SECTION 4
IGNITION SYSTEM

TABLE OF CONTENTS

4

OMC
SPECIAL TOOLS REQUIRED

UNIVERSAL PULLER	PART NUMBER 378103
COIL LOCATING RING	PART NUMBER 317001
CRIMPING PLIERS	PART NUMBER 322696
INSERT TOOL	PART NUMBER 322697
PIN REMOVER	PART NUMBER 322698
SOCKET REMOVER	PART NUMBER 322699

SHOP AIDS

ISOPROPYL ALCOHOL OR ACETONE	OMC MOLY LUBE

TEST EQUIPMENT REQUIRED

JUMPER WIRES (4 REQUIRED)	C.D. VOLTMETER TESTER
	OR
SPARK TESTER	NEON TESTER
OHMMETER	C.D. IGNITION COIL TESTER
	TIMING LIGHT

DESCRIPTION

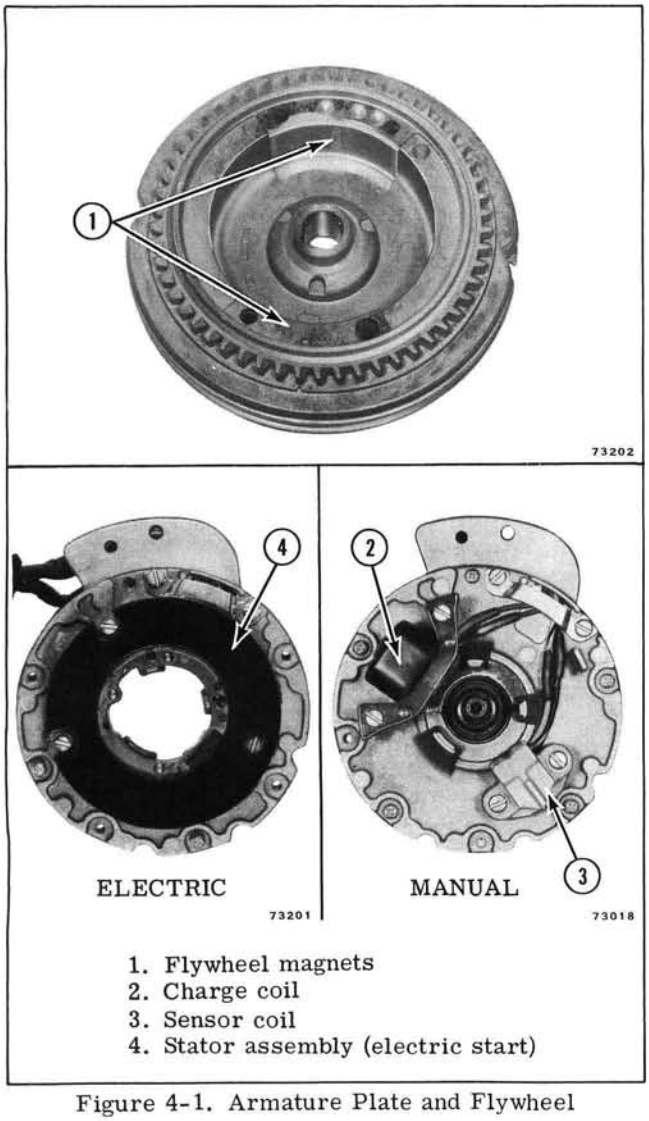
The magneto Capacitor Discharge (C.D.) Ignition System consists of five major components. They are:

1. Flywheel Assembly - Contains two magnets, cast into the flywheel 180 degrees apart. These magnets are magnetically charged of opposite polarity. See Figure 4-1.

2. Charge Coil Assembly - A large coil of wire which generates Alternating Current (A.C.) that is sent into the Power Pack. See Figure 4-1.

3. Sensor Assembly - A small coil of wire which generates the triggering voltage for the Power Pack. See Figure 4-1.

4. Power Pack Assembly (C.D.2) - Contains the electronic circuits necessary to produce ignition at the proper time:



1. Flywheel magnets
2. Charge coil
3. Sensor coil
4. Stator assembly (electric start)

Figure 4-1. Armature Plate and Flywheel

a. Capacitor Charge Circuit

b. Triggering Circuit

c. Capacitor Discharge (C.D.) Circuit

5. Ignition Coils - Generate the very high voltage required to ignite the fuel in each cylinder.

THEORY OF OPERATION

Simplified basic circuit illustrations support the theory of operation and are intended for instructional use only. The theory of operation and schematics for the Magneto Capacitor Discharge Ignition System use the following three basic electronic components:

DIODE - A component in which current can flow only in one direction (as indicated by the arrow).

GATE

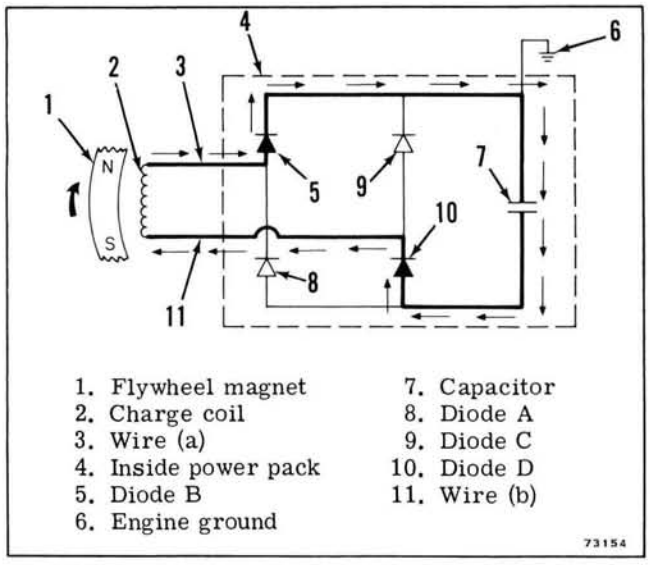
SILICON CONTROLLED RECTIFIER (S.C.R.) - A component (like a diode) in which current can flow through the S.C.R. only in one direction (as indicated by the arrow) and in which the current can flow only when the GATE of the S.C.R. receives a positive (+) input to trigger (or "turn-on") the S.C.R..

CAPACITOR - A component that stores voltage. One end of the capacitor is positive (+) and the other end is negative (-). The voltage is stored, until the trigger circuit is activated.

CAPACITOR CHARGE CIRCUIT (See Figure 4-2.)

As the flywheel is rotated, the magnetic field of a magnet passes through the charge coil winding, causing the charge coil to produce alternating current. Current flows from the charge coil through wire (a) which is positive (+), and enters the power pack, then flows through diode B which applies a positive (+) charge to the ground side of the capacitor. Current flow is blocked by diodes A and C. On the return path, current flows from the capacitor to the charge coil through diode D and wire (b).

When the opposite flywheel magnet passes by the charge coil, current flow is reversed, and wire (b) is positive (+). Current enters the power pack and flows through diode C which applies a positive (+) charge to the ground side of the capacitor. Current flow is blocked by diode B and bypasses diode D. On the return path, current flows from the capacitor to the charge coil through diode A and wire (a), and bypasses diode D.



1. Flywheel magnet
2. Charge coil
3. Wire (a)
4. Inside power pack
5. Diode B
6. Engine ground
7. Capacitor
8. Diode A
9. Diode C
10. Diode D
11. Wire (b)

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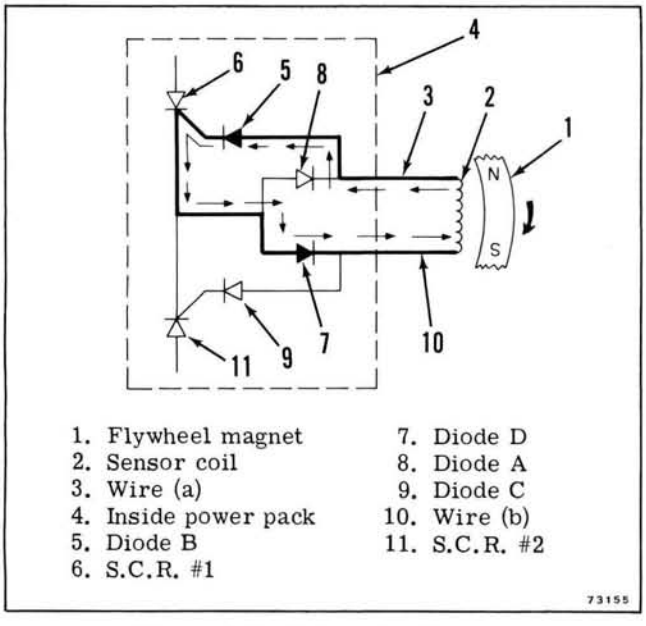
Figure 4-2. Capacitor Charge Circuit

Alternating current, from the charge coil, has been changed (rectified) into direct current for capacitor charge by the four diodes. The diodes maintain a positive (+) charge on the ground side of the capacitor, regardless of the constantly changing charge coil output.

TRIGGERING CIRCUIT (See Figure 4-3.)

The triggering circuit controls which S.C.R. will turn on and allow the capacitor to discharge. The sensor coil, located under the flywheel, produces the signal necessary to turn on the S.C.R. which controls the ignition timing.



1. Flywheel magnet
2. Sensor coil
3. Wire (a)
4. Inside power pack
5. Diode B
6. S.C.R. #1
7. Diode D
8. Diode A
9. Diode C
10. Wire (b)
11. S.C.R. #2

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Figure 4-3. Triggering Circuit

After the capacitor is charged, the flywheel continues to rotate so the magnetic field of a magnet passes through the sensor coil winding, producing alternating current.

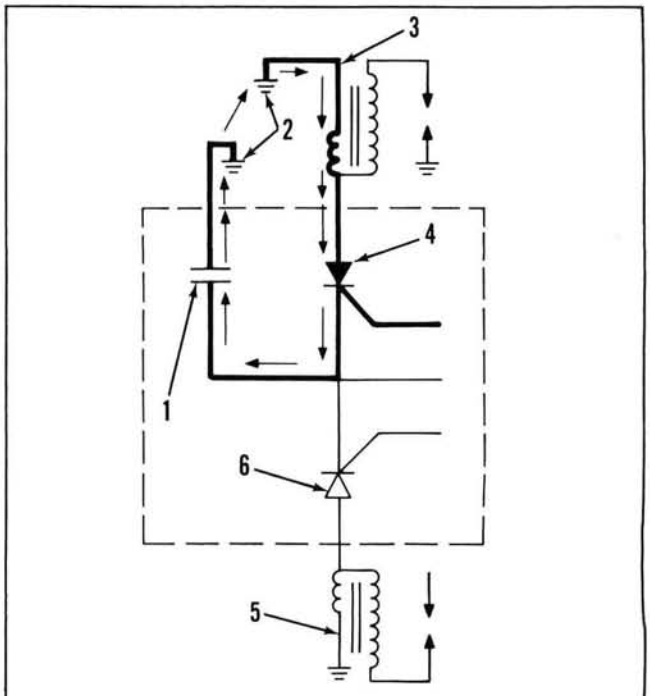
Current leaves the sensor coil through wire (a) which is positive (+), and enters the power pack. Current flows through diode B to the #1 S.C.R. gate, turning on S.C.R. #1 and returns to the other side of the sensor coil through diode D. Current flow is blocked by diodes A and C.

When the opposite flywheel magnet is passed by the sensor coil, current flow is reversed, and wire (b) is positive (+). Current enters the power pack and flows through diode C to the gate of S.C.R. #2 turning on S.C.R. #2 and returns to the other side of the sensor coil through diode A. Current flow is blocked by diodes B and bypasses diode D.

The four diodes in the triggering circuit direct current flow to the S.C.R. gates and back to the sensor.

CAPACITOR DISCHARGE (C.D.) CIRCUIT (See Figure 4-4.)

When S.C.R. #1 is triggered the positive (+) charge stored in the capacitor flows to engine ground, enters the No. 1 ignition coil through the grounded



1. Capacitor
2. Engine ground
3. No. 1 ignition coil
4. S.C.R. #1
5. No. 2 ignition coil
6. S.C.R. #2

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Figure 4-4. Capacitor Discharge Circuit

primary winding wire, and then flows through S.C.R. #1 to the other side of the capacitor.

During capacitor discharge, current flows through the ignition coil primary winding and S.C.R. #1 until the capacitor is discharged and S.C.R. #1 turns itself off. The capacitor can now be recharged as described in the capacitor charge circuit.

Current flowing through the No. 1 ignition coil primary winding produces a large magnetic field surrounding the secondary winding and produces the high voltage to the spark plug, igniting the fuel in the engine cylinder.

When S.C.R. #2 is triggered, the capacitor is discharged through the No. 2 ignition coil primary winding. Current flows through S.C.R. #2 and returns to the other side of the capacitor. The No. 2 ignition coil then produces the high voltage to the spark plug to ignite the fuel in the other cylinder.

IGNITION STOP/KILL CIRCUIT (See figure 4-5.)

Since the capacitor is the "heart" of the ignition system, the stop button is used to prevent capacitor charge. One end of the capacitor is connected to engine ground. The stop button, when closed, will connect the other end of the capacitor to engine ground. When both ends of the capacitor are connected to engine ground, current flow from the charge coil will by-pass the capacitor as shown in Figure 4-5. When the capacitor is not "charged," ignition cannot occur.

TROUBLESHOOTING THE C.D.2 SYSTEM

The magneto capacitor discharge ignition system is easy to troubleshoot. Remember these tips to obtain fast, accurate test results:

a. Visual Inspection - Check wiring for broken, pinched, or loose leads. Connectors should be securely fastened and free from moisture or water accumulation.

b. Test Equipment Condition - Be sure testers are in working order. Many hours can be wasted by replacing working components needlessly.

c. Follow Procedure - Troubleshooting can seem difficult if you vary your technique for each problem. Many times items in the system are overlooked because you "thought" you tested them. By following the same procedure each time you troubleshoot, all items in the ignition system are sure to be tested.

d. Test the Complete System - There may be occasions when more than one component is defective. If this condition is undetected, repeated ignition system failure may occur, or damage to replacement parts could result. Test everything.

TEST EQUIPMENT REQUIRED

a. Spark tester with the air gap adjusted to 1/2 inch (12 mm).

b. Neon test light - Model M-80 or S-80 with 1-1/2 volt battery adapter, or Model M-90 (no adapter required), or Stevens or Electro Specialties C.D. Voltmeter Tester. See Figure 4-6.

c. Ohmmeter - Capable of indicating low ohms (RX1) and high ohms (RX1,000).

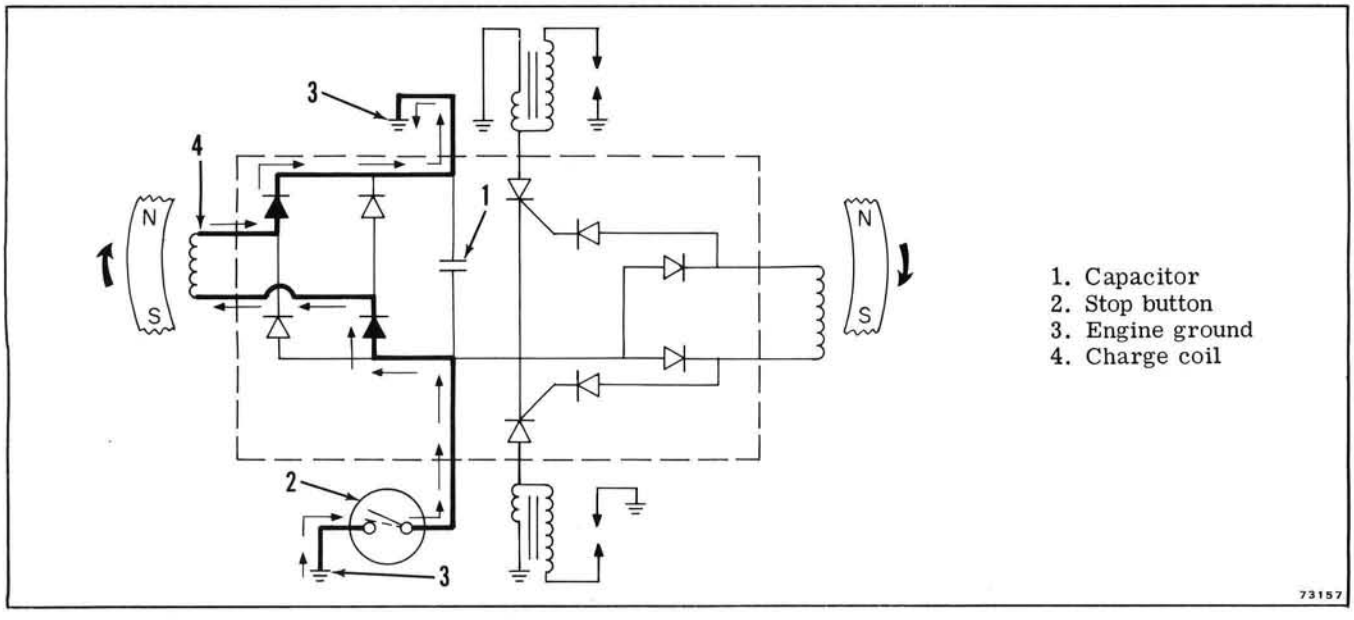
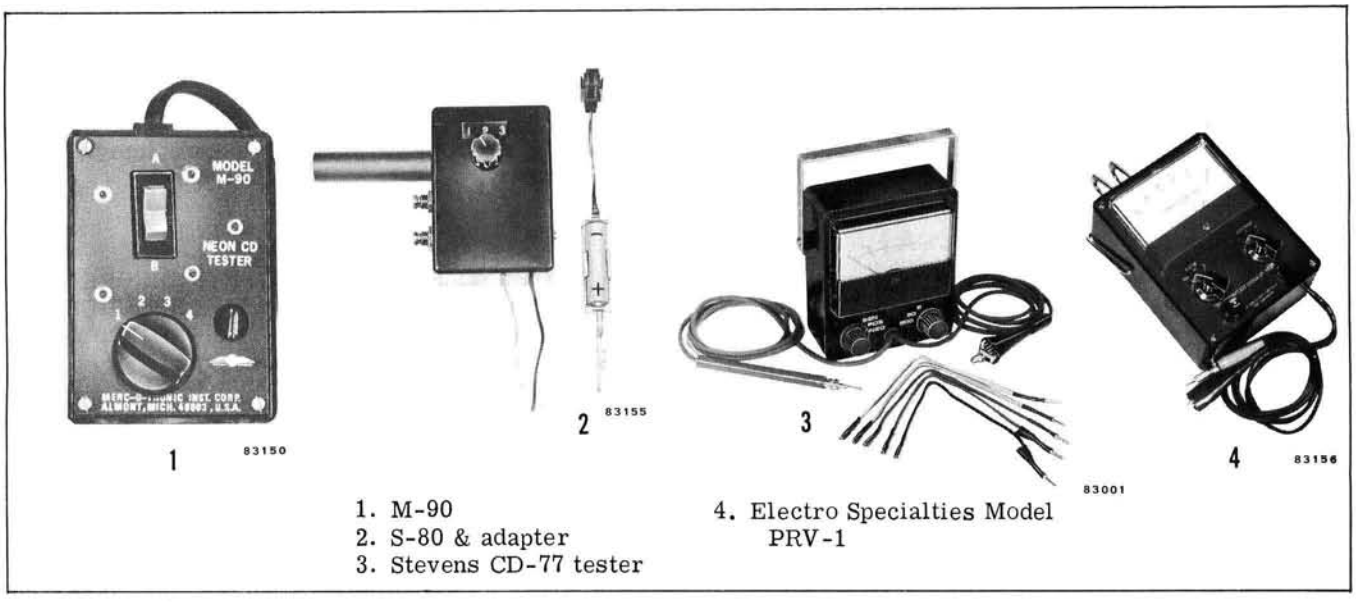


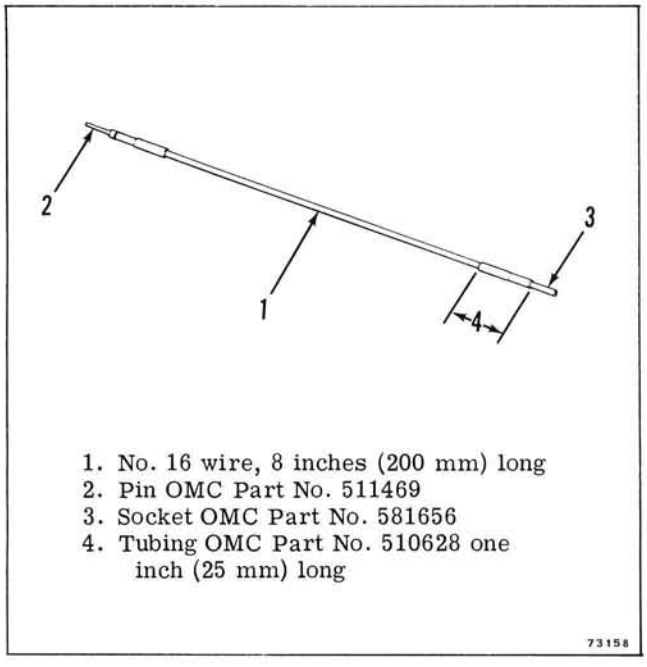
Figure 4-5. Ingition Stop/Kill Circuit



1. M-90
2. S-80 & adapter
3. Stevens CD-77 tester
4. Electro Specialties Model PRV-1

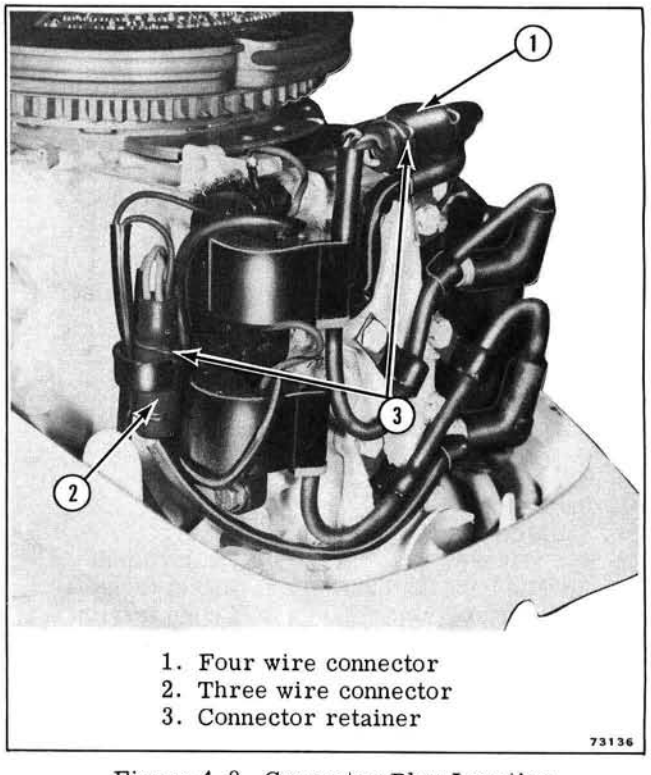
Figure 4-6. Ignition Testers

d. Jumper Wires (4 required). Jumper leads can be made as shown in Figure 4-7.



1. No. 16 wire, 8 inches (200 mm) long
2. Pin OMC Part No. 511469
3. Socket OMC Part No. 581656
4. Tubing OMC Part No. 510628 one inch (25 mm) long

Figure 4-7. Jumper Wires



1. Four wire connector
2. Three wire connector
3. Connector retainer

Figure 4-8. Connector Plug Location

CONNECTOR PLUGS

Two waterproof connectors, male and female plug-in type, are utilized in the ignition system. A four wire connector connects the charge coil and sensor coil leads to the power pack. The three wire connector connects the power pack leads to the ignition coils. See Figure 4-8. Each connector is secured by a retainer. The retainer must be removed to unplug the connector.

CONNECTOR TERMINAL REMOVAL

NOTE

Use the recommended lubricant for terminal removal. Substitutes may cause high resistance connections, short circuits between terminals, or have adverse effects on the connector material.

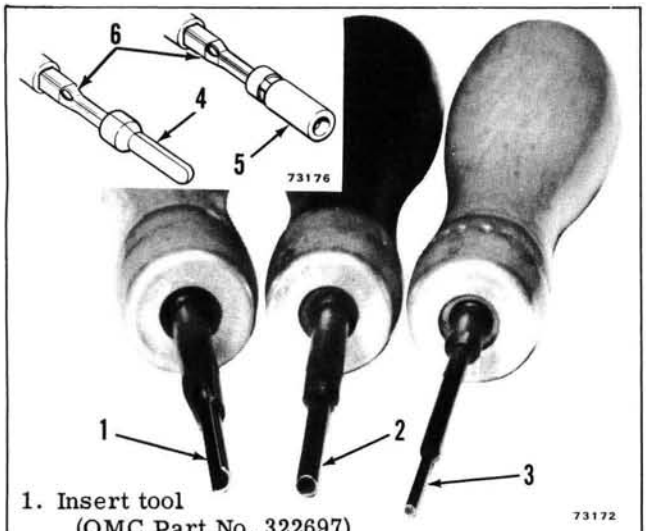
a. Apply Isopropyl alcohol or acetone into the connector cavity at both ends to lubricate the terminal and connector.

b. Place the connector against the edge of a flat surface and allow clearance for the terminal to be removed.

c. Select the proper removal tool for the terminal in the connector. See Figure 4-9.

d. Insert the removal tool onto the terminal and push the terminal from the connector. See Figure 4-10.

e. Pin and socket terminals may be replaced if damaged. Crimp new terminals onto the wire using OMC Crimping Pliers (Special Tool No. 322696). See Figure 4-9 for crimping locations. If crimping pliers are not available the terminals can be installed onto the wire using needle nose pliers, and then must be soldered to the wire to insure good electrical contact and security. No soldering is required when using the OMC Crimping Pliers.



1. Insert tool (OMC Part No. 322697)
2. Pin remover (OMC Part No. 322698)
3. Socket remover (OMC Part No. 322699)
4. Pin terminal
5. Socket terminal
6. Crimp terminal here

Figure 4-9. Tools for Connector Terminals

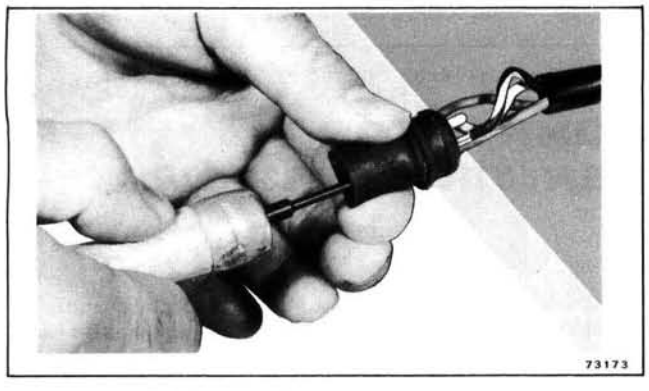


Figure 4-10. Removing Terminal from Connector

CONNECTOR TERMINAL INSTALLATION

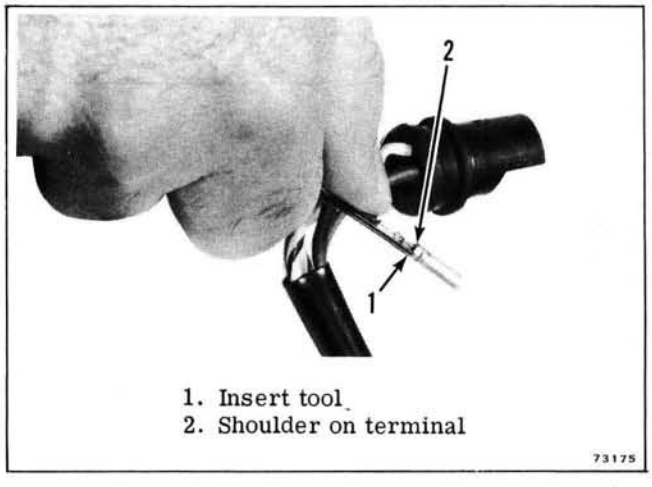
a. Apply Isopropyl alcohol or acetone into the connector cavity.

SAFETY WARNING

TO AVOID PERSONAL INJURY, SECURELY HOLD INSERT TOOL AGAINST SHOULDER OF TERMINAL WHILE INSTALLING TERMINALS INTO CONNECTOR CAVITY.

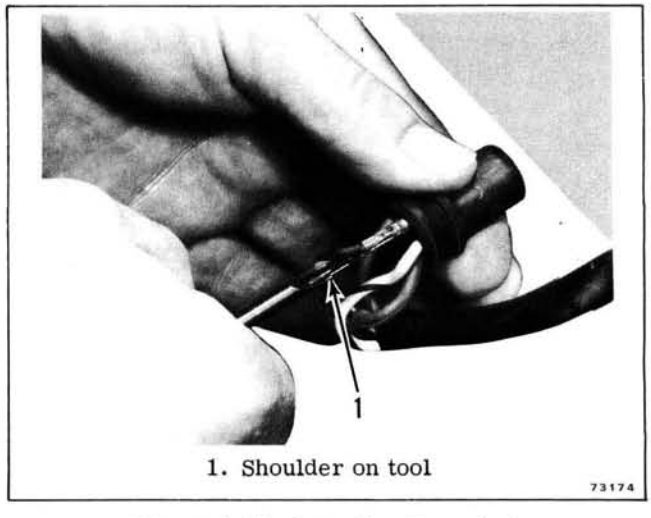
b. Position the insert tool against the shoulder of the terminal. See Figure 4-11.

c. Support the connector against a flat surface and push the terminal into the connector until the shoulder on the insert tool is at the end of the connector. See Figure 4-12.



1. Insert tool
2. Shoulder on terminal

Figure 4-11. Insert Tool on Terminal



1. Shoulder on tool

Figure 4-12. Inserting Terminal

IGNITION TEST PROCEDURE

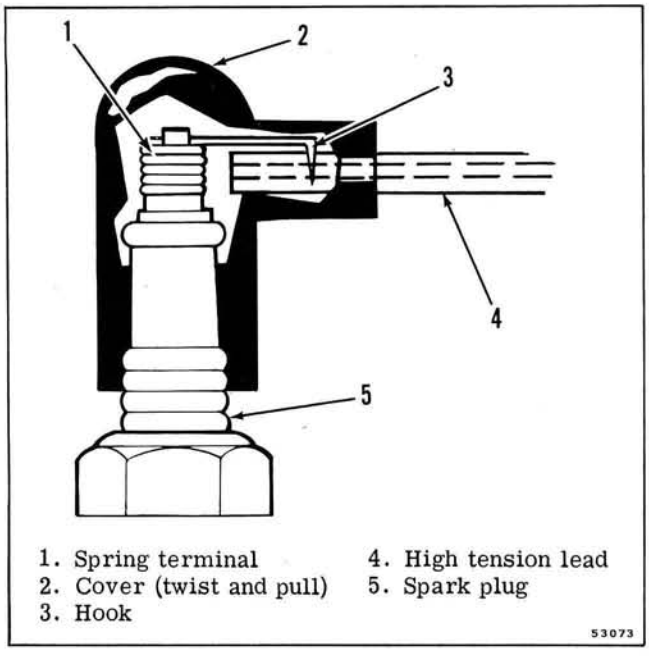
NOTE

Check the power pack ground wire to be sure it is clean and securely grounded before troubleshooting.

SPARK TEST

a. Remove the high tension lead from each spark plug. To prevent damage to the spring terminal on the high tension lead, twist and pull on the cover. See Figure 4-13.

b. Adjust the air gap of the spark tester to 1/2 inch (12 mm) and connect the tester leads to the high tension leads. Secure the other end of the spark tester to a clean engine ground. See Figure 4-14.



1. Spring terminal
2. Cover (twist and pull)
3. Hook
4. High tension lead
5. Spark plug

53073

Figure 4-13. Spark Plug Cover and Terminal

NOTE

To prevent possible arcing of high voltage, position the tester leads at least 2 inches (50 mm) from any metal surface.

SAFETY WARNING

THE SHOCK FROM THIS IGNITION SYSTEM IS SEVERE AND CAN DO SERIOUS PHYSICAL HARM. TO AVOID POSSIBLE SHOCK HAZARDS DO NOT HANDLE IGNITION COIL OR TESTER LEADS DURING THIS TEST.

c. Crank the engine and observe the results at the spark tester. On electric models, crank the engine by hand using an emergency starter rope.

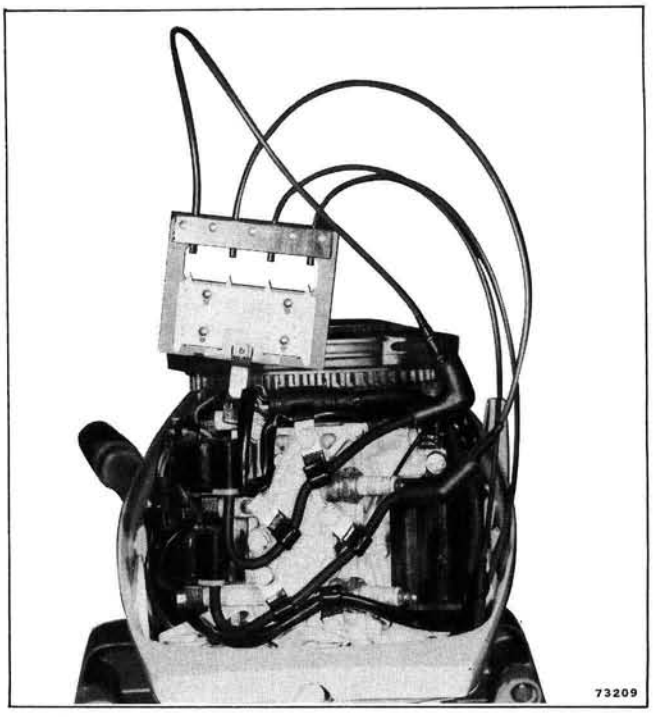


Figure 4-14. Spark Tester

If a spark jumps at both gaps, the ignition system is OK. Check the spark plugs, and other engine systems.

If there is no spark, or only a spark at just one gap, continue the troubleshooting procedure.

STOP BUTTON ELIMINATION TEST

a. Separate the three wire connector between the power pack and ignition coils. See Figure 4-15.

b. Insert a jumper wire between the "B" terminals of the three wire connector. See Figure 4-16.

c. Insert a jumper wire between the "C" terminals of the three wire connector.

SAFETY WARNING

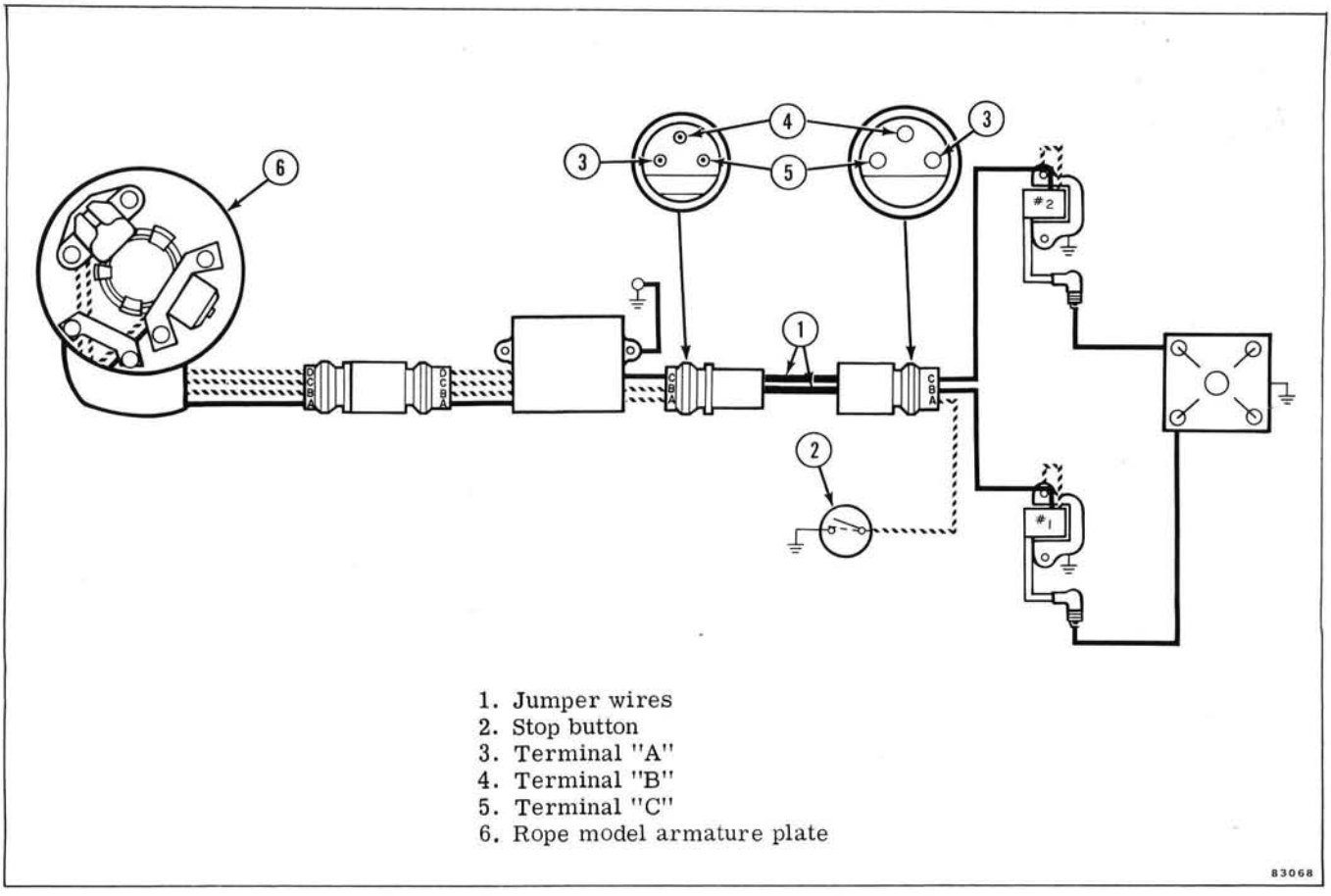
TO AVOID POSSIBLE SHOCK HAZARDS, DO NOT HANDLE IGNITION COIL OR TESTER LEADS DURING THE TEST.

d. Crank engine and observe the results at the spark tester. On electric starting models, crank the engine by hand using an emergency starter rope.

e. If a spark jumps at both gaps, the problem is in the stop button circuit. Refer to the stop button circuit test. If there is no spark, or a spark at only one gap, remove the jumper wires.

NOTE

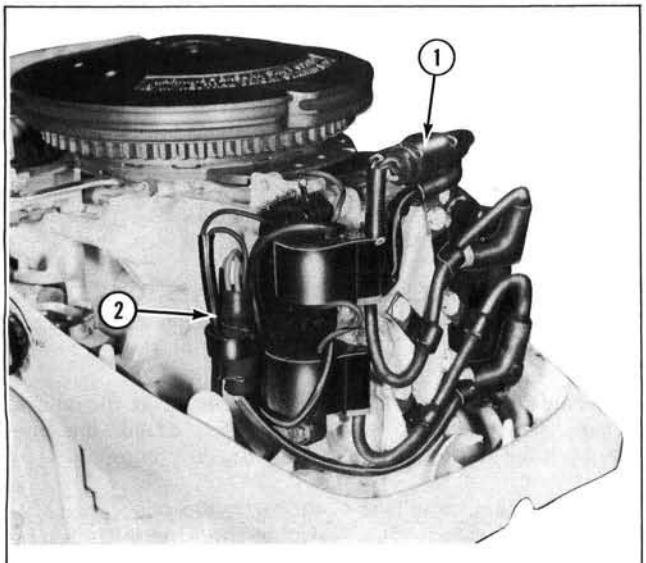
Carefully align the connector halves during assembly to insure proper terminal contact.



1. Jumper wires
2. Stop button
3. Terminal "A"
4. Terminal "B"
5. Terminal "C"
6. Rope model armature plate

83068

Figure 4-16. Stop Button Elimination Test



1. Four wire connector
2. Three wire connector

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Figure 4-15. Cable Connectors

f. Reconnect the three wire connector and continue troubleshooting procedure.

OHMMETER TESTS

Ohmmeter tests are necessary to determine if the sensor coil or charge coil have failed in a manner which could cause ignition failure.

NOTE

Resistance readings should be checked when the motor has completely cooled to ambient air temperature. The higher temperature, caused by running the motor, will increase the resistance reading and may result in unnecessary parts replacement.

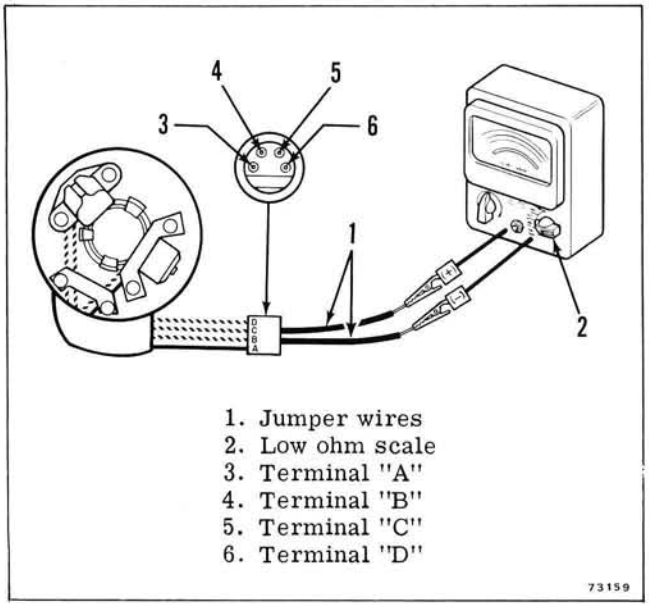
Sensor Coil Test (Ohmmeter)

a. Separate the four wire connector between the armature plate and power pack. See Figure 4-15.

b. Insert a jumper wire to terminal "B" in the armature plate end of the connector. See Figure 4-17.

c. Insert a jumper wire to terminal "C" in the armature plate end of the connector. See Figure 4-17.

d. To test the resistance, connect an ohmmeter (calibrated on low ohm scale) between the two jumper wires. The sensor coil resistance is good if the meter indicates 40 ± 10 ohms. Replace the sensor coil if the resistance reading is not within this range. See Figure 4-17.



1. Jumper wires
2. Low ohm scale
3. Terminal "A"
4. Terminal "B"
5. Terminal "C"
6. Terminal "D"

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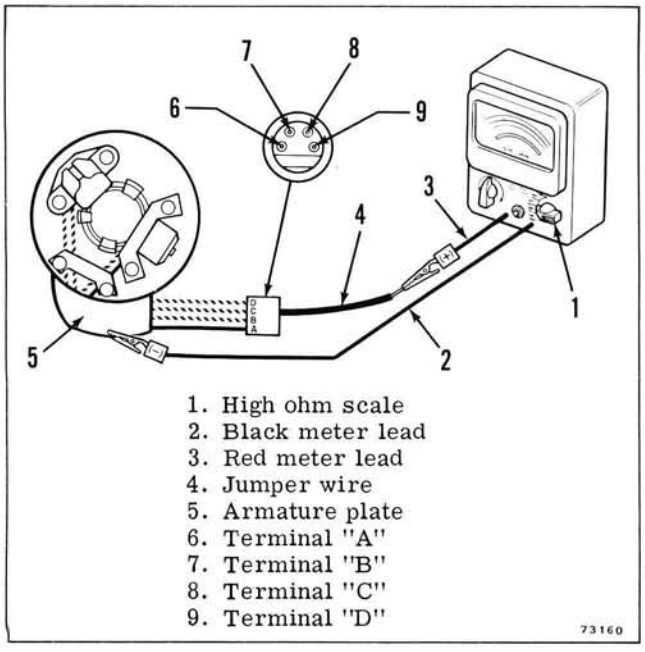
Figure 4-17. Sensor Coil Resistance



1. High ohm scale
2. Black meter lead
3. Red meter lead
4. Jumper wire
5. Armature plate
6. Terminal "A"
7. Terminal "B"
8. Terminal "C"
9. Terminal "D"

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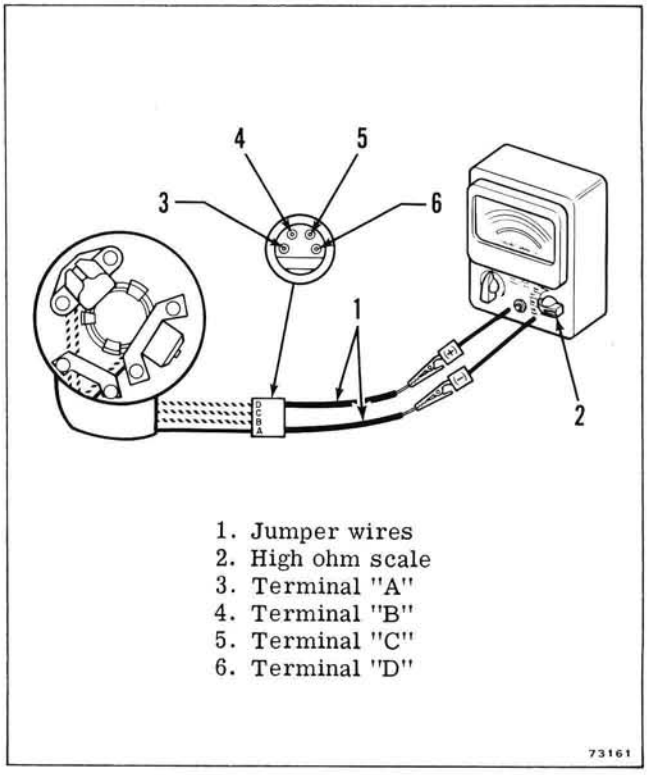
Figure 4-18. Sensor Coil Shorts to Ground

e. To test for shorts to ground, calibrate the ohmmeter to high ohm scale. Connect the black meter lead (-) to the armature plate (ground). Attach the red meter lead (+) to the "C" terminal jumper wire in the connector, then to the "B" terminal. See Figure 4-18. Any needle movement indicates the sensor coil or leads are shorted to ground. A shorted sensor must be replaced, or the grounded lead repaired to remove the shorted condition.



1. Jumper wires
2. High ohm scale
3. Terminal "A"
4. Terminal "B"
5. Terminal "C"
6. Terminal "D"

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Figure 4-19. Charge Coil Resistance

f. Remove the jumper wires from the connector and continue the troubleshooting procedure.

Charge Coil Test (Ohmmeter)

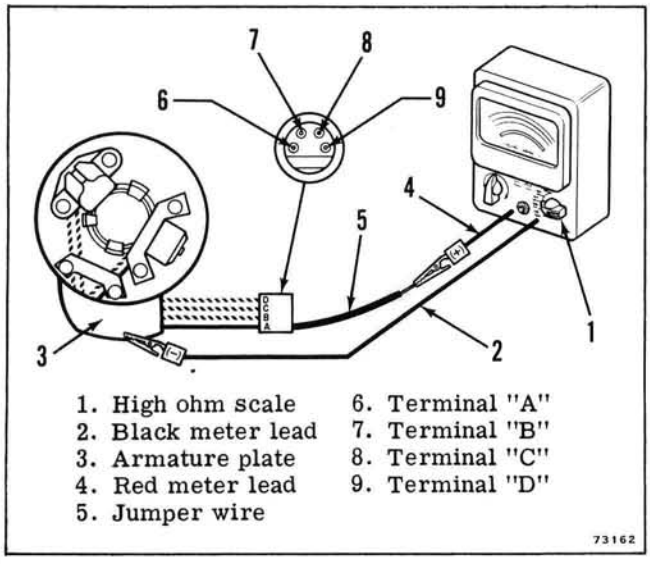
a. Insert a jumper wire to terminal "A" in the armature plate end of the connector. See Figure 4-19.

b. Insert a jumper wire to terminal "D" in the armature plate end of the connector. See Figure 4-19.

c. To test the resistance, connect an ohmmeter (calibrated to high ohm scale) between the two jumper wires. The charge coil resistance is good if the needle indicates 575 ± 75 ohms. See Figure 4-19. For electric starting models, resistance should be 475 ± 75 ohms. See Figure 4-19.

d. To test for shorts to ground, calibrate the ohmmeter to high ohm scale. Connect the black meter lead (-) to the armature plate (ground). Attach the red meter lead (+) to the "A" terminal jumper wire in the connector. See Figure 4-20. Any needle movement indicates the charge coil or leads are shorted to ground. A shorted charge coil must be replaced, or the grounded lead repaired to remove the shorted condition. On electric models, if charge coil is shorted, stator must be replaced.

e. Do not remove the jumper wires from the connector, and continue the troubleshooting procedure.



1. High ohm scale
2. Black meter lead
3. Armature plate
4. Red meter lead
5. Jumper wire
6. Terminal "A"
7. Terminal "B"
8. Terminal "C"
9. Terminal "D"

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Figure 4-20. Charge Coil Shorts to Ground

IGNITION SYSTEM TESTS USING NEON TESTER

CHARGE COIL OUTPUT TEST

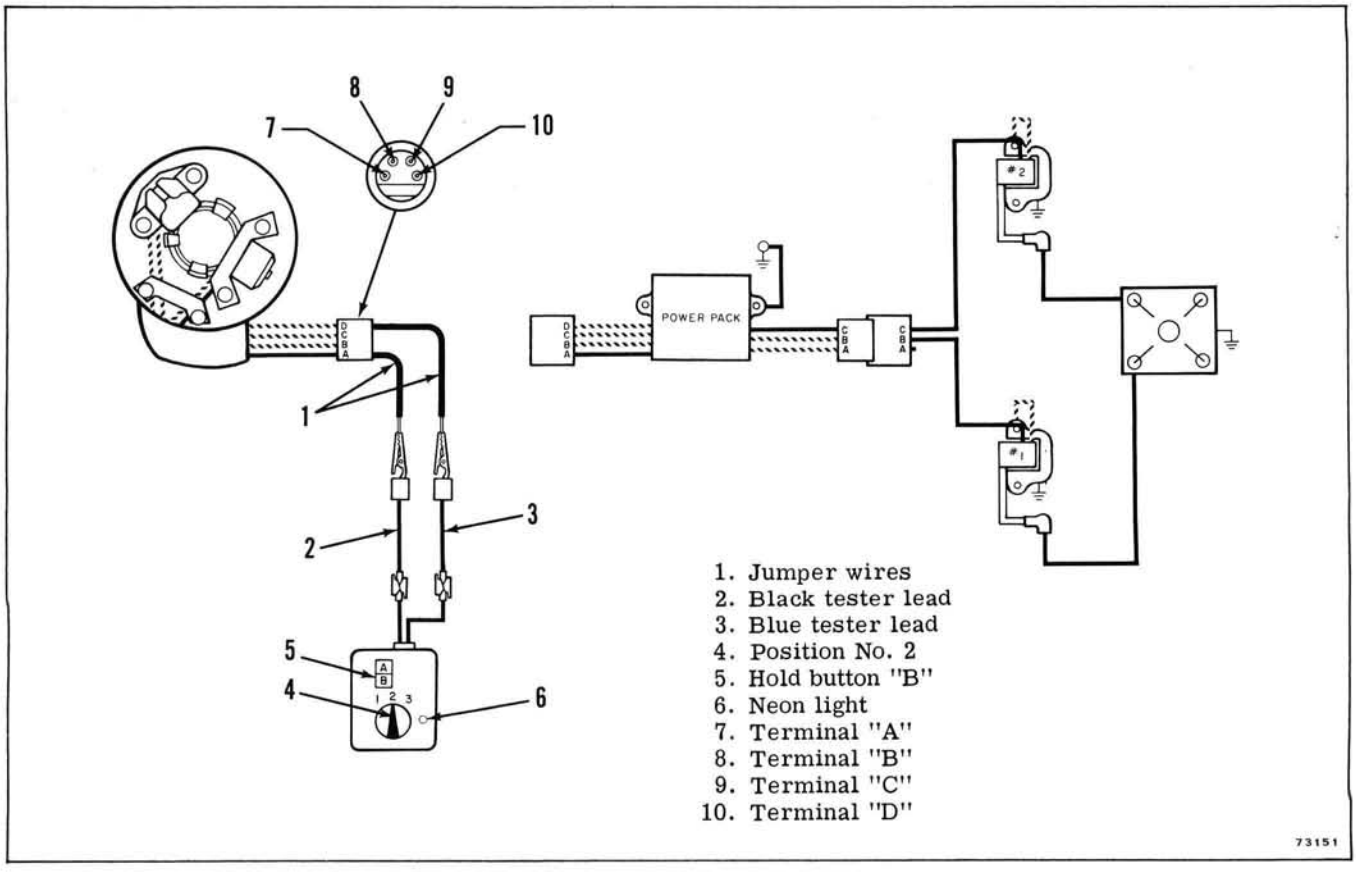
a. Insert a jumper wire to terminal "A" and terminal "D" in the armature plate end, of the four wire connector. See Figure 4-21.

b. Connect the neon tester leads to the jumper wires as shown. See Figure 4-21.

c. Set neon tester switch to position number 2.

d. While holding load button "B" depressed, crank the engine using the starter rope, and observe the light in the neon tester. If the neon light flashes, the charge coil is good. If there is no light, replace the charge coil and repeat the charge coil output test.

e. Continue the troubleshooting procedure.



1. Jumper wires
2. Black tester lead
3. Blue tester lead
4. Position No. 2
5. Hold button "B"
6. Neon light
7. Terminal "A"
8. Terminal "B"
9. Terminal "C"
10. Terminal "D"

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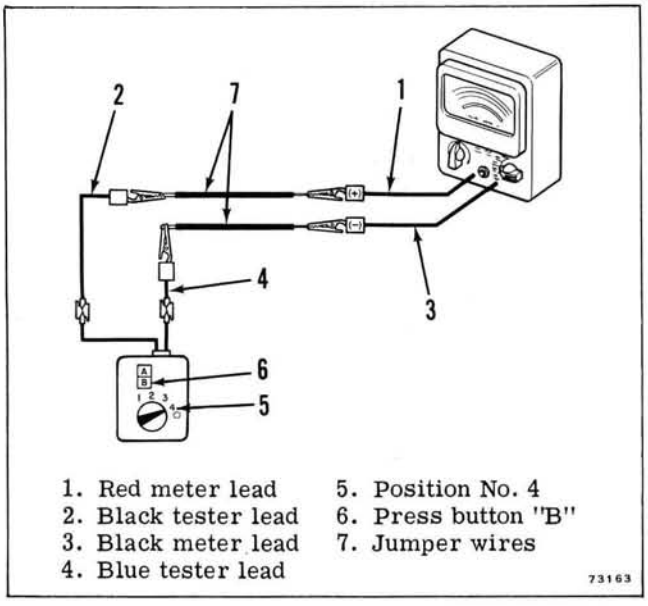
Figure 4-21. Charge Coil Output Test

TRIGGER INPUT TEST

Check neon tester battery voltage as follows:

a. Model M-90 - Connect voltmeter as shown in Figure 4-22. Set switch to position 4, and press load button "B." Battery voltage should be a minimum of 2-1/2 volts.

b. Model M-80 or S-80 - Connect the 1-1/2 volt battery adapter to the neon tester black lead with (-) negative end toward the neon tester, and connect the voltmeter as shown in Figure 4-23. Set switch to position 3, and press load button "B." Battery voltage should be a minimum of 2-1/2 volts.



1. Red meter lead
2. Black tester lead
3. Black meter lead
4. Blue tester lead
5. Position No. 4
6. Press button "B"
7. Jumper wires

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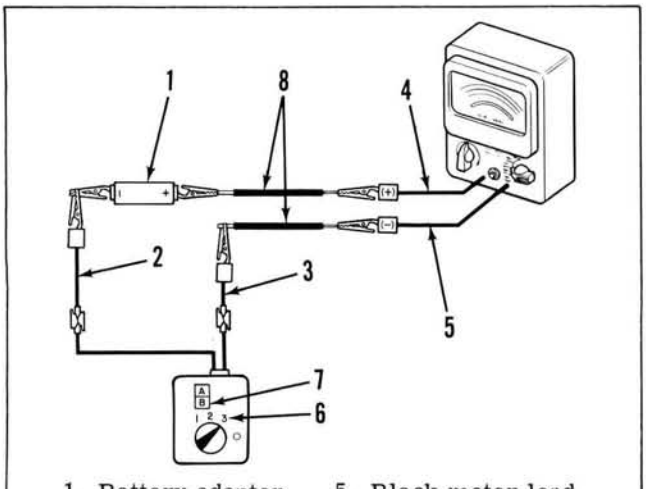
Figure 4-22. M-90 Neon Tester



1. Battery adapter
2. Black tester lead
3. Blue tester lead
4. Red meter lead
5. Black meter lead
6. Position No. 3
7. Press button "B"
8. Jumper wires

73164

Figure 4-23. M-80 or S-80 Neon Tester

c. Insert a jumper wire between the "A" terminals of both four wire connectors. See Figure 4-24.

d. Insert a jumper wire between the "D" terminals of both four wire connectors. See Figure 4-24.

SAFETY WARNING

TO AVOID POSSIBLE SHOCK HAZARDS, DO NOT TOUCH THE TERMINAL ENDS OF THE JUMPER WIRES WHILE MAKING CONNECTIONS TO THE POWER PACK, OR WHEN CRANKING THE ENGINE.

e. Attach a jumper wire to the blue lead of the neon tester, then insert the jumper wire to terminal "B" in the power pack end of the four wire connector. See Figure 4-24.

f. Connect a jumper wire to the positive (+) side of the battery adapter, (on M-90 neon testers, connect the jumper wire directly to the black lead of the tester), and insert the jumper wire to terminal "C" in the power pack end of the four wire connectors. See Figure 4-24.

g. Set M-80 or S-80 neon tester switch to position number 3 or set M-90 neon tester switch to position number 4.

h. Crank the engine with the starter rope and tap load button "B." When load button "B" is pressed, spark should jump at the gap of the spark tester connected to No. 2 ignition coil only. See Figure 4-24. If a spark occurs at both gaps of the spark tester during this test, replace the power pack.

i. Reverse the jumper wires on terminals "B" and "C" in the power pack end of the four wire connector, and repeat step h. to fire No. 1 ignition coil. If a spark occurred during each "trigger input test," the sensor coil is defective. If there was no spark, or a spark occurred on one "trigger input test" but not the other, continue the troubleshooting procedure.

NOTE

Carefully align the connector halves during assembly to insure proper terminal contact. Isopropyl alcohol may be used as a lubricant to ease assembly of the connector.

j. Remove the jumper wires and reconnect the four wire connector.

NOTE

Perform IGNITION COIL OHMMETER TEST prior to the POWER PACK OUTPUT TEST.

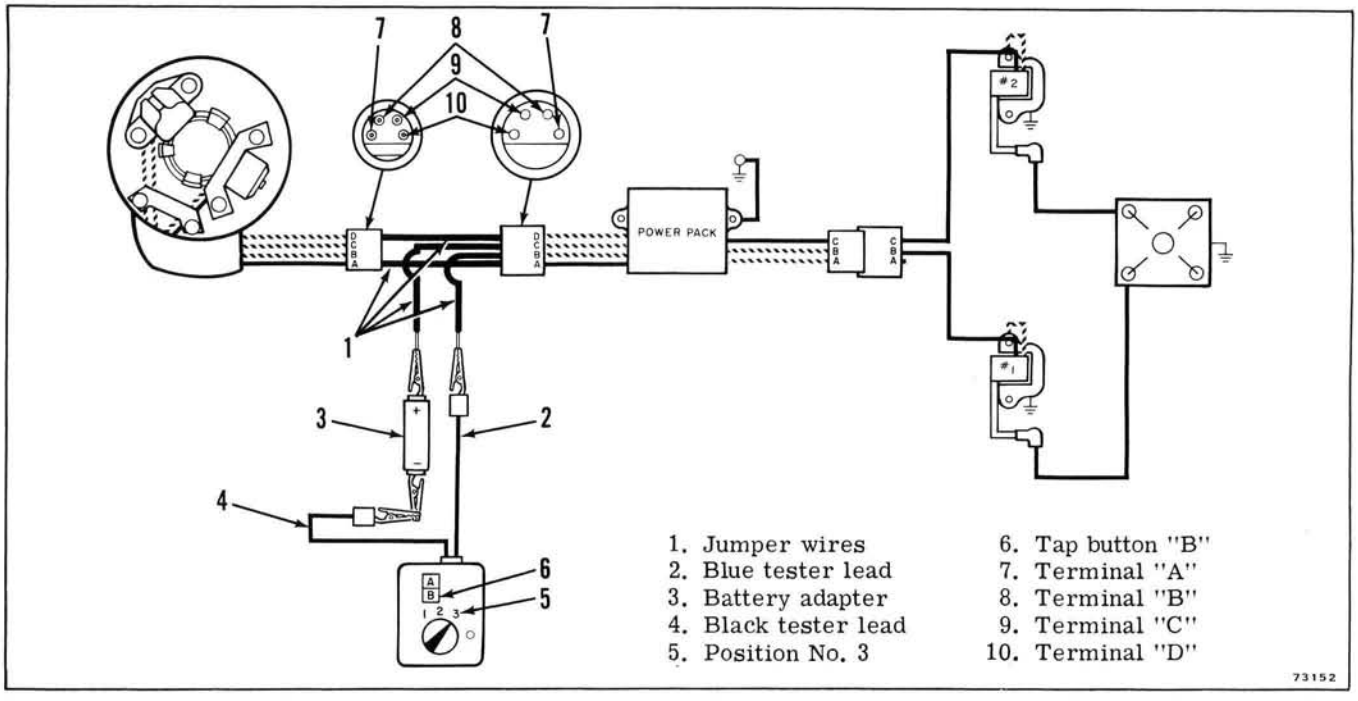


Figure 4-24. Trigger Input Test

POWER PACK OUTPUT TEST

a. Separate the three wire connector between the power pack and ignition coils.

b. Insert a jumper between the "C" terminals of both three wire connectors. See Figure 4-25.

c. Connect the neon tester blue lead to a clean engine ground.

d. Connect a jumper wire to the neon tester black lead, and insert the jumper wire to terminal "B" in the power pack end of the connector. See Figure 4-25.

e. Set the neon tester switch to position number 1.

f. While holding load button "A" depressed, crank engine with the starter rope, and observe the light in the neon tester.

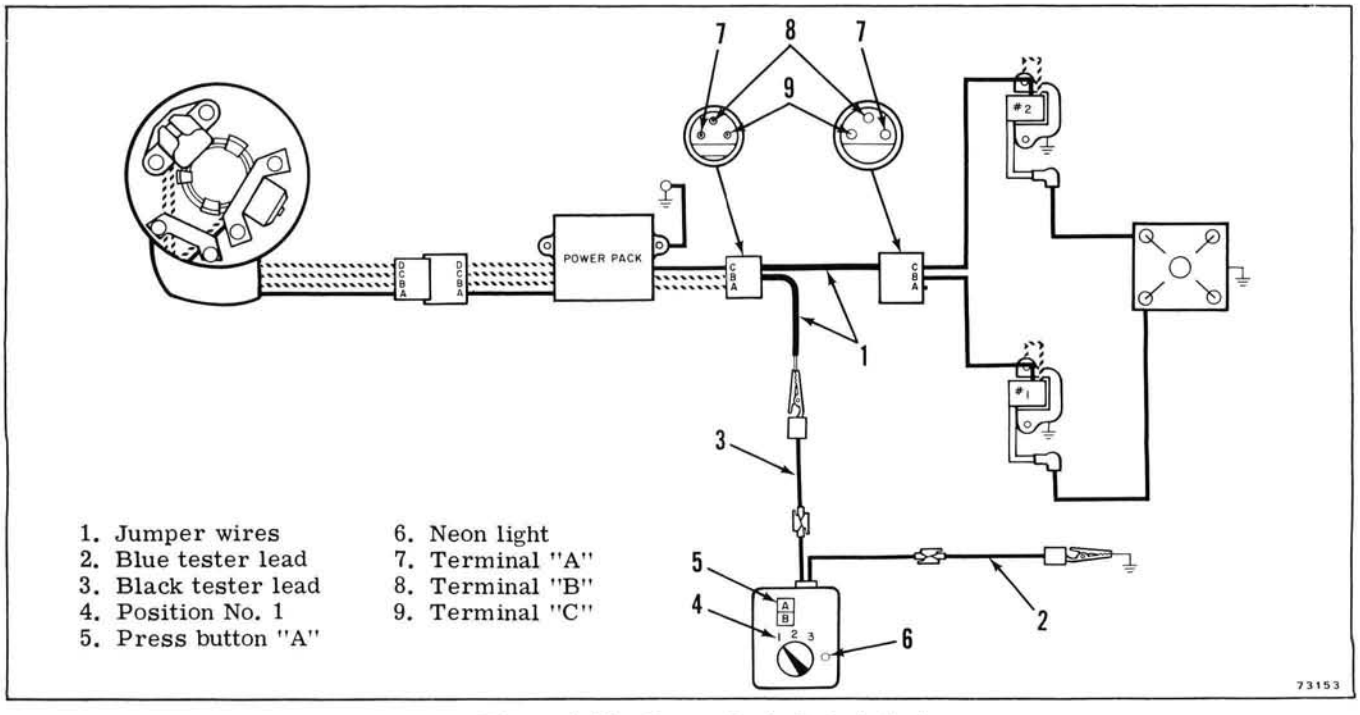


Figure 4-25. Power Pack Output Test

g. Reverse the jumper wires between terminals "B" and "C" in the power pack end of the connector. See Figure 4-25.

h. While holding load button "A" depressed, crank engine with the starter rope and observe the light in the neon tester. If neon light flashes on each output test, the power pack is good. Check the ignition coils. If the neon light does not flash, or flashes on only one output test, replace the power pack, and repeat the power pack output test.

Power Pack CD2 can be substituted with a known good pack. (Be sure power pack ground lead is securely grounded to the power head.)

i. Check all wires and terminals for proper location and secure the connectors with retaining clamps.

IGNITION SYSTEM TESTS USING CD VOLTMETER TESTER

NOTE

Before conducting these tests be sure to do the Spark Test, Stop Button Elimination Test and the Ohmmeter Tests starting on Page 4-8.

CHARGE COIL OUTPUT

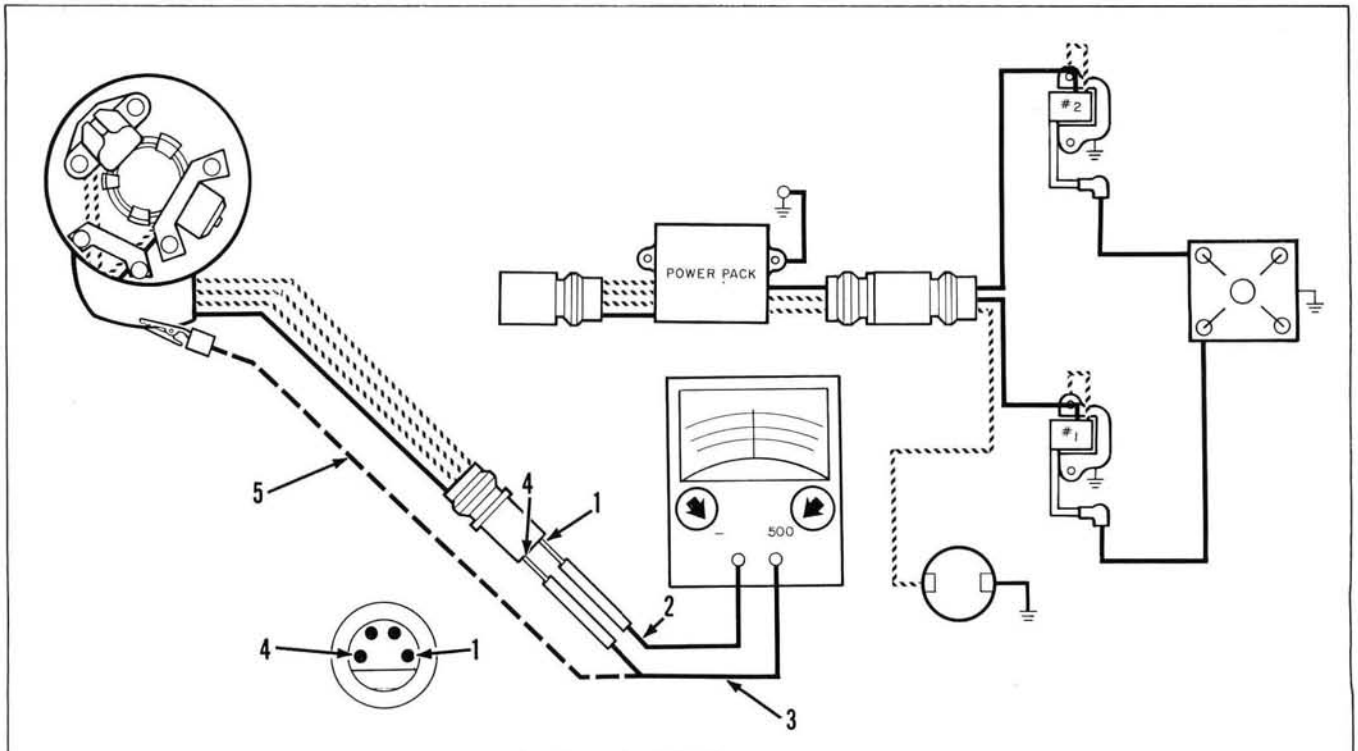
Set meter switches to negative and 500. Disconnect four wire connector between armature plate and power pack. Insert meter red lead probe into cavity "A" of four wire connector from armature plate. Insert meter black lead probe into cavity "D" of four wire connector. See Figure 4-26. Crank engine.

a. Meter reading 230 or higher. Go to Sensor Coil Output Test.

b. No reading, check for short to ground.

c. Low reading, check resistance of charge coil. If resistance does not meet specifications, replace charge coil.

To check for short to ground, set meter to negative (-) and 500. Remove black meter lead from cavity "D" and ground to armature plate ground. See Figure 4-26. Crank engine and observe meter. Remove lead from cavity "D" and insert into cavity "A." Crank engine and observe meter. Any reading on either test means charge coil is shorted to ground. Locate short and repair or replace charge coil.



1. Terminal "D"
2. Red meter lead
3. Black meter lead
4. Terminal "A"
5. Test for shorting to ground

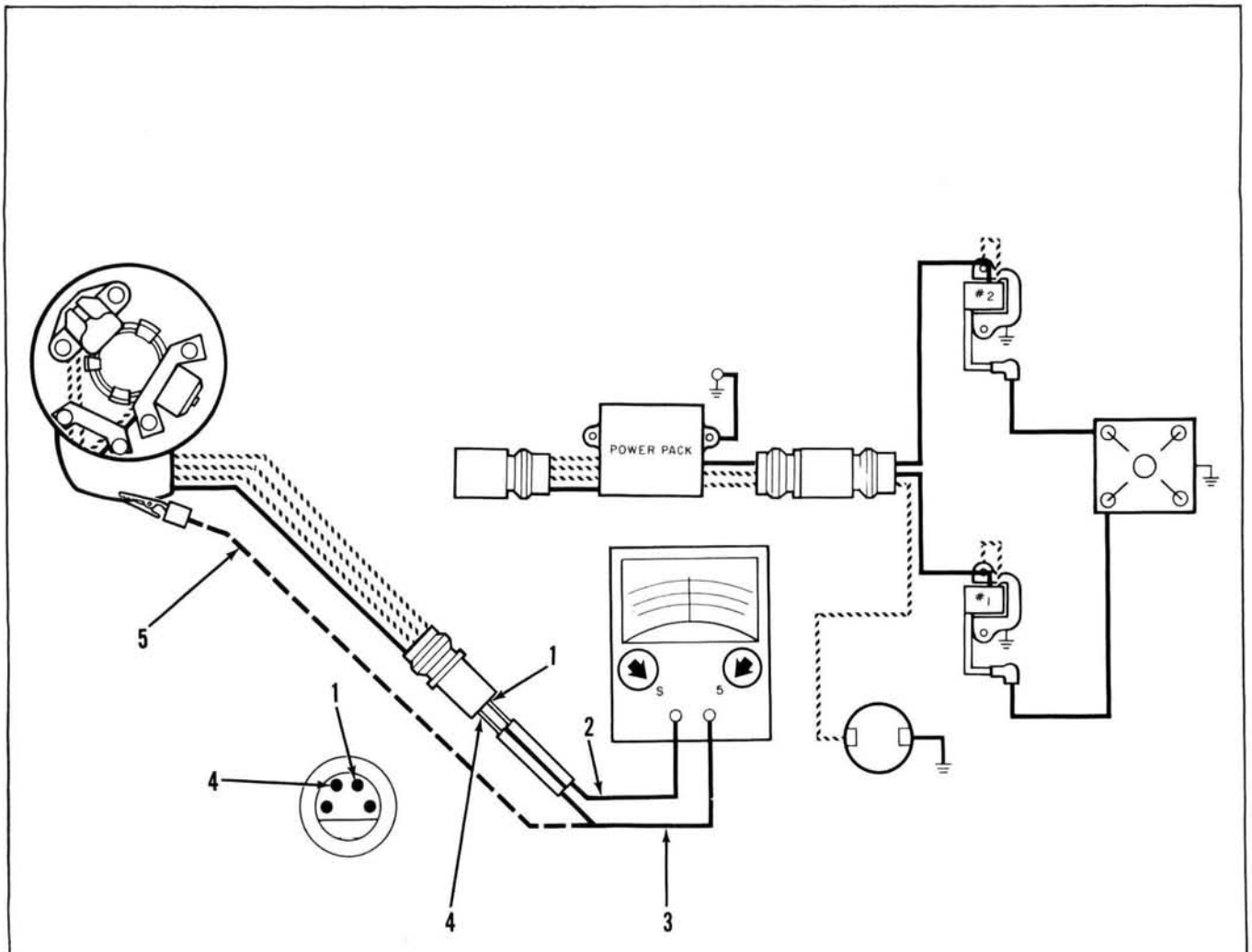
83078

Figure 4-26. Charge Coil Tests

SENSOR COIL OUTPUT TEST

Set meter switches to "S" and 5. Insert meter black lead probe into cavity "B" of four wire connector from armature plate. Insert meter red lead probe into cavity "C" of four wire connector from armature plate. See Figure 4-27. Crank engine. Observe meter reading - reverse meter leads, crank engine. Meter should indicate 0.3 or higher. No or low reading, on either check sensor coil for shorts to ground.

To check for shorts to ground, remove black meter lead from cavity "B" and ground to armature plate. See Figure 4-27. Crank engine and observe meter. Remove lead from cavity "C" and insert into cavity "B." Crank engine and observe meter. Any reading on either test means sensor coil is shorted to ground. Locate short and repair or replace sensor coil.



1. Terminal "C"
2. Red meter lead
3. Black meter lead
4. Terminal "B"
5. Test for shorts to ground

83079

Figure 4-27. Sensor Coil Tests

EJ10/15

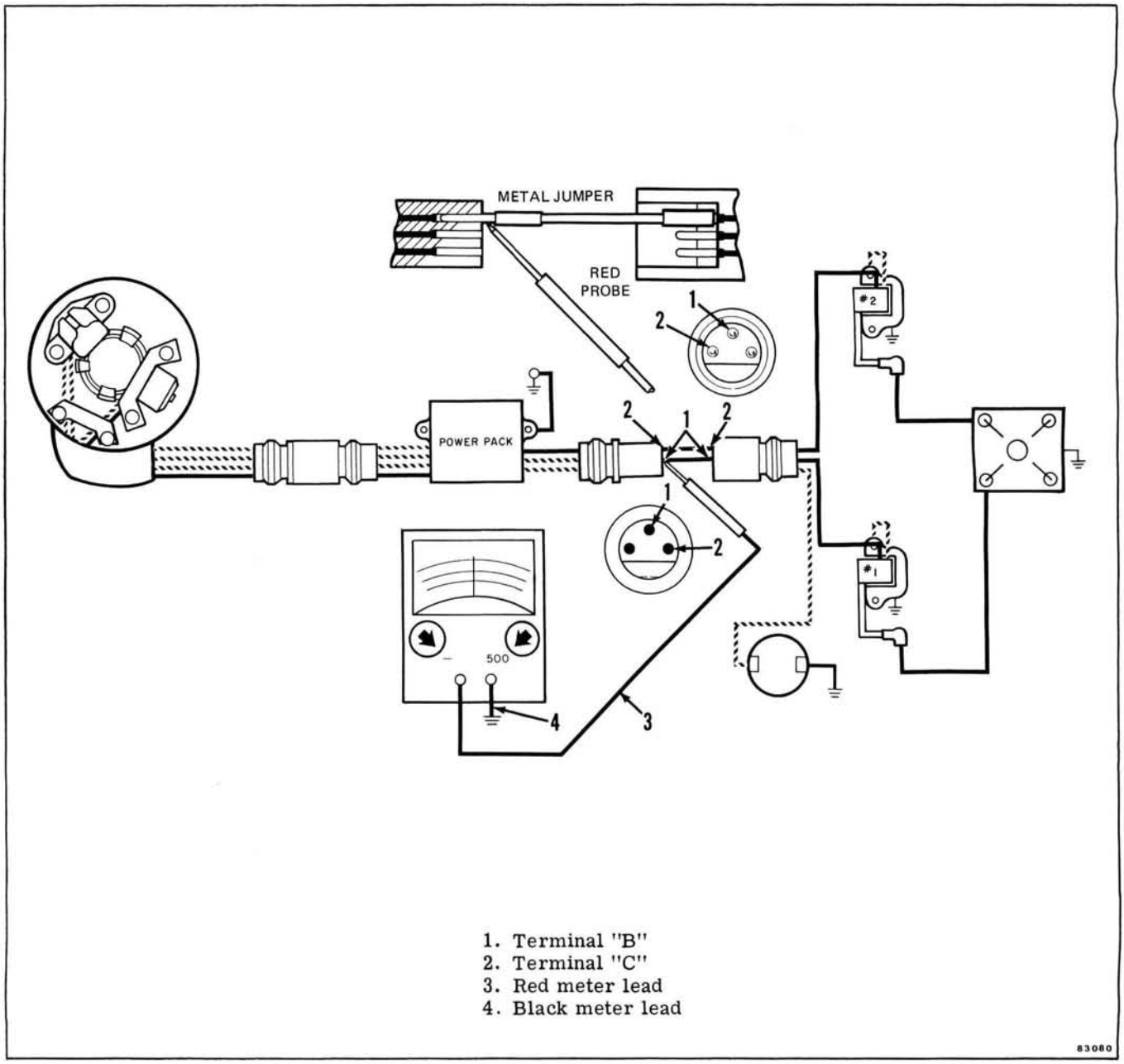
POWER PACK OUTPUT

Set meter switches to negative and 500. Disconnect three wire connector between power pack and ignition coils. Insert jumper leads between "B" terminals of connectors and between "C" terminals. See Figure 4-28. Connect meter black lead to engine ground. Connect meter red lead to metal part of jumper lead coming from power pack cavity "B." Crank engine. Observe meter reading. Connect meter red lead to metal part of jumper lead cavity "C." Crank engine. Observe meter reading.

a. If meter reads 180 or higher, check ignition coil, or coils.

b. If meter does not read 180 or higher on one output, remove jumper lead from that cavity of connector from power pack. Insert meter red lead into that cavity. Crank engine: If meter reads 180 or higher, ignition coil is defective. If meter does not read 180 or higher, power pack is defective.

c. If meter does not read on both outputs, power pack is defective.



1. Terminal "B"
2. Terminal "C"
3. Red meter lead
4. Black meter lead

Figure 4-28. Power Pack Output Test

IGNITION COIL TESTS

OHMMETER TEST

Resistance tests may be performed while the ignition coil is still mounted to the power head.

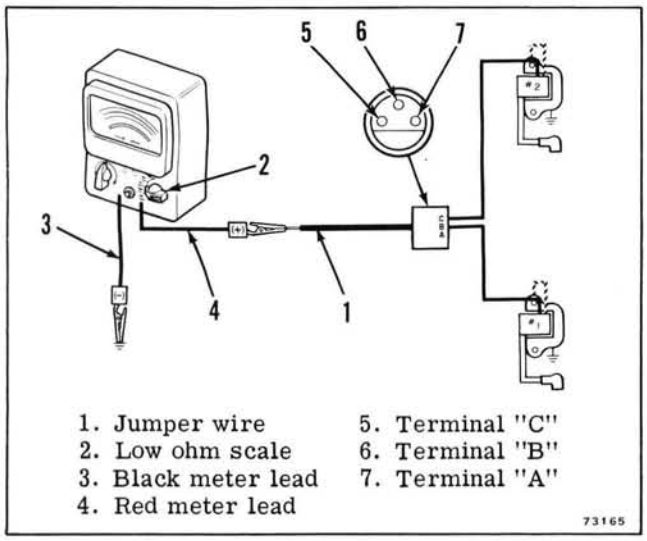
a. Remove the high tension lead from the spark plug.

b. Separate the three wire connector between the power pack and ignition coils.

c. Insert a jumper wire into the "B" terminal on the ignition coil end of the three wire connector. See Figure 4-29.

d. Calibrate an ohmmeter to low ohm scale, then connect the black meter lead (-) to a clean engine ground, and the red meter lead (+) to the "B" terminal jumper wire. See Figure 4-29.

e. Resistance of the primary winding should be 0.1 ± 0.05 ohms.



1. Jumper wire
2. Low ohm scale
3. Black meter lead
4. Red meter lead
5. Terminal "C"
6. Terminal "B"
7. Terminal "A"

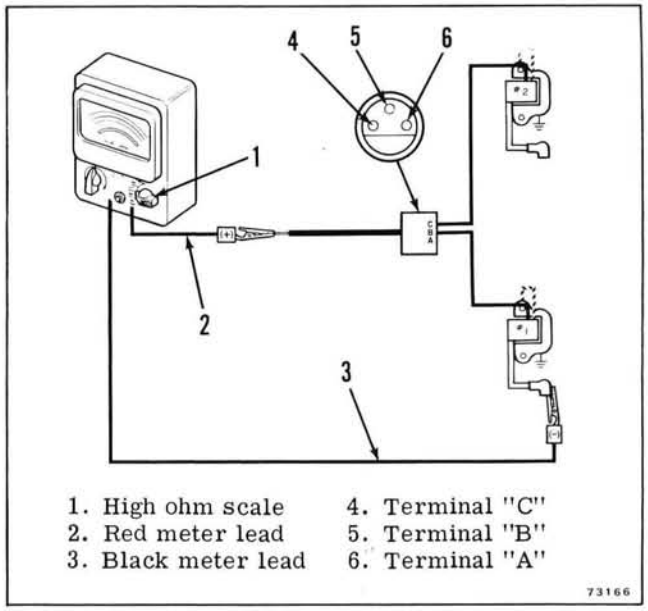
73165

Figure 4-29. Primary Winding Resistance

f. Calibrate the ohmmeter to high ohm scale, then connect the meter red lead (+) to the "B" terminal jumper wire. Connect the meter black lead (-) to the terminal inside the high tension lead cover. See Figure 4-30.

g. Resistance of the secondary winding should be 275 ± 25 ohms. Replace the ignition coil if the reading is other than specified.

h. To test No. 2 ignition coil, repeat the above procedure using terminal "C" in the three wire connector.



1. High ohm scale
2. Red meter lead
3. Black meter lead
4. Terminal "C"
5. Terminal "B"
6. Terminal "A"

73166

Figure 4-30. Secondary Winding Resistance

POWER TEST

A wide variety of ignition testers are available from various manufacturers. In addition, some automotive testers having the proper specifications can be used. The use of the Graham, Merc-O-Tronic, or Stevens ignition tester is recommended.

Detailed instructions for the use of any tester are provided with the unit; therefore, only general information is given here. See Coil Specifications, Section 2.

IGNITION COIL TESTING (IGNITION COIL MUST BE REMOVED FROM POWER HEAD FOR POWER AND LEAKAGE TESTING).

SAFETY WARNING

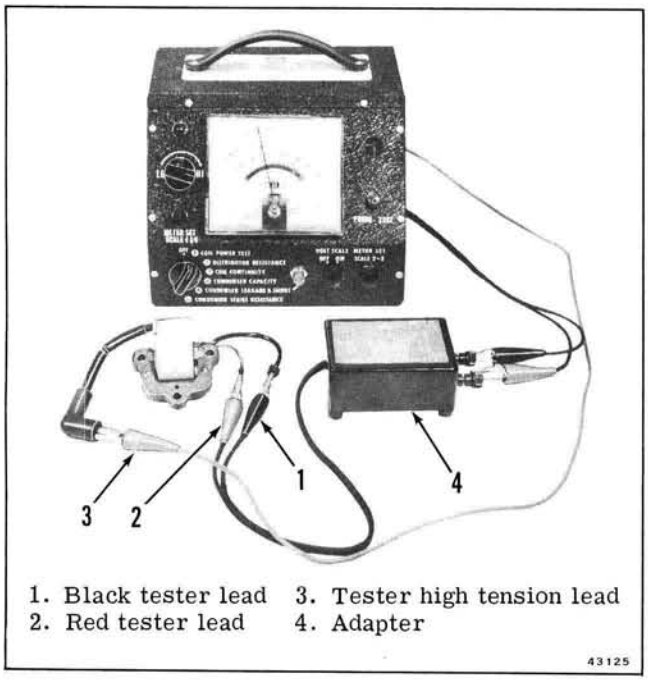
TO AVOID POSSIBLE SHOCK HAZARDS AND TO PREVENT LEAKAGE, PERFORM ALL TESTS TO THE COIL ON A WOODEN OR INSULATED BENCH TOP.

If the ignition coil is good, the tester's meter will fall within the good area, with the primary circuit adjusted as specified. Connect the test leads from the ignition tester to the coil.

Connect the black lead of the tester to the orange lead of the ignition coil and the tester's red lead to the coils orange/black stripe ground lead. Connect the high tension lead of the tester to the high tension lead (secondary) of the ignition coil. With the tester set to coil index (or operating amperage - Merc-O-Tronic illustrated) adjusted as specified, note meter reading. See Figure 4-31. A low reading on the tester indicates a weak coil which must be replaced. A dead coil will show no reading.

LEAKAGE TEST

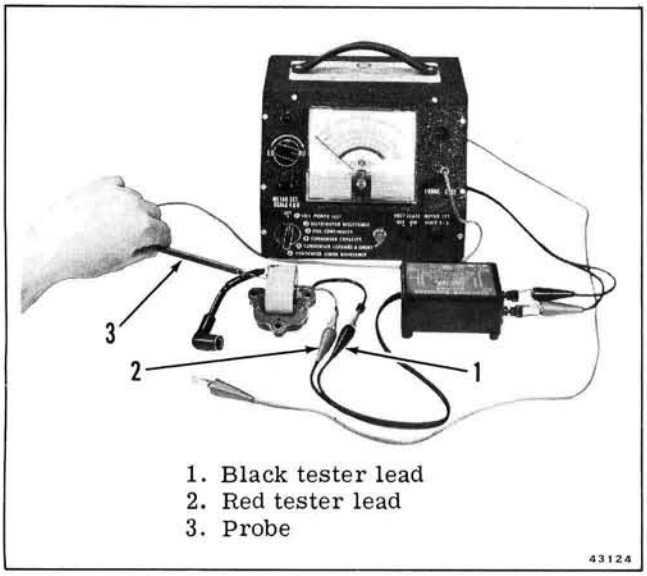
Ignition coil and high tension leads may be tested for leakage or insulation failures using the ignition analyzer. Leakage is caused by moisture, cracks in the coil housing or carbon paths. Connect the coil to the ignition tester per manufacturer instructions. Probe entire surface of the coil and high tension leads, flashover will be apparent wherever insulation has broken down. Replace any coil which shows leakage. See Figure 4-32. (High tension lead must be disconnected from tester.)



1. Black tester lead
2. Red tester lead
3. Tester high tension lead
4. Adapter

43125

Figure 4-31. Coil Power Test



1. Black tester lead
2. Red tester lead
3. Probe

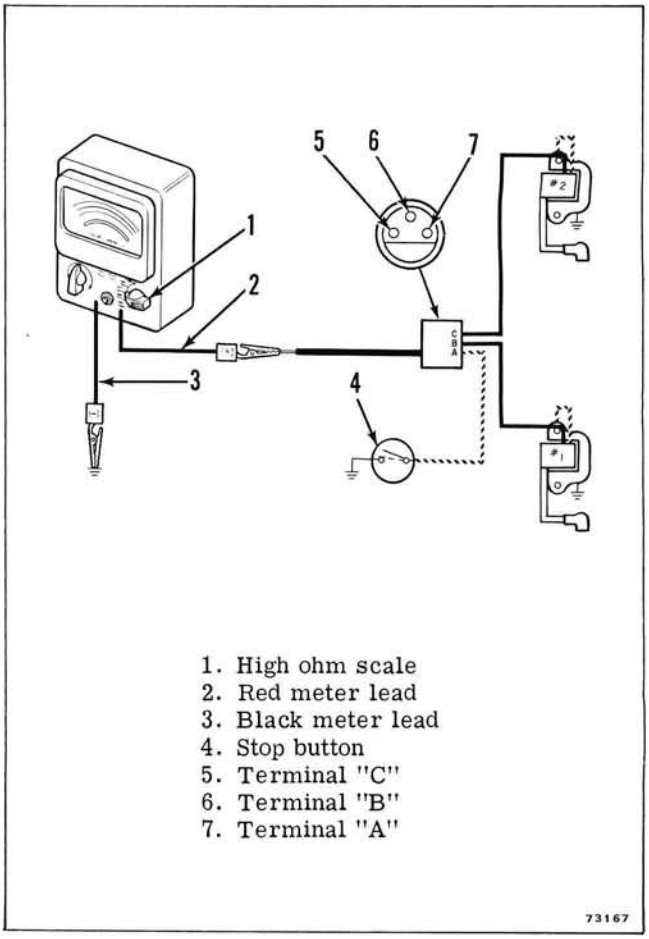
43124

Figure 4-32. Coil Leakage Test

STOP BUTTON CIRCUIT TEST

a. Separate the three wire connector between the power pack and ignition coils.

b. Calibrate the ohmmeter to high ohms scale. Connect the meter red lead (+) to the "A" terminal in the ignition coil end of the connector, and the meter black lead (-) to a clean engine ground. See Figure 4-33.



1. High ohm scale
2. Red meter lead
3. Black meter lead
4. Stop button
5. Terminal "C"
6. Terminal "B"
7. Terminal "A"

73167

Figure 4-33. Stop Button Circuit Test

c. The meter should indicate open circuit (∞). If there is any needle movement, replace the stop switch and lead assembly.

d. Push the stop button. The meter should indicate a closed circuit (0).

IGNITION TIMING

It is possible for the ignition system to produce a good spark and yet the engine will not start. If the engine "pops" or "backfires" during starting attempts, the ignition timing could be 180 degrees off. Check the following:

a. Sensor Wire Positioning - On the four wire connector between the armature plate and power pack be sure the white/black stripe wire is located in the "B" terminal of both connector halves.

b. Ignition Coil Wire Positioning - Check the three wire connector to be sure the No. 1 (TOP) ignition coil orange wire is in terminal "B" of connector, and that it mates with the orange/blue stripe wire from the power pack.

No timing adjustments are necessary. Correct wire positioning in the three and four wire connectors is all that is required to maintain proper ignition timing.

FLYWHEEL REMOVAL

SAFETY WARNING

TO PREVENT POSSIBLE PERSONAL INJURY, OR ACCIDENTAL STARTING OF MOTOR, SEPARATE THE FOUR WIRE CABLE CONNECTOR BETWEEN THE ARMATURE PLATE AND POWER PACK. SEE FIGURE 4-8.

a. Remove the flywheel nut using a strap wrench or other suitable tool to hold the flywheel. See Figure 4-34.

b. To remove the flywheel install OMC Universal Puller (Special Tool No. 378103) to the flywheel and tighten the center bolt. See Figure 4-35.

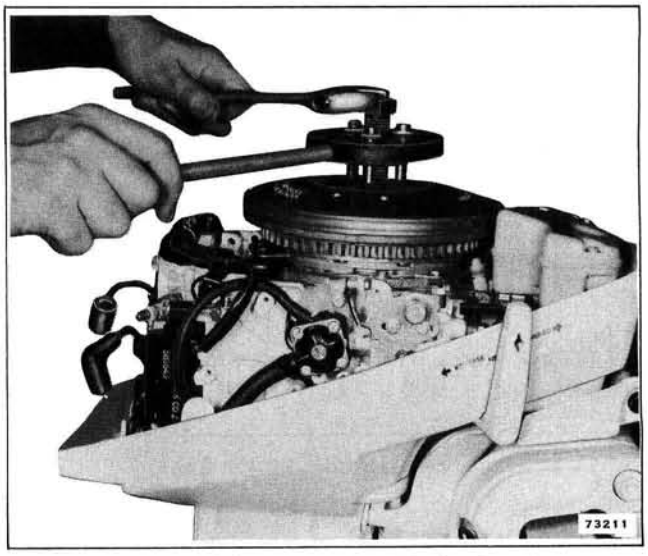


Figure 4-34. Removing Flywheel Nut

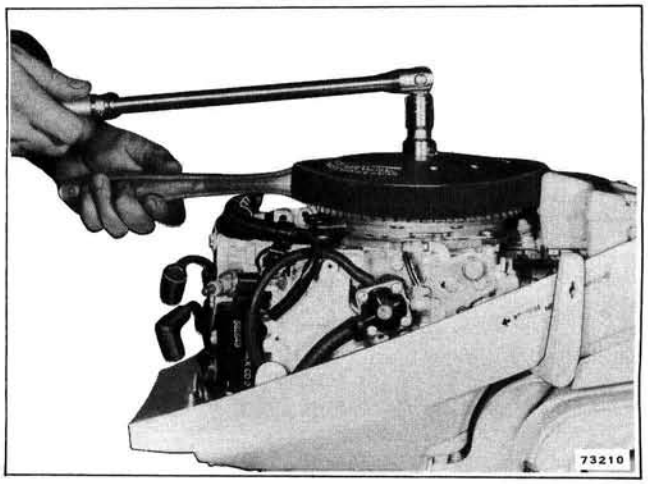


Figure 4-35. Removing Flywheel

NOTE

The flywheel may not "pop" from the crankshaft taper when tightening the puller bolt. To "pop" the flywheel, use a heavy plastic mallet and tap the top outside diameter of the flywheel or puller. Do not hit the center bolt to remove the flywheel.

FLYWHEEL INSTALLATION

a. Clean the crankshaft and flywheel tapers with solvent and blow dry with compressed air. These surfaces must be clean and dry to allow proper locking of the tapers.

b. Install the flywheel and tighten the nut to the torque specified in Section 2.

NOTE

Carefully align the connector halves during assembly to insure proper terminal contact.

c. Reconnect the four wire cable connector between the armature plate and power pack and secure it with the retainer.

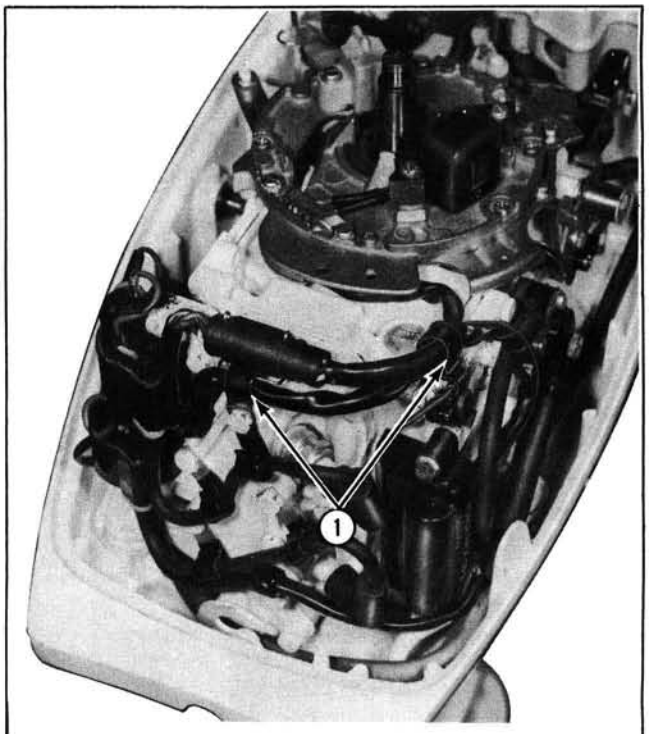
ARMATURE PLATE REMOVAL

a. Remove the flywheel. (Refer to Flywheel Removal.)

b. Remove the armature plate leads from the two support clamps. See Figure 4-36, view A (manual start). On electric starting models remove three armature plate leads from the terminal board. See Figure 4-36, view B.

c. Loosen the screws attaching the armature plate to the retainer plate and lift the armature plate from the power head. See Figure 4-37, view A (manual start) and view B (electric start).

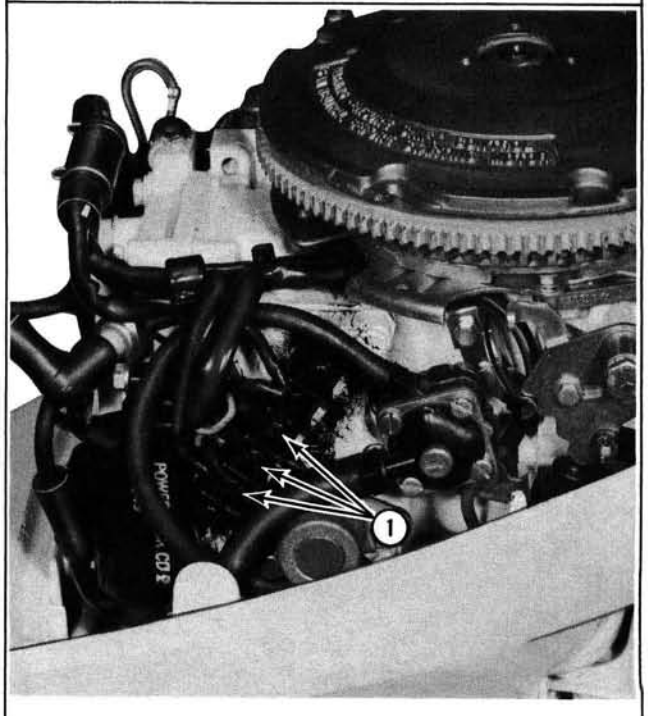
d. The retainer plate and support plate may be removed (if necessary for servicing) by disconnecting the throttle lever to armature plate link, then removing the screws from the support plate. See Figure 4-38.



1. Support clamps

VIEW A - MANUAL START

73206

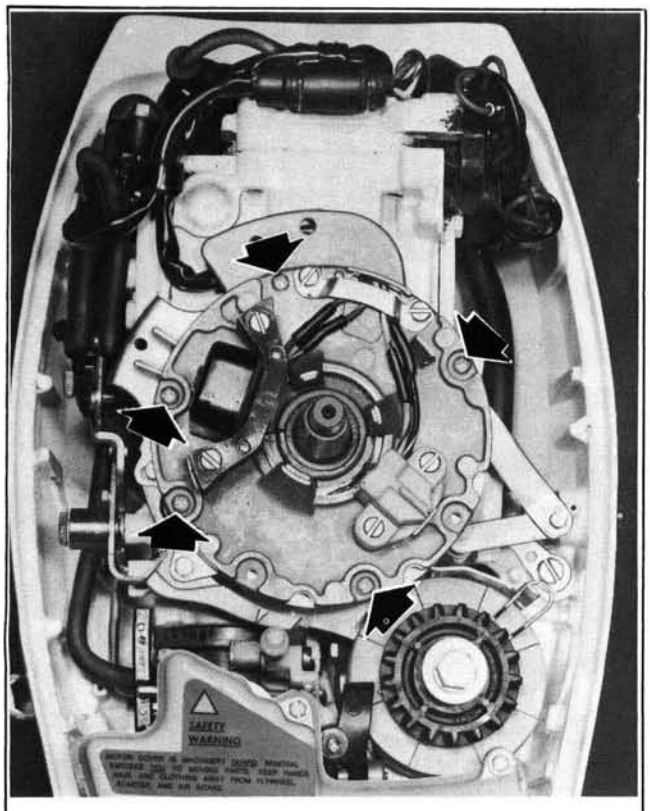


1. Armature plate leads

VIEW B - ELECTRIC START

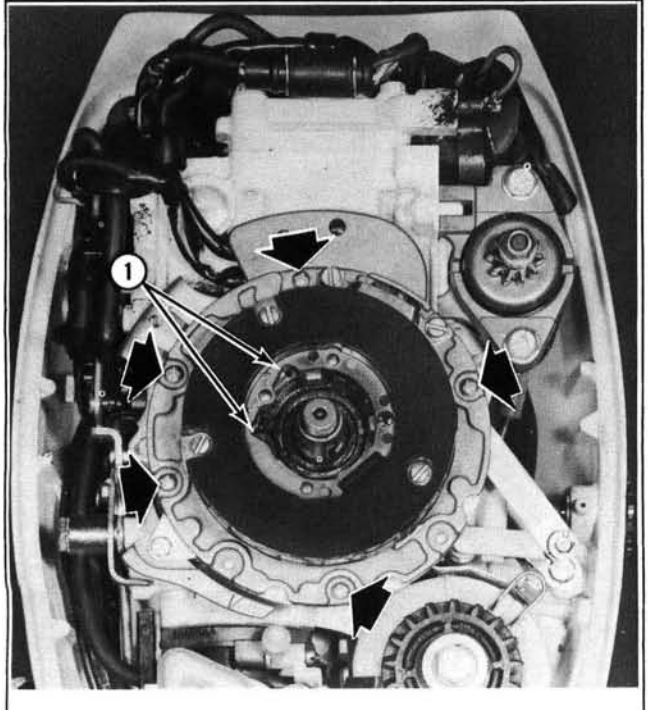
73199

Figure 4-36. Armature Plate Wiring



VIEW A - MANUAL START

73200

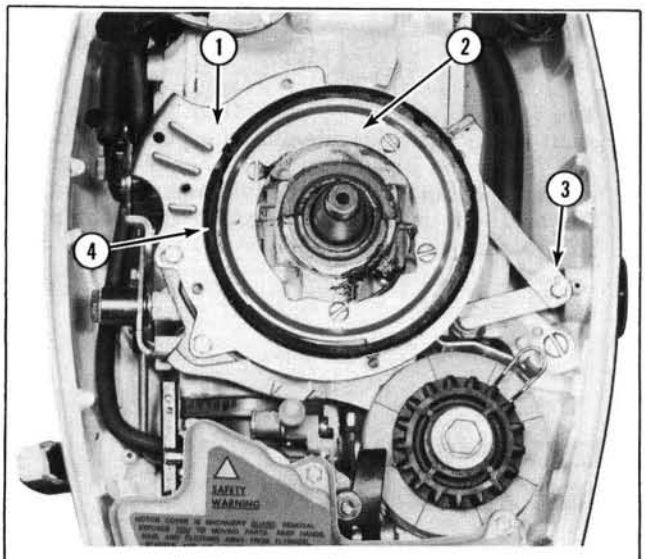


1. Armature plate cut-outs

VIEW B - ELECTRIC START

73207

Figure 4-37. Armature Plate Attaching Screws



1. Retainer plate
2. Support plate
3. Armature plate link
4. Armature plate bearing

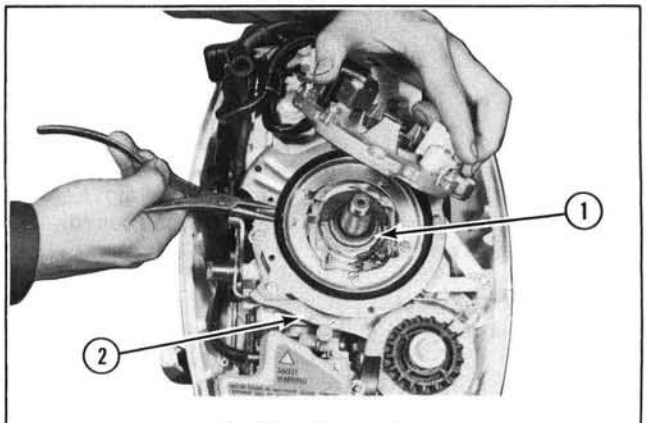
73208

Figure 4-38. Armature Support and Retainer Plates

ARMATURE PLATE INSTALLATION

a. If removed for servicing, install the retainer plate on the crankcase. Next, position the support plate over the retainer plate and align the holes between the plate and crankcase. Install the screws and torque to specifications in Section 2. Reconnect the throttle lever to armature plate link. See Figure 4-38.

b. Apply OMC Moly Lube to the crankcase boss (pilot for armature plate). See Figure 4-39.



1. Crankcase boss
2. Throttle cam

73205

Figure 4-39. Installing Armature Plate

c. Lubricate the armature plate bearing with a light coat of OMC outboard lubricant.

d. Be sure the throttle cam is behind the cam follower to prevent jamming the throttle lever.

e. Insert needle nose pliers into the slots provided and hold the armature plate bearing compressed while guiding the armature plate into position. See Figure 4-39.

f. Position the armature plate with the center of the charge coil in line with the stop on the retainer plate and tighten the screws to the torque specified in Section 2. See Figure 4-37, view A. On electric starting models, position the cut-outs in the armature plate assembly as shown in Figure 4-37, view B.

g. Secure the armature plate leads in the two support clamps. See Figure 4-36, view A. On electric starting models, connect the three armature plate leads to the terminal board. Be sure to match the wire colors with those from the rectifier. See Figure 4-36, view B.

h. Install the flywheel. (Refer to Flywheel Installation.)

CHARGE COIL OR SENSOR COIL REPLACEMENT (STATOR ASSEMBLY REPLACEMENT)

REMOVAL

a. Remove the flywheel. (Refer to Flywheel Removal.)

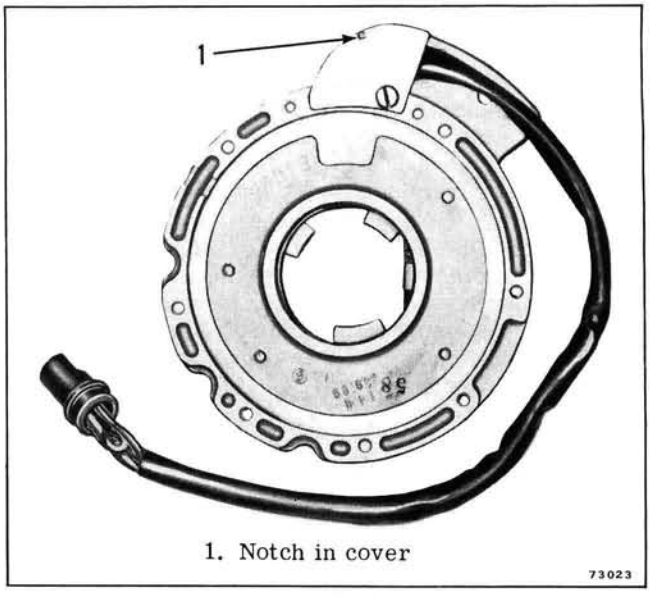
b. Remove the armature plate as described in Armature Plate Removal.

c. If replacing the charge coil, terminals "A" and "D" must be removed from the armature plate end of the four wire connector. To replace the sensor coil, remove terminals "B" and "C" from the armature plate end of the four wire connector. On electric starting models, remove all four terminals from the connector.

d. Remove the cover from the bottom of the armature plate. See Figure 4-40.

e. Next, remove the clamp on top of the armature plate retaining the leads. See Figure 4-41, view A or B.

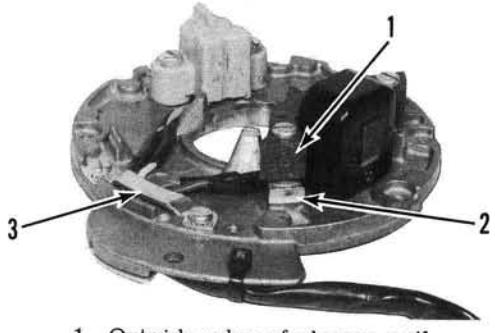
f. With the screws securing the charge coil or sensor coil removed, pull the coil and lead assembly from the insulation sleeve and armature plate. On electric starting models, remove the screws from the stator assembly and pull the stator from the insulation sleeve and armature plate.



1. Notch in cover

73023

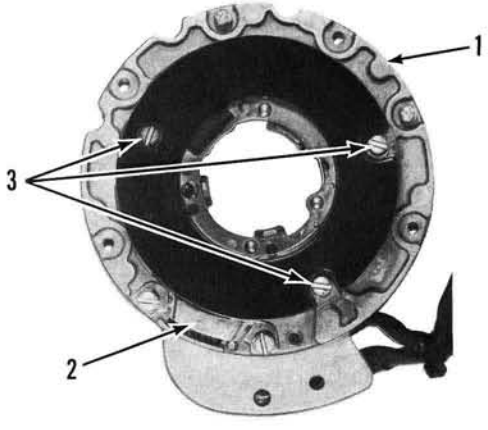
Figure 4-40. Bottom of Armature Plate



1. Outside edge of charge coil
2. Machined boss
3. Clamp

VIEW A - MANUAL START

73170



1. Armature plate
2. Clamp
3. Stator assembly mount screws

VIEW B - ELECTRIC START

73201

Figure 4-41. Stator and Armature Plate

INSTALLATION

a. Lubricate the insulation sleeve with Isopropyl alcohol and insert the coil leads through the armature plate and sleeve to the four wire connector.

b. Install the terminals into the connector.

c. Position the charge coil or sensor coil on the armature plate and insert the mount screws just finger tight. On electric starting models, position the stator assembly on the armature plate and install the mounting screws to the torque specified in Section 2, then proceed to step e.

d. Correct locating of the coil assembly is governed by machined mounting surfaces on the armature plate. The outside edge of the charge coil and sensor coil must be flush with the machined surfaces on the armature plate to prevent contact with the flywheel magnet and provide maximum output from the coils. See Figure 4-41, view A. Alignment of the charge, coil and sensor coil will be simplified when using the OMC Coil Locating Ring (Special Tool No. 317001) machined to fit over the armature plate bosses. See Figure 4-42. With the Coil Locating Ring in position over the armature plate bosses, push the ring toward the coil, while pulling the coil toward the ring, and tighten the coil mounting screws to the torque specified in Section 2.

e. Install the clamp on top of the armature plate to position the charge coil and sensor coil or stator assembly leads. See Figure 4-41, view A or B.

f. Slide the insulation sleeve to the armature plate to protect the coil leads, and install the cover on the bottom of the armature plate. Line up the notch in the plate with the notch on the cover during installation. See Figure 4-40.

g. Install the armature plate. Refer to Armature Plate Installation procedures.

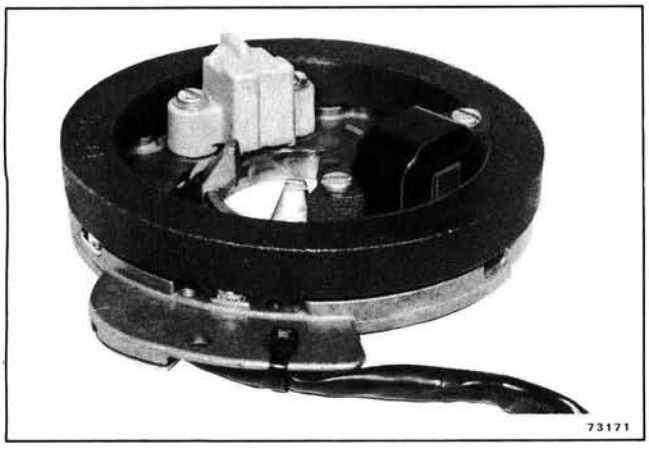


Figure 4-42. Coil Locating Ring

POWER PACK REPLACEMENT

REMOVAL

a. Separate the three wire connector between the power pack and ignition coils and the four wire connector between the armature plate and power pack.

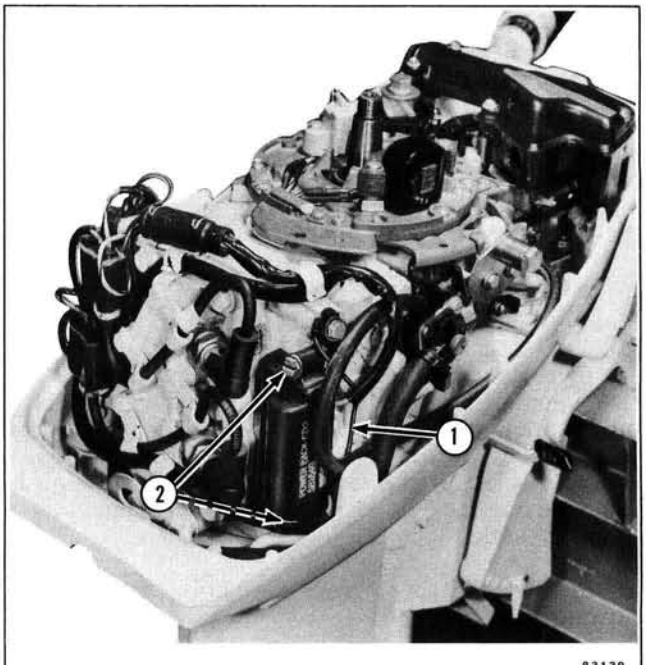
NOTE

Remember the routing of the power pack leads and the location of clamps for proper lead positioning during installation.

b. Unscrew the power pack mount screws and ground wire screw to remove the power pack. See Figure 4-43.

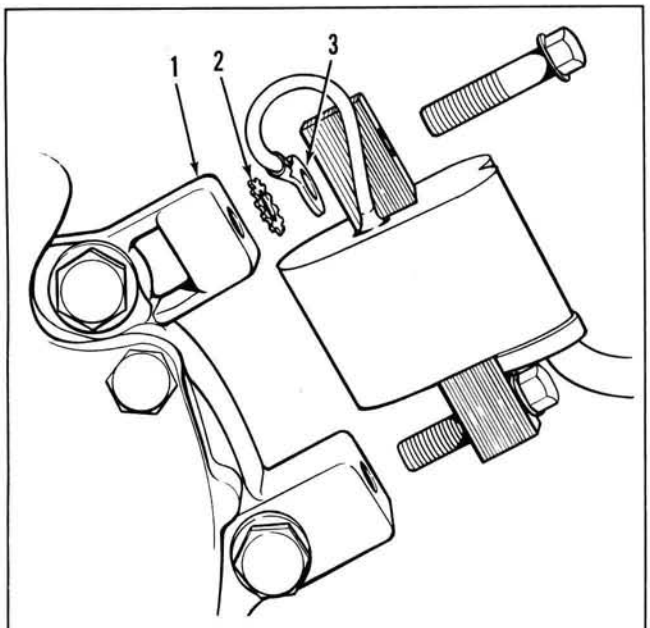
NOTE

Unless otherwise specified, when installing lockwashers on electrical connectors, place the washer on the engine side of the connector to provide a good ground. See Figure 4-44.



1. Ground wire
2. Mounting screws

Figure 4-43. Power Pack Mounting



1. Engine
2. Lockwasher
3. Electrical connector

73169

Figure 4-44. Lockwasher Positioning

INSTALLATION

a. Install the power pack ground wire and position the wire so there will be no pull (stretch) when the power pack is installed. Excessive pull on the ground wire could result in ignition failure. See Figure 4-43.

b. Mount the power pack and tighten the screws to the torque specified in Section 2.

NOTE

Carefully align the connector halves during assembly to provide proper terminal contact.

c. Reconnect the three wire and four wire connectors, and secure each connector with a retainer.

IGNITION COIL REPLACEMENT

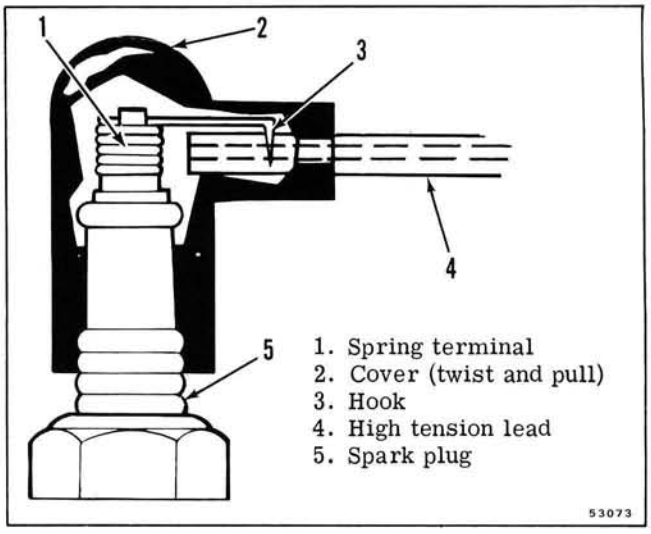
REMOVAL

a. Separate the three wire connector between the power pack and ignition coils.

b. Twist and pull on the cover to remove the high tension lead from the spark plug. See Figure 4-45.

c. Release the ignition coil wires from the support clamps and remove the coil mounting screws. See Figure 4-46.

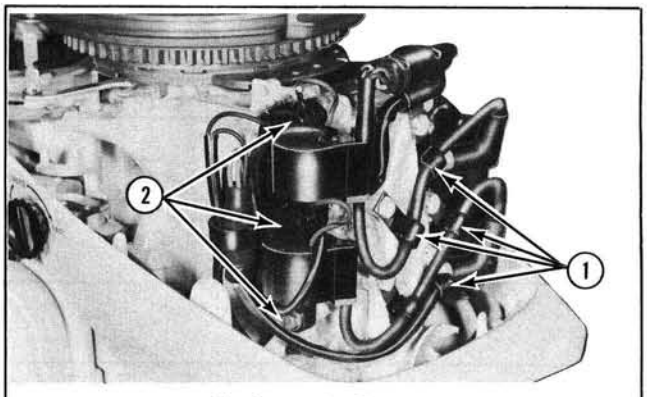
d. Remove the ignition coil terminal from the three wire connector.



1. Spring terminal
2. Cover (twist and pull)
3. Hook
4. High tension lead
5. Spark plug

53073

Figure 4-45. Spark Plug Cover and Terminal



1. Support clamps
2. Mount screws

73136

Figure 4-46. Ignition Coil Mounting

INSTALLATION

a. Insert the ignition coil terminal into the three wire connector.

b. Mount the ignition coil to the engine with the lockwasher between the engine block and ground wire connector. See Figure 4-44.

c. Secure the high tension lead to the spark plug.

NOTE

Carefully align the connector halves during assembly to provide proper terminal contact.

d. Reconnect the three wire connector and secure with retainer.

NOTE

To insure proper ignition timing check the No. 1 (TOP) ignition coil orange lead to be sure it is in the "B" terminal of the connector, and that it connects to the orange/blue stripe wire from the power pack.

SECTION 5
POWER HEAD

TABLE OF CONTENTS

OMC
SPECIAL TOOLS REQUIRED

HOLDING FIXTURE	PART NUMBER 303605
SEAL INSTALLER	PART NUMBER 319872
SEAL INSTALLER	PART NUMBER 319879
WRIST PIN STOP	PART NUMBER 319917
PISTON CRADLE	PART NUMBER 319919
WRIST PIN PRESSING PIN	PART NUMBER 319920
BEARING INSTALLER	PART NUMBER 319931
WRIST PIN DRIVER	PART NUMBER 319944
WRIST PIN CONE	PART NUMBER 319945
SEAL REMOVER	PART NUMBER 386629

5

DESCRIPTION

The power head consists of the cylinders, pistons, rods, crankshaft, and crankcase. The power head has two horizontally mounted cylinders. Alternate firing order is used so that each cylinder delivers one power impulse per crankshaft revolution. See Figure 5-1 for two stroke theory.

THEORY OF OPERATION

Two-cycle engines used on outboard motors require only two piston strokes - one up, one down, to effect a crankshaft revolution and to complete the exhaust-intake-compression-ignition sequence that produces power. In a two-cycle engine, ignition of the fuel-air mixture occurs as the piston reaches the top of each stroke. The explosion drives the piston downward. Toward the end of the downward stroke, ports which lead to the exhaust system are uncovered. The exhaust gases flow into these ports, thus reducing the pressure in the cylinder. At almost the same time, intake ports are opened. These ports connect with the crankcase where a fuel and air mixture has been induced by carburetion. The downward motion of the piston compresses this mixture in the crankcase and forces it through the intake ports into the cylinder. The inrushing charge of the fuel-air mixture helps in ejecting the last of the exhaust gases from the cylinder. See Figure 5-1A, Fuel Intake and Exhaust.

As the piston begins its upstroke, it closes the intake and exhaust ports and begins to compress the fuel and air mixture trapped in the cylinder. The upward travel of the piston also reduces the pressure in the crankcase compartment. The resulting reduced atmospheric pressure opens leaf valves which admit additional air and fuel from the carburetor into the crankcase, thus preparing the next cylinder charge. See Figure 5-1B, Compression Stroke.

At the top of the piston stroke, the compressed fuel-air mixture is ignited by a timed spark and the cycle begins anew. In an outboard motor engine running at full throttle, this cycle may be repeated 5000 or more times every minute. See Figure 5-1C, Power Stroke.

CRANKCASE AND CYLINDERS

A split crankcase and cylinder assembly simplifies power head servicing. The cylinder heads are combined in one casting.

PISTONS

The pistons, with the piston rings, receive the force of combustion in the cylinder head, so it is necessary that both the pistons and piston rings be properly fitted to form a seal between the piston head and cylinder walls. To retain maximum power within the cylinder above the piston head, the cylinder must be perfectly round and the piston rings correctly seated in their grooves.

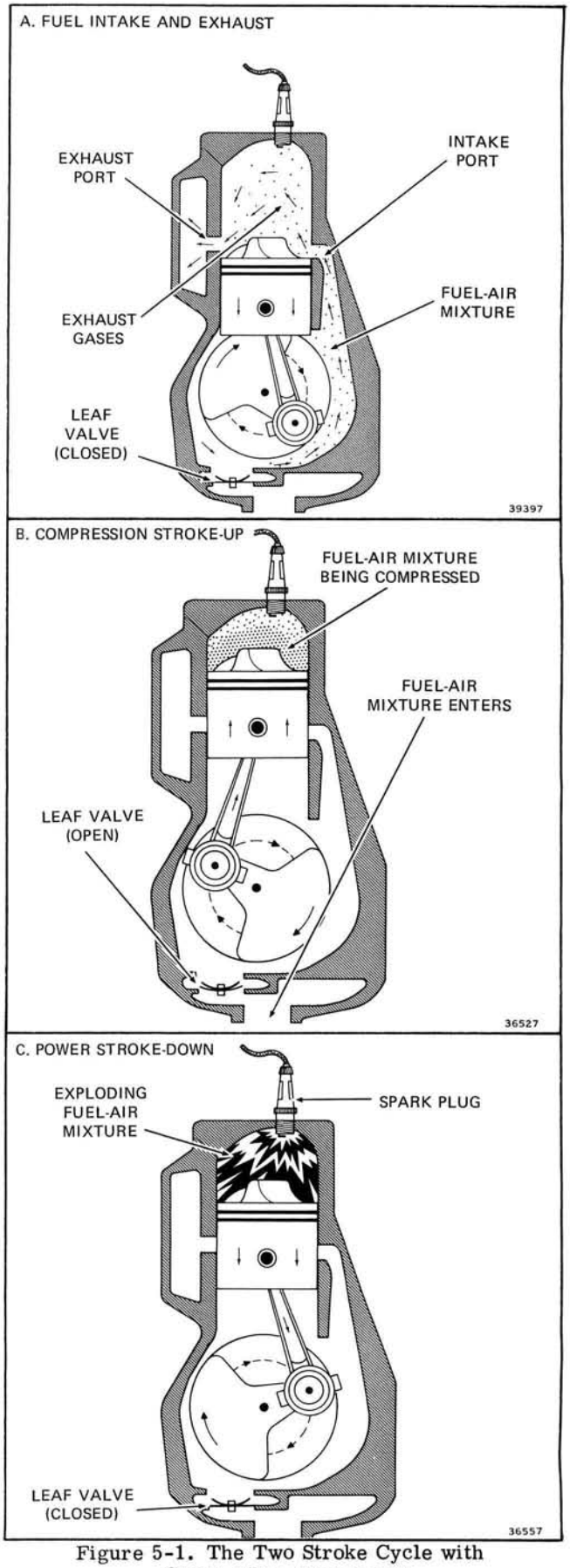


Figure 5-1. The Two Stroke Cycle with Cross-Flow Scavenging

CONNECTING RODS

The connecting rods provide linkage between the piston and crankshaft. Connecting rod bearings include a roller bearing at the wrist pin, and a split cage roller bearing at the crankshaft. The crankshaft is of the two-throw type and is supported by three main bearings. A single row roller bearing is at the upper journal. A split cage roller bearing at the center journal is aligned to the cylinder block by a dowel pin. A ball bearing at the bottom journal absorbs the radial and vertical thrust loads of the crankshaft.

COOLING SYSTEM

Water for engine cooling is supplied by a two-stage pump containing a rubber impeller. At low speeds, the pump operates as a full displacement pump. At higher speeds, the impeller blades bend back under the increased water pressure and the pump becomes a centrifugal action pump.

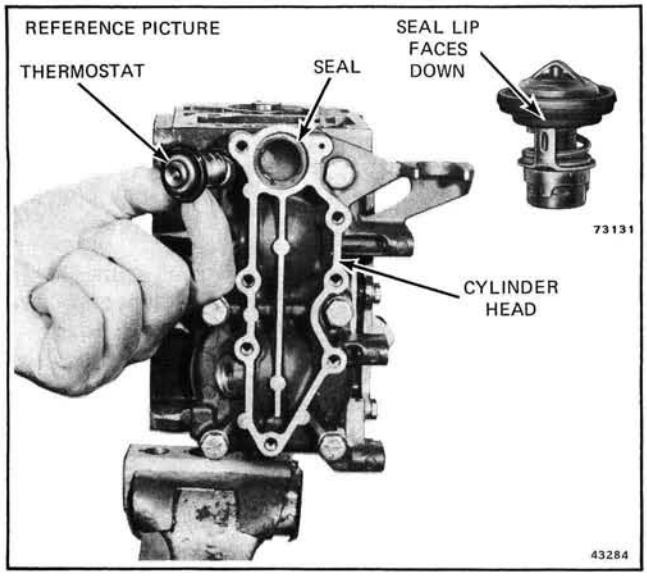


Figure 5-2. Thermostat and Seal

A thermostat maintains consistent operating temperatures throughout the entire range of motor operation, increasing motor life and efficiency. See Figure 5-2.

THERMOSTAT OPERATION

The thermostat housing, which is part of the cylinder head, contains the thermostat. Upon starting a cold motor the thermostat is closed and prevents the water pump from circulating water in the cooling system. Limited circulation as well as discharge of air from the cooling system is permitted by a bleed hole in the thermostat valve. When the power head and cooling system temperatures reach 145° F., (63°C) the thermostat valve opens, allowing heated water to pass through the water discharge and fresh water to be drawn through the water intake. The thermostat then continues to regulate power head temperature by periodically opening and closing as additional fresh water is required. To service thermostat, remove seven screws and cylinder head cover. See Figure 5-12. Install new gasket on reassembly.

CHECKING MOTOR TEMPERATURE

The Markal Thermomelt Stik, a heat sensitive stick similar to a crayon which melts on contact with a surface at a specific temperature, is used to measure power head temperature. The motor is best checked when operating on a boat. If this is not possible, run the motor in a test tank for at least five minutes, at a maximum speed of 3000 rpm (AND A MINIMUM OF 1500 rpm). Mark the surface to be checked with the Stik. The mark will appear dull and chalky. When the surface temperature reaches the temperature rating of the Stik, the mark will melt, becoming liquid and glossy in appearance. On some painted surfaces on which the Stik will not leave a mark, it will be necessary to hold the Stik against the surface. See Figure 5-3.

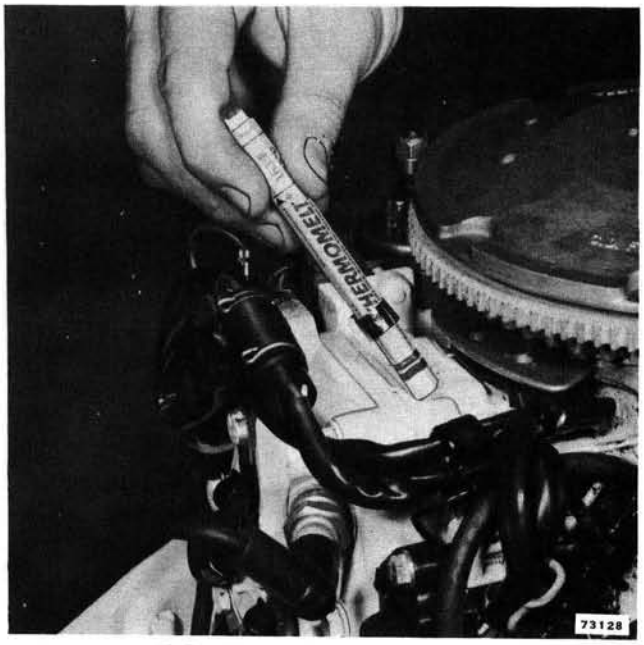


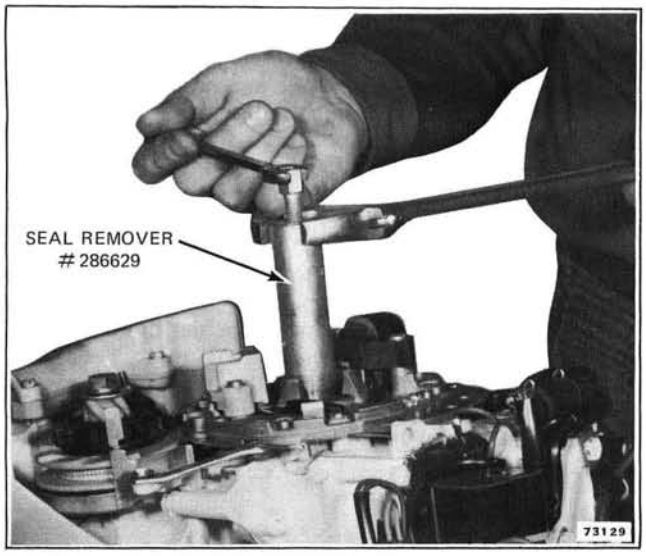
Figure 5-3. Checking Motor Temperature

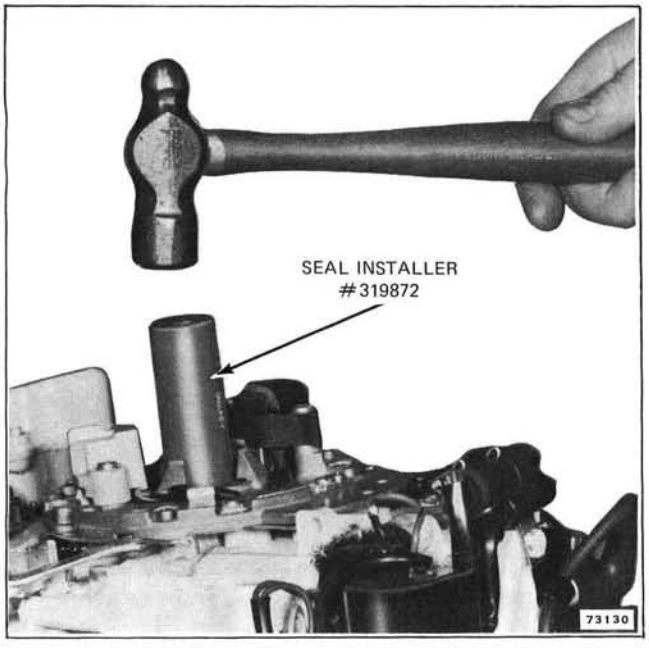
Two Thermomelt Sticks are necessary to check a motor - a 125° F. (52° C) Stik and a 163° F. (73° C) Stik. With the motor at operating temperature, the 125° (52°C) mark should melt and the 163° (73°C) mark should not melt. If the 125° (52°C) mark does not melt after a reasonable length of time, the thermostat is stuck open and the motor is running too cold. If the 163° (73°C) mark also melts, the cooling system is not functioning properly, allowing the motor to overheat. Check for a worn pump assembly, leaky water system, or malfunctioning thermostat.

POWER HEAD REMOVAL

NOTE

Upper main bearing seal can be replaced without disassembly of crankcase. Remove flywheel as described in Section 4. Use seal remover (Special Tool #396629). Use seal installer (Special Tool #319872) to install new seal. See Figure 5-4.





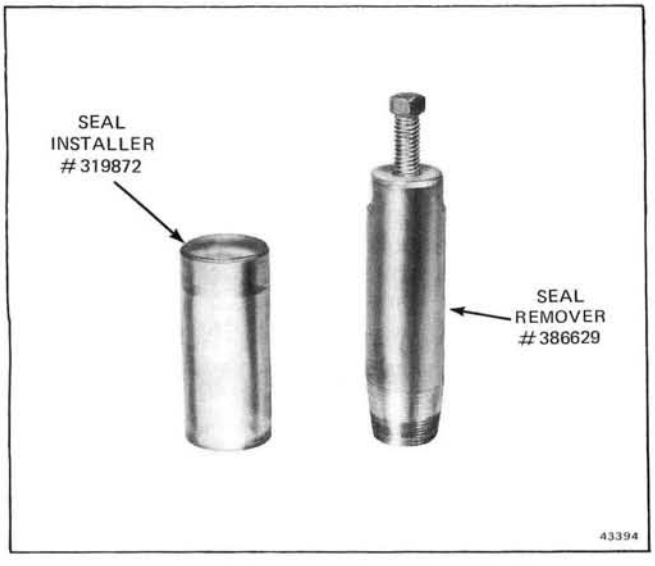


Figure 5-4. Replacing Upper Main Bearing Seal

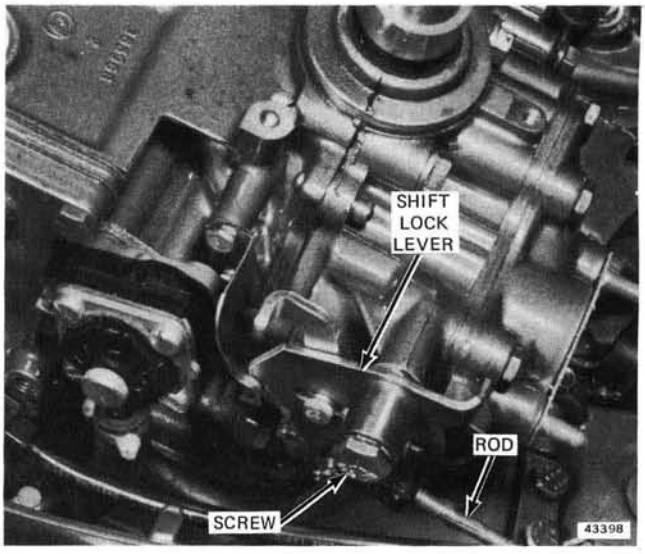


Figure 5-5. Shift Lock Lever Screw

a. Remove carburetor, fuel pump and filter as described in Section 3. Electric start model, remove starter as described in Section 7. Remove armature plate, support plate and retainer plate as described in Section 4. Remove coils from cylinder head.

b. Remove shift lock lever screw and swing lever and rod out of way. See Figure 5-5. Remove starter interlock cam screw.

c. Remove six screws attaching power head to exhaust housing. See Figure 5-6.

NOTE

Two aft screws are longer.

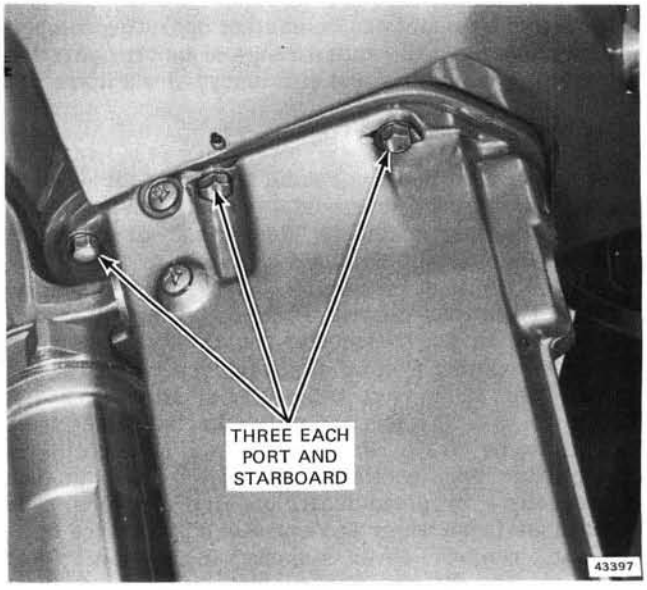


Figure 5-6. Exhaust to Powerhead Screws

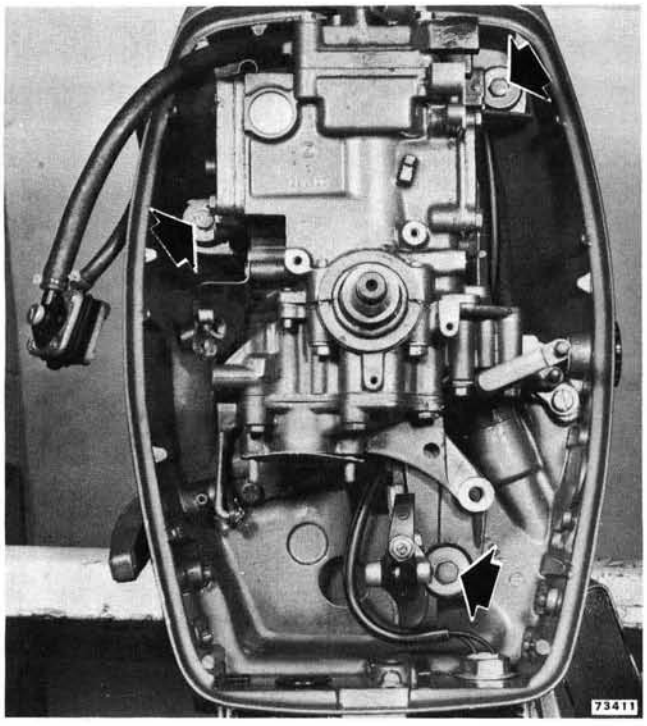


Figure 5-7. Rubber Mount Screws (Three)

d. Remove the three rubber mount screws.

NOTE

Power head ground wire installed under port mount screw. See Figure 5-7.

e. Lift power head from exhaust housing. See Figure 5-8. Place power head on bench in a suitable holding fixture such as OMC Special Tool #303605, and remove exhaust and water tube assembly. See Figure 5-9.

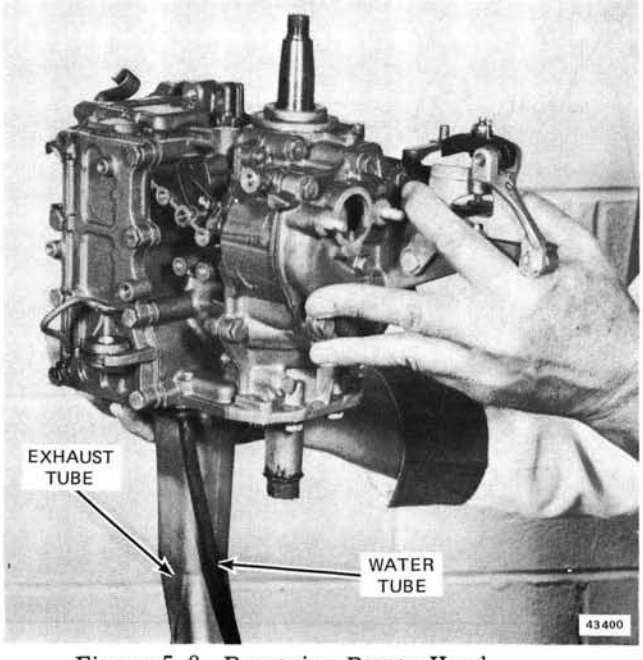


Figure 5-8. Removing Power Head

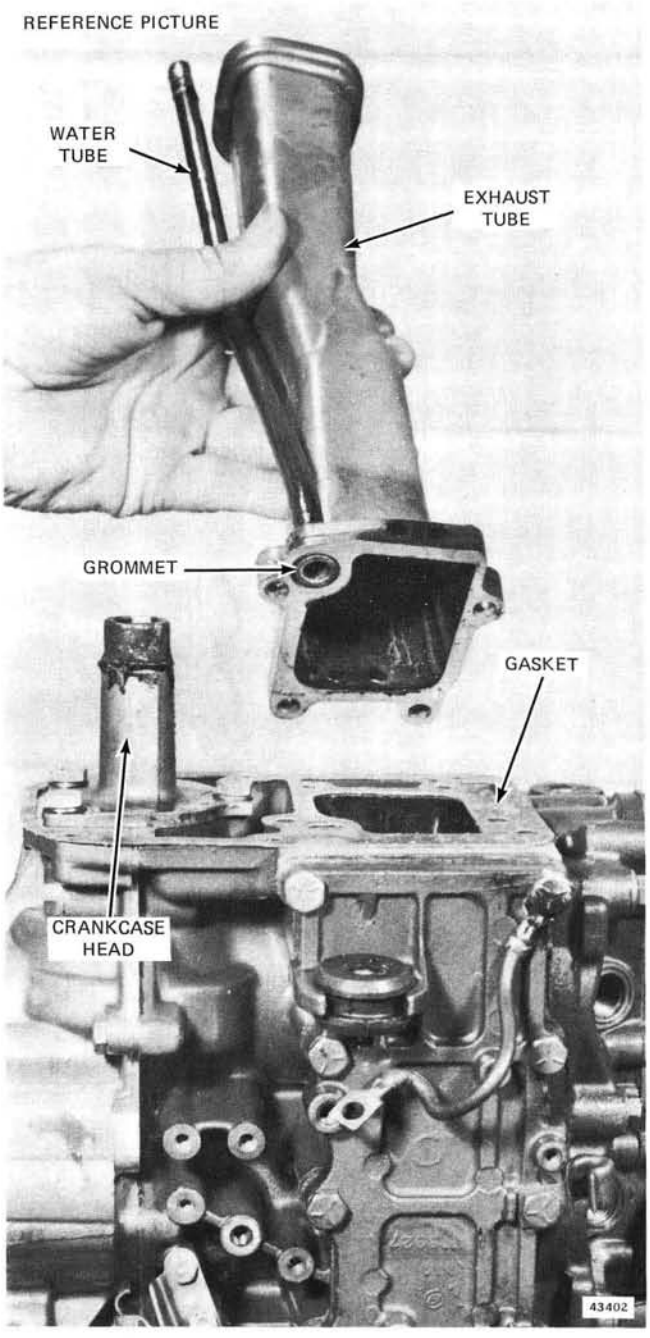


Figure 5-9. Removing Exhaust Tube and Water Tube Assembly

POWER HEAD DISASSEMBLY

See Figures 5-10A and 5-10B.

NOTE

To simplify reassembly and wiring installation, lay out the various screws and clamps in order of their proper location. Reference pictures end this section.

a. Remove three screws and crankcase head. See Figure 5-10C. Discard "O" ring.

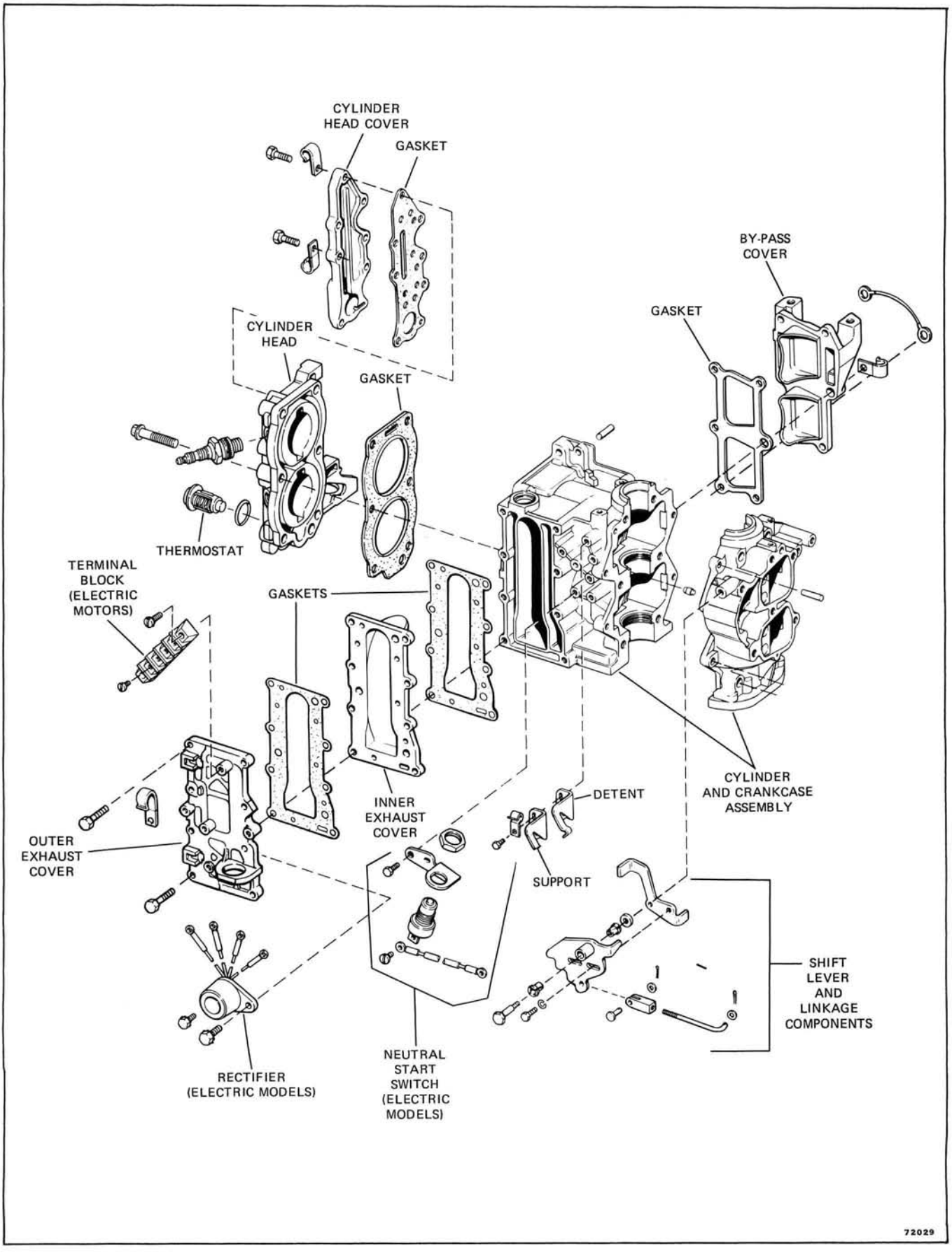


Figure 5-10A. Power Head - Exploded View

10/15E,J

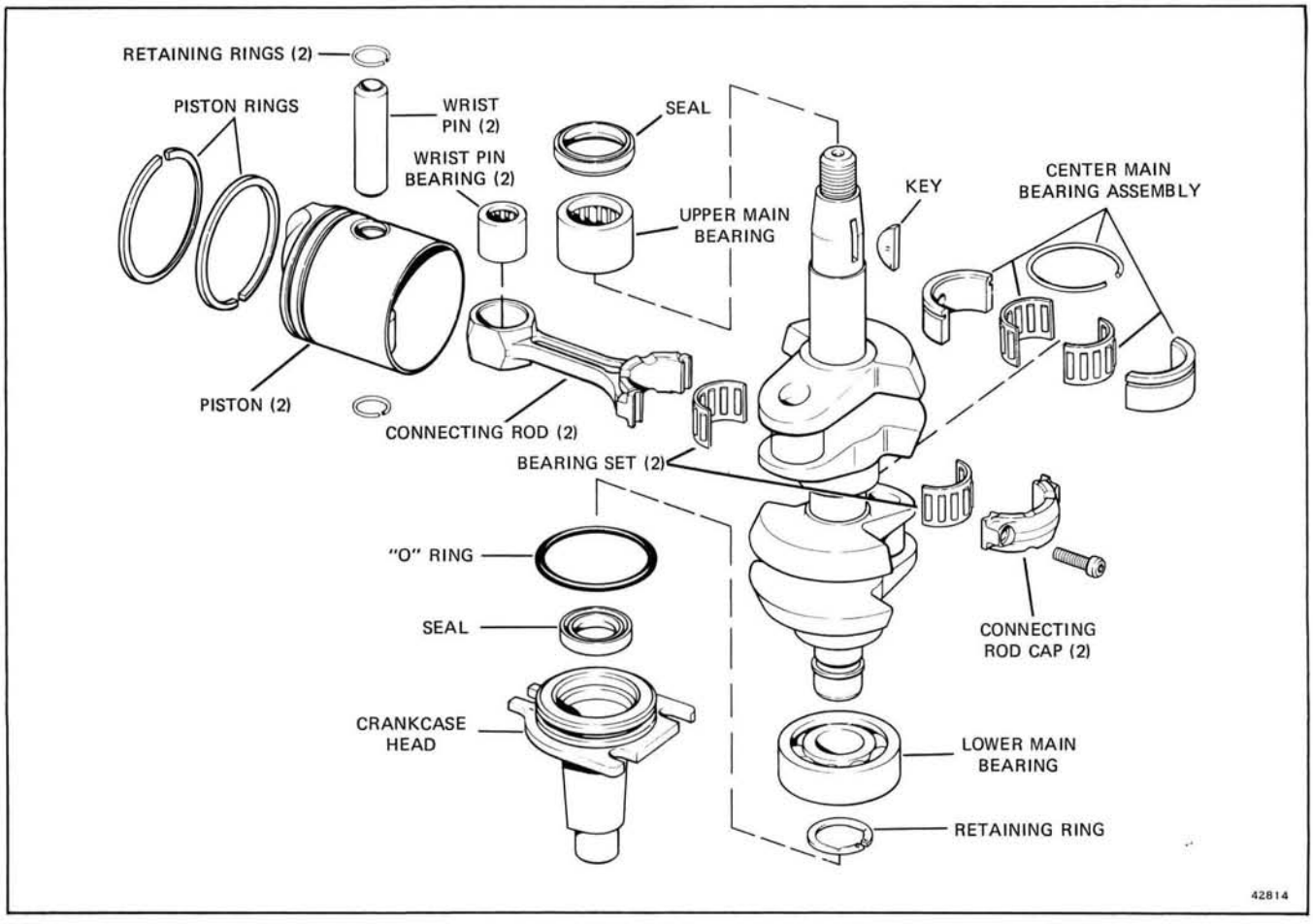


Figure 5-10B. Crankshaft, Pistons and Connecting Rod Components

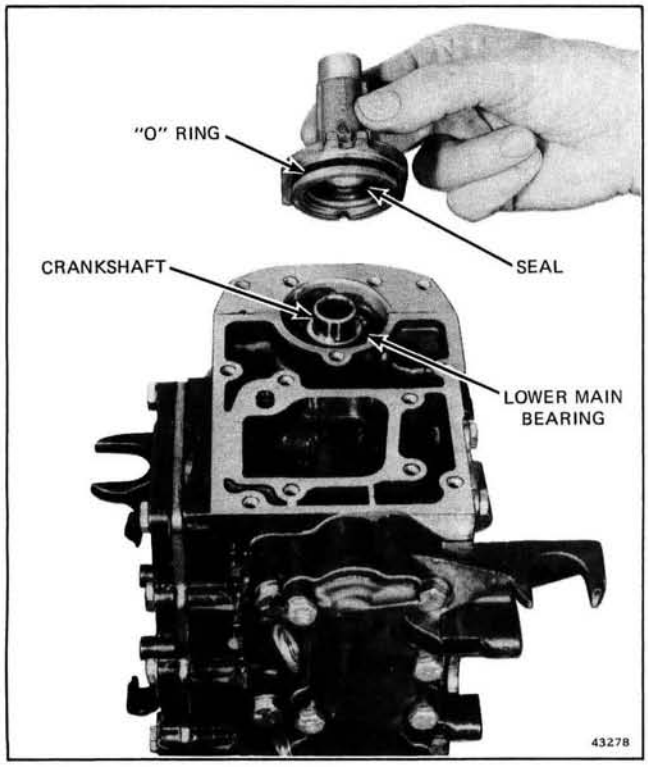


Figure 5-10C. Crankcase Head

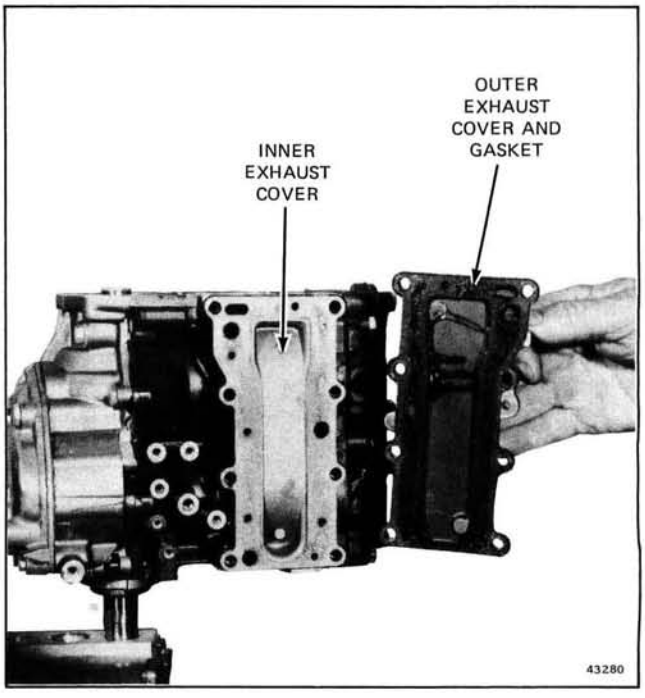


Figure 5-11. Exhaust Cover Removed

b. Remove outer and inner exhaust covers and gaskets. See Figure 5-11.

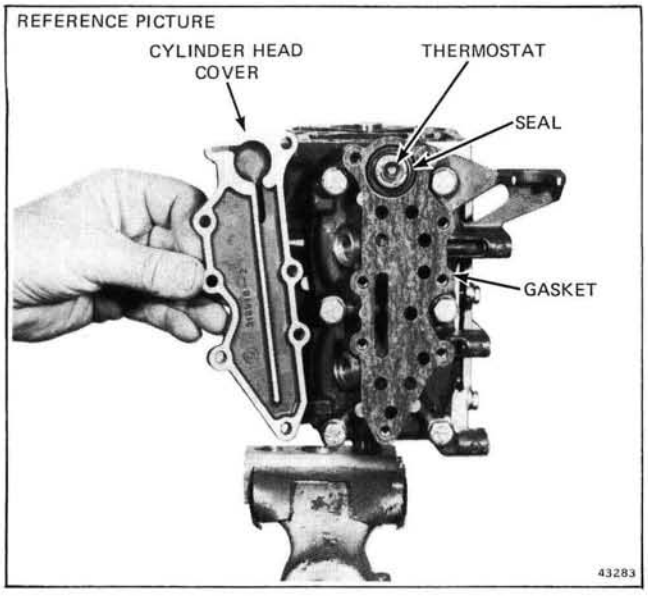


Figure 5-12. Cylinder Head Cover Removed

c. Remove cylinder head cover, gasket, thermostat and seal. See Figure 5-12.

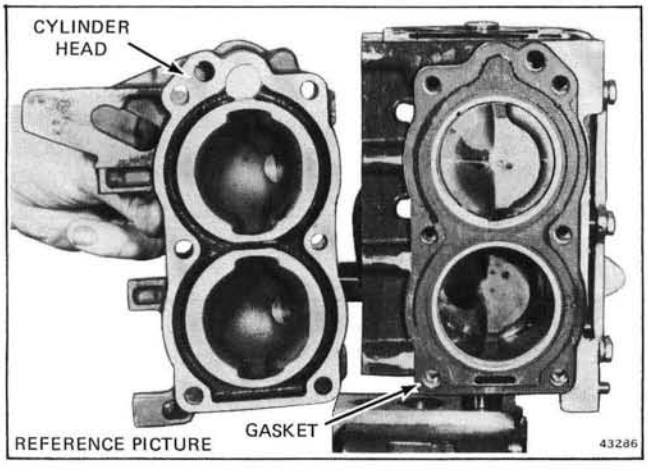


Figure 5-13. Cylinder Head Removed

d. Remove cylinder head and gasket. See Figure 5-13.

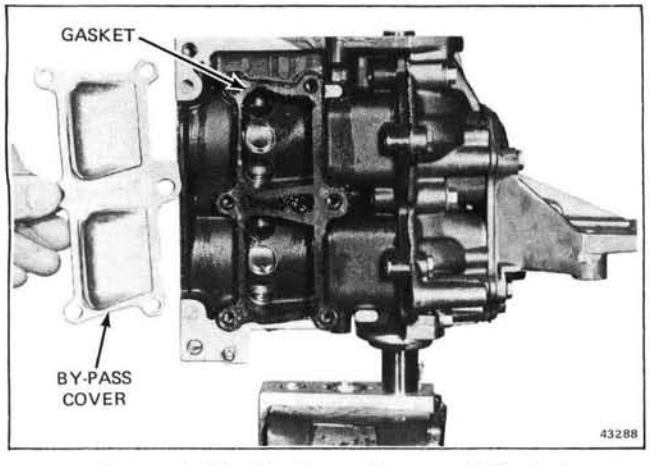


Figure 5-14. By-Pass Cover and Gasket

e. Remove by-pass cover and gasket. See Figure 5-14.

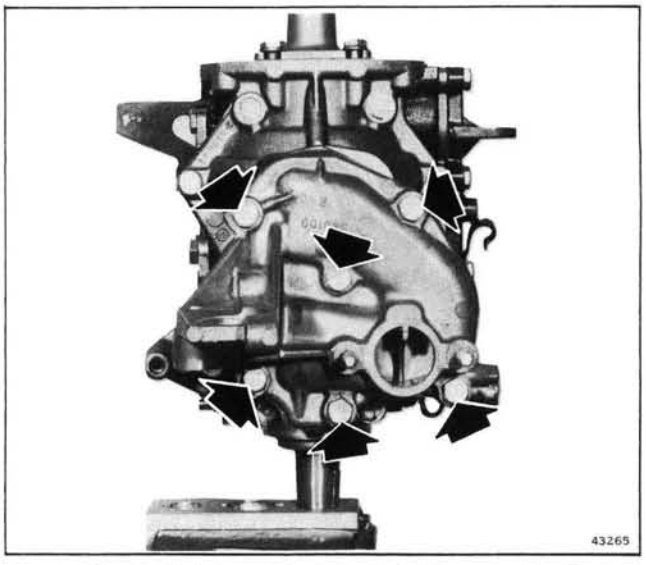


Figure 5-15. Intake Manifold Screws (Six)

f. Remove six intake manifold screws, intake manifold, leaf plate assembly and gaskets. See Figure 5-15.

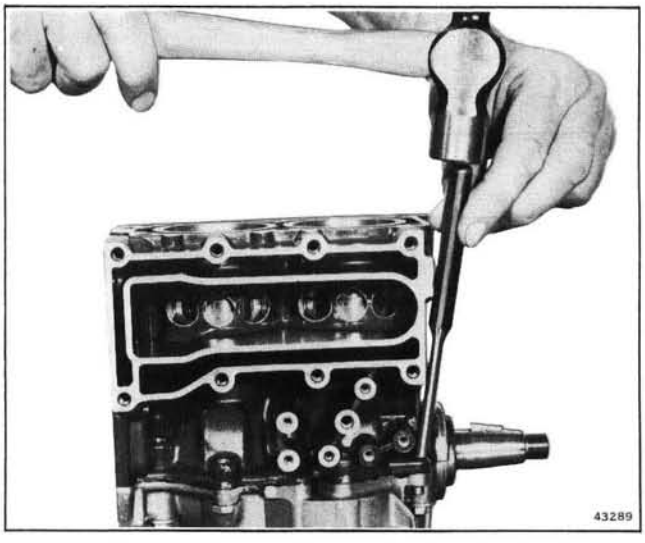


Figure 5-16. Driving Out Taper Pin

SAFETY WARNING

STRIKING A STEEL TOOL WITH A STEEL HAMMER MAY PRODUCE CHIPS WHICH CAN CAUSE SERIOUS DAMAGE TO EYES. SAFETY GLASSES MUST BE WORN TO PREVENT INJURY.

g. Drive out taper pin. See Figure 5-16.

NOTE

Six main bearing screws are washer head screws.

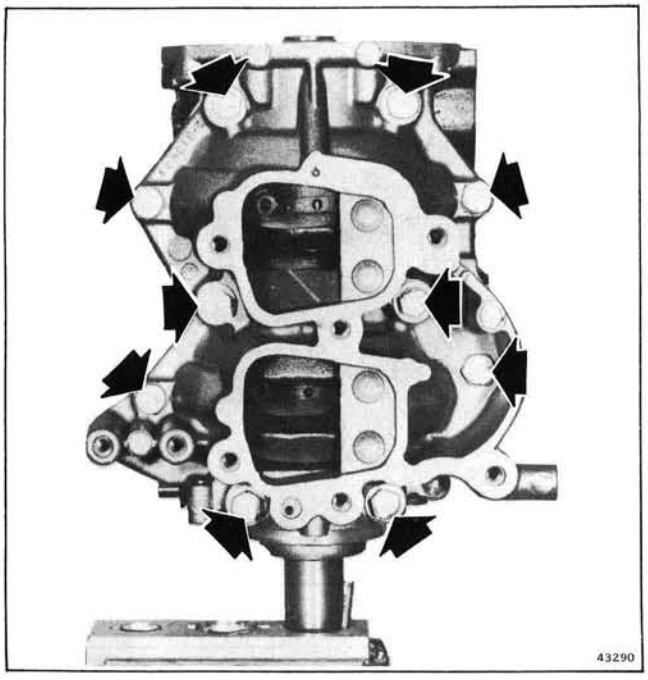


Figure 5-17. Crankcase Screws (Ten)

i. Tap crankshaft with soft mallet to break seal between crankcase and cylinder. See Figure 5-18. Remove crankcase from cylinder block.

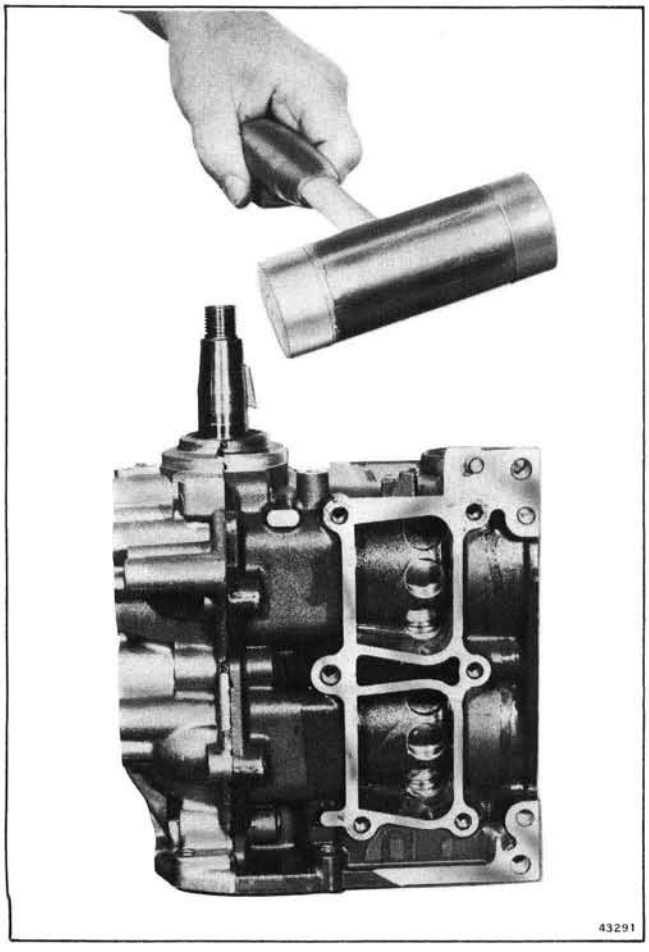


Figure 5-18. Separating Crankcase

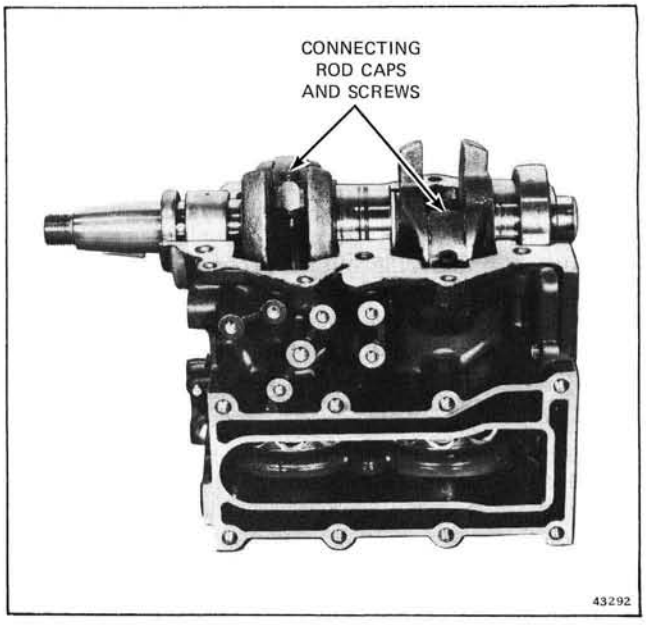


Figure 5-19. Connecting Rod Caps and Screws

j. Use a 5/32 inch, Allen wrench to remove connecting rod screws. Remove rod caps and bearing retainers. See Figure 5-19.

NOTE

Pistons, connecting rods, bearings, and caps are matched parts and seat with the operation of the motor. Because of this it is essential to maintain their original positions at reassembly. See Figure 5-20.

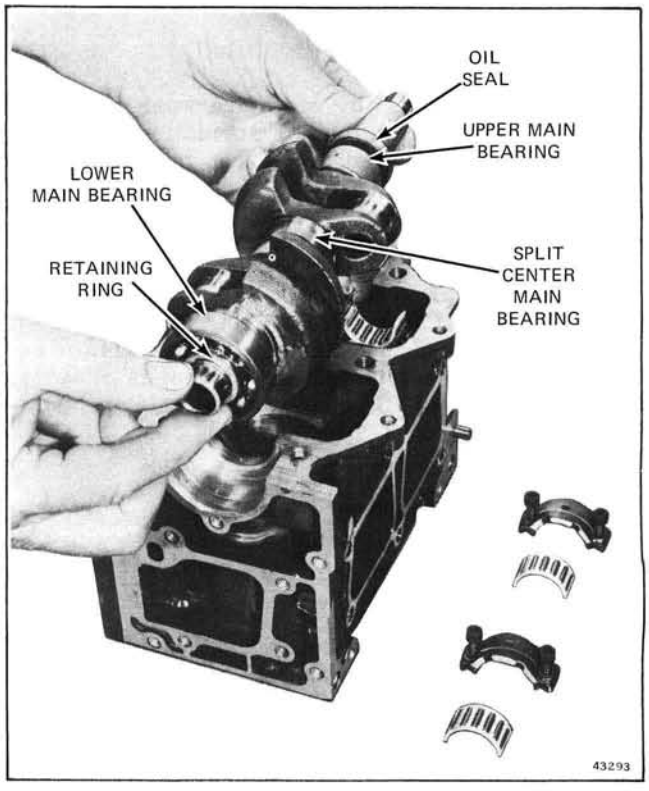


Figure 5-20. Removing Crankshaft

Mark each connecting rod and cap, piston, and bearing component to assure correct mating when they are reassembled. Also mark the cylinder from which piston assemblies are removed.

k. Lift crankshaft from cylinder block. See Figure 5-20. Reinstall matched caps on connecting rods and remove pistons and rods from cylinders.

l. Lift retaining ring out of groove and slide aside to remove the crankshaft center main roller bearing for cleaning and inspection. The top main bearing slides off. If necessary to remove the bottom main bearing, remove Truarc ring and use an appropriate bearing puller. See Figure 5-20.

m. Remove the rings from the pistons by prying the ends loose enough to grip them with pliers and then breaking them away from the piston. DO NOT try to save the rings. Install a complete set of new rings on every power head service job.

n. If necessary to remove piston from connecting rod, remove wrist pin retaining rings. See Figure 5-21. Use piston cradle (Special Tool #319919) and wrist pin pressing pin (Special Tool #319920). With piston skirt flush with cradle, press out pin using an arbor press. See Figure 5-22.

NOTE

One wrist pin boss inside of piston is marked "L" for loose. See insert, Figure 5-2. Place piston in cradle with "L" mark up. Press from loose side to tight side, being careful not to distort piston.

CLEANING, INSPECTION AND REPAIR

CYLINDER BLOCK AND CRANKCASE

Check cylinder walls for excessive wear and check cylinder ports for carbon accumulation. Cylinder walls wear in various degrees, depending on lubrication and conditions under which the motor is operated. Major portion of wear is in the port area and the area covered by ring travel.

Check cylinder for size and wall straightness by using an inside micrometer. Refer to Section 2 for specified dimensions. Replace cylinder block, or rebore block for oversize pistons if wear is in excess of .003" (0.08 mm). Pistons and ring sets are available .030" oversize.

NOTE

If your shop is not equipped to rebore cylinder blocks, write our Service Department about reboring service.

Carbon accumulation in the exhaust ports restricts the flow of exhaust gases and has considerable effect on performance of the motor. Carefully scrape carbon from cylinder heads and exhaust ports with scraper or other blunt instrument. Exhaust ports and all exhaust passages must be free from carbon deposits to insure maximum performance.

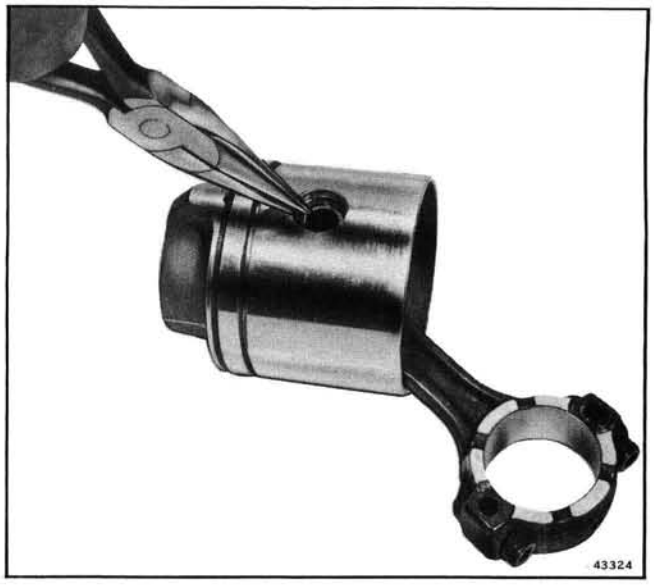


Figure 5-21. Removing Piston Pin Retaining Ring

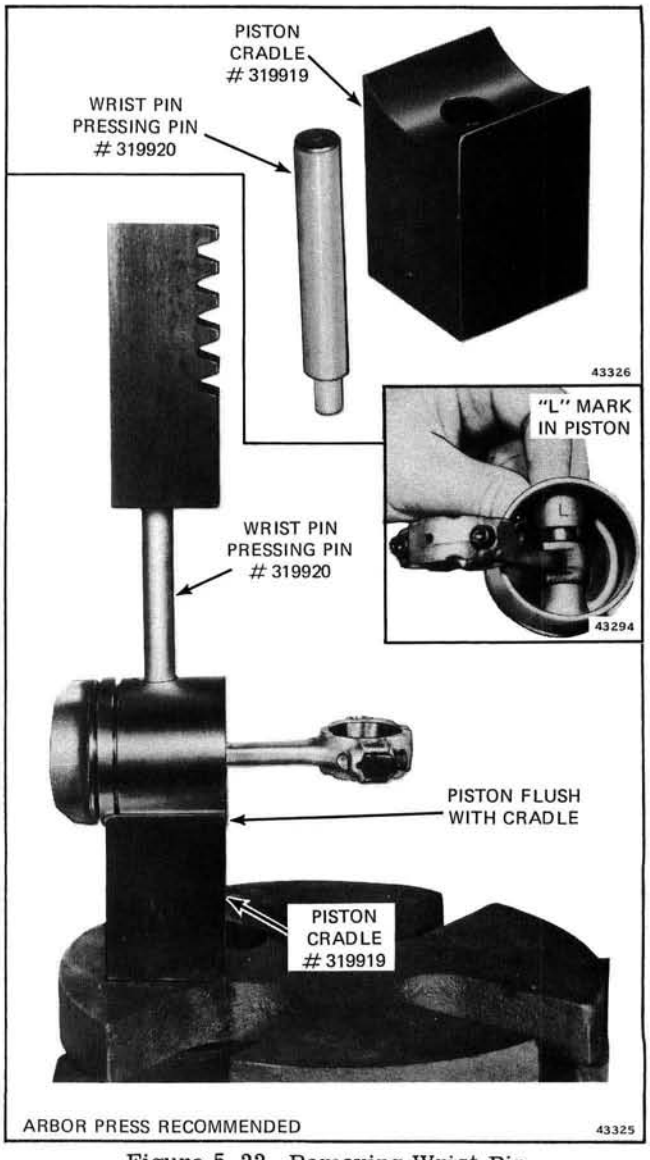


Figure 5-22. Removing Wrist Pin

NOTE

DO NOT scratch cylinder head gasket surface of cylinder. Use surface plate to surface this area.

With continued operation of the motor, the cylinder walls will take on a glaze which reduces the effectiveness of the seal between the piston rings and the cylinder walls. The result will be reduced compression and a decrease in performance of the motor. Before reinstalling the pistons, break the glaze by using a fine cylinder hone to refinish cylinder walls. Use low rpm on drill with rapid up and down movement to obtain a good crosshatch pattern for good oil retention. Use hone with medium stone (220 grit).

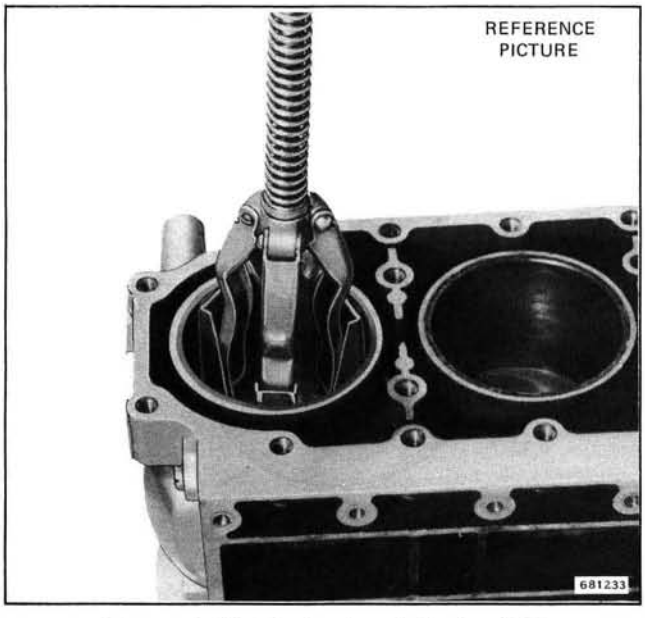


Figure 5-23. Deglazing Cylinder Wall

GASKET SURFACES

Remove all traces of dried cement, using trichlorethylene or lacquer thinner. Check all gasket faces for flatness. Under certain conditions, gasket faces may warp or spring, particularly where thin sections or flanges are employed and are subject to temperature changes.

To check for flatness, lay a sheet of No. 120 emery cloth on a surface plate or piece of plate glass. Place the part to be surfaced on the emery cloth and move slowly back and forth several times in a figure 8 motion, exerting evenly distributed, light pressure. See Figure 5-24. Lift part from surface plate to observe results.

If the surface is actually warped or sprung, high spots making contact with the surface plate will take on a dull polish, while the low areas will have retained their original state. To insure flatness over the entire surface, continue surfacing until the entire gasket surface has been polished to a dull luster. Finish surfacing with No. 180 emery cloth.

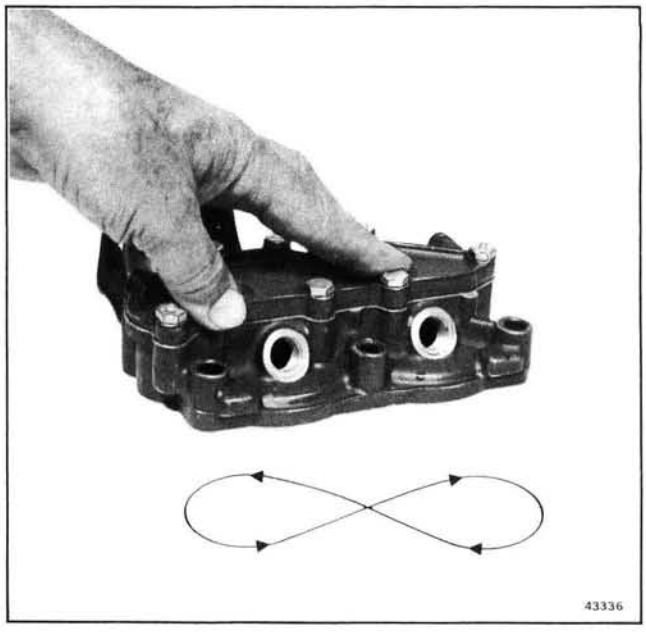


Figure 5-24. Surfacing Cylinder Head

CRANKSHAFT BEARINGS AND SEALS

a. All areas where the bearings are to be serviced should be kept free from accumulations of oil and dirt to avoid contaminating the bearings.

b. Place bearings in a wire basket and immerse in a solvent such as Solvasol. Tank should have a screened false bottom to prevent settlings from being stirred up into the bearings. Agitate basket frequently until grease, oil, and sludge are thoroughly loosened and can be flushed out. Bearings that contain especially heavy carbon deposits or hardened grease should be soaked in a separate container of solvent.

c. Using a spray gun with air filter and a clean solvent, flush each bearing until all dirt and residue are removed. Blow solvent out of bearings, using dry, filtered air, being careful not to spin bearings by force of air.

d. Since dry bearings rust rapidly, lubricate them at once in light, clean oil. Rotate them a few times and, after draining the excess oil, place them in a covered container until assembly.

e. Discard bearings which show any of the following:

(1) Rusted rollers or raceways.

(2) Fractured ring. This may be caused by forcing a cocked bearing off a shaft, or by too heavy a press fit.

(3) Worn, galled, or abraded surfaces. These may be caused by too loose a fit, or bearing locked by dirt and turning on shaft or in housing.

(4) Badly discolored rollers and races. This is usually due to an inadequate supply of lubricant. Moderate discoloration is not a cause for discard.

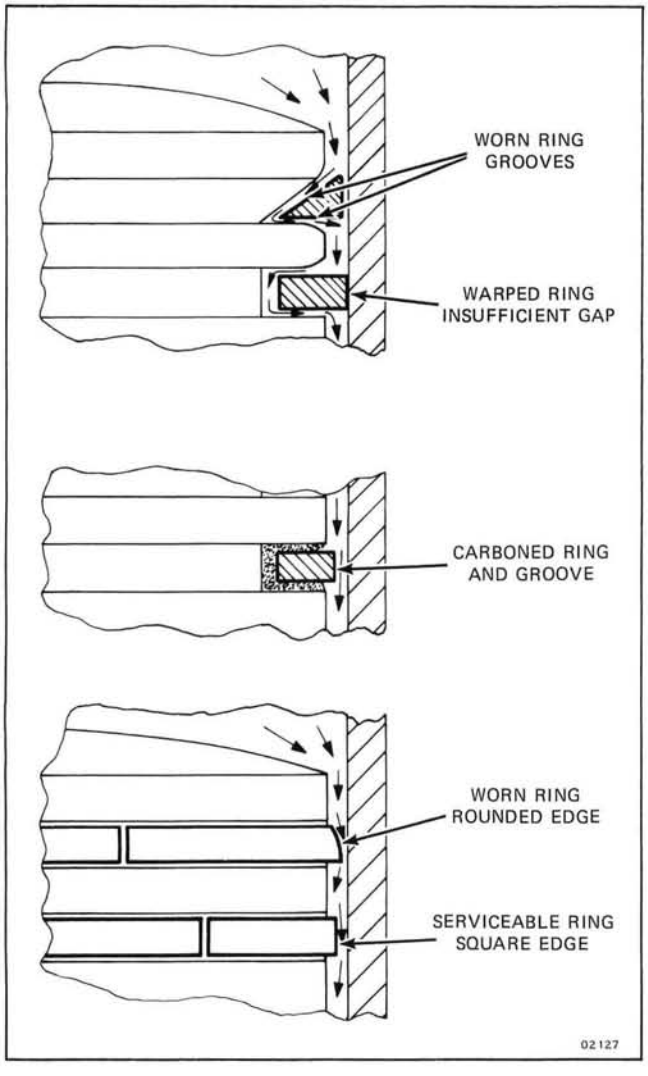


Figure 5-25. Piston and Ring Condition

f. Lower and upper crankcase seal and "O" ring should be replaced.

g. Roller bearing in connecting rod should be replaced if damaged.

PISTONS

Check the pistons for excessive skirt wear, and scoring. Carefully remove carbon deposits from inside piston head. Inspect the ring grooves for carbon accumulation, excessive wear, or damage to the ring seats. See Figure 5-25. Carefully scrape carbon from the ring grooves, making certain that carbon clinging to the bottom and sides of the grooves has been thoroughly removed without scratching or otherwise damaging the grooves. A tool for cleaning ring grooves can be made by breaking an old ring, grinding the edge and breaking the lower sharp edge. Care must be taken to prevent damage to lower ring land. See Figure 5-26. Check piston for size and roundness, using a micrometer. See Figure 5-27. Piston skirt must be perfectly round and not scratched. Correct sizes are given in Section 2.

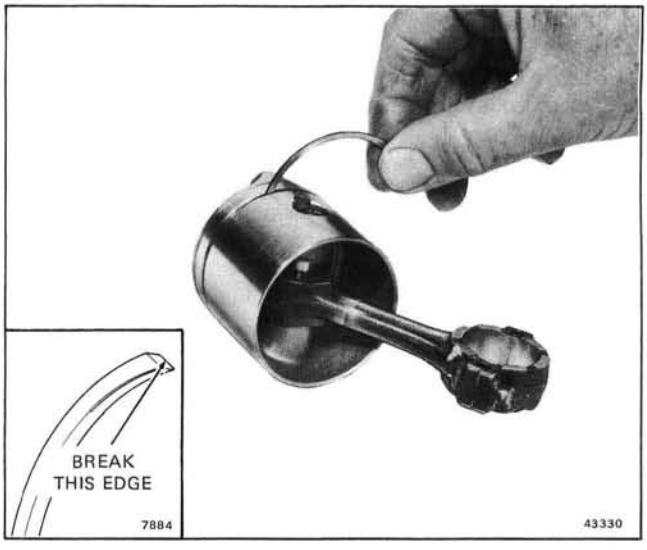


Figure 5-26. Cleaning Carbon from Ring Groves

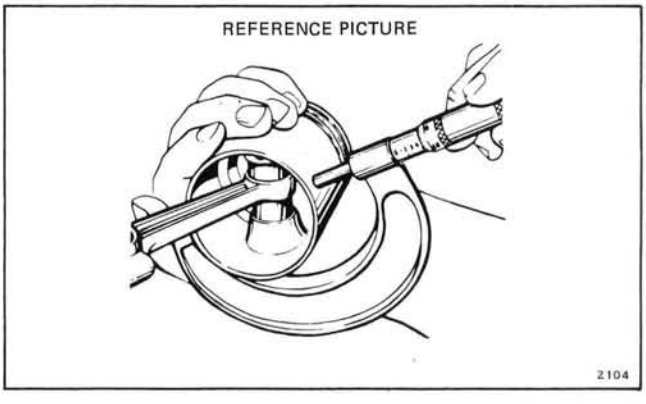


Figure 5-27. Check Piston Skirts for Roundness

Before installing new piston rings, check gap between ends of ring by placing ring in its respective cylinder bore, then pushing the ring down in the bore slightly with the bottom of the piston to square it up. See Figure 5-28. Check lower ring for evidence of tight-

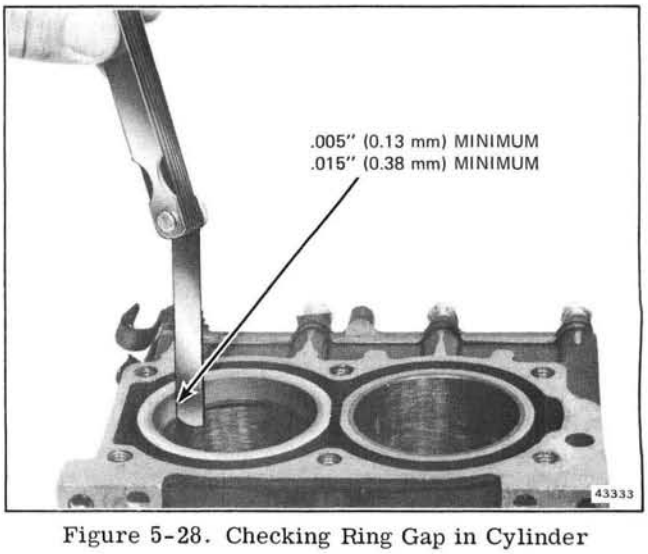


Figure 5-28. Checking Ring Gap in Cylinder

ness or binding by rolling the ring around the piston ring groove. See Figure 5-29. Check for groove side clearance with feeler gage. See Figure 5-30. Correct gap and side clearances are given in Section 2.

Figure 5-29. Checking Fit of Lower Ring in Groove

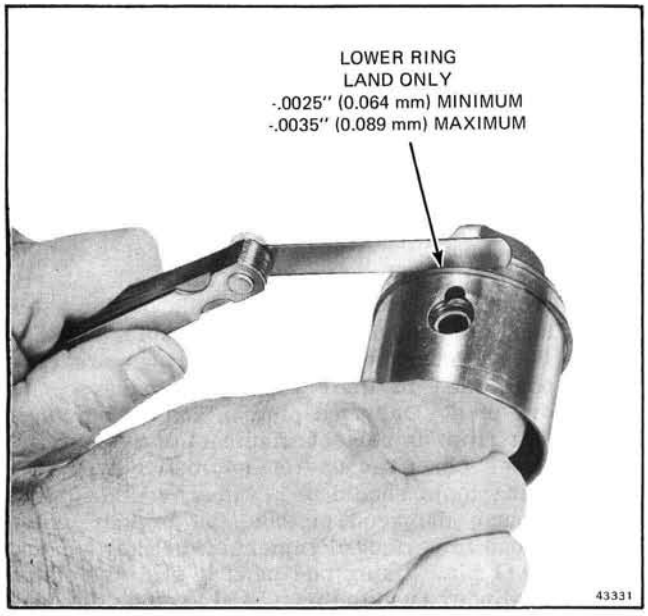


Figure 5-30. Checking Lower Ring Groove Side Clearance

REASSEMBLY OF POWER HEAD

Proceed slowly. Make no forced assemblies unless press fits are called for and make no "dry" assemblies. Be sure all parts to be assembled are clean and free from dirt and grit. Perfectly good cylinder walls, pistons and rings can be ruined in a few minutes of operation unless all forms of grit are removed before assembly. Work in clean surroundings and with reasonably clean hands. Coat all bearing surfaces, cylinder walls, etc., with clean oil before assembly. Where the use of "oil" is specified, we recommend OMC Outboard Lubricant.

NOTE

Always use new gaskets and seals throughout when reassembling the power head. Make certain all oil holes and passages are open.

PISTONS, WRIST PINS AND CONNECTING RODS

a. If removed, press new roller bearings in connecting rods using bearing installer (Special Tool #319931). See Figure 5-31.

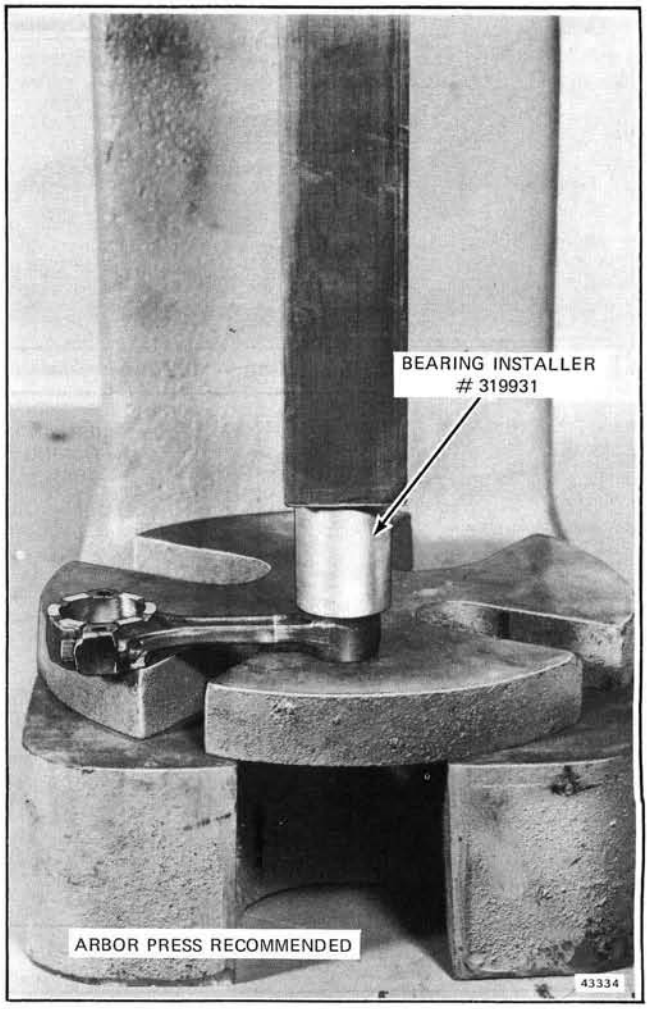


Figure 5-31. Pressing in New Wrist Pin Bearing

b. Using a piston cradle (Special Tool #319919), a wrist pin stop (Special Tool #319917), and wrist pin pressing pin (Special Tool #319920), press wrist pin through "L" side of piston until seated. See Figure 5-32. Wrist pin stop will locate wrist pin between retaining ring grooves.

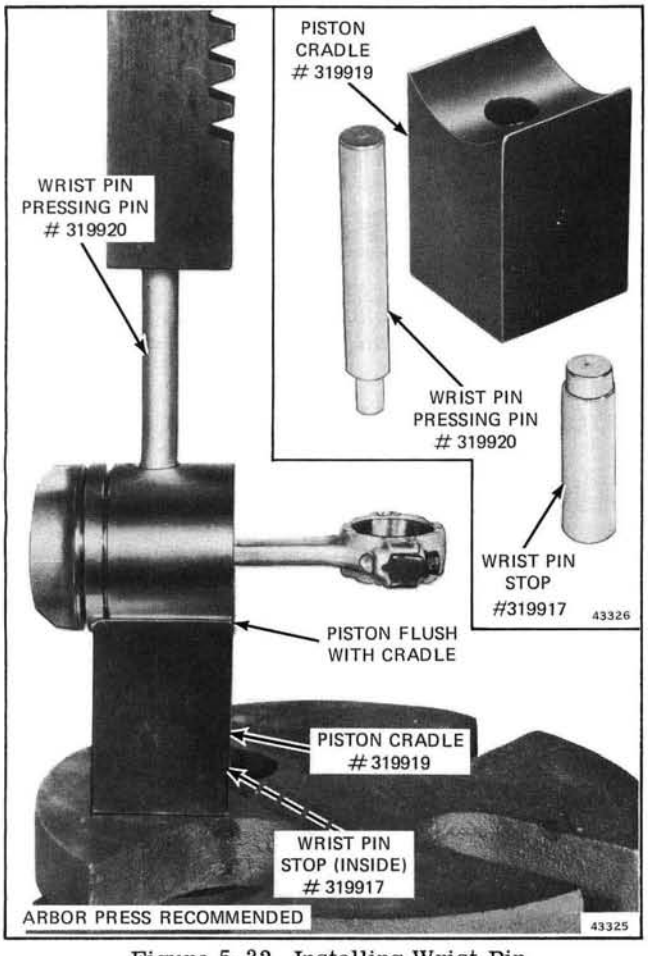


Figure 5-32. Installing Wrist Pin

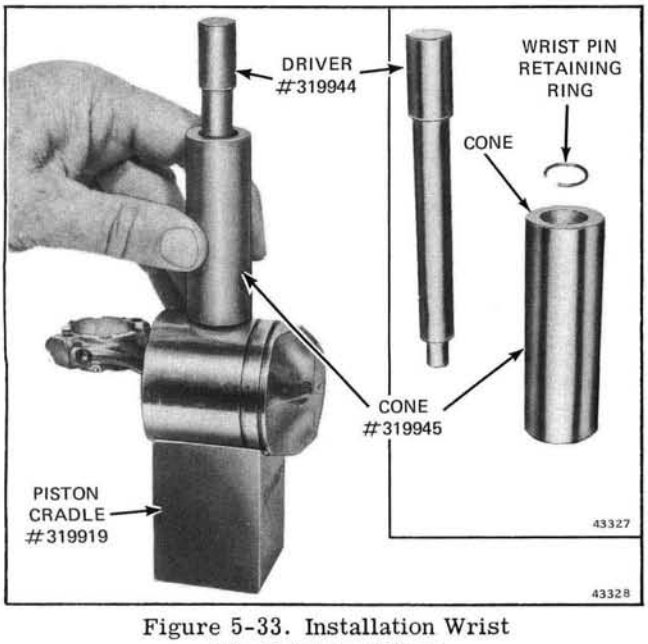


Figure 5-33. Installation Wrist Pin Retaining Rings

c. Using piston cradle, wrist pin driver (Special Tool #319944) and wrist pin cone (Special Tool #319945) start retaining ring in tapered end of cone. Press retaining rings into piston. Make sure retaining rings seat in grooves in piston. See Figure 5-33.

d. Check piston with micrometer to determine if piston has been distorted during assembly. If piston is more than 0.003" (0.08 mm) out of round, replace piston.

PISTON RINGS (UPPER RING IS A PRESSURE BACKED RING)

Install the piston rings on each piston. Spread each ring with a ring expander just enough to slip it over the head of the piston and down into place. Be sure the rings fit freely in the piston ring grooves. The ring grooves are pinned to secure the position of the rings, primarily to prevent ends of the rings from catching on the edges of the ports in the cylinders but also to assure staggering of the ring gaps.

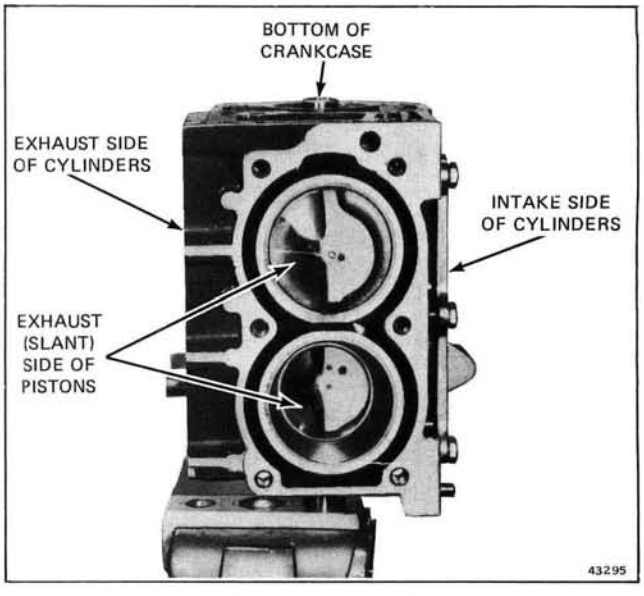


Figure 5-34. Correct Piston in Cylinder Position

PISTON AND CONNECTING ROD INSTALLATION

Coat pistons and cylinder bores with oil and install piston and connecting rod assemblies, being sure to match each assembly with the cylinder it was removed from. The exhaust (slant) side of the piston must face the exhaust side of the cylinder. See Figure 5-34. Make certain that the rings are correctly positioned in their grooves with respect to the groove pins. Damaged pistons and broken rings may result from imperfect alignment of the ring and piston dowel pin. The use of automotive type ring compressing tools should be avoided, as these frequently cause damaged pistons and broken piston rings through imperfect alignment of the ring gap and piston dowel pin. Using one hand to push the piston into the cylinder, use the free hand to guide the connecting rod into place and to align the rod with respect to the crankshaft.

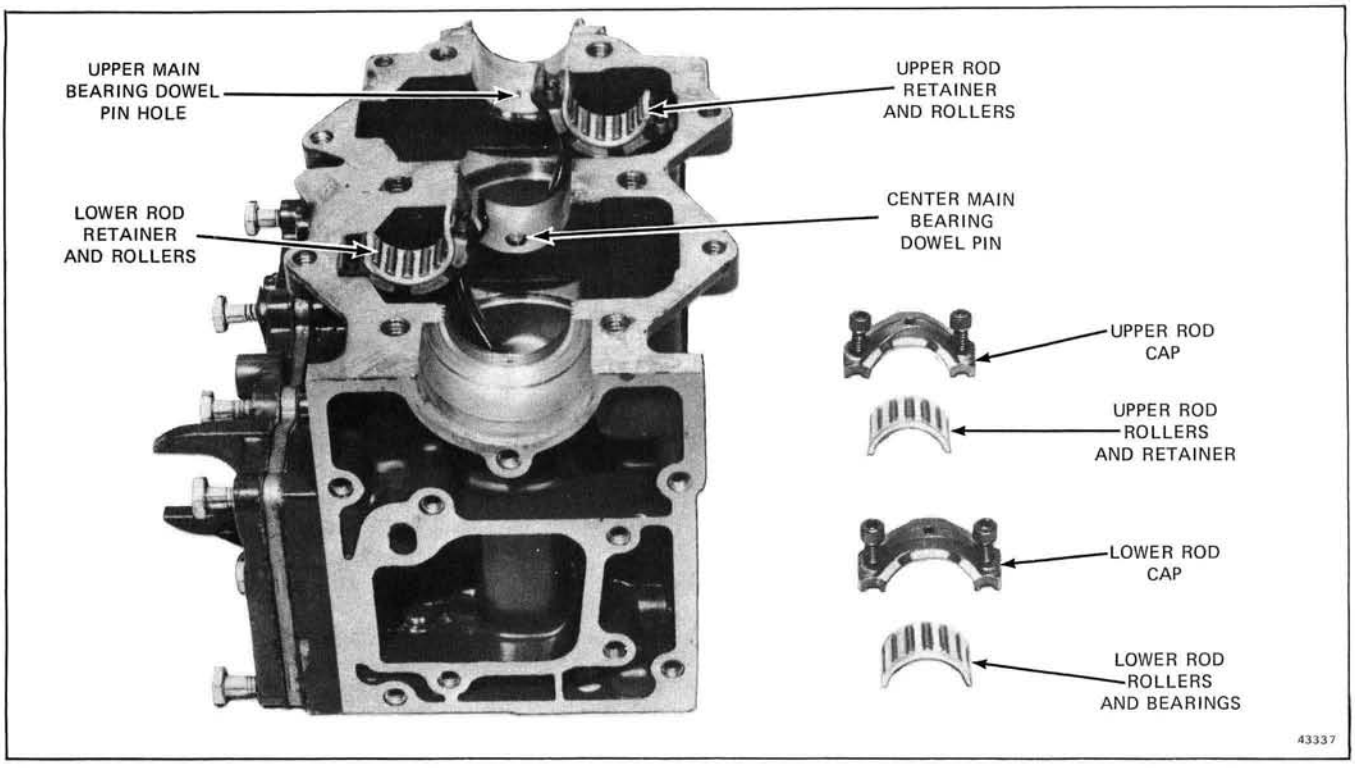


Figure 5-35. Installing Roller Bearings and Retainers

CRANKSHAFT

a. Oil crankshaft bearing surfaces. Replace main bearings on crankshaft.

NOTE

Install upper main bearing with lettered side facing flywheel end of crankshaft. Install center main bearing with retaining ring facing flywheel end of crankshaft.

b. Remove rod caps from connecting rods. Place one retainer half and bearings on each rod. See Figure 5-35.

c. Place crankshaft in position on cylinder block, upper main bearing dowel pin with dowel pin hole in cylinder block and center main bearing dowel pin hole with dowel pin in cylinder block. See Figure 5-35.

d. Place other retainer halves and bearings on crankpins. See Figures 5-36 and 5-37.

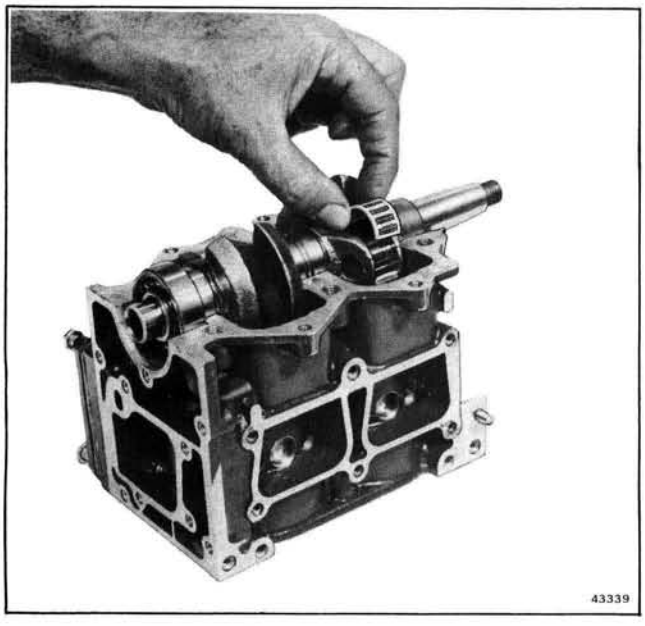


Figure 5-36. Installing Bearings

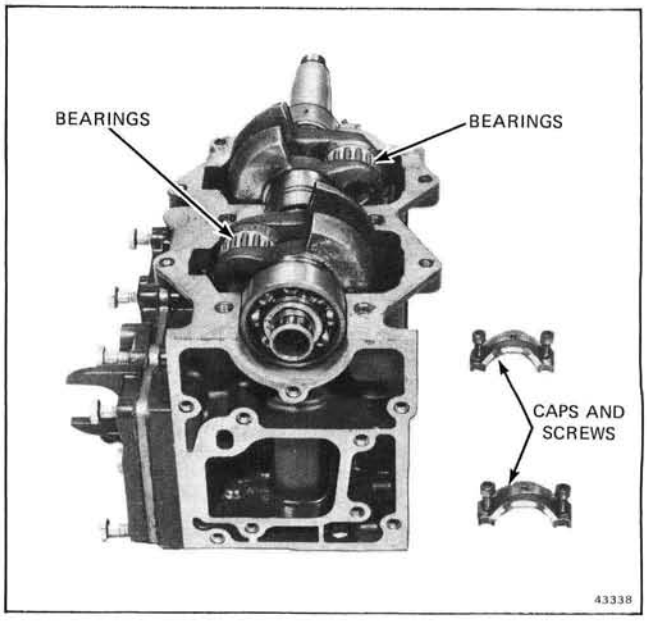


Figure 5-37. Connecting Rod Bearings

e. Install connecting rod caps, but do not torque the screws at this time. See Figure 5-38.

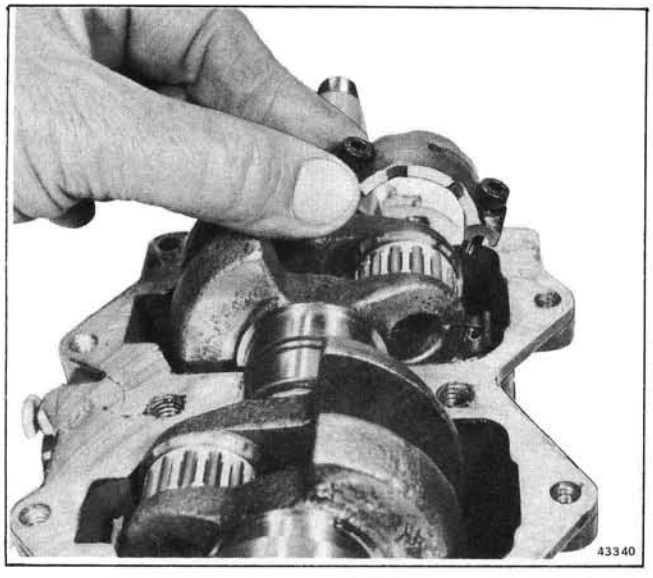


Figure 5-38. Installing Connecting Rod Caps

NOTE

One side of connecting rod and cap has raised dots, see insert, Figure 5-39, and the corners are also chamfered for alignment of rod and cap. See Figure 5-39. Connecting rod caps are not interchangeable with those of other rods, nor can they be turned end for end.

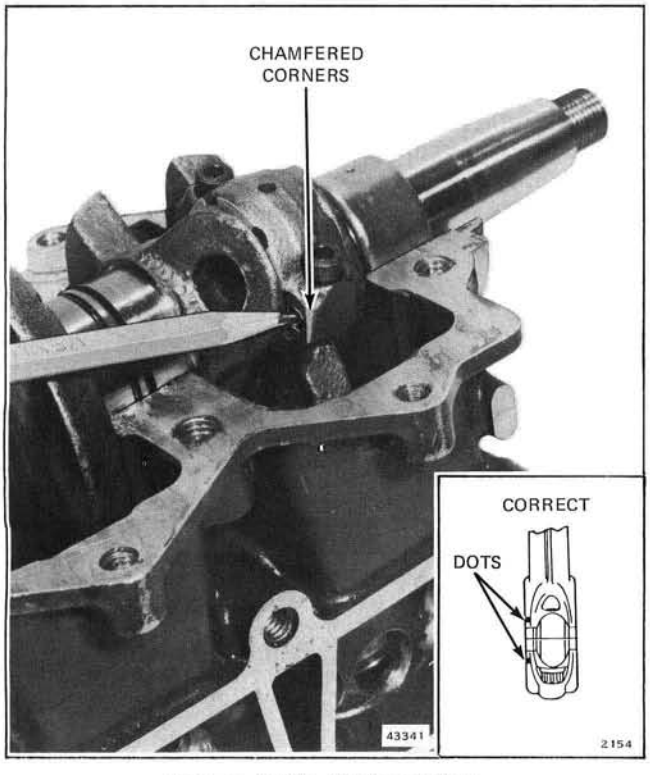


Figure 5-39. Rod and Cap Alignment Surfaces

Draw a pencil over the chamfered corners on both sides of rod to make certain that cap and rod are aligned at this point. If misaligned, the chamfered corners can be felt with the pencil point. See Figure 5-39. If misaligned, tap lightly with a punch and hammer.

f. Tighten connecting rod screws to torque specified in Section 2, using a torque wrench. Rods and bearings should float on crankpins. See Figure 5-40.

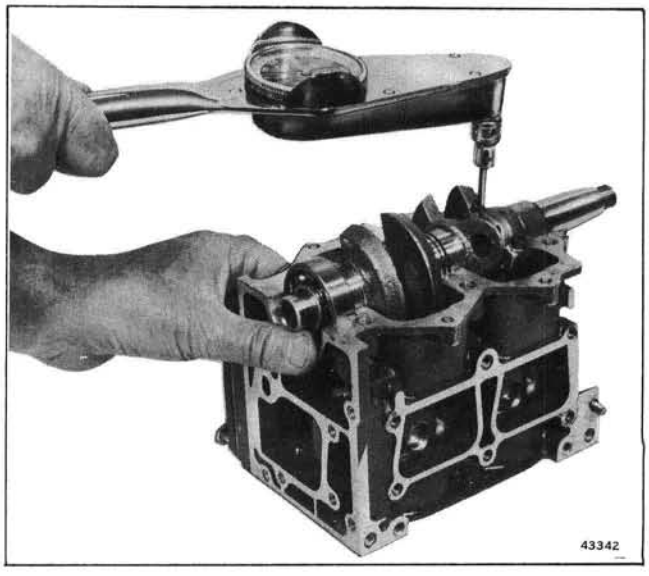


Figure 5-40. Tightening to Specified Torque

CRANKCASE AND CYLINDER

a. Clean the crankcase flange with OMC Locquic Primer (Part Number 384884). Squeeze out a 3/16" (5 mm) ball of Gel Seal (Part Number 322702) and dab it along one crankcase flange. Keep it 1/4" away from each labyrinth seal. Treat the other crankcase flange the same way.

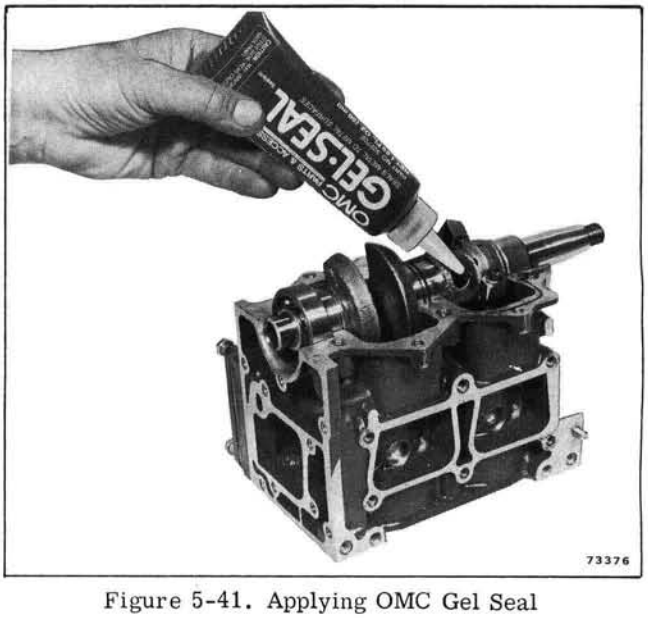


Figure 5-41. Applying OMC Gel Seal

b. Position crankcase on cylinder block, and install screws finger tight using OMC Adhesive "M" on the two center main screws. Replace crankcase taper pin, driving in carefully with a hammer. Rap bottom end of crankshaft with mallet to seat ball bearings and center crank throws in crankcase.

c. Check for binding between the crankshaft and the bearings or connecting rods by rotating the crankshaft with the flywheel.

d. Tighten the 6 center crankcase screws to torque specified in Section 2. See Figure 5-42. Tighten remaining smaller crankcase screws to specified torque in Section 2.

e. Install upper main bearing seal using seal installer (Special Tool #319872). See Figure 5-42.

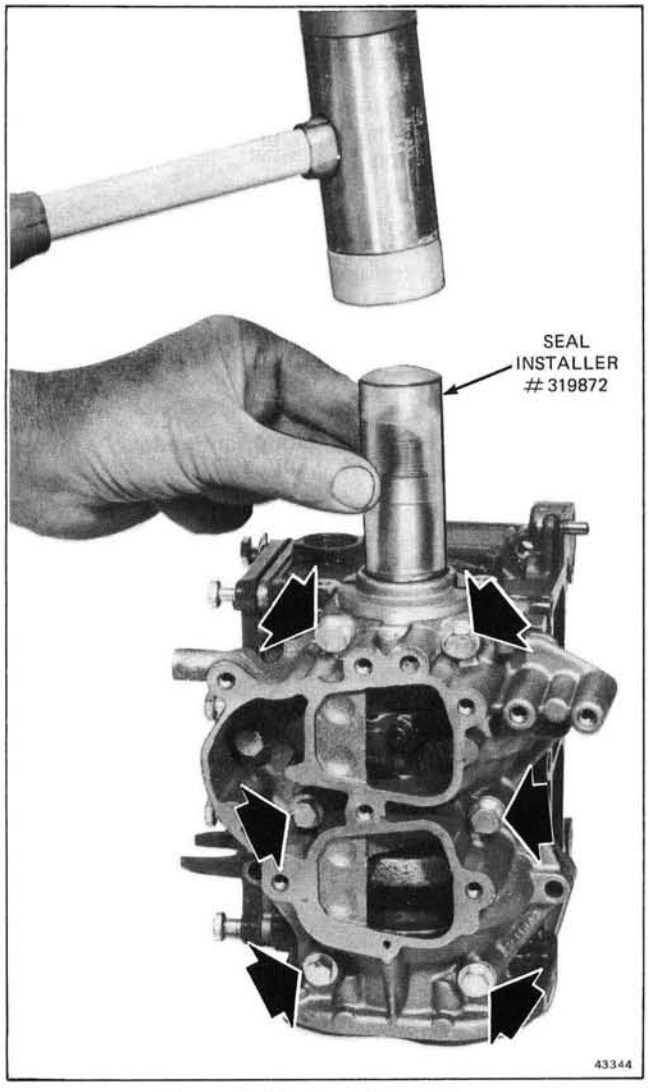


Figure 5-42. Installing Upper Main Bearing Seal

f. Install new seal in crankcase head, lip facing up, using seal installer (Special Tool #319879). See Figure 5-43. Place new "O" ring in groove in crankcase head and install on crankcase. Torque screws to specifications in Section 2.

g. Install cylinder head, using a new gasket coated lightly with OMC Gasket Sealing Compound. Do not use sealer if so stated on the gasket. Tighten cylinder head bolts to specified torque, following the sequence shown in Figure 5-44.

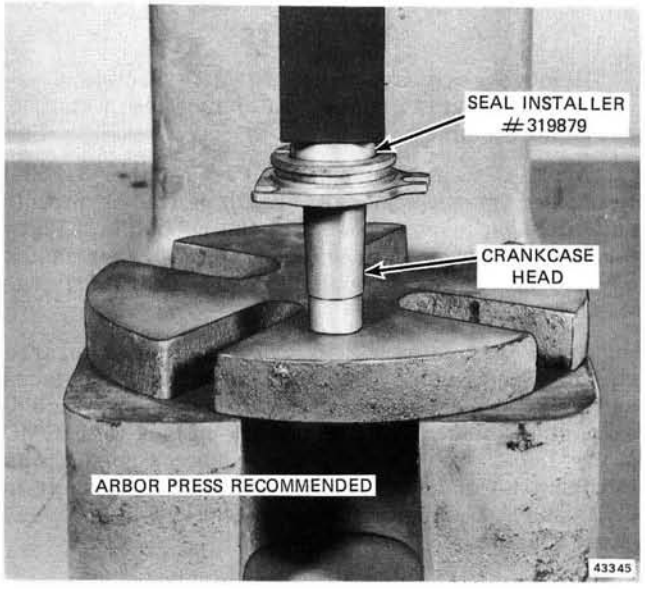


Figure 5-43. Installing Seal

NOTE

Re-torque cylinder head screws after motor test has been completed and motor has cooled comfortable to touch. See Section 2.

h. Reinstall thermostat. Install cylinder head cover, using a new gasket.

i. Install inner and outer exhaust covers using new gaskets. Tighten all screws to specified torque. See Section 2.

j. Install by-pass covers.

k. Install exhaust and water tube assembly using a new water tube grommet and a new crankcase-to-exhaust housing gasket. See Figure 5-45.

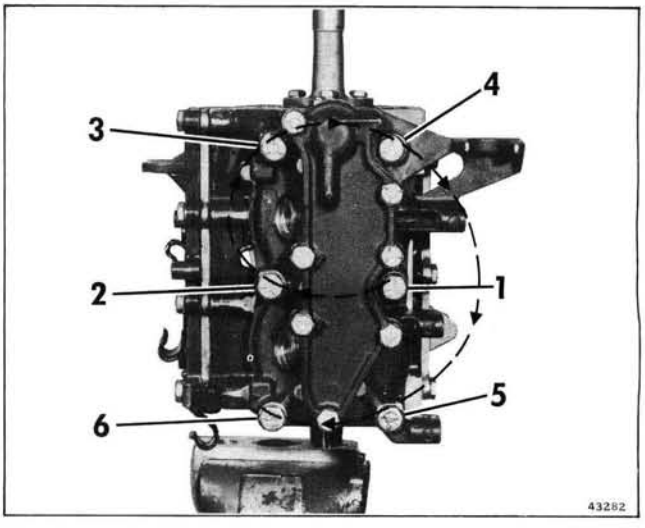


Figure 5-44. Cylinder Head Torquing Sequence

1. Install leaf plate and intake manifold using new gaskets. Be sure to install gaskets correctly. Torque screws to specifications in Section 2.

INSTALLATION OF POWERHEAD

NOTE

Remove gearcase as described in Section 6. This is to aid in guiding water tube into water pump grommet.

a. Apply OMC Adhesive "M" (Part Number 318535) to rubber mount washers. Position rubber mounts and sleeves in power head mounting points. Place large washers over mounting holes in lower motor cover. Place three small washers over the large washers.

b. Apply Permatex #2 to crankcase head in area shown. See Figure 5-45. Clean gasket surfaces and apply OMC Gasket Sealing Compound to face of exhaust housing. Coat driveshaft splines with OMC Moly Lube. Do not coat top surface of shaft as lubricant here may prevent seating of driveshaft in crankshaft. Carefully lower power head onto exhaust housing.

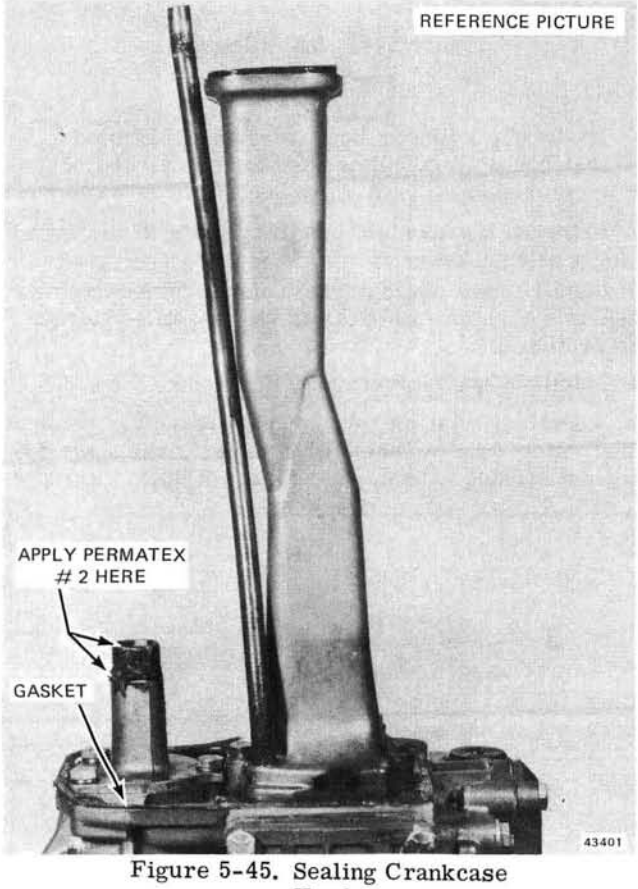


Figure 5-45. Sealing Crankcase Head

NOTE

Use a suitable tool to align rubber mount washers with threaded holes in lower motor cover.

c. Position small washers and then large washers over rubber mounts and install screws.

d. Install exhaust to power head screws with two longer screws in aft holes. Tighten to specifications in Section 2.

e. Install gearcase as described in Section 6.

f. Lubricate cross shaft through two fittings with OMC Anti-Corrosion Lube. See Figure 6-7.

g. Install vertical throttle shaft.

h. Install armature plate retainer, support plate, armature plate, flywheel, ignition coils and wiring as described in Section 4.

i. Attach shift lock lever and hub assembly to power head with screw, inner and outer bushings lubricated with OMC Anti-Corrosion Lube and washer.

j. Attach spring detent to power head loosely with upper screw. Adjust shift link as described in Section 6.

k. Install carburetor, fuel pump, and manual starter as described in Sections 3 and 8.

l. Install electric starter and adjust start in neutral switch as described in Section 7 (electric start models).

m. Adjust neutral speed stop as described in Section 4.

n. Tank test motor with proper test propeller, specifications, Section 2, and adjust carburetor.

BREAK-IN

Be sure that when an engine is returned to service after an overhaul, the owner is advised to follow break-in procedures exactly. See Break-In, Section 2.

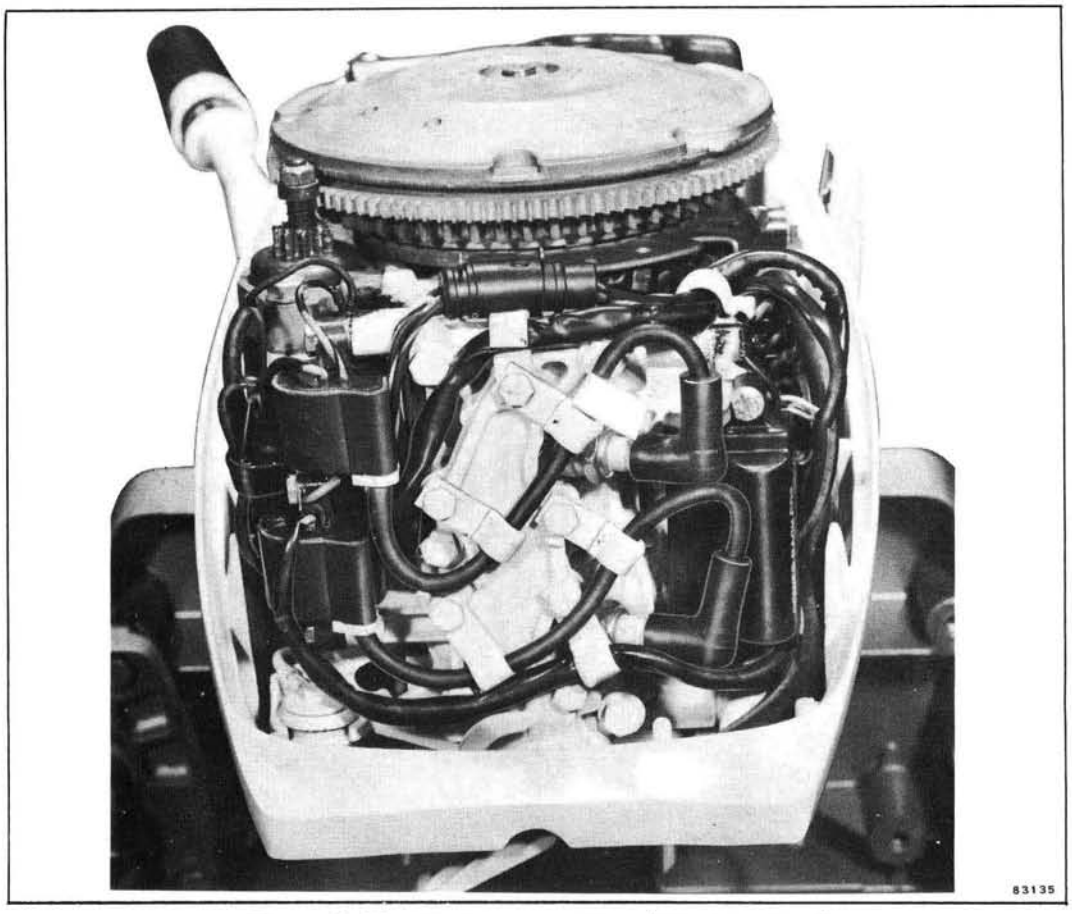


Figure 5-46. Aft Reference View (Electric Start)

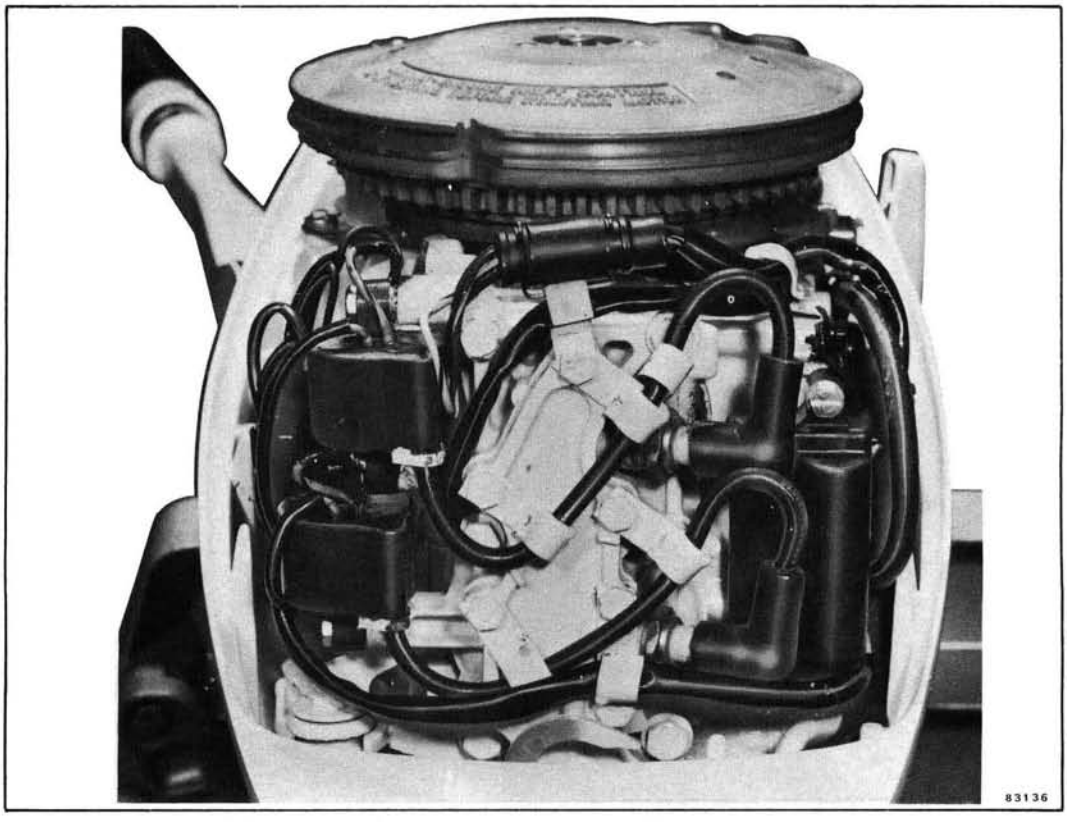


Figure 5-47. Aft Reference View (Manual Start)

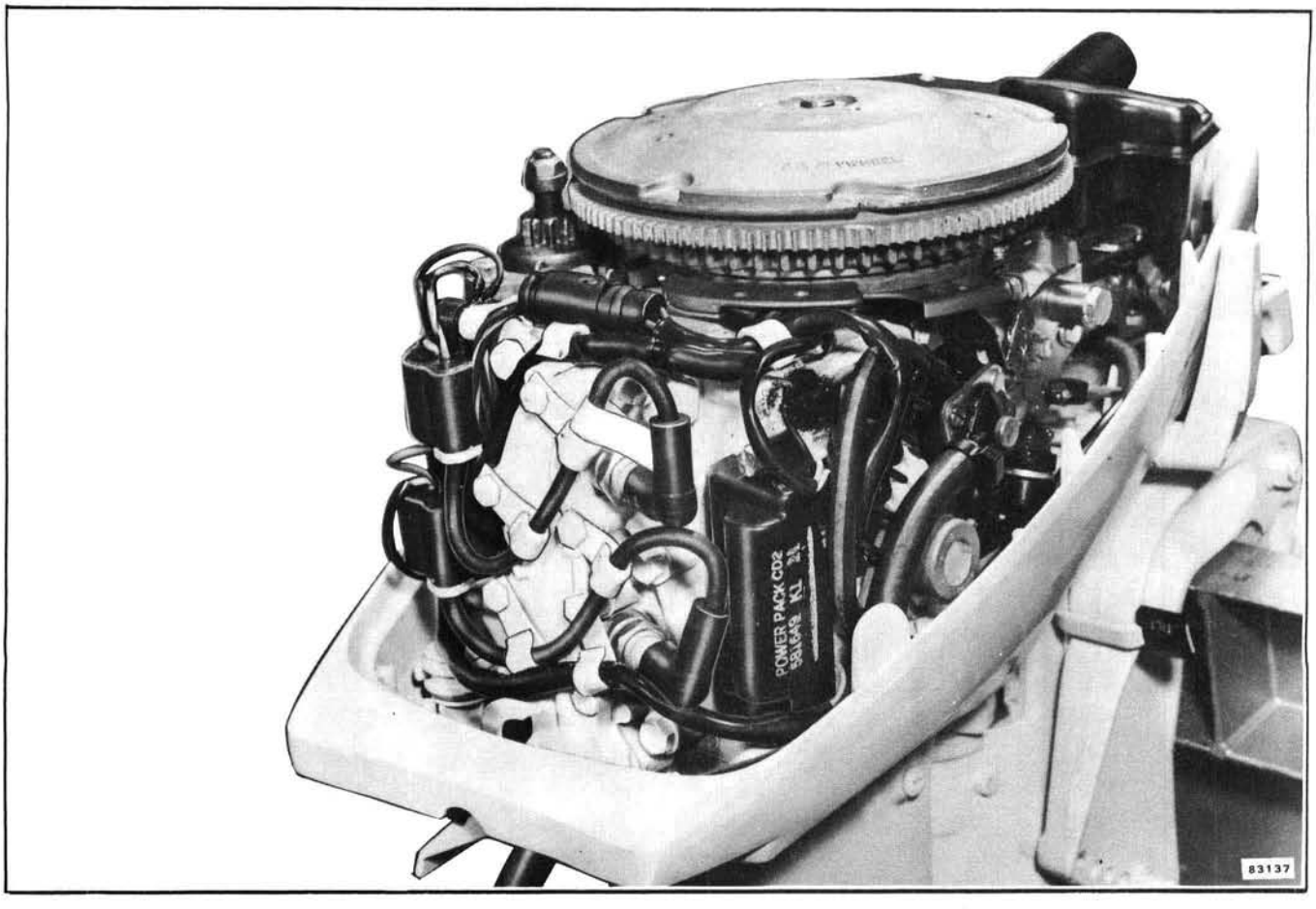


Figure 5-48. Starboard Reference View (Electric Start)

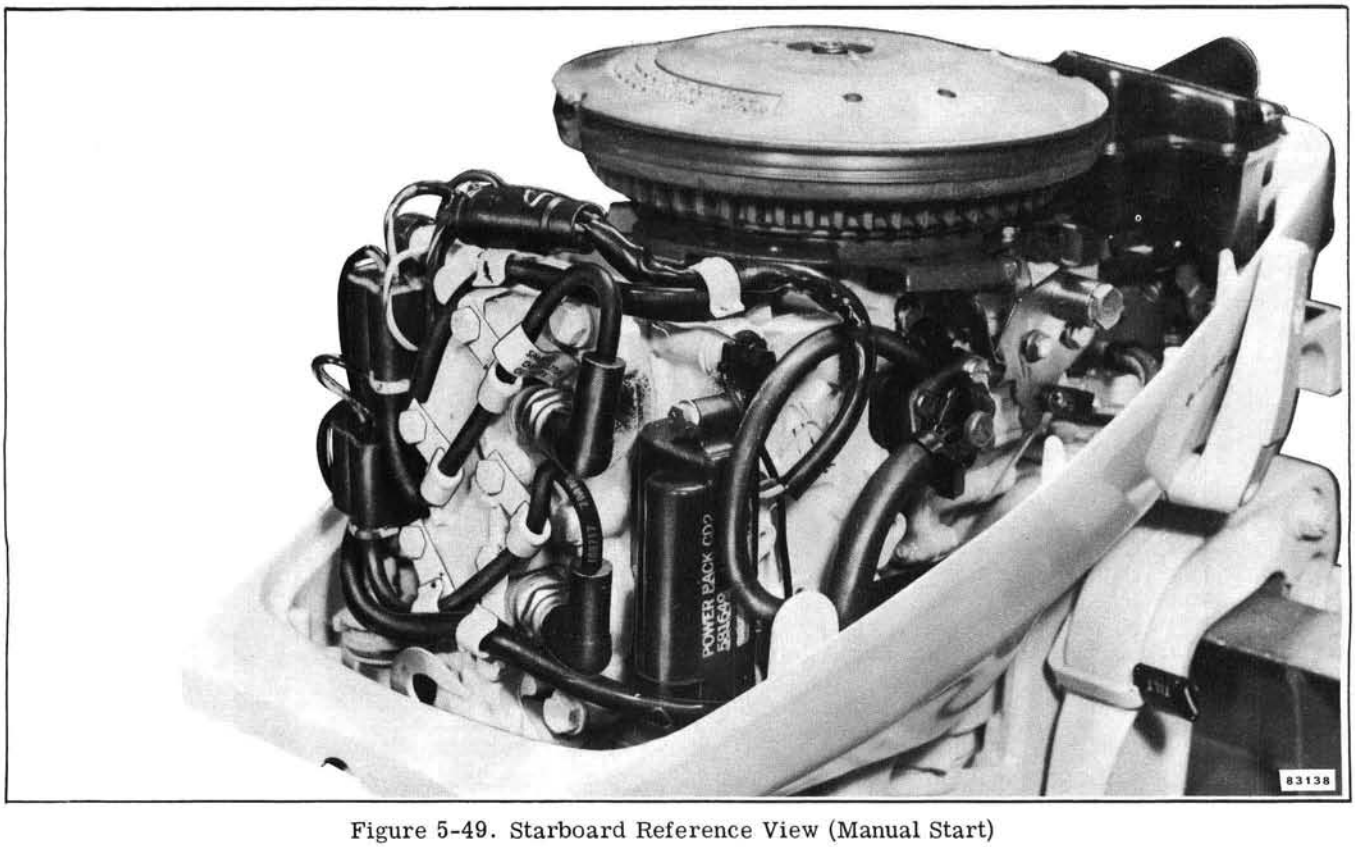


Figure 5-49. Starboard Reference View (Manual Start)

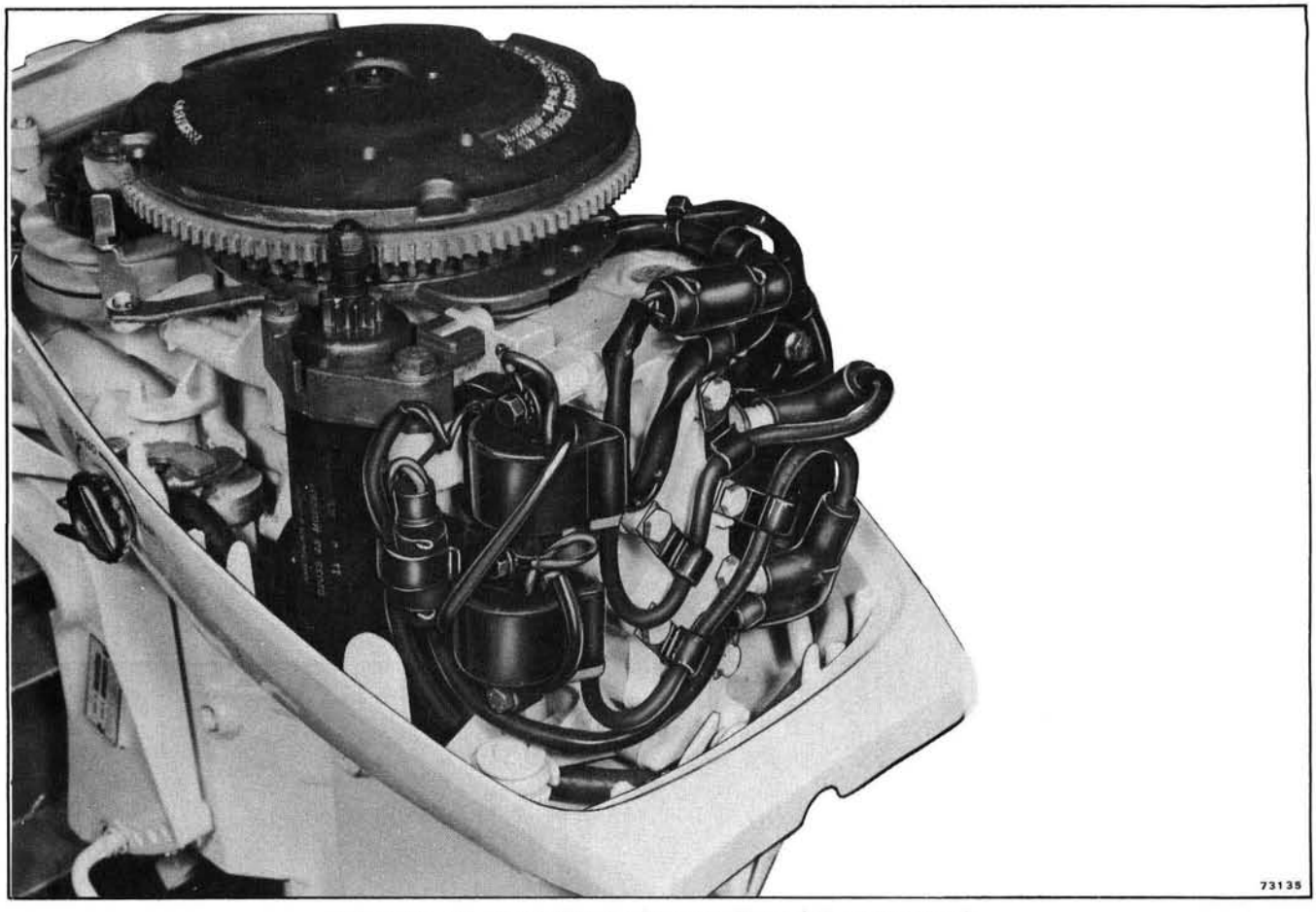


Figure 5-50. Port Side Reference View (Electric Start)

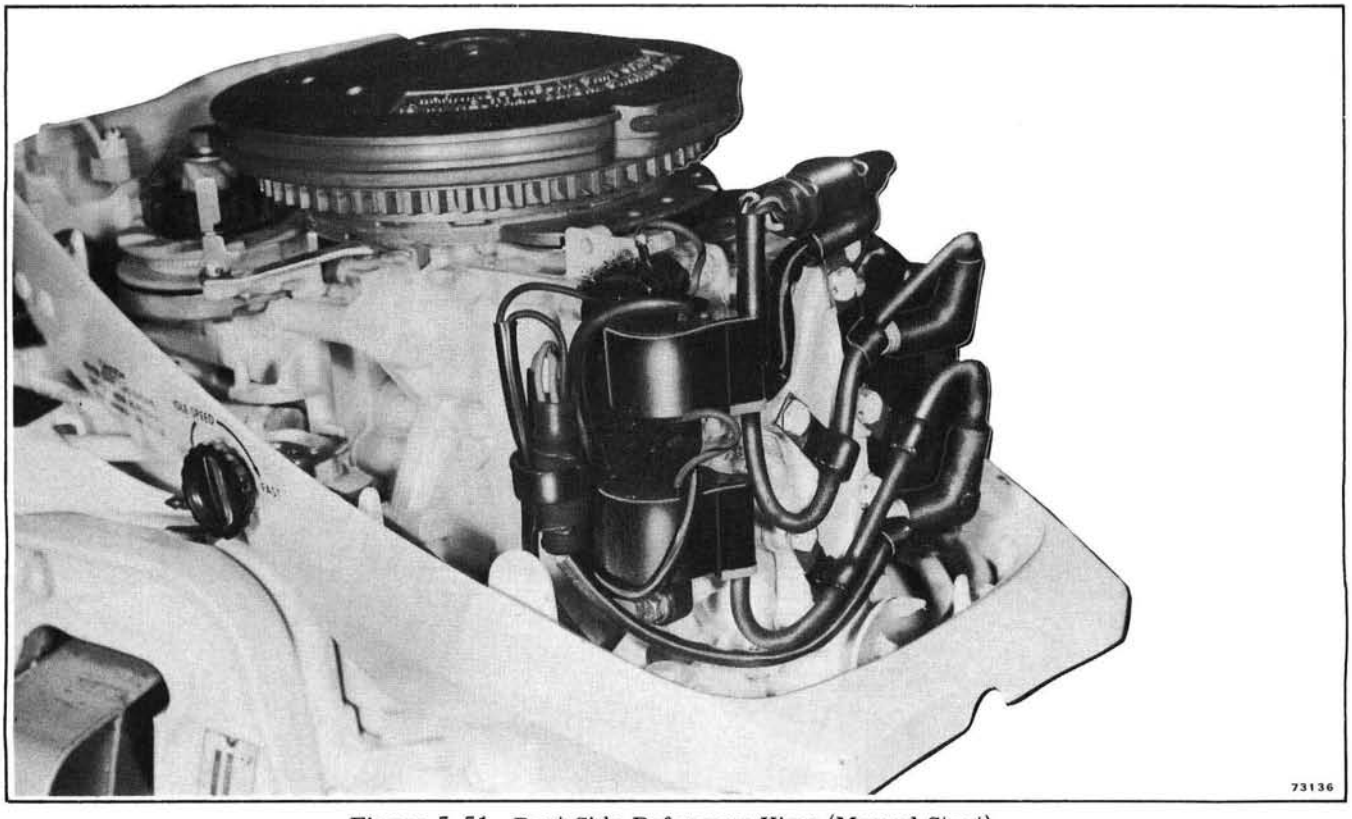


Figure 5-51. Port Side Reference View (Manual Start)

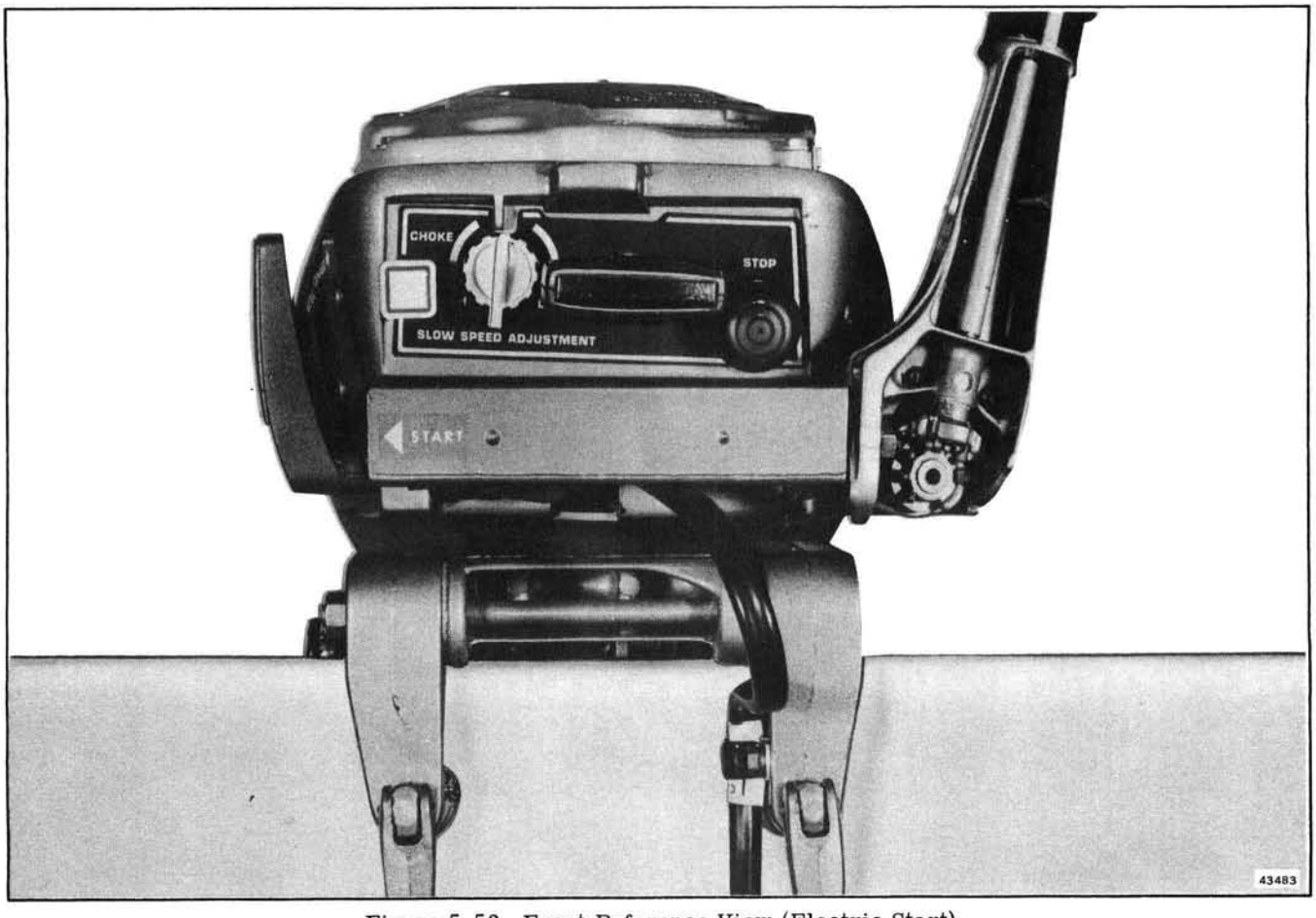


Figure 5-52. Front Reference View (Electric Start)

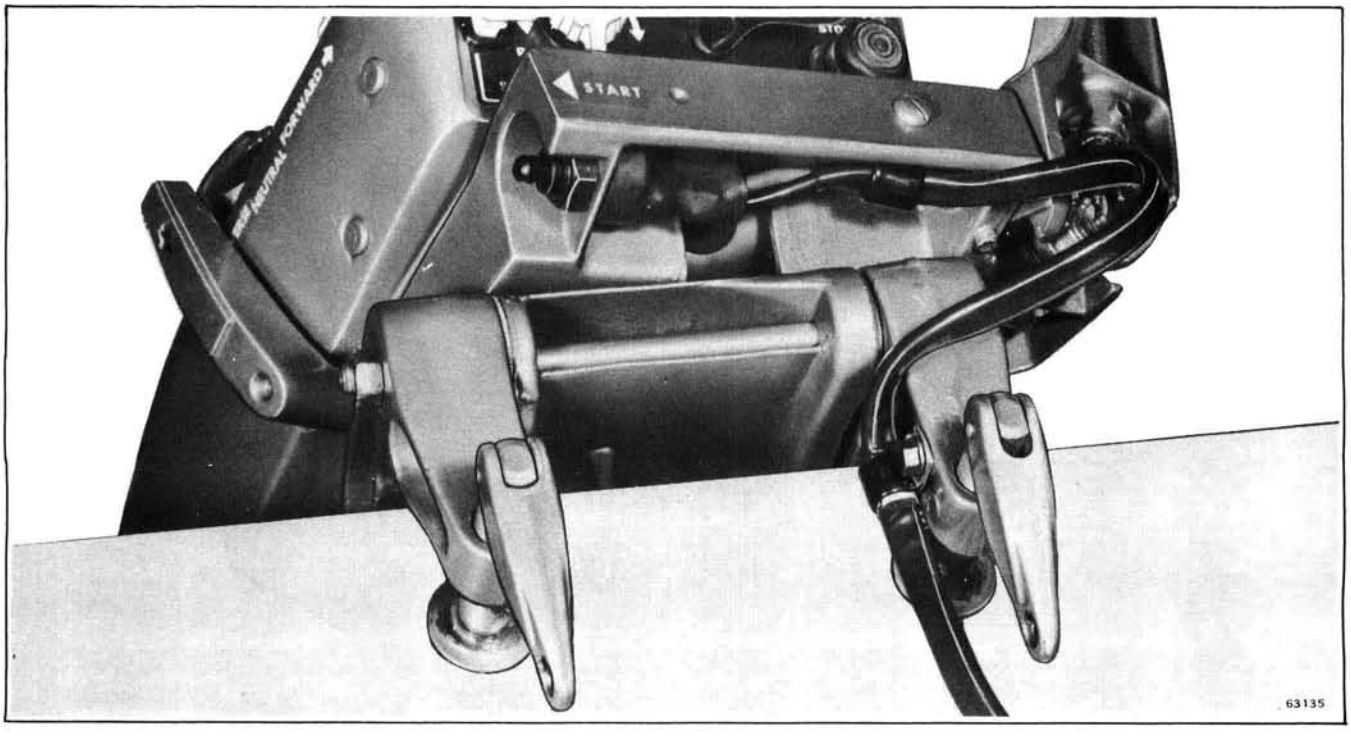


Figure 5-53. Electric Start Switch and Battery Cable