SERVICE REPAIR

MANUAL

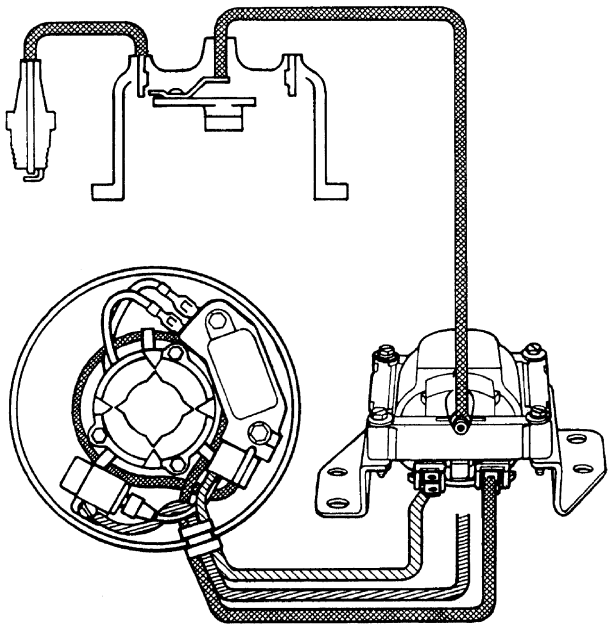
Hyster C187 (S40XL, S50XL, S60XL) Forklift

HYSTER

HIGH ENERGY IGNITION (HEI) SYSTEM

GM ENGINES

S30-120E, S40-50F, S3.50-5.50XL (S70-120XL), S3.50-5.50XM (S70-120XM), S6.00-7.00XL (S135-155XL), H30-60H, H60-110E, H110-150F, H3.50-5.00XL (H70-110XL), H6.00-7.00XL (H135-155XL), H3.50-5.50XM (H70-120XM), H150-250E, H150-275H, H250-300A, H300-350B, P150-200B, A66-80A, Z90A, S/H2.00-3.20XM (GM 3.0 LITER WHEN EQUIPPED WITH LPG), M200-400H, GM 6.0 LITER V8-366 ENGINE WHEN USED IN H8.00-12.00XL (H165-280XL), H13.00-16XL (H300-360XL), H10.00XL-12EC (H330XL-EC), H12.00XL-12EC (H360XL-EC)



HM080448

HYSTER

PART NO. 899788

2200 SRM 107

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks.
- Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **HYSTER APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

NOTE: The following symbols and words indicate safety information in this manual:

WARNING

Indicates a condition that can cause immediate death or injury!

CAUTION

Indicates a condition that can cause property damage!

TABLE OF CONTENTS

This section is for the following models:

S30-120E, S40-50F, S3.50-5.50XL (S70-120XL), S3.50-5.50XM (S70-120XM), S6.00-7.00XL (S135-155XL), H30-60H, H60-110E, H110-150F, H3.50-5.00XL (H70-110XL), H6.00-7.00XL (H135-155XL), H3.50-5.50XM (H70-120XM), H150-250E, H150-275H, H250-300A, H300-350B, P150-200B, A66-80A, Z90A, S/H2.00-3.20XM (GM 3.0 liter when equipped with LPG), M200-400H, GM 6.0 liter V8-366 engine when used in H8.00-12.00XL (H165-280XL), H13.00-16XL (H300-360XL), H10.00XL-12EC (H330XL-EC), H12.00XL-12EC (H360XL-EC)

"THE
QUALITY
KEEPERS"

HYSTER
APPROVED
PARTS

Description

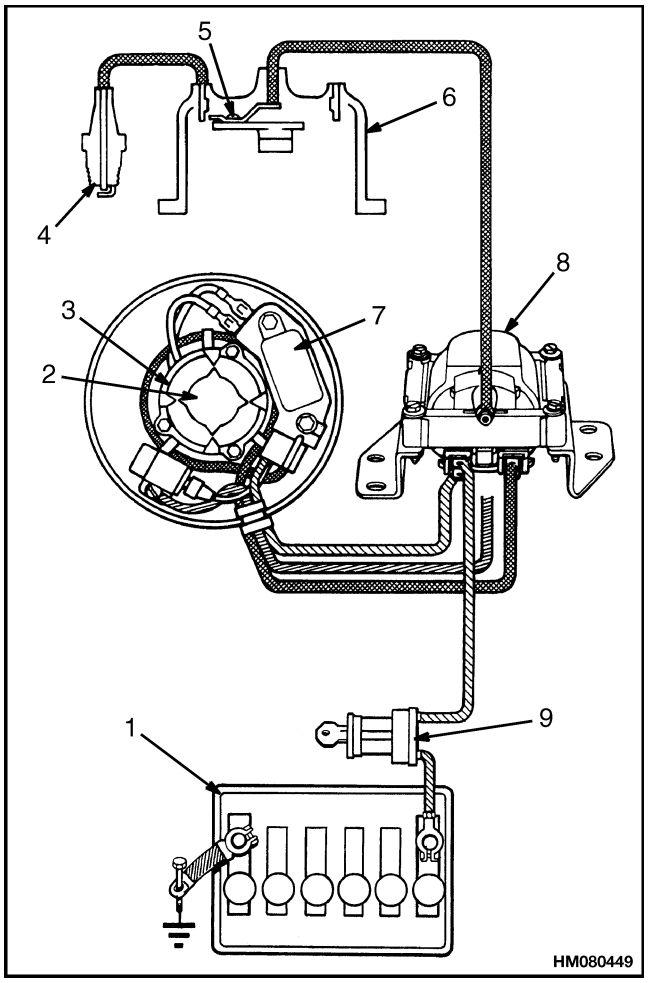
This section has a description and the service procedures for the High Energy Ignition (HEI) system for General Motors engines. See Figure 1.

The High Energy Ignition (HEI) system generates the spark which starts combustion. The main parts of the system are: the battery, key switch, distributor, ignition coil, spark plugs, and the wires. If the engine is starting or running, current flows from the battery to the key switch, primary winding of the ignition coil, electronic module and returns to the battery. A magnetic field is generated in the primary winding of the coil when current flows through it. The pole piece and sensing coil sends a signal to the electronic module to interrupt primary current. When the current flow in the primary windings are interrupted, the decreasing magnetic field generates a high voltage in the secondary windings of the coil.

The distributor rotor applies the secondary (high) voltage to the correct spark plug at the correct time. The secondary voltage is applied to the rotor. The rotor transfers this high voltage to one of the terminals in the distributor cap. When the high voltage is applied through the high voltage wire to the spark plug, the spark in the spark plug starts combustion in the cylinder.

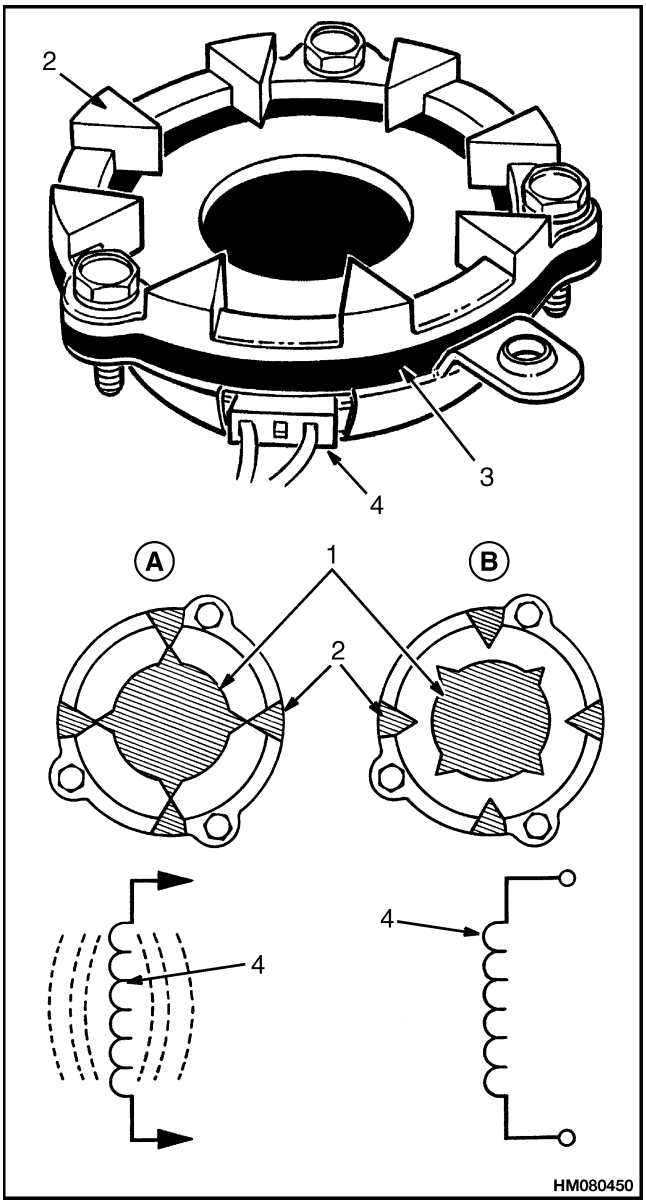
The parts that generate the voltage signal for the electronic module are shown in Figure 2. The timer core of the distributor shaft has a tooth for each cylinder in the engine. The pole piece also has a tooth for each cylinder. A permanent magnet is fastened under the pole piece. A sensing coil is put in the center of the magnet and pole piece. When the teeth are aligned, the magnetic field from the permanent magnet will have a path. The magnetic field generates a voltage signal in the sensing coil. When the teeth are not aligned, the magnetic path is removed. This disables the magnetic field and the voltage signal.

The electronic module is an electronic switch which controls the current in the primary of the ignition coil. The basic circuit is shown in Figure 3. When the electronic module receives a voltage signal from the sensing coil, the electronic module activates ON. Current now flows through the primary winding of the ignition coil. The flow of current generates a magnetic field around both windings. When the sensing coil removes the voltage signal, the electronic module deactivates OFF. Current stops flowing in the primary winding. The magnetic field decreases quickly. This changing magnetic field generates a high voltage in the secondary winding.



1. BATTERY
2. TIMER CORE
3. POLE PIECE/SENSING COIL
4. SPARK PLUG
5. ROTOR
6. DISTRIBUTOR CAP
7. ELECTRONIC MODULE
8. IGNITION COIL
9. KEY SWITCH

Figure 1. HEI System

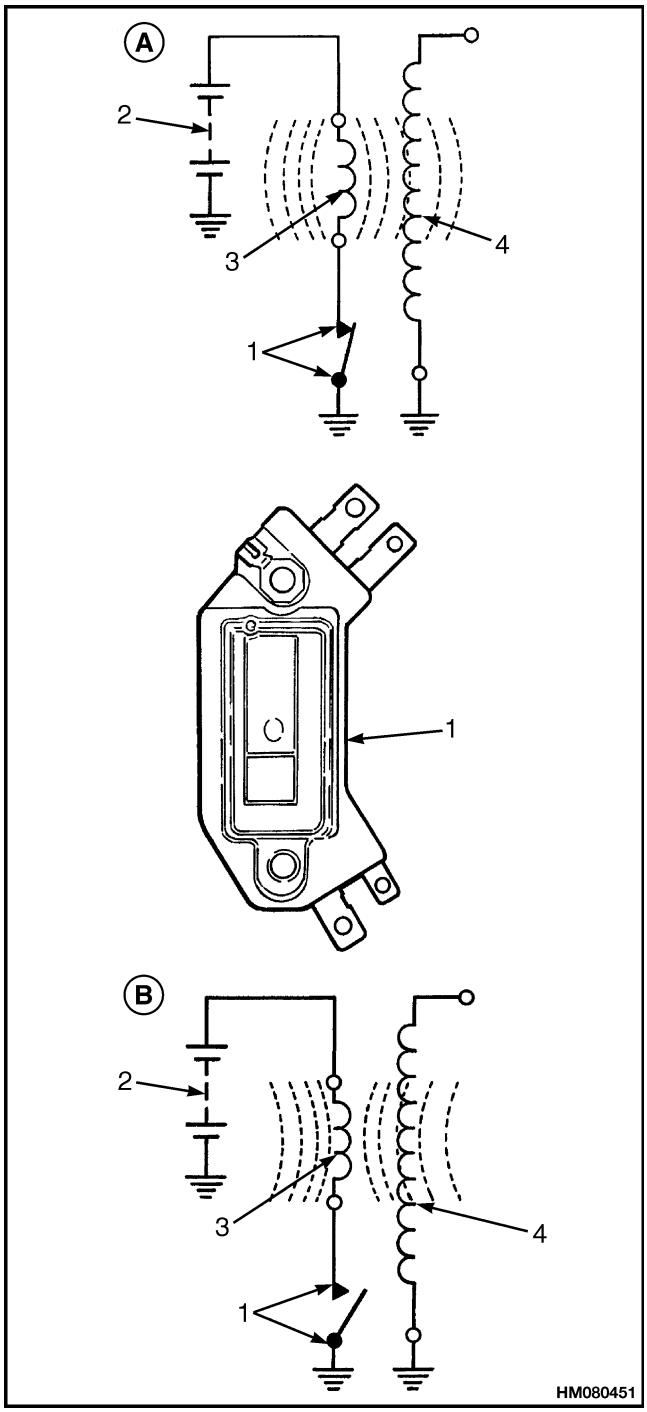


A. TEETH ALIGNED

B. TEETH NOT ALIGNED

1. TIMER CORE
2. POLE PIECE
3. PERMANENT MAGNET
4. SENSING COIL

Figure 2. Voltage Signal



A. MODULE "ON"

B. MODULE "OFF"

1. ELECTRONIC MODULE
2. BATTERY
3. PRIMARY (IGNITION COIL)
4. SECONDARY (IGNITION COIL)

Figure 3. Electronic Module Operation

Distributor Repair

REMOVE

WARNING

Do not disconnect the spark plug wires when the engine is running. The high voltage can cause electric shock.

1. Disconnect wire from negative terminal of battery.
2. Disconnect primary wiring connector to distributor. Some distributors have the primary wiring connected to the coil and others are connected to the distributor.

NOTE: Some four- and six-cylinder models have two latch screws. Some four- and six-cylinder models and all V8 models have four latch screws.

3. Unlock latch screws that fasten the cap to the housing. Remove cap and put it away from the distributor.

CAUTION

Do not rotate the engine after making the alignment marks.

4. Make a mark on distributor housing which aligns with rotor. Make a double mark on housing and engine to use during assembly.
5. Remove capscrew and clamp that fastens distributor to engine. Clean area around base of distributor.
6. Lift distributor from engine.

DISASSEMBLE

1. Remove distributor from engine according to the above procedure.
2. If installed, remove two screws that fasten rotor to shaft assembly. Remove rotor.

CAUTION

Do not clean the lubricant from the electronic module or the area where it is fastened.

3. If needed, remove electronic module as follows:
   a. Distributors shown in Figure 4, Figure 5, and Figure 6: Remove two screws which fasten electronic module to housing. Move electronic module to a position where connector can be removed from B and C terminals. Remove connector from electronic module. Carefully disconnect wires from W and G terminals. Remove electronic module. If installed, remove screw from capacitor. Disconnect capacitor from wire connector. Remove capacitor.
   b. Distributors shown in Figure 7: Remove three screws that fasten electronic module, wiring harness, and capacitor to housing. Disconnect connector for the green and white wire from the electronic module. Remove electronic module, wiring harness, and capacitor from the housing.
4. Make a mark on gear and shaft which can be aligned during assembly.

CAUTION

Do not damage the shaft when removing the gear. Hold the gear on a block of wood while removing the pin.

5. Remove pin from gear. Remove gear, shim, and thrust washer if used.

CAUTION

Make sure the roll pin area of the shaft is smooth before removing the shaft.

6. Remove shaft assembly from housing.

CAUTION

Do not disassemble the pole piece/sensing coil. If damaged, replace as a unit.

7. Remove snap ring/retainer from top of sleeve in center of housing. Remove pole piece/sensing coil and shield, if installed from the sleeve.

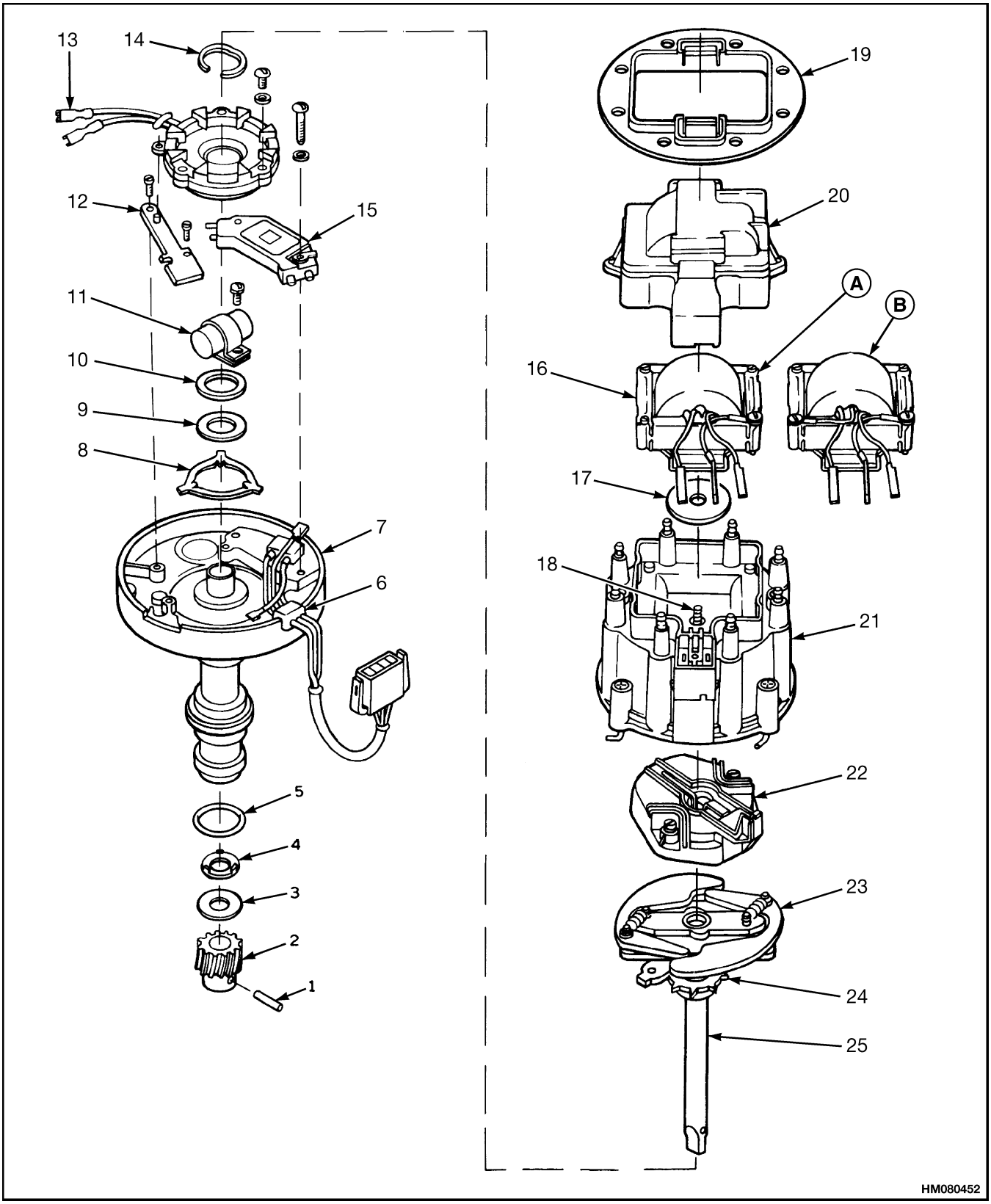


Figure 4. GM-V8, Some Models

Legend for Figure 4

A. DESIGN 1

1. PIN
2. DRIVE GEAR
3. SHIM
4. THRUST WASHER
5. O-RING
6. WIRING HARNESS
7. HOUSING
8. WIRE RETAINER
9. FELT WASHER

B. DESIGN 2

10. SHIM
11. CAPACITOR
12. SPACER RETAINER
13. POLE PIECE/SENSING COIL
14. SNAP RING
15. ELECTRONIC MODULE
16. IGNITION COIL
17. SEAL
18. SPRING
19. WIRE RETAINER
20. COIL COVER
21. CAP
22. ROTOR
23. CENTRIFUGAL MECHANISM
24. TIMER CORE
25. SHAFT

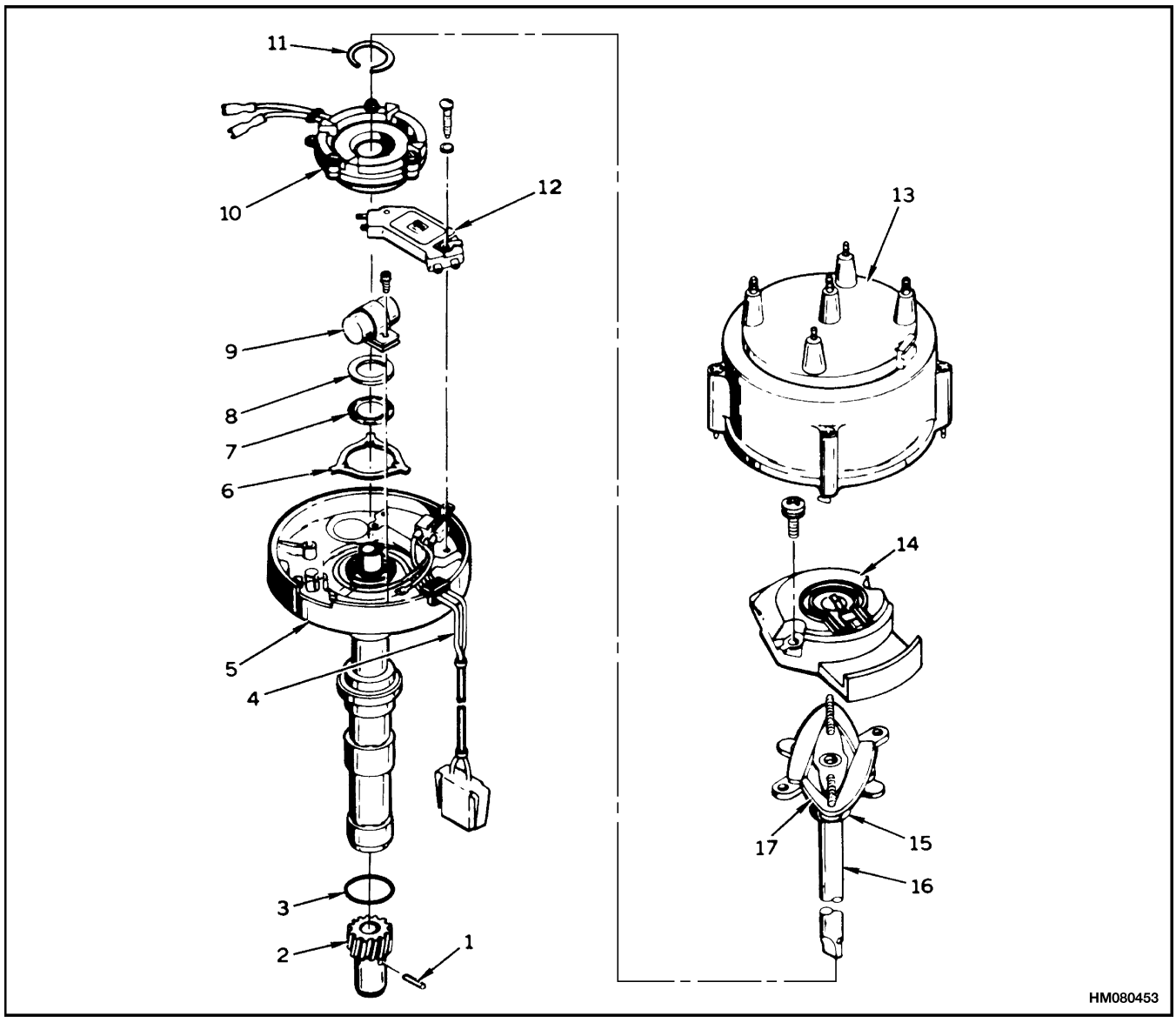
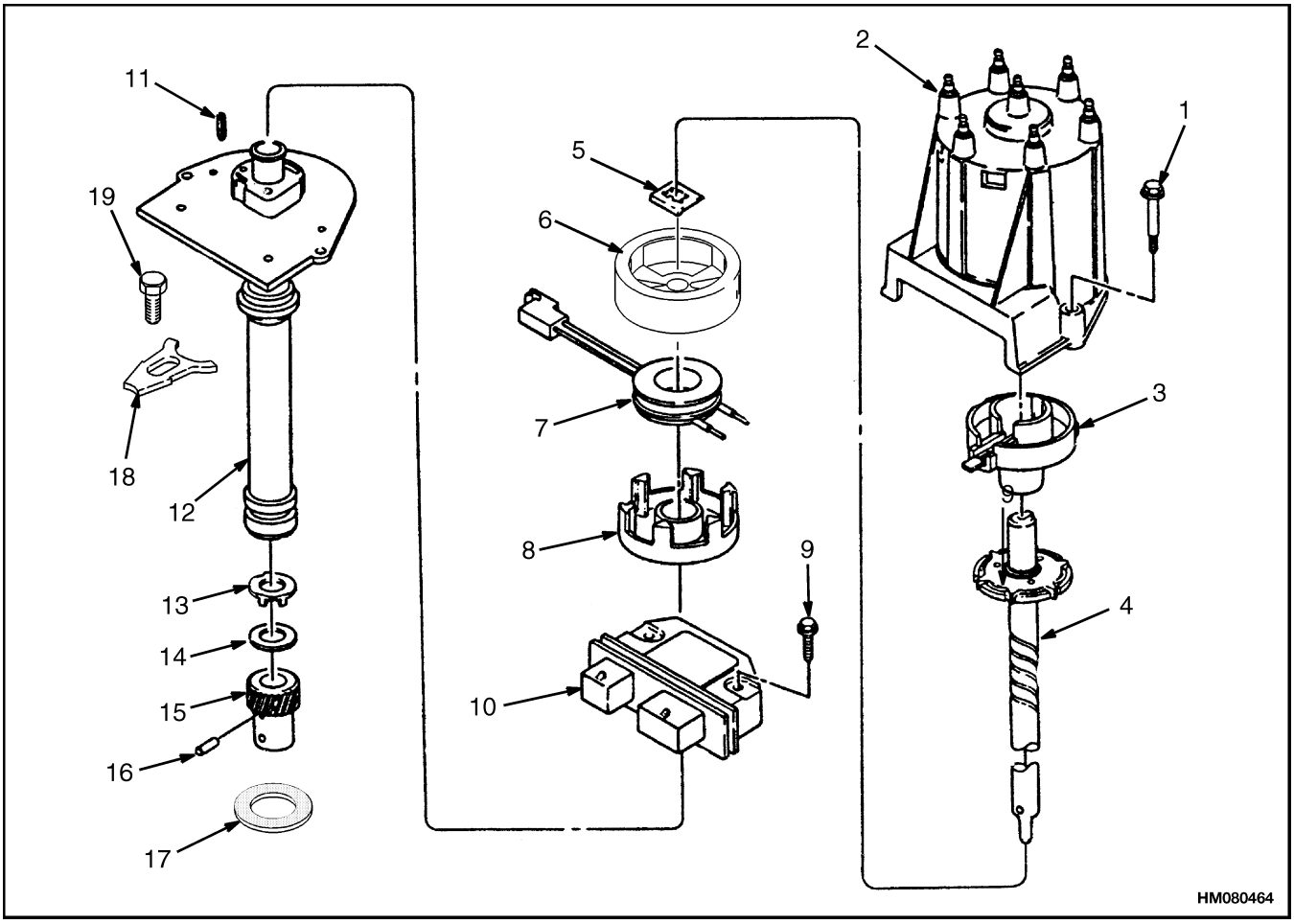


Figure 5. GM Four-Cylinder and Six-Cylinder Models with Separate Coil

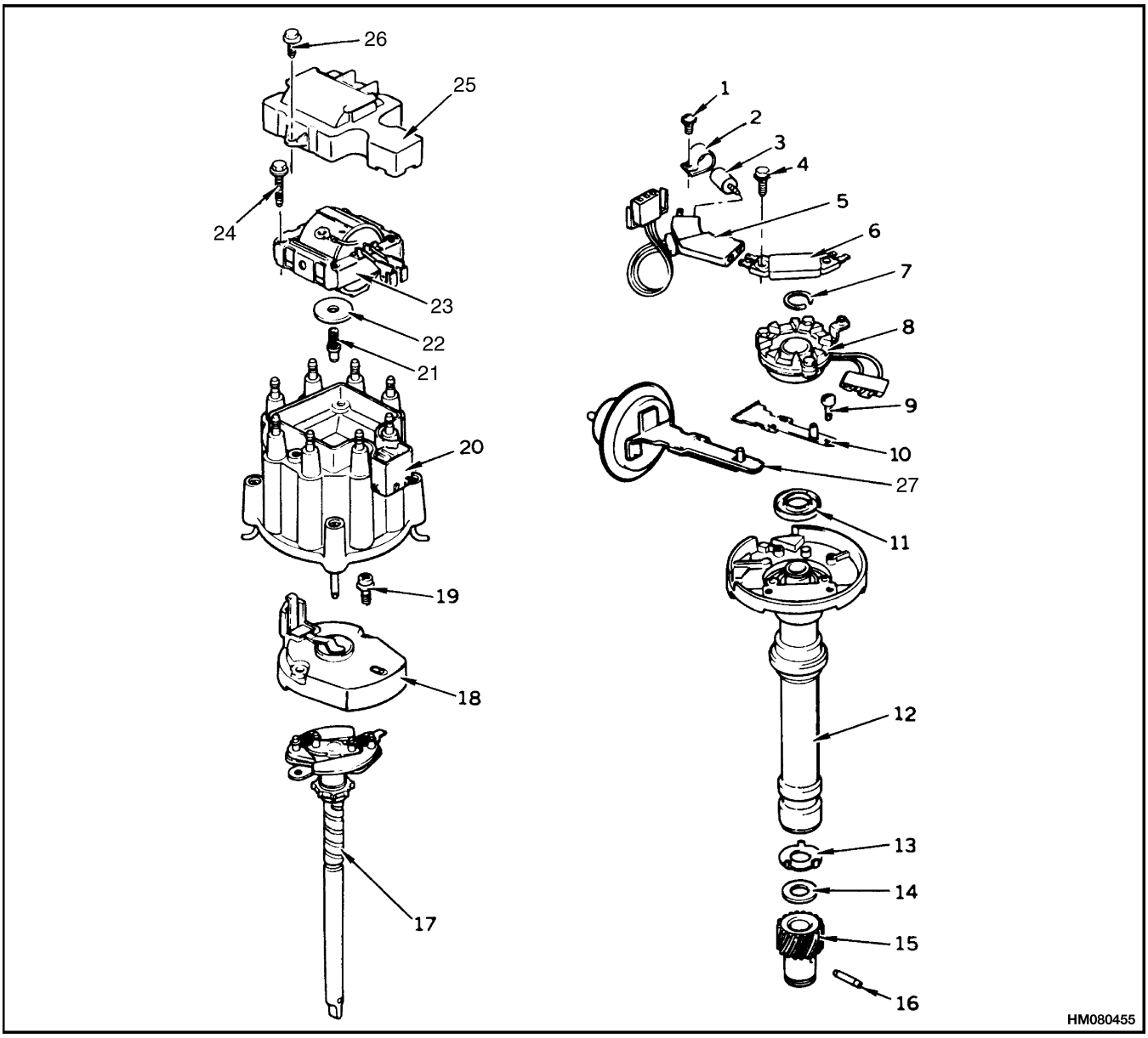
Legend for Figure 5

1. PIN
2. DRIVE GEAR
3. O-RING
4. WIRING HARNESS
5. HOUSING
6. WIRE RETAINER
7. FELT WASHER
8. SHIM
9. CAPACITOR
10. POLE PIECE/SENSING COIL
11. SNAP RING
12. ELECTRONIC MODULE
13. CAP (FOUR-CYLINDER SHOWN)
14. ROTOR
15. TIMER CORE
16. SHAFT
17. CENTRIFUGAL MECHANISM



1. SCREW
2. DISTRIBUTOR CAP
3. ROTOR
4. SHAFT ASSEMBLY
5. RETAINER
6. SHIELD
7. SENSING COIL
8. POLE (STATIONARY)
9. BOLT
10. ELECTRONIC MODULE
11. PIN
12. HOUSING
13. THRUST WASHER
14. SHIM
15. GEAR
16. PIN
17. GASKET
18. CLAMP
19. BOLT

Figure 6. GM V6 Models



1. SCREW
2. BRACKET
3. CAPACITOR
4. SCREW
5. WIRING HARNESS
6. ELECTRONIC MODULE
7. SNAP RING
8. POLE PIECE/SENSING COIL
9. SCREW
10. SPACER RETAINER*
11. GREASE SEAL
12. HOUSING
13. THRUST WASHER*
14. SHIM*
15. GEAR
16. PIN
17. SHAFT ASSEMBLY
18. ROTOR
19. SCREW
20. DISTRIBUTOR CAP (V8 SHOWN)
21. RESISTOR BRUSH AND SPRING
22. SEAL
23. IGNITION COIL
24. SCREW
25. COVER
26. SCREW
27. VACUUM ADVANCE UNIT

*V8 ONLY

Figure 7. HEI, Some Models with Coil as Part of Distributor

CAUTION

Do not remove the bushing from the center of the housing.

8. If needed, remove spacer retainer from housing. Remove other parts as follows:

   a. On distributors shown in Figure 4 and Figure 5, remove shim, felt washer, and wire retainer from housing. Remove wiring from housing.

   b. On distributors shown in Figure 7, remove plastic retainer that seals the grease.

WARNING

Compressed air can move particles so they cause injury to the user or to other personnel. Make sure the path of the compressed air is away from all personnel. Wear protective goggles or a face shield to prevent injury to the eyes.

CAUTION

Do not use solvents with an oil base to clean electrical parts.

9. Wash housing, shaft assembly, and gear in solvent. Dry parts with compressed air.

10. Check all parts for damage. Replace damaged parts with new parts.

ASSEMBLE

1. Fill lubrication reservoir with correct lubricant. Install parts as follows:

CAUTION

On four- and six-cylinder distributors shown in Figure 5, make sure the brown wire has a circle shape.

   a. On distributors shown in Figure 4, Figure 5, and Figure 6, install wiring in correct position in housing. Install wire retainer, felt washer, and shim in housing.

   b. On distributors shown in Figure 7, install plastic retainer on top of lubrication reservoir.

2. If removed, install spacer retainer and screws. Install pole piece/sensing coil and shield if used. Make sure hole in arm of pole piece connects to pin of retainer. Install snap ring/retainer on top of sleeve. Make sure ring fits in groove.

3. Install distributor shaft. Slowly rotate shaft. Check for equal clearance between pole piece and timer teeth of shaft. If wrong, loosen three screws fastening pole piece. Move pole piece until it is in center. Tighten three screws.

4. Install gear with teeth toward housing as follows:

   a. Install thrust washer and then shim, if used. Align marks and slide gear on shaft.

CAUTION

Put a block under the gear to prevent damage when installing the gear pin.

   b. Align hole in gear with hole in shaft. Install pin to lock gear to shaft.

CAUTION

Make sure to put silicone grease (1198757) between the module and the fastening plate.

5. Install electronic module as described in the following procedures:

   a. Distributors shown in Figure 4, Figure 5, and Figure 6: If used, install capacitor, but do not tighten screw. Connect wire connector to B and C terminals on electronic module. Apply silicone grease to bottom of electronic module. Fasten electronic module to housing with two screws. Make sure screws are tight. Put wiring grommet in the notch in the housing. Connect pink wire to capacitor terminal. If a black wire is used, connect it to screw that fastens capacitor. Tighten screw. Connect white wire from sensing coil to W terminal on electronic module. Connect green wire from sensing coil to G terminal on electronic module.

   b. Distributors shown in Figure 7: Connect wiring connector to electronic module. Connect capacitor to wiring connector. Apply silicone grease to bottom of electronic module. Put wiring connector assembly into correct position in housing. Make sure wiring grommet fits into notch. Install three fastening

screws and tighten. Install connector for green and white wires to electronic module.

CAUTION

The notch on the rotor must fit into the tooth of the centrifugal mechanism.

6. Install rotor and two screws to shaft assembly. Tighten screws.

INSTALL, IF CRANKSHAFT WAS NOT ROTATED WHEN DISTRIBUTOR WAS REMOVED

1. Turn rotor 1/8 turn to the left, past the mark put on the housing during removal.

NOTE: If needed, turn rotor until gears align correctly. The rotor must align with the mark on the housing after installation.

2. Push distributor into position in block. Turn housing until the double mark on the housing aligns with the marks on the engine.

3. Install distributor clamp and capscrew.

CAUTION

The tooth on the bottom of the cap must fit into the notch in the housing.

4. Put distributor cap on housing. Lock cap to housing with four latch screws. The early four- and six-cylinder distributors use only two latch screws.

5. Connect primary wiring harness to distributor.

   a. Some four- and six-cylinder models, connect connector to coil.

   b. V8 350 and some four- and six-cylinder models, connect connector at side of distributor.

6. If removed, connect battery wire to negative terminal of battery. Tighten nut on capscrew.

7. Adjust ignition timing according to the procedure in Ignition Timing Adjustment.

INSTALL, IF CRANKSHAFT WAS ROTATED WHEN DISTRIBUTOR WAS REMOVED

1. Find ignition position of the number one cylinder as follows:

   a. Remove valve cover (left valve cover on V8 350).

   b. Rotate crankshaft until inlet valve closes.

   c. Rotate crankshaft 1/3 turn more. Stop crankshaft when timing mark on pulley aligns with TDC mark.

2. Hold distributor just above the installation position. Rotate distributor rotor until it is aligned with number one terminal.

NOTE: If needed, turn rotor until gears align correctly. If needed, rotate oil pump driveshaft with a screwdriver so distributor shaft aligns with oil pump drive. The rotor must align with the number one terminal of the distributor cap. (See Figure 8.)

3. Push distributor into position in block. Turn housing until double mark on housing aligns with marks on engine.

4. Install distributor clamp and capscrew.

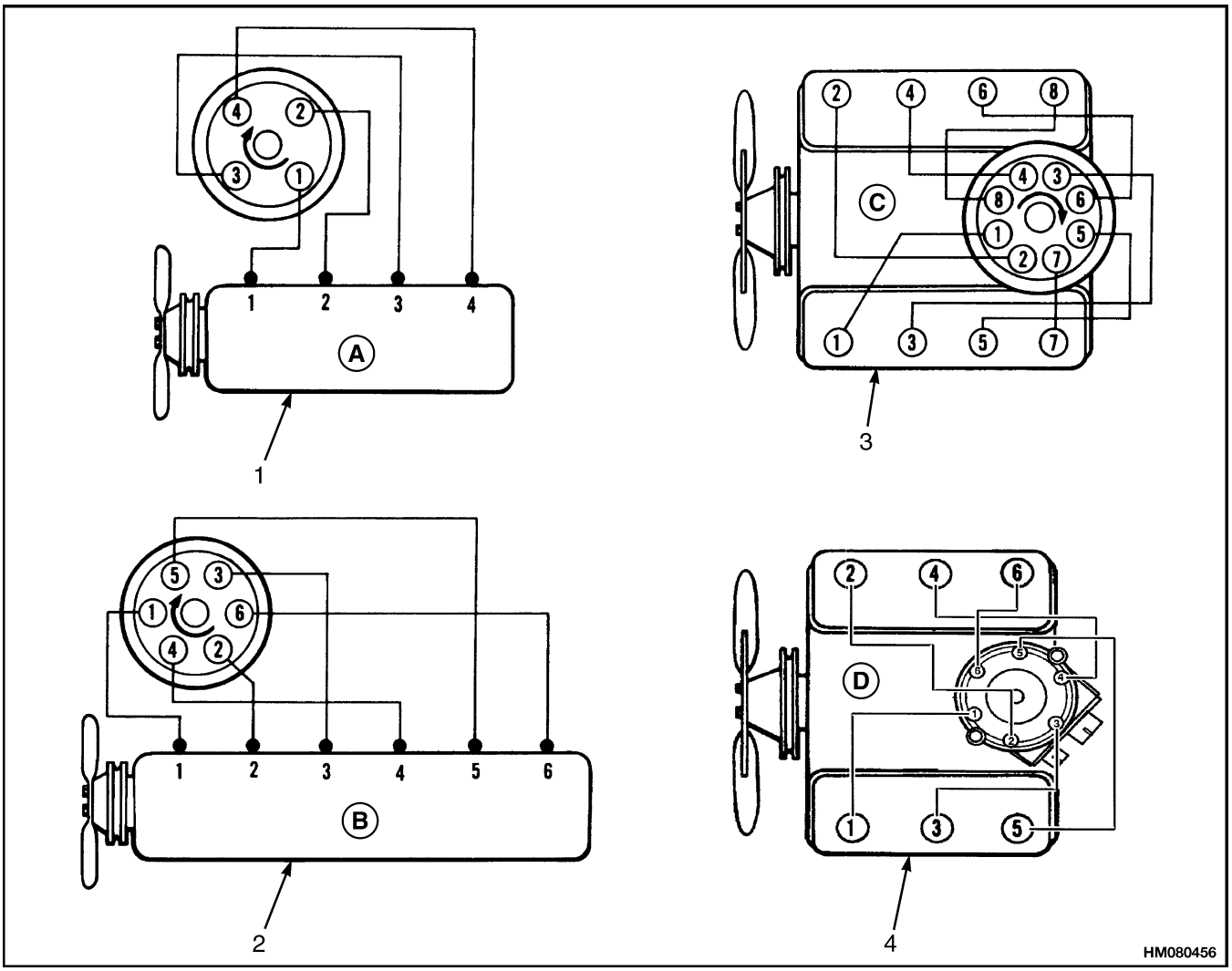
CAUTION

The tooth on the bottom of the distributor cap must fit into the notch in the housing or the alignment will not be correct.

5. Put distributor cap in position on housing. Lock cap to housing with latch screws.

6. Connect primary wiring harness to distributor. (See Figure 4, Figure 5, Figure 6, and Figure 7.)

7. Adjust ignition timing according to the procedure in Ignition Timing Adjustment.



A. FIRING ORDER 1-3-4-2
B. FIRING ORDER 1-5-3-6-2-4
C. FIRING ORDER 1-8-4-3-6-5-7-2
D. FIRING ORDER 1-6-5-4-3-2

1. FOUR CYLINDER
2. SIX CYLINDER
3. V8
4. V6

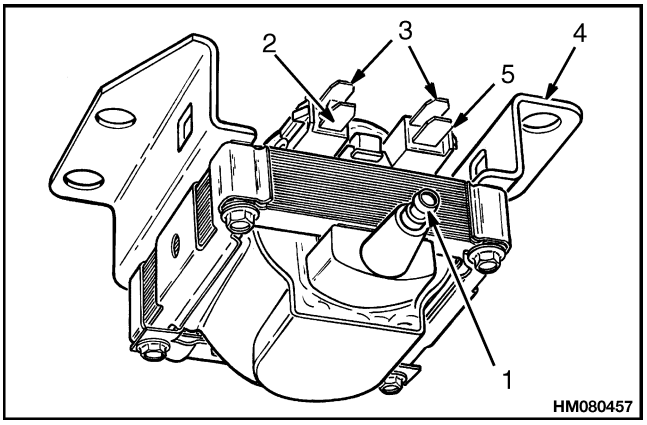
Figure 8. Firing Order

Ignition Coil Replacement

SOME FOUR- AND SIX-CYLINDER MODELS

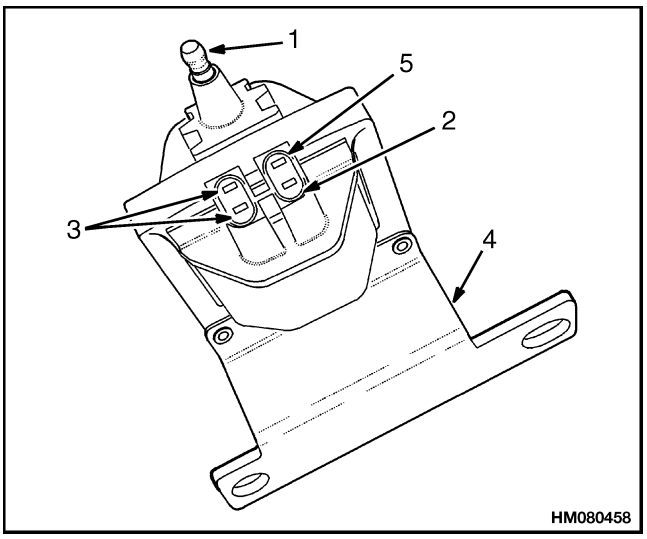
Remove

1. Disconnect wire from negative terminal of battery.
2. Disconnect secondary wire from coil. See Figure 9 and Figure 10.
3. Remove dust cover from primary wiring.
4. Disconnect primary wiring harness from coil.
5. Remove nuts from studs that fasten coil to block.



1. SECONDARY TERMINAL
2. TACHOMETER TERMINAL
3. PRIMARY TERMINAL
4. FRAME
5. BATTERY TERMINAL

Figure 9. Some Four- and Six-Cylinder Models Ignition Coil



1. SECONDARY TERMINAL
2. TACHOMETER TERMINAL
3. PRIMARY TERMINAL
4. FRAME
5. BATTERY TERMINAL

Figure 10. GM V6 Models Ignition Coil

Install

NOTE: It is normal for a new coil to be loose in the frame.

1. Turn coil so terminals are on top. See Figure 9 and Figure 10. Put coil frame on studs that fasten coil to engine. Install and tighten nuts.
2. Connect primary wiring harness to coil. Push connector until latches lock.
3. Install dust cover over primary wiring connector.
4. Connect secondary wire to coil. Push connector until latches lock.
5. If removed, connect battery wire to negative terminal of battery. Tighten nut on capscrew.

V8, SOME FOUR- AND SIX-CYLINDER MODELS

Remove

1. Disconnect wire from negative terminal of battery.
2. Unlock holder for secondary wires. See Figure 11. Remove secondary wires by carefully pulling on holder.
3. Disconnect wiring harness for primary wires from side of distributor.
4. Unlock four latch screws that fasten cap to housing. Remove distributor cap from distributor.

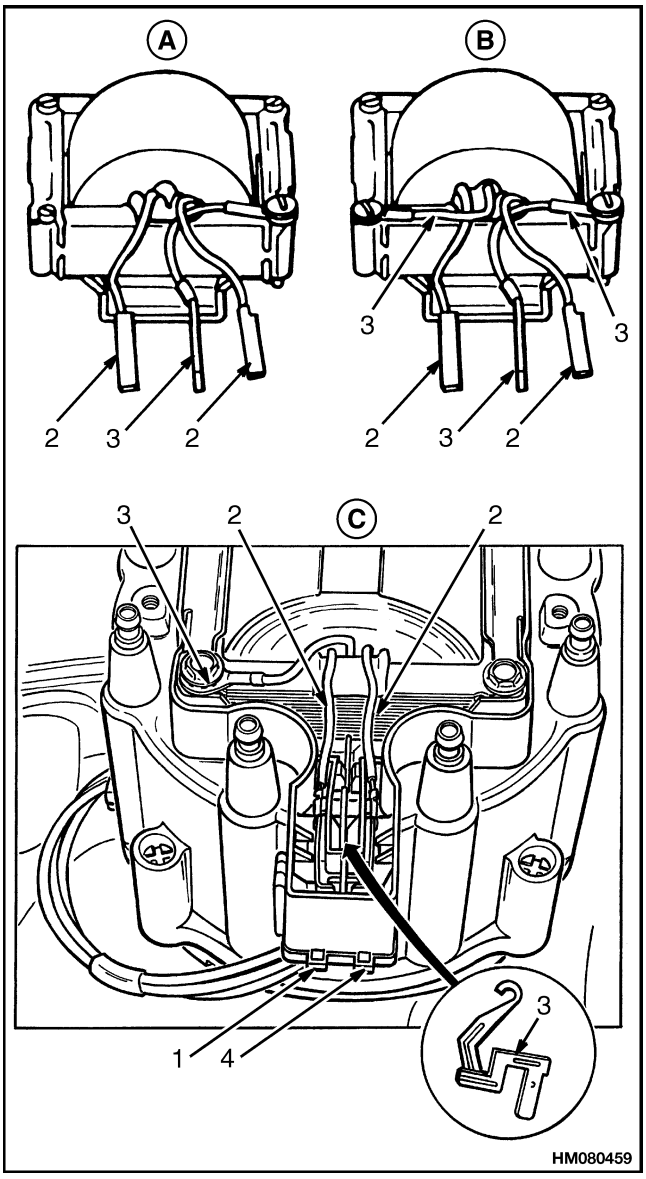
NOTE: Some V8-350 models used three screws to fasten the cover. Some V8-350, four- and six-cylinder models use two screws to fasten cover.

5. Remove screws that hold coil cover to distributor cap. Remove cover.

CAUTION

Do not damage the ground wires.

6. Remove four screws that hold coil to distributor cap. Loosen terminals of primary wires by pushing from connector side of cap. Carefully remove coil and primary wires.
7. Check rubber seal, spring, and resistor brush in cap for damage. Check cap for cracks or other damage. Replace parts that are damaged.



A. DESIGN 1
B. DESIGN 2
C. DESIGN 3

1. TACHOMETER TERMINAL
2. PRIMARY WIRE
3. GROUND WIRE
4. BATTERY TERMINAL

Figure 11. V8 and Some Four- and Six-Cylinder Models Ignition Coil

Install

NOTE: On some distributor models, the ground wire must be installed before the coil is installed.

1. If the ground wire was removed, install wire into position.
2. Install resistor brush, spring, and rubber seal in cap. See Figure 11.

NOTE: If the coil is new, make sure the part number is correct.

3. Put coil in correct position in cap. Push terminals of primary wires into connector on side of cap.
4. Align terminal(s) of ground wire(s) to hole in coil frame. Install four screws in frame of coil. Tighten screws.

CAUTION

Some V8 units use three screws to fasten the cover. Some V8, four- and six-cylinder models use two screws to fasten the cover.

5. Install coil cover and fastening screws. Tighten screws.

CAUTION

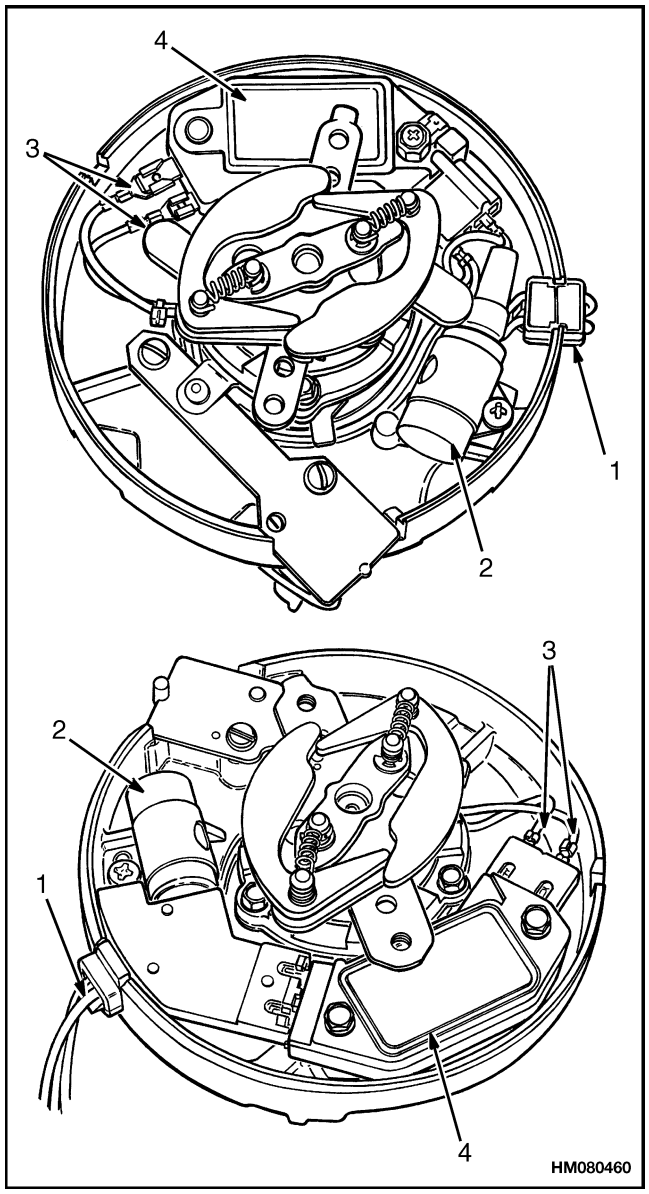
The tooth on the bottom of the distributor cap must fit into the notch in the housing or the alignment will not be correct.

6. Put distributor cap in position on housing. Lock cap to housing with four latch screws.
7. Connect wiring harness for primary wires to side of distributor. Make sure connector is locked together.
8. Connect secondary wires and holder to cap. Make sure holder is locked to cap.
9. If removed, connect battery wire to negative terminal of battery. Tighten nut on capscrew.

Electronic Module Replacement

REMOVE

1. Disconnect wire from negative terminal of battery. See Figure 12.



1. WIRING HARNESS
2. CAPACITOR
3. SENSING COIL WIRES
4. ELECTRONIC MODULE

Figure 12. Electronic Module Installation

2. Disconnect primary wiring harness to distributor. (See Figure 4, Figure 5, Figure 6, and Figure 7.)

3. Unlock latch screws that fasten cap to housing. Remove cap.

4. If used, remove two screws that fasten rotor to shaft assembly. Remove rotor.

5. Remove electronic module as follows:

   a. Distributors shown in Figure 4, Figure 5, and Figure 6: Remove two screws which fasten electronic module to housing. Move electronic module so connector can be removed from B and C terminals. Remove connector from electronic module. Carefully disconnect other wires from W and G terminals. Remove electronic module from housing.

   b. Distributors shown in Figure 7: Remove three screws that fasten electronic module, wiring harness, and capacitor to housing. Disconnect connector for the green and white wire from the electronic module. Remove electronic module, wire connector, and capacitor from housing. Disconnect electronic module from connector.

INSTALL

CAUTION

Apply silicone grease (Part No. 1198757) between the electronic module and the fastening plate.

1. The following procedure is for installation of the electronic module:

   a. Distributors shown in Figure 4, Figure 5, and Figure 6: Connect wire connector to B and C terminals on electronic module. Apply silicone grease to bottom of electronic module. Fasten electronic module to housing with two screws. Make sure screws are tight. Put wiring grommet in notch in housing. Connect pink wire to capacitor terminal. If a black wire is used, connect it to screw that fastens the capacitor. Tighten screw. Connect white wire from sensing coil to W terminal on electronic module. Connect green wire from sensing coil to G terminal on electronic module.