

RESTRICTED**TM 9-1726**TECHNICAL MANUAL }
No. 9-1726 }WAR DEPARTMENT,
Washington, March 20, 1942**ORDNANCE MAINTENANCE****CONTINENTAL ENGINE, MODEL W670-9A**Prepared under the direction of the
Chief of Ordnance**CONTENTS**

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ORDNANCE MAINTENANCE — CONTINENTAL ENGINE MODEL W670-9A**SECTION I****INTRODUCTION**

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1. PURPOSE. — This manual is published for the information and guidance of all personnel charged with the maintenance and overhaul of the Continental W670-9A Tank Engine used on Light Tanks.

2. SCOPE. — This manual contains information on the detailed construction of the unit, disassembly and assembly procedure, inspection, maintenance, and repair supplementary to those covered in TM 9-726.

3. REFERENCES. — Section XVII lists all Technical Manuals, Standard Nomenclature Lists, and other publications relative to the materiel described herein.

INTRODUCTION

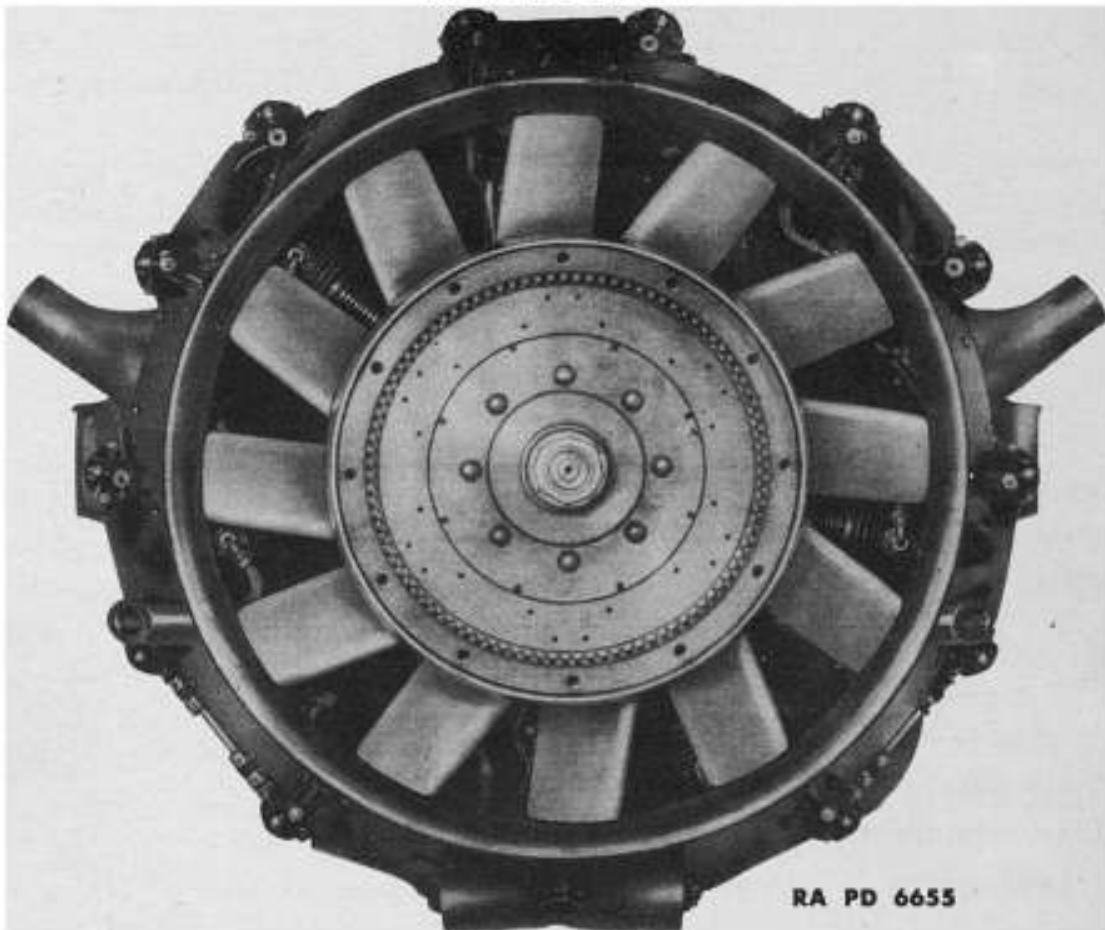


FIGURE 1 — FRONT VIEW OF ENGINE

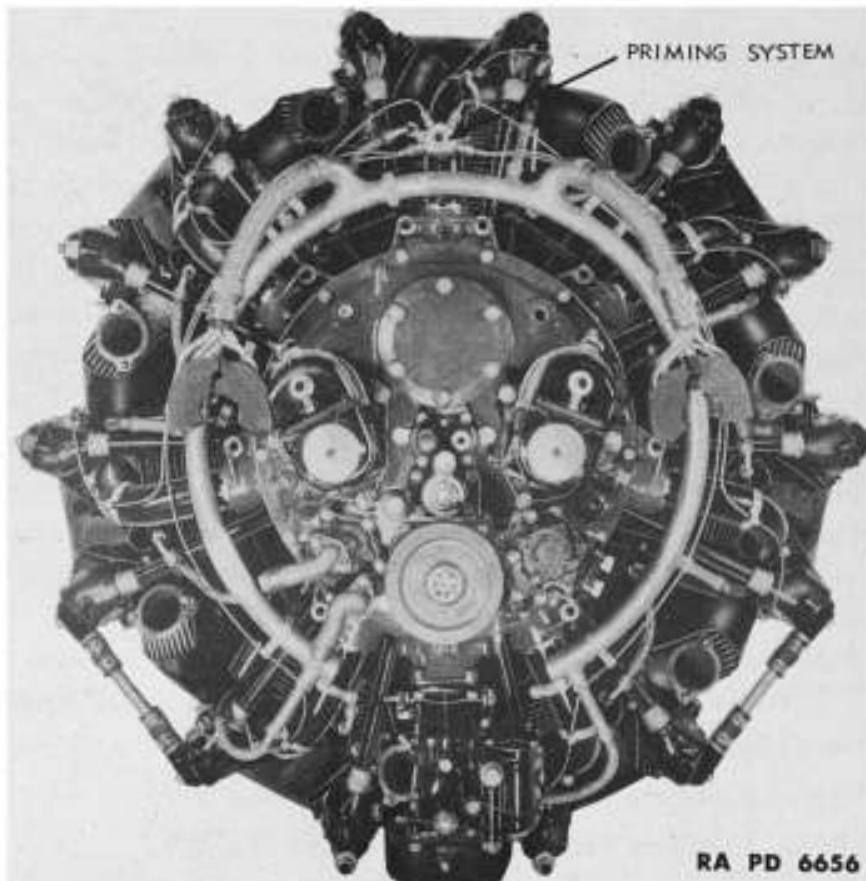


FIGURE 2 — REAR VIEW OF ENGINE

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ORDNANCE MAINTENANCE — CONTINENTAL ENGINE MODEL W670-9A**SECTION II****DESCRIPTION**

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4. GENERAL. — *a.* The W670-9A Ordnance Engine is a seven-cylinder, static-radial, air-cooled engine designed and built for light tank use. In describing the W670-9A Ordnance Engine the flywheel end of the engine is referred to as the "front" and the antiflywheel end (accessory case) as the "rear." The terms "right" and "left" designate the sides of the engine as viewed from the rear (engine in a vertical position). "Top" and "bottom" are referred to as viewing the engine in such a position that its carburetor points directly downward and the crankshaft extends horizontally. Directions of rotation are determined by looking from the rear of the engine toward the front. The cylinders are numbered in a clockwise direction, commencing with the top cylinder, designated as cylinder No. 1.

b. Serial numbers. — The Ordnance Department has been supplied with four series of the W670 Continental Engines, namely, the W670-7, W670-8, W670-9, and W670-9A. The W670-8 is identical with the W670-7, except that it is a low-compression engine. All of the W670-8 engines have now been converted back to the W670-7. The following table gives the serial numbers which identify three of the four series of engines:

W670 Serial Numbers 1100 through 1250 are W670-7.

W670 Serial Numbers 1251 through 1350 are W670-9.

W670 Serial Numbers 1351 through 4999 are W670-9A.

W670 Serial Numbers 30000 up are W670-9A.

DESCRIPTION

5. ENGINE CHARACTERISTICS. — a. Specifications. —

Model	W670-9A
Type	Single-row, static-radial, air-cooled
Number of cylinders	7
Bore and stroke	5.125 in. x 4.625 in.
Piston displacement	667.86 cubic in.
Compression ratio	6.1 to 1
Rated speed	2,250 rpm
Rated brake horse power at sea level (with fan and flywheel) ..	450 @ 2,400 rpm
Governed speed (full load)	2,250 rpm
Rotation of crankshaft	clockwise
Crankshaft spine size	SAE std. No. 30
Diameter of mounting bolt circle	20 in.
Number of mounting bolts	8
Diameter of mounting bolts	$\frac{3}{8}$ in.
Over-all diameter of engine (outside rocker covers)	42 $\frac{3}{8}$ in.
Over-all length of engine	32 in.
Dry weight of engine — maximum (all equipment)	750 lb.
Center of gravity ..	{ Distance from front end of crankshaft
	{ Distance from center line of crankshaft

b. Ignition. —

Ignition firing order (clockwise)	1-3-5-7-2-4-6
Magnetos — Scintilla type	VMN7-DFA
Rotation	counterclockwise
Speed	0.875 to 1 ($\frac{7}{8}$ to 1)
Right magneto fires (for timing purposes, spark fully retarded)	20° before top center
Left magneto fires (for timing purposes, spark fully retarded)	17° before top center
Right magneto attaches to all front spark plugs	
Left magneto attaches to all rear spark plugs	
Spark plugs	Champion 63-S or BG 417-S (radio shielded)

c. Valve timing. — (Cam Ring No. A-5160) Valve timing date — set valve clearance No. 1 cylinder at 0.124 inch cold: (Top cylinder).

Exhaust valve opens	49° before bottom center
Exhaust valve closes	0° top dead center
Intake valve opens	4° after top center
Intake valve closes	21° after bottom center
Valve lift (both valves)	$\frac{1}{2}$ in.
Adjust all valves for service (engine cold)	0.010 in.

d. Fuel system. —

Carburetor — Stromberg model	NA-R6B
Fuel	80 octane
Fuel pressure	1 $\frac{1}{2}$ to 2 lb.
Carburetor connection	$\frac{3}{8}$ -in. pipe thread
Priming system inlet connecting thread	$\frac{1}{8}$ -in. pipe thread

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ORDNANCE MAINTENANCE — CONTINENTAL ENGINE MODEL W670-9A*e. Lubrication system. —*

Oil consumption (rated power).....	0.025#/ brake hp./hr.
Oil consumption (70% power/89% rated speed).....	0.017#/ brake hp./hr.
Speed of oil pump (1¼ times crankshaft speed).....	1.250 to 1
Oil inlet and oil outlet connections.....	¾-in pipe thread
Oil flow	15 lb./min. at 2000 rpm
Oil pressure — high (desired).....	70 lb./sq. in. @ 2000 rpm
Oil pressure — low (desired).....	15-20 lb./sq. in. at idling speed
Minimum safe quantity of oil.....	3 gal.
Approved engine lubrication oil.....	{ above 32°F — SAE 60 below 32°F — SAE 50
Recommended viscosity.....	{ 50 for temperatures from +32°F to -10°F 60 for temperatures above +32°F

f. Accessory drives and instrument connection. —

Oil pressure — high and low.....	½-in. pipe thread
Crankcase breather	¾-in. pipe thread
Oil tank vent connection on accessory case.....	¾-in. pipe thread

(1) Fuel pump mounting pad and drive. —

Direction of rotation	clockwise
Speed	1.250 to 1 (times crankshaft speed)

(2) Starter mounting pad. — 3 jaw, type 1 — Army, Navy standard.

Direction of rotation	counterclockwise
Speed	1 to 1 (at crankshaft speed)

(3) Generator pulley support mounting pad and drive. —

Direction of rotation.....	clockwise
Speed	1.20 to 1 (times crankshaft speed)

(4) Tachometer drive. — Two connections, type 1 — Army, Navy 9533.

Direction of rotation	counterclockwise
Speed	½ to 1 (crankshaft speed)

*(5) Flywheel hub spline. — Air Corps Standard No. 30.**(6) Center of gravity. —*

Distance from front end of crankshaft.....	17½ in.
Distance below center line of crankshaft.....	¼ in.

6. CRANKCASE. — The main crankcase is a two-piece cast aluminum alloy assembly. The front and rear sections part at the center line of the cylinder ports and are held together by seven ⅞-inch bolts located between ports. Twelve ⅜-inch studs are inserted in the machined surfaces around each cylinder port for cylinder mounting. Thirteen ⅝-inch studs are inserted in the machined surface on the back of the crankcase rear section for attaching the accessory case. Bronze liners pressed and pinned in the internal webbing support the crankshaft rear and front main ball bearings. The nose of the front section of the crankcase contains a pressed-fit thrust bearing cage and the thrust bearing. The fuel induction system, cast into the crankcase rear section, provides a heated passage for the fuel from the carburetor to the cylinders.

DESCRIPTION

Tappet rollers (cam followers) and guides are installed radially, two between each cylinder port and induction port of the crankcase rear section. Drilled internal lines furnish lubrication for the tappet rollers (cam followers), guides, push rods, rocker arms, and crankshaft. Eight mounting lugs, cast integral with the crankcase rear section, are located around its outside diameter for attaching the engine to the banjo frame.

7. ACCESSORY CASE. — The accessory case is a one-piece aluminum alloy casting. A machined surface is provided on the rear of this case for mounting it to the crankcase rear section, and it has additional machined surfaces on its front in the form of accessory mounting pads and the accessory gear bushing recesses. Drilled passages are provided throughout the accessory case for high- and low-pressure oil. With the exception of the cam ring and the rear crankshaft cam drive gear, the entire accessory gear train is supported by the accessory case. All accessories except carburetor and generator are attached to the case in order to facilitate ease of installation and removal of these accessories.

8. CRANKSHAFT. — The crankshaft is of two-piece construction, the two sections coming apart at the juncture of the rear crank cheek and the crankshaft journal. The two sections are held solidly in place by the crankshaft cheek clamp bolt. The two counterbalances offset the weight of the master and articulated rod assembly. The master rod bearing and the knuckle pin bearings are pressure lubricated through the oil passage in the crankshaft. A No. 30 Air Corps spline is machined on the forward end of the crankshaft for mounting the flywheel hub. The rear end of the crankshaft is splined and female-threaded for accessory gear train power take-off drive.

9. MASTER AND ARTICULATED ROD ASSEMBLY. — *a. General.* — Several subassemblies make up the master and articulated rod assembly.

b. Master Rod. — The master rod is an alloy steel H-section forging with sandblast finish. A bronze bushing is pressed into the small end of this rod and is diamond-bored to receive the piston pin. A steel-backed lead-bronze bearing for the crankshaft journal is inserted into the crank end. The wide surfaces or cheeks of the master rod, crank end, have ground holes to receive the knuckle pins of the six articulating rods. The articulating rods are alloy steel H-section forgings with sandblast finish. The knuckle pins are machined from alloy steel seamless tubing, case-hardened, and ground to size. They are all equipped with pinned-in oil plugs.

c. Articulated rods. — Six articulated rods are assembled to the master rod by inserting the knuckle pin ends of the articulating rods between the master rod cheeks, lining up the bores and pressing the knuckle pins into place. Each knuckle pin is held in position by a Woodruff key at one end and a circlip on the other. The complete master and articulated rod unit is installed on the crankshaft journal before the two crankshaft sections are put together.

10. CYLINDERS. — Each cylinder is made up of a cast aluminum head screwed and shrunk onto a forged alloy steel barrel. The exhaust port is located at the side of the cylinder head, and the intake port at the rear. Each

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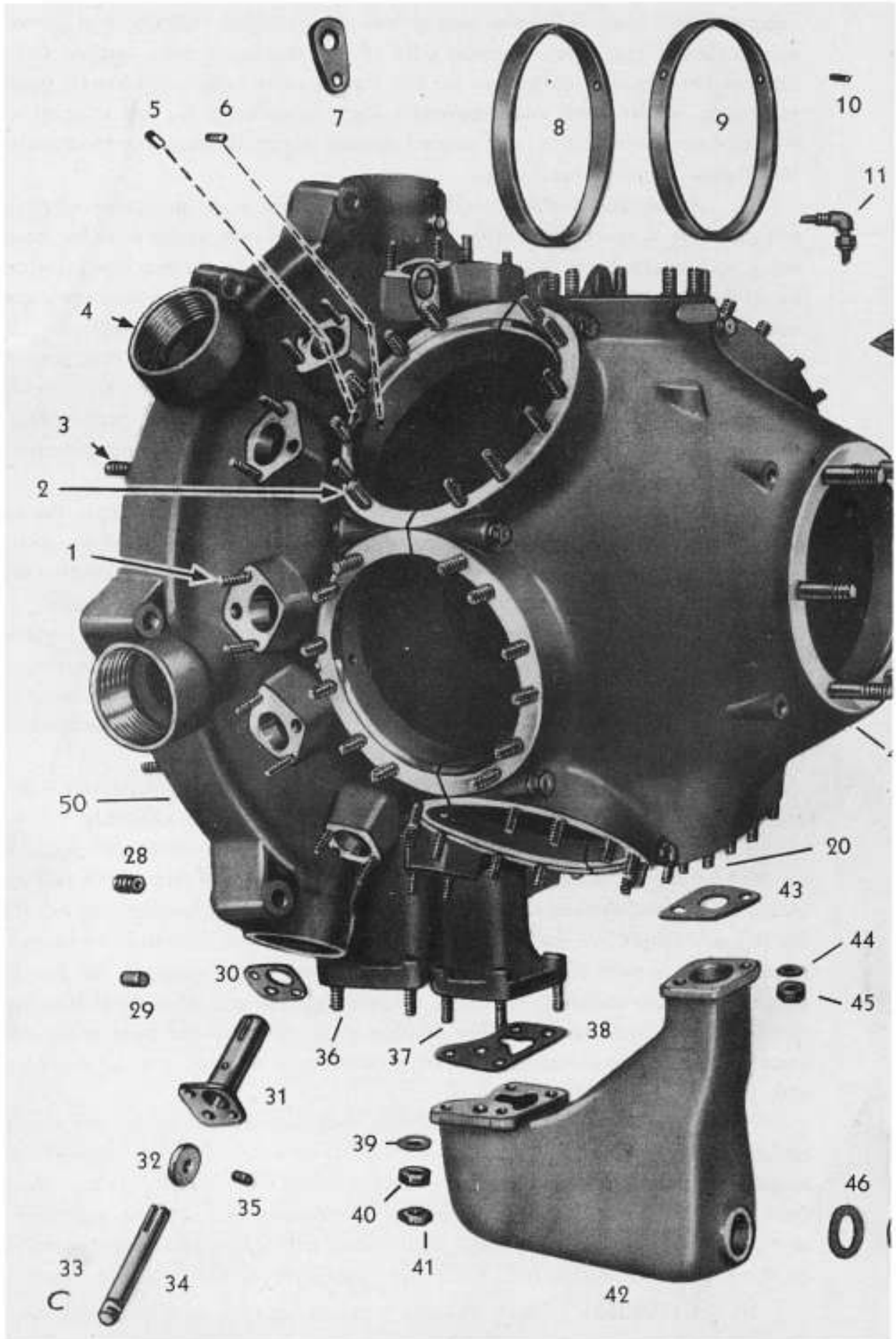
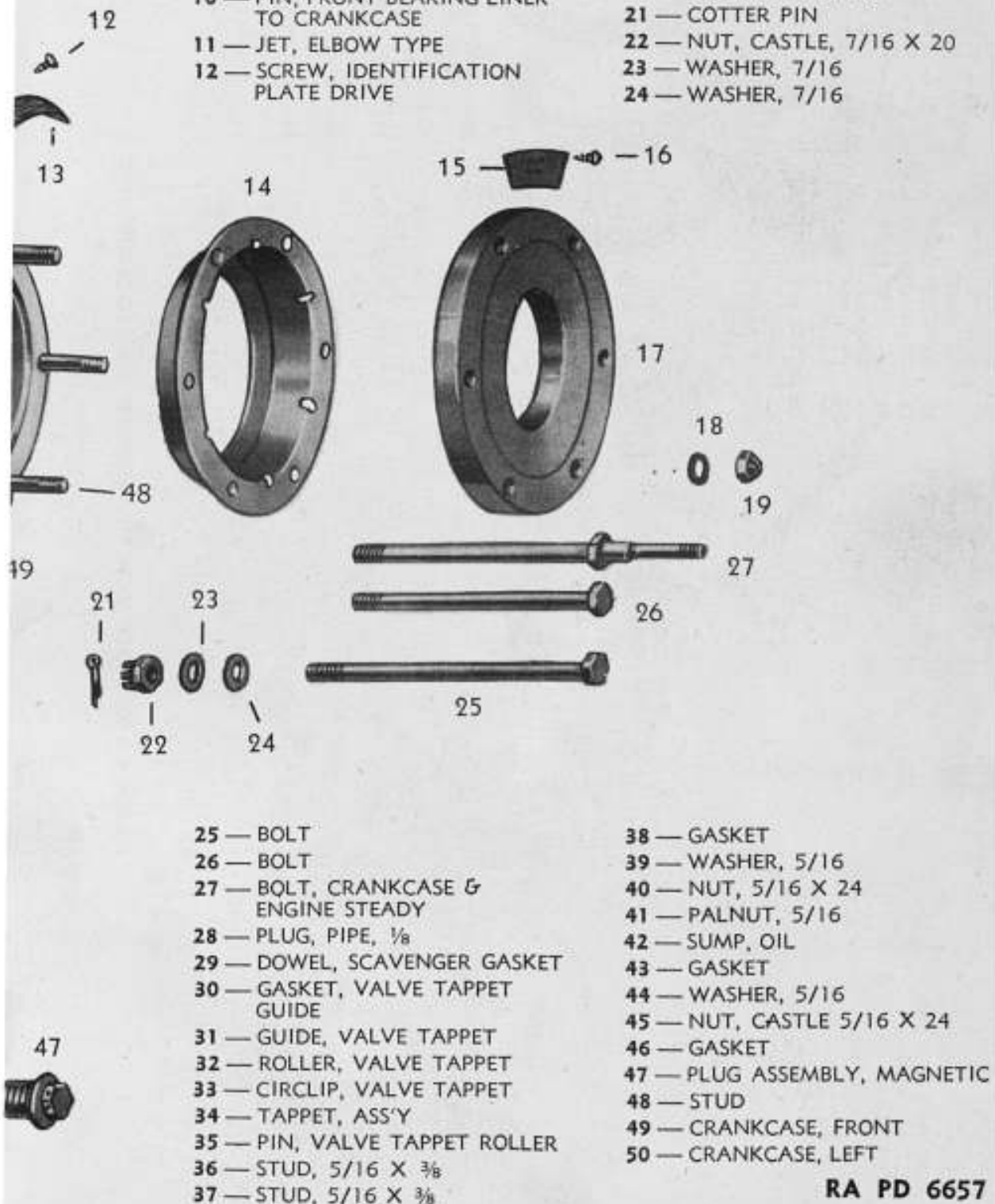


FIGURE 3 — EXPLODED

DESCRIPTION

- | | |
|--|---|
| 1 — STUD | 13 — PLATE, IDENTIFICATION |
| 2 — STUD, $\frac{3}{8}$ X $1\frac{3}{8}$ | 14 — CAGE, THRUST BEARING |
| 3 — STUD, $\frac{5}{16}$ X $1\frac{1}{4}$ | 15 — PLATE, CAM SETTING INSTRUCTIONS |
| 4 — CRANKCASE, ASS'Y | 16 — SCREW, CAM SETTING INSTRUCTIONS PLATE, DRIVE |
| 5 — CRANKCASE OIL LEAD PLUG | 17 — COVER, THRUST BEARING |
| 6 — CRANKCASE OIL LEAD PLUG | 18 — WASHER, $\frac{3}{8}$ |
| 7 — EYE, ENGINE LIFTING | 19 — NUT, $\frac{3}{8}$ X 24 |
| 8 — LINER, REAR BEARING | 20 — STUD, $\frac{5}{16}$ X $1\frac{3}{8}$ |
| 9 — LINER, FRONT BEARING | 21 — COTTER PIN |
| 10 — PIN, FRONT BEARING LINER TO CRANKCASE | 22 — NUT, CASTLE, $\frac{7}{16}$ X 20 |
| 11 — JET, ELBOW TYPE | 23 — WASHER, $\frac{7}{16}$ |
| 12 — SCREW, IDENTIFICATION PLATE DRIVE | 24 — WASHER, $\frac{7}{16}$ |



- | | |
|---|--------------------------------------|
| 25 — BOLT | 38 — GASKET |
| 26 — BOLT | 39 — WASHER, $\frac{5}{16}$ |
| 27 — BOLT, CRANKCASE & ENGINE STEADY | 40 — NUT, $\frac{5}{16}$ X 24 |
| 28 — PLUG, PIPE, $\frac{1}{8}$ | 41 — PALNUT, $\frac{5}{16}$ |
| 29 — DOWEL, SCAVENGER GASKET | 42 — SUMP, OIL |
| 30 — GASKET, VALVE TAPPET GUIDE | 43 — GASKET |
| 31 — GUIDE, VALVE TAPPET | 44 — WASHER, $\frac{5}{16}$ |
| 32 — ROLLER, VALVE TAPPET | 45 — NUT, CASTLE $\frac{5}{16}$ X 24 |
| 33 — CIRCLIP, VALVE TAPPET | 46 — GASKET |
| 34 — TAPPET, ASS'Y | 47 — PLUG ASSEMBLY, MAGNETIC |
| 35 — PIN, VALVE TAPPET ROLLER | 48 — STUD |
| 36 — STUD, $\frac{5}{16}$ X $\frac{3}{8}$ | 49 — CRANKCASE, FRONT |
| 37 — STUD, $\frac{5}{16}$ X $\frac{3}{8}$ | 50 — CRANKCASE, LEFT |

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VIEW OF CRANKCASE

ORDNANCE MAINTENANCE — CONTINENTAL ENGINE MODEL W670-9A

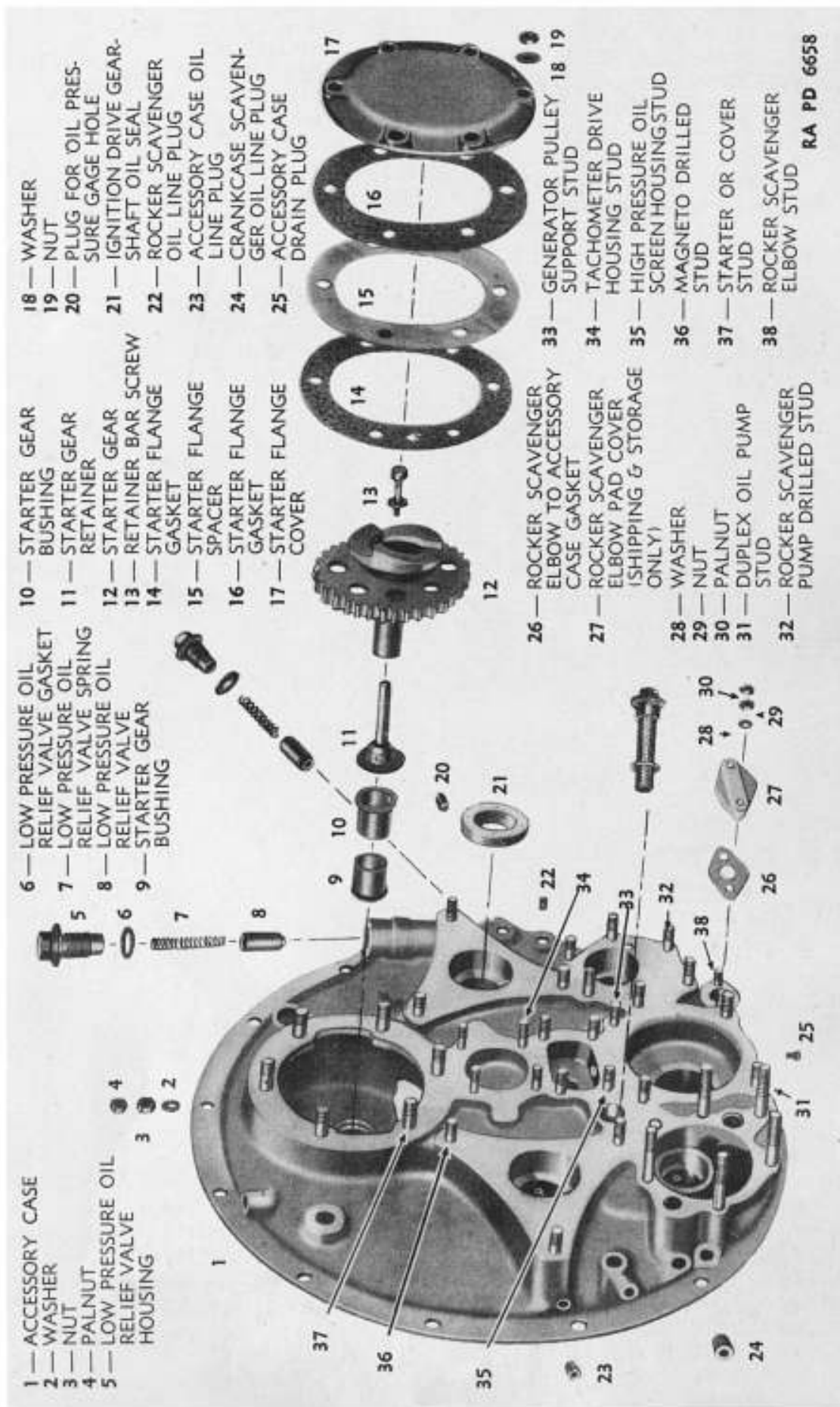


FIGURE 4 — EXPLODED VIEW OF "OUTSIDE" OF ACCESSORY CASE

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