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General

This section has a description and the repair procedures for the planetary gear axle.

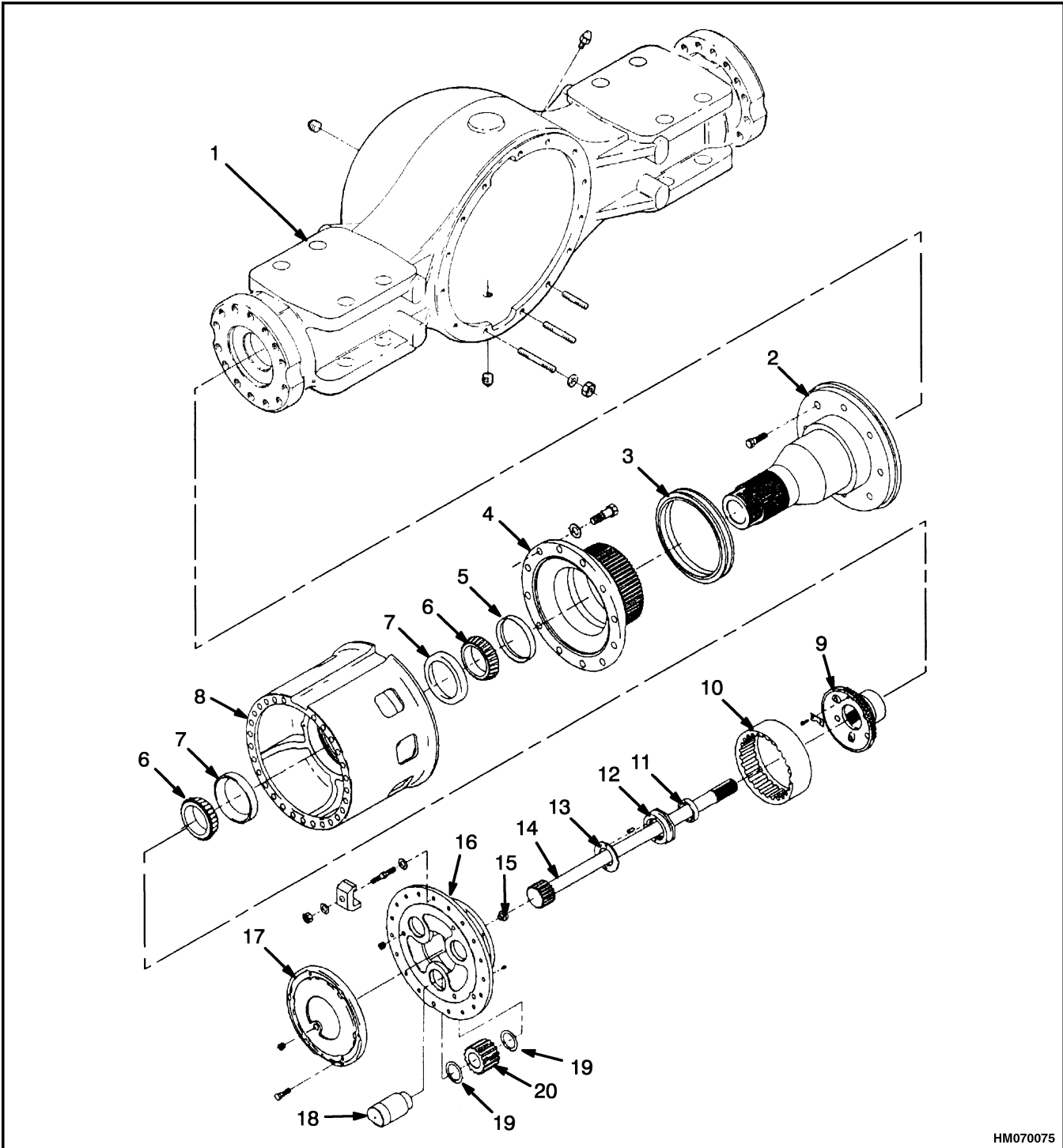
Description

The planetary gear axle has an axle housing and two final drive assemblies. See Figure 1 and Figure 2. Each final drive assembly is a planetary gear unit. The planetary gear assembly changes the final drive ratio, which increases the torque to the drive wheels. Each unit has a drive axle, sun gear, ring gear hub,

and ring gear. There are also three planetary pinions, a planetary spider, and a housing. The differential is also installed in the axle housing. The service brake is also installed on the drive axle. See the section **Service Brake** for your lift truck, for repair instructions of the brakes.

Operation

The rotation of the differential causes the axle shafts and the sun gears to rotate. The sun gears then cause the planetary pinions to rotate. Rotation of the pinions causes the planetary spiders to rotate the hubs and the drive wheels. The ring gear and the ring gear hub do not rotate.

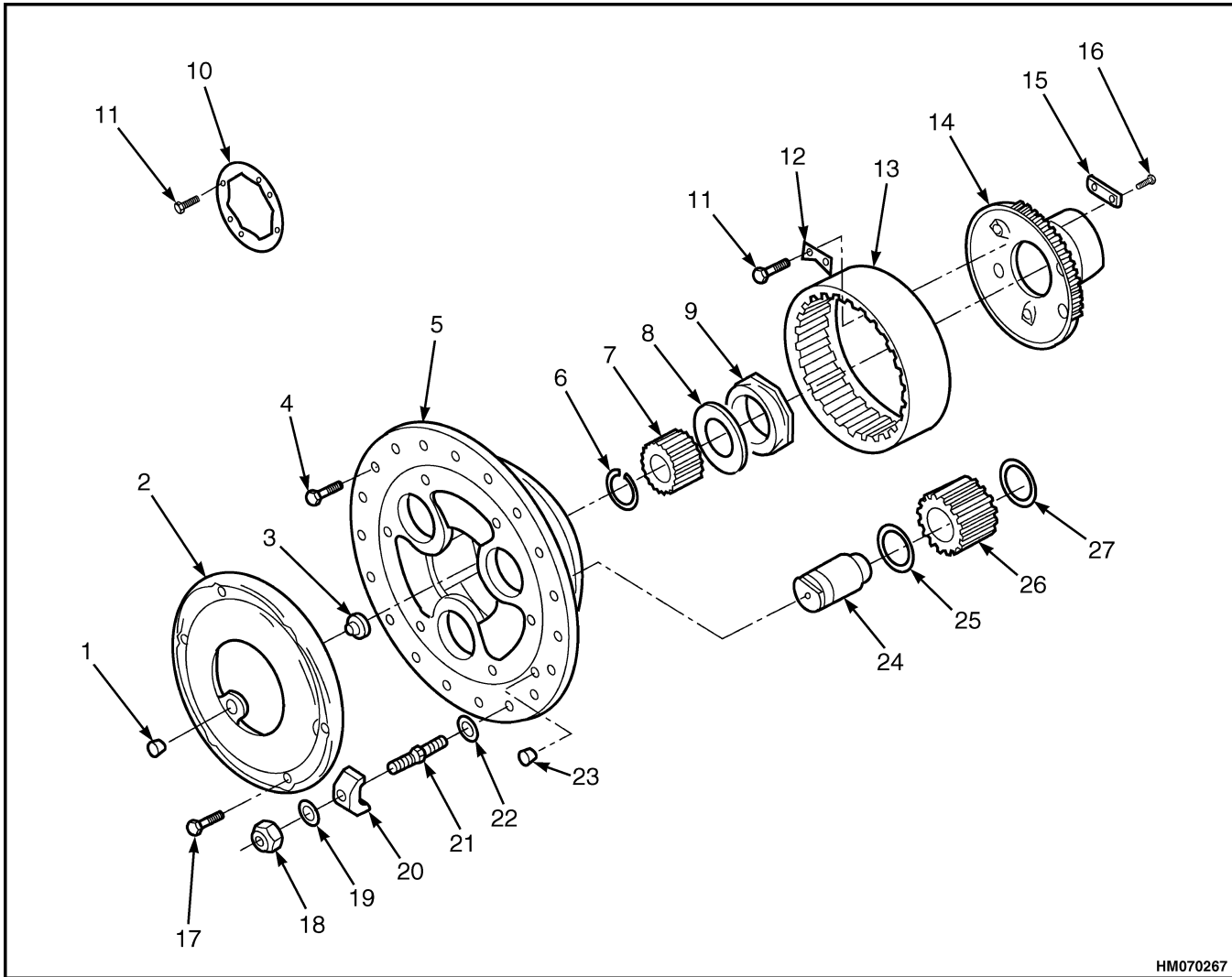


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Figure 1. Planetary Axle With Oil-Cooled Brakes

Legend for Figure 1

1. AXLE HOUSING
2. SPINDLE
3. SEAL
4. ROTOR
5. OIL SEAL
6. BEARING CONE
7. BEARING CUP
8. WHEEL HUB
9. RING GEAR HUB
10. RING GEAR
11. INNER HUB
12. WHEEL BEARING ADJUSTMENT NUT
13. WHEEL BEARING ADJUSTING LOCK NUT
14. AXLE
15. THRUST BUTTON
16. PLANETARY GEAR CARRIER
17. COVER
18. PINION SHAFT (3)
19. PINION THRUST WASHER
20. PINION GEAR (3)



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- | | |
|--------------------------------|--------------------------------|
| 1. DRAIN/FILL PLUG | 15. RETAINER PLATE |
| 2. COVER | 16. CAPSCREW |
| 3. AXLE SHAFT THRUST BUTTON | 17. CAPSCREW |
| 4. CAPSCREW | 18. WHEEL STUD NUT |
| 5. PLANETARY GEAR CARRIER | 19. WHEEL STUD NUT WASHER |
| 6. SNAP RING | 20. WHEEL RIM CLAMP |
| 7. SUN GEAR | 21. WHEEL STUD |
| 8. THRUST WASHER | 22. WHEEL STUD WASHER |
| 9. WHEEL BEARING ADJUSTING NUT | 23. OIL DRAIN PLUG |
| 10. LOCK NUT LOCK PLATE | 24. PINION SHAFT |
| 11. LOCK PLATE CAPSCREW | 25. PINION OUTER THRUST WASHER |
| 12. LOCK NUT LOCK PLATE | 26. PINION GEAR |
| 13. RING GEAR | 27. PINION INNER THRUST WASHER |
| 14. RING GEAR HUB | |

Figure 2. Planetary Axle Components

Planetary Gear Axle Repair

REMOVE

Drive Wheels and Tires

NOTE: The final drive assemblies can be removed with the drive axle installed in the lift truck. If the drive axle must be removed, do the following steps. If the drive axle will not be removed, do only the required steps.

1. Place lift truck on solid, level surface.
2. Put blocks on each side (front and back) of the steer tires to prevent movement of the lift truck. See Figure 3, Figure 4, and Figure 5.
3. Put mast in a vertical position.
4. Put a block under each outer mast channel.
5. Tilt mast fully forward until drive tires are raised from the surface.

CAUTION

Do not place blocks under fuel and hydraulic hoses or fuel and hydraulic tank. Damage to the lift truck may occur.

6. Put additional blocks under frame behind the drive tires.

WARNING

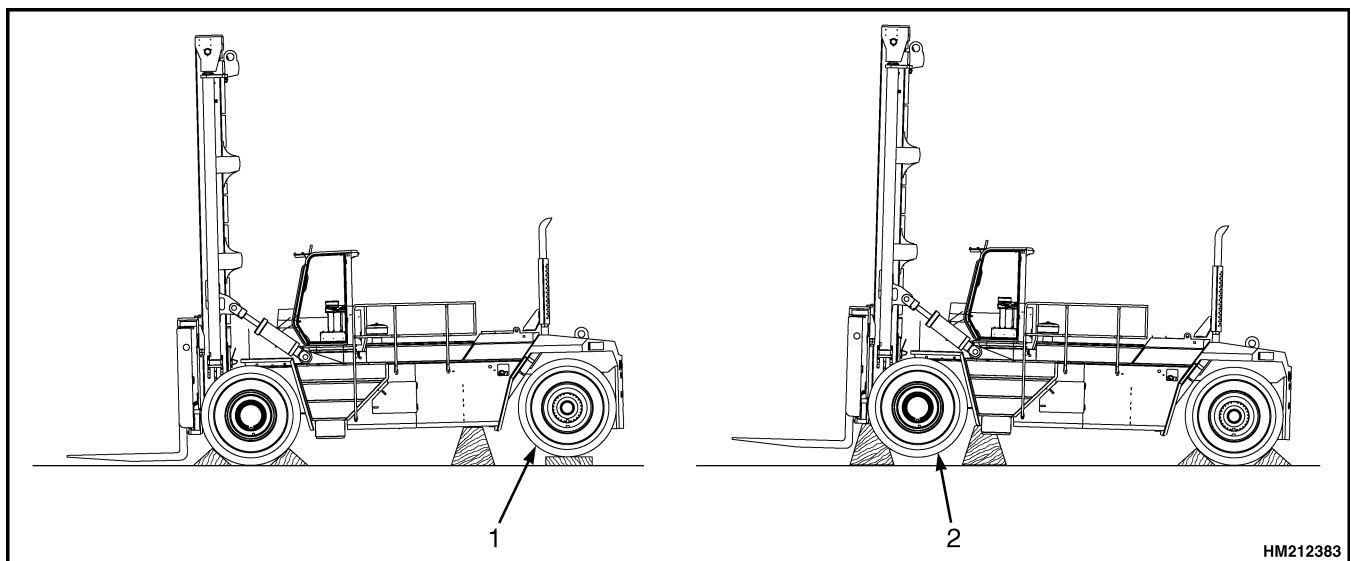
Completely remove air pressure from tire before it is removed from lift truck. Because dual wheels are installed, remove air pressure from both tires. Air pressure in tires can cause tire and wheel parts to explode, causing serious injury or death.

7. Remove air from tire.
8. Remove valve core to verify that all air is out of inner tube.
9. Push a wire through valve stem to verify the stem does not have a restriction.
10. Remove wheel nuts and clamps.

WARNING

The tires and wheels can weigh approximately 875 kg (1929 lb). Verify the lifting device has the rated capacity to lift the tires and wheels or personal injury may occur.

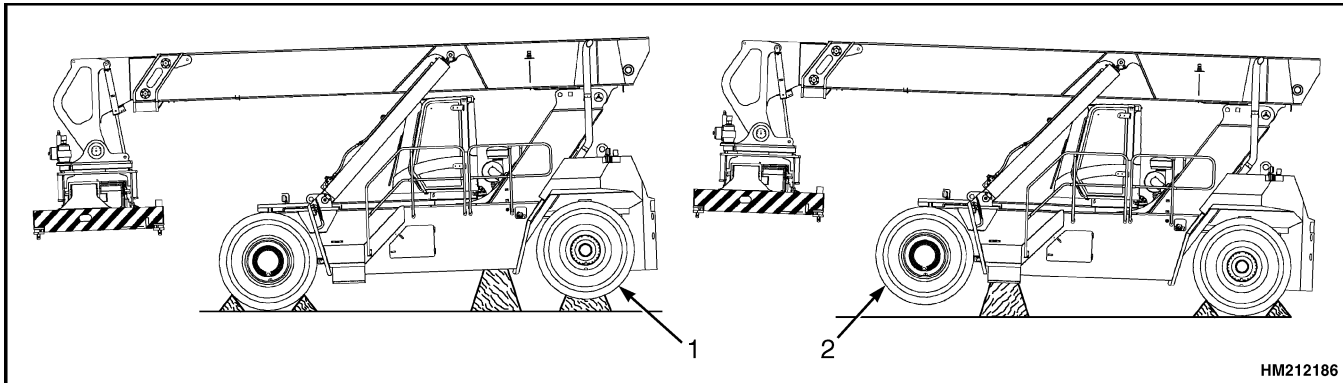
11. Remove wheel and tire from lift truck.



1. STEER AXLE/STEER TIRES

2. DRIVE AXLE/DRIVE TIRES

Figure 3. Put Lift Truck on Blocks (A917)



1. STEER AXLE/STEER TIRES

2. DRIVE AXLE/DRIVE TIRES

Figure 4. Put the Lift Truck on Blocks (B222)

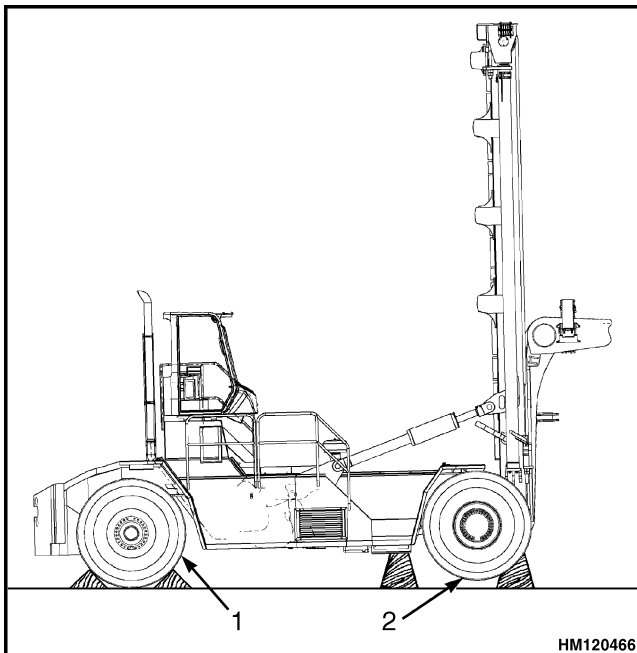
1. STEER AXLE/STEER TIRES
2. DRIVE AXLE/DRIVE TIRES

Figure 5. Put the Lift Truck on Blocks (E117 and F117)

DISASSEMBLE

Drive Axle

1. Apply brakes ten to twenty times until accumulated hydraulic brake pressure is released.
2. Drain oil from the end of axle housing.
3. Rotate hub assembly until oil drain plug in planetary gear carrier is at the bottom.

4. Remove oil drain plug and drain oil.
5. Drain cooling oil from service brakes.

WARNING

Brake linings can contain dangerous fibers. Breathing dust from these linings is a cancer or lung disease hazard. Do not create dust! Do not clean brake parts with compressed air or by brushing. Use vacuum equipment approved for brake dust or follow the cleaning procedure in this section. When the brake drums are removed, do not create dust.

Do not sand, grind, chisel, hammer, or change linings in any way that will create dust. Any changes to linings must be done in a restricted area with special ventilation. Protective clothing and a respirator must be used.

NOTE: Under normal conditions, the disc assembly (fixed and rotating discs) of the oil-cooled brakes is replaced when the drive axle is disassembled.

6. Disconnect service brake lines.
7. Disconnect brake lines for parking brake at the differential.
8. Disconnect cooling oil lines for oil-cooled brakes.
9. Put caps on all hydraulic lines, ports, and fittings.
10. Disconnect drive shaft at differential.
11. Put forks of another lift truck under the axle for support.

- Remove bolts and nuts that hold the axle to the frame.

WARNING

Verify the lifting device has the rated capacity of 4500 kg (9921 lb) when moving the drive axle.

- Remove drive axle from lift truck frame.

WARNING

Cleaning solvents are flammable and toxic and can cause skin irritation. When using cleaning solvents, always follow the solvent manufacturer's recommended safety precautions.

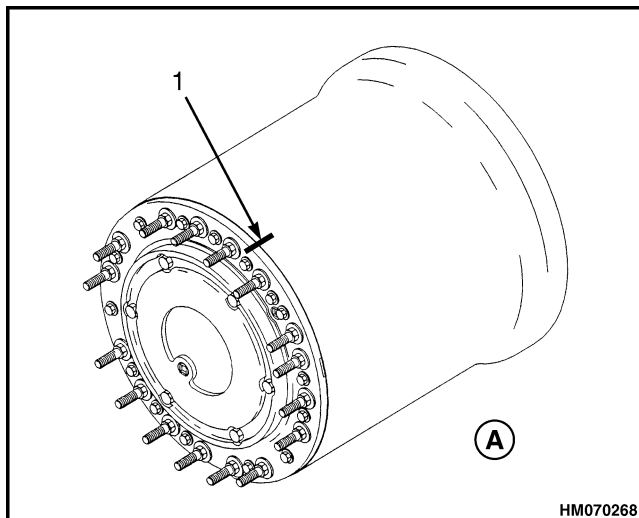
WARNING

Compressed air can move particles so that they cause injury to the user or to other personnel. Verify 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.

- Clean all parts in solvent and dry with compressed air.

Planetary Gear Carrier

- Align marks on planetary gear carrier and wheel hub for correct alignment when reassembling the unit. See Figure 6.

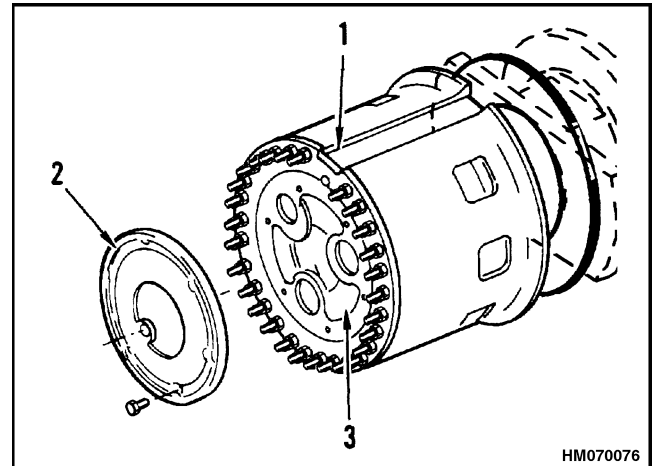


A. RIM MOUNTED

- ALIGNMENT MARKS

Figure 6. Alignment Marks

- Remove cover from planetary gear carrier. See Figure 7.



- HUB
- COVER
- PLANETARY GEAR CARRIER

Figure 7. Planetary Gear Carrier Cover

- Remove planetary gear carrier capscrews.

NOTE: Do not remove planetary gear carrier at this time.

- Insert a pry bar into assembly notches and separate planetary gear carrier from wheel hub assembly. See Figure 8.

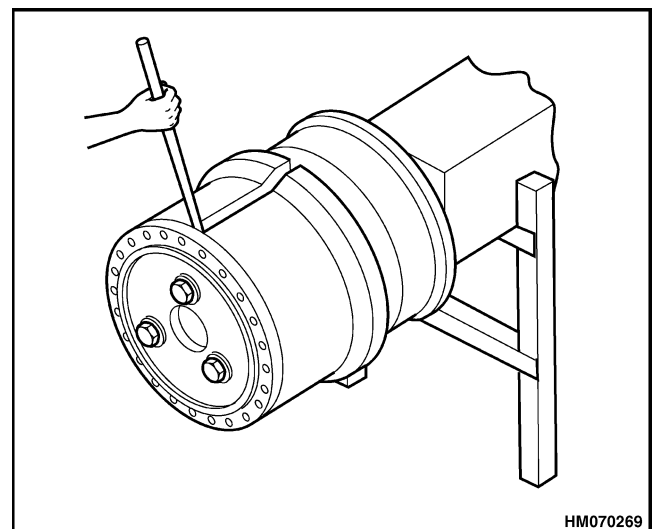


Figure 8. Planetary Gear Carrier Separation

WARNING

Use caution when using lifting devices. When using a lifting strap, inspect strap for damage before using. Do not use a lifting strap to shock load or drop load a component. Serious personal injury and damage to components may occur.

Verify the lifting device has the rated capacity of 150 kg (331 lb) when moving the planetary gear carrier.

5. Use a lifting device to remove planetary gear carrier from wheel hub assembly. See Figure 9.

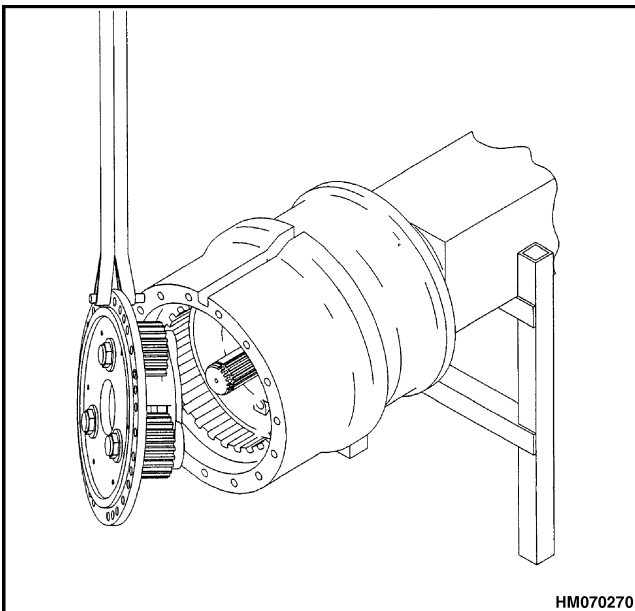


Figure 9. Planetary Gear Carrier Removal

WARNING

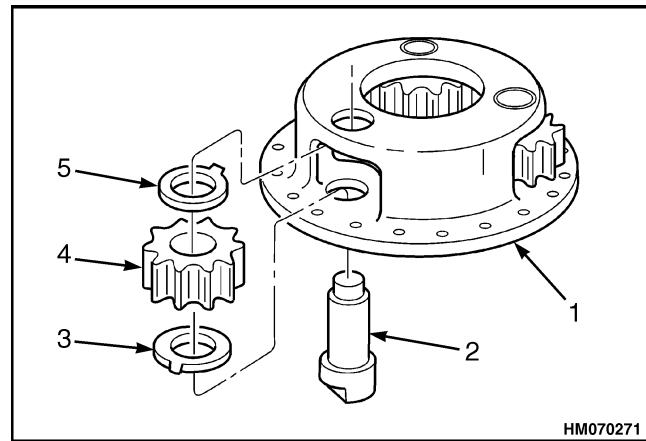
Observe all WARNINGS and CAUTIONS provided by press manufacturer concerning press operation to avoid serious injury and possible damage to components during assembly and installation procedures.

NOTE: If a press is not available, use a brass drift and mallet to remove pinion shafts.

6. Place the planetary gear carrier assembly in a press with flange side **DOWN**. Support the spider assembly as required.

NOTE: Use a soft material in bottom of the catch container to prevent damage to the pinion shafts.

7. Place a container under the press to catch the planetary pinion shafts as they are pressed out of the planetary gear carrier and planetary pinion gears.
8. Press each pinion shaft out of planetary gear carrier and planetary gear. See Figure 10.



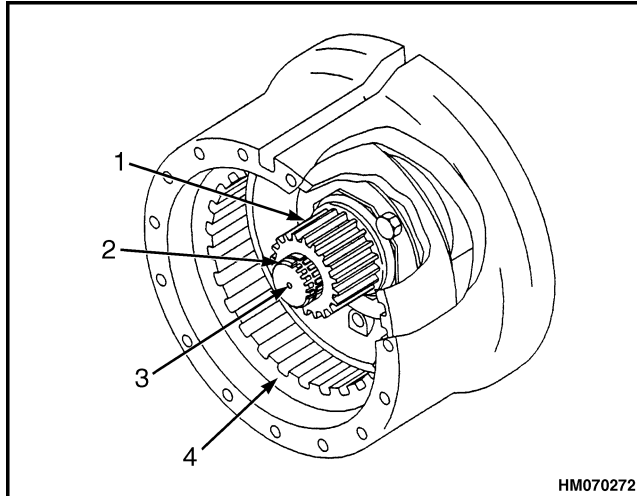
1. SPIDER
2. PINION SHAFT
3. OUTER THRUST WASHER
4. PLANETARY GEAR
5. SMALL BORE INNER THRUST WASHER

Figure 10. Pinion Shaft

9. Remove planetary gears and thrust washers from planetary gear carrier.

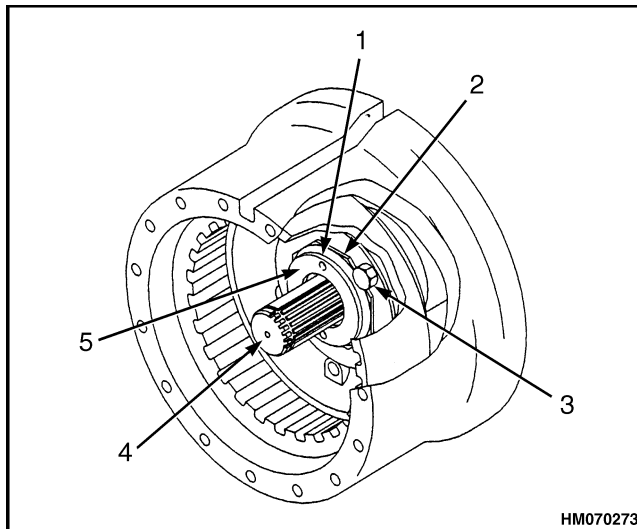
Ring Gear, Ring Gear Hub, and Wheel Hub

1. Remove snap ring from end of axle shaft. See Figure 11.
2. Remove sun gear. See Figure 11.
3. Remove sun gear thrust washer assembly. See Figure 12.



- 1. SUN GEAR
- 2. SNAP RING
- 3. AXLE SHAFT
- 4. RING GEAR

Figure 11. Sun Gear



- 1. WHEEL BEARING ADJUSTING NUT
- 2. WHEEL BEARING ADJUSTING LOCK NUT
- 3. CAPSCREW
- 4. AXLE SHAFT
- 5. THRUST WASHER

Figure 12. Thrust Washer Assembly

- 4. Remove capscrews from wheel bearing adjusting lock nut. See Figure 2 and Figure 12.
- 5. Remove wheel bearing adjusting lock nut and wheel bearing adjusting nut. See Figure 2 and Figure 12.

WARNING

Support the wheel hub before you remove ring gear and ring gear hub assembly. Do not remove ring gear and ring gear hub assembly without supporting the wheel hub. Serious injury and damage to components may occur. See Figure 13.

NOTE: To avoid dropping and possibly damaging the outer wheel bearing cone, verify the outer wheel bearing cone remains in place as you remove the ring gear hub.

NOTE: If the ring gear hub cannot be removed by hand, install capscrews into the puller screw holes in the ring hub flange. Tighten each capscrew the same amount to separate ring gear hub from spindle and wheel hub.

- 6. Remove ring gear hub by pulling it straight out of wheel hub and off of spindle.

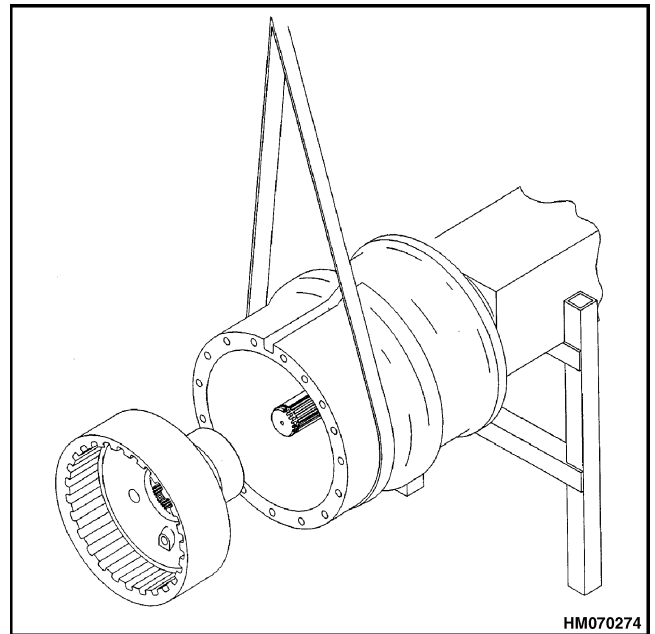


Figure 13. Ring Gear Hub

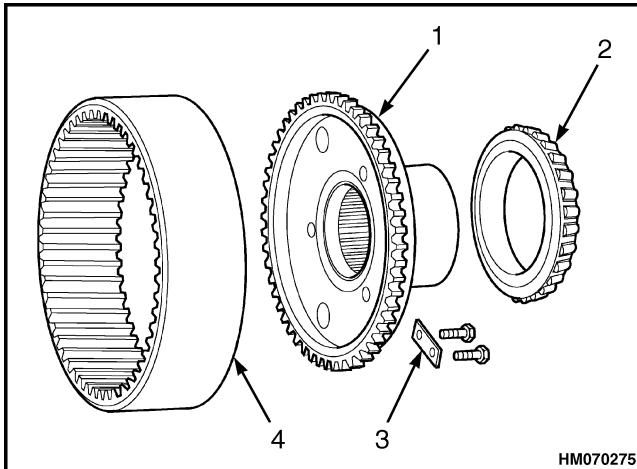
- 7. Remove retainer plate capscrews to remove ring gear from ring gear hub. See Figure 14.

(More Content includes: Brake system, Capacities, and specifications, Frame, Hydraulic, System, Industrial battery, Main control, Valve, Mast repair, Fasteners, Schematics diagrams, Steering axle, Steering system, Wire harness repair And more)

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1. RING GEAR HUB
2. OUTER WHEEL BEARING
3. RETAINER PLATE
4. RING GEAR

Figure 14. Retainer Plate

8. Remove outer wheel bearing from ring gear hub.

NOTE: The ring gear hub assembly includes the hub and ring sleeve insert. You cannot service these components separately.

9. Use a hoist or similar device to lift the wheel hub and drum slightly to relieve the hub weight and drum-to-brake shoe drag. See Figure 15.
10. Remove wheel hub assembly from wheel hub spindle.

Hub Oil Seal and Bearings

1. Position wheel hub with brake end **UP** to remove hub oil seal and bearings.
2. Remove rotor mounting capscrews and washers.
3. Remove the rotor.



CAUTION

Do not scratch hub seal bore surface.

4. Remove bearing cups with a suitable puller.
5. Remove bearing cone with a suitable puller.
6. Remove wheel hub oil seal.

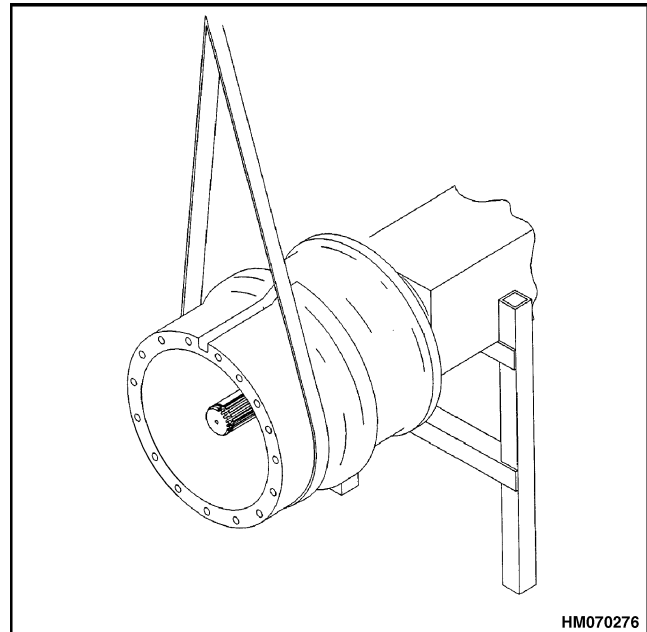


Figure 15. Wheel Hub and Drum

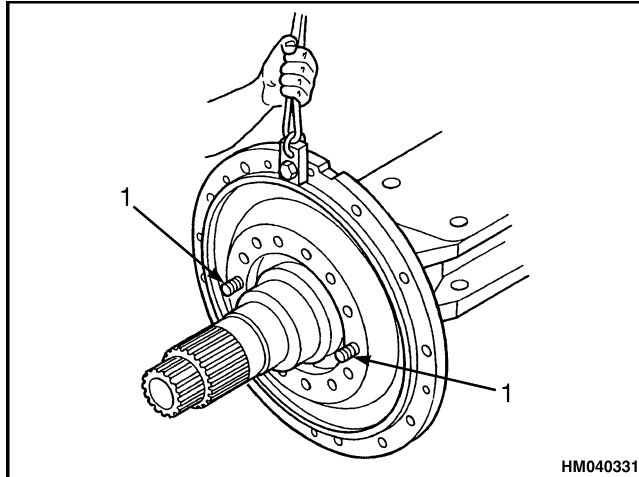
Axle Shaft

1. Remove axle shaft from spindle bore and housing.
2. Disassemble oil-cooled brakes as described in the section **Service Brake** for your lift truck.

Spindle

NOTE: The spindle and brake cover are assembled to the axle housing with the same capscrews.

1. Remove two of the capscrews (opposite each other) that fasten the spindle to the axle housing. Replace with two studs, which are long enough to support the spindle. See Figure 16.



- 1. STUD

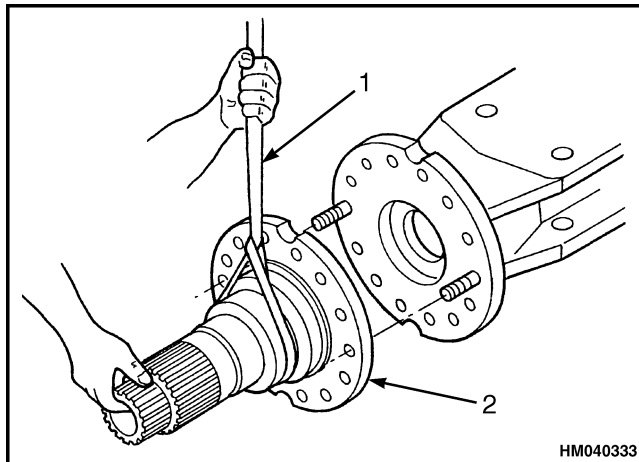
Figure 16. Brake Housing Studs

- 2. Remove the remaining capscrews.
- 3. Hold the spindle against the axle housing.

WARNING

Verify the lifting device has the rated capacity to lift the spindle.

- 4. Use a lifting device to remove the spindle. See Figure 17.



- 1. LIFTING DEVICE
- 2. SPINDLE

Figure 17. Spindle

REPAIR

Repairing or Replacing Parts

WARNING

Do not repair axle housings by bending or straightening. Repair of axle housings by bending or straightening can cause poor performance and possible unsafe operation of the axle. This can cause serious personal injury.

NOTE: Threads must be without damage and clean, so accurate adjustment and correct torque values can be applied to fasteners and parts.

Replace worn or damaged parts of an axle assembly. The following are some examples for possible repair and replacement:

- Replace any fastener if corners of wrench flats are worn.
- Replace washers if damaged.
- Replace gaskets, oil seals, and grease seals.
- Clean parts and apply silicon gasket material, where required.
- Remove nicks, marks, and burrs from parts having machined or ground surfaces. Use a fine file, India stone, emery cloth, or crocus cloth.
- Clean and repair threads of fasteners and holes. Use a die or tap of correct size or a fine file.

Welding

Do not repair the drive axle assemblies by welding. Welding can detract from the structural integrity of a component, particularly to heat-treated parts where the benefit of heat treatment can be nullified by welding.

CLEAN

Ground or Polished Parts

WARNING

To prevent serious eye injury, always wear safe eye protection when performing vehicle maintenance or service.

WARNING

Solvent cleaners are flammable, poisonous, and can cause burns. Examples of solvent cleaners are carbon tetrachloride, emulsion-type cleaners, and petroleum-based cleaners. To avoid serious personal injury when using solvent cleaners, carefully follow the manufacturer's product instructions and these procedures.

- Wear safe eye protection.
- Wear clothing that protects your skin.
- Work in a well-ventilated area.
- Do not use gasoline or solvents that contain gasoline. Gasoline can explode.
- Use hot solution tanks or alkaline solutions correctly. Follow the manufacturer's instructions carefully.

CAUTION

- Use only solvent cleaners to clean ground or polished metal parts. Hot solution tanks or water and alkaline solutions will damage these parts. Isopropyl alcohol, kerosene, or diesel fuel can be used for this purpose.
 - If required, use a sharp knife to remove gasket material from parts. Be careful not to damage the ground or polished surfaces.
1. Use a cleaning solvent, kerosene, or diesel fuel to clean ground or polished parts or surfaces. NEVER USE GASOLINE.
 2. Remove gasket material from parts. Use caution not to damage ground surfaces. Apply grease to prevent corrosion.
 3. DO NOT clean ground or polished parts in a hot solution tank, water, steam, or alkaline solution.

Parts With Rough Finishes

1. Use a cleaning solvent or a hot solution tank with a weak alkaline solution to clean parts with a rough finish.

2. Leave parts in the hot solution tank until they are completely cleaned and heated. When the parts are clean, remove them from the tank.
3. Wash the parts with water until alkaline solution is completely removed.

Axle Assemblies

NOTE: A complete axle assembly can be steam cleaned on the outside to remove dirt.

NOTE: Before the axle is steam cleaned, close or put a cover over all the openings in the axle assembly. Examples of openings are the breathers or vents in air chambers.

Drying Cleaned Parts

CAUTION

Dry bearings with clean paper or rags. Do not use compressed air, which can cause abrasive particles to contaminate the bearings. Damage to components and reduced lining life can result.

Immediately after cleaning, use clean paper, rags, or compressed air to dry parts.

PREVENTING CORROSION

NOTE: Parts must be clean and dry before lubricating them.

1. If assembling the parts immediately after cleaning them, lubricate the clean, dry parts with grease to prevent corrosion.
2. If storing the parts after cleaning them, apply a corrosion-preventive material to all machined surfaces. Store the parts in a special paper or other material that prevents corrosion.

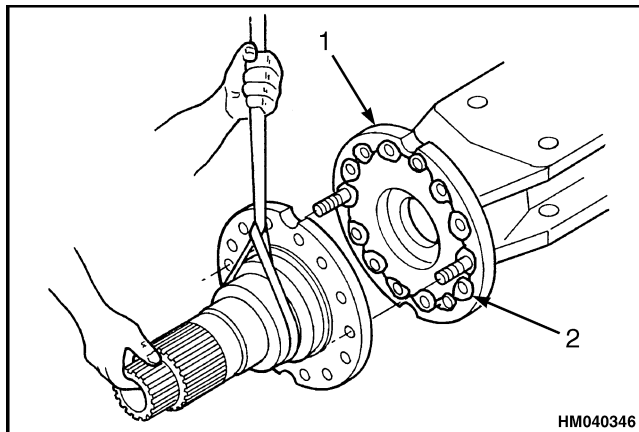
PARTS INSPECTION

It is very important to inspect all parts carefully and completely before axle or carrier is assembled. Check all parts for wear and replace damaged parts. Replacement of damaged or worn parts will prevent breakdown of assembly later.

ASSEMBLE

Spindle

1. Install two studs opposite each other on the axle housing flange. Verify the studs are long enough to support the spindle.
2. Apply a bead of silicone gasket material on the mounting surface of the axle housing flange. The bead must go around each capscrew hole. See Figure 18.



1. AXLE FLANGE
2. SILICONE BEAD

Figure 18. Axle Flange



WARNING

Verify the lifting device has the rated capacity to lift the spindle.

3. Use a lifting device to install the spindle on the guide studs. Verify the spindle cannot fall before removing the lifting device. See Figure 18.
4. Tighten the capscrews to the torque specified. See Table 2.

Axle Shaft

1. Replace oil-cooled brake as described in the section **Service Brake** for your lift truck.
2. Install axle shaft through the spindle bore and housing until it engages the differential side

gear. The shaft end with the snap ring groove must extend beyond the outer end of the spindle.

Hub Oil Seal and Bearings

1. Position wheel hub with brake end **UP** to install hub oil seal and bearings.
2. Position new wheel hub oil seal so that the spring lip of the seal faces the wheel bearing. Use a suitable seal driver to drive seal into same location as original wheel hub oil seal.



CAUTION

Use caution not to nick the seal oil wear sleeve end when installing the oil seal wear sleeve. A nicked oil seal wear sleeve end can damage the seal lip when installing the wheel hub. Lubricant loss and damage to components may occur.

3. Carefully install a new oil seal wear sleeve on the spindle.
4. Lubricate new seals as follows:
 - Lubricate the oil seal lips of conventional seals.
 - Lubricate the inside diameter of unitized seals.
 - Lubricate contact surfaces of the metal rings on face seals. Do not apply lubricant to any other part of the face seal.
5. Apply a thin coat of lubricant to the oil seal journal surface of the spindle.
6. Apply lubricant to the inner bearing cone rollers.
7. Install the inner bearing cone into wheel hub.

NOTE: If the hub bearing cups need to be replaced, install the new cups with a suitable driver.

8. Install bearing cups into wheel hub.

NOTE: If slinger fits loosely between wheel hub and drum, apply a bead of liquid gasket material to prevent rattling.

9. Install brake rotor or drum and oil slinger.
10. Install drum or rotor mounting capscrews and washers.