

in ratios varying from 1.5:1 to 4.12:1. Reduction gears supplied with various model engines are shown in Table 1.

a. Helical Reduction Gears

(1) The reduction gear unit consists of a helical drive pinion mounted on the reverse gear tailshaft supported in the reduction gear front cover and an internal helical gear rigidly supported on large capacity ball bearings in the reduction gear housing. The reduction gear ratio is determined by the number of teeth in pinion and internal gears. The centerline offset is the difference in pitch radii of the pinion and the internal gears. The pinion gear is keyed to the reverse gear tailshaft and held in place by a nut. It is supported in a large ball bearing in the adaptor plate and reverse gear housing. Correct alignment of the pinion gear is maintained by this ball bearing and the one on the engine sleeve gear at the forward end of the tailshaft.

(2) The internal helical gear is bolted to a flanged reduction gear shaft rigidly mounted on two large ball bearings. The one next to the gear and carrying most of the radial load is a single row unit. The propeller thrust bearing is a double row unit capable of taking

the heavy axial propeller thrust in addition to the radial load imposed by the helical gear.

(3) The propeller shaft coupling is keyed to the end of the reduction gear shaft and held in place by a lock nut. The propeller shaft coupling is supported by the large double row ball bearing.

(4) A ring type oil seal pressed into the propeller thrust bearing retainer rubs on the polished surface of the propeller thrust coupling. This prevents loss of reduction gear oil from the housing and the entrance of water or dirt into the reduction gear.

(5) On some models the reduction gear is oiled by crankcase pressure and on others separate lubrication is provided. See Table 4.

b. Universal Reduction Drive

The Universal reduction drive consists of two herringbone gears, a small gear press fit on the reverse gear tailshaft, and a larger gear which floats on the spline shaft below it. Both the drive shaft and the lower spline shaft are supported by heavy duty ball bearings. Running in a continuous bath of oil, this type of drive is positive, quiet, and smooth.

SECTION V PERIODIC SERVICE

1. GENERAL

Periodic maintenance procedures will do much to keep your engine operating at top efficiency. Regular inspection of the engine following the procedures listed in Paragraph 2 through 8 will reduce maintenance costs and uphold the high standards of quietness, reliability, and performance built into

every UNIVERSAL engine.

2. PRE-OPERATIONAL CHECK

a. Check engine oil level. If necessary, add oil to bring it up to the full mark on the bayonet stick. See Table 4 for proper weight oil.

b. On engines having separately oiled reduction gears, check oil level and if necessary refill. See Table 4 for engine requirements.

c. On engines equipped with hydraulic reversing gears, check to see that oil level is at full mark on bayonet stick. If necessary refill with same grade oil used in engine.

d. Turn grease cup on water pump one turn. If necessary refill with good grade waterproof grease. (Bronze gear water pumps only).

e. With engine operating check oil pressure.

f. With engine operating, check temperature. On engines equipped with temperature indicators, temperature should be between 130 and 160 degrees F. (Fresh water 160° - salt water 140°). If engine is not equipped with a temperature gauge, a rough determination can be made by placing a hand on the engine block. Engine should operate at a temperature which will allow holding a hand on the block for a period of 15 to 30 seconds.

3. FIFTY HOUR CHECK

a. Using sump pump, remove all oil from crankcase. Refill with a good grade oil as specified in Table 4.

b. Inspect oil cooler and remove any accumulation of grit or dirt.

c. Oil generator, using three to five drops of light engine oil.

d. Add three or four drops of medium engine oil to distributor oil cup.

e. Clean fuel pump strainer.

4. ONE HUNDRED HOUR CHECK

a. Remove glass bowl from fuel pump and clean out accumulated

sediment.

b. Inspect flame arrester to be sure air passages are clean and free from oil. If dirty remove and wash with kerosene. Be sure arrester is thoroughly dry before replacing.

c. Check adjustment of clutch. See Paragraphs 8 and 9, Section VI.

5. ONE HUNDRED FIFTY HOUR CHECK

a. Check valve tappet adjustment. See Paragraph 7, Section VI.

b. Remove, clean, and reset spark plugs. See Paragraph 13, Section VI.

c. Tighten all nuts and capscrews.

6. TWICE A SEASON CHECK

a. Apply one drop of light engine oil to the breaker arm hinge pin in distributor.

b. Apply two or three drops of light engine oil to the felt in the top of the breaker cam and to the governor weight pivots of the distributor rotor.

c. Clean the engine thoroughly.

d. Tighten all lag bolts holding engine to bed.

e. Check engine alignment. See Paragraph 4, Section II.

f. Check carburetor adjustment. See Paragraph 6, Section VI.

g. Clean and adjust distributor, magneto breaker points. See Paragraphs 1 and 5, Section VI.

h. Oil or replace cam lubricating wicks on magneto. See Paragraph 5, Section VI.

7. ONCE A SEASON CHECK

a. Clean generator commutator. See

Paragraph 3, Section VI.

b. Check generator and starter brushes for wear. If worn replace. See Paragraphs 3 and 4, Section VI.

c. Adjust valve tappets if necessary. See Paragraph 7, Section VI.

d. Remove and clean muffler.

e. Lubricate and repack bearings on magneto. See Paragraph 5, Section VI.

8. THREE THOUSAND HOUR CHECK

At the end of three thousand hours of operation the engine should be completely overhauled. All bearings should be checked for wear, valves ground, piston rings replaced, and the engine thoroughly cleaned.

SECTION VI MAINTENANCE

1. DISTRIBUTOR MAINTENANCE

a. Removal

(1) Unsnap the two springs holding the cap to the distributor body. Remove the cap.

(2) Loosen the clamping screw at the base of the distributor.

(3) Remove the timing adjusting screw which holds the clamp to the engine block.

(4) Note the position of the distributor in relation to the engine, to facilitate replacement in the same relative position.

(5) Remove distributor from engine.

b. Inspection

(1) Inspect the distributor for cracked, broken, or worn parts and for excessive burning. Replace all defective parts.

(2) Clean all parts with carbon tetrachloride.

c. Adjustment and Replacement of Points

(1) Points which show only a slight discoloration and are not badly pitted should be cleaned with a fine point file and reset for a gap

of 0.018 to 0.022 inch. See Fig. 60 (1).

(2) Badly worn or pitted points should be replaced. When replacing points be sure they are properly aligned. Bend stationary arm (2) slightly to align points. Do not bend breaker arm (3).

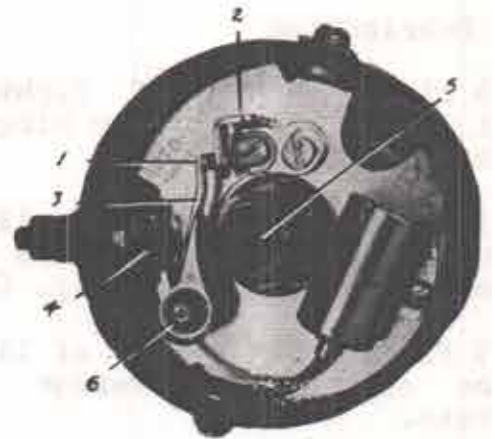


Fig. 60 Distributor Body

d. Adjustment of Breaker Arm Spring Tension

(1) Hook a spring scale to the contact end of the breaker arm and hold at right angles to the contact surfaces.

(2) Read the scale just as the contacts separate. Scale reading should be between 17 and 20 ounces.

b. On engines having separately oiled reduction gears, check oil level and if necessary refill. See Table 4 for engine requirements.

c. On engines equipped with hydraulic reversing gears, check to see that oil level is at full mark on bayonet stick. If necessary refill with same grade oil used in engine.

d. Turn grease cup on water pump one turn. If necessary refill with good grade waterproof grease. (Bronze gear water pumps only).

e. With engine operating check oil pressure.

f. With engine operating, check temperature. On engines equipped with temperature indicators, temperature should be between 130 and 160 degrees F. (Fresh water 160° - salt water 140°). If engine is not equipped with a temperature gauge, a rough determination can be made by placing a hand on the engine block. Engine should operate at a temperature which will allow holding a hand on the block for a period of 15 to 30 seconds.

3. FIFTY HOUR CHECK

a. Using sump pump, remove all oil from crankcase. Refill with a good grade oil as specified in Table 4.

b. Inspect oil cooler and remove any accumulation of grit or dirt.

c. Oil generator, using three to five drops of light engine oil.

d. Add three or four drops of medium engine oil to distributor oil cup.

e. Clean fuel pump strainer.

4. ONE HUNDRED HOUR CHECK

a. Remove glass bowl from fuel pump and clean out accumulated

sediment.

b. Inspect flame arrestor to be sure air passages are clean and free from oil. If dirty remove and wash with kerosene. Be sure arrestor is thoroughly dry before replacing.

c. Check adjustment of clutch. See Paragraphs 8 and 9, Section VI.

5. ONE HUNDRED FIFTY HOUR CHECK

a. Check valve tappet adjustment. See Paragraph 7, Section VI.

b. Remove, clean, and reset spark plugs. See Paragraph 13, Section VI.

c. Tighten all nuts and capscrews.

6. TWICE A SEASON CHECK

a. Apply one drop of light engine oil to the breaker arm hinge pin in distributor.

b. Apply two or three drops of light engine oil to the felt in the top of the breaker cam and to the governor weight pivots of the distributor rotor.

c. Clean the engine thoroughly.

d. Tighten all lag bolts holding engine to bed.

e. Check engine alignment. See Paragraph 4, Section II.

f. Check carburetor adjustment. See Paragraph 6, Section VI.

g. Clean and adjust distributor, magneto breaker points. See Paragraphs 1 and 5, Section VI.

h. Oil or replace cam lubricating wicks on magneto. See Paragraph 5, Section VI.

7. ONCE A SEASON CHECK

a. Clean generator commutator. See

rotor points to slot in distributor case when distributor drive gear is re-engaged. Rotate distributor body until breaker points are just beginning to open.

f. Tighten clamp holding distributor in position. Engine is now roughly timed.

g. Replace distributor cap on distributor body. No. 1 spark plug wire goes into the connection directly above the flat on the distributor body at which the rotor is aimed. The rest of the wires are inserted in the distributor cap in the proper rotation of firing order going from No. 1 in a clockwise direction.

h. Final setting for peak efficiency must be made with engine running.

i. With engine running at a fixed throttle setting, loosen distributor and rotate to maximum RPM, retighten at that point. Engines having matching timing marks are best adjusted with a timing light.

3. GENERATOR MAINTENANCE

Generators used on UNIVERSAL engines are nonventilated, three brush and shunt types. With the exception of periodic lubrication and occasional replacement of brushes and cleaning of the commutator, no maintenance should be required. If trouble of a major nature is encountered the generator should be sent to the Universal factory for repair.

a. Replacement of Brushes

If brushes should become oil soaked, or have worn to less than one-half their original length, they should be replaced.

(1) Disconnect generator wiring.

(2) On gear driven models, remove bolts holding generator to the timing gear train housing, and care-

fully pull generator away from housing.

(3) On models belt driven from fly-wheel, remove belt, remove nut holding generator pulley to shaft, remove bolts holding generator to fly-wheel housing, and carefully pull generator away from housing.

(4) On models belt driven from water pump, remove belt adjusting screw, belt, and hinge bolt.

(5) Loosen clamping screw and remove head band.

(6) Remove brushes from brush holder.

(7) Place new brushes in brush holders.

(8) Draw a piece of 00 sandpaper between the brushes and in the direction of the brush holder to properly seat the brush against the commutator. See Fig. 61.

(9) Blow out accumulated sand and dust and replace head band.

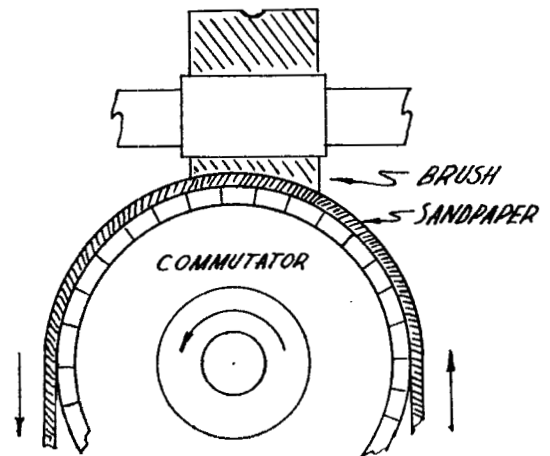


Fig.61 Sanding Distributor Brushes

(10) Replace generator on engine.

(11) On belt driven models adjust position of generator for proper belt tension.

b. Lubrication

The generator should be lubricated every 100 hours of operation. Place three to five drops of light engine oil in the oil cups at each end of the generator. Do not over oil.

c. Cleaning Commutator

- (1) Remove generator from engine as described in subparagraph a (1) through (5) above.
- (2) Loosen clamping screw and remove headband.
- (3) Remove brushes from holders.
- (4) Hold a piece of 00 sandpaper against commutator and rotate armature until commutator is clean.
- (5) Blow out sand and dust, replace brushes in holders, replace headband, and install generator on engine.

4. STARTER MOTOR MAINTENANCE

With the exception of periodic lubrication and occasional replacement of brushes and cleaning of the commutator, the starting motors used on UNIVERSAL engines will require very little maintenance. Every starting motor is equipped with a Bendix drive which acts as an automatic clutch that engages the starting motor with the engine flywheel when the motor cranks the engine and disengages when the engine starts. This drive should be inspected once each season and worn parts replaced. If trouble of a major nature is encountered the starting motor should be sent to the UNIVERSAL factory for repair.

a. Replacement of Brushes

If brushes have become oil soaked or have worn to less than one-half of their original length, they should be replaced.

- (1) Disconnect starting motor wiring.
- (2) Remove bolts holding starting motor to flywheel housing.
- (3) Remove motor from housing.
- (4) Loosen the clamping screw and slide head band off motor.
- (5) Remove brushes from holders. If brush lead is riveted to brush holder, remove the rivet. If brush lead is soldered to field coil line, unsolder and bend open the loop on the field coil lead.
- (6) Install new brushes. Be sure bevel of brush fits the commutator.
- (7) Draw a piece of 00 sandpaper between the brushes and in the direction of the brush holder to properly seat the brush against the commutator. See Fig. 61.
- (8) Blow out sand and dust and replace motor on engine.

b. Cleaning of Commutator

- (1) Remove starting motor from engine and remove brushes from brush holders as described in subparagraph a (1) through (4).
- (2) Hold a piece of 00 sandpaper against the commutator and rotate armature until commutator is clean.
- (3) Blow out sand and dust, replace brushes in holders, replace headband, and install starting motor on engine.

c. Bendix Drive Maintenance

- (1) Remove starting motor from engine, remove head band and brushes as described above.
- (2) Remove the pinion housing holding screws.
- (3) Pull armature and pinion housing from the motor.

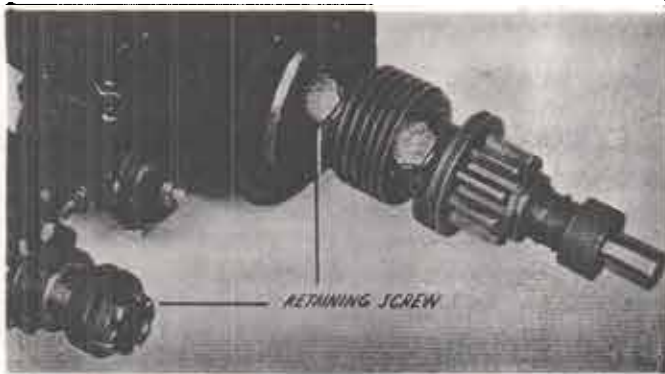


Fig. 62 Bendix Drive

(4) Press the armature out of the pinion housing.

(5) Remove the Bendix head spring screw (screw nearest armature or on end of shaft), and slide the Bendix from the shaft. See Fig. 62.

(6) Inspect all parts for wear and distortion. Replace all defective parts.

(7) Reassemble and install on engine.

d. Lubrication

The service requirements of this unit are light and it requires very little lubrication. Once each season the motor should be disassembled and the bronze bearings soaked in oil. Some models are equipped with oil holes on the commutator end of the shaft. Three or four drops of light oil every 100 hours of operation placed in this oil hole is sufficient.

5. MAGNETO MAINTENANCE

a. Removal

(1) Pull the ignition wires free of the magneto distributor cap.

(2) Remove the two capscrews holding the magneto to the mounting bracket.

(3) Pull the magneto in a direction away from the drive shaft and lift

it from the engine.

b. Inspection and Cleaning

(1) Loosen the screws and remove the end cap from the magneto. Be careful not to damage the gasket between the end cap and the magneto body.

(2) Remove the distributor cap from the end cap.

(3) Inspect magneto for worn or broken parts. Check end and distributor caps for cracks and burned areas.

(4) Replace all worn or broken parts.

(5) Clean all exposed portions of the magneto with carbon tetrachloride.

c. Adjustment of Points, American Bosch

(1) Inspect the points for evidence of pitting or burning. If points are only slightly burned, dress with fine point file. If points are badly burned, replace.



Fig. 63 Magneto - American Bosch

(2) Turn the magneto shaft until the cam shoe rides on the highest point of the cam.

(3) Loosen the locking screw (1).

(4) Turn the eccentric adjusting screw (2) until the points are open 0.015". Tighten the locking screw.

d. Adjustment of Points,
Fairbanks-Morse

- (1) Inspect the points for evidence of pitting or burning.
- (2) If points are badly pitted, replace. If pitting is minor, dress with fine point file.
- (3) Loosen the two locking screws (1 and 2).
- (4) Turn the magneto shaft until the cam shoe rests on the highest point of the cam.
- (5) Insert a screw driver in the slot (3) underneath the breaker arm. Turn the screwdriver against the two projections until a separation at the points of 0.015" is obtained. Tighten the locking screws.

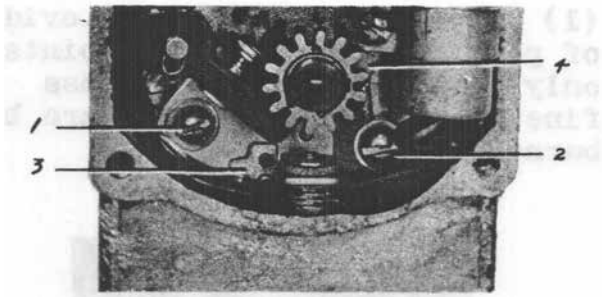


Fig.64 Magneto - Fairbanks-Morse

e. Lubrication, American Bosch
(Fig. 63)

- (1) Place two drops of light oil on the cam wick (3).
- (2) Lubrication of the remainder of the magneto requires special tools for disassembly and should not be attempted by the operator.

f. Lubrication, Fairbanks-Morse
(Fig. 64)

- (1) If the cam wick (4) is dry and hard, replace with new wick.

(2) Further lubrication of the magneto by the operator is not recommended.

g. Timing, American Bosch

- (1) Remove the distributor plate end cap.
- (2) Turn the distributor shaft in the opposite direction from its normal rotation until the arrow on the end of the shaft points to the center of cable outlet No. 1.
- (3) Crank the engine until piston No. 1 is at the top dead center position. This point is indicated by a mark on the flywheel.
- (4) Mount the magneto on the engine.
- (5) Loosen the impulse coupling adjustable drive and turn the magneto shaft until the points are just beginning to open.

(6) Tighten the impulse coupling and replace the end cap.

h. Timing, Fairbanks-Morse

- (1) Remove the distributor cap.
- (2) Turn the magneto shaft until the distributor rotor lines up with the projection on the inner wall of the end cap.
- (3) Replace the distributor cap.
- (4) Crank the engine until the No. 1 cylinder is at the top dead center position. This position is indicated by a mark on the flywheel.
- (5) Mount the magneto on the engine. Be careful not to disturb the setting of the magneto. If necessary loosen the impulse coupling connector and turn it until it is properly aligned.

6. CARBURETOR MAINTENANCE
All UNIVERSAL Marine Engines

covered by these instructions are supplied with Zenith marine type safety non-drip carburetors, except the V-8 models (See special V-8 instruction books.) With the exception of the following adjustments, maintenance of the carburetor by the operator is not recommended. If difficulties arise which are not correctable by the following adjustments, it is recommended that the carburetor be sent to the UNIVERSAL factory for repair or replacement.

a. Adjustment of Throttle Stop Screw, Idle Needle Valve and Main Jet

(1) Before any of the above adjustments to the carburetor are made, the engine should be operated for a sufficient length of time to reach operating temperature.

(2) With throttle in idling position, adjust the throttle stop screw for desired idling speed. See Fig. 65 and 66.

(3) Turn the idle needle valve in and out until the speed of the engine is steady and as fast as this throttle position will permit.

(4) Readjust the throttle stop screw for desired engine idling speed.

(5) Open the throttle approximately one-third.

(6) Loosen the packing nut on the main jet adjustment.

(7) Turn the main jet adjustment screw in until the engine speed is noticeably reduced.

(8) Turn the main jet adjustment screw out until the engine runs smoothly and as fast as this throttle position will permit.

(9) Hold the adjusting screw in place and tighten the packing nut.

(10) Return the throttle to idle position and readjust idle needle valve slightly for best idling performance.

b. Carburetor

The carburetors used on six cylinder gasoline marine engines are the Zenith updraft type with both idling and high-speed adjustments. Each has a large air entrance whose bowl shaped bottom acts as a drip collector with automatic drain.

A properly adjusted carburetor should be left alone.

If the fuel is free from dirt or other impurities, the carburetor should not clog or give trouble.

We recommend that a large size fuel strainer be inserted in the gasoline line between the fuel pump and carburetor to trap dirt and condensation.

Since a marine engine operates under more or less steady load conditions, it is comparatively easy to adjust the carburetor. To facilitate adjustment of the carburetor it is fitted with an idling jet "A", high speed jet "B", choke "C" and idling adjustment screw "D" as shown in Fig. 68.

When adjusting your carburetor, be sure that the flame arrestor is clean and free of obstructions, and that the choke "C" is wide open. Warm the engine up thoroughly before attempting the adjustment.

With the engine idling turn the idling jet "A" slowly to the right and left until the setting is found that will let the engine idle smoothly and as fast as that throttle setting will permit. Adjust the idling adjustment screw "D" to the