D	

1	2	3	4	
Col. No. Form 41B	Interval	INSPECTIONS	Symbol	Remarks pertaining to defects, replacements, or adjustments.
27		10. Check AN connector at waste-gate motor to see that it is inserted properly and is tight. CAUTION: Never disconnect AN connector of waste-gate motor when inverter is on; this may damage amplifier. Check motor for security and shifting its position.	D	
*	25	11. On the governor, check AN connector nut on flexible-drive connection for tightness. Check governor for security and shifting of position.	D	
	25	Check operation of Amplifier and Waste-Gate Motor. Plug in external power supply making sure that no voltage above 28.5 dc is used or burned out amplifiers may result. Turn on inverter switch and set dial of selector to "8". Remove AN connector at pressuretrol and plug in special test potentiometer in place of pressuretrol. Turn knob on test potentiometer until waste gate is fully closed. If test potentiometer is not handy use jumper between terminals A1 and A3 in the main "J" box and turn selector dial until waste gate is closed on engine No. 1. Use A2 and A4 for engine No. 2, C1 and C3 for engine No. 3, and C2 and C4 for engine No. 4.	D	
*	25	13. Check to see that there is at least ½" clearance between the linkage rod and any structural part of the airplane for all positions of the waste gate. This is necessary due to the heat expansion in the exhaust stacks and turbo.	D	
*	25	14. Clearance of waste gate from stop inside tail pipe should be about 3/32" with waste gate motor in fully closed position.	D	
	25	15. Remove test potentiometer used for closing waste and replace Pressuretrol AN connector. If jumper method was used, remove jumper and replace "J" box cover. Turn selector to "8" and look at exhaust ~~waste gates. At or near sea level, the~~ waste gate should be open or almost open when the engines are not running, but at higher altitudes, the waste gate will be partly closed when the dial is turned to "8".		

ENGINE SYSTEMS (Cont.)

1	2	3	4	5
Column No. Form 41B	Int	INSPECTIONS	Sym	Remarks pertaining to defects, replacements, or adjustments.
27*	25	16. Inspect hose which connects Pressuretrol to air scoop for leaks, cracks, and tightness of connections. A leak will cause manifold pressure "hunting" at certain powers or altitudes.		
*	25	17. Check induction system for condition of rubber couplings between ducts. Check gasket between turbo compressor housing and duct. Check air intake ducts for clogging such as dirty filters. Check for loose or worn linkage on filter control gates.	D	
	25	18. Check AN connector at turbo boost selector for tightness. Turn dial to "10", and waste-gate should go to half-closed position or beyond. Turn dial to "0" and waste gate should open fully. If gate does not move as it should, refer to trouble shooting procedure. Test operation of dial on selector to see that it turns freely but not too loosely. Make sure Allen-head screw in now is tight.		
	25	19. Check AN connectors on airplane's inverters for proper connection and tightness. Check main fuse contacts and wire connections to fuse clips on 400-cycle supply. Also check inverter fuse connections. Check output voltage of each inverter by connecting an a-c Voltmeter to main "j" box terminals B10 and B1. Voltage should be 115 volts (plus 10 minus 15 volts). Disconnect external power supply.		
	25	20. Check inside Main "J" box for loose terminal connections, especially at B10, where main power supply connects. Do not pull on wires, but grasp Sta-kon lugs near terminals and jiggle slightly sideways. Check for evidence of corrosion at leads and terminals. Remove loose or foreign material from inside "J" box. Check ground lead from main "j" box where it anchors to airplane, to see that it is firmly attached.		
	25	21. Remove amplifiers from their case and press down on tubes to make sure they are not loose in their sockets. Blow out accumulated dust around tube sockets. Visually inspect fuse contacts and all soldered connections. Replace amplifiers in their cases and reconnect AN connectors, making sure they are tight. Make sure Dzus fastener locks amplifier in its case		

ENGINE SYSTEMS (CONT'D)

1 Col.No. Form 41B	2 INT	3 INSPECTION	4 Symb.	5 Remarks pertaining to defects, replacements or adjustments.
		Check Lord mounts under amplifier platforms. If rubber is badly cracked; replace the mounts.		
*	25	22. Wire harness is regularly inspected every 50 hours. In very humid elimates it may be necessary to inspect the harness more frequently. Under these conditions the long cables inside the wing and inside the engine nacelles are checked every 25 hours for corrosion and accumulation of moisture inside the covering on the cable. If wing and nacelle disconnects are used, they should be inspected for good contact		
	25	23. In tropical areas or during very hot weather disconnect the flexible drive from the governor every 25 hours, and inspect the flexible shaft for lubrication. If necessary, lubricate, with light grease, Specification AN-G-3a. In normal operation, the inspection of the flexible shaft is taken care of at the 100-hour inspection.	D	
27 *	5C	24. Check Pressuretrol Lord mounts, and if rubber is badly cracked, replace mounts. Remove cover plate and check potentiometer wiper to see that it is tight on its shaft. To do this, grasp wiper near clamp and twist counterclockwise until wiper reaches Upper end of potentiometer winding. When released, wiper should return to its original position if it has not slipped. If wiper is loose, replace pressuretrol. At sea level, wiper should be about one-fourth of the distance up from the bottom of the potentiometer winding. If wiper is above the center of the potentiometer winding, the pressuretrol may be out of calibration, or the reference bellows may be leaking. Where altitude of air base is above 5,000 feet, normal position of wiper will be slightly above center of potentiometer winding. Inspect red lacquer on calibration screws to see that they have not been tampered with. Calibration is Fourth Echelon work. Inspect all soldered connections. Inspect base of AN-connector pins inside Pressuretrol for loose strands of wire. Replace cover on Pressuretrol. NEVER OIL ANY PART OF THIS UNIT.		

ENGINE SYSTEMS
(Cont'd)

1	2	3	4	5
Col.No. Form 41B	Int	INSPECTIONS	Sym.	Remarks pertaining to defects, replacements, or adjustments.
*	50	25. Check Nacelle "J" Box terminals for loose connections and wires for breaks. Check mounting of condenser and transormer. Check condensers for oil leakage and replace if leaking. Inspect soldered connections on the two 50,000 -ohm resistors and on condensers. Check condition of Dzus fasteners. In moist, humid climates, check transformers for deterioration of insulation and for corrosion around leads and terminals inside "J" boxes.		
	50	26. Check wiring harness inside fuselage at all points where wear or abrasion might occur. Also check harness inside engine nacelle from nacelle "J" box to each unit		
*	100	27. Disconnect flexible drive at Governor end, pull out the flexible shaft and inspect for wear. Lubricate if necessary (Grease Specification AN-G-3a). If drive is worn at some point replace complete drive. Replace flexible shaft. After sliding it into the housing, press it inward and turn until it slips into place engaging the drive connection on the turbo. Reconnect flexible drive to the governor.		
*	100	28. Disconnect AN connector from the governor. Remove the two screws which hold the cup-shaped cover on the accelerometer end of the governor, and remove the cover.		
27	100	28. Watch nut directly above the bearing plate inside governor to see that it turns while someone spins the turbine wheel. CAUTION: Do not press on wipers of potentiometer as this may change their tension. With the blade of a thin screw driver, slide wiper away from dead-spot end of potentiometer winding, then release the wiper, allowing it to return under the pull of its own spring.		
	100	29. In the Nacelle "J" Box check output voltages of transformer. Connect external power source, turn on inverter, and adjust d-c voltage input to give 115 volts inverter output. Voltage from transformer secondaries should then be as follows: Terminals — Voltage B7 to B9 — 30 volts (+2.5, -1.5) B5 to B3 — 24 volts (+2.5, -1.5) B3 to A2 — 6 volts (+ .4 - .4) A2 to B2 — 12 volts (+ .7, - .7)		

Col. No. Form 41E		INSPECTION		Remarks pertaining to defects, replacements, or adjustments.
	100	30. The accelerometer control should be checked during the first flight following the 100 hr. inspection. At some altitude above 6,000 ft., retard the throttles individually to half-closed position, and then advance throttles rapidly to full open position. The manifold pressure should not overshoot more than 2 inches unless rpm overshoots also. If engine rpm overshoots, repeat procedure several times until prop governor holds engine speed relatively constant.		
	300	31. Replace the two 7C5 tubes in the amplifier after approximately 300 hours operation.		
	300	32. Check Overspeed Control immediately following a complete installation of the type B control system for turbos and at about 300-hour intervals thereafter. The plane should be flown to an altitude of 35,000 feet. (Note: If carburetor intake duct is leaking, the overspeed will cut in at a much lower altitude. A serious leak in the exhaust stack may be misunderstood as overspeed control operation, as it will also cause a falling off in manifold pressure before and altitude of 35,000 feet is reached.) At 35,000 feet, level off and set prop governors for maximum cruise rpm. Slowly turn dial of boost selector toward "8". At some point before "8" is reached, the manifold pressure should stop increasing on all engines, indicating that the overspeed controls are cutting in. If the manifold pressure continues to increase on one or more engines, keep turning the dial clockwise, but do not exceed the maximum cruise manifold pressure. At 35,000 feet altitude, if the governor is set for the proper turbine speed the overspeed control should operate before maximum cruise manifold pressure is reached. When checking one of the engines at full throttle, the throttle may be retarded on the other engines.		
	300	32. Recheck the overspeed by lowering dial setting into control range, and again slowly increase dial setting until manifold pressures cease to increase.		
	900	33. Following 900 hours of operation, replace the following turbo control units with new or rebuilt units:		