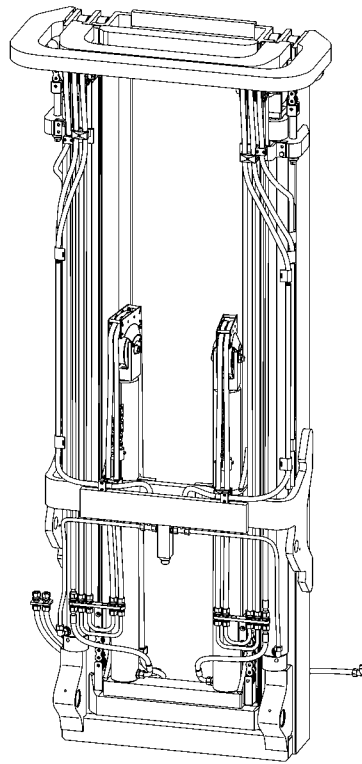


**MAST REPAIR
(S/N A513, A514, A613,
A614, A643, A644,
A683, A684)**

**H8.0FT, H8.0FT9, H9.0FT
(H170FT, H175FT36, H190FT) [A299, B299]**



HYSTER

SAFETY PRECAUTIONS

MAINTENANCE AND REPAIR

- The Service Manuals are updated on a regular basis, but may not reflect recent design changes to the product. Updated technical service information may be available from your local authorized Hyster® dealer. Service Manuals provide general guidelines for maintenance and service and are intended for use by trained and experienced technicians. Failure to properly maintain equipment or to follow instructions contained in the Service Manual could result in damage to the products, personal injury, property damage or death.
- 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 hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury and property damage.

On the lift truck, the **WARNING** symbol and word are on orange background. The **CAUTION** symbol and word are on yellow background.

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This section is for the following models:

H8.0FT, H8.0FT9, H9.0FT (H170FT, H175FT36, H190FT) [A299, B299]

**"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.



WARNING

Mast parts are heavy and can shift. 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. Disconnect the battery and put a tag or lock on the battery connector.**
- **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.**
- **Mast repairs require disassembly and removal of parts and can require removal of the mast or carriage. Follow the repair procedures in this section.**

WHEN WORKING NEAR THE MAST ALWAYS:

- **Lower the mast and carriage completely: Turn the key switch to the ON position and push the lift/lower control lever forward until there is no movement in the mast. Make sure that all parts of the mast that move are fully lowered.**

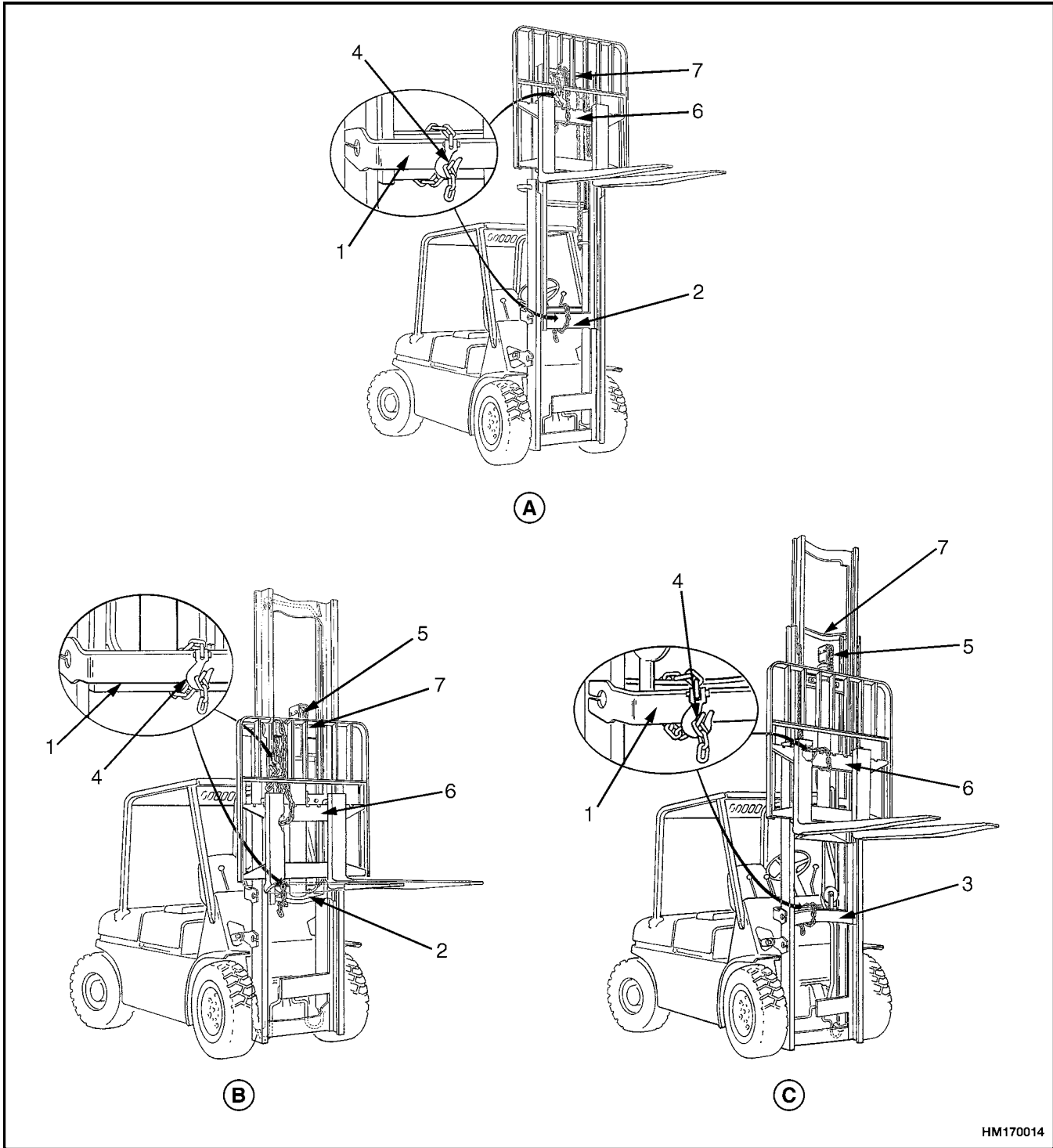
OR

- **If parts of the mast must be in a 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:**

1. Put mast in vertical position.
2. Raise mast to align bottom crossmember of mast upright that moves in outer mast with crossmember on outer mast. On the two-stage mast, the moving part is the inner mast. On the three-stage mast, it is the intermediate mast. See Figure 1 .
3. Use a 3/8-inch minimum safety chain with a hook to fasten the crossmembers together so the movable member cannot lower. Put hook on back side of mast. Make sure hook is completely engaged with a link in the chain. Make sure safety chain does not touch lift chains or chain sheaves, tubes, hoses, fittings, or other parts on the mast.
4. Lower mast until there is tension in safety chain and free-lift cylinder (full free-lift models) is completely retracted.

NOTE: Apply the parking brake. After lowering or restraining the mast, shut off the power, and remove key. Put a **DO NOT OPERATE** tag in the operator's compartment. Disconnect battery and put a tag or lock on battery connector.

5. Install another safety chain (9.5 mm (3/8 in.) minimum) between the top or bottom bar of the carriage and a crossmember on the outer mast as a secondary safety device. Install a **DO NOT REMOVE** tag on the safety chain(s).



HM170014

Figure 1. Safety Chaining the Mast (Sit-Down Lift Trucks)

Legend for Figure 1.

- | | |
|-----------------------|-------------------------|
| A. TWO-STAGE LFL MAST | C. THREE-STAGE FFL MAST |
| B. TWO-STAGE FFL MAST | |
| 1. OUTER MAST | 5. FREE-LIFT CYLINDER |
| 2. INNER MAST | 6. CARRIAGE BAR |
| 3. INTERMEDIATE MAST | 7. CROSSMEMBER |
| 4. HOOK | |

Fork Replacement

Forks are held on the carriage by hooks. Forks are held in position by pins that fit through the top fork hooks and into slots in top bar carriage. If pin does not remain engaged in carriage slot, replace with new pin. Always check that pins for forks keep forks in position on carriage. Replace damaged fork pin parts. Forks can be removed from carriage by aligning forks with fork removal notch. Fork removal notch is in the bottom bar of the carriage. See Figure 2.

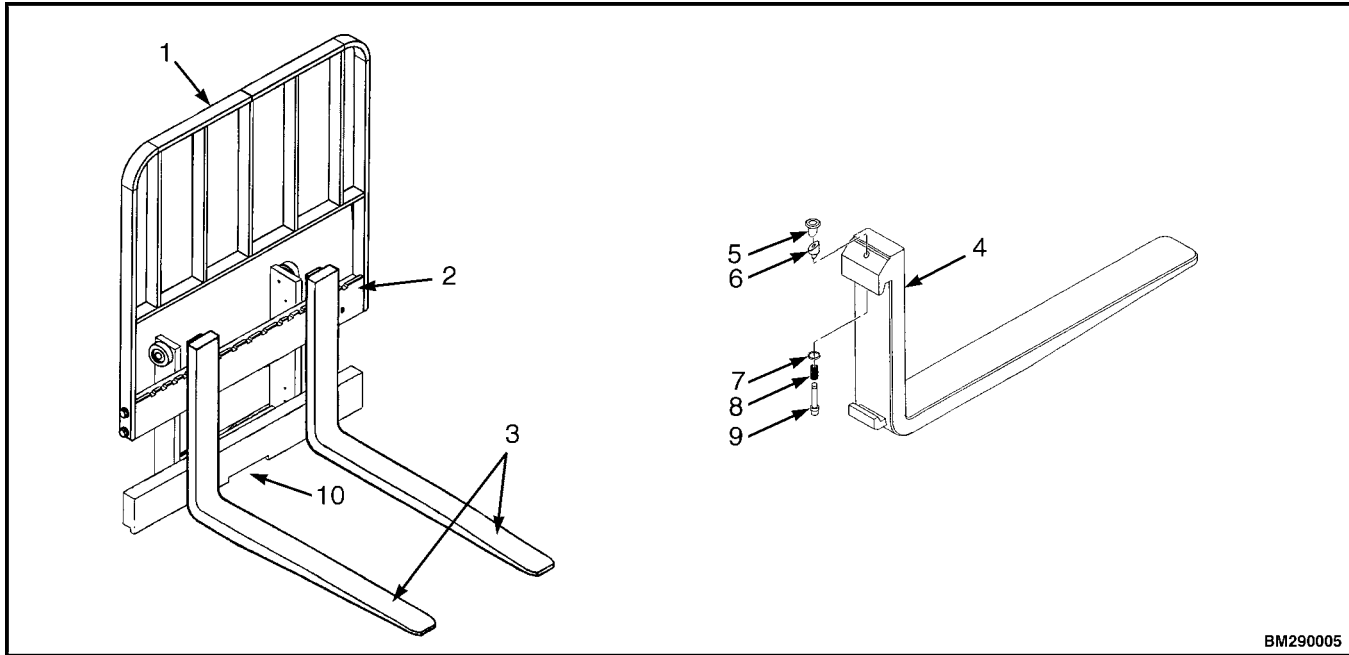
A fork can be removed from the carriage for replacement of the fork or other maintenance. Slide fork to the fork removal notch in bottom bar of the carriage. See Figure 2. Lower fork onto blocks so bottom hook of fork moves through fork removal notch. See Figure 3. Lower carriage further so top hook of fork is disengaged from top carriage bar. Move carriage away from fork or use a lifting device to move the fork away from carriage.

REMOVE



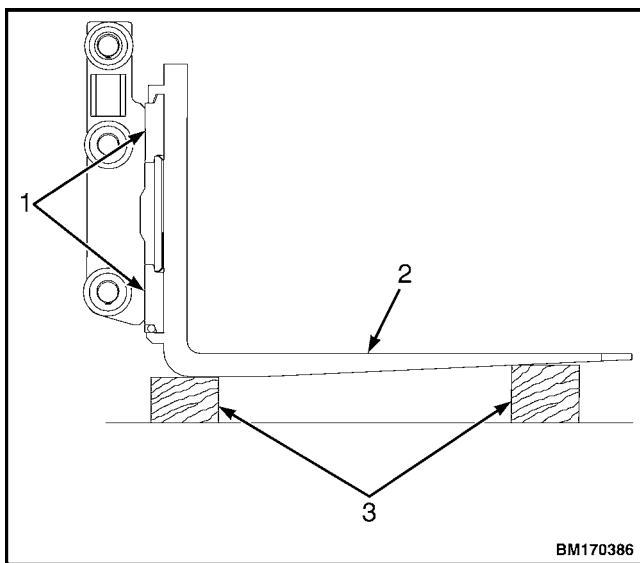
WARNING

DO NOT try to remove a fork without a lifting device. Each hook fork for these lift trucks can weigh 181 to 272 kg (400 to 600 lb).



- | | |
|---|--|
| <ul style="list-style-type: none"> 1. LOAD BACKREST 2. CARRIAGE 3. FORKS 4. FORK 5. KNOB | <ul style="list-style-type: none"> 6. WEDGE 7. WASHER 8. SPRING 9. PIN 10. FORK REMOVAL NOTCH |
|---|--|

Figure 2. Carriage and Forks



- 1. CARRIAGE BARS
- 2. HOOK FORK
- 3. BLOCKS

Figure 3. Hook Fork Removal

INSTALL

Move the fork and carriage so the top hook on the fork can engage the upper carriage bar. See Figure 3. Raise the carriage to move the lower hook through the fork removal notch. Slide the fork on the carriage so both upper and lower hooks engage the carriage bars. Engage the latch pin with a notch in the upper carriage bar.

CHECKS



WARNING

Never repair damaged forks by heating or welding. Forks are made of tempered steel using special procedures. Always replace damaged forks as a pair.

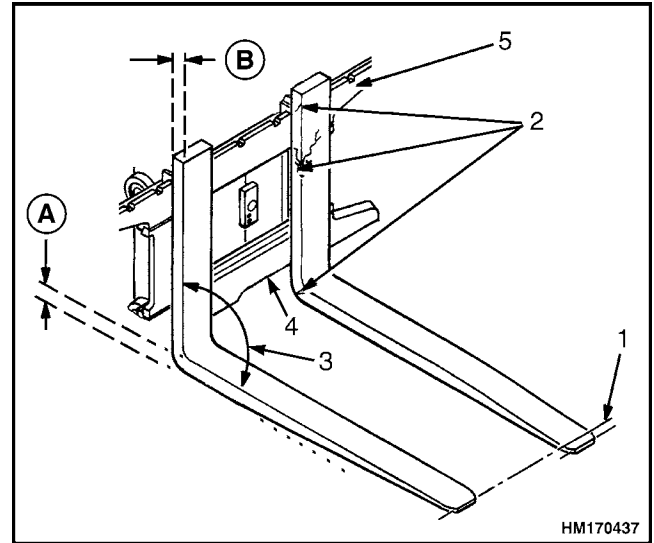
Inspect the forks for cracks and wear. Check the alignment of the fork tips. The difference in height of the fork tips must be less than three percent of the length of the forks. See Table 1 and Figure 4.

Table 1. Fork Tip Alignment

Fork Tip Alignment Specifications			
Standard Fork Lengths		Maximum Fork Tip Difference ₁	
mm	(in.)	mm	(in.)
1200	(47)	36	(1.42)
1500	(59)	45	(1.77)
1800	(71)	54	(2.13)
2100	(83)	63	(2.49)
2400	(94)	72	(2.82)

₁Difference of alignment between fork tips must be no more than 3% of the total fork length.

Some applications may require closer alignment. If the forks do not meet specification, they both must be replaced. Check that the bottom of each fork is not excessively worn. Check for smooth and proper operation of the fork lock pins. Repair or replace any damaged or broken fork lock pins or components and lubricate as necessary. See Figure 2.



- A. HEEL OF FORK (MUST BE 90% OF DIMENSION B)
- B. ORIGINAL FORK THICKNESS (DIMENSION B)
- 1. TIP ALIGNMENT (MUST BE WITHIN 3% OF FORK LENGTH)
- 2. CRACKS
- 3. MAXIMUM ANGLE 93°
- 4. FORK REMOVAL NOTCH
- 5. CARRIAGE

Figure 4. Fork Check

Carriage Repair

REMOVE



WARNING

DO NOT work under a raised carriage. Lower the carriage or use a chain or blocks to prevent the carriage and inner mast from lowering.

NOTE: If the mast is equipped with an integral sideshift carriage or an integral sideshift carriage with fork positioners, see the section Integral Sideshift Carriage And Fork Positioners Repair for procedures.

1. Remove the forks. See Fork Replacement for procedures.

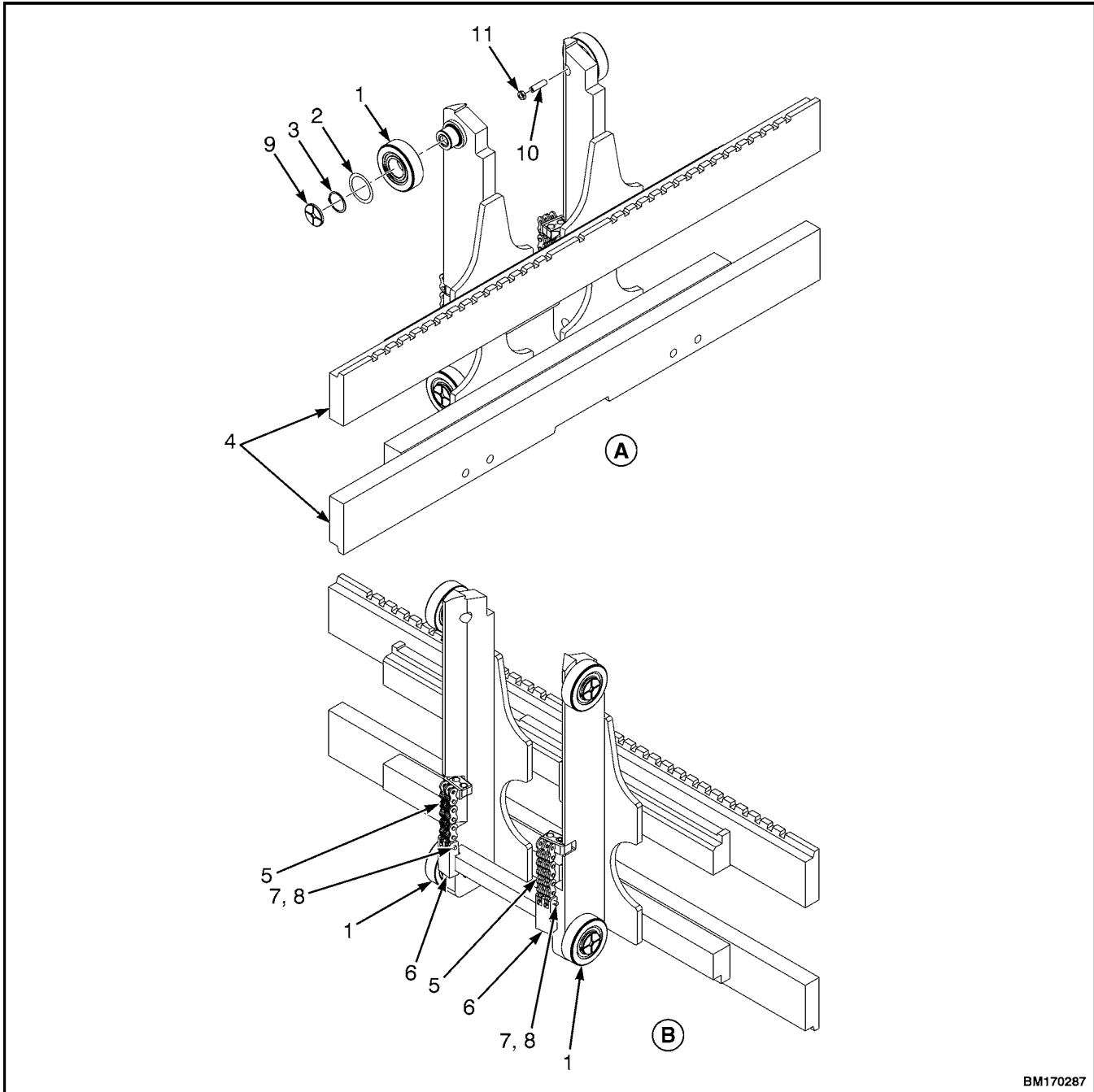
2. Lower carriage onto blocks until lift chains become loose.



WARNING

When disconnecting the lift chains, keep control of the ends. Use wire to temporarily connect the ends of the lift chains to the mast. This procedure will prevent the lift chains from falling and causing an injury or damage.

3. Remove pin from each chain anchor at the carriage. See Figure 5. Disconnect lift chains from carriage.



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A. FRONT VIEW

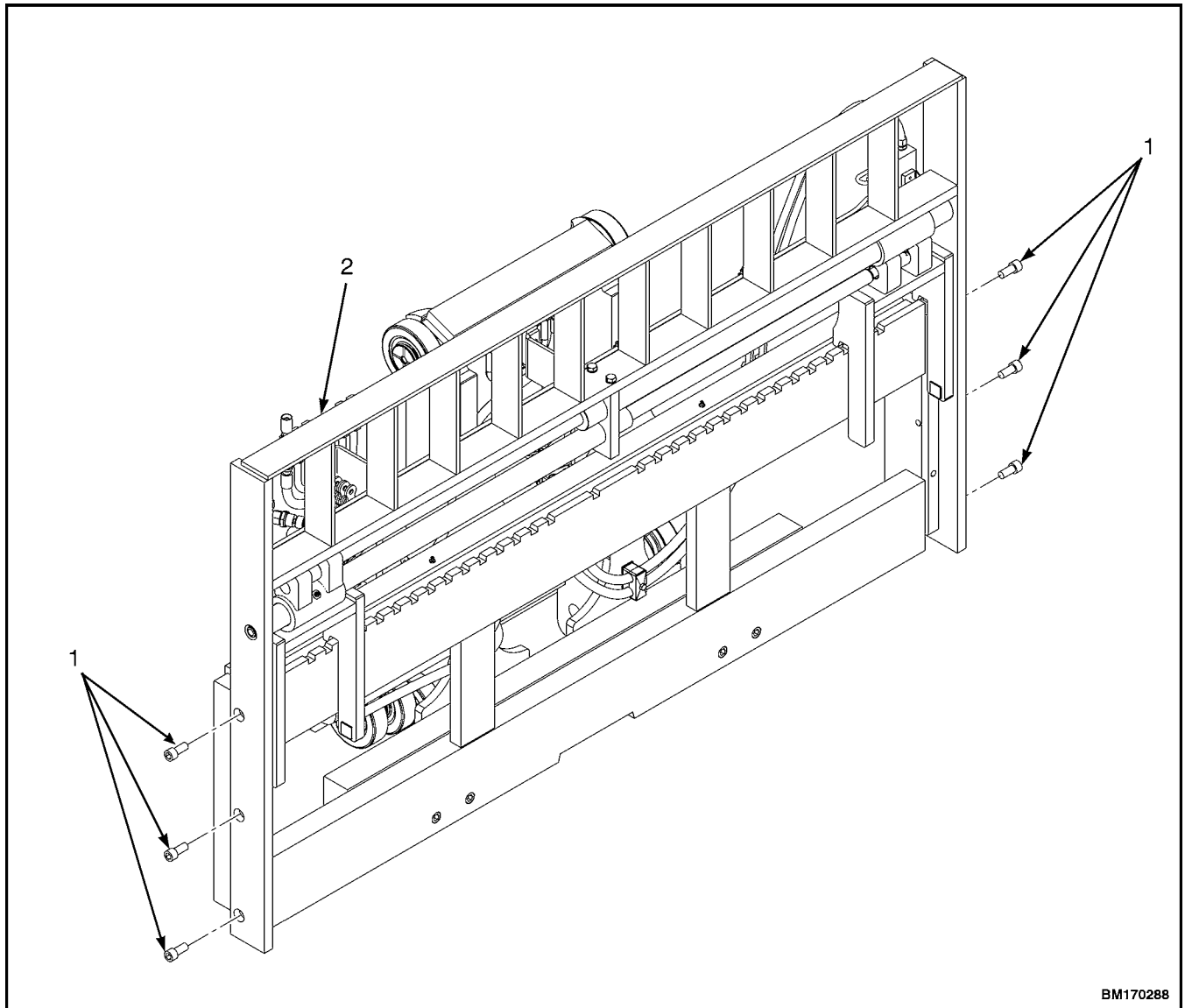
B. BACK VIEW

- 1. LOAD ROLLER
- 2. SHIM
- 3. SNAP RING
- 4. CARRIAGE BARS
- 5. CHAIN
- 6. CHAIN ANCHOR

- 7. CHAIN ANCHOR PIN
- 8. COTTER PIN
- 9. THRUST BEARING
- 10. SETSCREW
- 11. JAM NUT

Figure 5. Standard Carriage Assembly

4. If load backrest needs to be removed, attach a lifting device, with a capacity of 57 to 68 kg (125 to 150 lb), to load backrest. Remove six socket head capscrews and remove load backrest from carriage using lifting device. See Figure 6.
5. Use lift cylinders to raise the inner mast until it is above the load rollers of the carriage. If the hydraulic system cannot be used, connect a lifting device to the top of the inner mast. The lifting device must have a capacity of 816 kg (1800 lb). Carefully raise inner mast until it is above the load rollers of the carriage.
6. Install safety chains to secure the mast in its extended position and disconnect the lifting device. See Safety Procedures When Working Near Mast.



NOTE: CARRIAGE WITH INTEGRAL SIDESHIFT AND FORK POSITIONERS SHOWN. LOAD BACKREST REMOVAL IS THE SAME FOR STANDARD CARRIAGE.

1. SOCKET HEAD CAPSCREWS

2. LOAD BACKREST

Figure 6. Load Backrest Removal

7. Move lift truck away from carriage. Connect a lifting device to the carriage. The lifting device must have a capacity of 272 to 318 kg (600 to 700 lb). Place carriage on floor so that load rollers are up.

CLEAN AND INSPECT

1. If load rollers must be replaced, make a note of the location and number of shims. Install the shims, load rollers, snap rings, thrust bearings, setscrews, and jam nuts. See Figure 5. See Carriage Adjustment for correct adjustment of the load rollers.



WARNING

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



WARNING

Cleaning solvents can be flammable and toxic, and can cause skin irritation. When using cleaning solvents, always follow the recommendations of the manufacturer.



CAUTION

DO NOT use cleaning solvent, compressed air, or steam to clean lift chain sheaves or load rollers. The bearings in the lift chain sheaves and load rollers are sealed and lubricated. Cleaning solvent, compressed air, and steam can damage the load roller bearings.

2. Clean any oil, grease, dirt, and other debris from the carriage frame. Use a cleaning solvent and compressed air to dry.



WARNING

Improper welding procedures can damage the structure of the carriage and mast or cause incorrect function of the mast and carriage. Consult your Hyster lift truck dealer for more information before welding on the mast and carriage.

3. If the carriage bars have any protruding welds or damaged notches, repair by grinding, filing, or welding.
4. Clean and inspect the chain anchors and chain anchor pins. See Figure 5. Check chain anchors and anchor pins for wear and serviceability. Discard worn or unserviceable chain anchors and chain anchor pins. Discard cotter pins.

NOTE: If lift chains are replaced, chain anchors and chain anchor pins must also be replaced.

5. Inspect lift chains. Replace worn or damaged lift chains. See the **Clean and Inspect** procedures in the Two-Stage Mast With Limited Free-Lift Repair or Three-Stage Mast With Full Free-Lift Repair section for lift chain inspection procedures.

INSTALL

1. Connect a lifting device to the carriage. Move lift truck up to the carriage. Make sure carriage is stable.
2. Use lift cylinders or a lifting device with a capacity of 816 kg (1800 lb) to raise inner mast until it is above the load rollers of the carriage, and carefully lower the inner mast onto the carriage.

NOTE: Install chain anchor pins so that heads of pins face inside and center of mast. Both legs of cotter pin must be bent against chain anchor pin. Use new cotter pins each time the chain pins are removed.

3. Replace worn or unserviceable chain anchor pins and chain anchors on the carriage with new ones. Connect lift chains to the chain anchors on the carriage. See Figure 5.
4. Tighten chain anchor nuts to 370 N•m (273 lbf ft).
5. Install the load backrest on the carriage using six socket head capscrews. See Figure 6. Tighten the socket head capscrews to 195 N•m (144 lbf ft).
6. Install forks on carriages. See the section Fork Replacement.
7. Check the clearance of the load rollers. See Carriage Adjustment in this service manual.

Integral Sideshift Carriage And Fork Positioners Repair

INTEGRAL SIDESHIFT CARRIAGE

Remove

1. Lower the carriage completely. Remove the forks. See Fork Replacement for removal procedures.
2. Remove the load backrest. See Carriage Repair for removal procedures.



WARNING

Before disconnecting the hydraulic hoses, relieve the pressure in the hydraulic system. Serious injury can occur if pressure is not relieved from the hydraulic system prior to disconnecting hydraulic hoses.

3. Relieve hydraulic pressure from the sideshift cylinder by moving sideshift lever in both directions several times.



WARNING

Always wear proper protective equipment including eye protection and petroleum-resistant gloves when handling hydraulic oil. Thoroughly wash oil from exposed areas of skin as soon as possible.

Hydraulic oil is hot at normal operating temperatures. Be careful when draining the oil.

Never check for leaks by putting hands on hydraulic lines or components under pressure. Hydraulic oil under pressure can be injected into the skin.

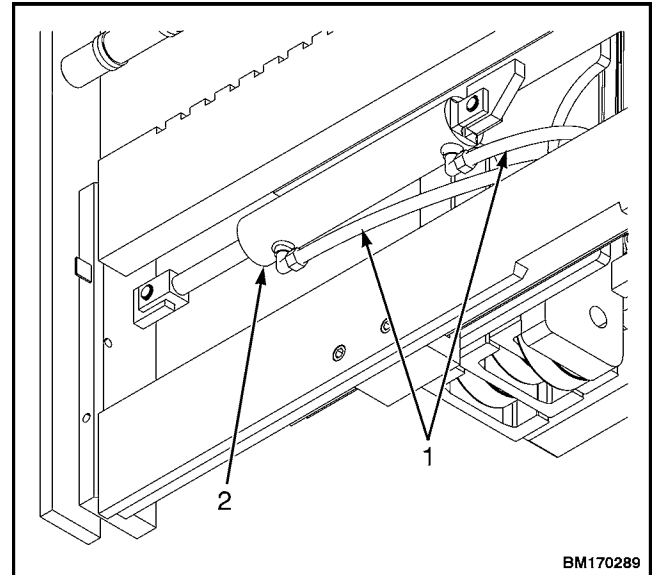


CAUTION

Protect the hydraulic system from dirt and contaminants when servicing the hydraulic system.

NOTE: Tag hydraulic lines and fittings prior to disconnecting to aid in connecting during installation.

4. Disconnect hydraulic lines from sideshift cylinder. See Figure 7. Put caps and plugs on open lines and cylinder ports.



1. HYDRAULIC LINES
2. SIDESHIFT CYLINDER

Figure 7. Sideshift Cylinder Hydraulic Lines Disconnect

5. Lower integral sideshift carriage onto blocks until lift chains become loose.



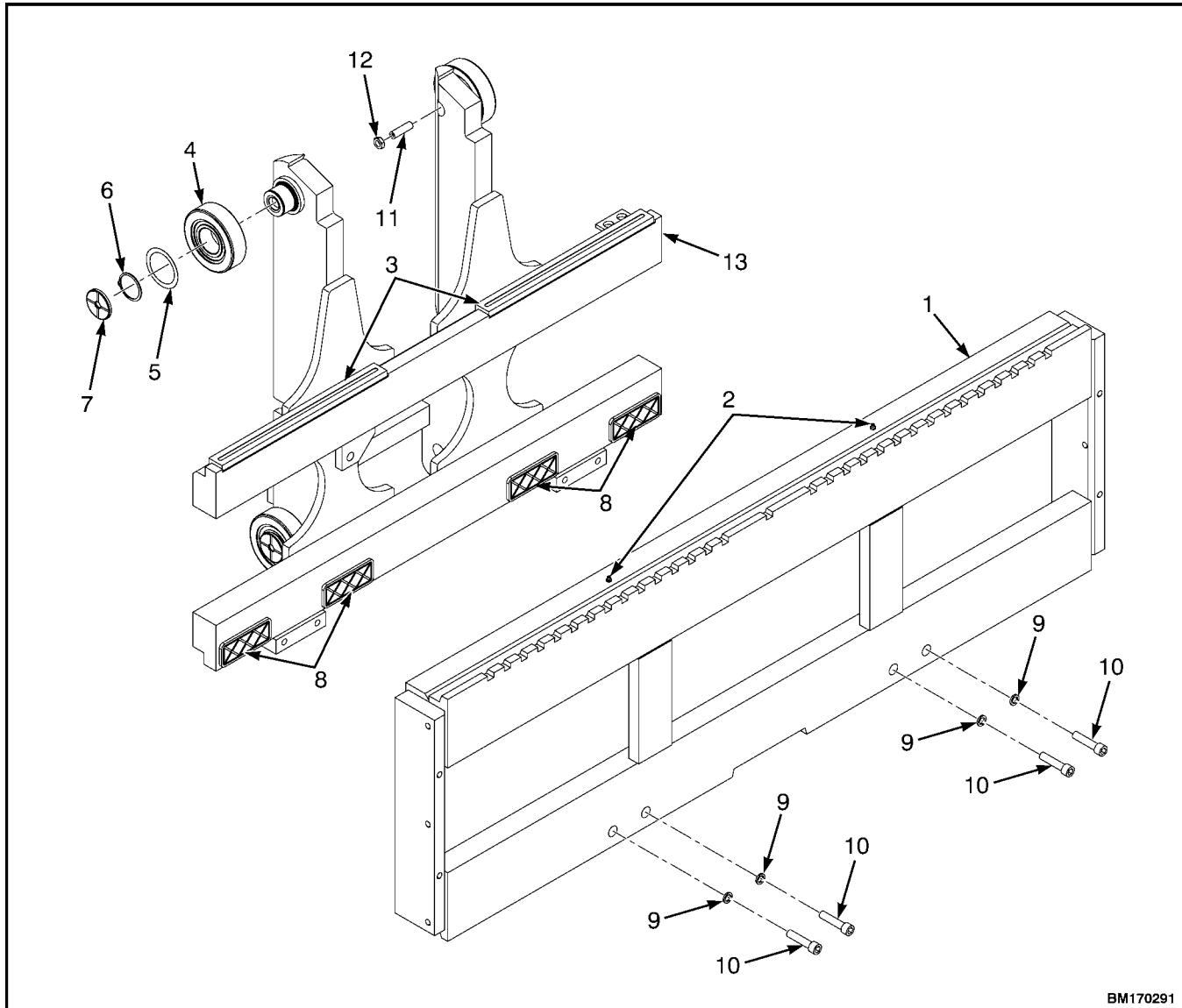
WARNING

When disconnecting the lift chains, keep control of the ends. Use wire to temporarily connect the ends of the lift chains to the mast. This procedure will prevent the lift chains from falling and causing an injury or damage.

6. Remove pins from each chain anchor at the carriage. See Figure 5. Disconnect lift chains from carriage.
7. Use lift cylinders to raise inner mast until it is above the load rollers of the carriage. If the hydraulic system cannot be used, connect a lifting device to the top of the inner mast. Carefully raise inner mast until it is above the load rollers of the carriage.
8. Attach a lifting device with a capacity of 363 to 454 kg (800 to 1000 lb) to integral sideshift carriage. Move lift truck away from carriage. Put integral sideshift carriage on floor so that load rollers are up.

Disassemble

1. Attach lifting device to outer frame. Remove four socket head capscrews and washers and remove outer frame from integral sideshift carriage. See Figure 8.



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- | | |
|-------------------|--------------------------|
| 1. OUTER FRAME | 8. LOWER BEARING |
| 2. LUBE FITTING | 9. WASHER |
| 3. UPPER BEARING | 10. SOCKET HEAD CAPSCREW |
| 4. LOAD ROLLER | 11. SETSCREW |
| 5. SHIM | 12. JAM NUT |
| 6. SNAP RING | 13. INNER FRAME |
| 7. THRUST BEARING | |

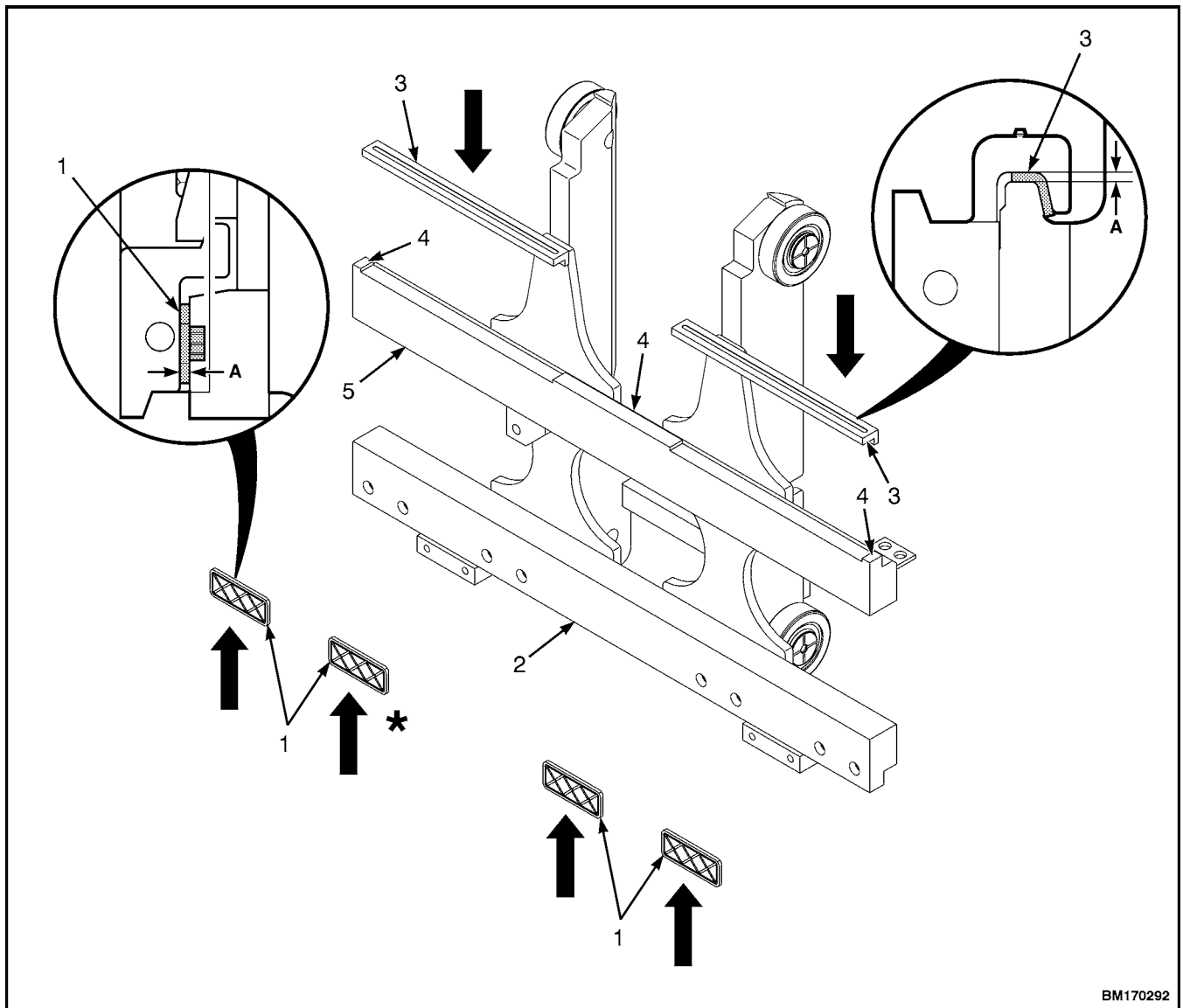
Figure 8. Integral Sideshift Carriage Removal

2. If the sideshift cylinder needs to be repaired, see service manual **Cylinder Repair (Mast S/N A513, A514, A613, A614, B513, B514) 2100SRM1328** for procedures to remove the sideshift cylinder.
3. Check the upper and lower bearings on carriage bars as follows:
 - a. If either upper bearing is worn to less than 2.5 mm (0.1 in.) thickness, replace both upper bearings. See Figure 9. Remove upper bearings by driving them from the inner frame. See Figure 8.

Refer to the Assemble section for procedure to install new upper bearings.

- b. If either lower bearing is worn to less than 2.5 mm (0.1 in.) thickness, replace both lower bearings. See Figure 9. Remove lower bearings by prying them from the inner frame. See Figure 8.

Refer to the Assemble section for procedure to install new upper bearings.



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Figure 9. Checking Upper and Lower Bearings

Legend for Figure 9.

A. MINIMUM THICKNESS, 2.5 mm (0.1 in.)

1. LOWER BEARINGS
2. LOWER CARRIAGE BAR
3. UPPER BEARINGS

4. NOTCHES
5. UPPER CARRIAGE BAR

*Bold arrows indicate which side to apply grease.

4. If damaged, remove lube fittings from outer frame. See Figure 8.

Clean and Inspect**WARNING**

Improper welding procedures can damage the structure of the mast and carriage or cause incorrect function of the mast and carriage. Consult your Hyster lift truck dealer for more information before welding on the mast and carriage.

1. Clean and inspect the carriage bars and outer frame for damage and smoothness. Ensure the bars on the frames are parallel and the ends are flush. If carriage bars have any protruding welds or damaged notches, repair by grinding, filing, or welding.
2. If upper or lower bearings were removed, clean the upper and lower bearing areas.

**WARNING**

Cleaning solvents can be flammable and toxic, and can cause skin irritation. When using cleaning solvents, always follow the recommendations of the manufacturer.

3. Inspect the sideshift cylinder. Replace the entire cylinder assembly if a cylinder rod is bent or scored or if there is damage on the outside of the cylinder shell that could impair performance or cause leaks under pressure. See service manual section **Cylinder Repair (Mast S/N A513, A514, A613, A614, B513, B514)** 2100SRM1328 for replacing sideshift cylinder.
4. Inspect load rollers for wear and damage. If load rollers must be replaced, make a note of the location and number of the shims to ensure

correct installation. Install the shims, load rollers, snap rings, thrust bearings, setscrews, and jam nuts. See Figure 8.

5. Clean and inspect the chain anchors and chain anchor pins. See Figure 5. Check chain anchors and anchor pins for wear and serviceability. Discard worn or unserviceable chain anchors and chain anchor pins. Discard cotter pins.

NOTE: If lift chains are replaced, chain anchors and chain anchor pins must also be replaced.

6. Inspect lift chains. Replace worn or damaged lift chains. See the **Clean and Inspect** procedures in the **Two-Stage Mast With Limited Free-Lift Repair** or **Three-Stage Mast With Full Free-Lift Repair** section for lift chain inspection procedures.

Assemble

1. If removed, install new lube fittings on outer frame. See Figure 8.
2. If removed, install upper and lower bearings on carriage bars:
 - To install new upper bearings, apply thin coat of grease and align bearings to notches on top carriage bar and slide into place on top carriage bar. See Figure 9.
 - To install new lower bearings, apply thin coat of grease and align the circular pins on the backside of lower bearings to holes on lower carriage bar and tap bearing into place on lower carriage bar using a rubber or brass hammer. See Figure 9.
3. If the sideshift cylinder was removed for repair, see service manual **Cylinder Repair (Mast S/N A513, A514, A613, A614, B513, B514)** 2100SRM1328 for procedures to install the sideshift cylinder.

4. Attach a lifting device to outer frame and secure it to carriage bars with four socket head capscrews and washers. See Figure 8.

Install

1. Use lift cylinders to raise inner mast until it is above the load rollers of the carriage, and carefully lower the inner mast onto the carriage.

NOTE: Install new chain anchor pins so that heads of pins face inside and center of mast. Both legs of cotter pins must be bent against chain anchor pins.

2. Replace worn or damaged chain anchor pins and chain anchors on the carriage with new ones and install new cotter pins. Connect lift chains to the chain anchors on the carriage. See Figure 5. Tighten chain anchor nuts to 370 N•m (273 lbf ft).
3. Remove protective caps and plugs from hydraulic lines and cylinder ports. Connect hydraulic lines to sideshift cylinder as tagged during removal. See Figure 7.

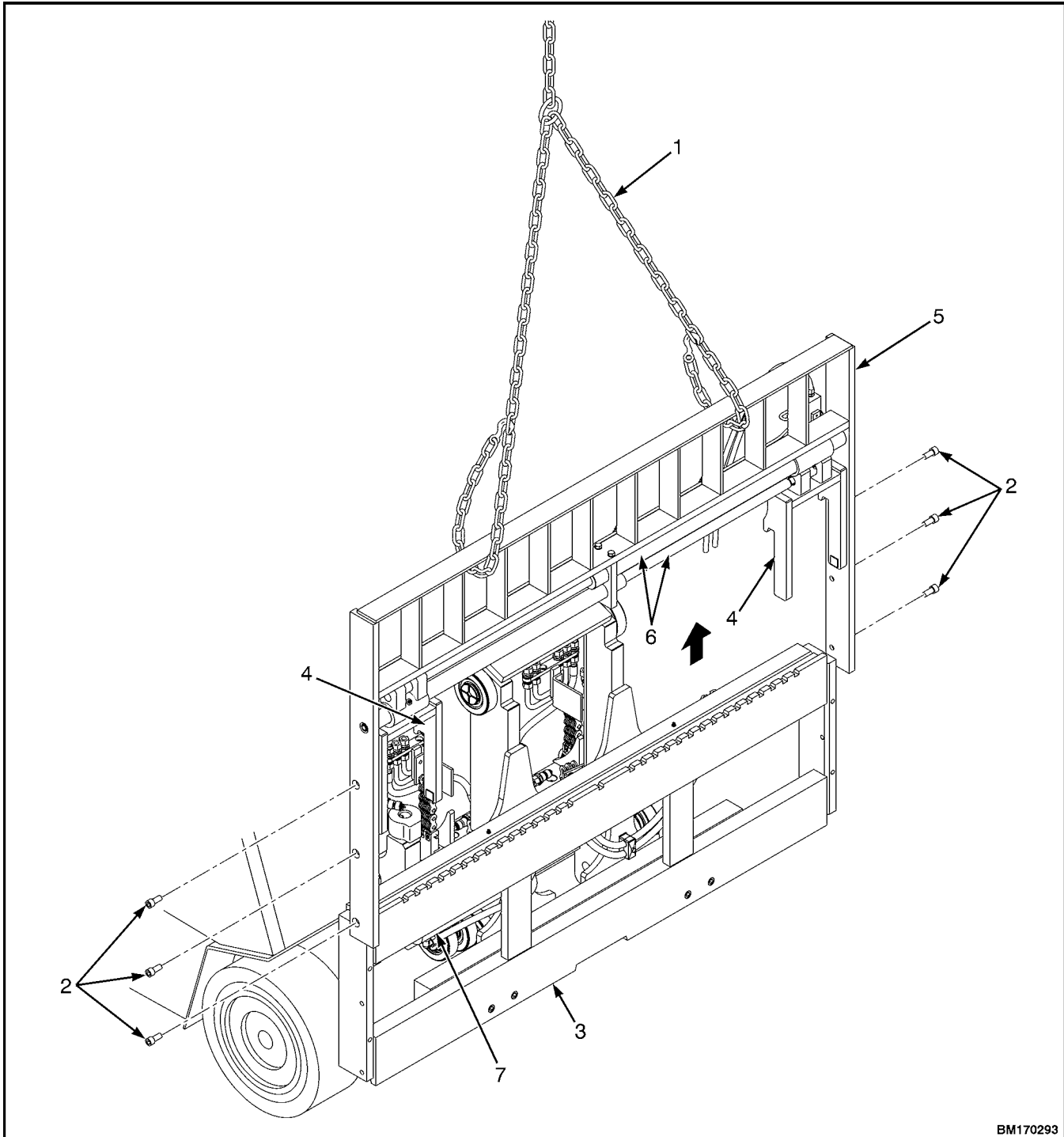
4. Install the load backrest. See Carriage Repair for Installation procedures.
5. Install the forks. See Fork Replacement for installation procedures.
6. Operate the integral sideshift carriage through several complete cycles and check for any leaks at the fittings and cylinder rod ends and to force any air in the system to the hydraulic tank.

FORK POSITIONERS

The lift truck models covered in this manual may be equipped with optional fork positioners on the integral sideshift carriage.

Remove

1. Attach a lifting device to the fork positioner frame. See Fork Replacement.



BM170293

NOTE: FORKS OMITTED FOR CLARITY.

- | | |
|---|--------------------------------|
| 1. LIFTING DEVICE | 5. FORK POSITIONER FRAME |
| 2. MOUNTING SOCKET HEAD CAPSCREWS | 6. FORK POSITIONER CYLINDERS |
| 3. INTEGRAL SIDESHIFT CARRIAGE ASSEMBLY | 7. INTEGRAL SIDESHIFT CYLINDER |
| 4. FORK CARRIERS | |

Figure 10. Fork Positioner Removal

**WARNING**

Before disconnecting the hydraulic hoses, relieve the pressure in the hydraulic system. Serious injury can occur if pressure is not relieved from the hydraulic system prior to disconnecting hydraulic hoses.

NOTE: Tag hydraulic lines and fittings prior to disconnecting to aid in connecting during installation.

2. Relieve hydraulic pressure from the fork positioner cylinders by moving the auxiliary lever in both directions several times.

**WARNING**

Always wear proper protective equipment including eye protection and petroleum-resistant gloves when handling hydraulic oil. Thoroughly wash oil from exposed areas of skin as soon as possible.

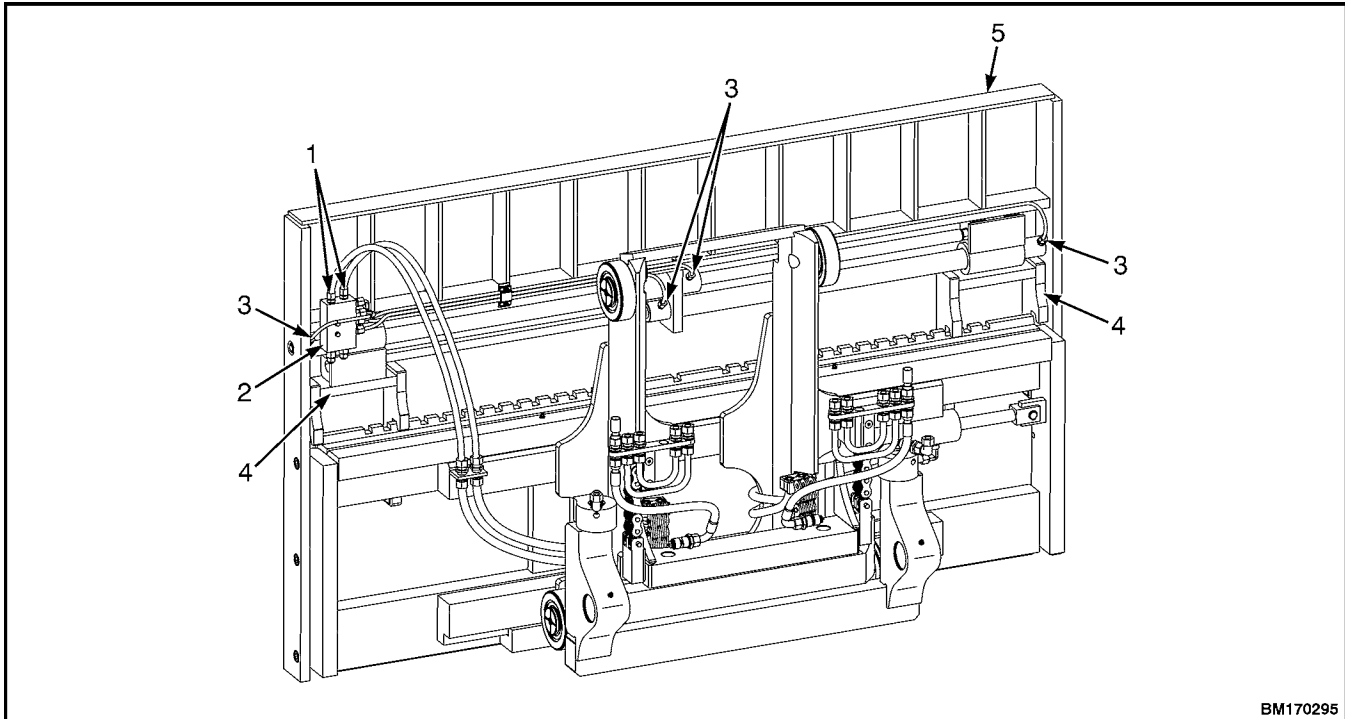
Hydraulic oil is hot at normal operating temperatures. Be careful when draining the oil.

Never check for leaks by putting hands on hydraulic lines or components under pressure. Hydraulic oil under pressure can be injected into the skin.

**CAUTION**

Protect the hydraulic system from dirt and contaminants when servicing the hydraulic system.

3. Disconnect hydraulic lines from fork positioner cylinders and fork positioner hydraulic valve, and put caps and plugs on open lines and cylinder ports. See Figure 11 and Figure 12.



- | | |
|--|--------------------------|
| 1. FORK POSITIONER HYDRAULIC VALVE CONNECTIONS | 4. FORK POSITIONERS |
| 2. FORK POSITIONER HYDRAULIC VALVE | 5. FORK POSITIONER FRAME |
| 3. FORK POSITIONER CYLINDERS HYDRAULIC CONNECTIONS | |

Figure 11. Fork Positioner Hydraulic Disconnection

- | | |
|--|--|
| 4. Remove the mounting socket head capscrews that fasten the fork positioner frame and fork carriers to the sideshift carriage and forks. See Figure 10. | 2. Disengage fork positioner cylinders from fork positioner frame by moving both cylinders inward into the center plate. |
| 5. Raise the fork positioner frame up and remove frame from sideshift carriage assembly. Place frame on a pallet or blocks. See Figure 10. | 3. Remove two capscrews and washers from center plate. See Figure 12. |
| | 4. Remove fork positioner cylinders and fork carriers as an assembly from fork positioner frame. |
| Disassemble | |
| 1. Remove two nuts that attach the fork positioner cylinders to fork positioner frame. See Figure 12. | 5. Slide fork carriers off of the cylinders and disengage the cylinders from the center plate. |

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