

**SERVICE REPAIR**

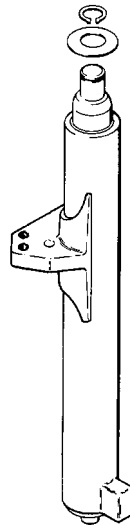
**MANUAL**

Hyster C176 (R40EH) Forklift

***HYSTER***

# LIFT CYLINDERS

ALL MODELS, EXCEPT  
H8.00-12.00XM (H170-280HD) [F007, G007];  
H13.00-16.00XM (H300-360HD) [E019, F019];  
H10.00-12.00XM-EC (H360HD-EC) [E019, F019];  
H20.00-32.00F (H440-700FS) [E008];  
H36.00-48.00E (H800-1050E) [D117];  
H3.50-5.50XM (H70-120XM) [K005, L005];  
S3.50-5.50XM, S5.50XMS (S70-120XM,  
S120XMS) [E004, F004]



HM170082

# **HYSTER**

# 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!**

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This section is for the following models:

All Models, Except H8.00-12.00XM (H170-280HD) [F007, G007];  
 H13.00-16.00XM (H300-360HD) [E019, F019];  
 H10.00-12.00XM-EC (H360HD-EC) [E019, F019];  
 H20.00-32.00F (H440-700FS) [E008];  
 H36.00-48.00E (H800-1050E) [D117];  
 H3.50-5.50XM (H70-120XM) [K005, L005];  
 S3.50-5.50XM, S5.50XMS (S70-120XM, S120XMS) [E004, F004]

**Thanks very much for your reading,  
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manual**

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[admin@servicemanualperfect.com](mailto:admin@servicemanualperfect.com)**

**"THE  
QUALITY  
KEEPERS"**

**HYSTER  
APPROVED  
PARTS**

## Safety Procedures When Working Near Mast

The following procedures must be used when inspecting or working near the mast. Additional precautions and procedures can be required when repairing or removing the mast. See the correct Service Manual section for the specific mast being repaired.



### WARNING

**Mast parts are heavy and can move. Distances between parts are small. Serious injury or death can result if part of the body is hit by parts of the mast or the carriage.**

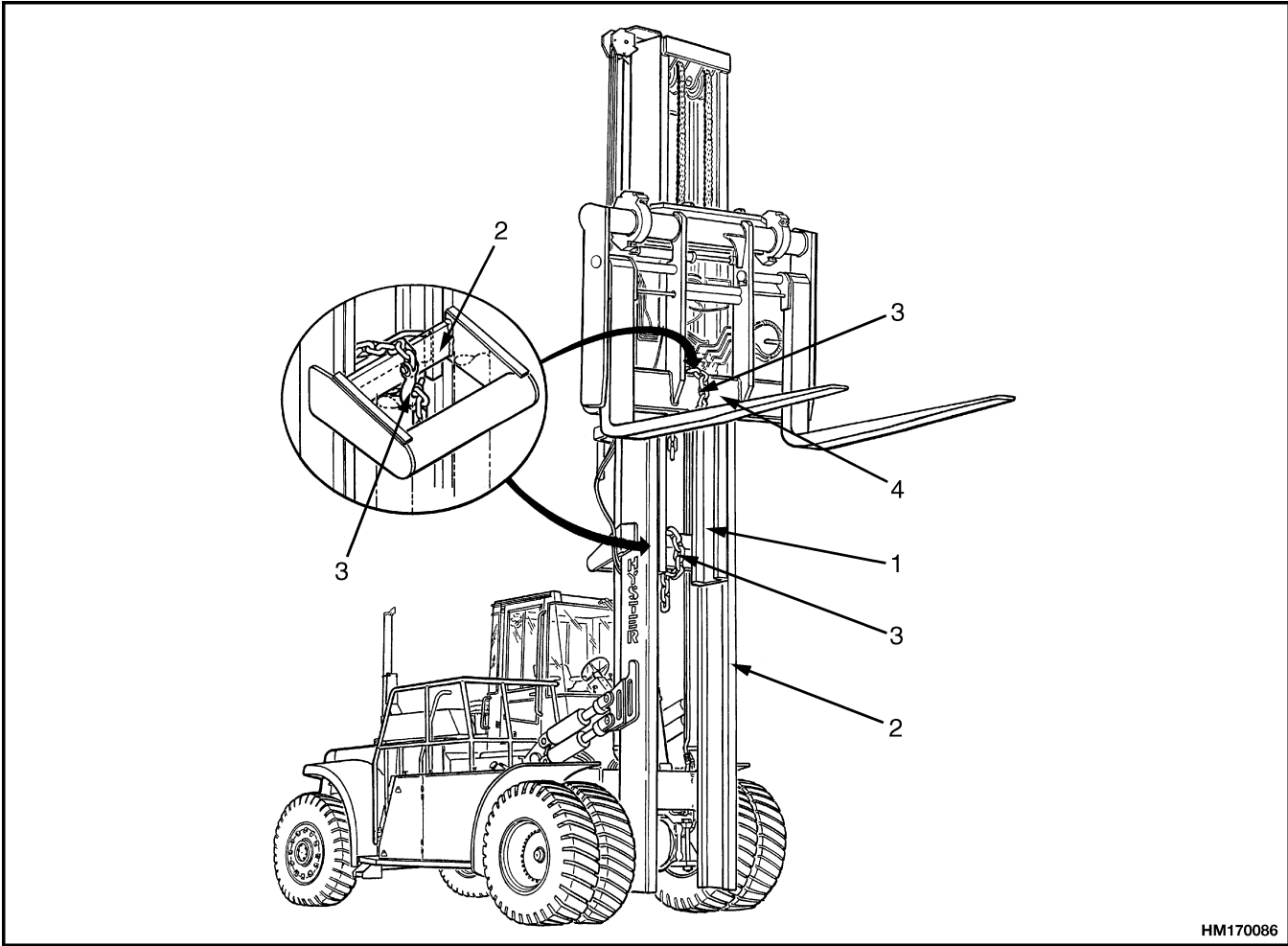
- **Never put any part of the body into or under the mast or carriage unless all parts are completely lowered or a safety chain is installed. Also make sure that the power is OFF and the key is removed. Put a DO NOT OPERATE tag in the operator's compartment.**
- **Be careful of the forks. When the mast is raised, the forks can be at a height to cause an injury.**
- **Do NOT climb on the mast or lift truck at any time. Use a ladder or personnel lift to work on the mast.**
- **Do NOT use blocks to support the mast weldments nor to restrain their movement.**
- **Mast repairs require disassembly and removal of parts and can require removal of the mast or carriage. Follow the repair procedures in the correct Service Manual for the mast.**

### WHEN WORKING NEAR THE MAST ALWAYS:

1. Lower the mast and carriage completely. Push the lift/lower control lever forward and make sure there is no movement in the mast. Make sure that all parts of the mast that move are fully lowered.

### OR

2. If parts of the mast must be in raised position, install a safety chain to restrain the moving parts of the mast. Connect moving parts to a part that does not move. Follow these procedures:
  - a. Put the mast in a vertical position.
  - b. Raise the mast to align the bottom cross-member of the inner weldment with a cross-member on the outer weldment. See Figure 1, Figure 2, and Figure 3.
  - c. Use a 12 mm (0.5 in.) minimum safety chain with a hook to fasten the crossmembers together so that the movable member cannot lower. Put the hook on the back side of the mast. Make sure the hook is completely engaged with a link in the chain. Make sure the safety chain does not touch lift chains or chain sheaves, tubes, hoses, fittings or other parts on the mast.
  - d. Lower the mast until there is tension in the safety chain. If running, stop the engine. Apply the parking brake. Install a DO NOT REMOVE tag on the safety chain(s).
  - e. Install another safety chain 12 mm (0.5 in.) minimum between the top or bottom cross-member of the carriage and a crossmember on the outer weldment.
3. Apply the parking brake. After lowering or restraining the mast, shut off the power and remove the key. Put a DO NOT OPERATE tag in the operator's compartment.



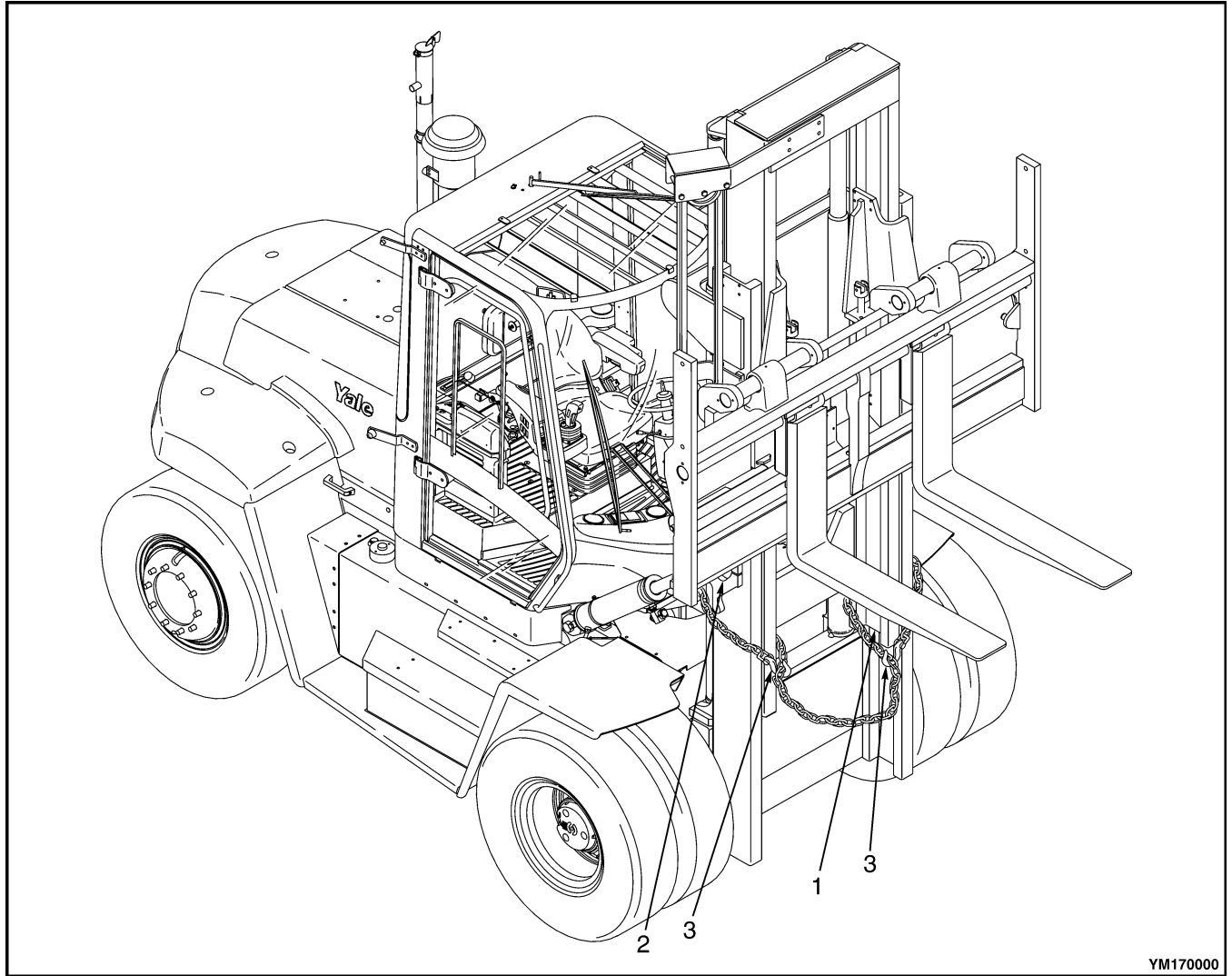
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- 1. INNER WELDMENT
- 2. OUTER WELDMENT

- 3. HOOK
- 4. CARRIAGE

**Figure 1. Mast**



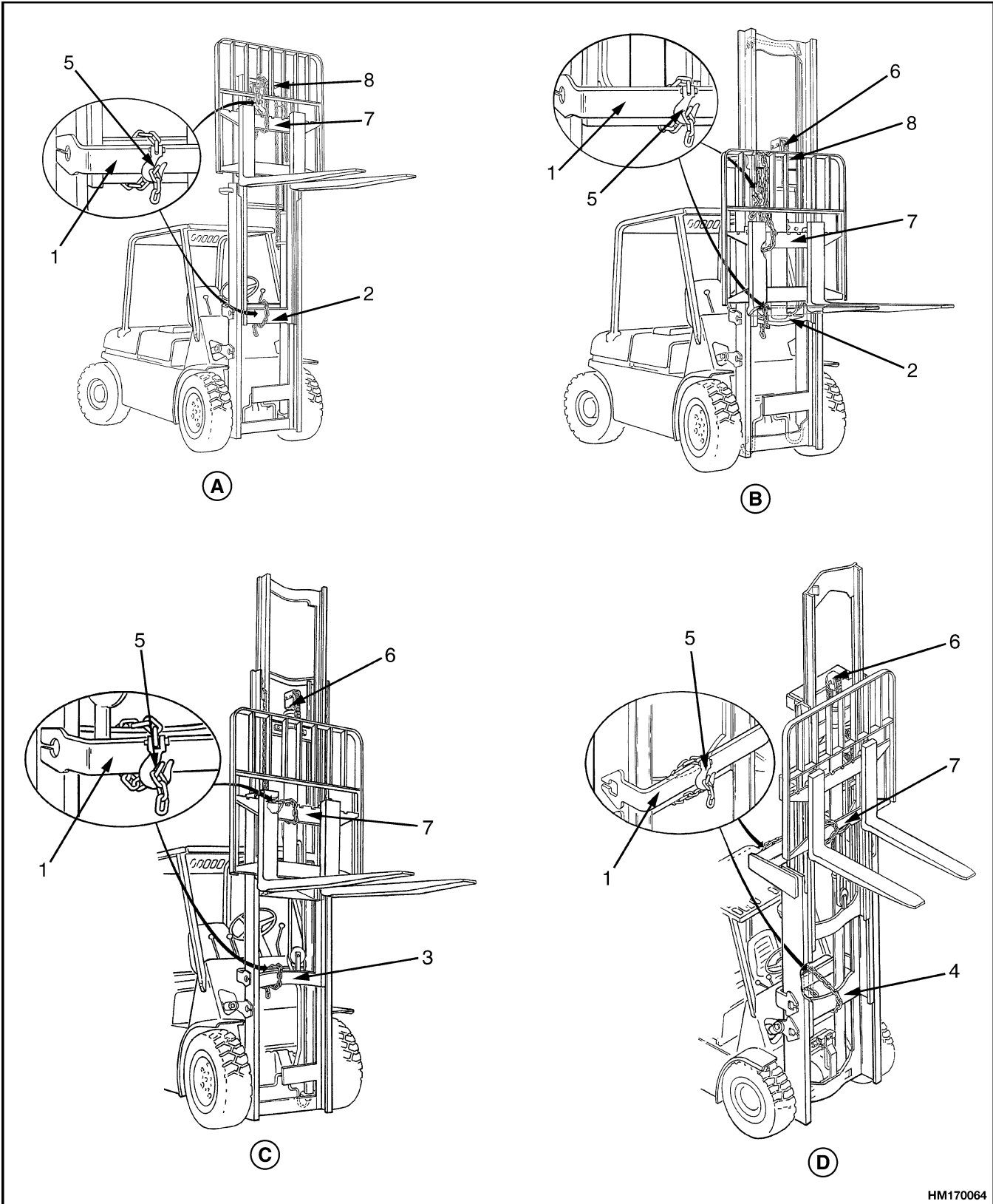


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- 1. INNER WELDMENT
- 2. TILT CYLINDERS

- 3. HOOK

**Figure 2. Mast**



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Figure 3. Two-Stage, Free-Lift, Three-Stage, and Four-Stage Masts

*Legend for Figure 3*

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>A. TWO-STAGE MAST</li> <li>B. FREE-LIFT MAST</li> </ul>   | <ul style="list-style-type: none"> <li>C. THREE-STAGE MAST</li> <li>D. FOUR-STAGE MAST</li> </ul>  |
| <ul style="list-style-type: none"> <li>1. OUTER WELDMENT</li> <li>2. INNER WELDMENT</li> <li>3. INTERMEDIATE WELDMENT</li> <li>4. FIRST INTERMEDIATE WELDMENT</li> </ul> | <ul style="list-style-type: none"> <li>5. HOOK</li> <li>6. FREE-LIFT CYLINDER</li> <li>7. CROSSMEMBER</li> <li>8. CROSSMEMBER</li> </ul> |

## General

This section has the description for lift cylinders used in masts and the instructions for their repair. There are many different sizes of lift cylinders used in Hyster Company lift trucks. The operation and repair procedures for the different lift cylinders are similar. The illustrations in this section are for typical

lift cylinders. All of the variations in lift cylinders used in lift trucks are not shown. A section for Lift Cylinders for VISTA® Masts is included later in this section.

## Description

All lift cylinders are single-acting cylinders. See Figure 4. The hydraulic force is applied only in one direction. When hydraulic oil enters one end of the lift cylinder, the hydraulic force extends the piston rod. When the force is removed, the weight of the carriage and inner mast retracts the piston rod.

A common maintenance problem is the repair of oil leaks from the seals and wiper around the piston rod. If the bore of the shell of the lift cylinder is damaged and cannot be repaired, the lift cylinder must be replaced.

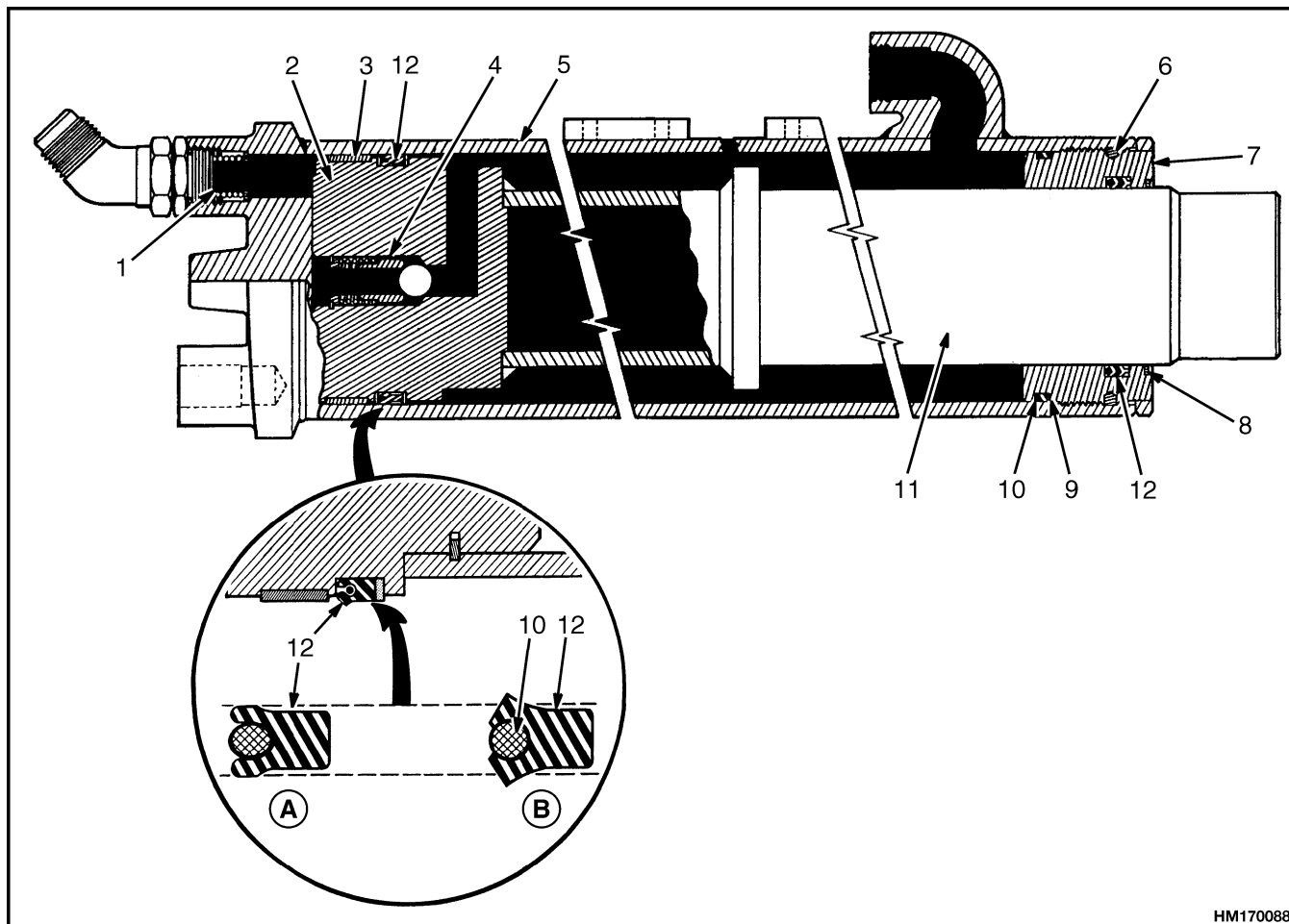
### LOWERING CONTROL VALVE

A lowering control valve is installed in the inlet port. See Figure 5. It permits easy entry of hydraulic oil into the cylinder, but gives a restriction when the rod is retracted. This restriction gives limits to the speed that a load on the forks can be lowered.

There are two types of lowering control valves. Both types have the same function and similar operation. The most common type of valve has a design that has good operation using large flows and lower pressures. Some lift trucks have a lift system design using higher pressures and a lower flow. These systems need a different type of lowering control valve.

The most common type of lowering control valve uses these parts: (1) a special fitting for the valve body, (2) a spring, and (3) a special washer. There is a variation in the shapes of the special washer. Different lift cylinders use different shapes of special washers. The volume of the hydraulic oil flowing through the inlet port controls the shape of the special washer. (A typical shape of a special washer is shown in Figure 5.) When the piston rod is lowered, the oil flow pushes against the special washer and spring. When the oil flow reaches the limit, the special washer is moved against the special fitting. The oil then flows only through the hole in the center of the special washer. This restriction permits the piston rod to lower only at a maximum controlled speed.

The other type of lowering control valve uses these basic parts: (1) valve body, (2) spring, (3) washer, (4) cylinder, (5) orifice sleeve, (6) plunger, and (7) main sleeve. The orifice sleeve position is controlled completely by oil flow. The plunger position is controlled by oil pressure and spring tension. During lifting, oil entering the lift cylinder goes through the center of the main sleeve to the large holes. The oil flow through the plunger and bore moves the orifice sleeve to the end of the plunger. The flange of the orifice sleeve is then aligned with the large part of the bore in the body. This alignment lets the oil flow past the orifice sleeve to the cylinder.



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**A. INSTALLED**

- 1. LOWERING CONTROL VALVE
- 2. PISTON
- 3. BEARING
- 4. CHECK VALVE
- 5. SHELL
- 6. NYLON RING

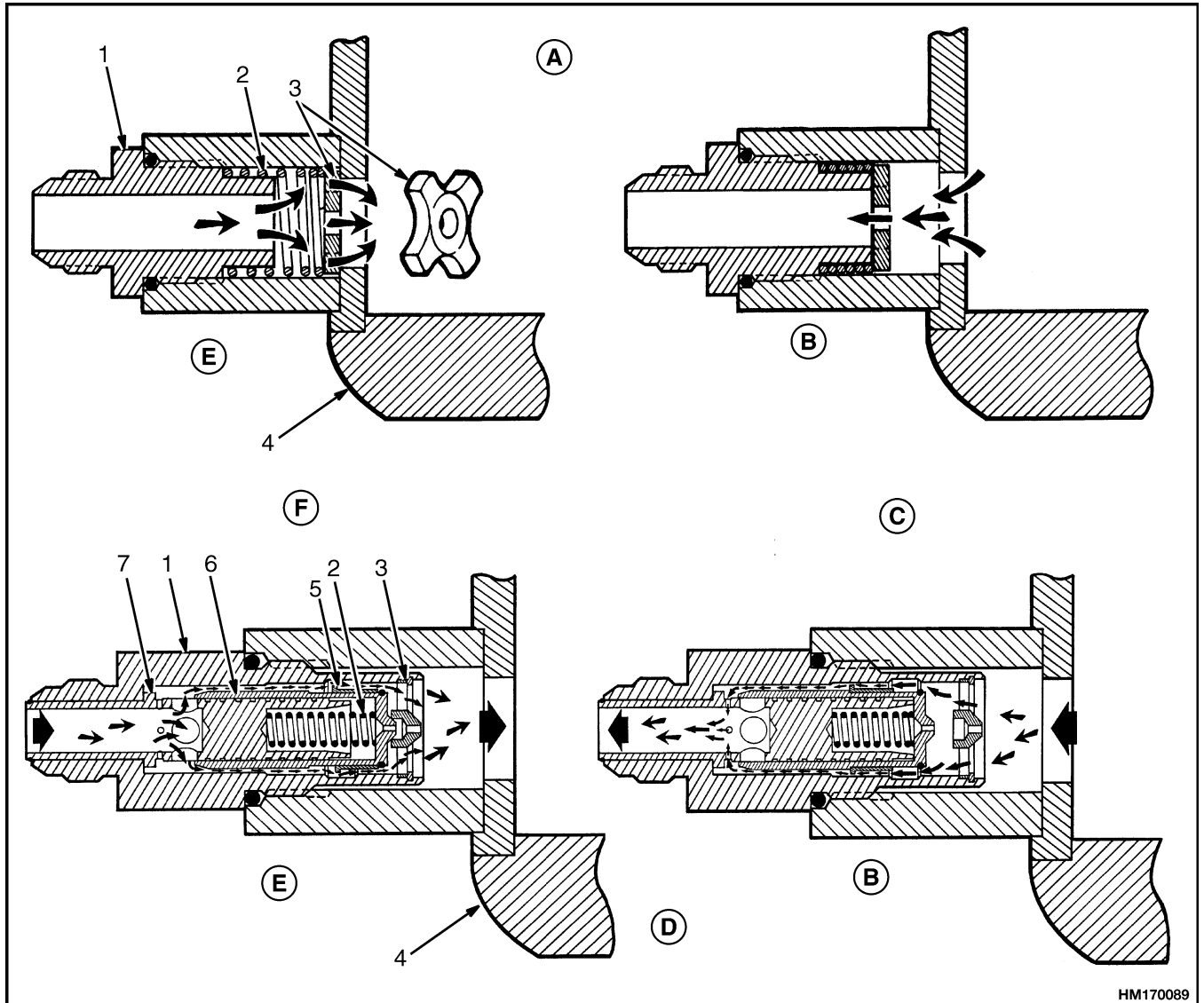
**B. NOT INSTALLED**

- 7. RETAINER
- 8. WIPER SEAL
- 9. BACKUP RING
- 10. O-RING
- 11. ROD
- 12. SINGLE-LIP SEAL

**Figure 4. Two-Speed Lift Cylinder**

During lowering, oil from the lift cylinder moves the orifice sleeve. The orifice sleeve moves away from the larger inner diameter area of the bore in the valve body. This movement makes a restriction to the oil flow. As the pressure increases, the plunger begins to move against the spring. The movement begins to close the openings of the large holes in the main

sleeve. Additional pressure will push the plunger against the main sleeve to close the large holes completely. All the oil must then go through the small holes to the center of the main sleeve. This restriction permits the piston rod to lower only at a maximum controlled speed.



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- A. LOW PRESSURE DESIGN
- B. LOWERING
- C. RESTRICTED FLOW

- D. HIGH PRESSURE DESIGN
- E. LIFTING
- F. FREE FLOW

- 1. SPECIAL FITTING OR VALVE BODY
- 2. SPRING
- 3. SPECIAL WASHER
- 4. CYLINDER

- 5. ORIFICE SLEEVE
- 6. PLUNGER
- 7. MAIN SLEEVE

Figure 5. Lowering Control Valves

## CYLINDERS (GENERAL)

Standard masts use a single-stage lift cylinder. Most three-stage and four-stage masts use two single-stage lift cylinders. A single-stage lift cylinder has one piston rod. See Figure 6.

Most full free-lift masts and some three-stage masts use a two-stage lift cylinder. A two-stage lift cylinder has two telescopic piston rods. See Figure 7. The two-stage lift cylinder operates similar to a one-stage lift cylinder. Hydraulic pressure pushes the primary (larger) piston rod from the cylinder first because it has a larger diameter. The secondary piston rod moves with the primary piston rod. When the primary piston rod reaches the limit of its stroke, the secondary piston rod extends from the primary piston rod.

Spacers are used in some cylinders to give a limit to the stroke of the piston rod. Worn spacers must be replaced with the same size spacer.

Most of the lift cylinders use a single-lip seal assembly to prevent hydraulic oil leaks past the piston and past the retainer. See Figure 4. There are many lift cylinders in use that have an older design chevron-style packing. The chevron-style packing can be replaced with a seal kit that has the newer single lip seal and an adaptor. There are no replacements of single lip seals for chevron-style packing for lift trucks over 7,000 kg (15,000 lb) capacity.

Lift cylinders and other hydraulic parts can have internal leaks. Internal leakage will increase as the temperature of the hydraulic oil increases. The internal leak rate of the hydraulic system is normally checked after every 1000 hours of operation. See Lift System Leak Check for test procedures and leakage rates within the specifications.

During operation, some leakage of hydraulic oil can move past the piston seal to the rod side of the piston. A small leakage is permitted if the internal leak rate of the hydraulic system is not greater than the specification. An internal check valve is installed in

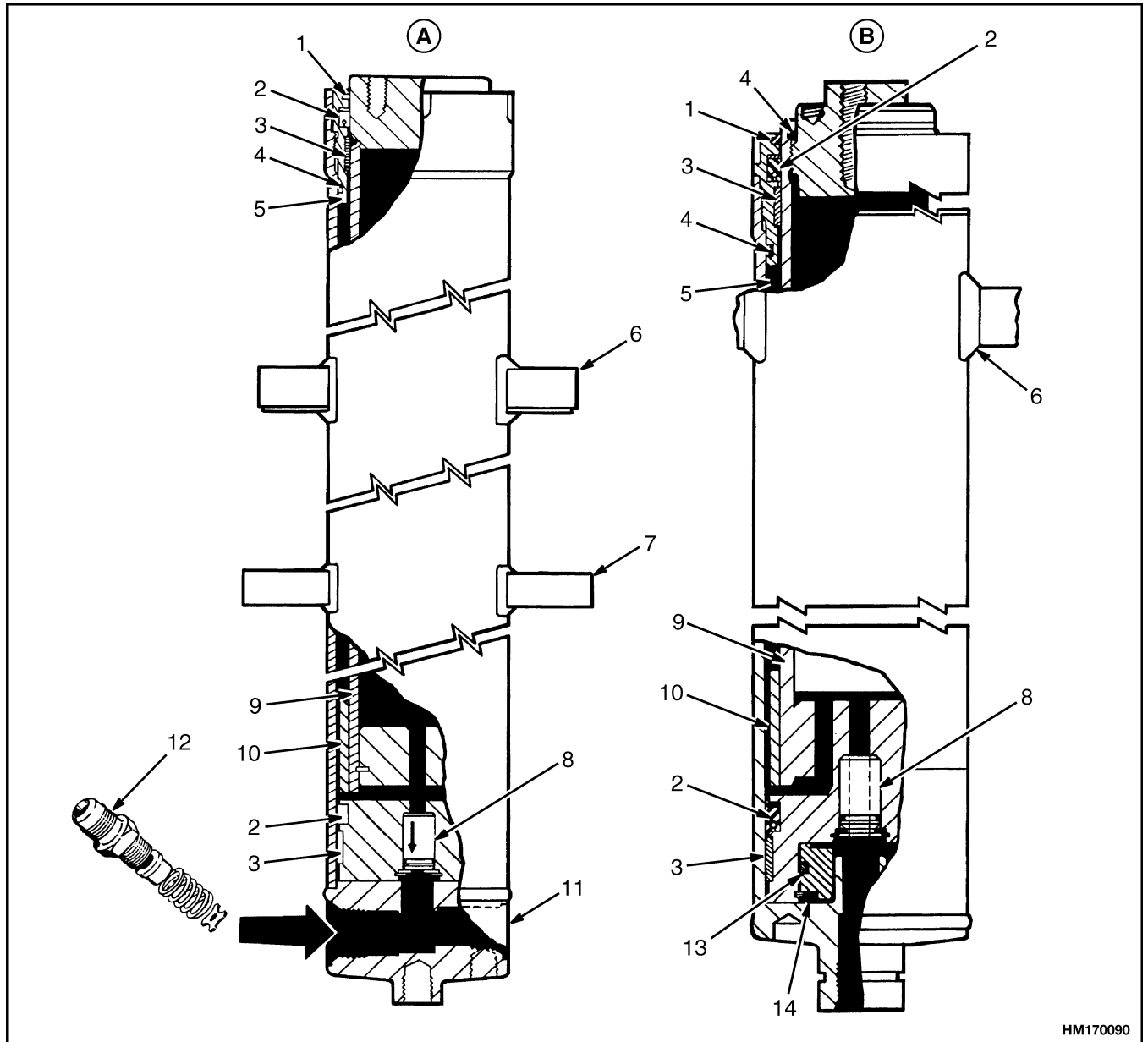
the piston of many of the lift cylinders. When the rod extends, the pressure increases more quickly on any oil in the rod end of the cylinder. The hydraulic oil transfers through the check valve to the piston end of the cylinder. This action prevents hydraulic damage to the wiper seal. See Figure 8. Lift cylinders that do not have an internal check valve have a drain line on the outside of the cylinder shell.

## CYLINDERS (H520-620B, H700-800A)

The rod side of the lift cylinder is used for the storage of hydraulic oil on the H520-620B and H700-800A lift trucks. This storage decreases the required size of the hydraulic tank. When the piston raises in the cylinder, the oil on the rod side of the piston transfers to the hydraulic tank. When the piston lowers in the cylinder, some of the oil transfers to the rod side of the cylinder. Approximately one half of the oil in the bottom of the cylinder goes through the main control valve to the rod side of the cylinder. See the **Main Control Valve of Service Manual** for more information. See Figure 9.

### Retainer, Install

1. Install the retainer over the piston and into the cylinder. Make sure the single-lip seal assembly, the O-ring, and the backup ring are not damaged. See Figure 9.
2. Turn the retainer ring into the threads in the cylinder. Turn the retainer ring until it is even with the top of the cylinder.
3. Install the capscrews loosely.
4. The stroke of the cylinder rod can be adjusted by turning the retainer ring one-half turn in either direction.
5. Install and tighten the setscrew.
6. Tighten the capscrews to 36 to 46 N•m (27 to 34 lbf ft).



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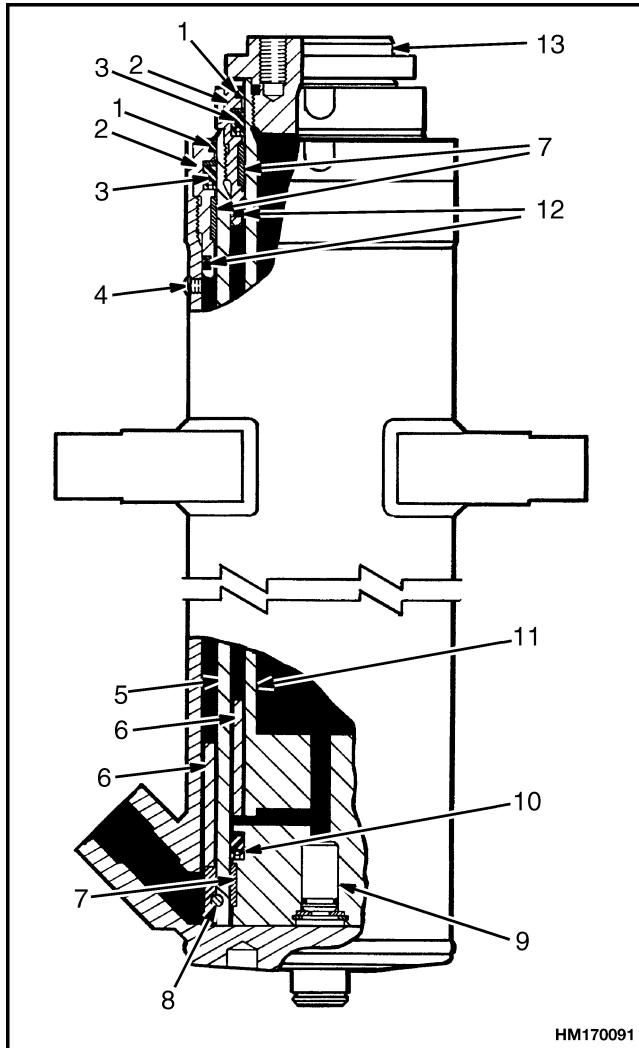
**A. MAIN LIFT CYLINDER**

- 1. WIPER RING
- 2. SINGLE-LIP SEAL
- 3. BEARING
- 4. O-RING
- 5. RETAINER
- 6. CHAIN ANCHOR MOUNT
- 7. HYDRAULIC LINE MOUNT
- 8. INTERNAL CHECK VALVE

**B. FREE-LIFT CYLINDER**

- 9. ROD ASSEMBLY
- 10. SPACER
- 11. TO SENSING PORT FOR PHASING VALVE PRESSURE
- 12. LOWERING CONTROL VALVE (ALL CYLINDERS)
- 13. PISTON RING
- 14. CUSHION RING

*Figure 6. Single-Stage Lift Cylinders*

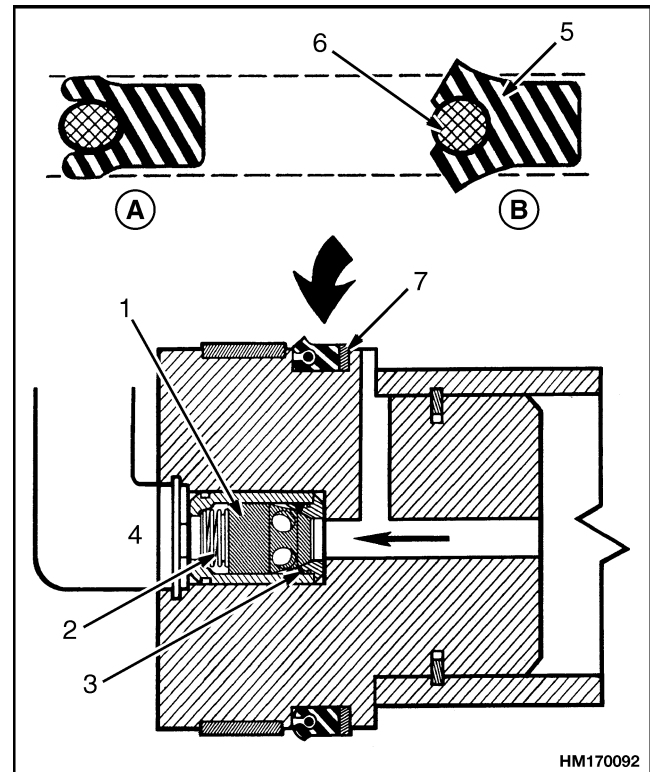


- |                                 |                            |
|---------------------------------|----------------------------|
| 1. WIPER RING                   | 8. PISTON HALF (1 OF 2)    |
| 2. RETAINER                     | 9. INTERNAL CHECK VALVE    |
| 3. SEAL                         | 10. SINGLE-LIP SEAL        |
| 4. SCREW (DO NOT CHANGE LENGTH) | 11. SECONDARY ROD ASSEMBLY |
| 5. PRIMARY ROD ASSEMBLY         | 12. O-RING                 |
| 6. SPACERS                      | 13. PLUG                   |
| 7. BEARING                      |                            |

**Figure 7. Two-Stage Lift Cylinder**

**CYLINDERS (H360-460B)**

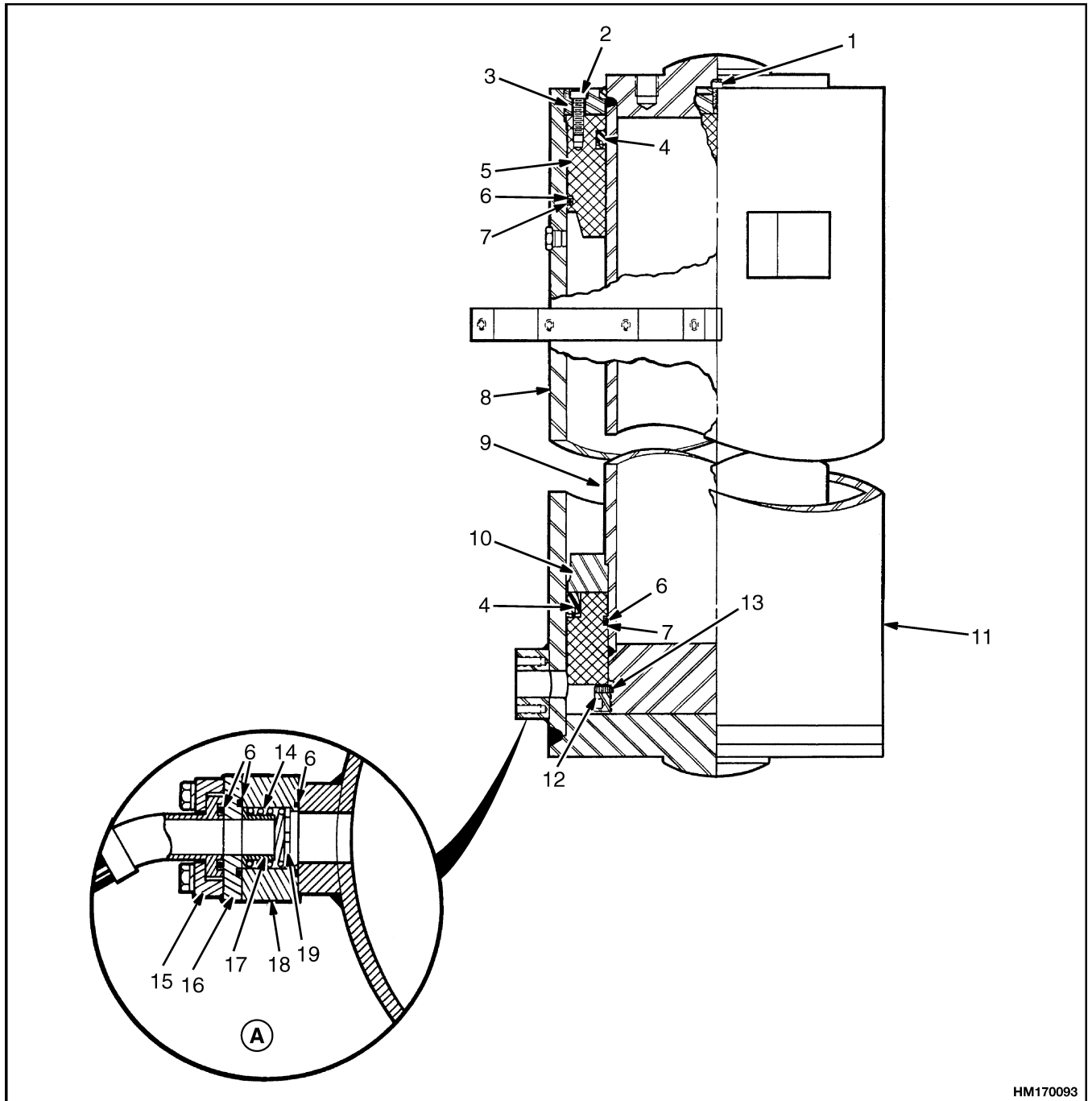
The lift cylinders used in the H360-460B lift trucks are displacement cylinders. The design and repairs for these cylinders are similar to the other lift cylinder in this section. A displacement cylinder does not have a piston or piston seal. The rod diameter is almost the same as the inside diameter of the cylinder. There are wear rings on the rod that are the bearings between the rod and the walls of the cylinder. The wiper seal at the top of the cylinder is also the high-pressure seal for these cylinders. The wiper seal has chevron-style packing. See Figure 10.



- |                          |                         |
|--------------------------|-------------------------|
| <b>A. INSTALLED</b>      | <b>B. NOT INSTALLED</b> |
| 1. POPPET                | 5. SINGLE-LIP SEAL      |
| 2. SPRING                | 6. O-RING               |
| 3. SEAL                  | 7. NYLON BACKUP RING    |
| 4. INLET AND OUTLET PORT |                         |

**Figure 8. Internal Check Valve and Single-Lip Seal**





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**A. LOWERING CONTROL VALVE**

- |                             |                   |                     |                    |
|-----------------------------|-------------------|---------------------|--------------------|
| 1. SETSCREW (1)             | 5. RETAINER       | 10. SPACER          | 15. FLANGE         |
| 2. CAPSCREW (2)             | 6. BACKUP RING    | 11. PISTON          | 16. SPACER PLATE   |
| 3. RETAINER RING            | 7. O-RING         | 12. PISTON RING NUT | 17. SPACER         |
| 4. SINGLE-LIP SEAL ASSEMBLY | 8. CYLINDER SHELL | 13. NYLON SETSCREW  | 18. VALVE BODY     |
|                             | 9. ROD            |                     | 19. SPECIAL WASHER |

**Figure 9. Lift Cylinder for H700-800A**

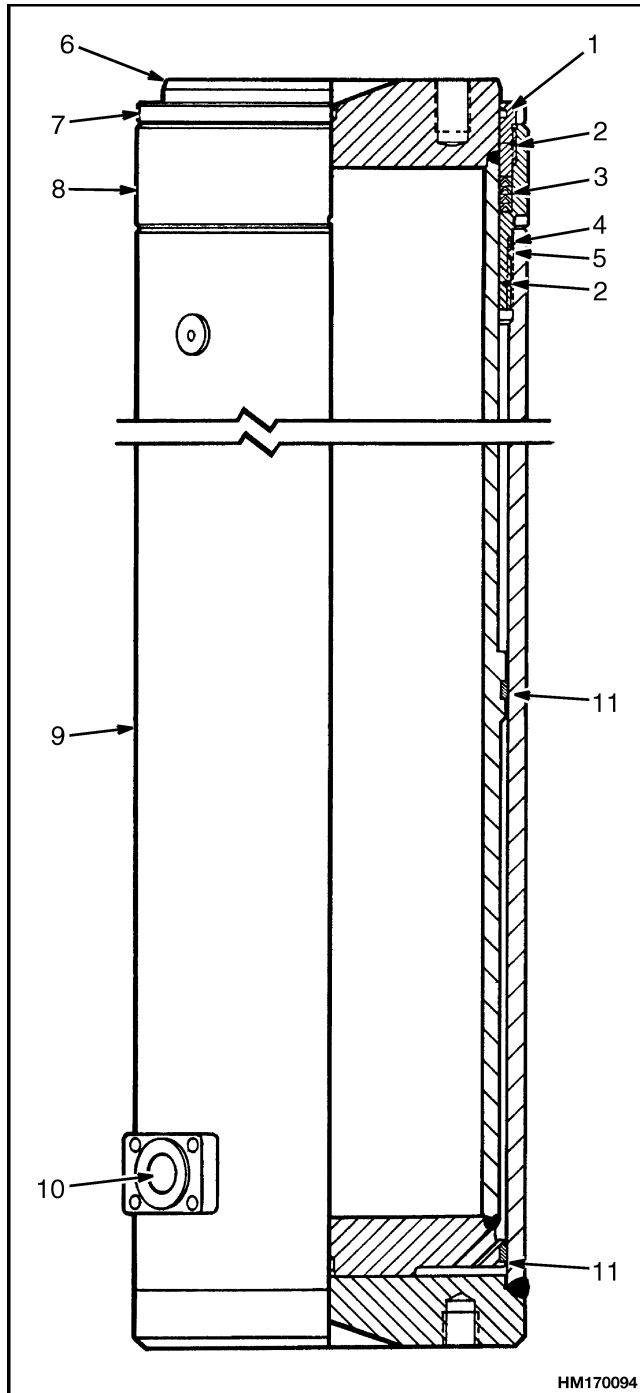


Figure 10. Displacement Cylinders

### Legend for Figure 10

**NOTE:** OIL LEAKAGE IS NOT CONTROLLED BY THE TORQUE ON THE PACKING GLAND. TIGHTEN THE PACKING RETAINER TO STOP OIL LEAKS. REPLACE CHEVRON-STYLE PACKING WHEN PACKING RETAINER CANNOT COMPRESS PACKING FURTHER TO CONTROL OIL LEAKS. DO NOT TIGHTEN MORE THAN NECESSARY TO STOP OIL LEAKS.

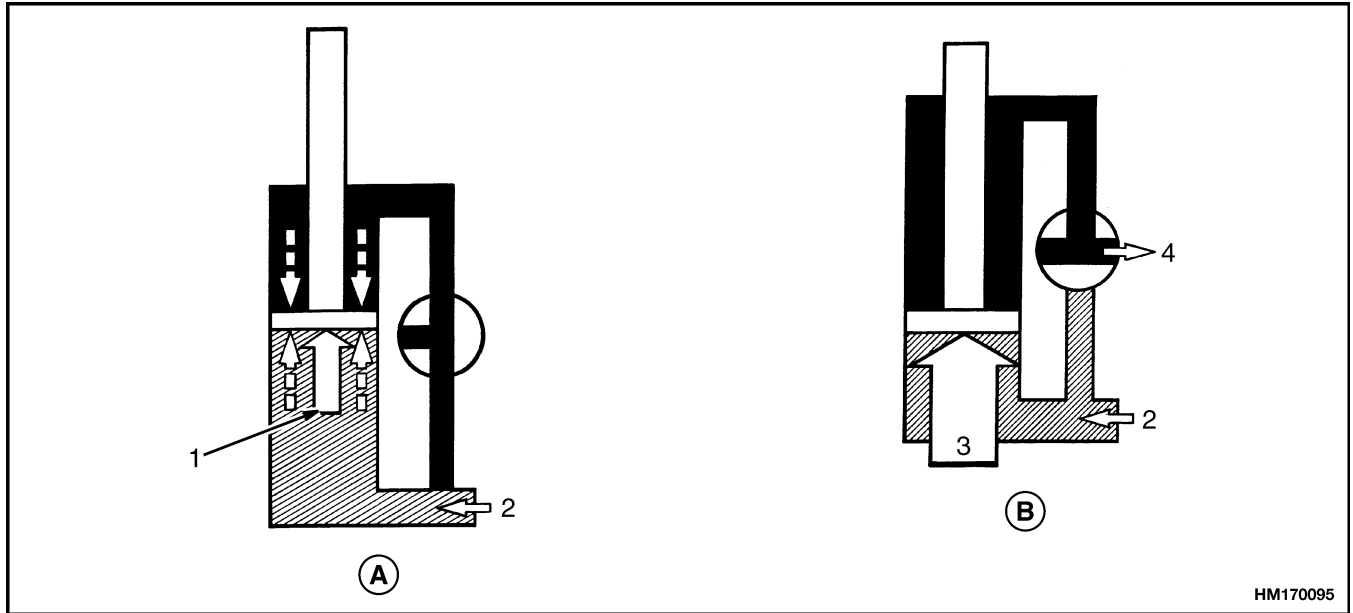
- |                          |                           |
|--------------------------|---------------------------|
| 1. WIPER                 | 7. PACKING RETAINER       |
| 2. NYLON RING            | 8. PACKING GLAND          |
| 3. CHEVRON-STYLE PACKING | 9. CYLINDER SHELL         |
| 4. BACKUP RING           | 10. INLET AND OUTLET PORT |
| 5. O-RING                | 11. WEAR RING             |
| 6. ROD HEAD              |                           |

### CYLINDERS (TWO-SPEED)

Two-speed lift cylinders are single-stage lift cylinders with a special valve and path for the hydraulic oil. The lift cylinder is filled with oil on both sides of the piston. For loads less than 45% of the rated capacity, the cylinder rod can be extended at high speed. When the cylinder rod extends, the oil on the rod side of the piston transfers to the bottom of the piston. When the oil transfers, the increase almost doubles the flow of oil to the base of the cylinder. The pump pressure is applied to both sides of the piston. The area on the bottom of the piston is greater than the rod side of the piston. The difference in force pushes the piston up the cylinder. See Figure 11.

For loads greater than 45% of capacity, the cylinder rod extends at normal speed. A special valve senses the increased oil pressure caused by the load. The oil is returned from the rod side of the lift cylinder to the hydraulic tank. All of the pump pressure is applied to the bottom side of the piston. The cylinder rod extends at a slower speed, but can lift a greater load. The two-speed lifting system is used only with standard masts. A two-speed lift system is used on the following lift trucks:

S60-80B	H150-250E
S125-150A	H150-275H
H60-80C	H250-300A
H300-350B	P125-180A
H110-150F	P150-200B



- A. HIGH-SPEED OPERATION FOR NO LOAD OR LIGHT LOADS
- B. NORMAL OPERATION FOR RATED CAPACITY LOAD OR HEAVY LOADS

- 1. FORCE
- 2. FROM HYDRAULIC PUMP
- 3. GREATER LIFTING FORCE
- 4. TO HYDRAULIC TANK

**Figure 11. Two-Speed Lift Cylinders**

**NOTE:** The maximum loads that the above models will lift at high speed are shown on Table 1.

**Table 1. Lift Trucks with Two-Speed Lift Cylinders**

Model	Load
S60-100B	1589 to 2043 kg (3500-4500 lb)
H60-80C	1589 to 2043 kg (3500 to 4500 lb)
H110-150F	1589 to 2043 kg (3500 to 4500 lb)
S125-150A	2270 to 2724 kg (5000 to 6000 lb)
H150-200ES, Standard Masts	2270 to 3087 kg (5000 to 6800 lb)
P125-180A, Standard Masts	2270 to 3087 kg (5000 to 6800 lb)
H150-250E, Heavy Duty Masts	3133 to 4041 kg (6900 to 8900 lb)
P125-180A, Heavy Duty Masts	3133 to 4041 kg (6900 to 8900 lb)
H250-300A	4540 to 4994 kg (10,000 to 11,000 lb)

This table shows the approximate maximum load that the mast will lift at high speed. Loads greater than those shown will cause the mast to lift at normal speed. These loads will have a variation because of the different attachments that can be installed on the lift truck.

## Lift Cylinder Repair

### LIFT CYLINDER REMOVAL WITHOUT REMOVING MAST

Remove the carriage before the lift cylinder. See the procedure described in the **Masts** section. If the mast must be removed for repairs, then remove the lift cylinder when the mast is disassembled. Remove the lift cylinder from the mast as described in the following paragraphs.

#### Standard Masts With Main Lift Cylinder Fastened to Crossmember of Inner Mast

1. Fully lower the mast. Loosen, but do not disconnect the capscrew that fastens the cylinder rod to the crossmember of the inner mast.
2. Clean the area next to the fittings that connect the hydraulic lines to the lift cylinder. Put a drain pan under the area where the hydraulic lines will be disconnected. Disconnect the hydraulic lines and put a cap on each open fitting.



#### WARNING

**Make sure the lifting mechanism has enough capacity to lift the loads. See the Weight Guide for lift cylinders in Table 2.**

3. Connect a lifting mechanism to the inner mast. Lift the inner mast approximately 300 mm (12 in.). Fasten the inner and outer masts together at the crossmembers with a heavy chain. Make sure that the inner mast cannot move. Remove the lifting mechanism.
4. Connect a heavy-duty sling to the upper part of the cylinder. Raise the lifting mechanism until the sling is tight. Make sure the sling will not slide.
5. Remove the capscrew and washer connecting the piston rod to the inner mast. Remove the spacer.



#### CAUTION

**Oil can come out of the cylinder fittings with pressure when retracting the rod.**

6. Loosen the cap on the lower fitting of the cylinder. Manually retract the piston rod.

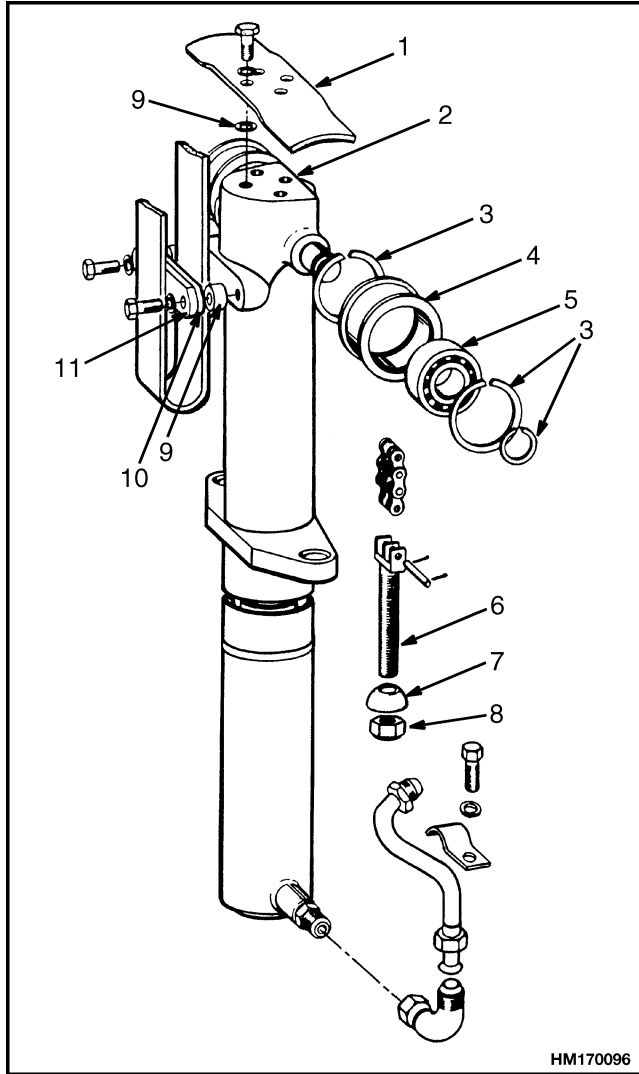
7. Remove the capscrew and the plate from the lower side of the cylinder.
8. Raise the cylinder and move it away from the mast. Move the lift cylinder to a position where it can be disassembled.

#### Standard and Full Free-Lift Masts With Lift Cylinder Fastened to Crosshead

1. Remove the lift chains and chain anchors from the mast and the lift cylinder. Connect a sling to the upper area of the lift cylinder. Raise the lifting mechanism until the sling is tight. See Figure 12 and Figure 13.
2. Remove the capscrews that connect the piston rod to the crosshead.
3. Disconnect and remove the crosshead assembly from the mast. Make a note of the shim arrangement on the crosshead guide.
4. Clean the area next to the fittings that connect the hydraulic lines to the lift cylinder. Put a drain pan under the area where the hydraulic lines will be disconnected. Disconnect the hydraulic lines and put a cap on each open fitting.
5. Remove the snap ring that connects the bottom of the lift cylinder to the outer mast.
6. Raise the lift cylinder and move it away from the mast. Move the lift cylinder to a position where it can be disassembled.

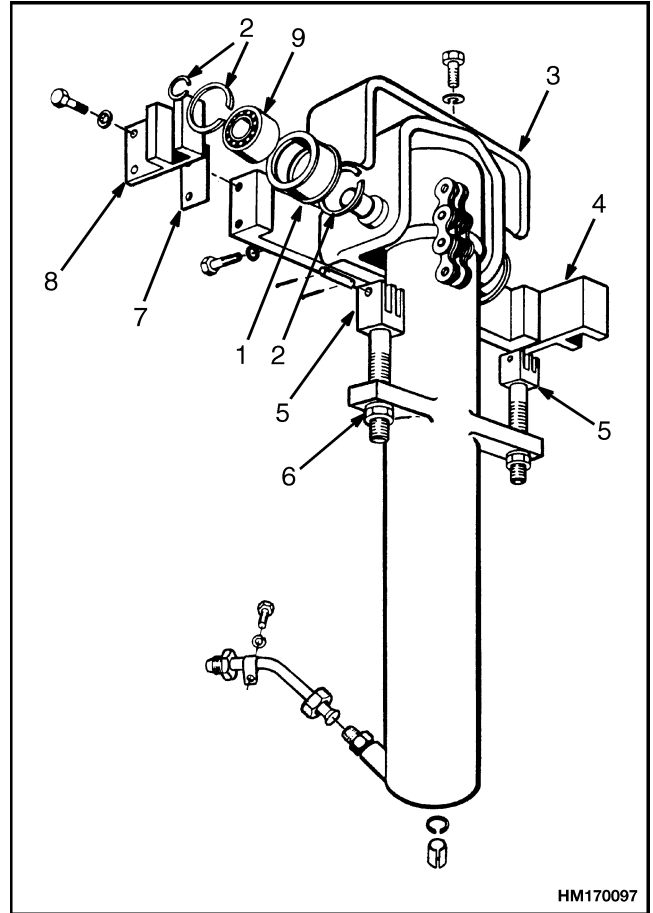
#### Masts That Have Two Cylinders, Main Lift Cylinder and Free-Lift Cylinder

1. Remove the free-lift cylinder as described in the section above for removing a lift cylinder fastened to a crosshead.
2. Remove the main lift cylinder as described in the section above for removing a lift cylinder fastened to an inner mast.



- |                       |                   |
|-----------------------|-------------------|
| 1. CHAIN GUARD        | 6. CHAIN ANCHOR   |
| 2. CROSSHEAD ASSEMBLY | 7. SPECIAL WASHER |
| 3. SNAP RING          | 8. LOCK NUT       |
| 4. SHEAVE             | 9. SPACER         |
| 5. BEARING            | 10. WEAR PLATE    |
|                       | 11. PAD           |

**Figure 12. Standard Mast Cylinder and Crosshead**



- |                            |                   |
|----------------------------|-------------------|
| 1. SHEAVE                  | 5. CHAIN ANCHOR   |
| 2. SNAP RING               | 6. WASHER AND NUT |
| 3. CROSSHEAD               | 7. SHIM           |
| 4. CYLINDER GUIDE ASSEMBLY | 8. GUIDE SHOE     |
|                            | 9. BEARING        |

**Figure 13. Free-Lift Cylinder and Crosshead**