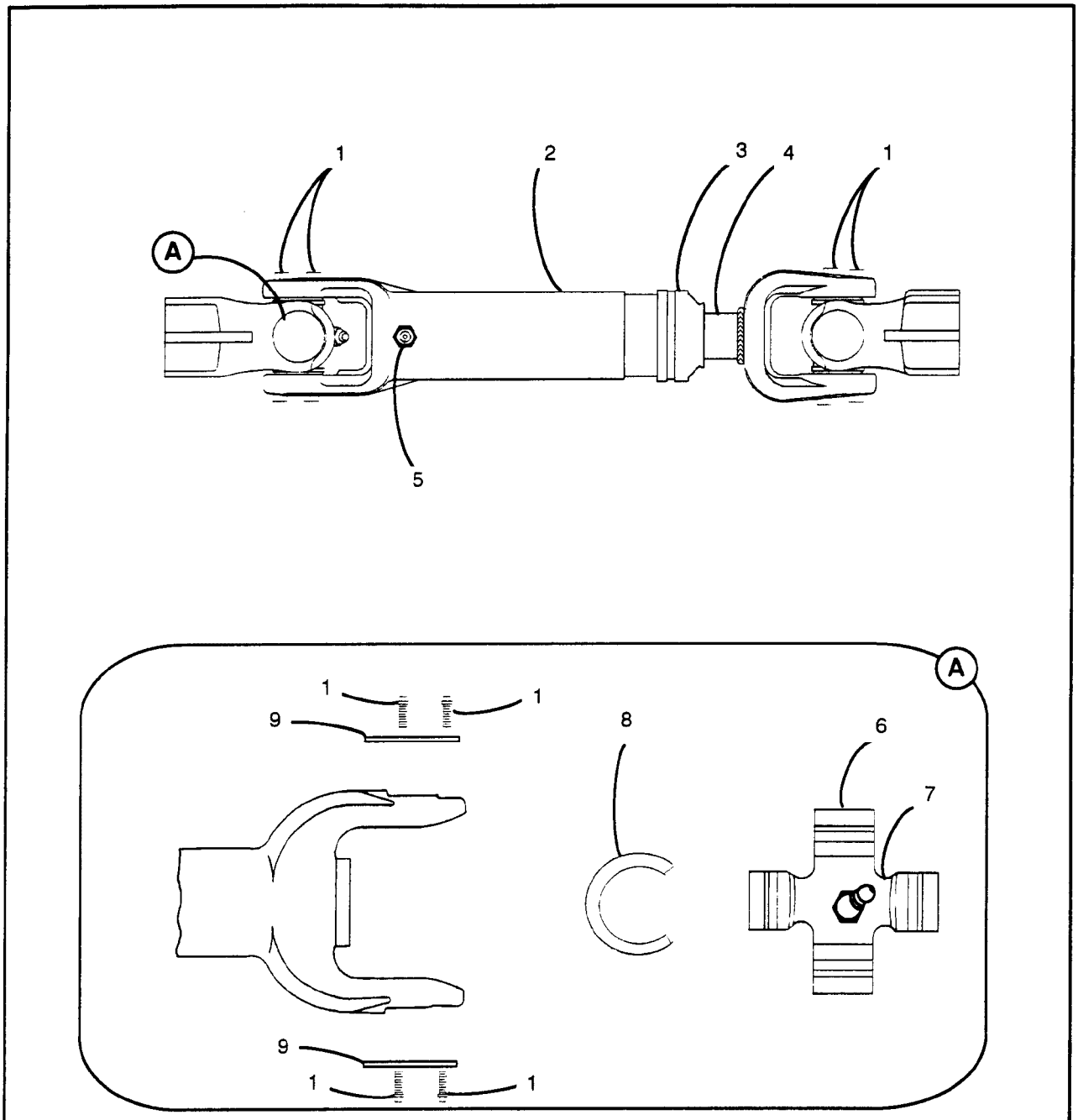


1. Capscrews
2. Slip Yoke
3. Dust Seal
4. Shaft
5. Grease Fitting
6. End Caps
7. Spider
8. C –Clips
9. Retaining Plates

Figure 1
Steering Drive Shaft Assembly

SD00284

Steering Drive Shafts, Recondition

This procedure covers the recondition of the steering drive shafts.

This procedure is intended to be generic in nature and cover all steering drive shafts. Some drive shafts may be slightly different in configuration, however recondition procedures will be very similar.

Disassembly

1. Remove capscrews (1) and retaining plates (9).
2. Remove C-clips (8).
3. Remove end caps (6).
4. Remove and discard spider (7).
5. Repeat disassembly steps 1 through 4 for opposite end of steering drive shaft assembly.
6. Slide shaft (4) from slip yoke (2).
7. Remove dust seal (3) from slip yoke (2). Discard dust seal (3).
8. Remove and discard grease fitting (5).

Cleaning And Inspection

1. Clean all parts with an approved cleaner, and air dry.

⚠ WARNING

Follow all manufacturer's recommendations concerning solvents and cleaning solutions. Serious personal injury may result from misuse of these products.

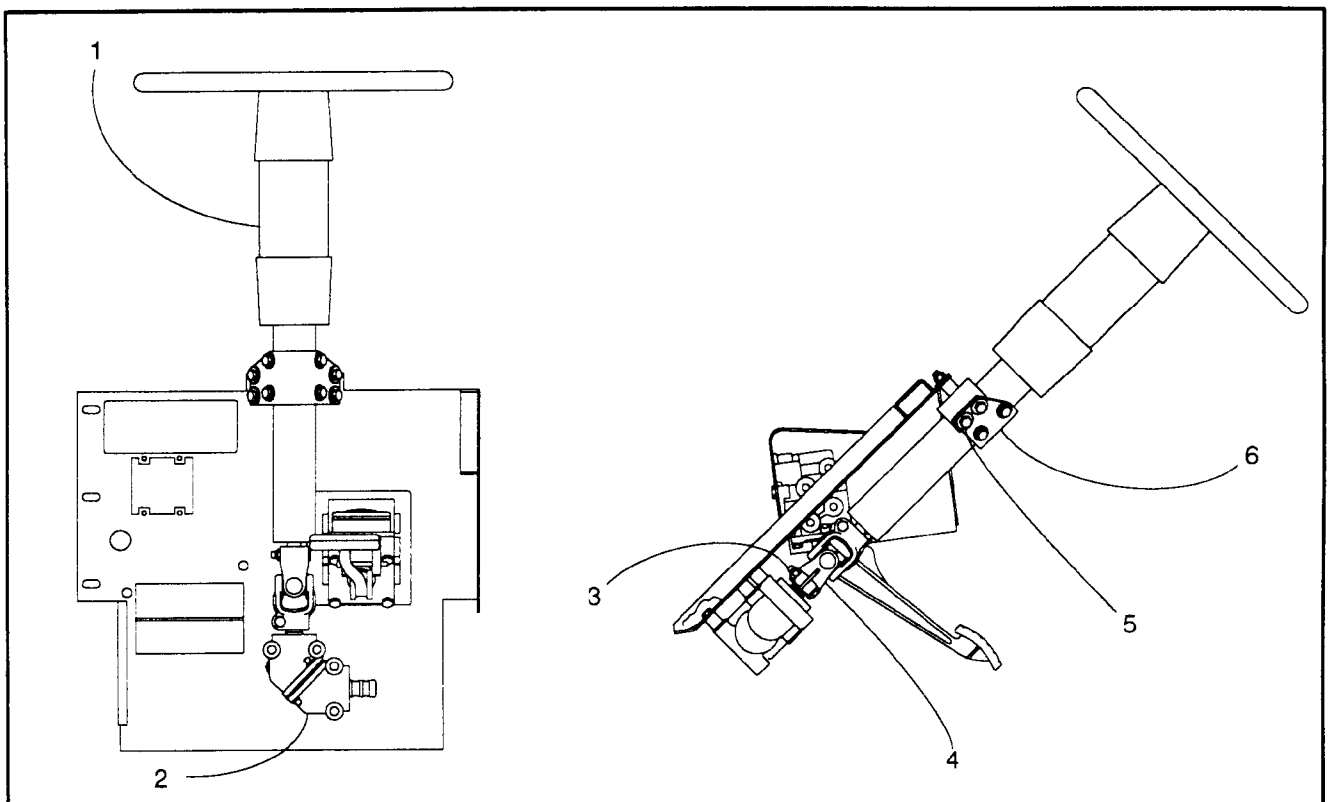
2. Inspect all parts for damage, wear and corrosion. Replace as required.

Assembly

1. Install new grease fitting (5).
2. Remove end caps (6) from new spiders (7).
3. Center new spider (7) into yoke.

   Note: Make certain that the needle bearings remain properly seated within the end caps during end cap installation.

4. Install end caps (6) on spiders (7).
5. Install C-clips (8).
6. Align retaining plates (9) on yokes and install capscrews (1).
7. Perform assembly steps 2 through 6 for opposite end of steering drive shaft assembly.
8. Install new dust seal (3) over shaft (4). Slide shaft (4) into slip yoke (2). Properly position dust seal (3) on the slip yoke (2).



1. Steering Column
2. Miter Box
3. Capscrew & Locknut
4. U–Joint
5. Capscrew, Locknut & Washer
6. Mounting Bracket

Figure 1
Steering Column

Steering Column, R & I

This procedure covers the removal and installation of the steering column. For recondition procedure, see SM Area 1–5.

Removal

1. Park the crane on a firm, level surface. Engage the park brake, shift the transmission to neutral.
2. Turn the steering wheel until the front tires are parallel with the carrier frame (tires straight ahead). Shutdown the engine.

Refer to Figure 1.

3. Label, for assembly purposes, and disconnect all wiring from the steering column (1).
4. Loosen the capscrews and locknuts (3) to disconnect the steering column (1) from the u–joint (4).
5. Remove the capscrews, washers and locknuts (5) from the mounting bracket (6).
6. Disconnect the u–joint (4) from the miter box (2) and remove the steering column (1).

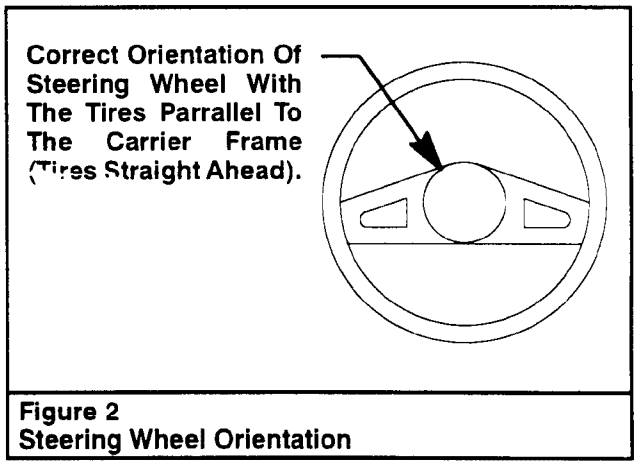


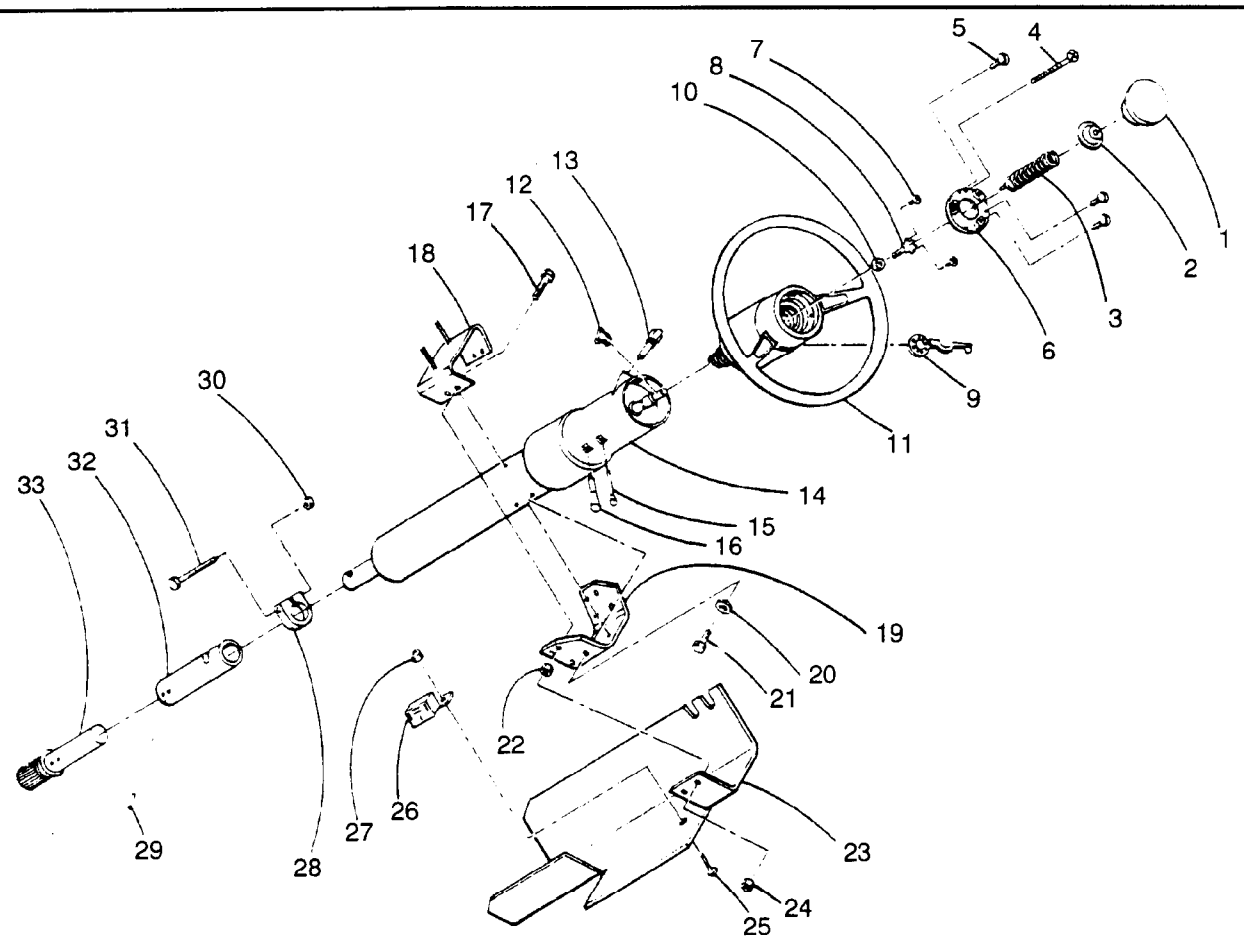
Figure 2
Steering Wheel Orientation

Installation

Refer to Figure 1.

1. Check that the front tires are parallel with the carrier frame (tires straight ahead); adjust as required.

2. Position the steering wheel, as shown in Figure 2, before engaging the u-joint (4) of the steering column (1) with the miter box (2).
3. Set the steering column (1) into place and connect the u-joint (4) to the miter box (2); do not tighten capscrew and locknut (3) at this time.
4. Install the mounting bracket (6) and the capscrews, washers and locknuts (5).
5. Make any necessary adjustments to get the column into position and tighten the capscrews, washers and locknuts (5) and the capscrew and locknut (3).
6. Connect all the wiring to the steering column (1).
7. Check the front wheel alignment and adjust as required. Refer to SM Area 1-6 for the correct procedure.
8. Test all steering and electrical functions prior to returning crane to service.



1. Horn Button	8. Locking Screw	15. Turn Sig. & W/W Lever	22. Locknut	28. Clamp
2. Contact Cap	9. Release Lever	16. Tilt Control Lever	23. Sheet	29. Roll Pins
3. Horn Spring	10. Locknut	17. Capscrew	24. Locknut	30. Nut
4. Screw	11. Steering Wheel Assy	18. Bracket	25. Screw	31. Clamp Bolt
5. Screw	12. Retainer	19. Strip	26. Relay	32. Shaft Coupling
6. Base Plate Assy	13. Ignition Cylinder	20. Washer	27. Locknut	33. Shaft
7. Screws	14. Steering Column Assy	21. Capscrew		

Figure 1
Steering Column And Wheel Assembly SD00311

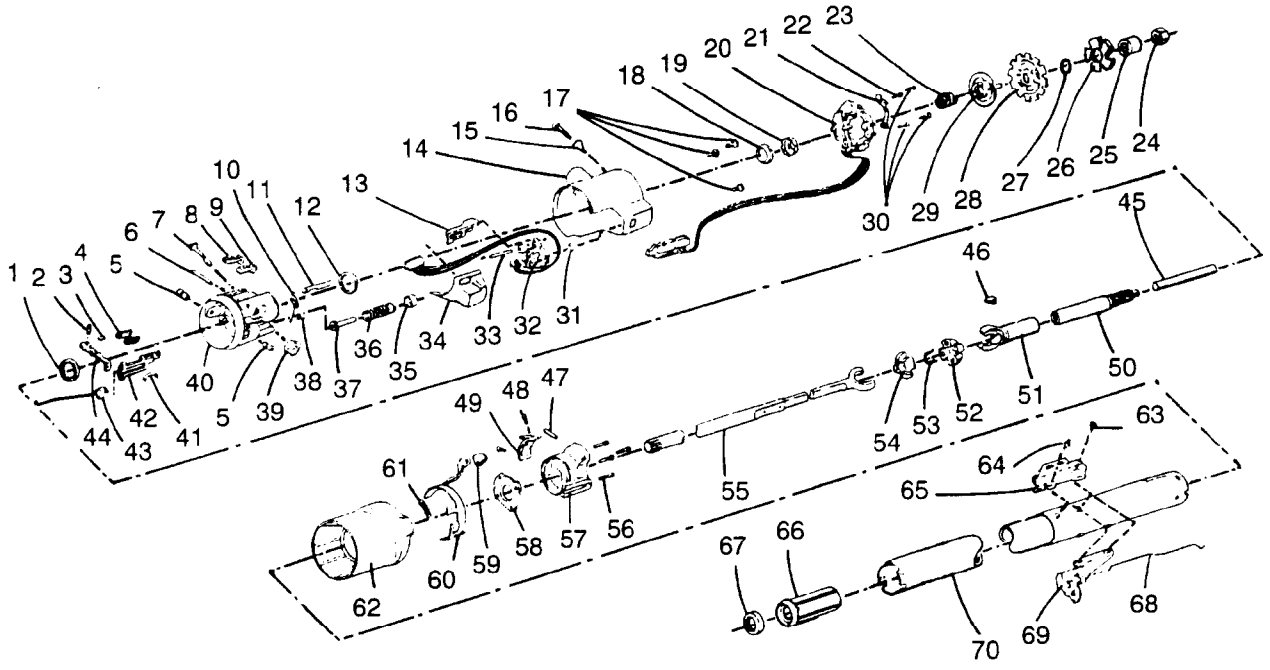
Steering Column, Recondition

This column may be easily disassembled and assembled. To ensure the energy absorbing action, it is important that only the specified screws, bolts, and nuts be used as designated and that they are tightened to the values specified in the torque chart.

Wheel Removal

Refer to Figure 1.

1. Press down on the horn button (1) and turn it clockwise. Remove the horn button (1), contact cap (2) and horn spring (3).
2. Remove screws (4,5) from base plate assembly (6). Remove base plate assembly (6).
3. Remove screws (7), locking screw (8), release lever (9), retainer (12) and locknut (10). Pull steering wheel assembly (11) from steering column assembly (14).
4. Brackets and covers may be removed from steering column if desired.
5. Turn and remove tilt control lever (16).
6. Push turn signal and windshield wiper lever (15) in, toward the column, rotate it forward out of its detent, and pull it out of the column.
7. Removal of ignition switch cylinder is covered in disassembly of the steering column.
8. Remove shaft (33) from shaft coupling (32) by removing roll pins (29). Pull shaft (33) out.
9. Remove shaft coupling (32) from steering column assembly (14) by removing clamp bolt (31) completely from clamp (28). Pull off shaft coupling (32).



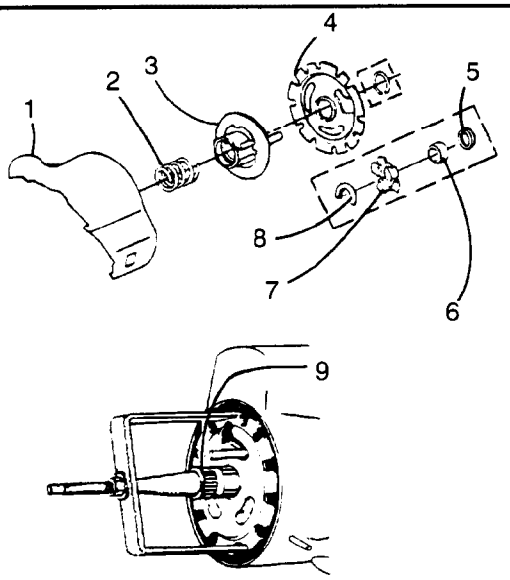
1. Bearing
2. Lever Pin
3. Lever Spring
4. Shoe Spring
5. Pivot Pins
6. Dowel Pin
7. Drive Shaft
8. Lock Shoe
9. Lock Shoe
10. Bolt Spring
11. Lock Bolt
12. Bearing
13. Actuator Rod
14. Cover
15. Hazard/Warning Knob
16. Screw
17. Screws
18. Inner Race
19. Race Seat
20. Turn Signal Switch
21. Signal Arm
22. Screw
23. Spring
24. Nut
25. Bumper
26. Snap Ring Retainer
27. Retaining Ring
28. Shaft Lock
29. Turn Signal Cancelling Cam
30. Screws
31. Pin Spring
32. Pivot & Switch Assy
33. Pin
34. Column Cap
35. Spring Retainer
36. Spring
37. Spring Guide
38. Screw
39. Switch Sector
40. Housing
41. Rack Spring
42. Switch Rack
43. Ignition Switch Actuator Assy
44. Release Lever
45. Telescope Locking Rod
46. Wedge
47. Dowel Pin
48. Screw
49. Shroud Plate
50. Upper Steering Shaft
51. Yoke
52. Sphere
53. Spring
54. Sphere
55. Shaft Assy
56. Screw
57. Housing Support
58. Lock Plate
59. Finger Pad
60. Lever
61. Spring
62. Shroud
63. Screw
64. Stud
65. Ignition Switch Assy
66. Adaptor
67. Bearing
68. Dimmer Switch Rod
69. Switch Assy
70. Jacket Assy

Figure 2
Steering Column Assembly

SD00311

Disassembly Of Internal Components Of Steering Column

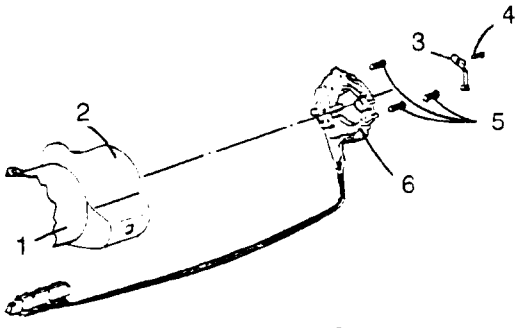
The following procedures are in sequential order. Example: To perform Step 3, Steps 1 and 2 must be completed first. Refer to Figure 2 for individual steering column components.



1. Cover
2. Spring
3. Cancelling Cam Assy
4. Shaft Lock
5. Nut
6. Retracted Steering Shaft Bumper
7. Snap Ring Retainer
8. Shaft Lock Retainer
9. Retaining Ring

Figure 3 SD00311
Removing And Installing Retaining Ring

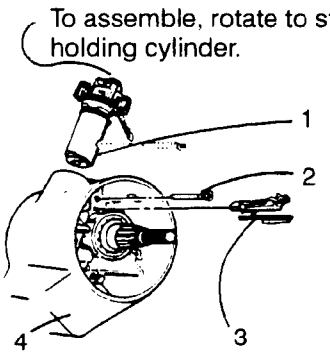
1. Remove and install shaft lock and/or cancelling cam.



1. Bowl
2. Cover
3. Signal Switch Arm
4. Screw
5. Screws
6. Turn Signal Switch

Figure 4 SD00311
Switch Components

2. Remove and install turn signal switch.
   a. Remove parts as shown.
   b. Install parts as shown.



1. Lock Cylinder
2. Lock Retaining Screw
3. Key Warning Buzzer Switch
4. Cover

Figure 5 SD00311
Lock Cylinder Removal

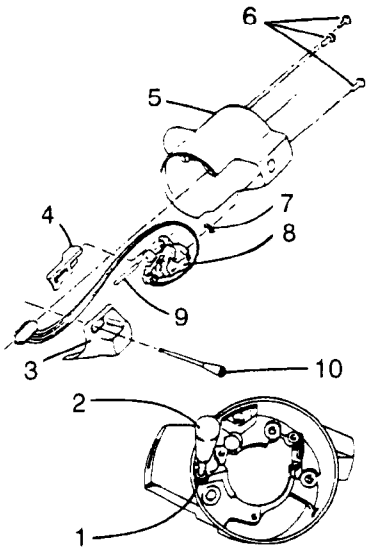
3. Remove and install ignition lock and key warning buzzer switch.

Removal:

a. Turn lock to "RUN" position and remove key warning buzzer.
b. Remove parts as shown.

Installation:

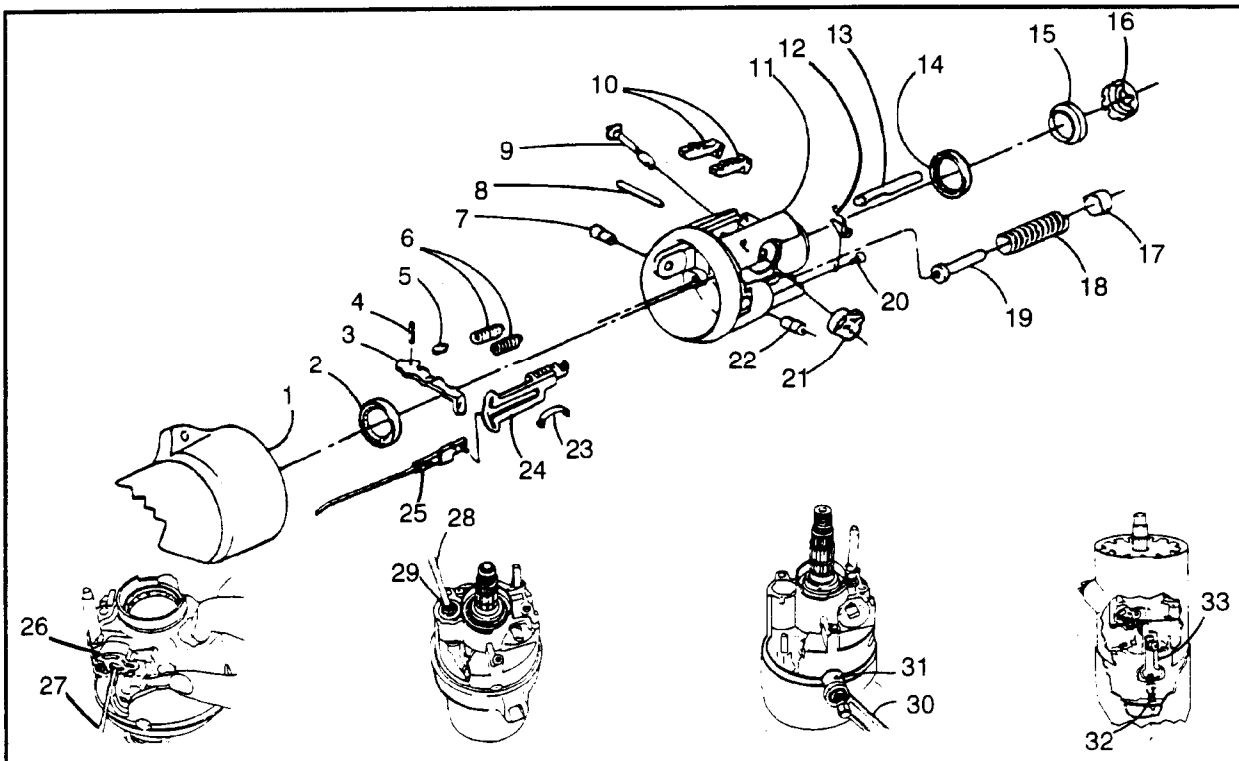
a. Install lock cylinder.
b. Turn lock to "RUN" position and install key warning buzzer switch.



1. Pivot Pin
2. Punch
3. Cap
4. Actuator Rod
5. Cover
6. Screws
7. Spring
8. Pivot & Switch Assy
9. Pivot Pin
10. Tilt Lever

Figure 6 SD00311
Pivot And Switch Assembly

4. Remove and install cover and wiper switch.
   a. Remove parts as shown.
   b. Install parts as shown.



Remove Drive Shaft And Sector

1. Bowl & Shroud Assy
2. Bearing
3. Shoe Release Lever
4. Release Lever Pin
5. Release Lever Spring
6. Shoe Spring
7. Pivot Pin
8. Pin
9. Drive Shaft

Remove Tilt Spring Retainer

10. Lock Shoes
11. Housing
12. Spring
13. Lock Bolt
14. Bearing
15. Inner Race
16. Upper Bearing Inner Race Seat
17. Spring Retainer

Remove Pivot Pins

18. Tilt Wheel Spring
19. Spring Guide
20. Screw
21. Sector
22. Pivot Pin
23. Preload Spring
24. Switch Actuator Rack
25. Ignition Switch Actuator Rod

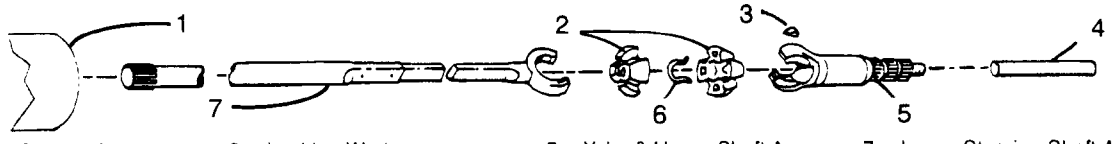
Engage Switch Actuator Rack

26. Sector
27. Punch
28. Screwdriver
29. Spring Retainer
30. Wrench
31. Pivot Pin
32. Actuator Rod
33. Switch Actuator Rack

Figure 7
Housing Components

SD00311

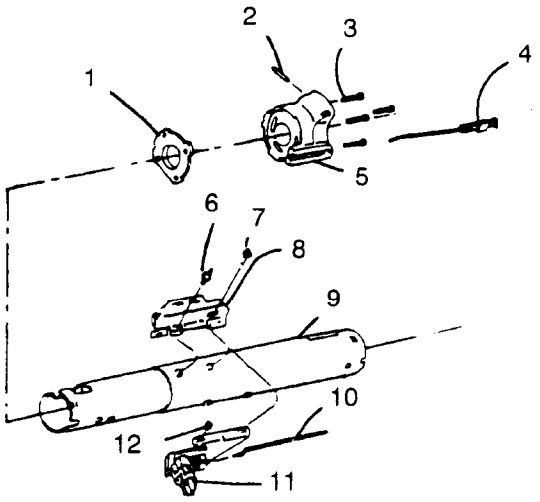
5. Remove housing
   a. Install tilt lever and place column in full "UP" position.
   b. Remove tilt spring and pivot pins.
   c. Remove housing by pulling upward on tilt lever and pull housing upward until it stops. Move housing to the right to disengage rack from actuator. Remove tilt lever.
   d. Remove parts as shown.
6. Install housing
   a. Install parts as shown,
   b. While holding up on tilt lever to disengage lock housing over steering shaft. Move rack downward and hold. Tip housing to the left until rack engages pin on actuator rod. Push housing down until pivot pin holes are in alignment.
7. Remove and install lower steering shaft assembly.
   a. Remove parts as shown.
   b. Install parts as shown.

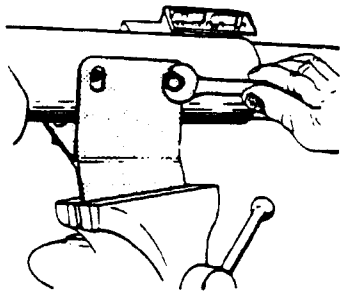


1. Bowl & Shroud Assy
2. Centering Spheres
3. Locking Wedge
4. Telescoping Locking Rod
5. Yoke & Upper Shaft Assy
6. Joint Preload Spring
7. Lower Steering Shaft Assy

Figure 8
Lower Steering Shaft

SD00311



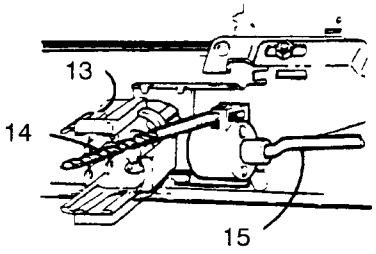


Steering Column Holding Fixture

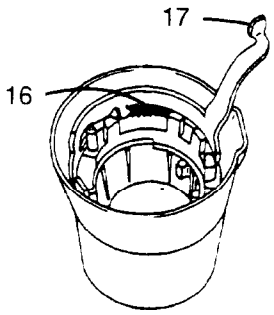
Key Release

Move slider to extreme right position (Acc.) Then move slider two detents to the left to "Off-Unlock" position.

Install Ignition Switch Assembly



Adjust Dimmer Switch Assembly



Key Release Lever

1. Lock Plate
2. Pin
3. Screws
4. Ignition Switch Actuator Rod
5. Support
6. Stud
7. Screw
8. Ignition Switch Assy
9. Jacket Assy
10. Dimmer Switch Rod
11. Dimmer Switch Assy
12. Nut
13. Dimmer Switch Assy
14. 3/32 in (*2.4mm*) Drill
15. Dimmer Switch Rod
16. Key Release Spring
17. Key Release Lever

Figure 9
Housing Components

SD00311

8. Remove and install steering shaft, ignition and dimmer switch assemblies.

   Remove

   a. Remove parts as shown.

   Install

   a. Install parts as shown.
   b. Position rod in slider hole and install ignition switch. Install lower stud and tighten to 3 ft-lb (*4Nm*).
   c. Install dimmer switch and depress switch slightly to insert 3/32 in (*2.4mm*) drill. Force switch up to remove lash, then tighten screw and nut to 3 ft-lb (*4Nm*).

Recommended Torque Specifications (See Figure 2.)			
Reference No.	Description	ft-lb	*Nm*
16	Hazard Warning Knob Screw	.5	*.7*
17	Lock Housing Cover Screws	7.4	*10.0*
22	Turn Signal Switch Actuator Arm Screw	1.7	*2.3*
24	Steering Wheel To Shaft Nut	30	*41.0*
30	Turn Signal Switch Attaching Screws	2.5	*3.4*
38	Lock Bolt Spring Screw	2.9	*4.0*
48	Shroud Retaining Plate Screws	2.9	*4.0*
56	Support To Lock Plate Screws	5.8	*7.8*
63	Dimmer & Ignition Switch Mounting Screw	2.9	*4.0*

Steering Gears, R & I

This procedure covers the removal and installation of the steering gears. For recondition procedure, see SM Area 1–5.

Due to similarity of components, the removal and installation of both steering gears is basically identical. Use this procedure as applicable to remove and install both the master steering gear and the slave steering gear.

Removal

1. Lower, detach, and secure load, as required.
2. Stabilize the crane for service: Park the crane out of the way on a firm and level surface, engage the park brake or properly block the tires, engage the travel swing lock, level the crane on fully extended outriggers, and/or fully lower the boom, as required.
3. Position the tires so they are parallel with the carrier frame. (Straight ahead.)
4. Check that all control levers are in the neutral position and move the function lockout switch to the "DISABLE" position.
5. Shutdown the engine and disengage the main hydraulic pump.

⚠ WARNING

Solvents and cleaning solutions can be hazardous. Serious personal injury may result from misuse of these products. Read and follow all the manufacturer's recommendations concerning solvents and cleaning solutions.

6. Thoroughly clean area to be disassembled with an approved cleaning solvent to prevent contamination from entering the air and/or oil circuits. Allow the area to air dry.

⚠ WARNING

Hydraulic oil is under pressure and may be hot. A sudden release of hot oil could cause burns or other serious injury. Shutdown the engine and exhaust all trapped hydraulic pressure from the system before removing any line or component.

7. To relieve hydraulic system pressure:
   a. Open the drain valve on the air system reservoirs to bleed the air system pressure.
   b. Relieve the hydraulic system precharge pressure by pushing the button on the pressure relief valve, located on the hydraulic reservoir.
   c. Turn the ignition switch to **"ON"**, but **DO NOT START THE ENGINE.**
   d. Work the crane control levers and outrigger switches back and forth several times.
   e. Turn ignition switch to the **"OFF"** position**.**
   f. When pressure is fully relieved, close the drain valves on the air system reservoir.

⚠ WARNING

Hydraulic oil is under pressure and may be hot. A sudden release of hot oil could cause burns or other serious injury. Shutdown the engine and exhaust all trapped hydraulic pressure from the system before removing any line or component.

8. Label for assembly purposes and disconnect the hydraulic lines and hoses as required. Cap/plug the open hydraulic lines, hoses, fittings and ports to prevent excessive oil loss and contamination of the system.

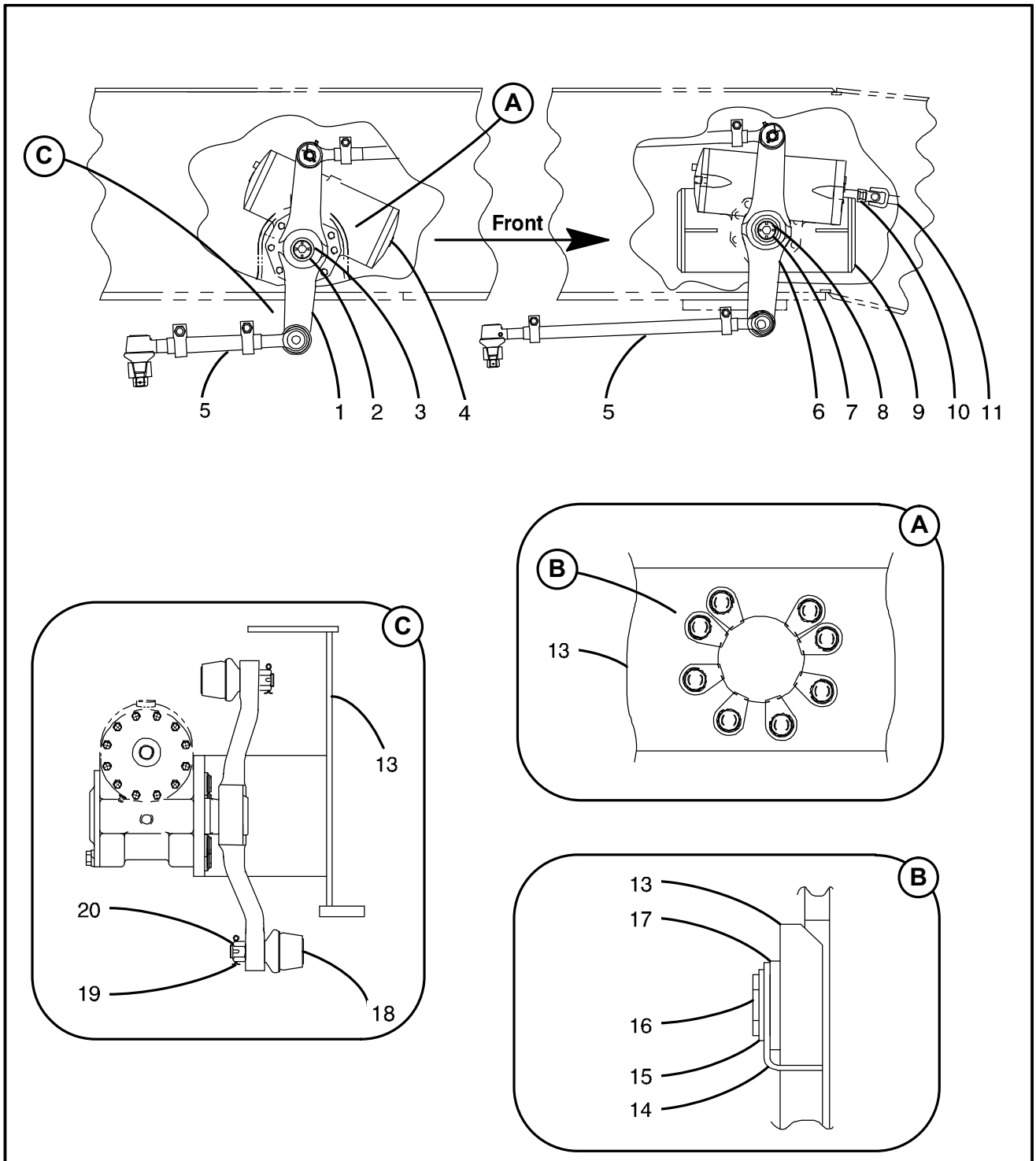
Refer to Figure 1.

9. As required, remove the cotter pins (19) and castle nuts (20) from the ball joint studs (18). Disconnect the drag links (5) from the pitman arms (1,6), by removing the ball joint studs (18) out of the pitman arms (1,6).
10. Remove capscrew and locknut (10) and disconnect steering drive shaft (11) from master steering gear (9) as required.

CAUTION

Hydraulic components and gears are machined to close tolerances. The interior steering gear components could be damaged if an impact wrench is used to remove retainers. Do not use an impact wrench.

11. Use one of the following steps to remove pitman arm (6) from either master steering gear (9) or pitman arm (1) from slave steering gear (4):
    a. On master steering gear (9). Using a hand wrench, remove retainer (7) and washer (8).



1. Pitman Arm
2. Retainer
3. Locking Tab Washer
4. Slave Steering Gear
5. Draglink
6. Pitman Arm
7. Retainer
8. Washer
9. Master Steering Gear
10. Capscrew & Locknut
11. Drive Shaft
12. Output Shaft
13. Carrier Frame
14. Retaining Tab
15. Snap Ring
16. Capscrew
17. Washer
18. Ball Joint Stud
19. Cotter Pin
20. Castle Nut

Figure 1
Steering Linkage

b. On the slave steering gear (4), bend tabs of locking tab washer (3) back out of slots of retainer (2). Using a hand wrench, remove retainer (2) and locking tab washer (3).

Note: Pitman arms (1,6) are not interchangeable. They are allocated specifically to each individual steering gear (4,9). For assembly purposes, label and tag pitman arm (1,6) as to what steering gear (4,9) it was removed from.

12. Remove pitman arm (1,6) from steering gear (4,9).

Note: Each steering gear (4,9) weighs approximately 150–160 lb (*68–73kg*).

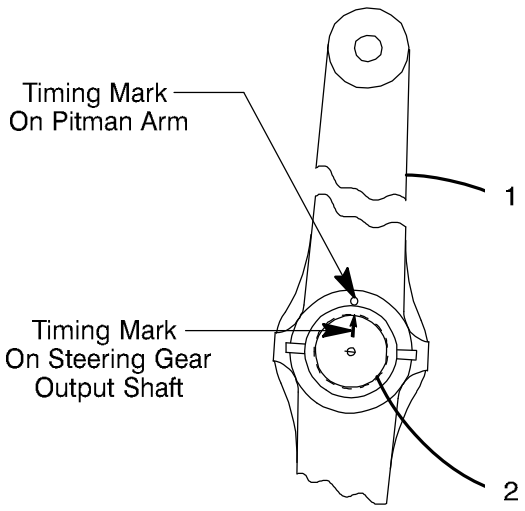
13. Using an adequate lifting device, support the steering gear (4,9).
14. Remove snap rings (15), retaining tabs (14), washers (17), and capscrews (16).
15. Remove steering gear (4,9) from the carrier frame (13).
16. Repeat steps 9–15 as required for removal of the second steering gear.

Cleaning And Inspection

WARNING

Solvents and cleaning solutions can be hazardous. Serious personal injury may result from misuse of these products. Read and follow all the manufacturer's recommendations concerning solvents and cleaning solutions.

1. All components should be thoroughly cleaned with an approved cleaning solvent, air dried, and carefully inspected.
2. All Loctite® residue should be removed from threads of hardware and parts that are going to be reused.
3. In the event of severe defects, contact factory personnel for directions whether to repair or replace any major component.
4. Inspect all hoses and/or lines, replace as necessary.



1. Pitman Arm
2. Output Shaft

Figure 2
Pitman Arm Assembly

Installation

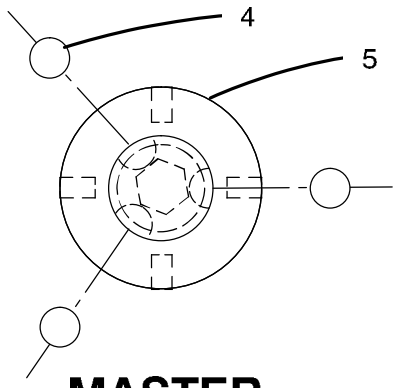
WARNING

Lubricants, sealants, joint, and thread locking compounds, etc. can be hazardous. Serious personal injury may result from misuse of these products. Read and follow all manufacturer's recommendations concerning these products.

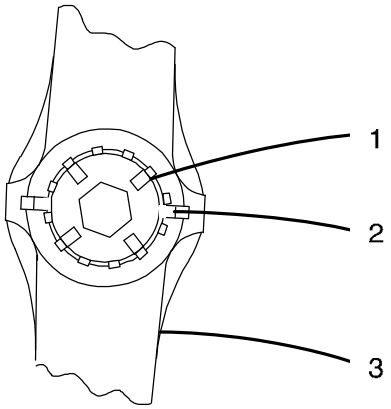
Refer to Figure 1.

Note: Each steering gear (4,9) weighs approximately 150 – 160 lb (*68–73kg*).

1. Using an auxiliary lifting device, carefully position and align steering gear (4,9) to the carrier frame (13).
2. Apply light coat of Loctite® No. 242 to threads of capscrews (16).
3. Install washers (17) and capscrews (16) securing steering gear (4,9) to the carrier frame (13). Torque capscrews (16) in a criss–cross pattern to 165 ft lb (*223Nm*).
4. Install retaining tabs (14) and snap rings (15).



MASTER



SLAVE

1. Retainer
2. Locking Tab Washer
3. Pitman Arm
4. Locking Balls
5. Retainer

Figure 3
Pitman Arm Assembly

Note: Pitman arms are not interchangeable. They are allocated specifically to each individual steering gear. Make sure that correct pitman arm is installed on the correct steering gear.

Note: Be sure to maintain the position of timing mark "↑" on the output shaft to the pitman arm timing mark "O" as shown in Figure 2.

Refer to Figure 2.

5. Install the pitman arm (1) on the output shaft (2) with the pitman arm (1) timing mark "O" directly aligned with the output shaft (2) timing mark "↑".

Refer to Figure 3.

6. Apply a light coat of anti seize compound to threads of retainer (1,5) and on both sides of locking tab washer (2).
7. Use one of the following procedures to install the retainer (1,5) and locking tab washer (2):
   a. **Master:** With pitman arm (3) properly positioned on the master steering gear (9,Figure 1). Install new locking balls (4) into retainer (5), and install retainer (5) into master steering gear (9,Figure 1) output shaft.
   b. **Slave:** With pitman arm (3) properly positioned on the slave steering gear (4,Figure 1), install locking tab washer (2) so that the two largest tabs located 180° apart align with the two slots milled into the pitman arm (3) 180° apart. Install retainer (1) into slave steering gear (4,Figure 1) output shaft.

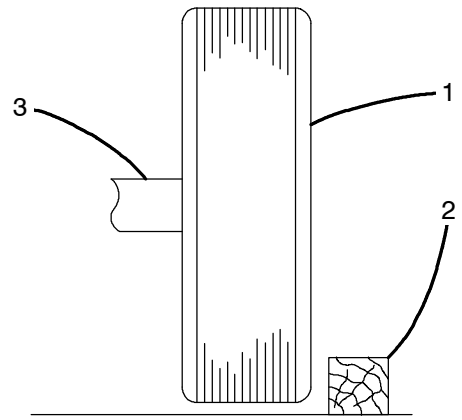
CAUTION

Hydraulic components and gears are machined to close tolerances. The interior steering gear components could be damaged if an impact wrench is used to install retainers (1,5). Do not use an impact wrench. Torqued the retainer (1,5) to 450 ft lb (*610Nm*) using a hand wrench only. On slave steering gear only, bend any tabs of the locking tab washer (2) into slots that align with milled slots in retainer (1).

8. Hand torque retainer (1,5) to 450 ft lb (*610Nm*).
9. Only on the slave steering gear (4,Figure 1). Bend any tabs on locking tab washer (2) into slots that align with milled slots in retainer (1).

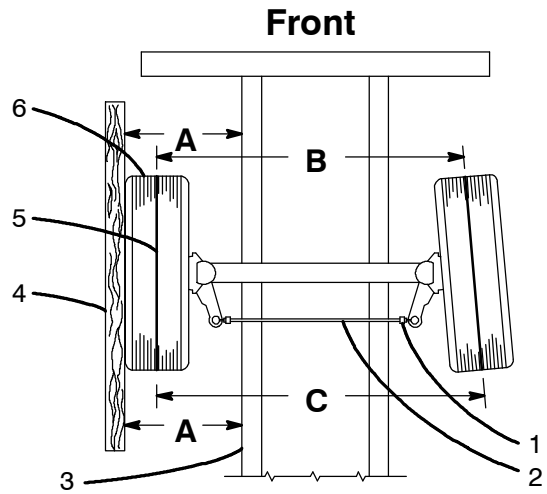
   Note: Installation of remaining components will be addressed in "Front Wheel Alignment and Steering Linkage Adjustment".

10. Refer to "Front Wheel Alignment and Steering Linkage Adjustment" in SM Area 1–6.
11. Start engine and check for leaks. Repair as necessary.
12. Check that all steering functions are operating normally before returning the crane to service.



1. Tire & Rim Assembly
2. Stationary Object
3. Axle

Figure 1
Tire & Rim Alignment



1. Clamps
2. Tie Rod
3. Carrier Frame
4. Straight Edge
5. Scribed Lines
6. Tires

Figure 2
Wheel Alignment

Front Wheel Alignment And Steering Linkage Adjustment

This document includes the following procedures:

These procedures are potentially very dangerous. They require no fewer than three people to perform. One person to operate the steering, one person to make the adjustments, and one person to carefully watch so no one gets hurt.

DANGER

Use extreme caution when operating the crane with someone under the carrier. The hydraulic force behind the steering components is capable of severely injuring anyone caught in the steering linkage or trapped behind a tire. Post a signalman to watch carefully to ensure the safety of the person under the carrier.

Wheel Alignment

The best way to check for proper alignment is by evaluating the straightness of the crane's tracking on the highway and inspecting tire wear. If the crane travels straight down the highway without "drifting" to one side and the tires show no abnormal wear, the alignment should be correct. If the tires are not wearing correctly, the following procedure can be used for an approximate alignment. To achieve a higher quality alignment, laser type alignment equipment should be used. Consult a professional alignment service facility if necessary.

Note: Wheel alignment should be performed on each axle independently and then synchronized by adjusting the steering linkage.

1. Park the crane on a firm level surface, shift the transmission to neutral, and engage the park brake.
2. Level the crane on outriggers, and release the park brake.
3. If equipped with air ride suspension, move the air ride switch to the "Up" position.
4. Shutdown the engine.
5. Check the air pressure in the tires for proper inflation.