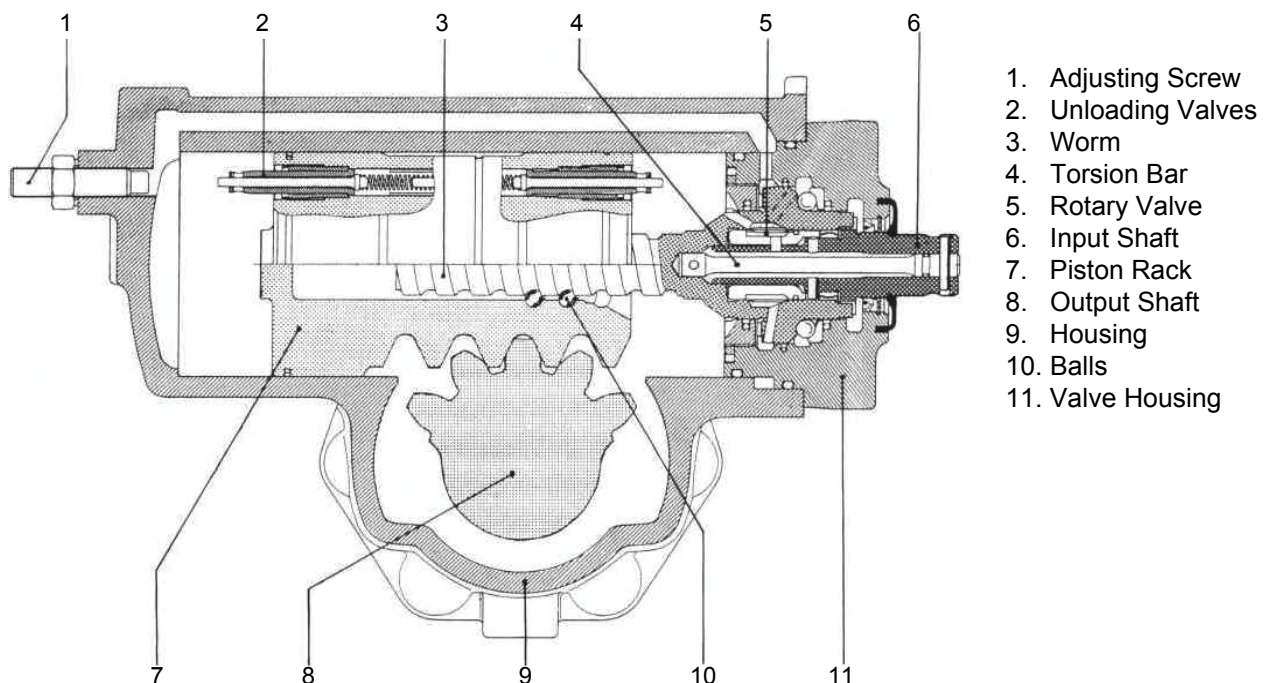


Integral Hydraulic Power Steering Gear Design Features

1. Integral Hydraulic Power Steering Gear

TAS 30, TAS 55, TAS 75, TAS 85, TAS 86 AND TAS 87 THP-35, THP-60, THP-70, THP-80, THP-81, THP-82, THP-90, THP-91, THP-92

The TAS/THP series steering gears were specifically designed for motor vehicles, new design features and our design experience with previous series of integral hydraulic power steering gears have been combined into this new product.



1.1 Design Features

- Rotary Valve. This device provides responsive steering control.
- Unloading Valves. Automatically set to furnish power steering pump protection and reduce pressure to unload steering linkage at vehicle axle stop settings.
- Recirculating balls. Combine high mechanical efficiency with smooth operation.
- Dirt and Water Seals. Lip type seals on both input and output shafts
- Torsion Bar. Provides positive valve centering with definite "feel of the road".
- Relief Valves. Furnish pump protection by limiting maximum pressure.
- Balanced Area Cylinder. Back pressures cannot affect steering stability.
- High Temperature Seals. These specially developed seals may be operated intermittently at 120° C.
- Manual Steering Capability. Provides for steering control in the event of hydraulic failure.
- Compactness. Lowest weight-to-Output torque ratio in the industry.
- Auxiliary Porting Available. For auxiliary cylinder control
- Seal Protectors. Provide protection from harsh environment

Integral Hydraulic Power Steering Gear

Definitions

1.2 Definitions

NOTE:

A NOTE gives key information to make a procedure easier or quicker to follow.

CAUTION:

A CAUTION refers to those procedures that must be followed to avoid damage to a steering component or the gear.

WARNING:

A WARNING REFERS TO THOSE PROCEDURES THAT MUST BE FOLLOWED FOR THE SAFETY OF THE DRIVER AND THE PERSON INSPECTING OR REPAIRING THE GEAR.

1.3 Disclaimer

This Maintenance Manual has been prepared by TRW AESL for reference and use by mechanics who have been trained to service steering components and systems on heavy commercial vehicles. TRW AESL has exercised reasonable care and diligence to present accurate, clear and complete information and instructions regarding the techniques and tools required for maintaining, repairing and servicing the complete line of TRW TAS and THP Series Integral Power Steering Gears. However, despite the care and effort taken in preparing this general Maintenance Manual, TRW makes no warranties that (a) the Maintenance Manual or any explanations illustration, information, techniques or tools described herein are either accurate, complete or correct as applied to a specific TAS and THP steering gear, or (b) any repair or service of a particular TAS / THP steering gear will result in a properly functioning steering gear.

If inspection or testing reveals evidence of wear or damage to the TAS/THP steering gear or you encounter circumstances not covered in the Manual, STOP - CONSULT THE VEHICLE MANUFACTURERS SERVICE MANUAL AND WARRANTY.

It is the responsibility of the mechanic performing the maintenance or service on a particular TAS / THP steering gear to (a) inspect the steering gear for abnormal wear and damage, (b) choose a work procedure which will not endanger his/her safety, the safety of others, the vehicle, or the safe operation of the vehicle, and (c) fully inspect and test the TAS steering gear and the vehicle steering system to ensure that the service of the steering gear has been properly performed and that the steering gear and system will function properly.

1.4 Patents

TRW AESL TAS / THP Power Steering Gear are covered by several Spanish and foreign patents either issued or pending.

Introduction

Maintenance Manual TAS and THP series

2. Introduction

2.1 Maintenance Manual TAS and THP series

This service manual has one purpose: to guide you in maintaining, troubleshooting and servicing the TAS and THP Integral Power Steering Gears.

Material in this manual is organised so you can work on a TAS / THP series steering gear and get results without wasting time or being confused. To get these results, you should review the contents of this manual before you begin any work on the steering system.

The section of this manual on General Design and operation addresses the major components of the steering gear and explains how they function together. The knowledge you acquire from reviewing this section should assist you in solving your steering problem.

This manual also contains trouble shooting information and checklists. With them, you can diagnose a steering problem without removing the TAS / THP steering gear from the vehicle. If you must service the TAS / THP steering gear, the checklists will help you to determine where the problem may be.

The three-column format of the Adjustments section will make it easier for you to service the steering gear. Column 1 gives a brief key for each procedure. Column 2 explains in detail the procedure you should follow. Column 3 illustrates this procedure with photographs. Pay special attention to the "NOTES", "CAUTIONS" and "WARNINGS".

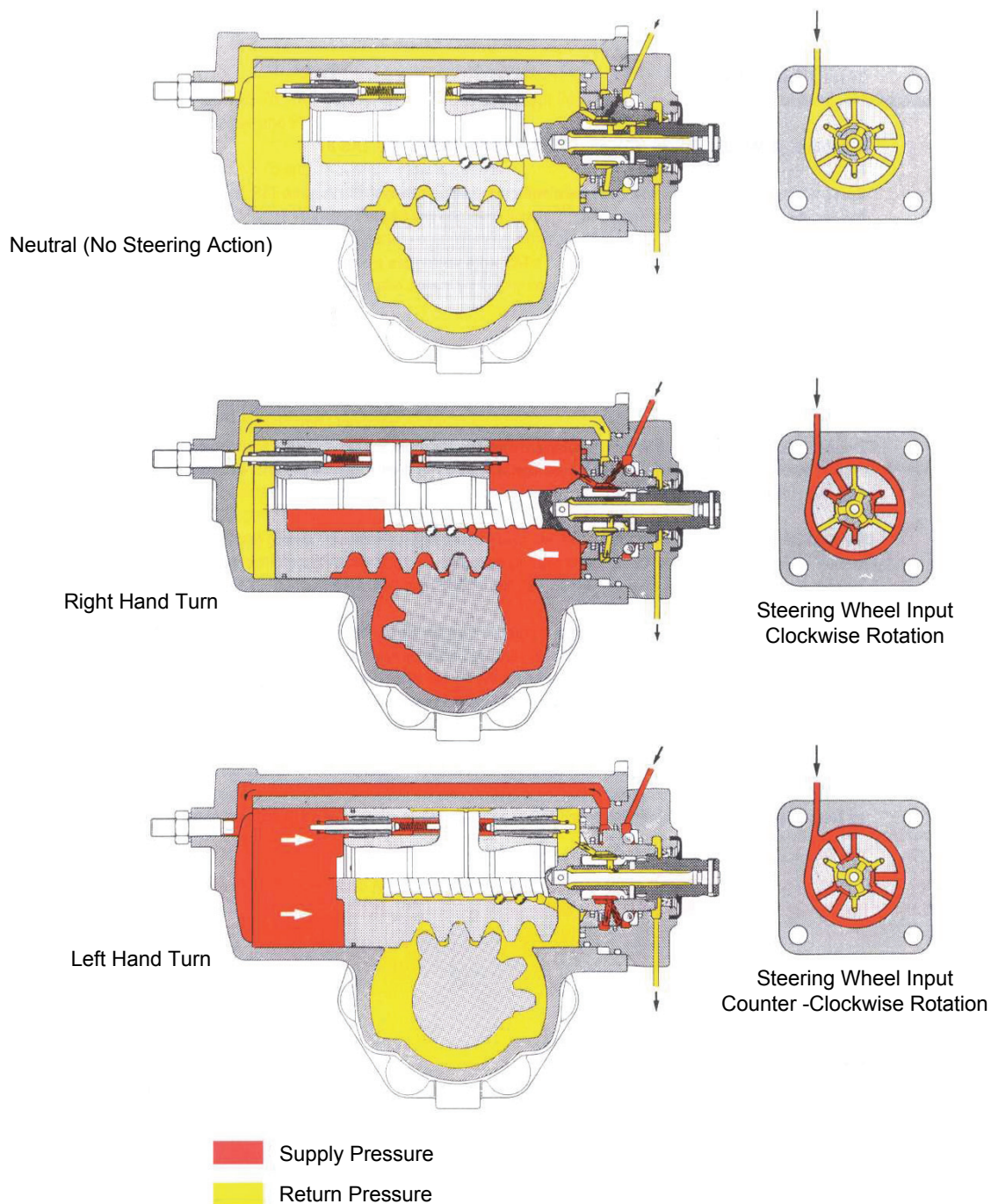
A foldout page (page 23) with the same typical TAS / THP steering gear exploded assembly view on both sides is provided in this manual. The component part names and item numbers assigned on this exploded assembly view correspond with names and item numbers (in parentheses) used in the adjusting procedures set forth in this manual. When this exploded assembly view page is folded out, you can easily identify components and locate their relative position on the exploded assembly view as you follow the procedures.

As you gain experience in servicing the TAS steering gears you may find that some information in this manual could be clearer and more complete. If so, let us know about it. Don't try to second guess the manual; if you are stuck, contact us. Maintaining the TAS / THP series steering gears should be a safe and productive procedure.

TAS / THP Oil Flow Illustration

Maintenance Manual TAS and THP series

3. TAS / THP Oil Flow Illustration



TAS / THP General Design and Operation Design

4. TAS / THP General Design and Operation

4.1 Design

4.1.1 Integral Power Steering

The THP power steering gear series are the latest design in the family of integral hydraulic power steering gears. Integral hydraulic power steering means that the gear box contains a manual steering mechanism, a hydraulic control valve, and a hydraulic power cylinder, all in a single, compact package.

4.1.2 Rotary Control Valve

The rotary control valve combines simplicity of construction with desirable performance characteristics. The speed at which the driver can turn the steering wheel with power assist is dependent upon the pump flow (measured in litres per minute/lpm) directed to a cylinder cavity. The pressure (measured in bar) required for the gear to steer the vehicle is created by the power steering pump to overcome resistance at the steered wheels.

The control valve senses these requirements and directs fluid to the appropriate cylinder cavity in the steering gear and in the auxiliary cylinder if it is a dual steering system at the proper flow rate and pressure.

4.1.3 Pressure Means Work, Flow Means Speed

The TAS / THP series gears can steer a vehicle within its front-end weight rating through a turn at low speed and engine idle. As the driver turns the steering wheel faster or slower, more or less fluid will be required by the gears. The higher pressure a steering gear can withstand, the more work it can perform. TAS and THP series might work up to a maximum operating pressure of 185 bar and to a maximum flow rate of 26.5 lpm, depending on the model.

4.2 Operation

4.2.1 What Happens During a Steering Manoeuvre.

When the driver turns the steering wheel, he transmits force from the steering wheel to the steering gear input shaft. A torsion bar, pinned at its one end to the input shaft and at its other end to the worm shaft, turns with the input shaft and exerts a rotational force on the worm shaft. In response to this rotational force, the worm shaft, acting through the recirculating ball mechanism, tries to move the rack piston axially through the gear housing cylinder bore.

The rack piston's axial movement is resisted by its engagement to the sector shaft which is connected by linkage to the steered wheels. Because of this resistance, the torsion bar is twisted by the input shaft, thereby actuating the control valve. Pressurised fluid, directed by the control valve, assists in moving the rack piston axially through the cylinder bore: The rack piston then turns the sector shaft to steer the vehicle.

4.2.2 Shock Loads to the Gear

If the steered wheels receive a shock load, the shock forces are transmitted through the sector shaft to the rack piston, and onto the worm shaft. The internal geometry of the steering gear causes the control valve to send high-pressure fluid to the correct cylinder cavity to resist the shock forces. By absorbing the shock forces hydraulically, the steering gear prevents objectionable kickback at the steering wheel.

TAS / THP General Design and Operation

Operation

4.2.3 Unloading (Poppet) Valves

TAS / THP gears are equipped with two unloading valves, one at each end of the rack piston. One valve or the other depending on the direction of turn, will trip as the steered wheels approach the axle stops (which must be set according to manufacturer's specification). The tripped valve reduces pressure in the gear and helps to reduce heat generated by the pump. At the same time, the valves also reduce forces on the steering linkage. These valves are automatically set to axle stops after installation in vehicle at first full-right and left turn.

4.2.4 Relief Valve

TAS / THP gears are supplied with a relief valve. The relief valve limits maximum supply pressure to protect the power steering system and linkages, but it does not reduce pressure as the steered wheels approach the axle stops.

4.2.5 Bleed Systems

Some TAS / THP gears which are mounted with the output shaft above the rack piston bore are equipped with either an automatic bleed system or a manual bleed screw.

The procedure for servicing or using the manual bleed screw is described under "Filling and Air Bleeding" in this manual. If the unit has an automatic bleed system, no servicing is required on the vehicle.

4.2.6 Dual circuit valve

To pass the 92/62/CEE directives for emergency steering TAS-85, THP-80 and THP-90 models can be equipped with a dual circuit valve. Two versions are available. TAS-86, THP-81 and THP-91 for a single steered axle vehicle. TAS 87, THP-82 and THP-92 for a twin steered vehicle with auxiliary cylinder.

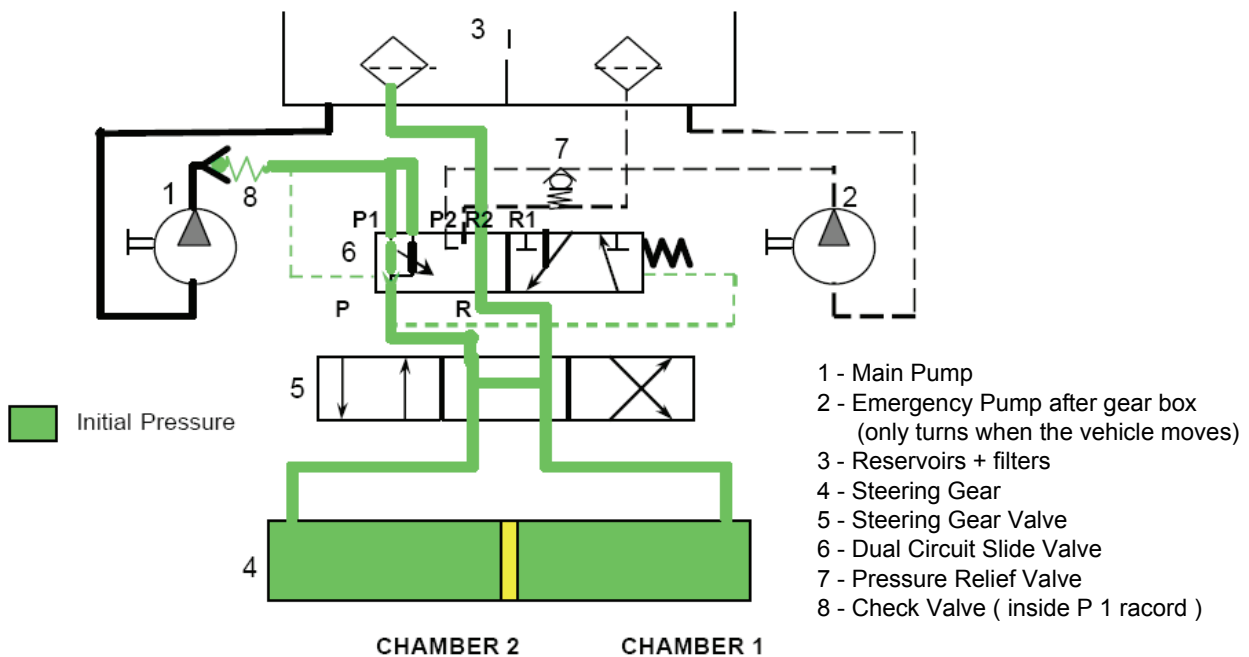
TAS / THP General Design and Operation

TAS-86, THP-81 and THP-91 Dual Circuit Valve Working Principle

4.3 TAS-86, THP-81 and THP-91 Dual Circuit Valve Working Principle

With the vehicle stationary and the engine off; the spring shown on the right side of the valve schematic will position the spool to complete the hydraulic circuit shown. In this position the wheel driven pump, item number 2, is connected to the steering gear, item number 4. When the engine is started, the primary pump, item number 1, begins to send fluid to the valve, the fluid passes through the check valve (8), the fixed orifice, and the steering gear. As the fluid passes through the fixed orifice, a pressure differential is created. The higher pressure is communicated to the left and the lower pressure is communicated to the right side of the spool. As the flow increases, so does the differential pressure. When the force created by the differential pressure exceeds the spring force, the spool moves to the position shown on the left side of the valve schematic. This is the normal operating position. The variable orifice shown in the diagram is an area formed between the edges of the spool and housing that enlarges to the extent that flow exceeds that needed to shift the spool. When a failure occurs to this normal operating circuit, the fluid flow delivered to the fixed and variable orifice will diminish to a level where fluid will cease to flow through the variable orifice and the fluid flow past the fixed orifice will not be enough to hold the spool shifted against the spring force. At this time the spool will shift and all the flow from the road wheel driven pump (2) will be directed to the steering gear (4) and added to that being delivered by the engine driven pump (1) that is below the minimum threshold requirement. If the fluid flow from the engine driven pump (1) fails due to a rupture hose, for example, the check valve (8) would prevent the wheel driven pump from being lost through the rupture and all the flow being delivered to the steering gear would be from the wheel driven pump (2).

Dual Circuit Double Spool Valve Hydraulics Scheme - Straight Line Position - Working Situation



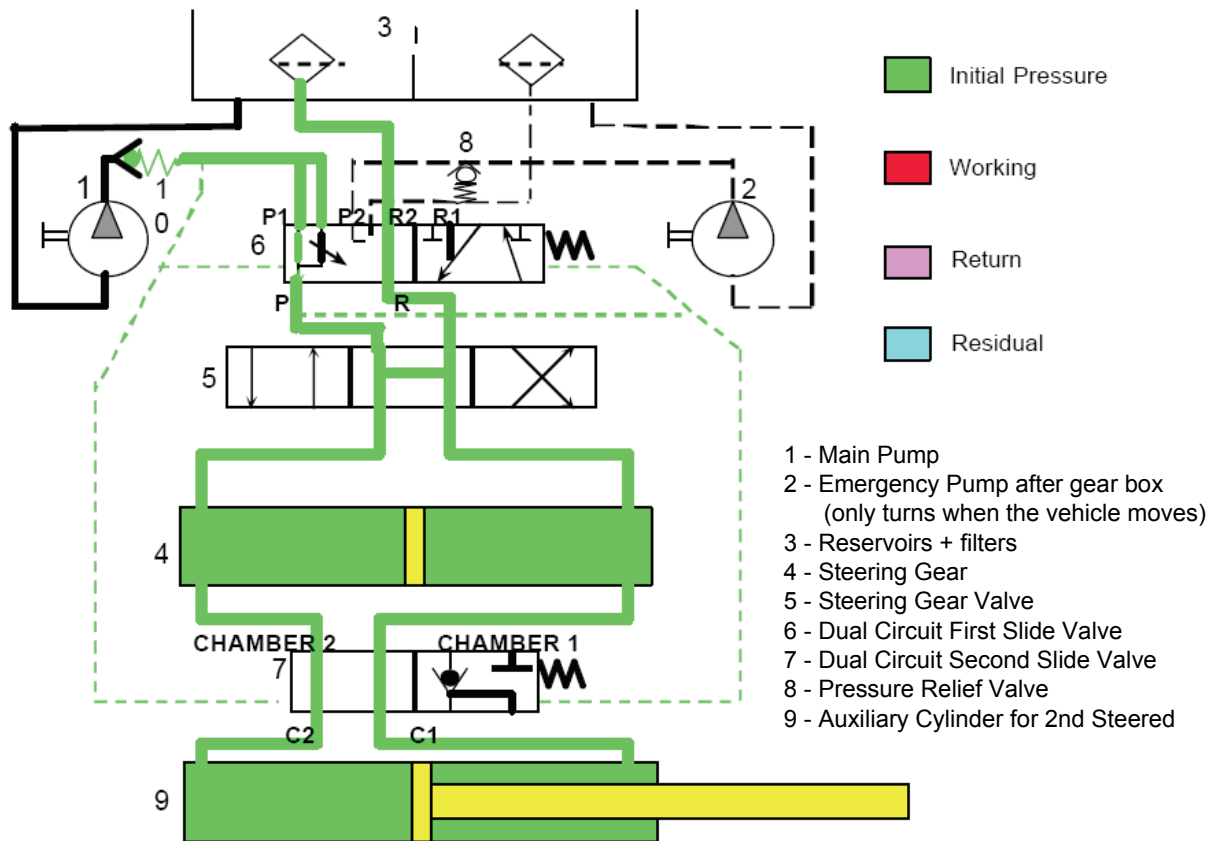
Dual Circuit Steering System that automatically switches from the primary (Engine Driven Pump) to the secondary (Road Wheel Driven Pump) fluid power source upon failure of the primary source to deliver fluid flow.

TAS / THP General Design and Operation

TAS-87, THP-82 and THP-92 Dualcircuit Valve for Two Steered Axle Trucks

4.4 TAS-87, THP-82 and THP-92 Dualcircuit Valve for Two Steered Axle Trucks

The primary difference between this system and the single axle one is the addition of another spool type manifold valve (7) that is actuated by the same pressure differential as the first valve. When the P1 pump (1) fails to deliver enough flow to hold the first valve spool (6) over against the spring load, the first spool (6) shifts and the pressure differential between either end of the spool drops rapidly. Since the second valve spool is held in the operating position due to this pressure differential, when the differential is lost, the spool shifts. In this shifted position the power to steer the second axle (9) is no longer available, but the remaining power available should be satisfactory to meet the 92/62/CEE performance specifications.



Dual Circuit Steering System that automatical switches from the primary (Engine Driven Pump) to the secondary (Road Wheel Driven Pump) fluid power source upon failure of the primary source to deliver fluid flow. It also by-passes the action of the cylinder upon same failure.

Troubleshooting Preliminary Checks

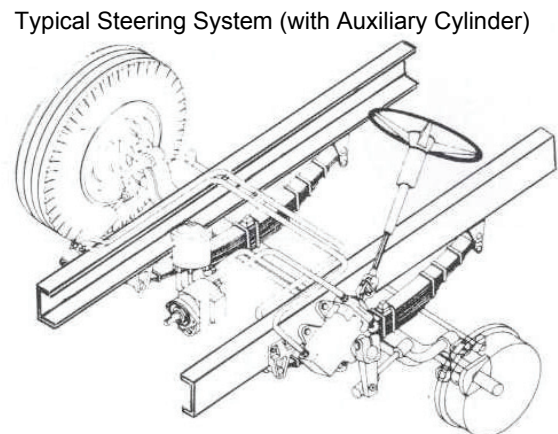
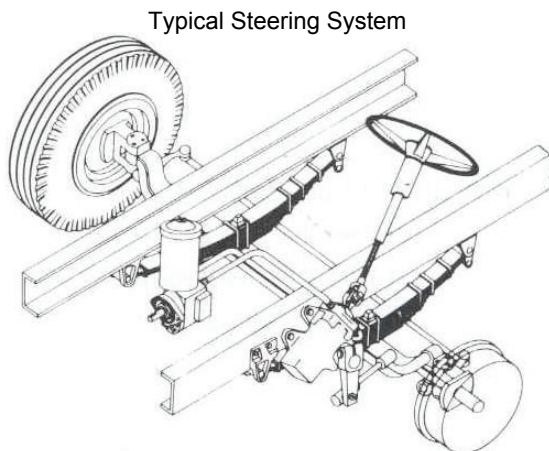
5. Troubleshooting

5.1 Preliminary Checks

When a customer comes to you with a problem related to his vehicles steering, you can save a lot of time and work if you first verify the problem. Make sure you are both talking the same language about the same problem. If he says the vehicle's hard to steer, find out exactly what he means. Is it hard steering into a right or left turn? Only when turning the steering while the vehicle is sitting still? Is there only intermittent power steering? Or is there no power assist at all?

If at all possible, and if it is safe to do so, test drive the vehicle. If you are not familiar with the rig, let the customer drive it while you sit beside him. Take hold of the wheel while he drives to get a feel for the problem he is talking about. Since most of his driving will be with his vehicle hauling a load, arrange for a load if one is required to reproduce the steering problem.

Once you've determined the problem and its symptoms, don't jump right in to tear the steering gear or pump apart. In most cases, in fact, the gear should be the last component you check. There are many other components in the steering system that could be causing the problem. These you should check first.



Begin, then, by checking the steered wheels: make sure that the tires are at correct pressure and equal all around, that they are properly sized, and that they are not worn or damaged. Next, have the frontend alignment checked and look for abnormal looseness or tightness in the steering linkage, ball joints, and kingpins.

A service replacement hose or fluid line may be misrouted or may be too small in diameter, or it may be restricted in some other way. Replace any hose that is kinked or bent sharply. Replace any hoses that are not the same as original equipment.

Continue by checking the power steering fluid reservoir to make sure that oil is up to the correct level. Also, check the pump drive belt, if one is used, to see if it is slipping. The belt may be tight, but it may also be glazed, and a slipping belt doesn't always squeal. If you adjust the belt, check the specifications.

These are just some of the checks you should make before you turn to the steering gear or pump. The Troubleshooting Guide on pages 12 thru 14 explains what to diagnose for a particular steering problem. Match the trouble symptom against the chart and follow the recommended troubleshooting sequence. Doing so will most likely save you time and may prevent unnecessary repairs and costs.

Troubleshooting

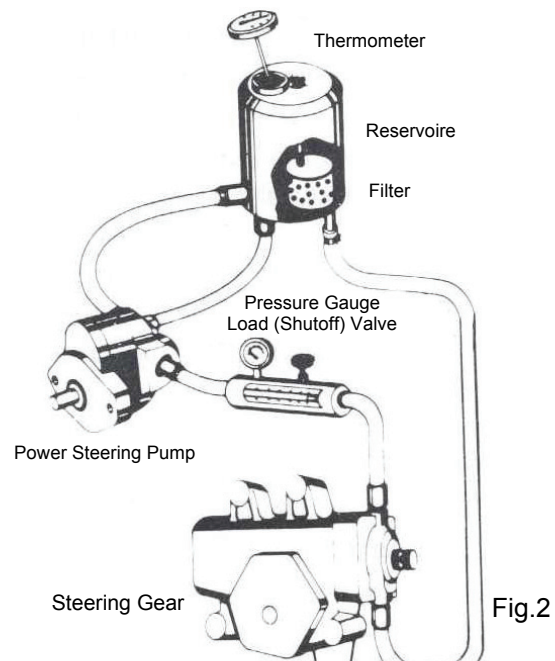
Hydraulic Tests

5.2 Hydraulic Tests

If the checks described above all prove satisfactory, it is possible that the cause of the steering problem can be traced to a lack of pressure or insufficient flow. In this case, you may have to do more detailed troubleshooting that involves conducting hydraulic tests.

5.2.1 Preparation for Hydraulic Tests

To conduct the following hydraulic tests, first install a flow meter, pressure gauge and load (shut off) valve in the fluid supply line to the steering gears, as indicated by the instructions that come with the flow meter. Place a thermometer in the reservoir (Fig.2). You must use a flow meter, and it is recommended that you use a thermometer, if you are to troubleshoot the hydraulic system accurately. Start the engine and warm the hydraulic system up by partially closing the load valve until the pressure gauge reads 70 Bar. When the fluid temperature, as indicated on the thermometer, reaches between 50°C and 60°C open the load valve. The system is warmed up. And you can conduct the tests.



CAUTION: Do not close the load valve completely and leave it closed, or you may damage the pump. At no time allow fluid temperature to exceed 80°C. Run all the tests at the prescribed temperature range of 50°C and 60°C.

5.2.2 Power Steering Pump Pressure Test

With the engine idling, close the load valve and read the pressure gauge. If the pressure reads below the minimum specified by the pump manufacturer, repair or replace the pump.

CAUTION: Do not keep the load valve closed for longer than 5-10 seconds to avoid damaging the pump. Closing the load valve causes the pump to operate at relief pressure and the fluid temperature to increase rapidly. Allow fluid to cool to between 50°C and 60°C before you resume with the other tests.

5.2.3 POWER STEERING PUMP FLOW TEST

WARNING: DO NOT EXCEED THE MAXIMUM FLOW AND PRESSURE RATE SPECIFIED BY THE VEHICLE MANUFACTURER. EXCESSIVE FLOW OR PRESSURE CAN CAUSE DAMAGE TO INTERNAL PARTS OF THE STEERING GEAR, WHICH COULD RESULT IN A LOSS OF POWER STEERING.

NOTE: If flow specifications and methods of checking flow rate are provided by the vehicle manufacturer, you should follow those instructions rather than the procedure described below.

Troubleshooting Hydraulic Tests

With the engine idling and the fluid temperature between 50°C and 60°C check the pump manufacturer's specifications for flow rate. Compare these specifications with the flow rate on the flow meter. Now, fully close the load valve until the pressure gauge registers the maximum working pressure of the steering gear.

IMMEDIATELY OPEN THE LOAD VALVE. The flow rate must instantly return to the original reading. If this rate does not return immediately, the pump is malfunctioning, which can result in intermittent power assist.

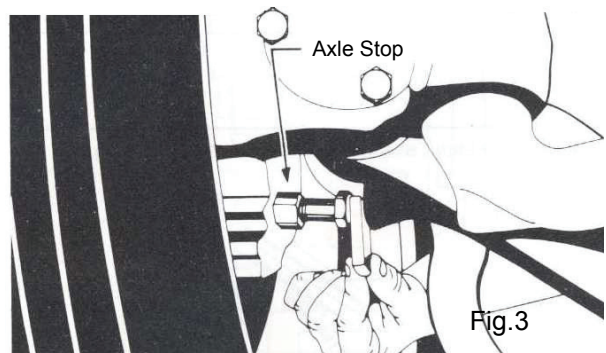
NOTE: Conduct the pump flow test once at idle rpm and once more at three times the idle rpm.

CAUTION: Do not allow the fluid temperature to exceed 80°C.
Run each phase of this test between 50°C and 60°C.

5.2.4 STEERING GEAR INTERNAL LEAKAGE TEST

To test the steering gear for internal leakage, you must first prevent operation of the gears internal unloading (poppet) valves or relief valve (or both, in some gears). This will allow full pump relief pressure to develop. To prevent operation of the poppets, place an unhardened steel spacer block, about 25mm thick and long enough to keep your fingers clear, between the axle and stop at one wheel (see Fig.3).

To prevent operation of the relief valve, remove the relief valve and install the relief valve plug, special tool SK12986 in its place (Consult TRW).



NOTE: Be sure you reinstall the relief valve and valve cap with new o-ring, back onto the gear after leakage test.

With the fluid temperature between 50°C and 60°C turn the steering wheel until the axle stops bottom on the spacer block (FIG.3).

CAUTION: When running this test, do not hold the steering wheel in the full turn position for longer than 5 to 10 seconds at a time to avoid damaging the pump

WARNING: KEEP YOUR FINGERS CLEAR OF THE AXLE STOPS AND SPACER BLOCK DURING THIS TEST. MAKE SURE THAT THE SPACER BLOCK CONTACTS THE AXLE STOP SQUARELY. A CONTACT THAT IS NOT SQUARE COULD BREAK THE AXLE STOPS OR DANGEROUSLY THROW OR EJECT THE SPACER BLOCK.

Apply 100 N to the rim of the steering wheel during this test to ensure that the steering gear control valve is fully closed. The pressure gauge should now read the maximum pump pressure, as noted during the pump pressure test. You can now read steering gear internal leakage on the flow meter. Repeat this test for the opposite direction of turn. Acceptable internal leakages of the hydraulic system can range from 0 to 5.7 litre/min.

If internal leakage is greater than 3.8 Litre/min depending on the model and maximum working pressure and there is no auxiliary hydraulic cylinder in the system, repair the gear.

Troubleshooting

Troubleshooting Guide

If the internal leakage is greater than 5.7 Litre/min and there is an auxiliary hydraulic cylinder in the system, controlled by the TAS/THP gear, isolate the auxiliary cylinder from the system by disconnecting the auxiliary cylinder lines at the TAS/THP units auxiliary ports. Plug those ports with suitable pressure plugs or caps. Connect the disconnected lines together if a rotary auxiliary cylinder is in the system. Plug the disconnected lines if a linear auxiliary cylinder is in the system and disconnect the linear cylinder from the steering linkage making sure it will clear the steered axle.

Repeat the internal leakage test. If the internal leakage is less than 3.8 Litre/min repair the auxiliary cylinder. If the internal leakage is greater than 3.8 Litre/min, repair the TAS / THP gear.

NOTE: When hydraulic tests are completed and fluid lines are reconnected, check fluid level and air bleed the system.

5.3 Troubleshooting Guide

5.3.1 Normal Noises I

- You or the driver may hear a hissing noise from the control valve when it is actuated during a steering manoeuvre
- You or the driver may hear a noise as fluid bypasses through the poppets at full turn.
- You or the driver may hear a noise from the system relief valve when it is required to actuate.
- You or the driver may hear pump growl from some types of power steering pumps.

5.3.2 Abnormal Noises

- If the power steering pump is belt driven, a squealing noise may indicate that the belts should be tightened or replaced.
- A clicking noise heard during a turn, or when changing directions, may indicate that some component is loose and shifting under load.
- A change in the normal noise of the pump may indicate that air has been induced into the system or that fluid level is low.

5.3.3 Possible Steering Problems and Causes

5.3.3.1 Road Wander

- Tire pressure incorrect or unequal left to right.
- Components in steering linkage loose or worn (Steering wheel to road wheel)
- Wheel bearings improperly adjusted or worn.
- Front end alignment out of specification.
- Dry fifth wheel or poor finish on fifth wheel or trailer plate.
- Steering gear mounting bolts loose on frame.
- Steering gear improperly adjusted.
- Looseness in rear axle assemblies or trailer bogies.

Troubleshooting Troubleshooting Guide

5.3.3.2 No Recovery

- Tire pressure low
- Front end components binding
- Tight front axle kingpins
- Dry fifth wheel or poor finish on fifth wheel or trailer plate
- Steering column binding
- Pump flow insufficient
- Steering gear improperly adjusted
- Steering gear control valve sticking
- Front end alignment incorrect

5.3.3.3 Shimmy

- Badly worn or unevenly worn tires
- Improperly mounted tire or wheel
- Wheel bearings improperly adjusted or worn
- Components in steering linkage loose or worn
- Wheels or brake drums out of balance
- Front end alignment incorrect
- Air in the hydraulic system

5.3.3.4 External Oil Leakage

- Finding the location of a leak may be difficult, since oil may run away from the leak source, the fittings, hoses, pump or gear to a low point on the gear or chassis.
- A leak from the vent plug at the side cover indicates failure of the sector shaft oil seal inside the side cover.

5.3.3.5 Oversteering or Darting

- Dry fifth wheel or poor finish on fifth wheel or trailer plate
- Front end components binding or loose
- Steering column binding
- Steering gear improperly adjusted
- Steering gear control valve sticking
- Rear axle mounts (rear steer)

5.3.3.6 High Steering Effort in One Direction

- Unequal tire pressure
- Vehicle overloaded
- Inadequate hydraulic system pressure
- Excessive internal leakage in one direction of turn only (verify with internal leakage test)

Troubleshooting

Troubleshooting Guide

5.3.3.7 High Steering Effort in both Directions

- Low tire pressure
- Vehicle overloaded
- Low hydraulic fluid level
- Low pressure or flow from pump
- Components of steering system binding
- Restriction in return line, or line to a small in diameter
- Excessive internal leakage (verify with internal leakage test)
- Oversize tires (check manufacturer's specifications)

5.3.3.8 Lost Motion (Lash) at the Steering Wheel

- Steering wheel loose on the shaft
- Loose connection between the steering gear, intermediate column, and steering column.
- Steering gear loose on frame
- Pitman arm loose on output shaft .
- Components in steering linkage loose or worn
- Steering gear improperly adjusted

5.3.3.9 Excessive Heat Oil temperature not to exceed 120°C Continuously

- Excessive pump flow
- Vehicle overloaded
- Undersized replacement hose or line
- Restricted hose or line that is kinked or severely bent or internally blocked
- Restricted re-entering of gear valve caused by column bind or side load on the input shaft
- Poppet not functioning properly
- Prolonged stationary vehicle operation

WARNING: IF THE HYDRAULIC SYSTEM FLUID BECOMES OVERHEATED, IT CAN CAUSE THE SEALS IN THE STEERING GEAR AND PUMP TO SHRINK, HARDEN, OR CRACK AND LOSE THEIR SEALING ABILITY

Adjustments on Vehicle Sector-Shaft Adjustment

6. Adjustments on Vehicle

NOTE: All Numbers in the brackets refer to chapter 6.4 page 23. When you have conducted the checks and tests described in the troubleshooting sections, you may find it necessary to adjust the steering gear. There are two adjustments to be made to the steering gear while it is installed on a vehicle. One is the sector shaft adjustment, and only if the shaft adjusting screw and jam nut (45) are accessible. A manual poppet adjustment is possible after initial poppet valve adjustment at installation. If the steering gear has a fixed stop screw (38) and washer (39), you must replace them with a special service poppet adjusting screw (41) and sealing nut (40) to make this adjustment. Some of the photographs in this section show a gear mounted on a mock-up frame for clear illustration.

Worm preload was achieved during assembly of the steering gear. If axial lash (movement) of input shaft is evident during a steering manoeuvre, the steering gear must be disassembled and repaired.

6.1 Sector-Shaft Adjustment

6.1.1 Locate adjusting nut

(With vehicle engine off) If the sector-shaft adjusting screw jam nut (45), located on the side cover, is not accessible, the steering gear must be removed prior to adjustment.

6.1.2 Centre the sector shaft

To position the sector shaft (42) on centre of travel for this adjustment, rotate steering wheel (input shaft, valve worm assembly) until the timing mark across the end of the sector shaft is perpendicular to the input shaft, valve worm assembly and in line timing mark on the end of housing (31) trunnion (Fig.4).

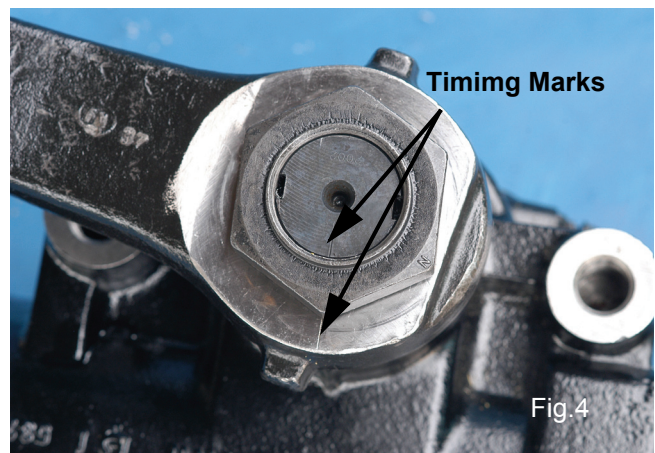


Fig.4

CAUTION: This adjustment must be performed with the sector shaft on its centre of travel..

6.1.3 Remove the drag link

If the sector shaft adjusting screw is accessible for adjustment, remove the drag link from the pitman arm (Fig.5).

CAUTION: The input shaft, valve worm assembly (14), must not be rotated more than 1-1/4 revolutions from the centre of travel while the drag link is detached from steering gear to avoid possible maladjustment of the poppet system.

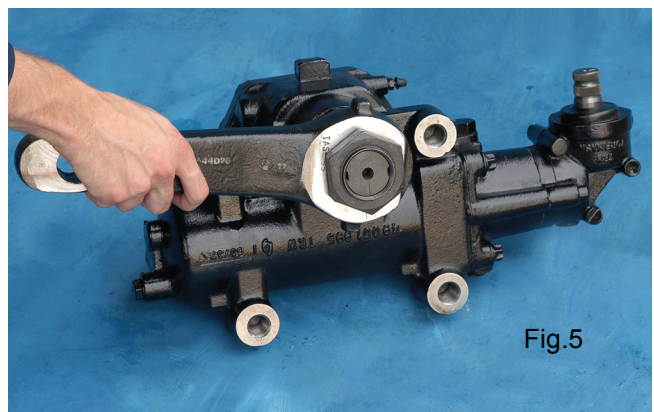


Fig.5

Adjustments on Vehicle

Sector-Shaft Adjustment

6.1.4 Check for lash

With the sector shaft (42) in the centre position, grasp the pitman arm and gently try to move this arm back and forth in the direction of travel. Fingertip force is adequate to detect lash of loose sector shaft. There must not be movement of the input shaft or sector shaft (Fig.5).

6.1.5 Position Adjusting Screw

Loosen jam nut (45). If no lash was detected, turn shaft adjusting screw counter clockwise until lash is detected.

6.1.6 Adjust Shaft

To adjust, slowly turn the shaft adjusting screw clockwise until no lash is felt at the pitman arm. (Use no more than 14 Nm of torque). From this no lash position, turn screw clockwise an additional 1/8 to 1/4 of a turn. Hold the adjusting screw in place, and tighten the jam nut (45). Final torque: as per Torque Chart (Fig.6).

CAUTION: Overadjustment of shaf adjusting screw clockwise could induce a no recovery, over-steering or darting condition in the vehicle.

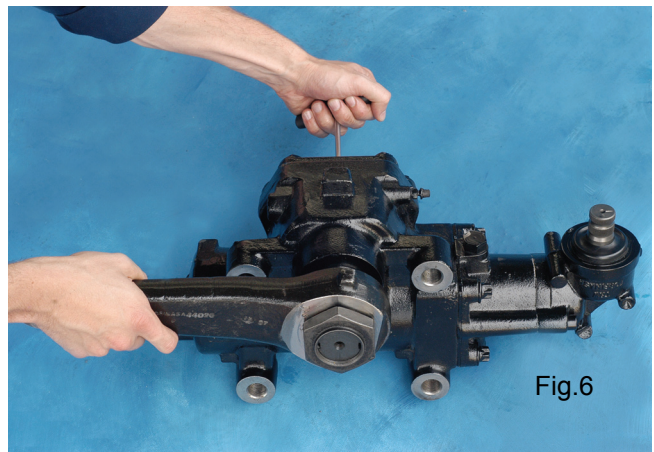


Fig.6

6.1.7 Recheck for lash

Recheck the pitman arm for lash. Turn the steering wheel 1/4 turn each side of centre. No lash should be felt. If lash exists, repeat step 5 through 7.

6.1.8 Connect drag link

Reconnect drag link to pitman arm

Adjustments on Vehicle Poppet Valve Manual Readjustment

6.2 Poppet Valve Manual Readjustment

Most TAS steering gears are equipped with two hydraulic pressure relieving poppet valves that were automatically or manually set to trip, relieving pressure just before reaching the axle stops. This was achieved after initial installation into the vehicle at the first full right and left turn. The pressure relieving poppet valves that were automatically set at initial installation will have a fixed stop screw (38) and washer (39). These units will automatically reset themselves, within the poppets adjustment limits, if the axle stops are reset for **increased** steering gear travel based on **acceptable** equipment revisions from original factory installations. If the axle stops are reset for **decreased** steering gear travel with the steering gear installed on the vehicle, the fixed stop screw (38) and washer (39) must be replaced by a special length service poppet adjusting screw (41) and seal locknut (40) kit. Check the vehicle manufacturers specifications or service manual or the TRW AESL steering gear service parts list to determine the correct replacement poppet adjusting screw and nut kit required for the specific TAS steering gear being serviced. The vehicle manufacturer's poppet adjustment procedures must take precedence over the poppet adjustment procedures in this maintenance manual. The poppet adjusting screw (41) and locknut (40) are supplied as original equipment on some TAS/THP steering gears. If the adjusting screw and locknut are already part of the steering gear assembly, remove the screw from the gear and measure the total screw. Following adjustment procedures are only valid when 55mm screw length is required.

Note: If a longer screw is used (65 or 75 mm) all the dimensions indicated in this adjusting procedure have to be increased in +10 mm or +20 mm respectively.

6.2.1 Set Axle Stop

Set the axle stops to vehicle manufacturer's specifications, allowing for the revisions from the original equipment installation.

CAUTION: If the axle stops are adjusted such that a minimum of 1.4 steering wheel turns from straight ahead position is not available, the poppets are not functional nor can they be adjusted to function.

6.2.2 Assemble Adjusting Screw into Nut

Figure 7A If a new poppet adjusting screw and nut are being installed, adjust the locknut on the screw according figure 7A or 7B. Before adjusting the locknut you need to verify the shape of the housing (31) in the poppet screw area, present on the gear installed into the vehicle. See also figure 7A and 7B.

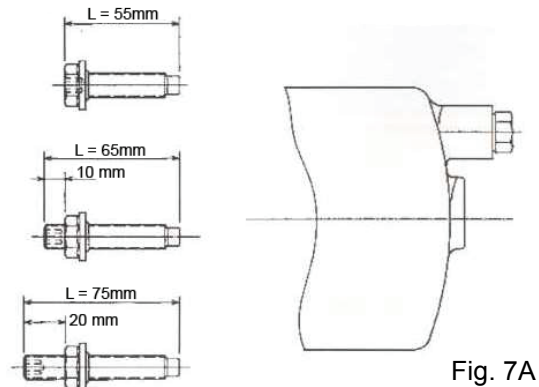


Fig. 7A

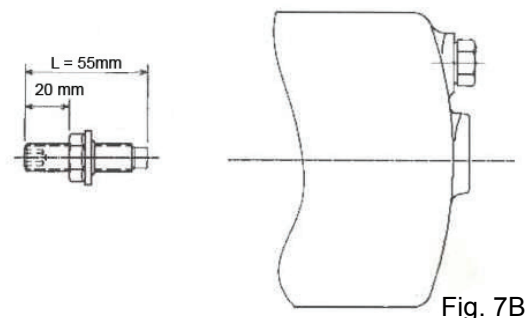


Fig. 7B

Adjustments on Vehicle

Poppet Valve Manual Readjustment

6.2.3 Remove Poppet Stop Screw

With the vehicle unloaded, the engine off and the road wheels in "straight ahead position", remove and discard the poppet fixed stop screw (38) and washer (39) from the lower end of housing (31) if the unit is so equipped (Fig.8). If the unit has a poppet adjusting screw (41) and nut (40), and they are to be replaced, remove and discard them at this time.

NOTE: With the road wheels in the "straight ahead position", the steering gear is in its centre position only when timing marks on the end of the sector shaft and housing trunnion are aligned.



Fig.8

6.2.4 Turn Adjusting Screw Assembly into Housing

Adjust the locknut on the screw according step 2 of this procedure as described before. Turn the new adjusting screw (41) and locknut (40) assembly, without rotating the nut on the screw, into the housing until the nut is firmly against the housing (Fig.9). Final torque the nut to 20-30 Nm (Fig.10).

NOTE: It may be necessary to move the sector shaft slightly from the "straight ahead position" to assemble the service adjusting screw as instructed and then return into „straight ahead“.

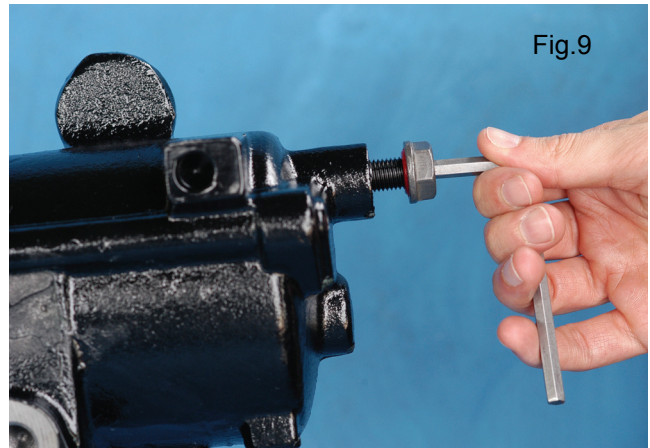


Fig.9

6.2.5 Refill Pump Reservoir

Refill pump reservoir with approved hydraulic fluid.

NOTE: If excessive input shaft torque to apply in the steering wheel is encountered prior to reaching the axle stop, allow vehicle to roll slowly forward while rotating steering wheel or jack up the vehicle at the front axle.



Fig.10

Adjustments on Vehicle Poppet Valve Manual Readjustment

6.2.6 Rotate Sector Shaft to Position Rack Piston

To position the rack piston for resetting poppets, observe the end of sector shaft (42) for direction of travel. With the engine idle, have the steering wheel rotated direction necessary to rotate the sector shaft towards the end of travel (axle against axle stop) clockwise (cw) or counter clockwise (ccw) that will position the rack piston toward the adjustable poppet screw (41) at the closed end of housing (31) by referring to figures 11 & 12. When the initial internal engagement of poppet adjuster seat and sleeve assembly (22) and adjusting screw is felt, evidenced by torque rise at the steering wheel, continue the steering wheel rotation until the axle stop is contacted. The upper poppet adjuster seat and sleeve assembly (22) is now pre-set internally for automatic adjustment to the related axle stop.

NOTE: Make note of the steering wheel rotation direction, clockwise (cw) or counter clockwise (ccw), required to position the rack piston toward adjusting screw in step #6.

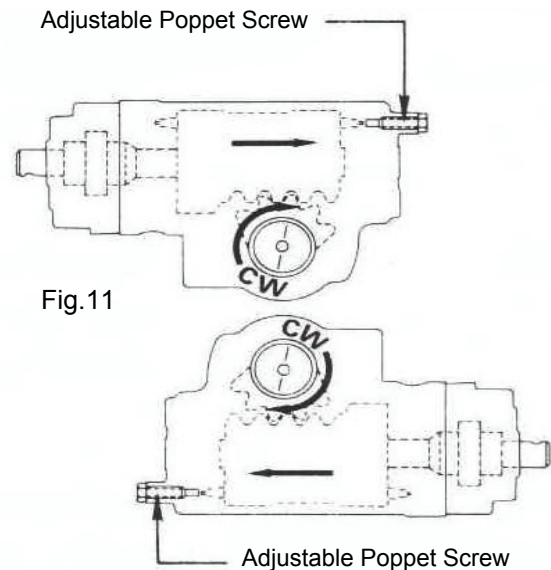


Fig.11

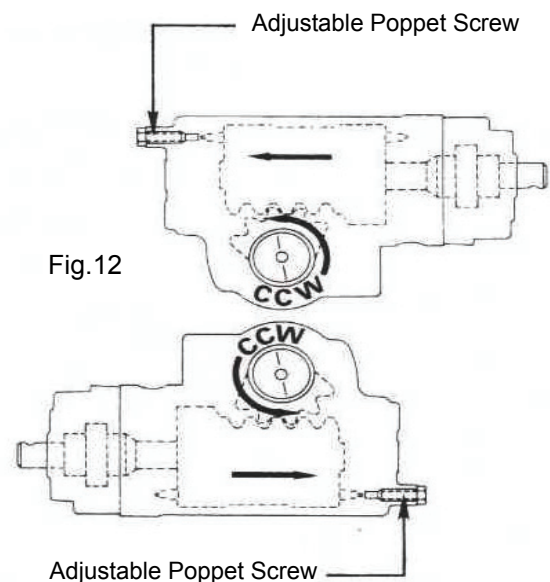


Fig.12

Adjustments on Vehicle

Poppet Valve Manual Readjustment

6.2.7 Back out Adjusting Screw

Loosen nut (40) and back out adjusting screw (41) an extra 15-17 mm (dimension as found in 6.2.2 + 15 to 17 mm - Fig.13). Torque nut firmly against housing while maintaining the screw protrusion dimension. Final torque nut to 20-30 Nm (Fig.14).



Fig.13

6.2.8 Position upper Poppet to Axle Stop

With the engine at idle and the vehicle unloaded, turn steering wheel toward full travel in the opposite direction used and noted in step 6.2.6 until axle bottoms against the axle stop. This will automatically position the upper poppet valve to the related axle stop.



Fig.14

6.2.9 Install Pressure Gauge

Install a pressure gauge in the fluid supply line to the steering gear.

6.2.10 Position Rack Piston toward Adjusting Screw

With the engine at idle, have the steering wheel rotated in the direction determined and noted in step 6.2.6 until the axle stop is contacted, positioning the rack piston toward the poppet adjusting screw (41) at closed end of housing (31). At this point, the system will be operating at system (pump) relief pressure.

CAUTION: At no time should relief pressure be maintained for longer than 5 seconds, as damage to the steering pump may result.



Fig.15

6.2.11 Position Adjusting Screw and Torque Nut

With the steering wheel being held in this axle stop contact position, loosen the nut (40) one turn and turn the adjusting screw (41) in while holding the nut (Fig.15). Continue turning adjusting screw until a pressure drop is seen on the pressure gauge. Final torque nut: See Torque Chart (Fig.16). and disconnect the pressure gauge.



Fig.16

Adjustments on Vehicle Poppet Valve Manual Readjustment

WARNING: THE MAXIMUM ADJUSTING SCREW PROTRUSION FROM SEALING NUT AS GIVEN IN STEP 6.2.7 MUST NOT BE EXCEEDED TO INSURE ADQUATE SCREW THREAD ENGAGEMENT IN HOUSING. INADEQUATE SCREW ENGAGEMENT COULD CAUSE LOSS OF THE ADJUSTING SCREW DURING OPERATION WITH RESULTANT LOSS OF POWER STEERING.

The manual poppet valve readjustment is now completed.

CAUTION: *Once an adjustable poppet screw and nut are in place and the manual readjustment procedures have been use d, the procedures must be repeated completely for additional adjustments for either increased or decreased gear travel at either axle stop to ensure that both poppets relieve pressure as required.*

NOTE: *Properly functioning poppet valves will also facilitate the bleeding of trapped air from the steering gear.*

Adjustments on Vehicle

Torque Chart

6.3 Torque Chart

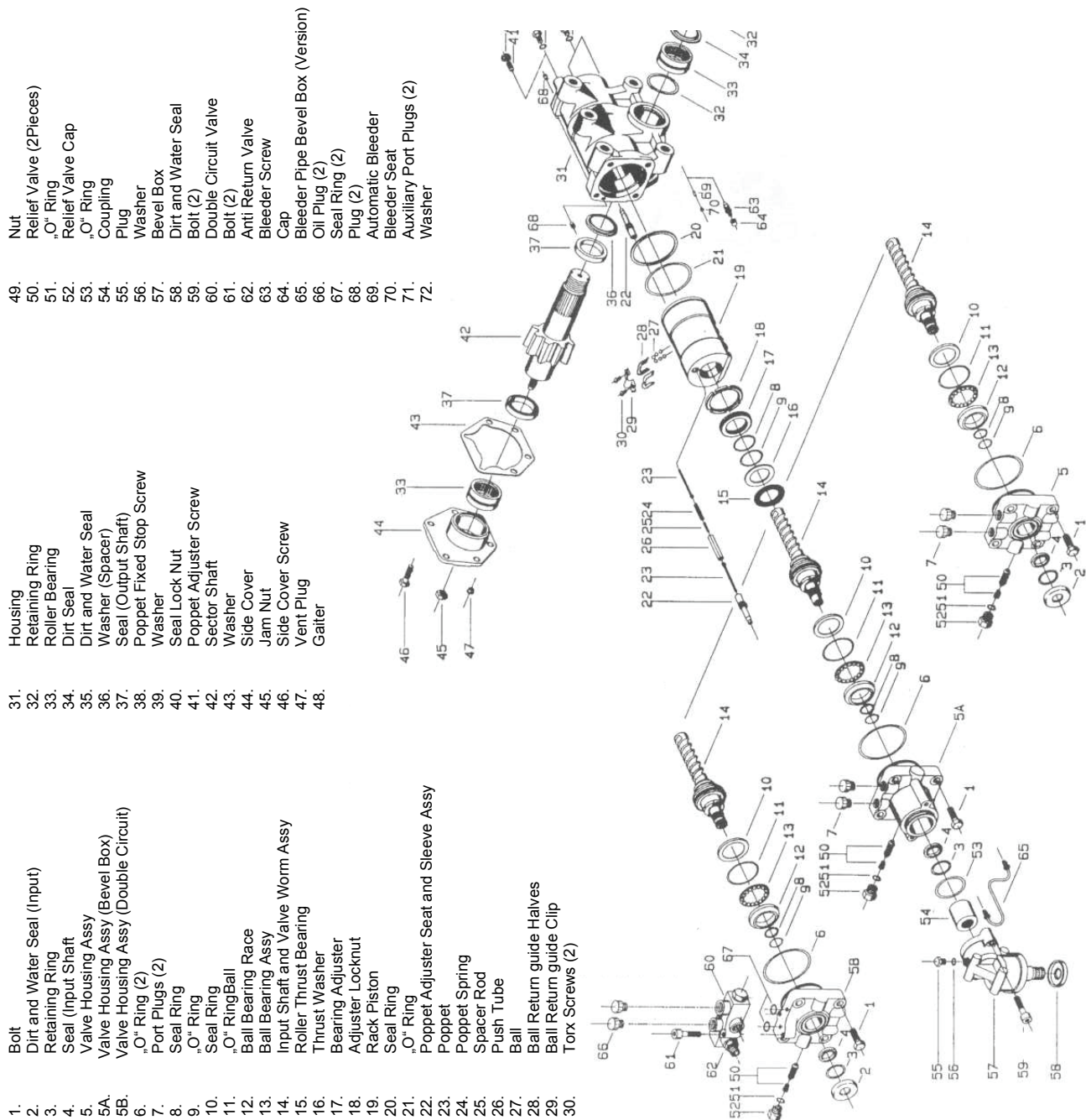
Part Name	Model	Torque Conditions	Item Number	Torque (Nm)
Poppet Fixed Stop Screw	-	Dry	38	75+/-10%
	-	Oiled		55+/-10%
Poppet Adj. Screw Seal Lock Nut	-	Dry	40	75+/-10%
	-	Oiled		55+/-10%
Relief Valve Cap	-	Oiled	52	30 - 60
Manual Bleeder Screw	-		63	15+/-10%
Auxiliary Cylinder Plug	-	Dry	71	75+/-10%
	-	Oiled		55+/-10%
Sector Shaft Adj. Screw Jam nut	-	Greased	45	47+/-4Nm
Bevel Box Filling Plug (if resent)	-	Dry	55	70+/-10%
Pitman Arm Nut	TAS 30	Dry	49	330+/-15%
	TAS 55	Dry	49	Minimum 500 Recom. 700+/-5%
	TAS 75	Dry	49	Minimum 500 Recom. 700+/-5%
	TAS 85/86/87	Dry	49	Minimum 500 Recom. 700+/-5%
	THP 60	Dry	49	Minimum 500 Recom. 700+/-5%
	THP 80/81/82	Dry	49	Minimum 500 Recom. 700+/-5%
	THP90/91/92	Dry	49	Minimum 500 Recom. 700+/-5%
Gear Mounting Bolt (10.9, phosphated)	TAS 30 – M18x1.5	Dry	-	500+/-5%
	TAS 30 – M20x1.5	Dry	-	600+/-5%
	TAS 55 – M18x1.5		-	500+/-5%
	TAS 55 – M20x1.5	Dry	-	600+/-5%
	TAS 75 – M18x1.5		-	500+/-5%
	TAS 75 – M20x1.	Dry	-	600+/-5%
	TAS 85/86/87 – M20x1.5		-	600+/-5%
	THP 60 – M20x1.5	Dry	-	600+/-5%
	THP 80 – M20x1.5	Dry	-	600+/-5%
	THP90 – M20x1.5	Dry	-	600+/-5%

Universal Joint Bolt: Torque to vehicle manufacturer's specification.

Torque values shown in the chart will be applied to general applications, different torques calculated by TRW for special applications are shown on „customer drawings“.

Adjustments on Vehicle Exploded View

6.4 Exploded View



Bevel Box: General Design and Operation

Design

7. Bevel Box: General Design and Operation

7.1 Design

This bevel box design is the most advanced technology of the TRW angular bevel box patents. The bevel box is a mechanism that permits functions coming from the entrance shaft of a steering gear at an angle of 90½ to the steering wheel column, thus permitting greater applications in the existing field of vehicles.

The bevel box is a compact package made up of a robust housing and incorporating the input shaft connected to the steering wheel column, and the output shaft which transmits the movement to the steering gear through the coupling.

All the mechanism is lubricated for life.



7.2 Operation

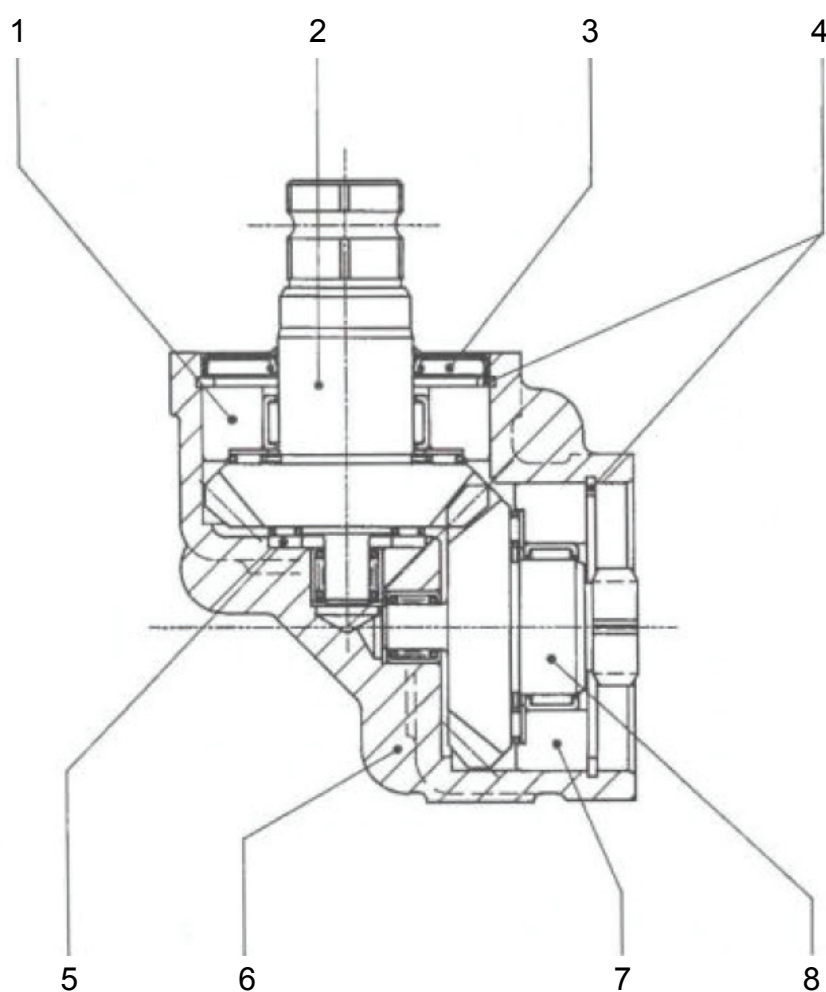
The input shaft receives the movement that is transmitted from the steering wheel. Transmission of the movement from the bevel box to the steering gear is made by a coupling of variable length, depending on the model of the gear.

Bevel Box: General Design and Operation Components

7.3 Components

7.3.1 First Design

The input shaft is supported by four bearings, two of them are thrust bearings and the others are radial, the whole assembly is adjusted for zero freeplay by means of an adjusting washer and two circlips.

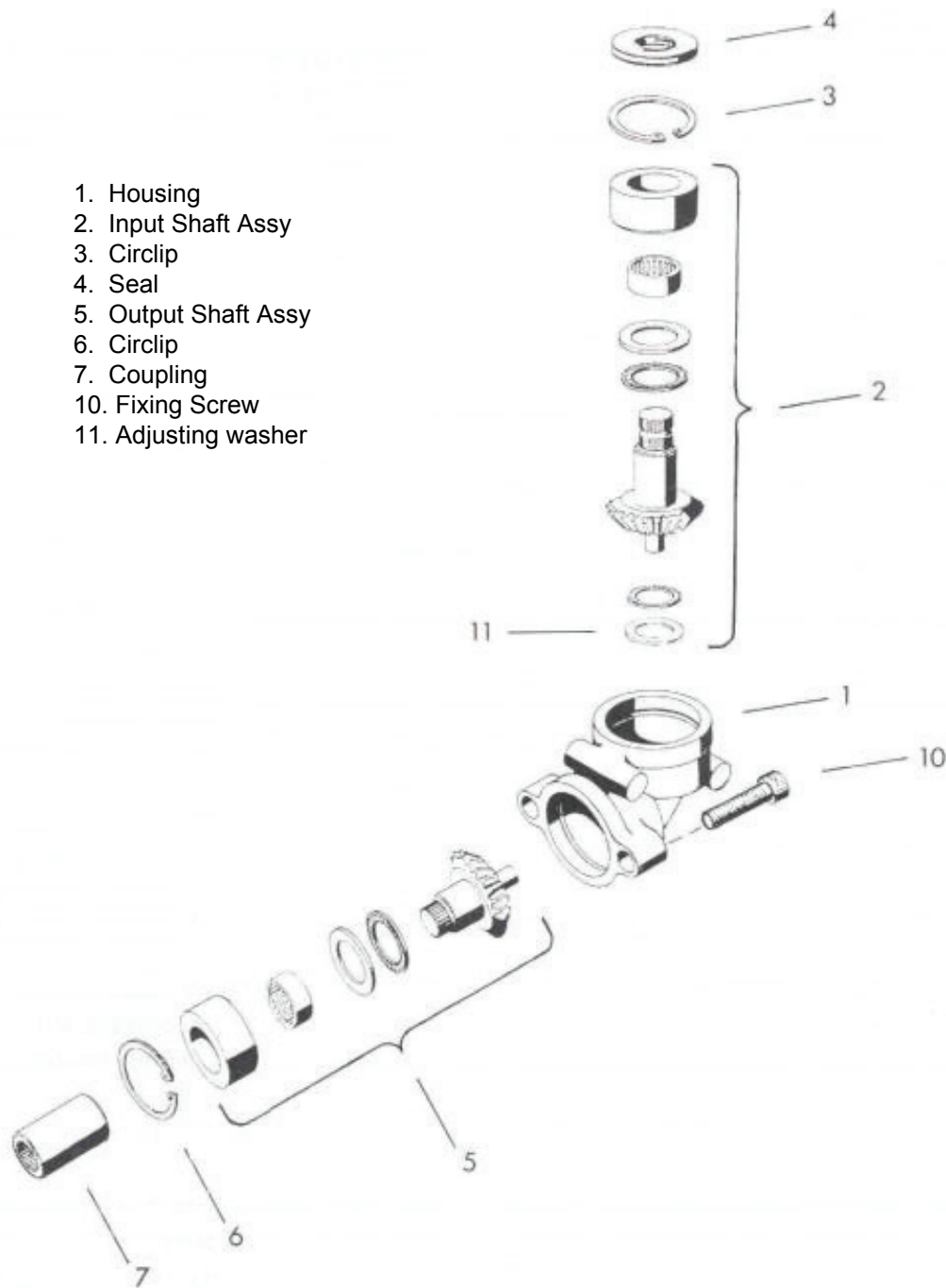


Current Components

2 Bearing Supports
3 Thrust Bearings
4 Needle Bearings
1 Shimming Washer
2 Thrust Washers
(12 components)

1. Ring Guide
2. Input Shaft
3. Seal
4. Circlip
5. Adjusting Washer
6. Housing
7. Ring Guide
8. Output Shaft

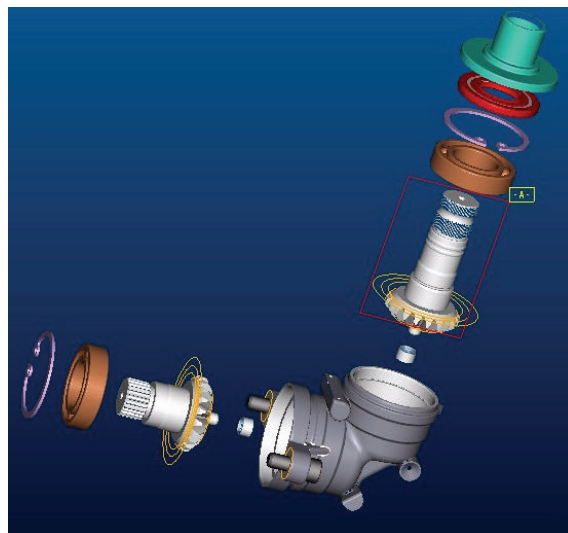
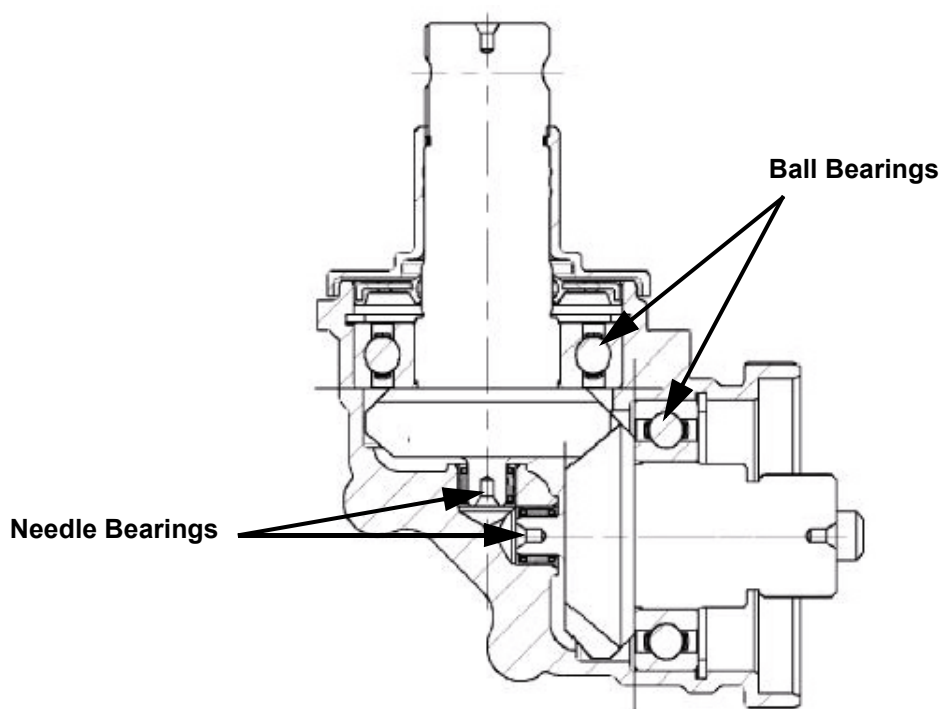
Bevel Box: General Design and Operation Components



Bevel Box: General Design and Operation Components

7.3.2 New design

The input shaft is supported by two bearings, one of them is ball bearing and the other is a needle bearing, the whole assembly is adjusted for zero freeplay by means of two circlips.



New Components

2 Ball Bearings
2 Needle Bearings
(4 components)

Hydraulic Fluid Components

8. Hydraulic Fluid

The steering system should be kept filled with one of the following fluids:

- AUTOMATIC TRANSMISSION FLUID TYPE "E" or "F"
- AUTOMATIC TRANSMISSION FLUID DEXRON 11
- CHEVRON TORQUE 5 FLUID
- CHEVRON CUSTOM 10W40 MOTOR OIL
- CHEVRON 10W40
- EXXON NUTO H32 HYDRAULIC FLUID
- FLEETRIDTE PSF (CAN # 990625 C2)
- FORD SPEC. M2C138 CJ
- MACK ED-K2 ENGINE OIL
- MOBIL ATF 210
- MOBIL SUPER 10W40 MOTOR OIL
- SHELL ROTBIA T SAE30
- SHELL ROTBIA T30W
- SHELL DONA>< TM
- SHELL DONA>< TF
- TEXACO 1QW40
- TEXACO TL-1833 POWER STEERING FLUID
- UNjaN 10W40
- UNION 15W40
- UNOCAL GUARDOL 15W40 MOTOR OIL

WARNING: COMPLETELY FLUSH THE STEERING SYSTEM WITH ONE OF THE RECOMMENDED FLUIDS ABOVE ONLY. DO NOT MIX OIL TYPES. ANY MIXTURE OR ANY UNAPPROVED OIL COULD LEAD TO SEAL DETERIORATION AND LEAKS. A LEAK COULD ULTIMATELY CAUSE THE LOSS OF FLUID, WHICH COULD RESULT IN A LOSS OF POWER STEERING ASSIST.

Filling and Bleeding Required Tools and Materials

9. Filling and Bleeding

9.1 Required Tools and Materials

Caution: For steps 1 and 2, do not turn the steering wheel. Otherwise, air may be induced into the system!

Make sure poppets are set correctly before beginning this procedure.

1. Fill the reservoir nearly full. Crank the engine for 10 seconds without allowing it to start, if possible. If the engine does start, shut it off immediately. Repeat at least three times, each time checking and refilling the reservoir if needed.

Do not allow the fluid level to drop significantly or run out of the reservoir. This may induce air into the system.

Run engine for 10 seconds, turn off and fill reservoir

2. Start the engine and let it idle for 2 minutes. Shut off the engine and check the fluid level in the reservoir. Refill as required.

Run engine for 2 minutes, turn off and fill reservoir

3. With the poppets correctly adjusted to relieve pressure at the end of the travel, start the engine again. Steer the vehicle from full left to full right several times. Add fluid, as necessary, to the full line on the dipstick. The above procedures should remove all the air from the steering system, unless the gear is mounted in an inverted position and is equipped with the manual bleed screw (63). Manual bleed systems continue with step 4.

Steer vehicle

4. Remove the air from the gear mounted in an inverted position and equipped with a manual bleed screw (63) by following steps 1, 2, and 3 above. Then, with the engine idling, steer the gear from left turn to right turn several times. With the steering gear in neutral (no steering action), loosen the manual bleed screw about one turn, allowing air aerated fluid to bleed out around the bleed screw until only clear (not aerated) fluid is bleeding out. Then close the bleed screw. Check and refill reservoir. Repeat step 3 to 4 times starting with the steering manoeuvre with bleed screw closed, until only clear (not aerated) fluid is discharged when bleed screw is loosened. Torque the manual bleed screw to 5-7 Nm. Check and refill reservoir.

Steer vehicle Allow air to bleed out from bleed screw

CAUTION: Do not turn steering wheel with bleed screw loosened as it could introduce air into the system.

WARNING: DO NOT LOOSEN OR REMOVE THE POPPET FIXED STOP SCREW(38), AND IF INCLUDED IN THE ASSEMBLY, DO NOT LOOSEN OR REMOVE THE AUTO-BLEED TUBE (65) OR AUXILIARY PORT PLUGS (71) WHEN THE STEERING GEAR IS MOUNTED ON THE VEHICLE. IF LOOSENED OR REMOVED, THERE MAY BE A LOSS OF POWER STEERING ASSIST IN ONE DIRECTION OF TURN.

Warnings

Warnings for Proper Steering Gear Operation

10. Warnings

10.1 Warnings for Proper Steering Gear Operation

WARNING: DO NOT WELD, BRAZE OR SOLDER ANY STEERING GEAR OR SYSTEM ARM COMPONENTS

WARNING: MAXIMUM OPERATING PRESSURE MUST NOT EXCEED THE PRESSURE RELIEF VALVE SETTING MARKED IN THE IDENTIFICATION LABEL OF THE STEERING GEAR

WARNING: ALWAYS CAREFULLY INSPECT ANY STEERING COMPONENT WHICH HAS BEEN (OR IS SUSPECTED TO HAVE BEEN) SUBJECTED TO IMPACT. REPLACE ANY DAMAGED OR QUESTIONABLE COMPONENT

10.2 WARNINGS FOR PROPER STEERING GEAR APPLICATION

WARNING: GEAR APPLICATION IN THE VEHICLE ACCORDING TO TRW STANDARD 31 877 003

WARNING: PERMISSIBLE THERMAL LOAD OF THE GEAR ACCORDING TO TRW STANDARD 31 877 002

Positioning Automatic Poppets after installing Steering Gear

Position Poppet to Axle Stop

11. Positioning Automatic Poppets after installing Steering Gear

CAUTION: *If the poppet adjuster seat and sleeve assemblies (22), were not set for automatic poppet adjustment after installation. When steering gear was disassembled and the unit has a fixed stop poppet screw (38) and washer (39), and if the axle stops were adjusted for decreased travel or if the steering gear is being installed in a different vehicle, it will be necessary to procure the special service poppet adjusting screw (41) and nut (40). You will then have to follow the "alternate method" of setting the poppets manually. (page 18)*

CAUTION: *The axle stops and all steering linkage must be in accordance with vehicle manufacturer's specifications. The pitman arm correctly aligned on the steering gear sector shaft or the poppets may be automatically set incorrectly and require disassembly of the steering gear or a service adjusting screw procedure to rectify.*

11.1 Position Poppet to Axle Stop

This procedure assumes that the steering gear automatic poppet adjuster seat and sleeve assemblies (22) are as pre-set at the factory or have been reset while disassembled for automatic poppet adjustment after installation in the vehicle. It also assumes the fixed stop screw (38) and washer (39) is in the housing or that fixed stop screw length (standard 30 mm) that protrudes into the housing has been duplicated with the poppet adjusting screw (41) and nut (40). With the engine at idle and the vehicle unloaded, turn the steering wheel toward full travel in one direction until the steering gear linkage firmly bottoms against the axle stops. Maximum input torque to be applied during this procedure is 55 Nm or 220 N rim pull on a 500 mm diameter steering wheel. This will automatically position the poppet adjuster seat and sleeve assembly in relation to the axle stop.

NOTE: *If excess input shaft torque or rim pull is encountered prior to reaching the axle stop, allow vehicle to roll forward or jack up the vehicle at the front axle.*

11.2 Position other Poppe

Follow the same procedure while turning the steering wheel in the other direction. The poppet valves are now positioned to trip and reduce pressure as the steered wheels approach the axle stops in either direction.

Steering System maintenance

Position other Poppe

12. Steering System maintenance

- Prevent internal bottoming of the steering gear. Carefully check axle stops to be sure that they meet the manufacturer's specifications.
- Regularly check the fluid and the fluid level in the power steering reservoir.
- Change the fluid in the steering system every two years.
- Keep tires inflated to correct pressure.
- Always use a puller, never a hammer or torch, to remove Pitman arms.
- Investigate and immediately correct the cause of any play, rattle, or shimmy in any part of the steering linkage or steering mechanism.
- Remove the cause of steering column misalignment.
- Encourage all drivers to report any malfunctions or accidents that could have damaged steering components.
- Do not attempt to weld any broken steering component. Replace the component with original equipment only.
- Do not cold straighten, hot straighten, or bend any steering system component.
- Always clean off around the reservoir filler cap before you remove it. Prevent dirt or other foreign matter from entering the hydraulic systems.
- Investigate and correct any external leaks, no matter how minor.
- Replace filters and pumps in compliance with specifications.
- If extended stationary use of vehicle is developing excessive hydraulic fluid temperatures, consult vehicle manufacturer for auxiliary cooling method.
- Maintain grease pack applied behind the input and output shaft's dirt and water seal and seal protector as a general maintenance procedure.