

OPERATING AND MAINTENANCE INSTRUCTIONS

Section 3

PACKING, UNPACKING, AND PREPARATION FOR STORAGE

1. SHIPPING BOXES

Each engine is packed for domestic shipment in a light weight crate, the sides and top of which are of wood frame and corrugated cardboard construction. The crate base is constructed of wood planking with 3 skids on the lower side. The engine is supported in the inverted position on a formed plywood cradle which is bolted to the crate base. The engine crate must always be hoisted by a sling passed under the base or by a fork-lift truck so that the engine weight is never supported by the crate side panels. Overall dimensions of the crate are approximately: 34" wide x 34" long x 30" high.

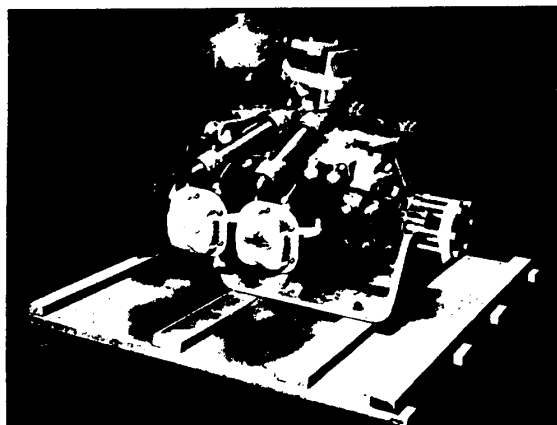
2. PACKING

Four bolts and nuts attach the top engine mounts and the crankshaft propeller flange to the cradle. If the engine has a tapered crankshaft, the tapered end rests in a hole bored in the end of the cradle. The propeller hub nut thread of a tapered shaft is covered by a plastic cap. The crankcase breather and carburetor fuel inlet are plugged, and the carburetor air intake flange and

cylinder exhaust flanges are covered by cardboard seals. A moisture-proof paper shroud is placed over the engine. Its edges overlap the edges of the base so that the nails which are driven through the side panel frames into the base planks pass through the shroud to hold it in place. The Air Intake assembly and propeller hub, if any, are attached to the base planks inside the shroud. This packing is not intended for long-term storage. A heavier, all-wood crate is provided for export shipping. Internal corrosion preventive compound is applied through the lubrication system and as a spray through the induction system and into spark plug holes and exhaust ports. The effective duration of this protection will depend entirely on atmospheric conditions during storage. Crated engines should be inspected at intervals of not more than thirty days during storage and re-preserved if a generous film of preservative oil is not found on all internal surfaces and unpainted surfaces.

3. UNPACKING THE ENGINE

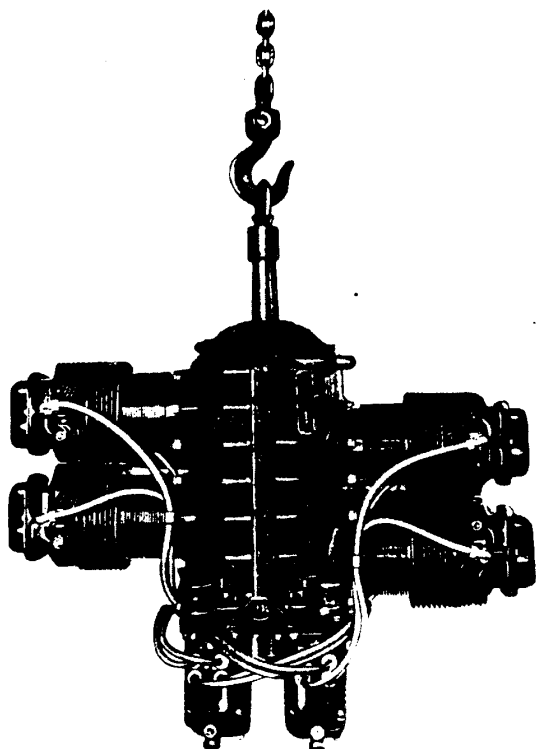
Pull out the nails which attach the side panels to the crate base. Lift off the side and top panel assembly and the engine shroud. Remove the air intake assembly from the crate. Attach a crankshaft lifting eye, such as those supplied by the Kent-Moore organization, to the crankshaft flange bushings or tapered shaft hub nut thread, as applicable. Attach a hoist to the lifting eye and take up the slack. Remove the shipping bolts which attach the crankshaft propeller flange to the cradle. While two men support the rear of the engine, remove the bolts which attach the top engine mounts to the cradle, and lift the engine clear of the cradle. Raise the front end until the engine is suspended by the crankshaft clear of obstructions. Place the engine on a suitable work stand, such as supplied by the Kent-Moore organization, for installation of fittings, baffles, etc.



Engine in Shipping Cradle — Figure 7

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OPERATING AND MAINTENANCE INSTRUCTIONS — Continued



Hoisting Engine by Lifting Eye — Figure 8

4. TREATMENT OF ENGINES FOR PERIODS OF IDLENESS

When the aircraft (or a crated engine) cannot be operated daily, or weekly in very dry climates, it should be treated for storage as follows:

- a. Drain the oil sump
- b. Remove all spark plugs and exhaust port covers or exhaust manifolds
- c. With a long, thin nozzle of suitable shape, and which produces a 90°, atomized spray, connected to a source of dry, compressed air and a clean container of internal corrosion preventive compound spray each cylinder through the upper spark plug holes, moving the nozzle in and out in step with the piston through two sweeps while the crankshaft is slowly rotated. Do not flood the cylinders.
- d. Direct the spray into each exhaust port while the crankshaft is rotated several revolutions.
- e. Stop the crankshaft and again spray through each upper spark plug hole so as to sweep the

cylinder wall exposed. Do not turn the crankshaft thereafter.

f. Spray the crankcase interior through the oil sump drain plug and the breather elbow. Attach the drain plug to the sump with a length of safety wire, but do not install it.

g. Remove the pressure oil screen and spray the pump through the screen housing. Replace the screen.

h. If the propeller is not installed coat the exposed end of the crankshaft with a preservative grease, such as Federal Spec. 52-C-18, Grade 1, or AN-C-124, and wrap it with grease-proof paper or fabric or non-hygroscopic tape.

i. Replace all spark plugs and exhaust port covers. Seal any openings to the interior of the crankcase with non-hygroscopic tape.

j. In the vicinity of salt water, the exterior surfaces may be further protected by spraying with a waterproof varnish.

k. Crated engines should be protected from dripping water by covering with a moisture-proof shroud. They should also be protected from sweating with atmospheric changes by storage in a location where the smallest possible variations in temperature occur.

l. A tag should be attached to the engine crate (or aircraft instrument panel) to warn that the oil supply has been drained and the drain plug removed. The tag should also state the date of preservation.

m. A pan of adequate size should be positioned to catch preservative oil dripping from the open sump drain.

The internal preservative mixture recommended for use with this procedure is composed of one part Army Spec. AXS-934, Grade 2, corrosion preventive oil well mixed with one part S.A.E. No. 30 aircraft engine lubricating oil. AXS-934 oil is obtainable at most refineries and bulk storage plants.

The above preservation should be repeated at intervals of thirty days during storage.

5. PREPARATION OF ENGINES FOR SERVICE AFTER PRESERVATION AND STORAGE

Engines prepared for storage in accordance with the foregoing instructions may be placed in service after making the following checks:

- a. Turn the propeller slowly by hand through

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eight or ten revolutions to permit drainage of preservative oil from cylinders and to listen for intake and exhaust flow. If the valve action is not normal, remove rocker covers and check for sticking valves. Lubricate stems of sticking valves with flushing oil or a mixture of lubricating oil and gasoline. Continue to rotate the crankshaft until the valves all operate normally. If sticking persists, the cylinder must be removed and disassembled for inspection and necessary repair.

b. Remove all spark plugs and wash out oil with Acetone, carbon tetrachloride, or clean, unleaded gasoline. Re-install spark plugs, using serviceable gaskets. See the Table of Limits for correct tightening torque.

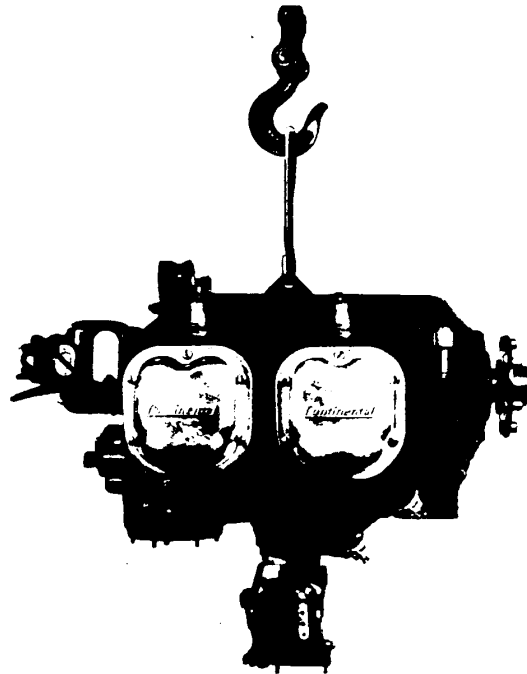
c. Install the oil sump drain plug with a serviceable gasket. Fill the oil sump to the "Full" mark on the gauge rod with the recommended seasonal grade of aircraft engine oil.

d. Remove any seals, covers, or caps installed on carburetor air intake and connectors such as the crankcase breather. Connect the proper hoses, tubes, etc.

e. Check all engine controls for full range and free operation, proper support, and safe connection to the engine. Check fuel supply, primer, temperature, and gauge lines for tight installation.

f. Drain any water from the fuel strainer.

It is recommended that the oil supply be drained and the sump refilled with fresh oil of correct grade after approximately five hours of operation



Hoisting Engine with Crankcase Lifting Eye — Figure 9

following removal from storage. While AXS-934 preservative should do no harm to the engine, this oil change will assure removal of the preservative and any foreign material. It is always advisable to avoid mixing types of oil.

Section 4

INSTALLATION IN AIRPLANE AND REMOVAL

1. MOUNTING THE ENGINE

a. A lifting Eye is permanently attached to the crankcase upper flange by the third and fourth screws from the rear. A hook, such as that supplied by the Kent-Moore Organization, may be engaged to the lifting eye hole and the hoist attached to it for lifting the engine in the flight attitude. See figure 9. A special sling is supplied by the Kent-Moore Organization for hoisting older engines not equipped with the crankcase lifting eye.

b. Hoist the engine to its installed position in relation to the aircraft engine mount. Install the

conical rubber mount bushings in the front and rear recesses of the four Engine mount bosses at the rear of the crankcase. Place one steel washer (of the thickness required to locate the engine C.G.) between each rear rubber bushing and its mount pad, and install the four mounting bolts. Install the front washers, nuts and cotter pins. See figure 11 for mount details. Tighten the mounting bolt nuts to the torque specified in the Table Of Limits. This is very important.

c. Remove the exhaust port covers and install the exhaust manifolds. Tighten the nuts to the torque specified in the table of limits.

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d. Remove the shipping plug from the carburetor fuel inlet and attach the fuel supply line.

e. Connect the priming pump inlet line to the proper fitting as required by the aircraft fuel system. Connect the priming pump discharge line to the primer jet installed in the intake manifold, or make the necessary connections if an intake port priming manifold is used. Test the system for fuel leaks when ready to start the engine.

f. Connect the throttle control, ignition switch wires, oil temperature gauge capillary, oil pressure gauge line, and the tachometer cable and conduit nut to the proper points on the engine as illustrated in figures 10 and 11.

g. Install the carburetor air intake assembly on the carburetor lower flange with the air filter forward. Connect the carburetor air heater hose from the rear inlet to the source of warm air (100°F.). Install the air heat valve control wire

in the valve lever swivel, and check the valve and control operation for free movement and full range.

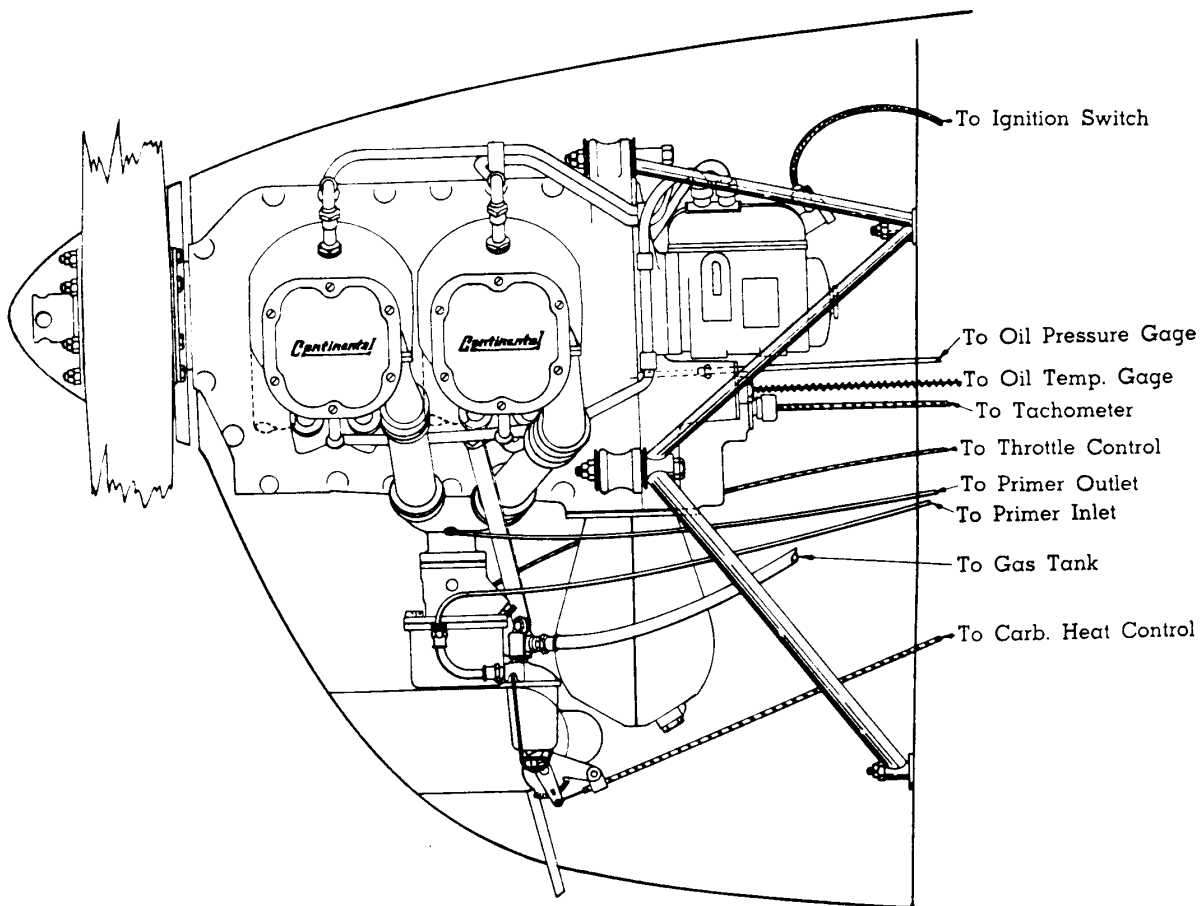
h. Mount the propeller on the crankshaft flange, using the bolts, flange ring, and moisture impervious plate provided. If the engine is equipped with a tapered crankshaft install the hub assembly in the propeller and check track and balance before mounting it on the crankshaft.

2. REMOVING THE ENGINE

a. Remove the propeller and engine cowling.

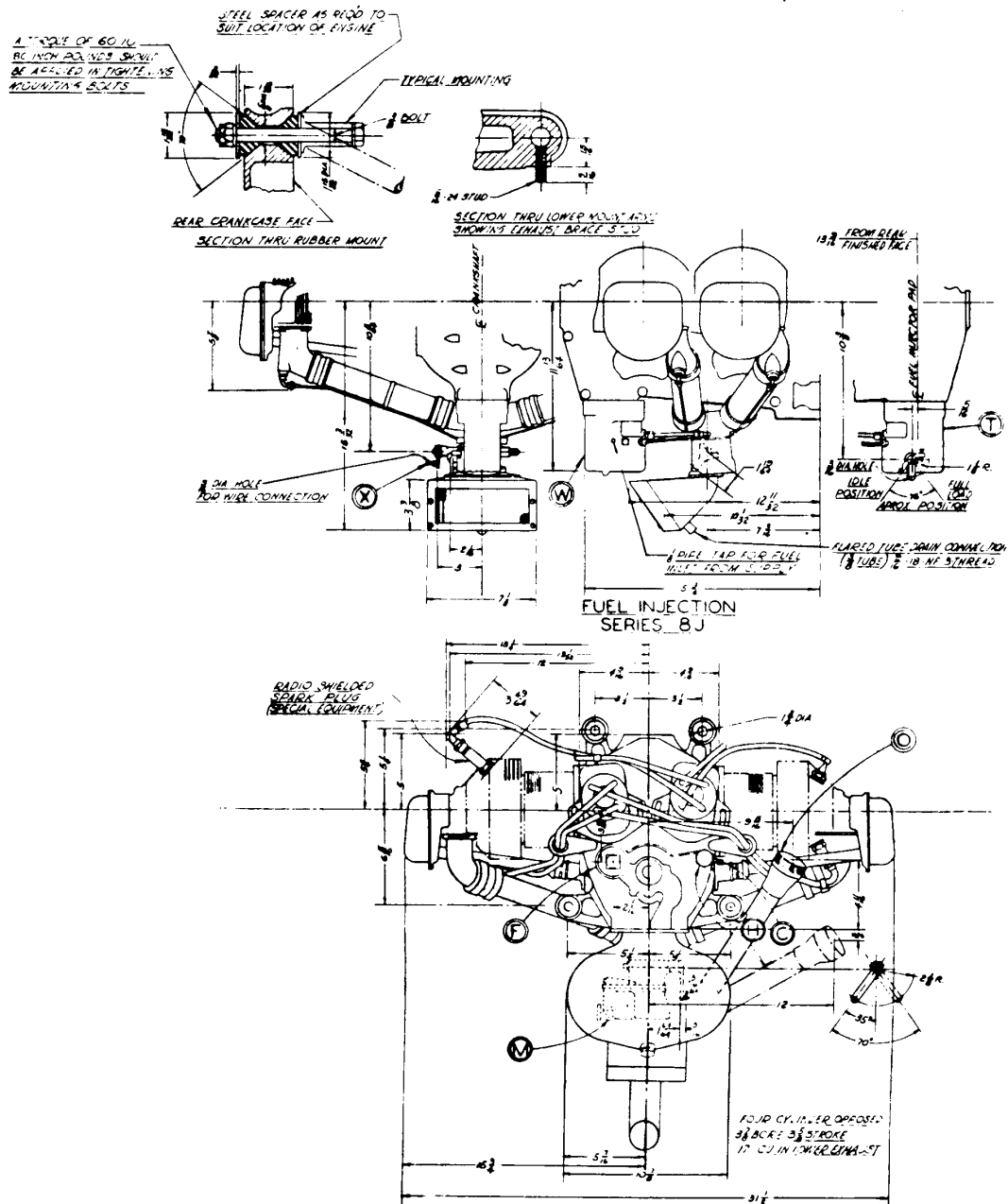
b. Disconnect from the engine the throttle control, carburetor air heat control, tachometer cable, fuel supply and primer lines, oil temperature gauge capillary, oil pressure gauge line, and the magneto switch wires.

c. If necessary, loosen the magneto attaching nuts and rotate the magnetos to clear the engine



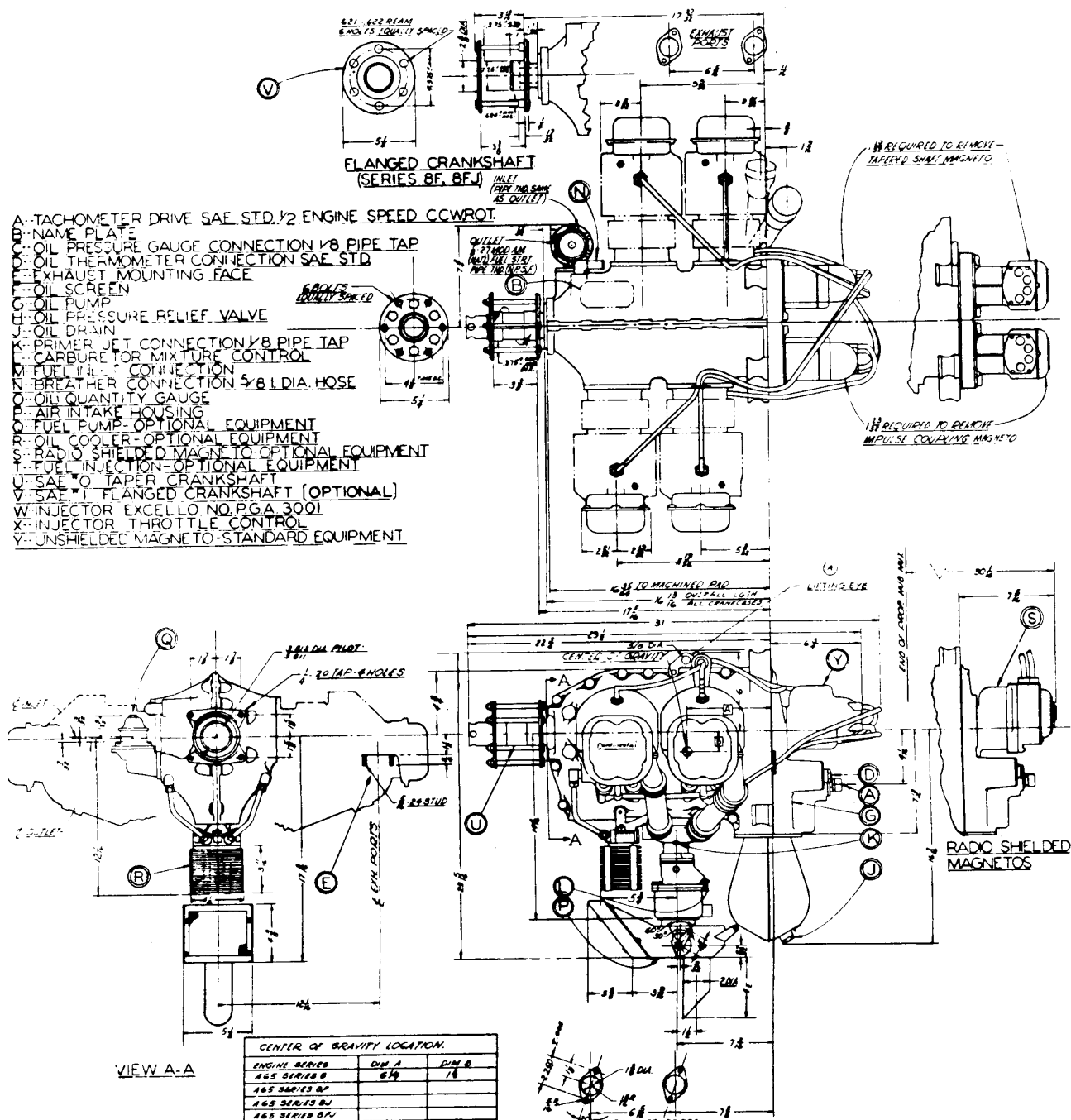
Typical Installation Diagram — Figure 10

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INSTALLATION DRAWING — Figure 11

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INSTALLATION DRAWING — Figure 11a

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mount structure.

d. Attach a hoist to the crankcase lifting eye, or attach the special sling to the engine and the hoist to the sling. Take up the engine weight on the hoist.

e. Remove the lower engine mount bolts. Adjust the hoist to prevent movement of the engine as the lower mount bolts are removed. While removing the upper mount bolts it is advisable to

have a second man controlling the hoist and the front end of the crankshaft to relieve vertical binding of the bolts and to prevent pitching of the engine.

f. Observe points of possible interference and avoid damage to accessories as the engine is hoisted clear of the aircraft. Place and fasten the engine on either a shipping cradle or a suitable work stand.

Section 5

GENERAL OPERATING INSTRUCTIONS

1. PROCEDURE PRELIMINARY TO STARTING.

a. If the engine has been idle for over 2 hours, or if excessive priming has been used during starting attempts, make certain that ignition is turned to the "OFF" position, open the throttle wide and pull the engine through by hand four or five complete revolutions. If fuel or oil is present in any combustion chamber, as evidenced by excessive compression, remove the spark plugs from that cylinder, drain all liquid from the cylinder and intake pipes, and dry spark plugs thoroughly before replacing.

CAUTION: Starting the engine with excessive oil or fuel in the cylinders may result in bent or broken rods.

b. Set mixture control at "FULL RICH."

c. Open cowl flap (if installed), except in extreme cold weather.

d. Place carburetor heat control in COLD position.

2. STARTING.

a. With throttle "CLOSED," switch "OFF," and gasoline supply valve turned "ON," prime the engine three or four strokes (depending on weather conditions, warm engine, etc.) as the engine is turned over by hand five or six times. Avoid overpriming.

b. Turn ignition switch "ON" and open throttle slightly. Start engine by pulling propeller through.

c. If engine fires on one or two cylinders with weak exhaust report and resultant black smoke, it is overprimed and should be unloaded in the following manner:

(1) Turn ignition switch "OFF."

(2) Open throttle and turn the engine backwards five or six times.

d. For cold weather starting, a half or quarter stroke on the primer when the motor fires once or twice will enable it to keep running. In extremely cold weather the oil should be preheated.

e. If the engine fails to start after a reasonable number of attempts, consult paragraph 1 of Section 6 for possible cause.

3. WARM-UP AND GROUND TEST.

a. As soon as engine is started, check oil pressure gage. If the gage does not indicate pressure within 30 seconds, the engine should be shut down and investigation made.

b. All ground testing and running of engine will be accomplished with carburetor set at "FULL RICH" position and all controllable cowl flap, gills, etc., (if installed) will be in the full "OPEN" position.

c. After engine has run approximately 3 minutes between 700 and 800 rpm, increase throttle gradually until tachometer shows from 1200 to 1500 rpm and run for an additional 5 to 7 minutes.

d. Test magnetos separately for proper firing. Speed of engine with steady throttle should not drop off more than 75 rpm on either single magneto from a "BOTH" magneto operating position.

NOTE: Prolonged running of the engine at or near "FULL THROTTLE" position should be avoided on the ground. Under average conditions, for continuous operation on the ground, speeds up to 1850 rpm are permissible. However, due to

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variations in the wooden propellers used, it is extremely difficult to give definite permissible and top ground rpm.

4. TAKE-OFF.

a. Immediately before take-off, set brakes. Open to "FULL THROTTLE" for approximately 10 seconds and check individual magneto operation. Check oil pressure, oil temperature gages and carburetor air heater control.

b. During take-off and climb the engine should be kept at "FULL THROTTLE." When a safe altitude has been attained the engine can be throttled down.

5. FLIGHT.

a. The rpm, cylinder head temperatures, oil pressure, and temperature give the most satisfactory indication of the engine's performance. If any of these appears irregular, the engine should be throttled and, if the cause cannot be eliminated, a landing should be made to investigate and remove the trouble.

b. In flight the mixture control can be leaned out only when a higher rpm can be obtained, i.e., a higher rpm must result from any leaning of the mixture, otherwise the mixture control must be returned to the "FULL RICH" position.

6. LANDING.

a. The mixture control must be replaced in its "FULL RICH" position prior to landing.

b. From cruising operation, slowly close throttle to 1000 rpm.

c. The carburetor air heater should be used in long glides.

d. When throttle is closed while making long glides from high altitude, open throttle periodically to clear the cylinders and to prevent spark plug fouling.

7. STOPPING.

a. Preliminary Procedure.

(1) Set mixture control at "FULL RICH" position.

(2) Set throttle at normal idling position.

(3) Allow the engine to run at normal idling speed with the nose cowl or radiator shutters (if installed) fully opened until the engine has cooled appreciably below cruising temperature. Cylinder and oil temperature will normally reach values below cruising temperatures during the gliding for landing and taxiing. The resulting temperature during this idling period will vary according to climate and the amount of power that was required for taxiing.

b. **Regular Procedure.** — The following procedure will be followed upon completion of preliminary procedure outlined in paragraph (a) to stop from idling speed.

(1) Close the fuel valve and allow engine to stop from idling speed. Turn Ignition Switch to "Off."

(2) Place the throttle in the "OPEN" position after stopping the engine, as this lessens the possibility of accidental starting while the engine is hot.

8. CARBURETOR HEAT CONTROL.

The engine should be operated on "COLD" air at all times, except when operating under conditions where icing is likely, in which case the carburetor air control should be placed in the "FULL HOT" position. If improved engine operation is not obtained the heat control should be returned to the "COLD" position.

9. MIXTURE CONTROL.

The following expressions are applicable to manual adjustment of the mixture control:

a. "FULL RICH" is the setting of the mixture control lever in the position giving maximum fuel flow.

b. "BEST POWER" is the setting of the mixture control lever which, with a given throttle setting, results in obtaining a higher rpm., i.e., a higher rpm must result from any leaning of the mixture, otherwise the mixture control must be returned to the "FULL RICH" position.

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OPERATING AND MAINTENANCE INSTRUCTIONS — Continued

10. GASOLINE AND OIL RECOMMENDATIONS

Engine Model	Recommended Gasoline Octane Rating	OPERATING TEMPERATURE OF OIL — °F.			
		Below 120°F.	120° — 160°	160° — 190°	Above 190°F.
		APPROXIMATE EQUIVALENT IN OUTSIDE AIR TEMPERATURE — °F.			
		Below + 32°	32° — 70°	70° — 100°	Above 100°
A50	73	SAE 20	Aero grade No. 60	Aero grade No. 80	Aero Grade No. 100
A65	73	SAE 20	Aero grade No. 60	Aero grade No. 80	Aero Grade No. 100
A75	73	SAE 20	Aero grade No. 60	Aero grade No. 80	Aero Grade No. 100
A80	80	SAE 20	Aero grade No. 60	Aero grade No. 80	Aero Grade No. 100

Recommended oil changes in all models — each 20 to 30 hours of operation. When operating oil temperatures overlap above column ranges, use the lighter oil.

Section 6

ENGINE TROUBLES AND SERVICE REPAIRS

1. FAILURE OF ENGINE TO START.

a. Lack of Fuel.

(1) Check whether there is a sufficient level of gasoline in airplane tank to flow to the carburetor.

(2) Check the gasoline flow at the carburetor; see that the carburetor float is not stuck, and that the jets are not clogged.

(3) Make certain that the vent holes in the gasoline tank caps are open.

b. Under-priming or Over-priming.

(1) If engine is under-primed, close throttle; with gasoline supply valve turned on, prime the engine two or three strokes.

(2) If the engine is over-primed, turn the ignition switch off, open the throttle, and turn the engine backward to unload the cylinders.

c. Defective Ignition.

(1) Examine ignition wiring for breaks in the insulation.

(2) Check all spark plugs for correct gap setting. Whenever the gap is found to exceed .020 inch, the electrodes will be regapped .015 to .016 inch.

(3) Check magneto points for clearance and possible pitted or oily condition.

(4) Examine the magnetos for correct timing to the engine. (Refer to section 11, paragraph 3, i.

(5) Check ground terminal for possible shorting inside terminal housing.

d. Valve Action.

(1) Check valve stems to be sure they are not gummed with carbon and sticking open.

(2) Check condition of valve springs and see that they are assembled to the valve stem correctly.

(3) Check the working order of the rocker arm assemblies.

(4) Check for worn or bent push rods.

e. **Cold Oil** — With the ignition switch off, turn propeller over by hand to break the drag created by cold oil between the pistons, piston rings, and cylinder walls. If the engine is very stiff, it will be necessary to free the pistons in the cylinders either by applying heat or injecting small quantities of very light oil through the spark plug holes.

f. **Hot Engine** — Do not prime. The engine will frequently start without an additional prime over that left in the cylinders when the engine was shut off. It may be necessary to unload the cylinders by turning the propeller opposite to the direction of rotation.

2. LOW OIL PRESSURE.

a. Check for dirt in the oil screen. Remove screen and clean thoroughly.

b. Check for poor connections in the oil suction tube, causing the pump to draw air.

c. Check the quantity of oil in sump. A minimum of two quarts of oil must be used.

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d. Inspect relief valve to see whether plunger is operating smoothly in its guide and seating well, and the control spring is functioning properly. Clean.

e. Inspect and clean oil screen at end of oil suction tube.

3. HIGH OIL TEMPERATURE.

a. This condition may be due to the following:

- (1) Insufficient amount of oil in sump.
- (2) Dirty oil.
- (3) Failure to remove winter baffles, or inefficiency of loose baffles.
- (4) Excessively lean carburetor mixture.
- (5) Worn or stuck rings, indicating piston score.
- (6) Altitude control mixture not adjusted properly.
- (7) Operation at full throttle, low speed.

4. LOW POWER OR SPEED

- a. Check propeller for track, balance, and pitch.
- b. Check spark plugs, wires, condensers, coils.
- c. Check for air leaks at all connections of carburetor and intake manifold.
- d. Check for full opening of throttle valve.
- e. Check for unrestricted flow of fuel to carburetor inlet and for proper operation of carburetor.
- f. Check cylinder compression and valve action.
- g. Check carburetor air temperature. Check for proper operation of carburetor heat control.
- h. Check tachometer to see that it is registering correctly.

5. ROUGH RUNNING.

a. Check propeller for balance, track and correct installation on the propeller hub and shaft.

b. Clean, re-gap, and bomb test spark plugs.

c. Check magneto operation. Check whether ignition cables are breaking down at high speeds.

d. Check valve operation, especially evidence of sticking, or any lag in valve operating mechanism.

e. Check engine mounting bolts for tightness.

f. Check engine mount for cracked or broken members.

g. Check carburetor air temperature. Check for proper operation of carburetor heat control.

6. ENGINE FAILS TO ACCELERATE PROPERLY.

- a. Motor not sufficiently warm.
- b. Heater control not on, or not functioning properly.
- c. Spark plugs fouled by long idling.
- d. High float level.
- e. Worn intake valve guides and piston rings.

7. ENGINE FAILS TO IDLE PROPERLY.

a. Air leaks at joints of the carburetor and intake manifold can be located by squirting raw gasoline from a hand oil can around all connections and packing while the engine is running about 400 to 500 rpm. If gasoline is applied at a leaking connection, it will be drawn in, causing the engine to increase its rpm. As soon as this extra fuel is burned, the engine will again fall back to its former rpm.

b. Leaking primer jets.

c. Idle air bleed blocked by dirt.

d. Engine idling jet set too lean or plugged.

e. Worn intake valve guides and piston rings.

Section 7

SERVICE INSPECTION AND ASSOCIATED MAINTENANCE

1. GENERAL.

a. The work outlined in this section consists of the periodic inspection, cleaning, servicing, lubricating, adjusting, and such maintenance work as is associated with the routine Inspection System.

2. INSPECTION AND MAINTENANCE.

a. Daily — Power Plant.

(1) Check oil level. Replenish oil supply if necessary.

(2) Inspect for evidence of engine throwing oil.

(3) Check security of carburetor air intake and its control valve for operation.

(4) Inspect carburetor for fuel leakage at connections, drain plugs, and passage plug. Clean

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fuel filter bowl and fuel tank sump if necessary. Make sure drains are properly safetied.

(5) Check throttle and mixture control connections to insure that no binding exists and they are tight and properly safetied.

(6) Check all wiring terminals for tightness and condition of wiring.

(7) Make visual inspection of entire engine for: missing or loose nuts, bolts, manifolds; proper safetying of all plugs.

(8) Remove carburetor air intake filter and clean with hot water or steam. Spray front and rear with just enough oil to coat all wires.

b. Ignition and Electrical.

(1) 25-Hour.

(a) Remove magneto breaker cover and clean breaker housing.

(b) Inspect magneto for damaged breaker felts or cushions.

(c) Check for excessive lubrication. Clean and dry the breaker mechanism to insure that oil will not touch the breaker contacts.

(d) Make certain all necessary safety wiring or pins are installed.

(e) Replace breaker assembly, if necessary.

(f) Check security of spark plug elbow terminal and shielding nuts on radio shielded engines.

NOTE: When checking the elbow assembly, extreme care must be exercised that the barrel is not rotated with respect to the shell. Discontinue the common practice of slightly tightening the elbow nut at each 24-hour inspection. Never check the tightness of the elbow by twisting the body of the elbow.

(2) 50-Hour — Inspect all wiring for breaks in the insulation and proper securing of terminals. Replace, if necessary.

(3) 100-Hour.

(a) Remove spark plugs and clean, or replace with new or reconditioned plugs of approved type.

(b) Install serviceable spark plug gaskets.

(c) Test Ignition cables for high tension leaks.

c. Fuel System.

(1) 25-Hour.

(a) Lubricate throttle shaft bearings, using light machine oil.

(b) Remove fuel filter bowl. Clean screen and bowl. Replace bowl and refill. Check for leaks and bubbles. Tighten bowl and safety.

(c) Remove float chamber drain plug, fuel strainer plug and strainer. Clean strainer. Flush out water and sediment by allowing fuel to flow through strainer and drain plug opening.

d. Oil System.

(1) 25-Hour.

(a) Drain engine oil after each 25-hours' operation, unless operating conditions indicate otherwise, and refill with the proper grade and quality of oil. The draining should be done while the engine is hot. See table, page 18 for proper grade.

(b) Check oil sump for security of mounting and proper safetying of all nuts.

(d) The oil screen assembly located in the crank case cover back of No. 2 cylinder should be cleaned at least once every 25 hours.

(2) 100-Hour — Clean oil screen and oil suction tube screen.

(3) At Engine Change — Clean oil screens on newly installed engines at the following periods:

(a) At completion of ground installation test.

(b) At completion of flight test.

e. Cooling System.

(1) 50-Hour.

(a) Check air deflectors for cracks, security of fastening, and to make sure they do not chafe cylinder fins.

(b) Inspect cylinders for damaged or broken fins.

f. Valve Mechanism.

(1) These engines have internal automatic lubrication of the valve mechanism which should be inspected in accordance with the following periods and instructions:

(a) 25-Hour — A complete inspection of the valve mechanism should be made at the first 25-hour inspection after the engine is installed.

(b) 100-Hour — A complete inspection of the valve mechanism should be made at 100-hour intervals.

(2) In making the inspection set forth above, the following instructions should be observed:

(a) Remove rocker box covers. Inspect rocker arm for cracks, excessive side or end play, signs of interference with adjacent parts.

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- (b) Check for broken springs, condition of valve spring retainers and security of valve spring seat locks.
- (c) Make certain all oil passages are open before replacing rocker box cover. Interior of rocker boxes should show complete coverage with engine oil.
- g. Manifold and Hose Connections.**
 - (1) **25-Hour.**
 - (a) Check intake manifold for proper mounting and for security of the two plain nuts and palnuts.
 - (b) Inspect rubber hose connections and clamps on the intake pipes and elbows for proper and secure adjustment.
 - h. Propeller and Accessories.**
 - (1) **100-Hour.**
 - (a) Check propeller hub bolts for tightness and check propeller for track, making corrections if necessary. The propeller should track within $\frac{1}{8}$ -inch.
 - i. General.**
 - (1) Check engine mounting bolts for proper torque.
 - (2) All unattached ignition cable ends must be covered with friction tape or other suitable protective covering and secured.
 - j. Run-In And Test**
 - (1) New or overhauled engines installed in an airplane should be ground-tested as follows:
 - (a) Run for a period of approximately 30 minutes during which time the operation of the engine, engine instruments, and related accessories may be thoroughly checked for proper functioning.
- (b) Care must be taken not to exceed maximum cylinder or oil temperatures during this running period. Continual operation at either low idling speeds or at manifold pressures approaching rated power must be held to a minimum. Engine cowling should not be installed during the ground running.
- (c) Warming-up speeds of 800 to 1000 rpm are recommended. Operation with speeds and manifold pressures that will give rated power must be limited to short bursts of only sufficient duration to obtain instrument readings and to make certain that the acceleration of the engine is satisfactory.
- (d) Upon completion of the installation ground test, each airplane in which a new or overhauled engine has been installed should be flight-tested as specified below:
 - 1. A flight of one hour's minimum duration, the first 50 minutes of which must be at reduced power and the last 10 minutes at normal rated power, followed by a careful inspection for evidence of any visible defects, malfunctioning parts, etc. If inspection does not indicate any malfunctioning or defects, the airplane may be released for service.
 - 2. The mixture control must be kept in the "Full Rich" position at all times during the flight tests.

Section 8

ADJUSTMENT, REPLACEMENT, AND MINOR REPAIRS

1. GENERAL.

a. The work outlined in this section can be performed without the facilities usually available at major overhaul shops.

b. This section of the manual contains all necessary instructions for the replacement (but not repair) of accessories and removal of external or readily removable parts.

2. CARBURETOR.

a. The carburetor is located at the bottom of the crankcase and is attached to the intake manifold, which in turn is assembled on the two studs provided in the crankcase.

b. The carburetor is installed to the mounting pad of the intake manifold with a gasket between the parting flanges, and is retained by four castle nuts.

CONTINENTAL A 50, A 65, A 75, A 80 ENGINES

OPERATING AND MAINTENANCE INSTRUCTIONS — Continued

c. The carburetor air intake and filter assembly is mounted on the base of the carburetor with a gasket, and is retained by four castle nuts with palnuts.

d. Controls connecting to the carburetor are as follows:

(1) The throttle control lever is at the right side of the carburetor as viewed from the rear of the engine.

(2) The mixture control lever is located on top of the float chamber on the left side as viewed from the rear of the engine.

e. The carburetor may be removed from the engine by detaching the fuel line, throttle and mixture controls, removing the air intake assembly and the four castle nuts at the mounting pads.

3. MAGNETOS — The two magnetos are mounted on the right and left sides of the crankcase cover. The mounting flange of each magneto is attached by two studs, nuts and palnuts.

4. MAGNETO INSTALLATION AND TIMING TO THE ENGINE.

a. Rotate the magneto until the mark on the gear, visible through the inspection window, is in line with small pointer, which is also visible. This places the magneto in firing position for cylinder No. 1. Rotate engine in counterclockwise direction until the firing stroke of No. 1 cylinder is reached.

b. Installing the left and right magneto, set the engine as follows:

A50 Series 8, 9...Right Magneto: 25° B.T.C.

Left Magneto: 28° B.T.C.

A65 Series 8, 9...Right and Left

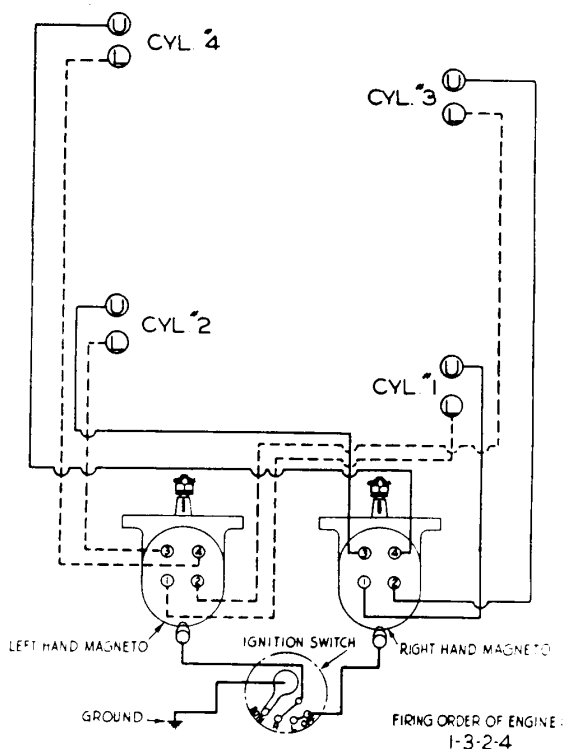
Magneto: 30° B.T.C.

A75 Series 8, 9...Right Magneto: 29° B.T.C.

A80 Series 8, 9...Left Magneto: 32° B.T.C.

c. Tighten the mounting nuts enough to hold magneto in position against the accessory case. Before checking exact breaker opening position, rotate magneto counter-clockwise by tapping the mounting flange until it is near the end of travel permitted by the slots. Turn crankshaft backward slightly, and bring slowly up to firing position to take backlash out of the driving gear train. Insert a .0015-inch feeler between breaker points and tap magneto flange in a clockwise direction until the exact point of release is reached. Tighten mounting nuts and recheck

timing by backing up crankshaft and turning it slowly forward to determine if the feeler is released the instant the disc reaches the correct mark. Turn shaft only 5° or so to check impulse coupled magnetos.



Ignition Wiring Diagram — Figure 12

5. IGNITION WIRING.

a. Refer to figure 12 where the complete ignition wire system is diagrammed and firing order given.

b. The following table shows the individual ignition cable lengths in inches and the total amount required for the Series 8 engines with SF-4R magnetos:

CYLINDER NUMBER	LEFT MAGNETO TO LOWER PLUG	RIGHT MAGNETO TO UPPER PLUG
1	36"	23"
2	26"	29"
3	36"	24"
4	34"	32"

Total length required per engine.....20'

CONTINENTAL A50, A65, A75, A80 ENGINES

OPERATING AND MAINTENANCE INSTRUCTIONS — Continued

c. The following table shows individual ignition cable lengths in inches and the total amount required for the Series 9 engine with SF-4R magnetos:

CYLINDER NUMBER	LEFT MAGNETO TO LOWER PLUG	RIGHT MAGNETO TO UPPER PLUG
1	33"	23"
2	19"	33"
3	34"	28"
4	25"	36"

Total length required for engine.....19'-5"

6. REMOVAL OF PARTS:

a. Cylinder and Piston.

(1) Remove wires from spark plugs, and remove spark plugs from cylinder head.

(2) Loosen the hose connections at the cylinder elbow to the intake pipe. Slide rubber hose toward carburetor.

(3) Remove screws holding the rocker box covers to the cylinders and remove covers. Push rocker arm shaft out with the finger. Make sure that the intake and exhaust valves are closed. Remove rocker arms and push rods from push rod housings.

(4) Loosen clamps holding the hose connections at foot of push rod housing. Push clamp and rubber hose up the housing toward the cylinder head.

(5) Remove the six cylinder base nuts. Remove the cylinder from the crankcase; the piston must be at the outer end of the stroke.

CAUTION: Do not allow piston to drop down as cylinder is removed from it, or damage will result.

(6) Push piston pin out and remove piston from the connecting rod.

b. **Valves** — Compress the valve springs in the rocker box, using a suitable valve spring compressor. Remove valve spring locks from valve stem. Remove spring seat, springs, and spring retainer. In removing valves from guides extreme caution must be exercised that they do not scratch or mar the valve guide bores.

7. GENERAL INSPECTION.

a. Replace all spark plugs with new or reconditioned plugs. Carefully inspect the entire ignition harness for serviceable condition.

b. Remove all cylinder hold-down studs that are loose, broken, or have damaged threads, and install proper replacements. Available oversize replacements are listed in the Illustrated Parts List.

c. Check entire engine and make sure all nuts are tight in accordance with torque values set forth in the Table of Limits, and see that all safetying is complete and tight. Palnuts must be tightened as follows: After the regular nuts are tightened to the desired torque, install palnuts with the smooth face against the plain nuts. Tighten the palnuts with the fingers, then turn with a wrench until the nut is locked, or approximately one-sixth of a turn. Never tighten palnuts more than one-quarter of a turn. Excessive tightening will render them unserviceable.

CAUTION: Do not attempt to tighten or loosen the palnut and plain nut at the same time.

d. Inspect, tighten, and safety all engine mounting bolts.

8. REASSEMBLY.

a. **General** — In this operation it will be assumed that all parts and assemblies are in a serviceable condition, thoroughly clean, and have been lubricated with engine oil on their bearing surfaces. When assembling the engine, use new gaskets and packing throughout.

b. **Valves** — Clean and oil valve guides and stems. Insert valve stems in guides.

c. Valve Springs.

(1) Insert valve spring retainer, valve outer and inner springs in rocker box housing.

(2) Fit spring seat over springs.

(3) Observe the following instructions before compressing valve springs for installation:

(a) Place a block (having the same contour as the inside of the head) against the dome of the combustion chamber to prevent the valve stems from descending in the guides when the springs are compressed for installation.

(b) Compress valve springs and install locks.

d. Piston Pins, Pistons, and Cylinders.

(1) Install new rings on piston. Fit assembly to its respective connecting rod with numbered side facing the propeller end of the crankshaft. Push piston pin carefully into position. Be sure piston pin plugs remain in place.

CAUTION: Piston must be carefully supported to avoid coming into contact with other metallic surfaces.

(2) Turn crankshaft until its position is brought to the outer end of the stroke. Carefully

CONTINENTAL A 50, A 65, A 75, A 80 ENGINES

OPERATING AND MAINTENANCE INSTRUCTIONS — Continued

wipe off cylinder with clean cloth. Oil both cylinder and piston. Use new cylinder base packing between the cylinder base flange and crankcase.

(3) Install push rod housing rubber hoses on the housing and push back toward the cylinder head for clearance.

(4) Before placing cylinder on the crankcase section, all of the cylinder studs and hold-down nuts should be examined for cracks, damaged threads, or other visible defects. Any stud or nut that is defective must be disposed of. The threads of the studs and hold-down nuts must be thoroughly cleaned. Both faces of the stud washers and the recesses in the cylinder flange for the washers will also be cleaned, and any roughness or burrs removed.

(5) Assemble cylinder over piston. Rotate rings until gaps are evenly spaced about the piston, compress rings and slide the cylinder over them.

(6) Tighten cylinder hold-down nuts in the following manner: Tighten all hold-down nuts to a snug position to insure that the cylinder is seated on the crankcase section. Loosen one nut at a time and retighten until contact is just made with the cylinder flange or washer. From this position, tighten the nut to the torque specified in the table of limits. It is very important that the position of the wrench be maintained so that the turning axis of the wrench always coincides with the vertical center line of the hold-down nut which is being tightened. All nuts will be tightened slowly and smoothly until the proper torque has been applied.

CAUTION: Jerking of the torque wrench must always be avoided. Care must be exercised at all times to insure that the socket of the wrench does not contact the cylinder wall during the tightening procedure as such contact will cause an incorrect torque reading.

(7) Cylinder hold-down nuts should be checked by installing the torque wrench on the particular nut and gradually turning to the desired torque limit. If any movement is noted during this check, the nut will be loosened and retightened in accordance with instructions in paragraph (6) above.

(8) Upon completion of the check specified in paragraph (7) above, install palnuts. No further inspection of cylinder stud hold-down nuts will be necessary between engine overhauls.

(9) Slip rubber hose connections down in place on the push rod housing and tighten with metal hose clamp.

(10) Attach intake manifold and install intake pipes and hose connections.

(11) Attach and safety the carburetor.

e. Rocker Arms and Push Rods.

(1) Rotate crankshaft so that intake and exhaust valve tappets are at their inward position.

(2) Insert push rods in the housings, hold rocker arms in place, and push in rocker arm shaft. If the tappets fill with oil, it will be necessary to compress valve springs while inserting the shaft.

f. Rocker Box Cover.

(1) Fit gasket on mounting face of rocker box cover.

(2) Fasten cover on rocker box housing with $\frac{1}{4}$ -inch screws.

g. Spark Plugs.

(1) Apply a small quantity of mica thread lubricant on the threads of the spark plugs.

CAUTION: Do not allow any of the compound to collect on the electrodes, as subsequent fouling of the spark plug may result.

(2) Screw spark plugs in cylinder head and tighten.

NOTE: Spark plugs will be tightened to a maximum torque of 360-inch pounds.

h. Adjustment of Valve Tappet Clearances — As these engines are equipped with hydraulic tappets, no method of adjusting clearances is provided. Tappets will function properly with clearances ranging from .030 inch to .110 inch, (with tappets deflated).