



700 SERIES GRADER

Series III

Service Training Manual

Serial Number 21911 to 24735

700 SERIES GRADER

Series III

Service Training Manual

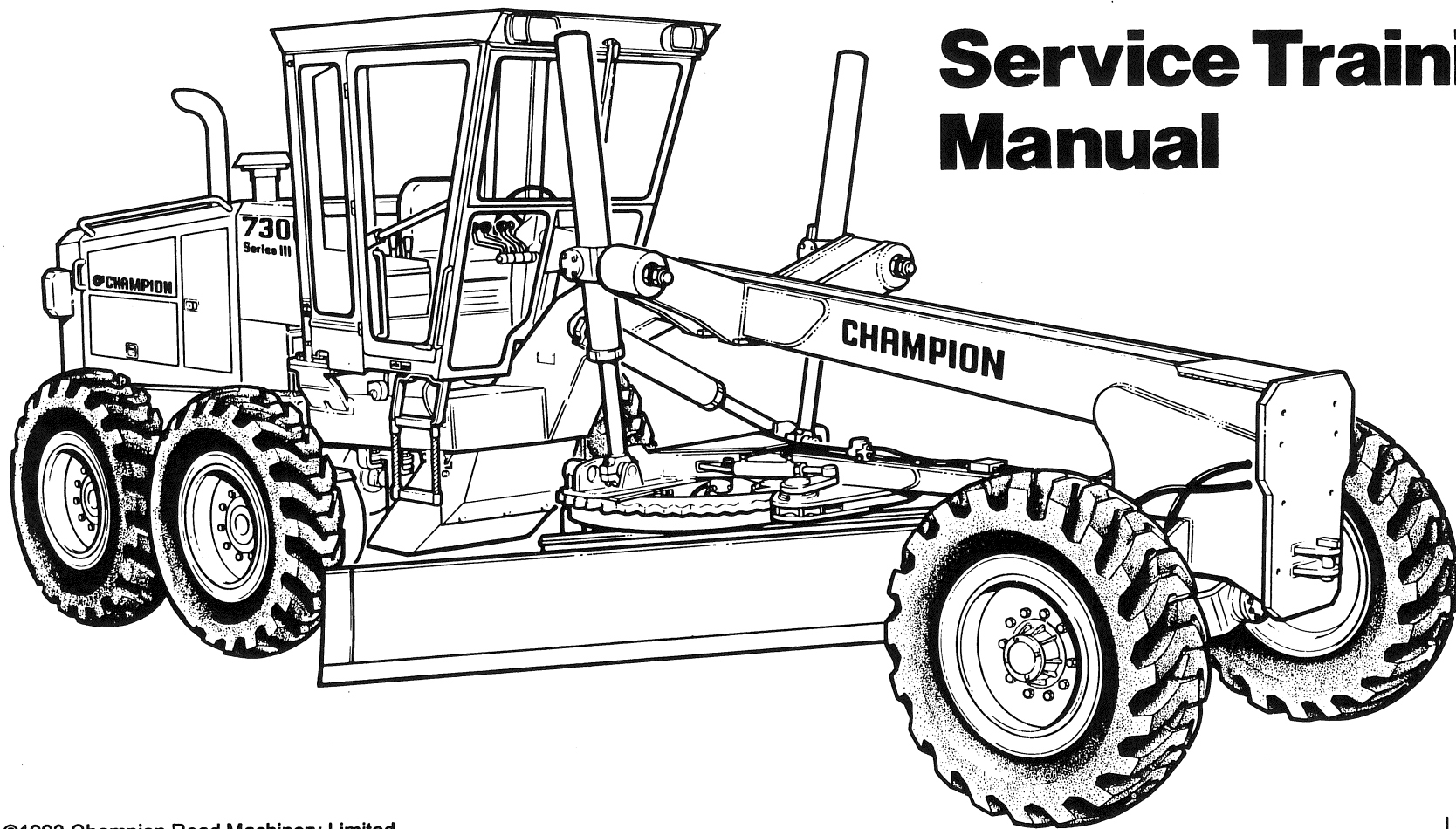


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The following abbreviations are used in this manual:

R.H. - Right-hand
L.H. - Left-hand
rpm - Revolutions per minute
psi - Pounds per square inch
gpm - Gallons per minute
MPLS - Moveable Point Blade Lift System

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700 SERIES GRADER**SERIES III****Service Training Manual**

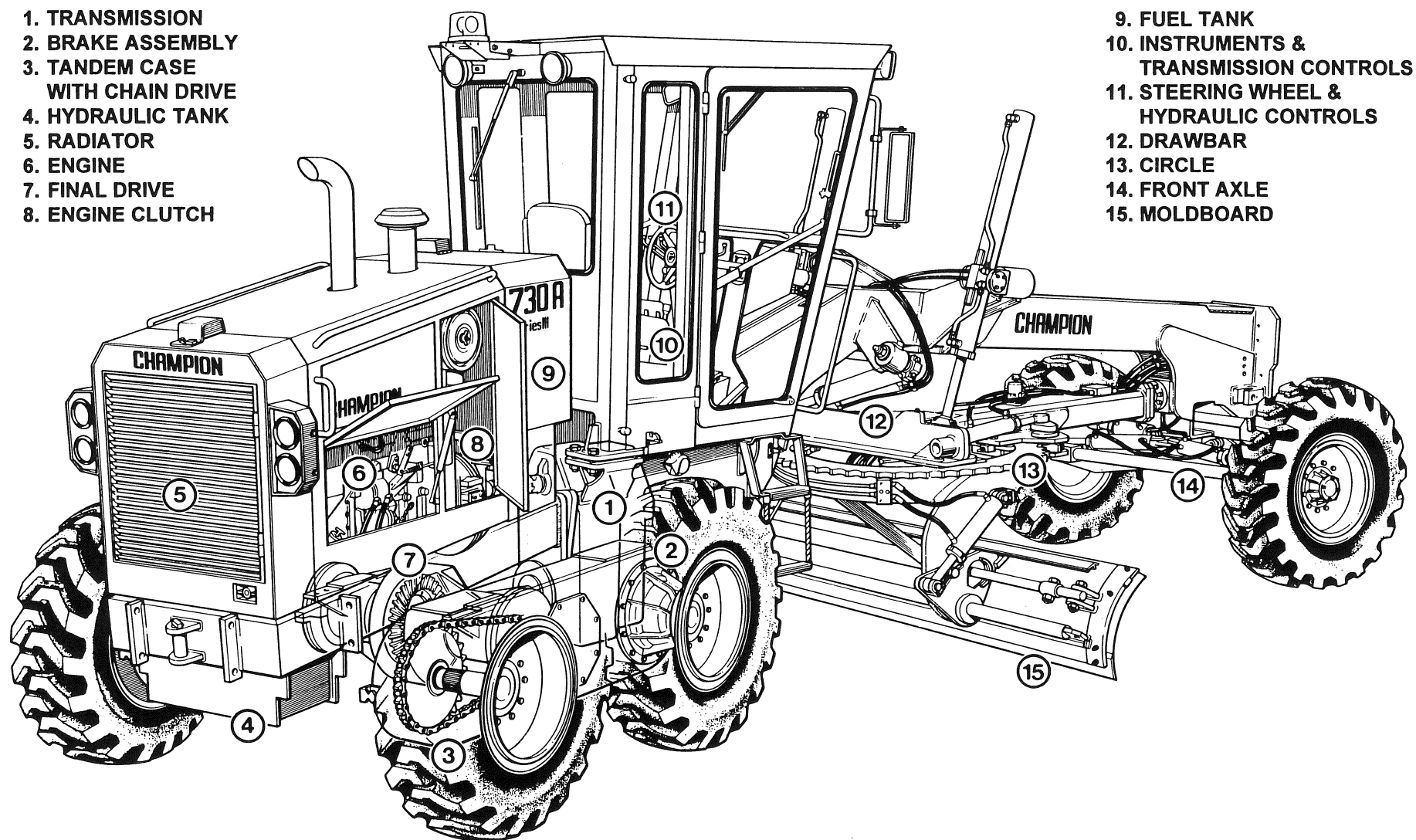
This Service Training Manual has been prepared only to assist you in understanding the basic theory and relationship of the systems on the Champion Series III motor grader.

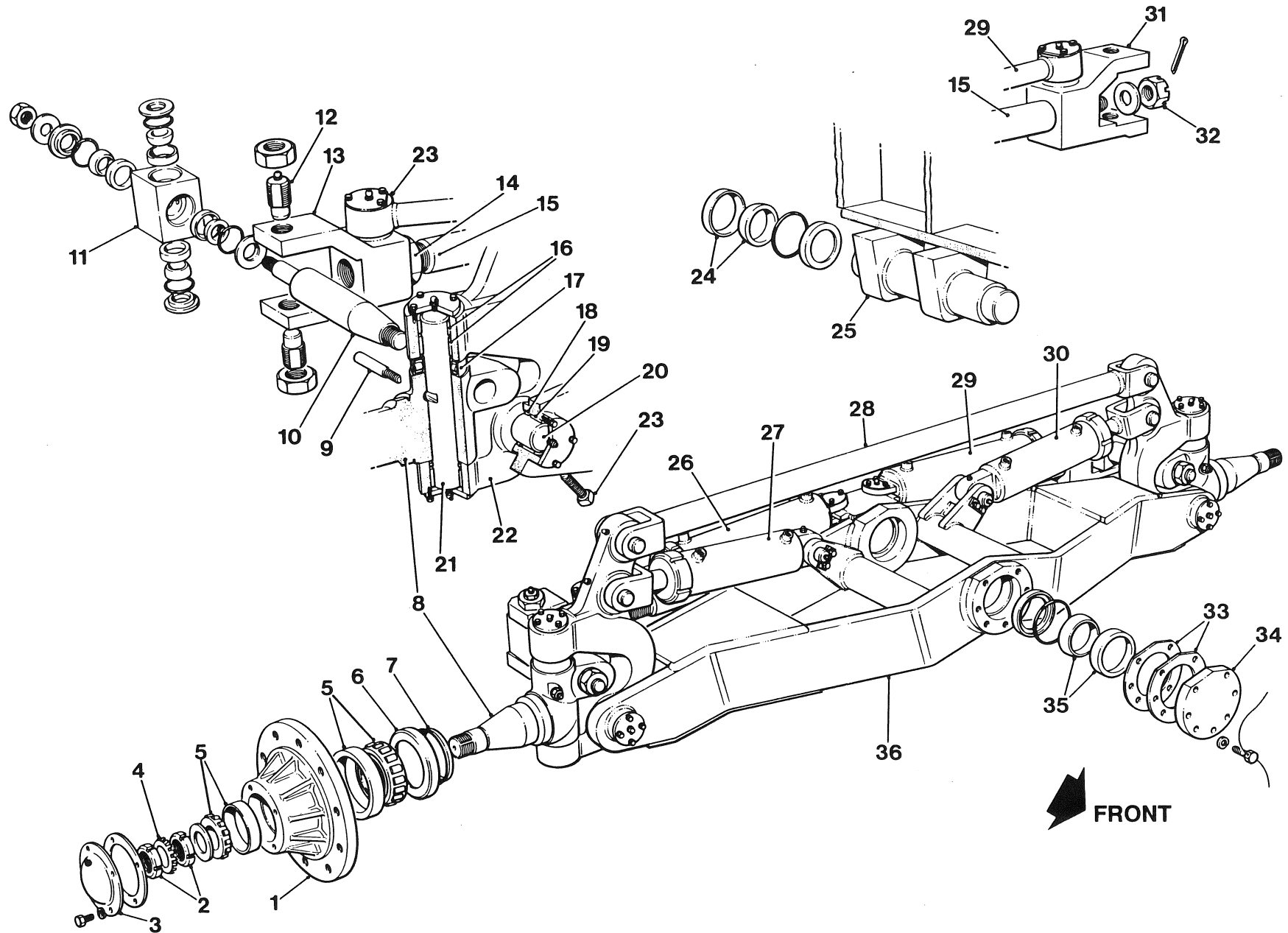
Refer to the Shop Manual for safety warnings, specifications, special tools and service procedures. Always read and understand the safety warnings and operating precautions found in the grader Operator's Manual before attempting to operate any motor grader.

This manual generally applies to **Series III** motor graders **S/N 21911 and up**. However, most principles presented apply to earlier machines also.

The information in this manual is correct at time of publication. Your grader may be equipped with options not illustrated. Champion reserves the right to make product improvements without notice.

MAJOR COMPONENTS IDENTIFICATION ILLUSTRATION





LEGEND

- | | |
|-------------------------------|---|
| 1. Wheel Hub | 21. King Pin |
| 2. Spindle Nuts | 22. R.H. Knuckle |
| 3. Hub Cap | 23. Knuckle Pin Lock |
| 4. Tab Washer | 24. Rear Pivot Pin Bushing |
| 5. Wheel Bearings | 25. Axle Pivot Pin (Frame) |
| 6. Back-up Ring | 26. R.H. Steering
Cylinder Assembly |
| 7. V-Ring Seal | 27. R.H. Leaning Wheel
Cylinder Assembly * |
| 8. Spindle | 28. Leaning Wheel Tie-Bar |
| 9. Key Pin | 29. L.H. Steering
Cylinder Assembly |
| 10. Radius Arm | 30. L.H. Leaning Wheel
Cylinder Assembly |
| 11. Pivot Block Assembly | 31. L.H. Steering Yoke |
| 12. Adjustment Pin | 32. Castellated Retaining Nut |
| 13. R.H. Steering Yoke | 33. Pivot Adjustment Shims |
| 14. Lock Nut | 34. Front Bushing Cap |
| 15. Steering Drag Link | 35. Front Pivot Pin Bushing |
| 16. King Pin Needle Bearings | 36. Axle Frame |
| 17. Thrust Bearing | |
| 18. Dust Seal | |
| 19. Knuckle Pivot Pin Bearing | |
| 20. Knuckle Pivot Pin | |

* *Optional on some models.*

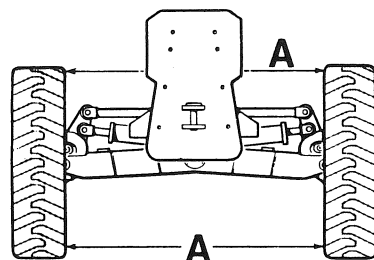
The front axle of a motor grader must perform several functions: **steering**, **oscillation** and **front wheel lean**. It must also have the ability to carry heavy front mounted attachments. The Champion front axle is designed to provide long life with minimum maintenance.

The front wheel is supported by two tapered roller bearings. The tightness of the spindle nuts determines front wheel preload. After adjustment, tab washers prevent the spindle nuts from turning. A self-relieving V-Ring grease seal prevents over greasing of the bearing cavity.

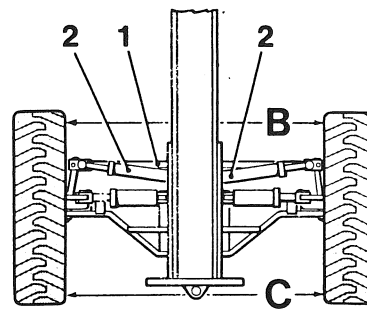
Two hydraulic cylinders pivot the spindles on their king pins to accomplish steering. The drag link makes both sides turn together. Toe-in is adjusted by loosening the lock nut on the right-hand yoke and turning the drag link. See page 9 for details. Front wheel lean is accomplished by pivoting the knuckle/spindle assemblies on the knuckle pivot pins. The tie bar makes both wheels lean together. The king pin and the knuckle pivot pin are uniform in diameter. Both are supported by needle bearings. Thrust loads, including weight of attachments are transmitted between the knuckle and spindle by a sealed thrust roller bearing. The pivot block assembly acts like a universal joint, allowing movement in two directions at the same time; wheel lean and steering. The design of the pivot block permits easy adjustment without removal or replacement of parts.

The axle pivot uses angular contact bushings placed under a slight preload which is shim adjustable. This design permits axle oscillation over uneven ground or in ditch cutting applications. Axle pivot preload is increased by removing shims.

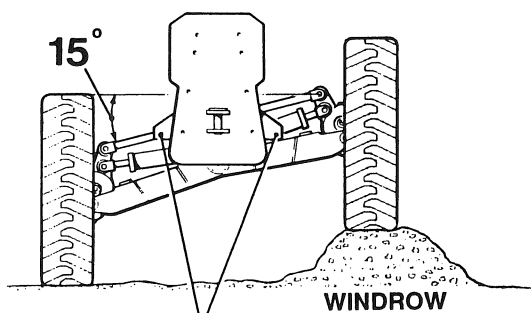
Under most applications, the front axle requires greasing only once a week. Champion recommends the front wheels be lifted off the ground at every fourth greasing. Place a suitable safety stand under the nose plate before greasing. Always increase the greasing intervals if operating in extremely dusty or wet applications or if the joints are dry.



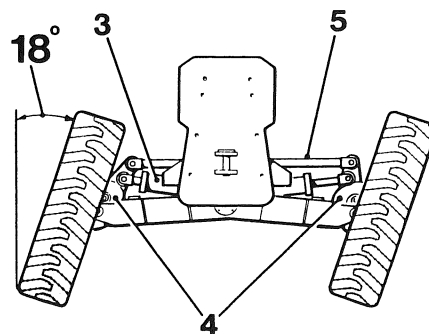
CAMBER



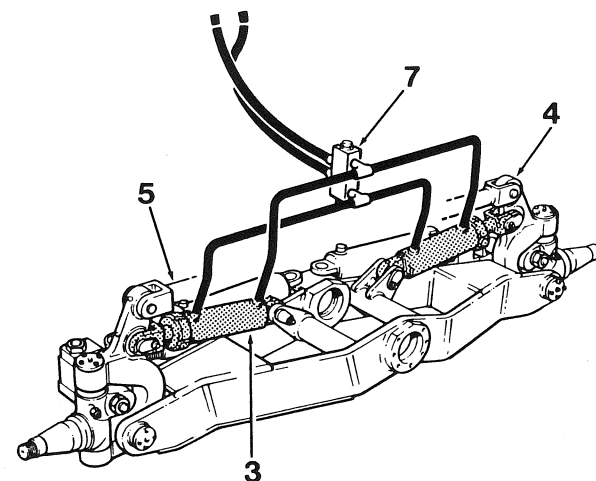
TOE-IN



OSCILLATION



WHEEL LEAN



LEGEND

- | | |
|----------------------------|---------------------|
| 1. Drag Link | 5. Tie-bar |
| 2. Steering Cylinders | 6. Axle Pivot Stops |
| 3. Leaning Wheel Cylinders | 7. Lock Valve |
| 4. Knuckles | |
-

The front axle is designed around three basic functions:

1. Oscillation of the front axle assembly under the grader main frame allows the wheels to travel over uneven ground with little movement of the main frame. It also allows one wheel to ride a windrow as shown. The blade will move or spread the windrow while the grader stays level because the driving wheels are on the graded surface. Axle stops limit oscillation to 15° each side of centre.
2. The Leaning Wheel function allows the wheels to lean 18° right or left of centre to brace against side draft imposed by the moldboard. It gives better stability while grading on slopes by allowing the operator to keep the wheels vertical. It also gives better cornering ability by reducing the turning radius. Depending on the model, one or two hydraulic cylinders lean the wheels. A lock valve eliminates hydraulic cylinder drift to maintain wheel position. Too much wheel lean will stress the tires' side wall. A tie-bar keeps both wheels parallel.
3. The third function is Steering. It is directly affected by the other two. Steering is accomplished through two steering cylinders and a drag link that turns the two wheels together.

Caster and 1° positive camber are built into the front axle assembly. They cannot be adjusted as indicated by dimension **A**.

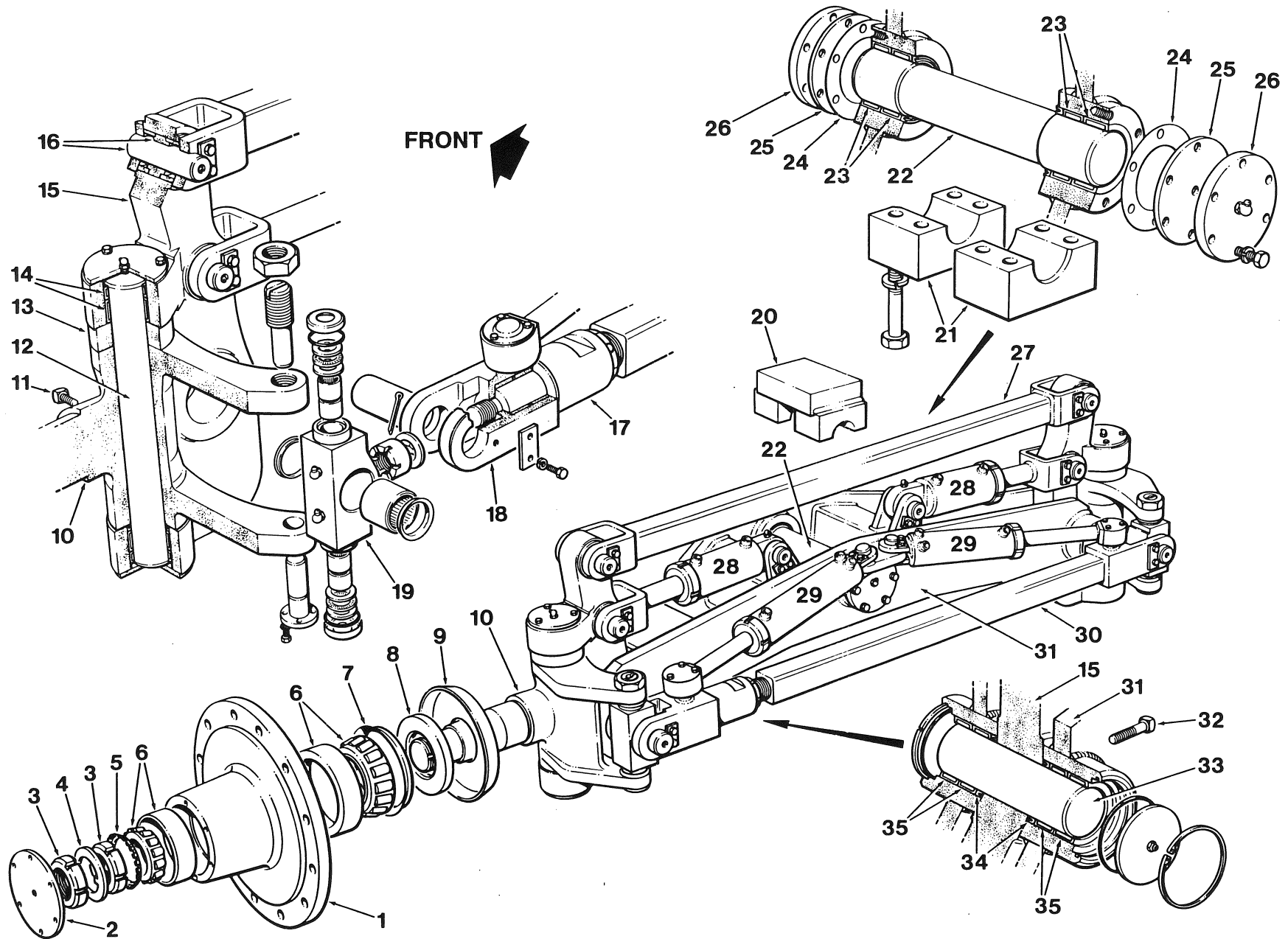
Toe-in means the toe or front of the wheels are closer together than the rear. On Champion graders, dimension **B** is 1/2" - 5/8" larger than dimension **C**, (except on All Wheel Drive models where 0 toe-in is specified). A tires' natural tendency is to pivot on the king pin or toe-out as it rolls forward. By having the front of the wheels closer together, toe-out is counteracted, allowing the wheels to run true.

To set toe-in:

1. With the wheels straight, move the grader ahead on smooth ground two complete tire revolutions. This removes any side wall flex.
2. Place the grader in the service position. Mark an **X** on each tires' inside side wall parallel with the spindle at the tires' front. Measure the distance **C**, between the two tires at the **X** marks.
3. Move the grader ahead half a tire revolution, until the **X** marks are parallel with the spindle at the rear of the tire. Measure this distance, **B**.
4. Subtract the **C** measurement from the **B** measurement. If the result is not within specification, adjust the toe-in by:
 - A) Increase the length of the drag link to increase toe-in.
 - B) Decrease the length of the drag link to decrease toe-in.

After making an adjustment, secure the drag link lock nut and repeat the first three steps.

Tires - Generally front tires on a motor grader are mounted with the tread facing the opposite of the rear drive tires. This allows the front tires to clean themselves, providing better traction to any side thrust. All Wheel Drive model graders are the exception. The front tires are also drive tires and must have the tire tread facing the same direction as the rear tires.



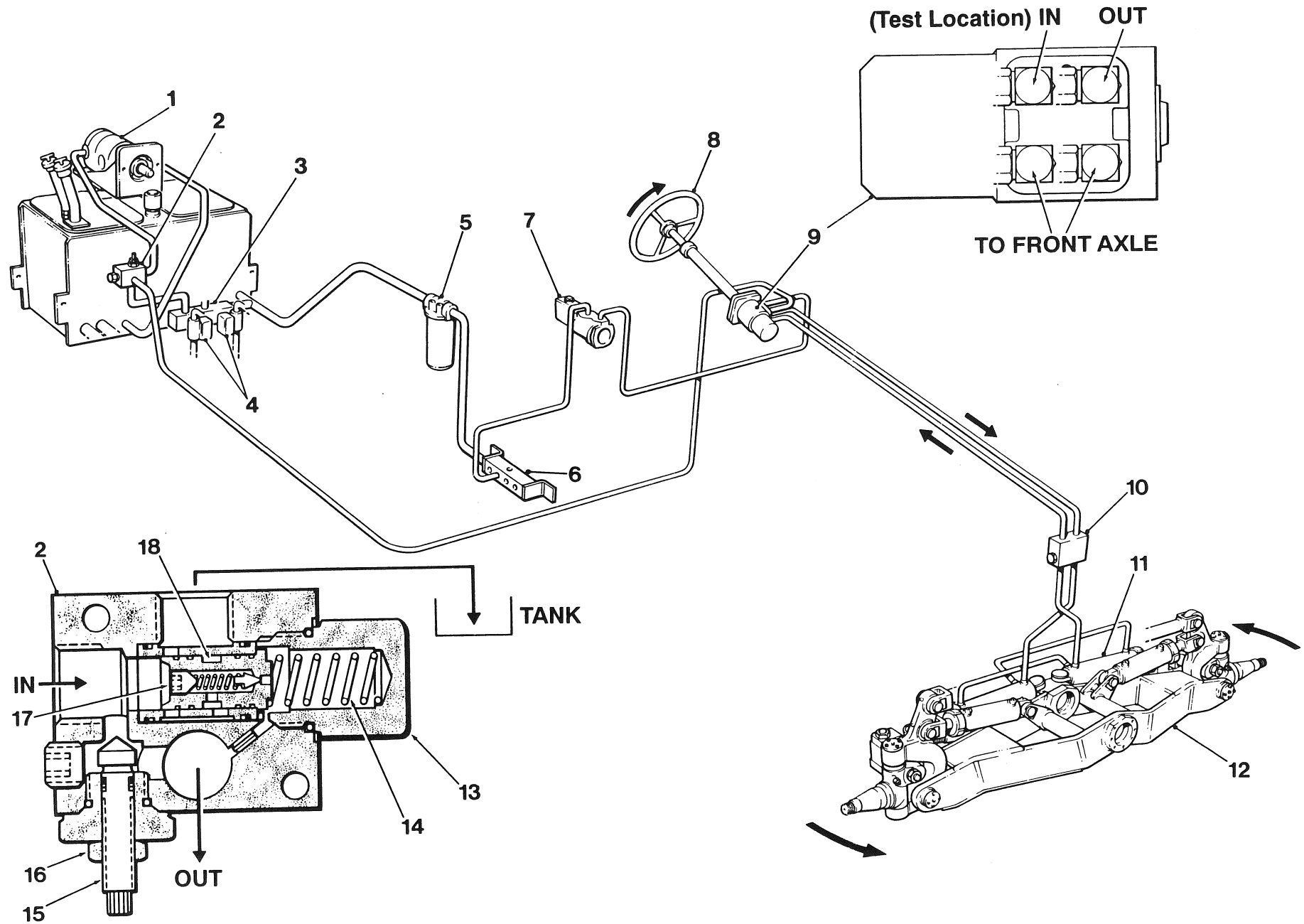
LEGEND

- | | |
|--------------------------------|--------------------------------|
| 1. Wheel Hub | 19. Pivot Block Assembly |
| 2. Hub Cap | 20. Mounting Block - Frame |
| 3. Spindle Nuts | 21. Mounting Block - |
| 4. Tab Washer | Matched Halves |
| 5. Lock Washer | 22. Pivot Pin |
| 6. Wheel Bearings | 23. Axle Pivot Needle Bearings |
| 7. V Ring Seal | 24. Shims |
| 8. Spacer | 25. Thrust Washer |
| 9. Dust Shield | 26. End Cap |
| 10. Spindle | 27. Leaning Wheel Tie-bar |
| 11. Lock Screw | 28. Leaning Wheel Cylinders |
| 12. King Pin | 29. Steering Cylinders |
| 13. Thrust Bearing | 30. Drag Link |
| 14. King Pin Bearing | 31. Axle Frame |
| 15. R.H. Knuckle | 32. Lock Screw |
| 16. Pin and Bearing | 33. Knuckle Pivot Pin |
| 17. Adjustment Collar - Toe-in | 34. Dust Seals |
| 18. R.H. Steering Yoke | 35. Knuckle Pivot Bearings |
-

Models 780/780A front axle performs all the functions that the standard front axle does. The fundamental difference between models 780/780A front axle and other 700 Series grader axles is size. This axle is larger and more heavily constructed to withstand the higher stress exerted in 780/780A applications. This axle has a wider stance (or track width) between the front tires to allow full axle mobility with 20.5 x 25 tires. The axle pivot, king and knuckle pins are all supported by double row needle roller bearings. End thrust on the axle pivot pin is measured on the thrust washer. It is limited to .003" - .005" and shim adjustable.

Under most applications the front axle requires greasing only once a week. Champion recommends the front wheels be lifted off the ground at every fourth greasing. Place a suitable safety stand under the nose plate before greasing. Always increase the greasing intervals in extremely dusty or wet conditions or if the joints are dry.

Refer to the Shop Manual for specifications.



LEGEND

- | | |
|---|--|
| 1. Transmission/Steering Pump | 9. Steering Valve - Open Centre |
| 2. Priority Flow/Relief Valve Assembly | 10. Cushion Valve |
| 3. Manifold Return Block (Reference only) | 11. L.H. Steering Cylinder |
| 4. Main System Relief Valves (Reference only) | 12. Axle |
| 5. Return Line Filter | 13. Spring Cap |
| 6. Return Collector Manifold | 14. Balance Spring |
| 7. Clutch Master Cylinder Booster Assembly | 15. Flow Adjustor |
| 8. Steering Wheel | 16. Lock Nut |
| | 17. Pressure Regulation Adjustment Set Screw |
| | 18. Pressure Regulation Spool Assembly |
-

The transmission/steering pump is a two section gear pump driven from the engine crankshaft. Each section is sealed from the other. The steering pump draws oil directly from the hydraulic tank. It has an output displacement of approximately 22 U.S. gpm @2100 rpm. Since displacement of a gear pump is directly proportional to its speed, Champion uses a priority flow valve to maintain consistent steering response throughout the entire engine operating range. With engine speed between low idle and approximately 1300 rpm, 100% of the flow is directed to the steering valve. At engine speeds above this, the first 12 U.S. gpm is directed to the steering valve, the remainder returns to the tank.

If the operator is not turning the steering wheel, hydraulic oil circulates through the valve and enters the clutch booster to provide clutch pedal hydraulic assistance. After flowing through the booster, the steering oil joins the main hydraulic oil at the return collector manifold, continues through the filter and returns to the tank.

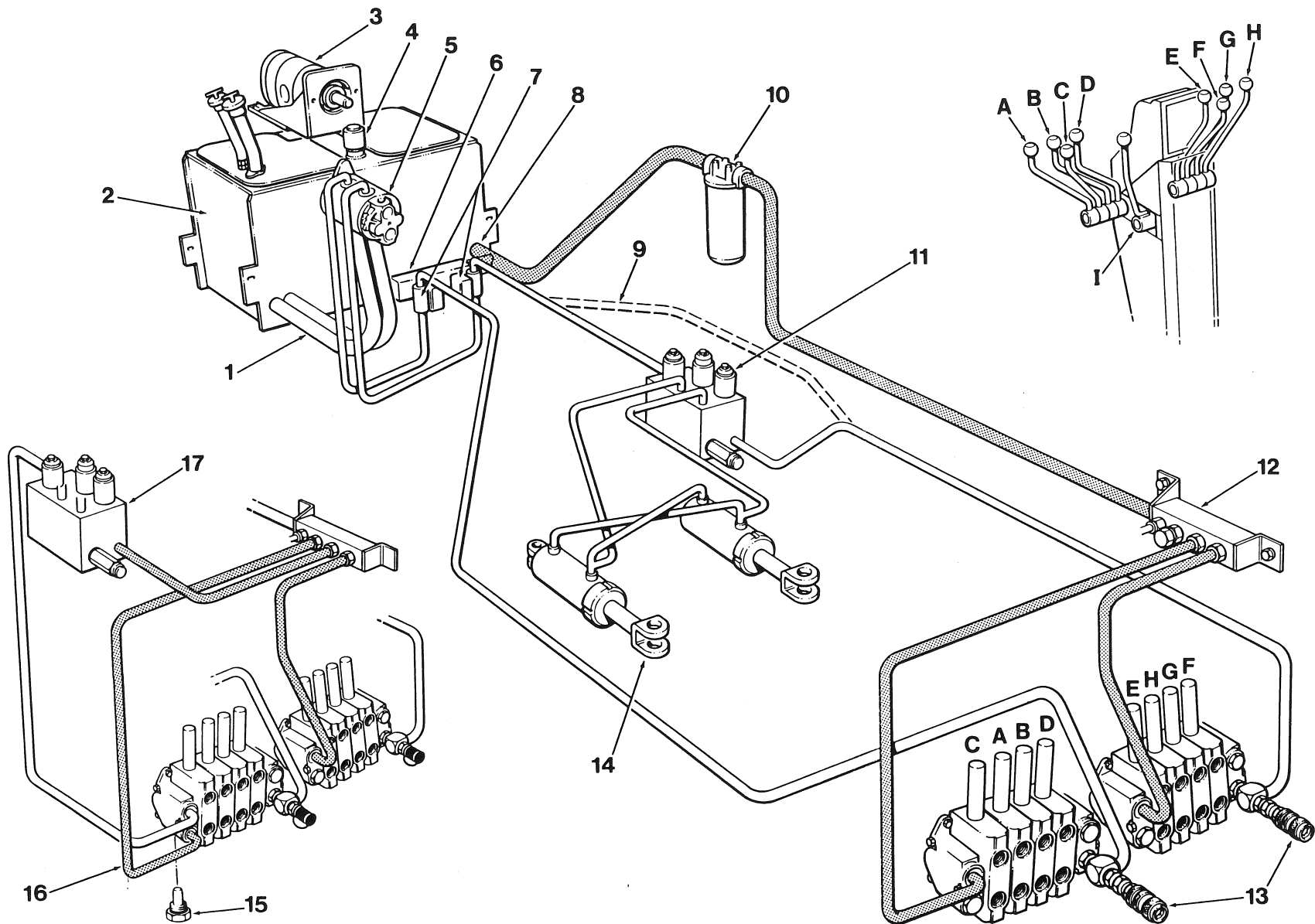
When the operator turns the steering wheel to the left for example, oil is directed to the front axle as shown. The right hand steering cylinder extends and the left hand cylinder retracts, causing the grader to steer to the left. Return oil flow from the cylinders passes back through the steering valve and supplies the clutch booster, finally returning to tank. If the steering wheel is turned to the right the process is reversed.

The cushion valve has two important functions in the steering system: See page 19 for more details.

The system is protected by a relief valve (set at 2200 ± 100 psi @2100 rpm) incorporated into the priority flow valve. Under normal operating conditions the relief valve does not open.

The relief valve setting, as well as the left-hand and right-hand cushion valve settings can be checked by installing a pressure gauge on the quick coupler located on the inlet hose.

**Refer to the Shop Manual
for detailed instructions and Specifications**



LEGEND

- | | |
|--|-------------------------------|
| 1. Dual Suction Lines | 11. Articulation Valve |
| 2. Hydraulic Tank | 12. Return Collector Manifold |
| 3. Transmission/Steering Pump (Reference only) | 13. Quick Coupler Test Ports |
| 4. Breather | 14. Articulation Cylinders |
| 5. Main Hydraulic Pump | |
| 6. Relief Valve Manifold Block | VIEW 'A' |
| 7. Relief Valve | Front Mounted |
| 8. Tank Return | Attachment Circuit |
| 9. Rigid Frame Bypass | 15. Power Beyond Plug |
| 10. Return Line Filter | 16. Drain Line |
| | 17. Attachment Valve |

Champion motor graders use two main hydraulic systems. This twin flow hydraulic system uses separate gear pumps, relief valves and open centre manifold control valves for each side. Both main hydraulic pumps are contained in a single housing mounted to the engine's accessory drive. Each section has its own suction line and is protected by a separate relief valve set at 2100 ± 100 psi @ 2100 rpm. Oil enters each separate manifold on the left side and exits from the right where it joins the return from the steering system at the return collector manifold, continues through the filter and returns back to the tank.

Levers to the **left** of the steering wheel, control the **left-hand** manifold valve and levers to the **right** of the steering wheel control the **right-hand** manifold.

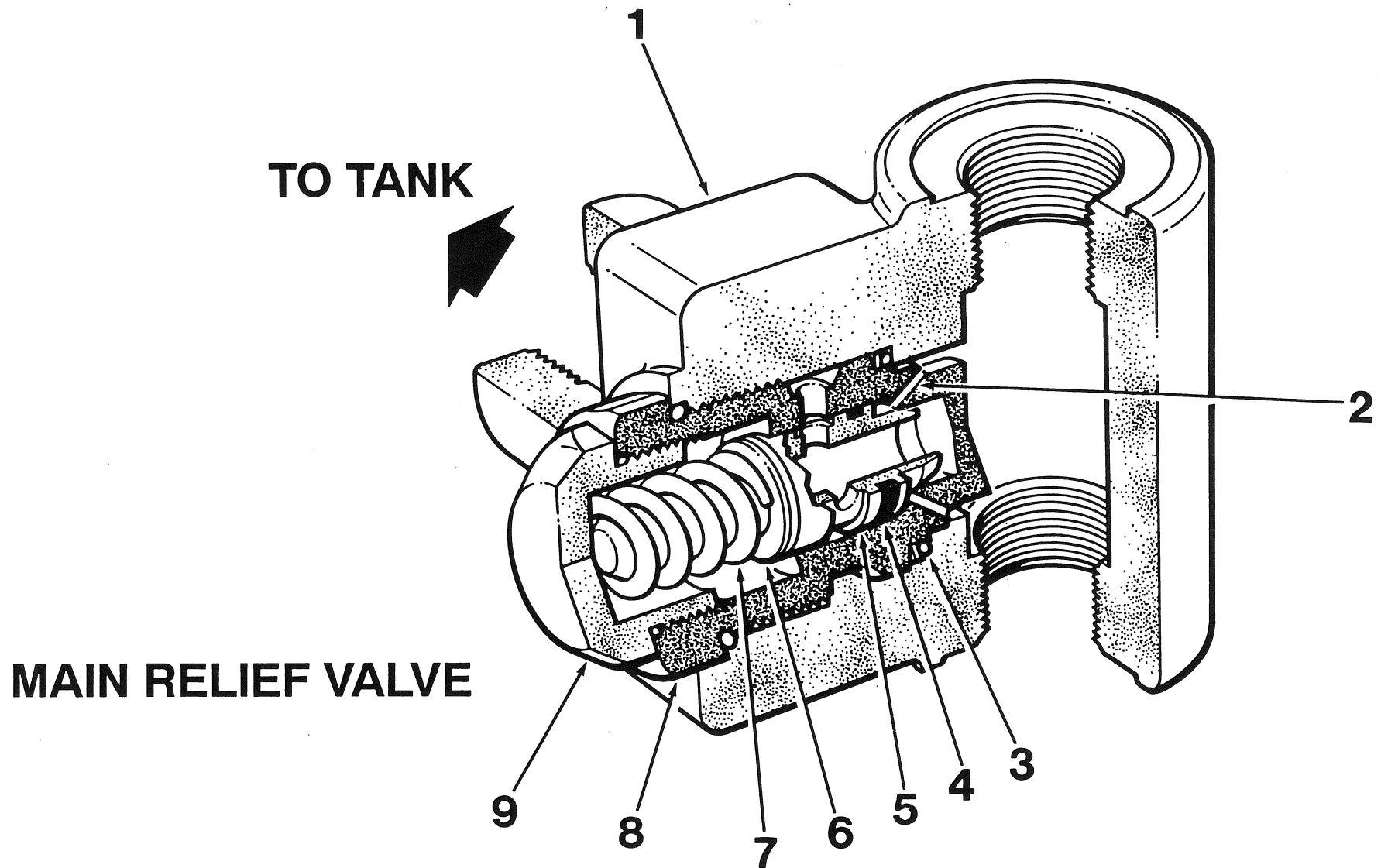
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|--|----------------------------------|
| A - R.H. Blade Lift | E - Circle Turn |
| B - Front Wheel Lean | F - Moldboard Tilt |
| C - Scarifier, Front Mounted Plow | G - Moldboard Slide Shift |
| D - Circle Shift | H - L.H. Blade Lift Lever |
| I - MPLS Lock Cylinder | |

Each manifold is equipped with a quick coupler test port on the inlet. By bottoming out a cylinder, relief valve pressure setting can be obtained. Champion recommends taking pressure readings only at these specified test points.

Articulated graders use a double acting solenoid valve located in the **left-hand** hydraulic system to control frame articulation. All articulated graders use two diagonally powered cylinders, providing even articulation speed left or right of centre.

Special consideration must be given when connecting additional solenoid valves to the manifolds for snow wings or dozer blades. A power beyond plug must be installed as shown. An additional drain line is used to vent controlled internal spool leakage back to the tank to prevent internal pressure build up in the manifold control valve.

Refer to the Shop Manual for specifications.



LEGEND

Main Relief Valve

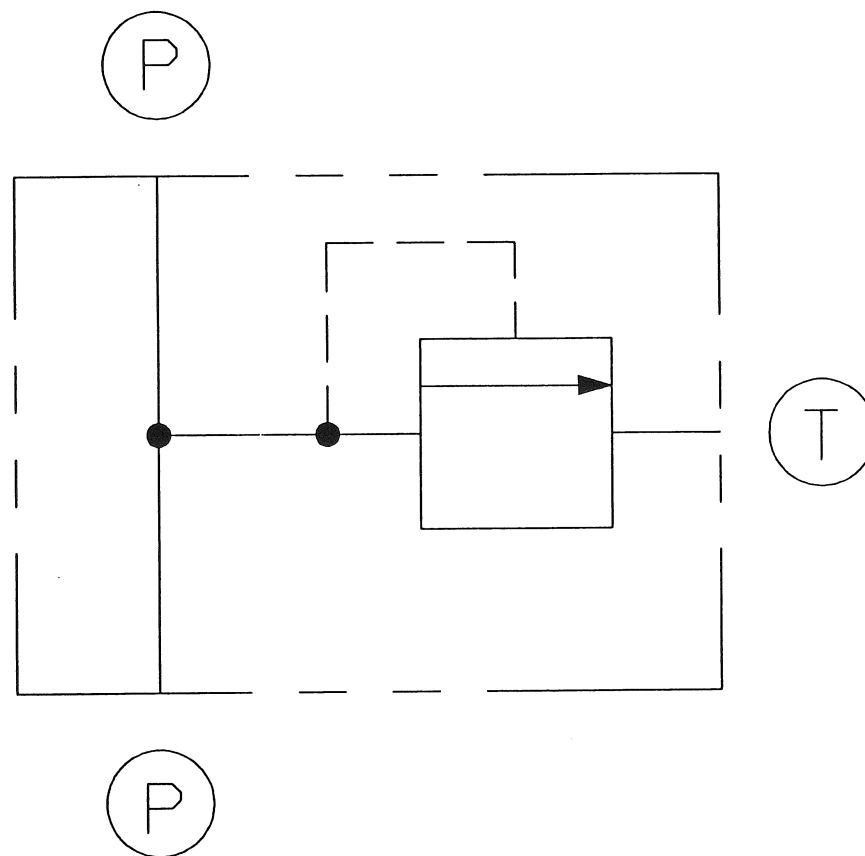
- | | |
|------------------------------|--------------------|
| 1. Valve Body | 5. Poppet |
| 2. Valve Seat | 6. Shims |
| 3. O-Ring and Back-up Washer | 7. Spring |
| 4. Poppet Seal | 8. Valve Cartridge |
| | 9. End Cap |

Relief valves limit the pressure in a hydraulic system to protect system components from damage. The two main hydraulic relief valves are identical and are mounted to the return manifold block on the front of the hydraulic tank. Oil leaving the pump flows straight through the valve under most operating conditions. When pressure exceeds the relief valve setting of 2100 ± 100 psi (e.g. when a cylinder is bottomed out), the valve poppet moves off its seat, and opens a passage directly into the hydraulic tank.

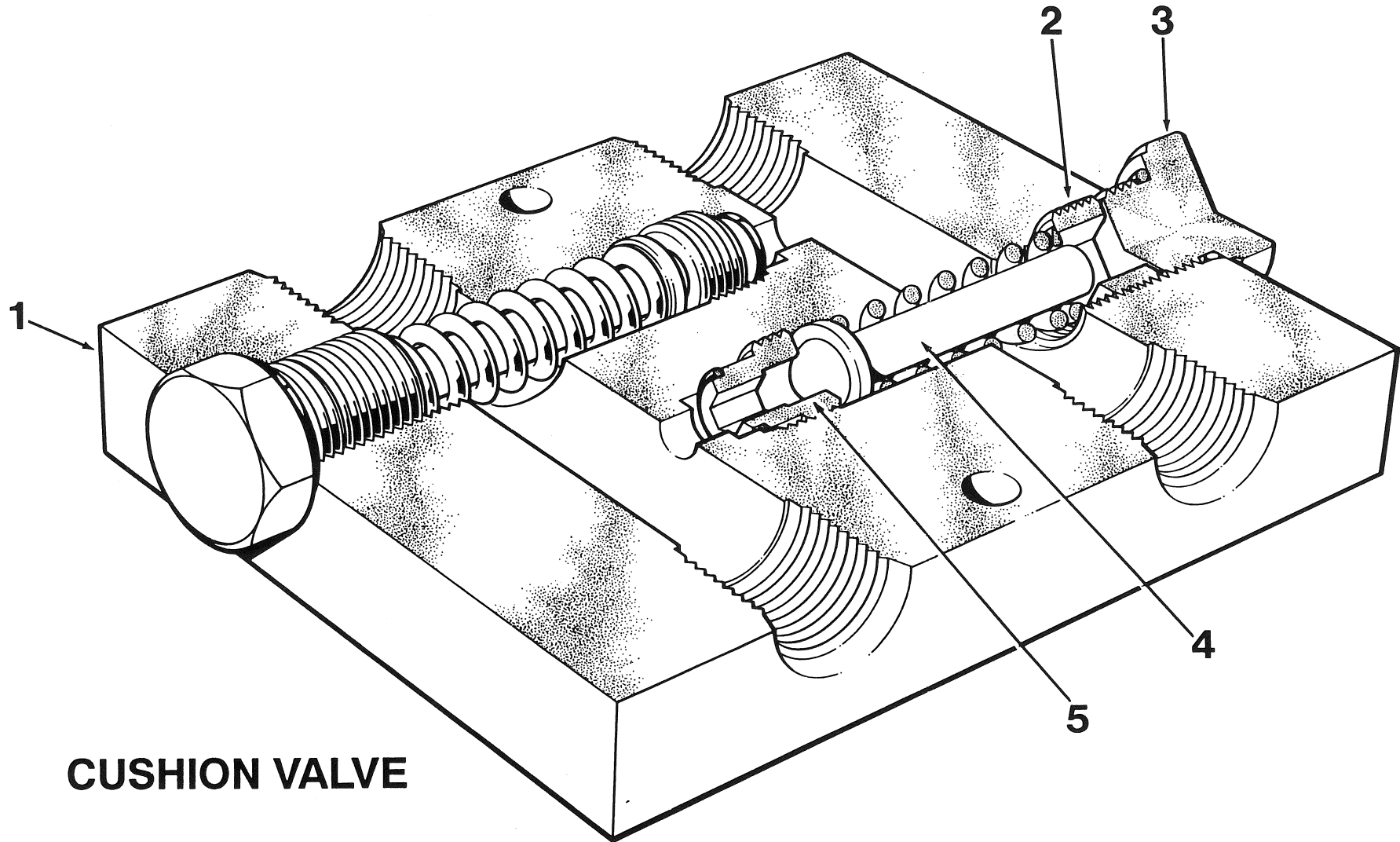
To check relief valve operation:

- A) Install a 0-3000 psi gauge into one of the quick coupler test ports located on the inlets to the manifold valves.
- B) When it is safe to do so start the engine and fully retract the blade lift cylinder on the same side as the gauge installation. Hold the blade lift lever in the retracted position. Read the gauge with the engine at 2100 rpm.
- C) Add shims to raise, or remove shims to lower the relief valve setting. The shims are between the spring and poppet. Never add shims between the spring and end cap as the poppet travel could be restricted resulting in a reduced flow rating of the valve and higher system pressures.
- D) Always retest the relief valve setting.

Repeat Steps A) through D) for the other side of the twin flow hydraulic system and its relief valve.



ISO Schematic - Relief Valve



CUSHION VALVE

LEGEND

Cushion Valve

- | | |
|---------------------|----------------|
| 1. Body | 4. Poppet |
| 2. Adjustment Screw | 5. Poppet Seat |
| 3. O-Ring Cap | |

Cushion Valves are found in the steering and circle turn circuits. This valve, commonly known as a crossover relief valve, is actually two relief valves in one body. It protects both sides of a circuit from high pressure spikes created by shock loads. Under these conditions, a small amount of oil vents across the valve to the opposite low pressure side. During normal operation, oil flows straight through the valve and the poppets remain seated.

STEERING CIRCUIT

The cushion valve in the steering circuit performs two important functions:

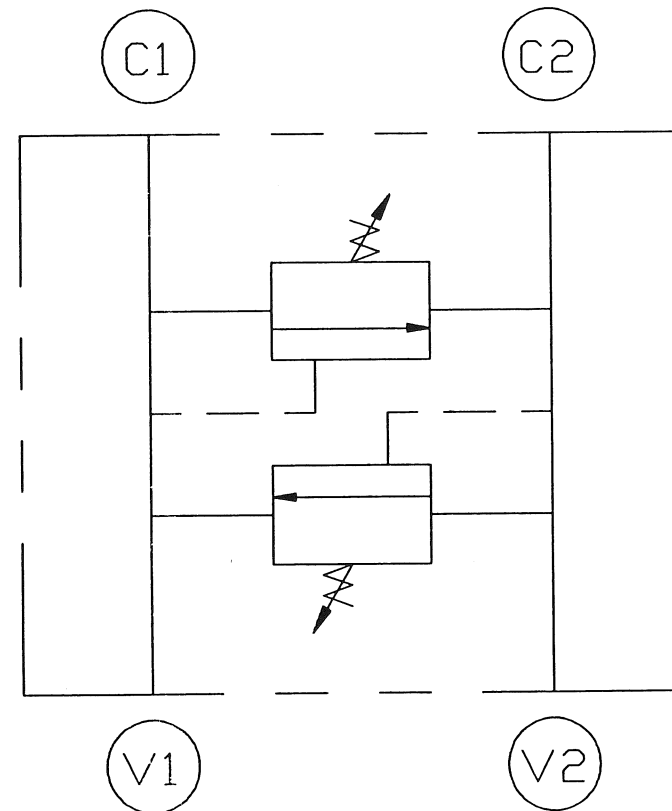
1. It prevents shock forces from being transferred to the steering wheel.
2. It becomes a bypass valve allowing oil to return to the steering valve if the operator continues to turn the steering wheel after the wheels reach lock.

NOTE: Turning the steering wheel after the wheels have reached lock places unnecessary stress on the steering components.

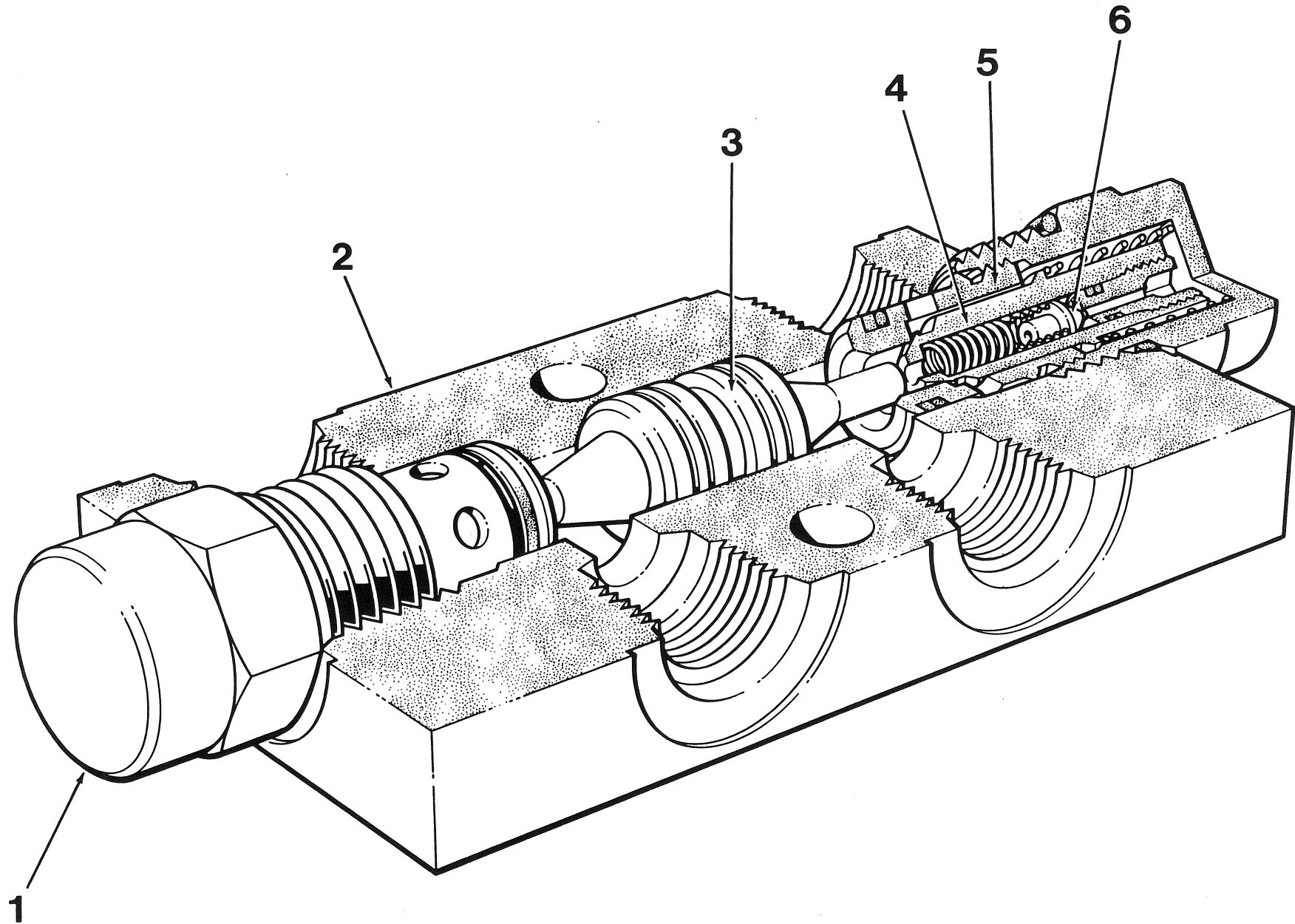
To test the cushion valve settings, start by installing a pressure gauge on the quick coupler located on the inlet hose to the steering motor. Run the engine at 2100 rpm and turn the steering wheel to the left until the wheels reach lock. Continue to turn the steering wheel 1 revolution every 2 seconds. The gauge should read 1150 (± 100) psi. If the valve needs adjustment, use the right hand side screw. Repeat these procedures steering the wheels to the right. If the valve needs adjustment, use the left hand side screw.

CIRCLE TURN CIRCUIT

Whenever the moldboard strikes an immovable object, the cushion valve allows for the pressure spike to vent to the low pressure side. The cushion valve is internally orificed so that the amount of oil that crosses over does not allow the circle to turn suddenly. The valve setting for this application is 2200 (± 100) psi. Because this is higher than the main relief setting, it can only be checked with a hand pump.



ISO Schematic - Cushion Valve



LEGEND

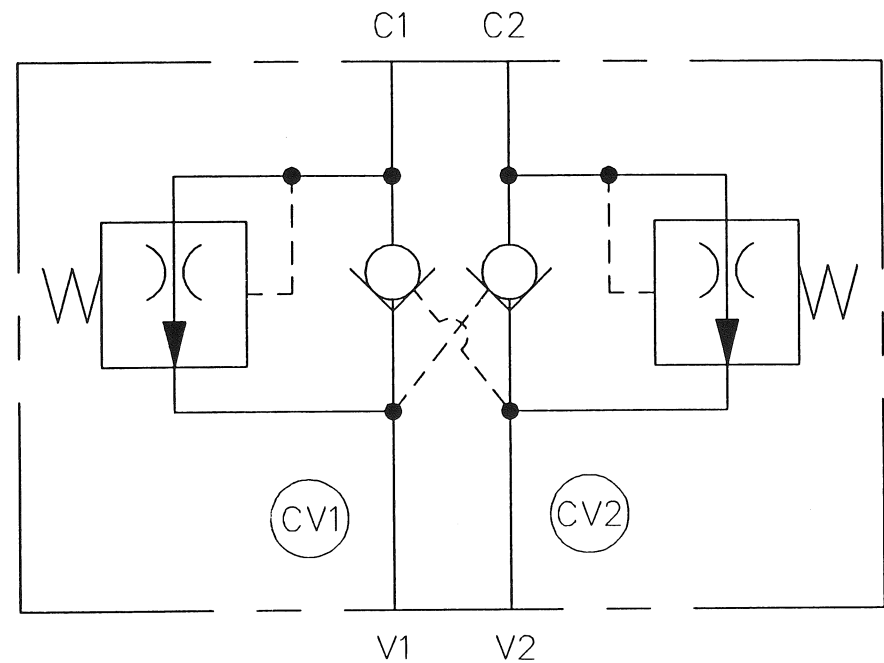
- | | |
|--------------------------|--------------------------|
| 1. Check Valve Cartridge | 4. Check Valve Poppet |
| 2. Valve Body | 5. Check Valve Sleeve |
| 3. Pilot Piston | 6. Thermal Relief Poppet |

The **lock valve** is a pilot operated check valve used on scarifier lift, A-frame, leaning wheel and dual moldboard tilt circuits. It is used to prevent cylinder drift under load and moldboard warpage due to cylinder leakage.

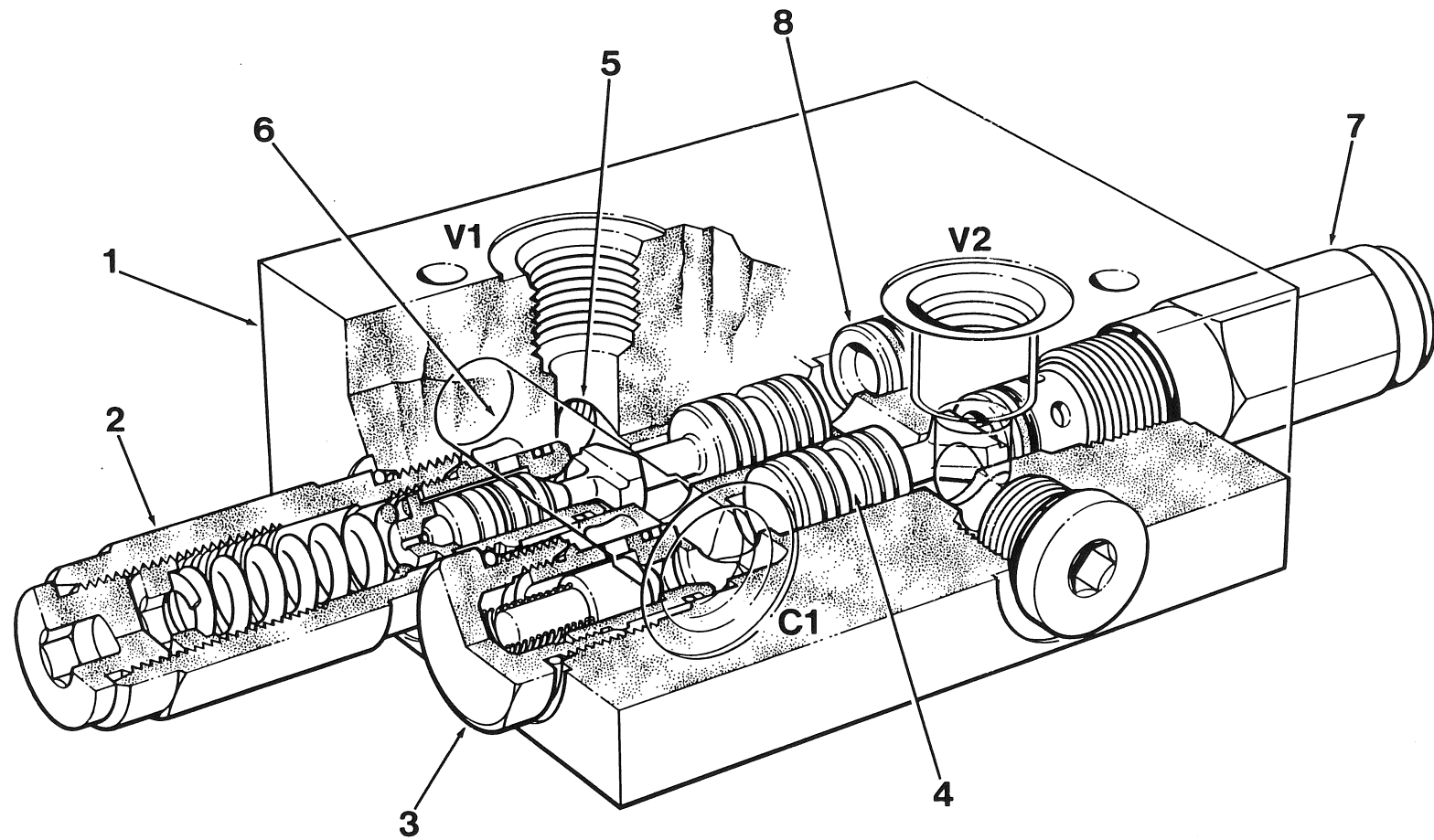
Oil pressure directed to V1 unseats the R.H. check poppet and flows to the cylinder. At the same time the pilot piston moves to the left unseating the L.H. poppet and allows oil leaving the cylinder to exit at V2.

Thermal relief is accomplished through a secondary internal poppet valve. When the manifold valve is in neutral, both check valves are closed and oil is locked in both ends of the cylinder. Oil is also present in the end caps of the cartridges due to clearance between the check poppet and its mating sleeve. Should pressure exceed 3000 psi the thermal relief poppet unseats and allows oil to exit to port V1 or V2. Because this is higher than the main relief valve setting, the valve cannot be checked by using the main hydraulic system.

NOTE: R.H. and L.H. are for the purpose of explanation only. R.H. components are identical to L.H.



ISO Schematic - Lock Valve



LEGEND

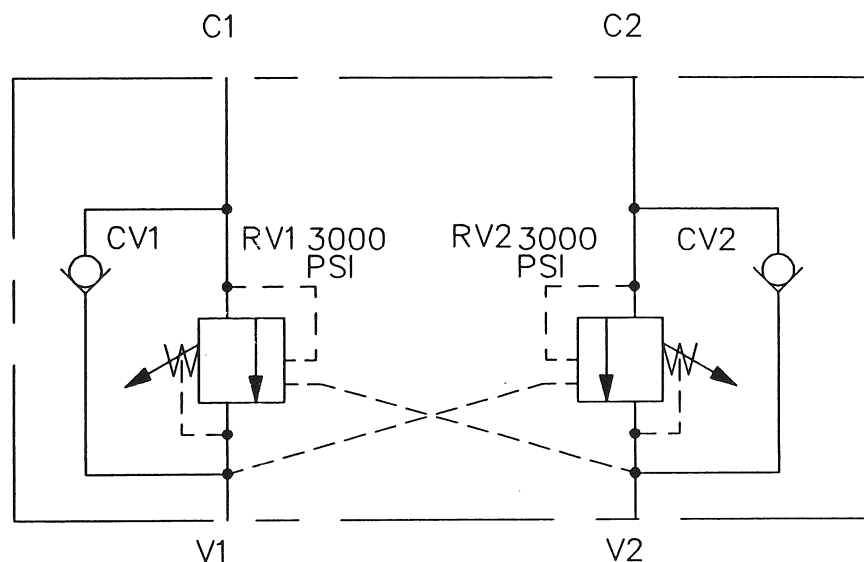
- | | |
|--------------------------------|--------------------------------|
| 1. Valve Body | 5. Pilot Passage |
| 2. L.H. Relief Valve Cartridge | 6. Cylinder Passage |
| 3. L.H. Check Valve Cartridge | 7. R.H. Relief Valve Cartridge |
| 4. Pilot Piston | 8. R.H. Check Valve Cartridge |

The **counterbalance valve** is a combination valve utilizing check valve and relief valve cartridges. It is found in the hydraulic blade lift and moveable point lock cylinder circuits. It's purpose is to prevent cylinder drift and cavitation when lowering a cylinder.

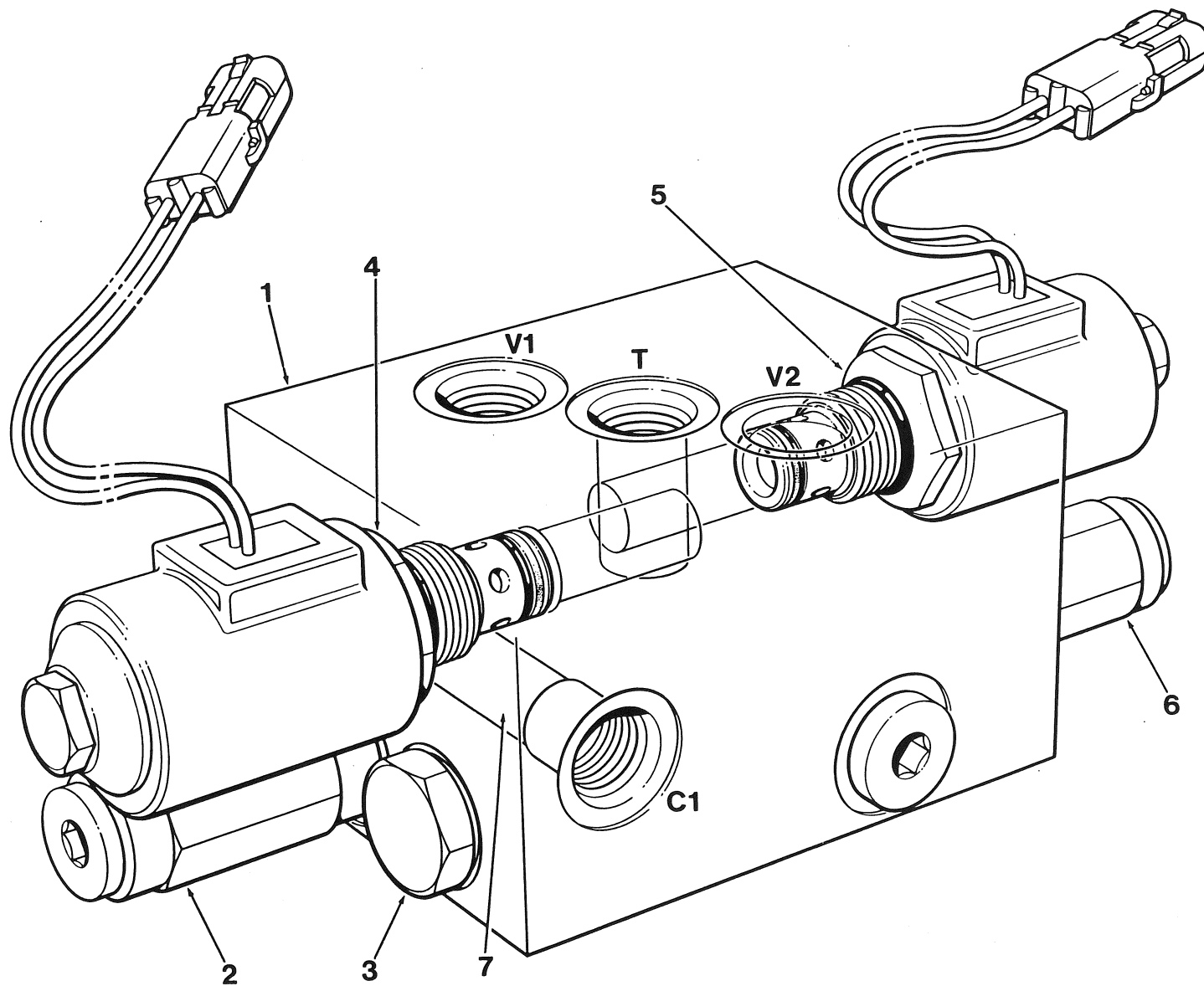
Oil pressure directed to V1 flows into the L.H. pilot passage, unseats the L.H. check valve, flows into the L.H. cylinder passage and out to the cylinder through C1. Oil exiting the opposite end of the cylinder enters the R.H. cylinder passage at C2 but is trapped by the R.H. check valve and relief valve. As pressure builds in the L.H. pilot passage, the R.H. pilot piston pushes the R.H. relief valve off its seat and allows oil to flow out V2.

When the cylinder is at rest, oil is present in both the R.H. and L.H. cylinder passages. The check valves prevent cylinder drift while the relief valves allow for shock loads and thermal expansion of oil. Should pressures exceed 3000 psi, the relief valves open and oil is allowed to exit to port V1 or V2. Because this is higher than the main relief valve setting, the valve cannot be checked by using the main hydraulic system.

NOTE: R.H. and L.H. are for purpose of explanation only. R.H. components are identical to L.H.



ISO Schematic - Counterbalance Valve



LEGEND

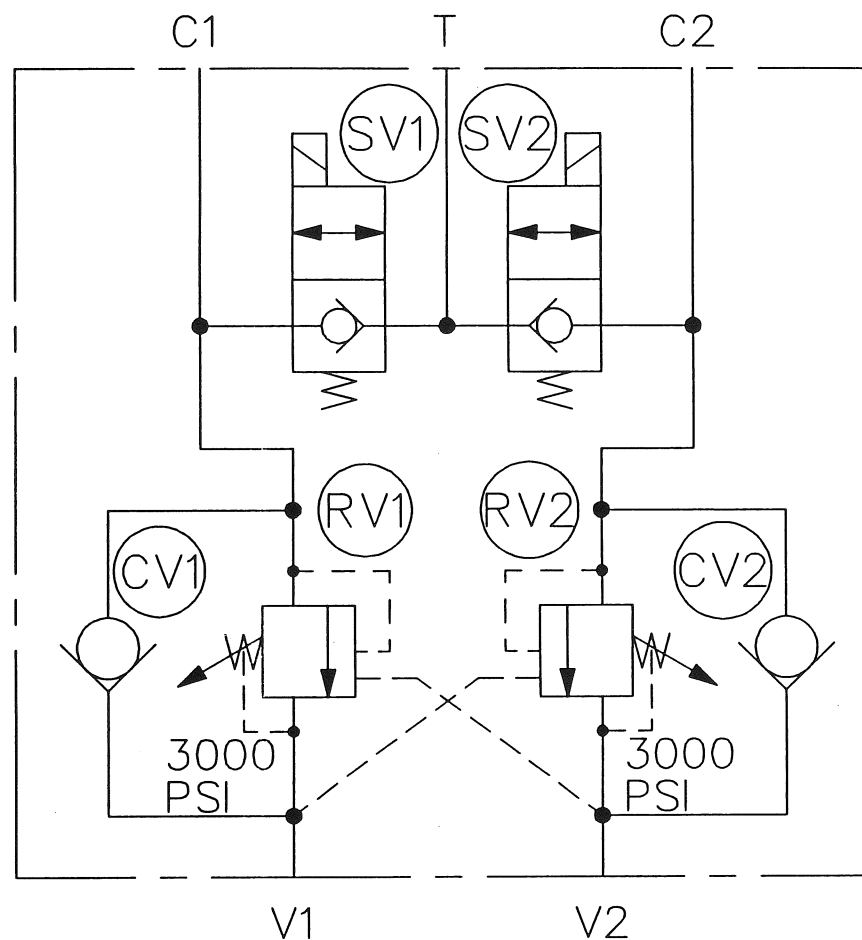
- | | |
|----------------------------------|----------------------------------|
| 1. Valve Body | 5. R.H. Solenoid Valve Cartridge |
| 2. L.H. Relief Valve Cartridge | 6. R.H. Relief Valve Cartridge |
| 3. L.H. Check Valve Cartridge | 7. Cylinder Passage |
| 4. L.H. Solenoid Valve Cartridge | |

The **electric float valve** is a combination valve utilizing check valve, relief valve and solenoid valve cartridges. It is an option available in the hydraulic blade lift circuit. Like the counterbalance valve, it prevents cylinder drift and cavitation when extending the cylinder. It also allows a cylinder to float up and down for snow plowing and ditch cleaning applications.

See page 23 for an explanation of the counterbalance valve.

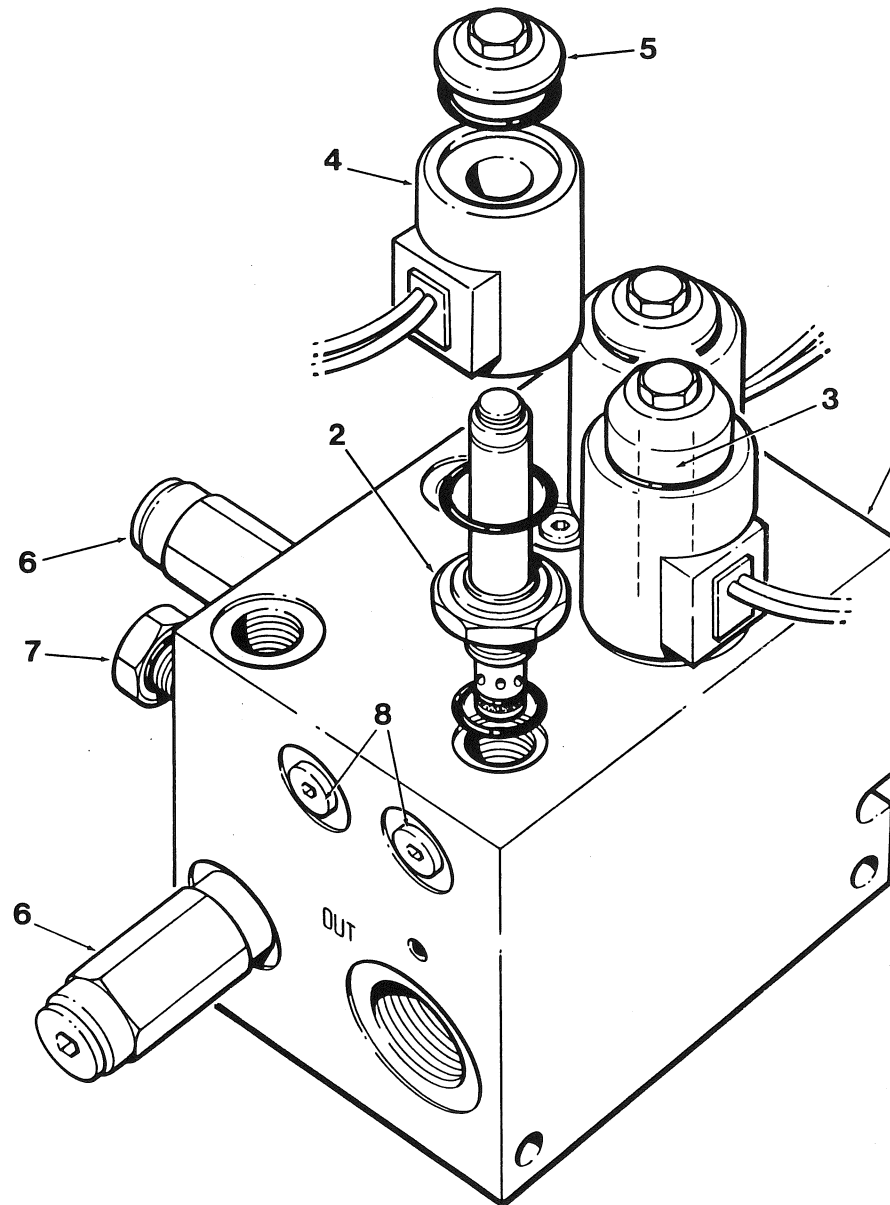
The electric float valve incorporates 2 normally closed solenoid operated valves which are present in the R.H. and L.H. cylinder passages along with the check valve and relief valve cartridges. To initiate the float function, both solenoids are energized. Once energized, they join the top and bottom of the cylinder together with a line to the hydraulic tank. This line is necessary to compensate for the differential area of the cylinder piston. When the cylinder retracts, oil from the top of the cylinder is displaced to the bottom and excess oil is sent to tank. When the cylinder extends, oil from the bottom of the cylinder is displaced to the top and additional oil is drawn from the tank.

NOTE: R.H. and L.H. are for purpose of explanation only. R.H components are identical to L.H.



ISO Schematic - Electric Float Valve

Attachments:
S/N 22688 & up
Articulation:
S/N 22132 & up



LEGEND

- | | |
|-----------------------------------|------------------------------------|
| 1. Valve Body | 5. Coil Fastening Nuts (Qty 3) |
| 2. Directional Cartridges (Qty 2) | 6. Relief Valve Cartridges (Qty 2) |
| 3. Unloader Cartridge | 7. Check Valve Cartridges (Qty 3) |
| 4. Solenoid Coils (Qty 3) | 8. Plugs (Qty 7) |

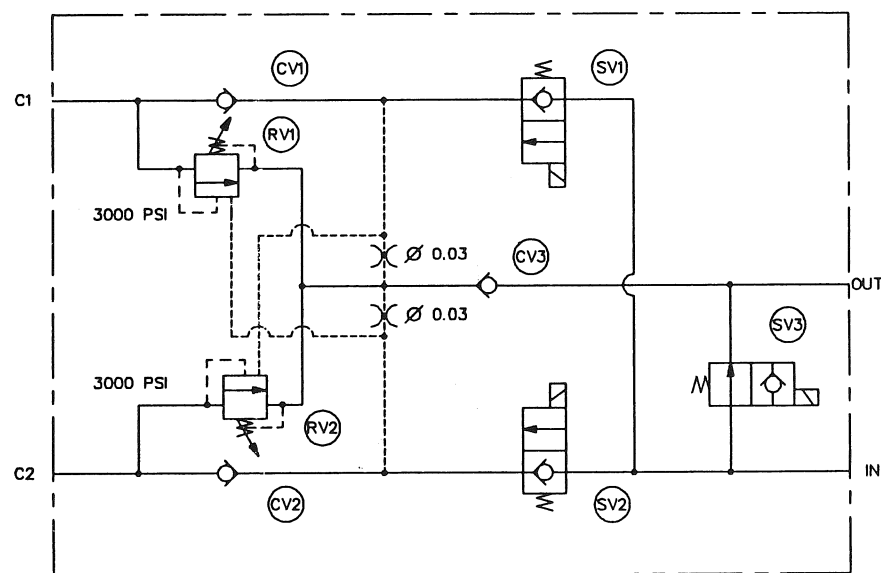
Solenoid operated valves are combination valves utilizing check valve, relief valve and solenoid valve cartridges. They are used to control articulation and most attachments. Both single and dual valves are used depending on the application.

Like the counterbalance valve, they prevent cylinder drift and cavitation when operating cylinders. These valves are self contained units as they are able to provide directional control along with relief and lock functions. In comparison, the manually operated sections of the main hydraulic manifolds provide only directional control and require accessory valves (ie. counterbalance, lock) to accomplish these additional functions.

A large capacity, normally open, unloading cartridge allows these solenoid operated valves to function "open center" like the main hydraulic manifolds. This permits hydraulic oil to pass straight through them when not required for cylinder operation. To obtain directional flow, this unloader cartridge along with one directional cartridge must energize. This blocks the straight IN to OUT passage of oil and directs oil towards one of the cylinder ports.¹ From this point on, these valves are similar in function to the counterbalance valve. See page 23 for a complete explanation of the counterbalance valve.

Proper torquing of the valve cartridges and coils will prevent internal distortion of the cartridge and ensure correct operation. When reinstalling a cartridge after service, dip it in clean oil and screw in **BY HAND** until the top o-ring contacts the valve body. **Torque to the following values:**

	Cartridge	Coil
Unloader Cartridge	35 ft.lbs 48 N.m 484 kgf.cm	5 ft.lbs 7 N.m 69 kgf.cm
Directional Cartridge	25 ft.lbs 34 N.m 345 kgf.cm	5 ft.lbs 7 N.m 69 kgf.cm

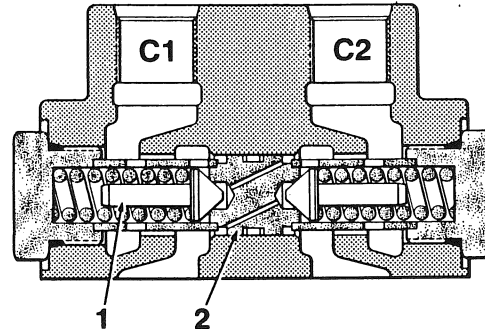


ISO Schematic - Solenoid Valve

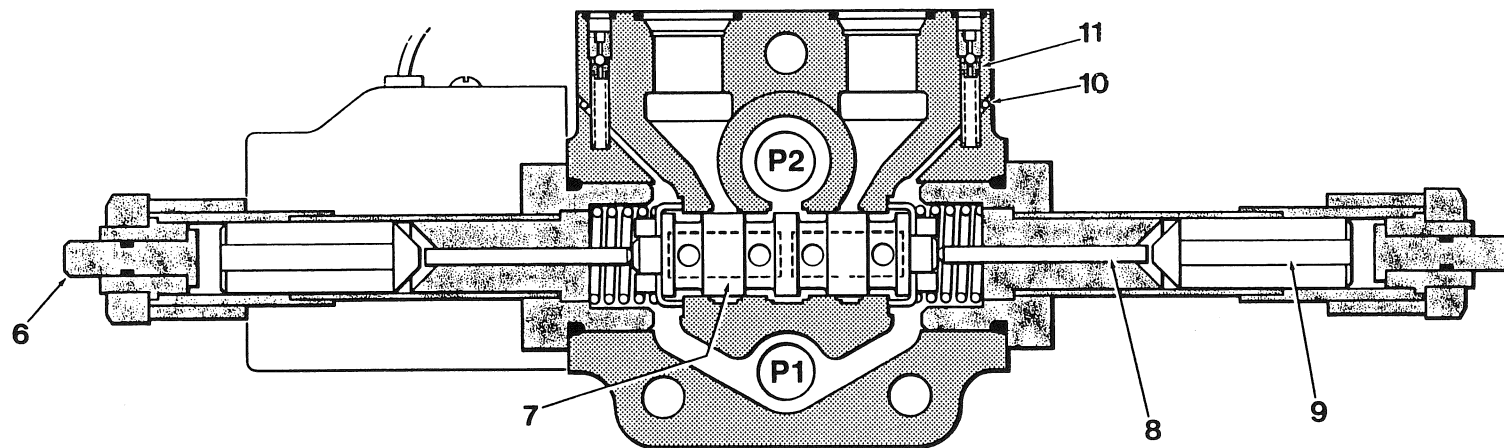
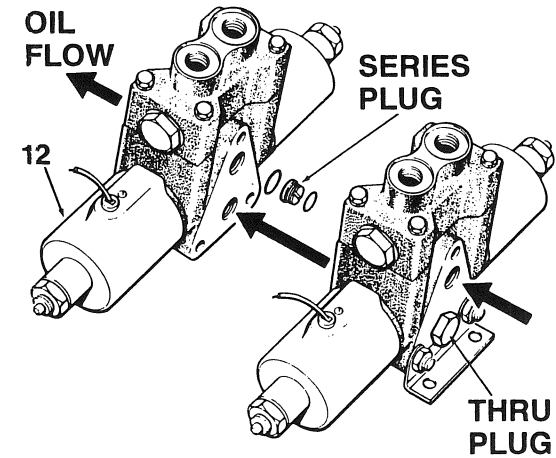
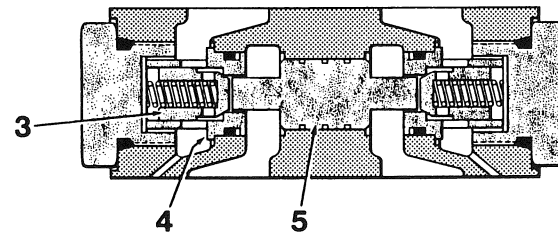
¹ - In the articulation application, SV1 articulates right and SV2 articulates left.

Attachments:
Up to S/N 22687
Articulation:
Up to S/N 22131

CROSS OVER RELIEF



LOCK VALVE



**DIRECTIONAL WITH INTEGRAL
THERMAL RELIEF VALVES**

LEGEND

- | | |
|----------------------------|-----------------------------|
| 1. Poppet | 7. Spool |
| 2. Crossover poppet seat | 8. Pin |
| 3. Check Poppet | 9. Plunger |
| 4. Lock Valve Cage | 10. Plug |
| 5. Pilot Piston | 11. Thermal Relief Assembly |
| 6. Manual override Plunger | 12. Solenoid Coil |
-

Solenoid operated valves are used to control articulation and most attachments. Depending on the use, the valve configuration can vary.

When the valve is in neutral with both solenoids de-energized, the spool is centered. Oil enters **P-1** and splits left and right, flowing through the hollow portions of the spool and exits through **P-2**. (**NOTE:** Oil could enter at **P-2** and exit at **P-1** but cylinder operation would be reversed). Since these valves are used in series, the through port must be plugged by an O-ring plug.

If the left-hand solenoid is energized, the spool is moved to the left, directing oil from **P-1** up the right-hand passage to the lock valve. Pressure opens the right-hand check poppet and moves the pilot piston to the left which unseats the left-hand check poppet. Oil then continues up the right side flowing through the crossover relief valve and out **C-2**. Oil exiting the cylinder enters at **C-1**, flows through the crossover relief valve and the now open lock valve. Oil enters the left-hand section of the hollow spool and exits the valve assembly at **P-2**.

CROSSOVER RELIEF SECTION

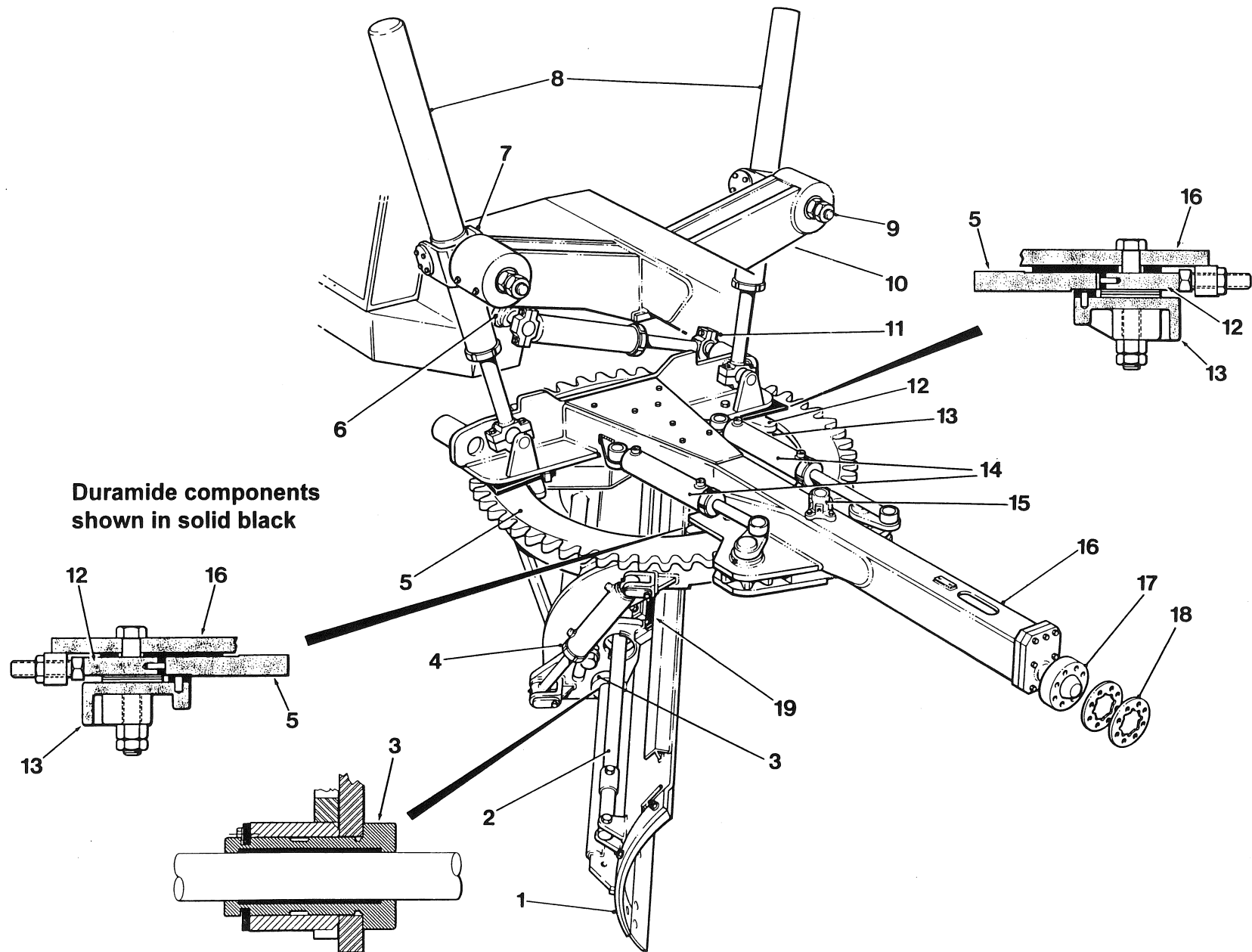
If a shock load occurs, the high pressure oil is transferred to the low pressure side, reducing the stress on other components. The relief setting of 3100 psi is shim adjustable. This valve section is similar in operation to the cushion valve discussed on Page 19.

LOCK VALVE SECTION

When the directional control section is in neutral, the lock valve traps oil in the cylinder. This prevents articulation 'wandering' or a ripper slowly being forced up. Two different peg sizes are available on the pilot piston. Generally the larger peg size is used in articulation valve assemblies. Although this slows the speed of articulation slightly at high rpm, it prevents valve chatter (rapidly opening and closing lock valves) at low rpm by slightly increasing back pressure.

DIRECTIONAL CONTROL SECTION

Non-adjustable thermal relief valves are incorporated into the body. Whenever trapped oil pressure exceeds 3500 psi due to thermal expansion, oil is vented into the main hydraulic system. On graders prior to **S/N 20719** the thermal relief valves were external and vented to the atmosphere. Casting differences do not allow component interchangeability.



LEGEND

- | | |
|-------------------------------|---------------------------------|
| 1. Moldboard | 11. Circle Shift Cylinder |
| 2. Slide Shift Cylinder | 12. Guide Plate - with Duramide |
| 3. Slide Tube - with Duramide | 13. Clamp Plate - with Duramide |
| 4. Power Tilt Cylinder * | 14. Circle Turn Cylinders |
| 5. Circle | 15. Timing Valve |
| 6. R.H. Shift Cylinder Anchor | 16. Drawbar |
| 7. Stirrup | 17. Drawbar Ball Stud |
| 8. Blade Lift Cylinders | 18. Ball Stud Shims |
| 9. Stirrup Nut/Lock Nut | 19. Slide Bearing |
| 10. Fixed Point Hi-Lift Arm | -with Duramide |

** Models 710/710A feature one centre mounted tilt cylinder.*

The standard duty Fixed Point Hi-Lift as equipped on models 710 thru 740A is illustrated. Models 750A & 780A use the heavy duty circle moldboard blade lift assembly. Its' heavier construction is required for mining and forest industry applications. Five sets of guide and clamp plates are used however, the set-up principle is the same.

The circle, drawbar, moldboard assembly is the working area of the grader. Long life and good performance depend on proper adjustment, lubrication and maintenance. Carefully follow the lubrication chart and Operator's Manual to perform these tasks.

Duramide circle support bearings are standard on all models. Duramide's nonmetallic composition provides reduced maintenance, extended life, and an easier turning circle. Duramide assemblies can be easily interchanged with metallic components with the benefit of retaining the same set up procedures.

A properly adjusted circle has the front guide plate(s) tight against the circle. The two rear guide plates must have .040" - .080" clearance between the circle.

To keep the blade properly adjusted, all excessive "free play" must be taken out of the assembly. This may be done by removal of shims from between the guide and clamp plates, drawbar ball stud, and cylinder ball caps.

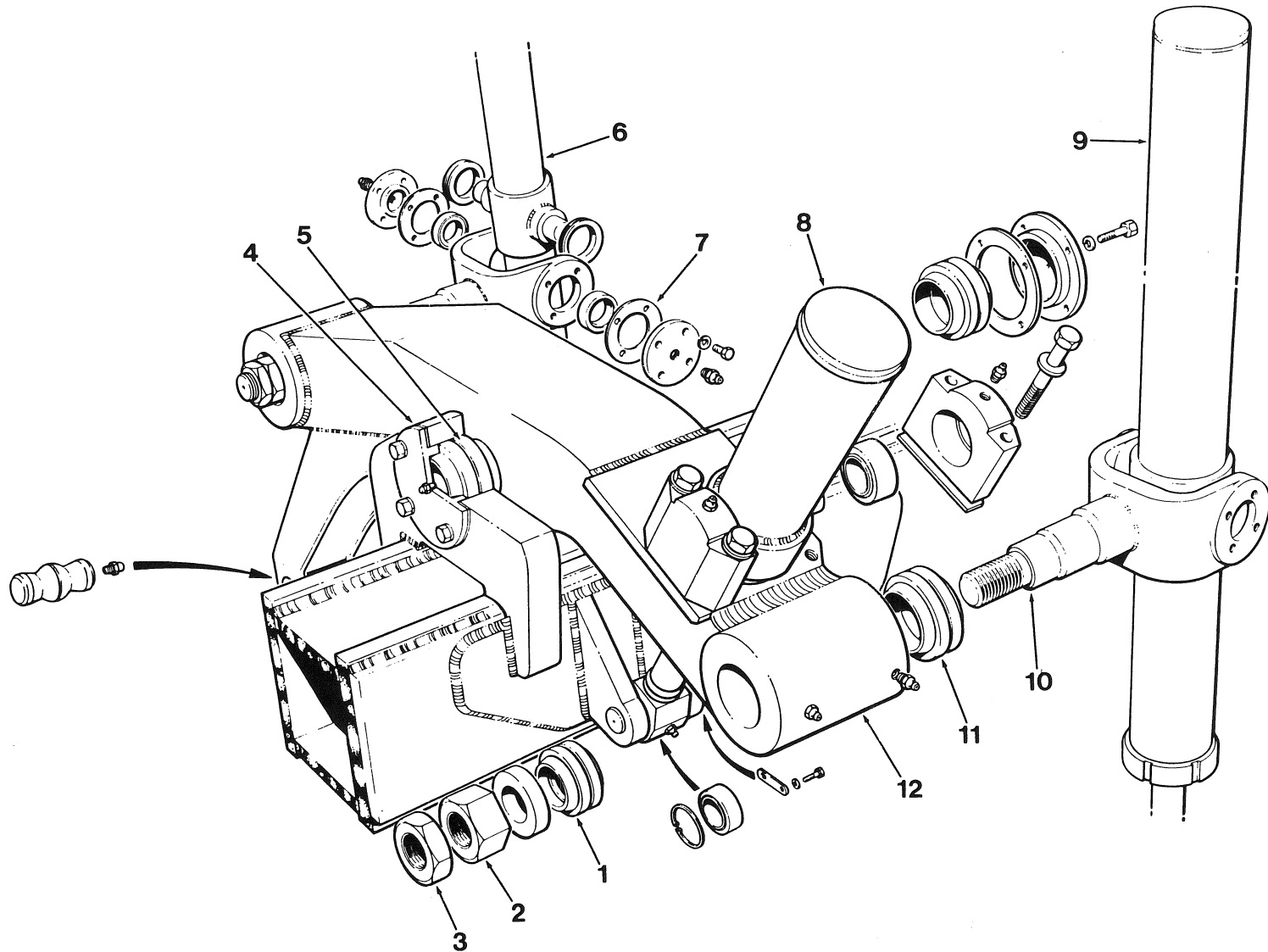
NOTE: Ball caps are a matched set and cannot be interchanged or reversed.

Excessive 'free play' of the moldboard affects blading tolerance. It may be removed from the slide rails by replacing slide castings and/or shimmming upper slide rail bearings. Always slide the moldboard end-to-end to check for binding after any adjustments.

Any visible movement of the stirrup shank or trunion bushings indicate adjustment is required. Seat the stirrup shank bearing by torquing the stirrup nut to 250 ft.lbs, then back-off the nut and re-tighten to 50 ft.lbs. Tighten the locknut to 400 ft.lbs. while holding the stirrup nut. The trunion bushings have a preload sufficient to require 15-25 lbs. on the top of the cylinder to move the cylinder in the stirrup. Adjust this preload by adding or removing shims. Always inspect the V-Ring seal on the trunion for damage and replace as necessary.

Lubrication is required on the circle top surface, inner surface and underside where the clamp plates support the circle, regardless of whether the circle is supported by Duramide or metallic guide and clamp plate assemblies. Recommended lubrication is a coating of spray graphite dampened with diesel fuel. Grease or molycoat may be used in some operating conditions. Fresh lubricant should be applied only after cleaning the surface. Do not allow a build up of dry lubricants.

Refer to the Shop Manual for specifications.



LEGEND

- | | |
|-----------------------------|-----------------------------|
| 1. Bushing | 7. Shims |
| 2. Adjusting Nut | 8. Lock Cylinder |
| 3. Lock Nut | 9. R.H. Blade Lift Cylinder |
| 4. Shims | 10. Stirrup Yoke |
| 5. Bushing | 11. Bushing |
| 6. L.H. Blade Lift Cylinder | 12. Over Frame Arm |
-

The Moveable Point Blade Lift System is optional on models 710 thru 740A. The Fixed Point Hi-Lift System is standard on all models and is the only system available on models 750A & 780A. The Moveable Point Blade Lift System is available for applications where extreme reaches are required.

COMPONENTRY

Champion's Moveable Point Blade Lift System consists of three major components.

The Over Frame Arm rotates on a pin and bearing assembly welded directly to the top of the frame. Controlled from the cab, the arm is hydraulically rotated over an infinite range of positions through 70°.

The Arm Lock Cylinder is mounted to the frame and extends through the over frame arm. By activating the control lever in the cab, the arm lock cylinder repositions the arm through its 70° arc. The cylinder locks the arm in position when the desired angle is attained. A counterbalance valve prevents cylinder drift and cavitation when extending the cylinder.

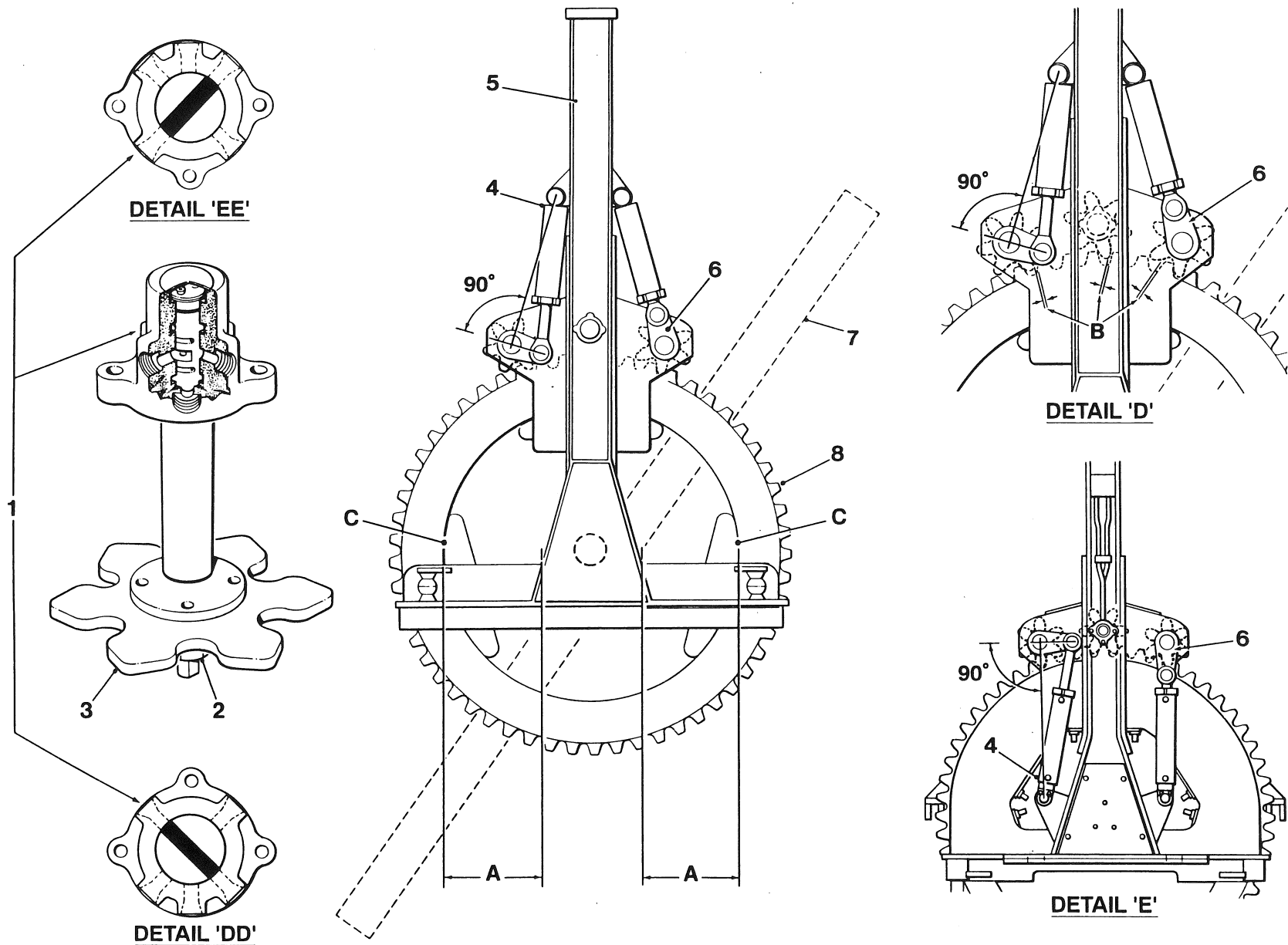
The Circle Side Shift Cylinder is mounted directly between the circle drawbar and the over frame arm. Functioning similarly to other fixed or moveable point blade lift systems, the circle side shift provides lateral movement of the circle. However, the circle side shift on Champion's Moveable Point Blade Lift System permits movement either left or right without a mechanical change to the circle side shift cylinder or the use of a latch/detach mechanism.

ADJUSTMENTS

The stirrup bearing adjustment procedure is similar to the fixed point system, as is the blade lift cylinder trunion bushing adjustment.

The over frame arm pivot bearings are shim adjustable. The clearance specification is .002" - .007" on both sides.

Refer to the Shop Manual for specifications.



LEGEND

- | | |
|------------------------------|---|
| 1. Circle Timing Valve | A. Centering Dimension |
| 2. Timing Shaft Lock Nut | B. Tooth Clearance |
| 3. Timing Valve Pinion | C. Horizontal Clearance |
| 4. L.H. Circle Turn Cylinder | D. Forward Mounted Circle Turn Cylinders |
| 5. Drawbar | DD. Cross Section of Valve Showing Blocked Forward Left Port |
| 6. R.H. Circle Turn Crank | E. Rear Mounted Circle Turn Cylinders |
| 7. Moldboard | EE. Cross Section of Valve Showing Blocked Forward Right Port |
| 8. Circle | |

The Champion grader uses two hydraulic cylinders in conjunction with a timing valve to turn the circle. This system is the strongest in the industry for turning and holding power. The circle must be kept properly adjusted through regular maintenance for smooth operation and long life. If the circle fails to turn smoothly, one of the corrective measures is re-timing.

To time the circle there is a three step procedure. Follow this procedure whenever the timing is checked or whenever the circle is adjusted.

STEP 1

CENTRE THE CIRCLE TO THE DRAWBAR

Measure the distance from the inside lip of the circle to the side of the drawbar on both sides. These measurements should be approximately equal as indicated by dimension A. Note that this is only a starting point.

Setting drive pinion to circle clearance:

- A) **Graders with flat tips on the circle teeth:** adjust the guide plates until .040" - .080" backlash clearance is between the drive pinion and circle teeth, as indicated by dimension B.

- B) **Graders with round tips on the circle teeth:** adjust the guide plates until .060" - .120" root to tip clearance is between the drive pinion and circle teeth.

In either version, the timing valve pinion should have the same clearance as the circle to drive pinions. If not, check for wear on the drive pinion teeth. Adjust the rear guide plates to obtain the specified clearance at the circle. See detail C.

STEP 2

POSITION THE CYLINDER AND CRANKS

Fully retract the right hand cylinder so that a straight line intersects all three pivot points. Ensure the left-hand cylinder and crank is towards the drawbar. Position the cylinder so that a straight line, drawn between the centre of the cylinder anchor and the centre of the crank shaft will form a 90° angle with a line drawn through the centres of both the crank shaft and pivot. This set-up is very important and applies to both orientations of circle turn cylinders. See details D and E.

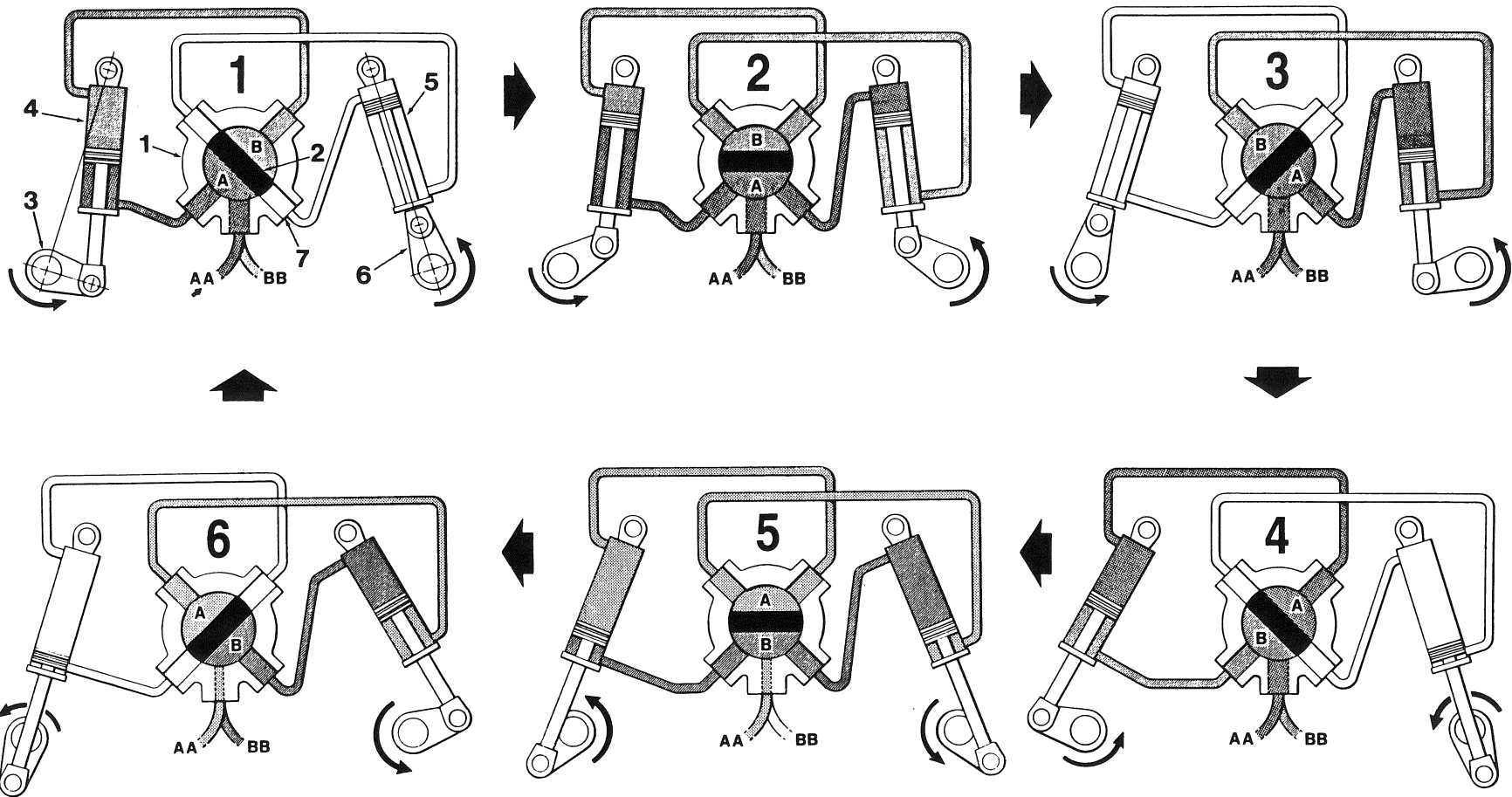
STEP 3

SET THE TIMING VALVE

After relieving all hydraulic pressure, locate and remove the hose and fitting from the port on the timing valve as shown in details "DD" or "EE". Looking inside, the spool must completely block the timing port as shown. If adjustment is required, loosen the timing pinion shaft lock nut and rotate the shaft until the spool completely blocks the port. Secure the lock nut and ensure the spool did not move. Replace the fitting and hose.

Refer to the Shop Manual for specifications.

 **SUPPLY**
 **RETURN**
 **STATIONARY**



LEGEND

- | | |
|--------------------------------|------------------------------|
| 1. Timing Valve Body | 5. R.H. Circle Turn Cylinder |
| 2. Centre Land of Timing Spool | 6. R.H. Crank |
| 3. L.H. Crank | 7. Timing Port |
| 4. L.H. Circle Turn Cylinder | |
-

To understand the theory of Champion's circle turn system it is important to know the following:

The L.H. cylinder and crank is always 90° out of phase to the right and due to the internal porting of the circle turn valve:

- Port **AA** is always connected to cavity **A**
- Port **BB** is always connected to cavity **B**

Regardless of which circle turn cylinder orientation is on your grader, the principle of operation remains the same. The following series of illustrations will show what happens when the circle turn lever is pulled back, turning the circle clockwise from the timing position, e.g. oil enters port **AA**.

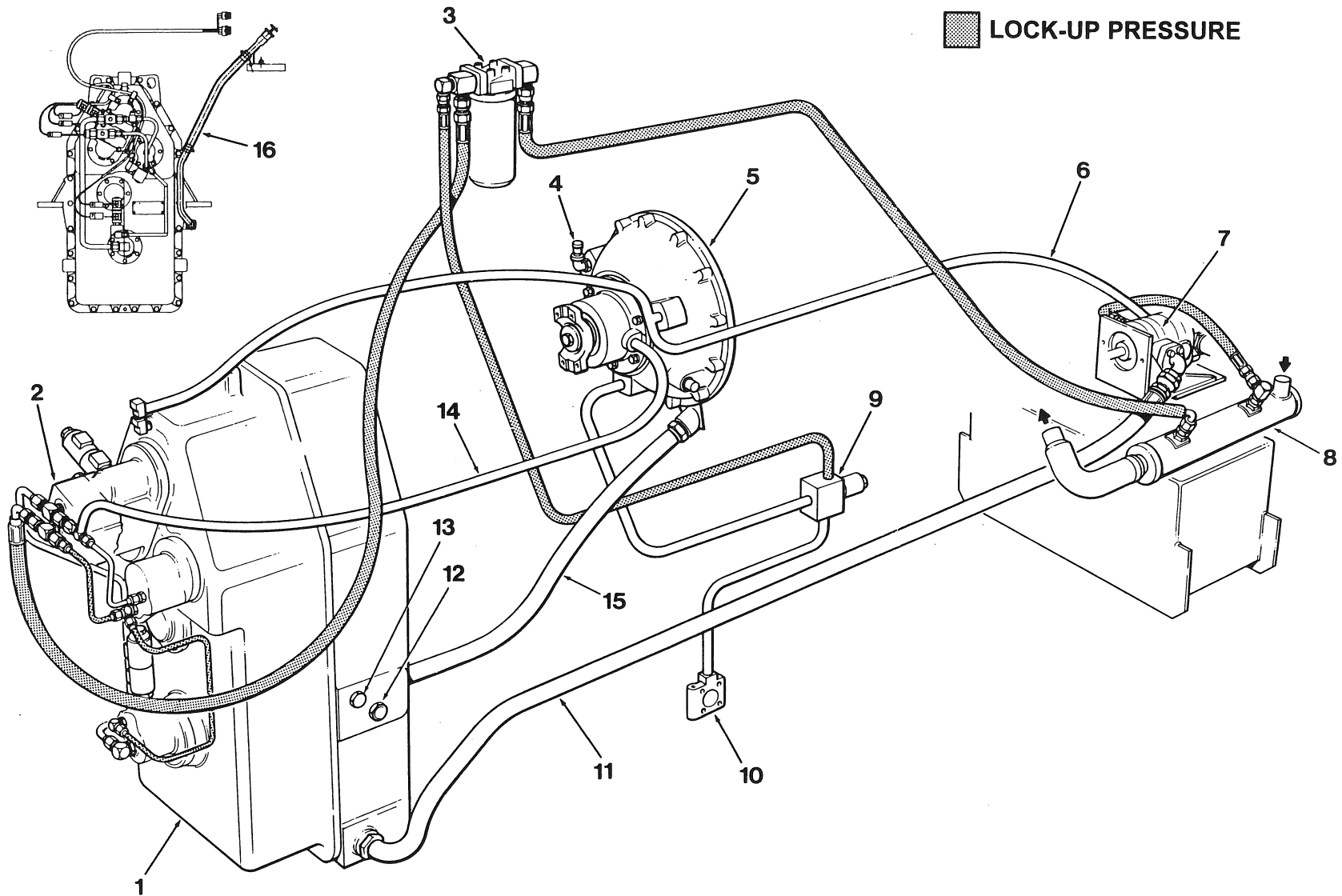
In diagram 1, the cylinders and timing valve are in the circle timing position. The R.H. cylinder is fully retracted and cannot provide any useful force. The L.H. cylinder is half way through its stroke, and at the maximum torque angle. It is capable of turning the circle (under load) by itself. The timing valve spool is positioned so that 100% of the oil flow entering at **AA** is directed by cavity **A** to the rod end of the L.H. cylinder. The L.H. cylinder retracts, driving the circle clockwise which also turns the timing valve spool and R.H. cylinder to position 2.

In diagram 2 the rotated spool permits oil to flow to the base end of the R.H. cylinder which extends and assists the left hand cylinder to turn the circle. Oil exiting the cylinder enters cavity **B** of the timing valve and exits through Port **BB**.

As long as the circle turn lever is pulled back, the assembly rotates to diagram 3 which is 90° from diagram 1. The R.H. cylinder is now turning the circle by itself as the L.H. cylinder is straight and momentarily at rest. The timing valve spool has blocked the ports leading to the L.H. cylinder.

In Diagram 4, the cylinders and timing valve are positioned 180° from diagram 1. Oil still enters at Port **AA** and flows through the internal porting of the valve to the base end of the L.H. cylinder which extends, driving the circle clockwise.

Follow the oil flow in diagrams 5 and 6 to understand the sequence.



LEGEND

- | | |
|---------------------------------|--|
| 1. Model 8400 Transmission | 9. Shift Cylinder Control Valve |
| 2. Pressure Regulating Valve | 10. Final Drive Lock/Unlock Shift Cylinder |
| 3. Oil Filter | 11. Pump Suction Line |
| 4. Transmission Clutch Breather | 12. Fluid Level Sight Glass |
| 5. Clutch Housing | 13. Transmission Filler Plug |
| 6. Pump Vent Line | 14. Clutch Lubrication line |
| 7. Transmission/steering Pump | 15. Clutch Drain Line |
| 8. Transmission Cooler | 16. Transmission Filler Tube |
-

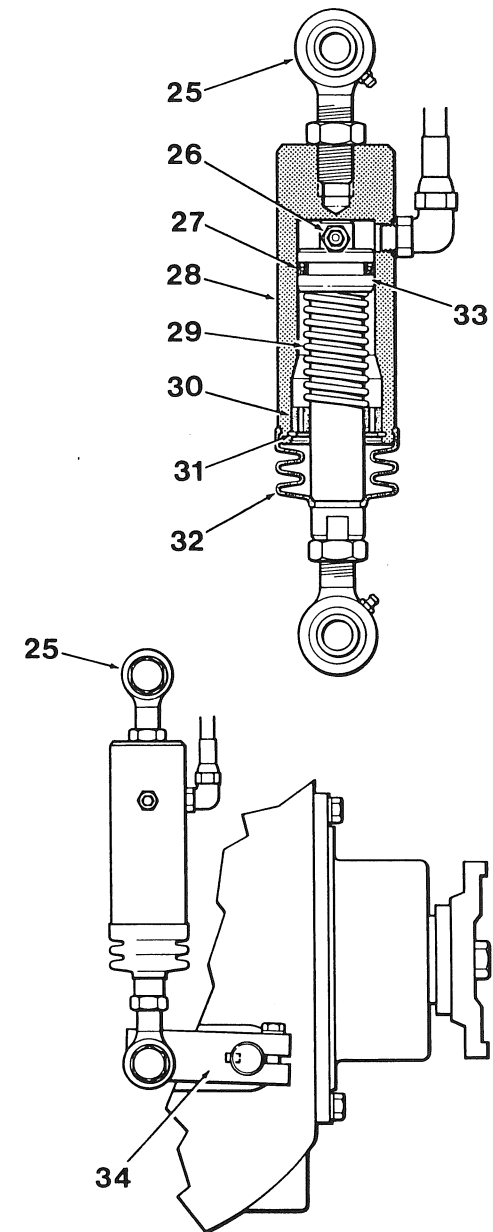
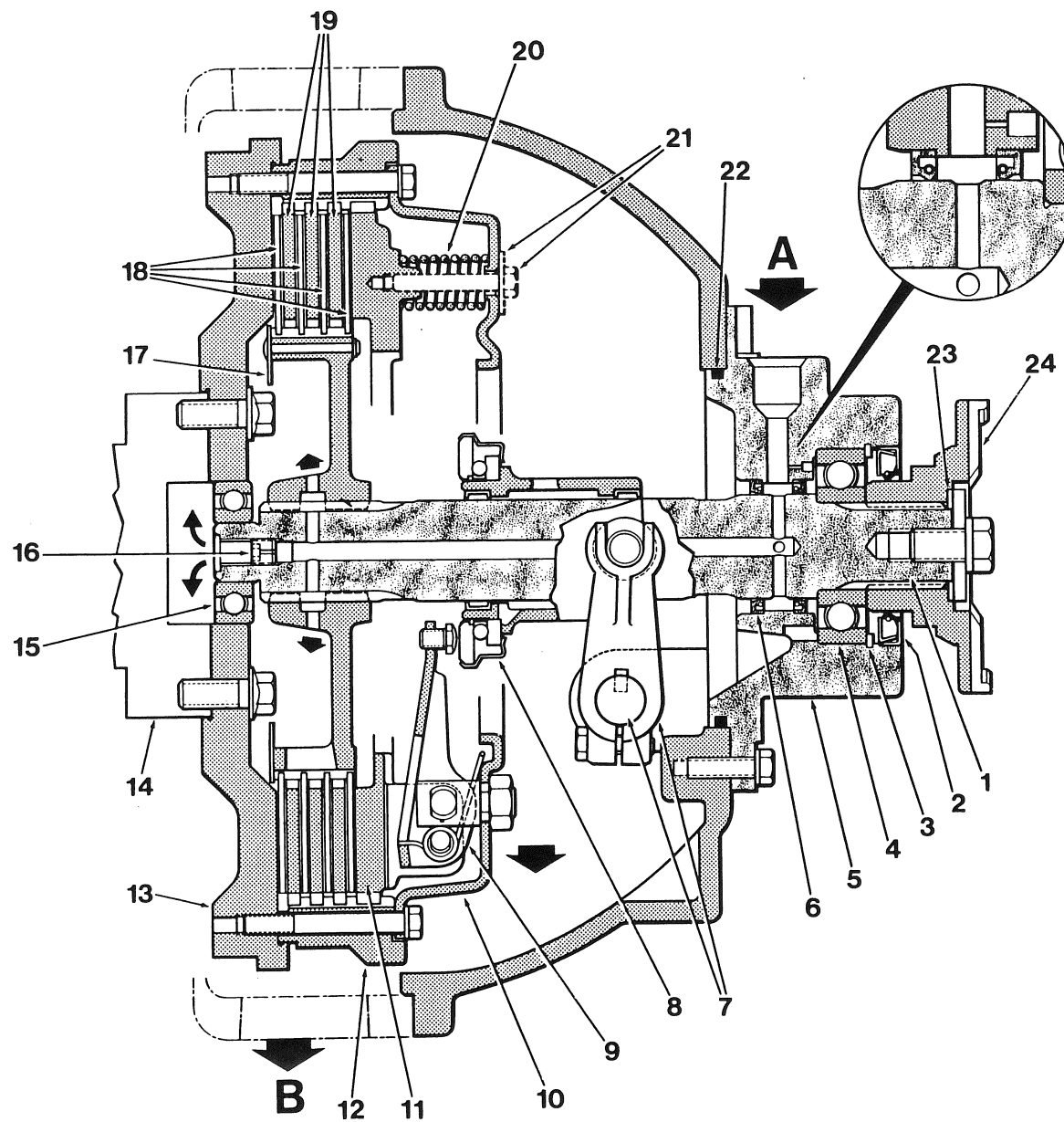
Oil is supplied to the transmission, engine clutch and differential lock/unlock circuit by one section of the transmission/steering pump. The pump is located below the radiator and is driven by the engine's crankshaft unless the grader is an All Wheel Drive model, then the pump is driven from the right side of the pump drive gearbox. The oil in this circuit is completely separate from the oil of the hydraulic system.

Oil is drawn from the transmission sump directly into the pump. Oil leaving the pump enters an oil to engine coolant bundle type cooler. Coolant exiting the radiator passes through this cooler before entering the engine's water pump. This type of heat exchanger maintains a consistent temperature regardless of ambient temperature.

Oil then flows to the transmission oil filter. This is a special large capacity, spin-on type disposable filter with a 7 micron rating. A bypass valve is built into the filter head to allow cold oil to bypass the filter element if the pressure differential between the inlet and outlet exceeds 25 psi. If the filter is plugged by contamination the bypass valve will also open and allow unfiltered oil to continue to the transmission regulating valve. **Filter replacement at the recommended intervals is critical to transmission operation.**

Mounted on the front of the transmission is the transmission pressure regulating valve. This two stage valve regulates both lock-up and lubrication pressures. Oil first enters the lock-up section where pressure is controlled for use in the clutch pack lock-up circuits. Lock-up pressure affects the shift characteristics of the transmission. The remainder and majority of the oil enters the lubrication section where pressure for the lubrication circuit is controlled. Lubrication oil is used to cool and lubricate both the transmission and engine clutch. Lubrication oil then drains back into the transmission sump.

A small amount of oil is taken from a tee on the outlet of the filter head to operate the differential lock/unlock circuit. Oil flows through the control valve to the lock/unlock shift cylinder. Models 710 thru 740A use a single acting spring return lock cylinder while models 750A & 780A use a double acting cylinder with spring assist.



LEGEND

Clutch Assembly

1. Clutch Shaft
2. Output Yoke Seal
3. Snap Ring
4. Clutch Shaft Bearing
5. Bearing Support Housing
6. Clutch Shaft Seals (Qty 2)
7. Cross Shaft and Yoke
8. Release Bearing
9. Clutch Fingers
10. Backing Plate
11. Pressure Plate
12. Adapter Drive Ring
13. Flywheel
14. Crankshaft
15. Pilot Bearing
16. Orifice Plug
17. Oil Deflector & Clutch Hub
18. Friction Plates (Qty 4)
19. Steel Spacers (Qty 3)

20. Clutch Springs*
21. Caging Capscrew & Washer (for clutch assembly servicing only)
22. O-Ring
23. Gasket
24. Output Yoke

Slave Cylinder Assembly

25. Rod End
26. Bleeder Screw
27. Piston Cup
28. Barrel
29. Spring
30. Gland
31. Snap Ring
32. Rubber Boot
33. Piston & Rod
34. Cross Arm Shaft

* 6BT5.9, 6CT8.3 and 6CT8.3 VHP - 12 springs • L10 - 15 springs

OVERVIEW

The function of the clutch assembly is to disengage the driveline from the engine to facilitate smooth starts, stops and direction changes. The illustration here shows the clutch in the engaged position.

The engine clutch is spring applied and disengaged by a master cylinder/slave cylinder hydraulic circuit. Hydraulic oil returning from the steering circuit enters the clutch booster. When the operator depresses the clutch pedal, the booster utilizes this return oil to assist in pushing the master cylinder piston. The displaced fluid from the master cylinder

causes the slave cylinder to extend and rotate the cross shaft. This causes the release bearing to move towards the flywheel and contact the clutch fingers which, through a lever action, pull the pressure plate away from the clutch plates. This disengages the clutch drive mechanism.

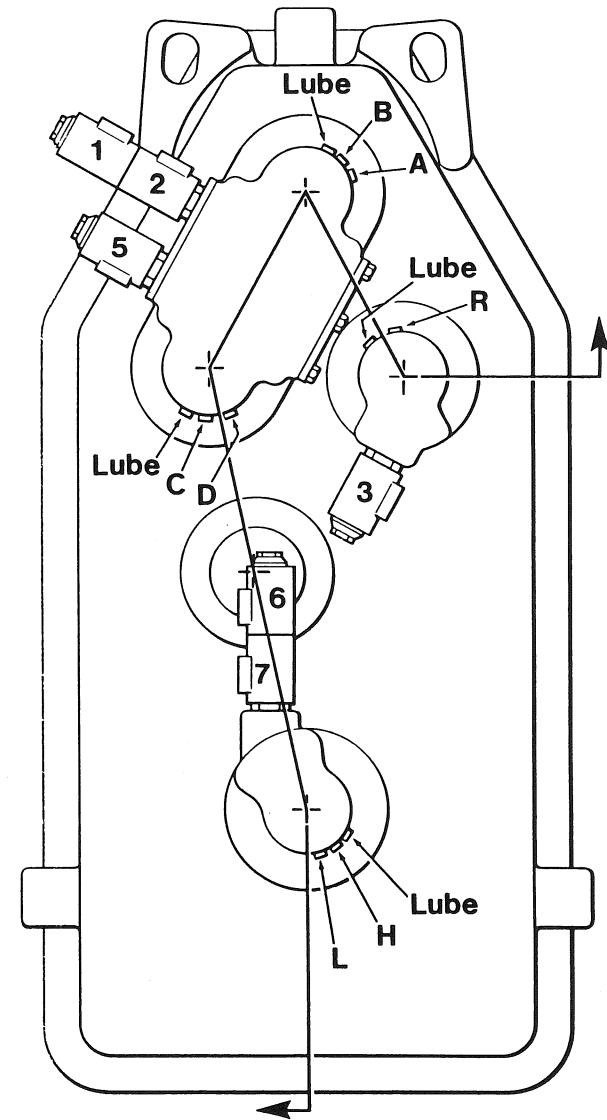
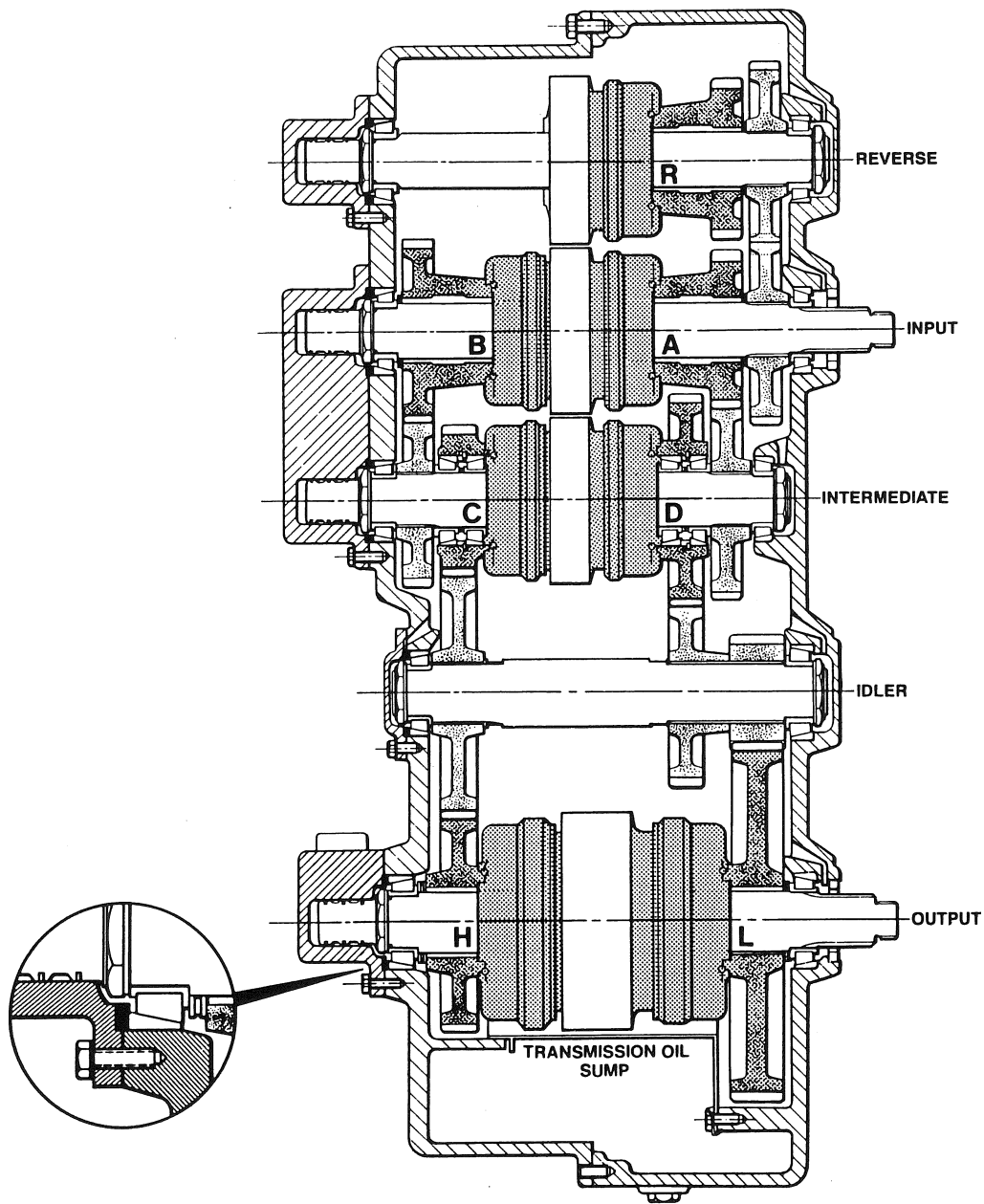
Oil is used to lubricate the bearings and to cool the clutch plates. Oil from the transmission lube circuit enters at point A (shown on top for illustrating purposes only). The oil is directed into the clutch shaft by two lip seals and into the clutch shaft bearing through a drilled passage. Some oil flows through the orifice plug to lubricate the pilot bearing. The majority of oil collects in the clutch hub where under centrifugal force, it flows outward through the clutch plates providing a cooling effect. The release bearing receives splash lubrication. All oil drains down into the sump and then returns to the transmission at point B.

ADJUSTMENTS

Since the cross shaft arm and yoke have the same effective length, the distance the slave cylinder extends until a resistance is felt represents the clearance between the release bearing and the adjustment screws on the clutch fingers. Check the clutch slave cylinder adjustment weekly. The specified clearance is:

3.20mm to 3.80mm
0.125" to 0.150"
1/8" to 5/32"

As the clutch plates wear through normal use, this clearance will become smaller. Adjustments can be made at either end of the slave cylinder. Shorten the slave cylinder assembly to increase clearance; lengthen to decrease clearance. Since the slave cylinder is hydraulic, a bleeder screw is provided. Always remember to check the clutch pedal linkage free play as well.



OVERVIEW

The 8400 transmission was developed to provide an 8 speed forward, 4 speed reverse full powershift transmission for grader applications. It was designed with a wide ratio spread of 10.35:1 between first and eighth speeds. The eight speeds were carefully selected to match the engine's power curve, providing an even increase in road speed with each upshift. Seventh and eighth speeds provide an overdrive ratio since output shaft speed is greater than input speed. It's simple operation and construction make it easy to troubleshoot and repair. As part of the modular powertrain, the transmission is easy to remove from the grader as no other powertrain components need to be disturbed.

Shifting is accomplished by an electronic controller which completes the ground circuit to combinations of the four solenoid valve cartridges. A digital display informs the operator of which gear they are in as well as monitoring the electrical system to provide diagnostic information for troubleshooting.

CONSTRUCTION

The cast iron housing is vertically split to ease assembly and disassembly and allow complete access to all seven clutch packs and the idler shaft. Each of the five shafts are supported by tapered roller bearings to handle the end thrust created by helical gearing. The A/B,C/D and R shafts have .002"-.007" shim adjustable end float while the idler and L/H shafts have .000"-.005". Shims are piloted in the counterbores of the collector caps. The size of the clutch packs along with the number of friction discs and separator plates varies according to the torque loading of the packs. See **Chart 1**.

OPERATION

To provide power flow through the transmission, three of the seven clutch packs must be locked up (engaged). Power flow must travel through 5 shafts when in reverse compared to 4 when in forward. This accomplishes the directional change of power. **Chart 2** shows clutch packs locked up vs. speed as well as which reverse gears correspond to which forward gears.

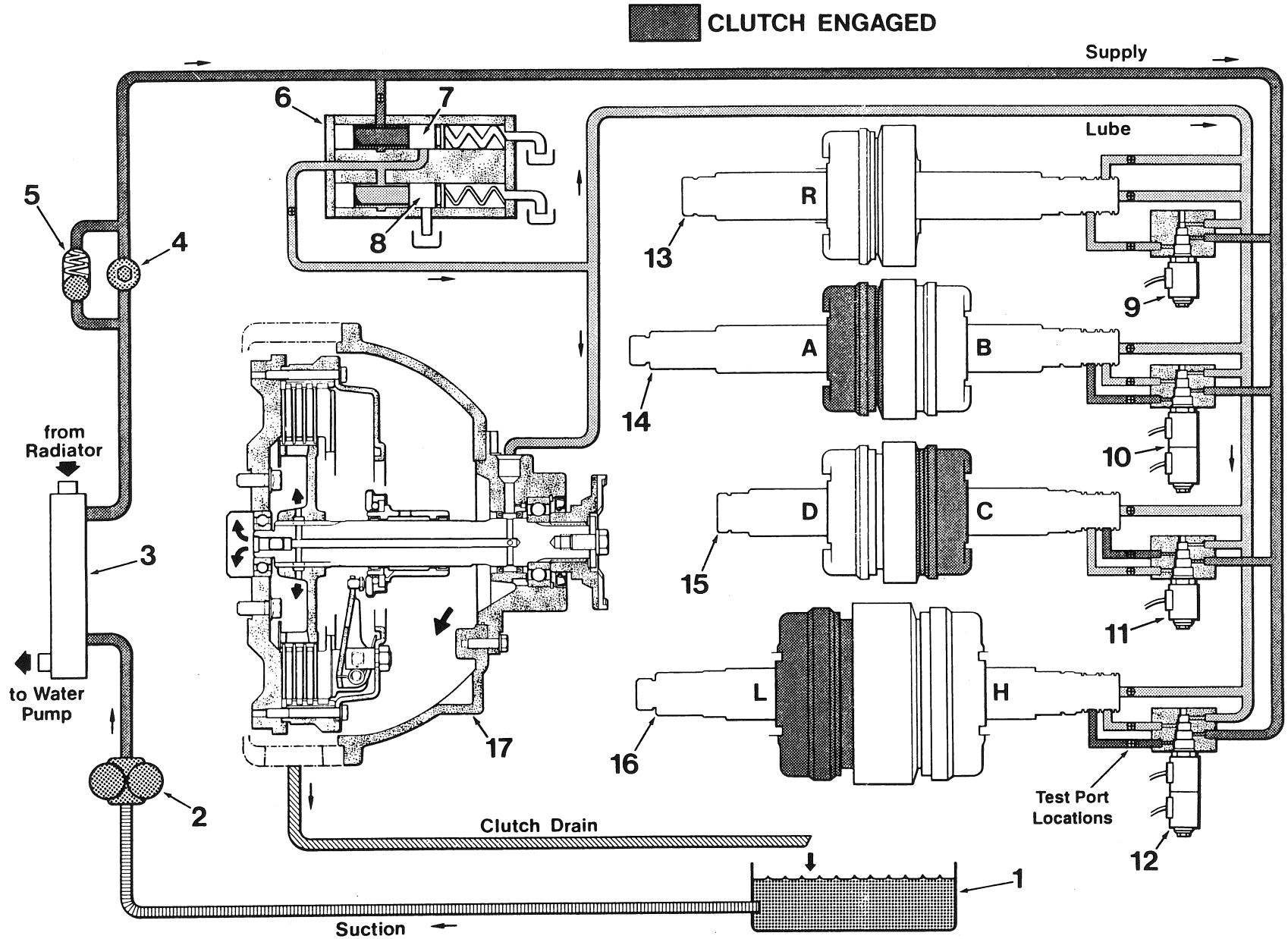
Chart 1

CLUTCH PACK	DIAMETER	PLATES	DISCS
R	5 1/4"	10	11
A	5 1/4"	10	11
B	5 1/4"	10	11
C	5 1/4"	12	13
D	5 1/4"	12	13
L	6 5/8"	10	11
H	6 5/8"	8	9

Chart 2

GEAR	FORWARD	REVERSE	RATIO
F1/R1	ACL	RCL	7.317:1
F2	BCL		5.236:1
F3/R2	ADL	RDL	3.777:1
F4	BDL		2.703:1
F5/R3	ACH	RCH	1.916:1
F6	BCH		1.369:1
F7/R4	ADH	RDH	.987:1
F8	BDH		.707:1
N	C	C	

NOTE: The cutaway illustration shows the reverse shaft above the input shaft, when in fact it is not. This has been done for illustrative purposes only. The right hand illustration shows the location of the cutting plane, pressure test ports and four solenoid cartridge valves.



FIRST FORWARD SHOWN

LEGEND

- | | |
|-------------------------------|-------------------------|
| 1. Transmission Case | 10. A/B Cartridge Valve |
| 2. Transmission/Steering Pump | 11. C/D Cartridge Valve |
| 3. Oil/Water Cooler | 12. L/H Cartridge Valve |
| 4. Filter Assembly | 13. Reverse Shaft |
| 5. Filter Bypass Valve | 14. Input Shaft |
| 6. Pressure Regulator Valve | 15. Intermediate Shaft |
| 7. Lock-up Pressure Spool | 16. Output Shaft |
| 8. Lube Pressure Spool | 17. Engine Clutch |
| 9. R Cartridge Valve | |
-

Transmission oil is drawn from the transmission's sump by the pump and passes through the cooler and filter assembly. Oil is then directed to the 2 stage transmission regulator valve. The first stage sets clutch pack lock-up pressure to 215-235 psi. Once this pressure is reached, the lock-up pressure spool uncovers a passage to the second stage which controls lubrication pressure to a maximum of 25 psi. Should this pressure be exceeded, the lubrication pressure spool uncovers a passage to the transmission sump. Accepted minimum pressure for lubrication is 5 psi. The lock-up pressure section contains 2 springs while the lubrication section has one. Both are shim adjustable.

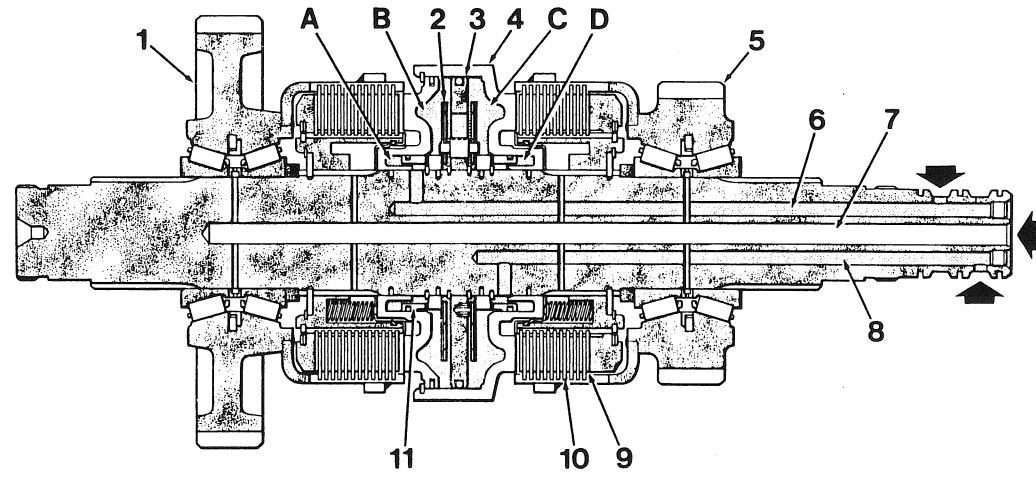
Whenever the engine is running, lubrication oil goes through the centre passage of each transmission shaft as well as to the engine clutch. This supplies oil to lubricate and cool all bearings and friction plates. Having done this, the oil drains back into the transmission sump. Lubrication pressure is also supplied to the four solenoid valve cartridges. Whenever a clutch pack is not applied, the valve directs oil at lubrication pressure to the lock-up cavity. This keeps the cavity full of oil to ensure rapid clutch pack lock-up.

Along with lubrication pressure, lock-up pressure is supplied to the solenoid valve cartridges. With the exception of the C clutch pack, the solenoids block lock-up pressure to the packs until energized. The C clutch pack is always engaged, even in neutral, until the controller energizes the D solenoid.

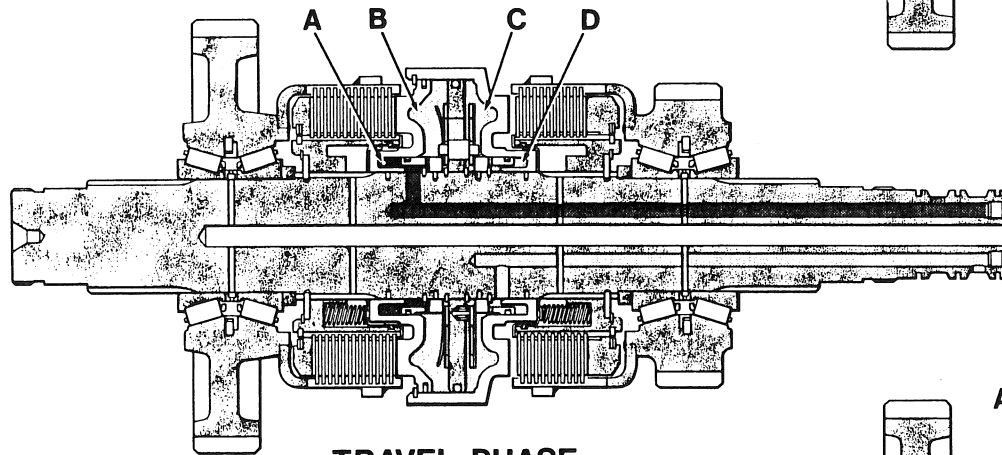
When the operator moves the mode lever out of neutral, the electronic controller energizes the appropriate solenoids by completing their ground circuits. To obtain first gear forward, the operator moves the pulser lever to indicate 1 on the display. With the mode lever in forward, the controller energizes the A and L coils. This combination of clutches, A-C-L, provides the lowest gear ratio available and results in first gear forward.

When the operator wishes to increase speed, he pushes the pulser lever forward to upshift the transmission. Each movement increments the speed by one gear. The controller automatically selects the correct solenoids for the particular gear selected.

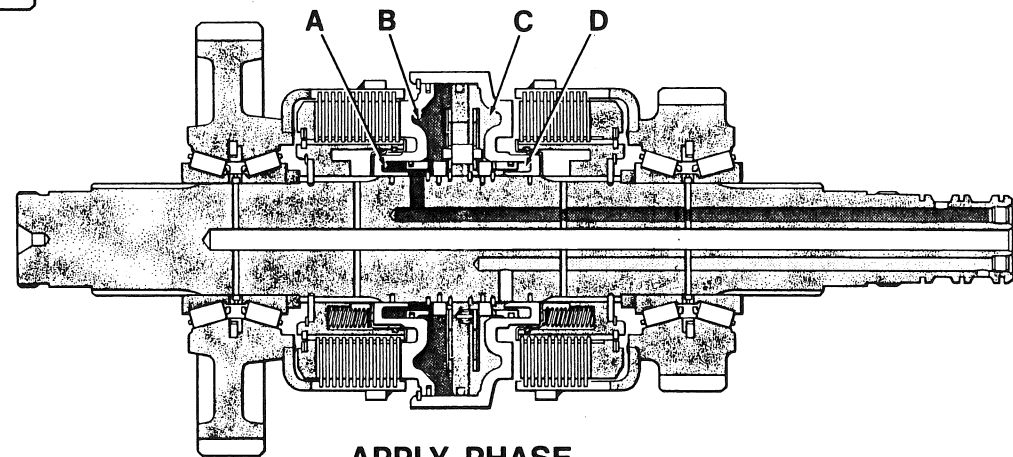
Whenever the mode lever is in reverse the digital display will show a "-" in front of the gear. For example, when first reverse is selected by the operator, the display will show -1. The controller energizes the R and L coils. This combination of clutches, R-C-L, provides the lowest reverse gear ratio available and results in first gear reverse.



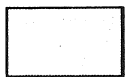
NEUTRAL PHASE



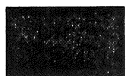
TRAVEL PHASE



APPLY PHASE



LUBE PRESSURE



LOCK-UP PRESSURE

LEGEND

- | | |
|----------------------------|---|
| 1. High Gear | 10. Steel Drive Plates |
| 2. Disc Valve (2 Parts) | 11. Accelerator Piston |
| 3. Separator Plate | A. High Gear Accelerator
Piston Cavity |
| 4. Lock-up Piston | B. High Gear Lock-up Cavity |
| 5. Low Gear | C. Low Gear Lock-up Cavity |
| 6. High Clutch Oil Passage | D. Low Gear Accelerator
Piston Cavity |
| 7. Lubrication Oil Passage | |
| 8. Low Clutch Oil Passage | |
| 9. Friction Disc | |
-

Hydraulic clutch packs consist of one set of bronze-faced friction discs, splined to a rotating shaft and one set of steel plates retained in a drum and gear assembly by means of external tangs. The drum and gear are allowed to rotate independently of the shaft by mounting them on a bearing. The discs and plates are alternated in the pack so that two of the same type are not located side by side. By squeezing these discs and plates together, we can effectively connect or lock the gear to the shaft. To perform this function an assembly similar to a hydraulic cylinder is used. The operation of the assembly is detailed below.

NEUTRAL PHASE

Lube oil is fed to both sides of the clutch pack by the high and low¹ oil passages. At all times oil at lube pressure flows down the centre lubrication passage and through cross drillings to lubricate the bearings and cool the clutch discs in both packs.

TRAVEL PHASE

Travel phase begins when the solenoid valve is energized to engage high clutch. This delivers oil at lock-up pressure down the high clutch oil passage into the high gear accelerator piston cavity. Lube oil is fed down the low clutch and lubrication oil passages. As pressure builds within the accelerator piston cavity, the lock-up piston begins to move to the left. At the same time the accelerator piston pushes the guide pins and holds the low clutch disc valve open on the right side of the separator plate allowing oil to transfer through into the high gear lock-up cavity. This transfer of oil ensures the high gear lock-up cavity is quickly filled with oil.

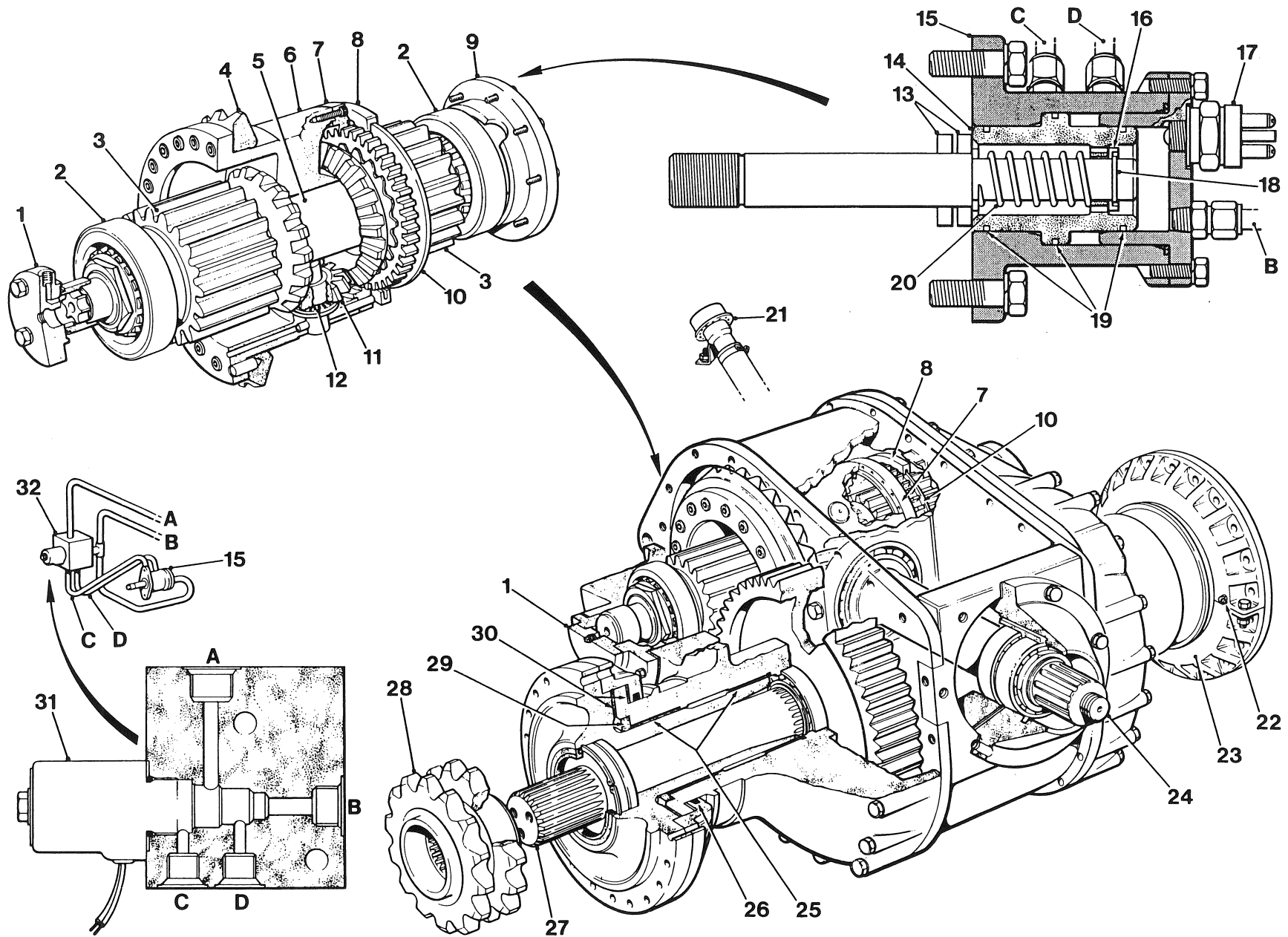
APPLY PHASE

At the end of the travel phase, pressure builds within the lock-up cavity due to oil entering via a small drilling in the accelerator piston. The disc valve closes and full lock-up pressure is achieved. The clutch pack will remain applied as long as lock-up oil pressure is directed to it. Very little oil is required to maintain lock-up.

To engage low clutch, low solenoid valve is energized directing lock-up pressure down the bottom passage, and lube oil down the top and centre passages.

The oil transfer between cavities is used to quicken lock-up and eliminate pressure drops while the clutch cavity fills. During the apply phase lock-up oil pressure in B is opposed by lubrication oil pressure in C. Both pressures must be maintained within specifications as the apply force is dependent upon the difference. Conversely, too high of an apply force can lead to friction disc damage.

¹ - High and Low are used for the purpose of clarification only. The diagram is not representative of the actual High/Low shaft found in the 8400 transmission.



LEGEND

- | | |
|----------------------------|---------------------|
| 1. Oil Pump | 20. Spring |
| 2. Taper Roller Bearing | 21. Vent |
| 3. Bull Spider Pinion | 22. Grease Fitting |
| 4. Ring Gear | 23. Half Ring |
| 5. Cross Shaft | 24. Pinion Shaft |
| 6. Differential Hub | 25. Sleeve Bushings |
| 7. Shift Clutch Gear | 26. Uniring Seal |
| 8. Shift Fork | 27. Drive Axle |
| 9. Cross Shaft Bearing Cap | 28. Drive Sprocket |
| 10. Shift Clutch | 29. Lip Seal |
| 11. Spider Gear | 30. Thrust Plates |
| 12. Bearing | 31. Shift Solenoid |
| 13. Shift Rail Seals | 32. Shift Valve |
| 14. Shift Piston | |
| 15. Shift Cylinder Body | A - Pressure |
| 16. Spring Retainer | B - Drain |
| 17. Switch | C - Unlock Port |
| 18. Snap Ring | D - Lock Port |
| 19. Hook Type Seal Rings | |

The double reduction final drive is used on models 750A and 780A graders, and incorporates a lock/unlock differential as standard equipment. The double reduction final drive is a positive drive gear box providing a gear reduction and a directional change of the power flow. The power enters on the pinion shaft and is transferred to the crown gear which is in turn, splined to the cross shaft. The cross shaft is supported by taper roller bearings, and also carries two bull pinions. The bull pinions mesh with twin bull gears which are supported by roller bearings.

Splined to the bull gear is a semi-floating drive axle (so named because it carries no weight). It is supported at the outer end by a double race, self-aligning roller bearing. The weight of the grader is transferred from the final drive to the tandem by means of the flanged sleeve which oscillates in two teflon-coated, steel-backed bronze bushings, pressed

into the extension housing. This assembly is held together by the split ring, which allows oscillation, but prevents lateral movement of the flanged sleeve in the bushings. Differential lock/unlock allows both maximum traction in the locked position and minimum turning radius in the unlocked position. Normal operating position should be locked. An indicator light in the cab energizes when the differential is unlocked.

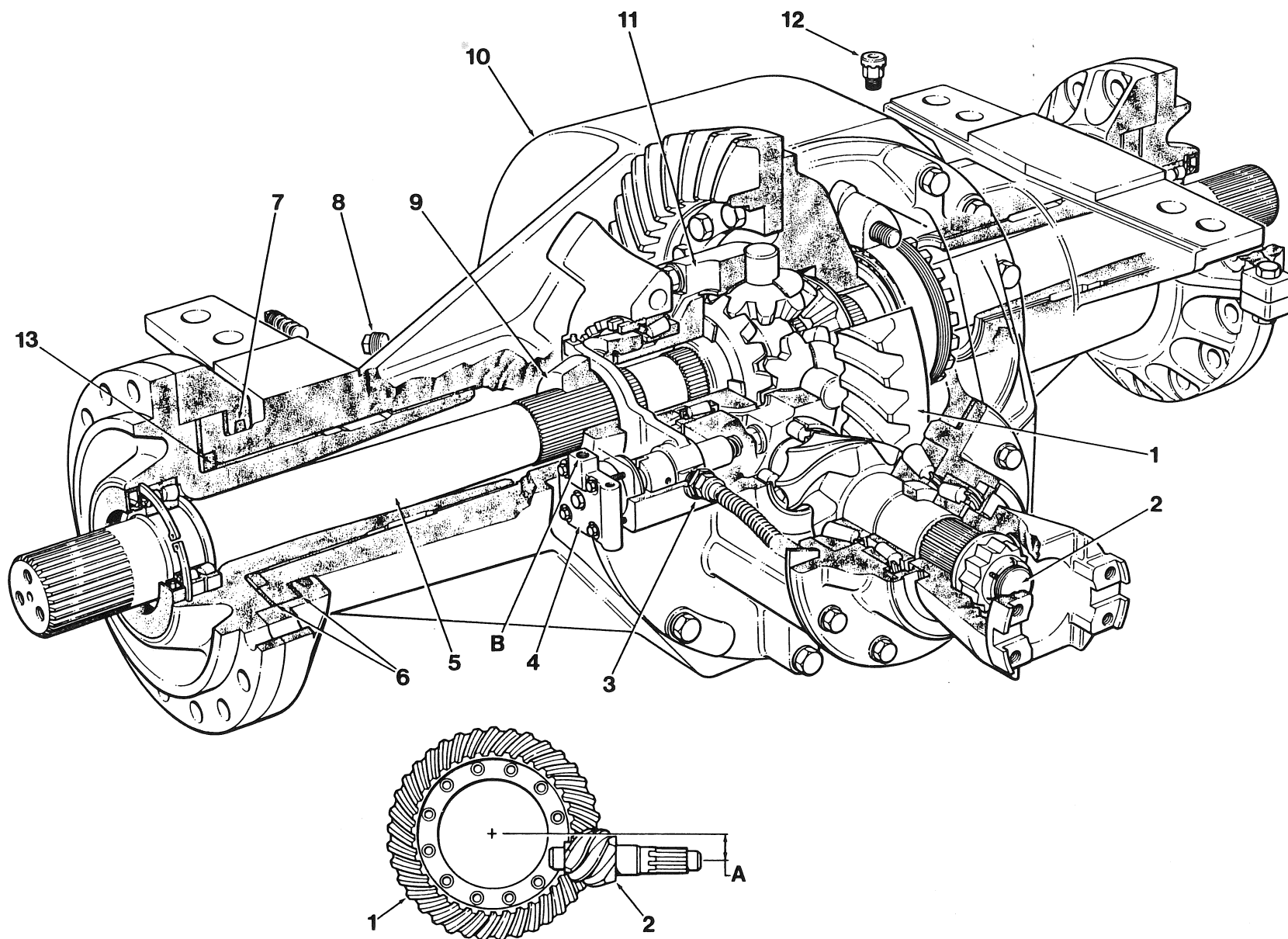
To lock or unlock the differential an electric solenoid valve is controlled by a switch on the right-hand cab door post. Energizing the solenoid directs transmission lock-up oil pressure to port C on the cylinder body. This pulls the shift fork to unlock the spider pinions, disengaging the shift clutch from between the left-hand axle shaft and the differential hub, allowing differential action. At full travel the shift piston contacts a normally open switch, closing it to energize the indicator light in the cab.

To lock the differential, the solenoid is de-energized. This directs oil to flow to the shift cylinder body at port D. Oil pressure against the shift piston engages the shift clutch, locking the left-hand axle to the differential hub.

All return oil exits at port B and returns to the clutch housing cover, eventually draining back to the transmission sump. See page 38.

To lubricate the bull gear pinion bearings and the spider gears, a small bi-directional oil pump is mounted on the end of the right cross shaft. It sends oil flow down the cross shaft and lubricates the bearings and gears through small cross drilled passages. The recommended final drive lubricant is a hypoid gear oil. Do not use a mineral base lubricant. First lubricant change at 100 hours, thereafter every 2000 hours or 12 months, whichever comes first. The lubricant level check interval is weekly, or every 50 hours, whichever comes first.

Refer to the Shop Manual for specifications.



LEGEND

- | | |
|---------------------------------|---------------------------------|
| 1. Ring Gear | 9. Shift Collar |
| 2. Pinion Shaft/Gear | 10. Final Drive Housing |
| 3. Lock/Unlock Indicator Switch | 11. Differential Housing |
| 4. Shift Cylinder | 12. Breather |
| 5. R.H. Axle Shaft | 13. Lip Seal |
| 6. Thrust Plates | |
| 7. Seal | A. Hypoid Gear Offset |
| 8. Level Check Plug | B. Shift Cylinder Pressure Port |
-

The Single Reduction SR30 Final Drive is used on models 710 thru 726A VHP graders and the Single Reduction SR40 Final Drive is used on models 730 thru 740A graders. Refer to the Parts Manual for the effective grader serial numbers.

Both SR final drives use a hypoid gear set. Hypoid gear sets position the drive pinion shaft below the center line of the ring gear - dimension A. Hypoid gear design provides the drive pinion to ring gear one and one half additional tooth contact over conventional spiral bevel ring gear drive design, resulting in 30% more tooth strength against shock loads. They use a similar design of semi-floating axle and flanged sleeve as the double reduction final drive. This permits the weight of the grader to be transferred directly to the tandems through the final drive housing.

Both SR final drives feature differential lock/unlock as standard equipment. The differential lock is operated by a hydraulic actuated shift cylinder assembly that is mounted on the differential housing assembly. An electric switch on the right-hand cab post is activated to lock or unlock the differential. With the switch in the down position, the solenoid valve is energized and directs continuous oil pressure, supplied from the filtered side of the transmission filter to port B on the shift cylinder. The piston moves the shift fork against a spring until the collar engages the splines on the differential case. The right-hand axle shaft is now locked to the differential assembly. No differential action occurs between the tandems.

For differential action, the operator moves the switch to the UP position, opening the circuit and de-energizing the solenoid valve. The spring moves the shift fork and collar away from the differential case, providing differential action.

The red indicator light is mechanically switched by the shift fork. Therefore, the light is independent of the switch and reflects the true position of the differential lock.

The recommended final drive lubricant is a hypoid gear lube. The lubricant level check interval is weekly, or every 50 hours, whichever comes first. First lubricant change at 100 hours, thereafter every 1000 hours or 6 months, whichever comes first.

Refer to the Shop Manual for specifications.

LEGEND

- | | |
|--------------------------------------|-------------------------|
| 1. Brake Master Cylinder | 8. Secondary Piston |
| 2. Return Collector Manifold | 9. Primary Piston |
| 3. Relief Valve | 10. Flow Switch |
| 4. Hydraulic Pump -
Third Section | 11. Inlet |
| 5. Compensator Valve | 12. Orifice |
| 6. Cap | 13. Power Piston |
| 7. Reservoir | 14. Booster |
| | 15. Motor/Pump Assembly |
-

The booster is a self-contained reservoir and pump assembly. It effectively provides the operator with hydraulic pedal assistance when the brake pedal is applied.

The master cylinder features two separate chambers providing two independent brake circuits. Refer to the Champion Operator's Manual Lubrication Specifications for important fluid information.

A third section on the main hydraulic pump provides hydraulic power for the brake booster. It is independent of any other hydraulic functions. The brake hydraulic circuit also has its own relief valve, identical to the main hydraulic system relief valves, set at 2100 psi.

Reserve Power Assist

In the event of an engine stall or any situation where oil flow is interrupted to the service brake booster, an electric motor/pump will supply hydraulic power assist automatically. In this instance, the operator is alerted that the grader is functioning on the reserve system by a brake warning light and alarm. This supplementary system provides power assisted brake capability at a reduced level until main hydraulic flow is restored. The system automatically shuts off when hydraulic flow is restored.

NOTE: All reserve or supplementary braking systems are designed to bring the machine to a safe stop, or hold the machine on a slope until the **PARK/EMERGENCY** brake is applied. These systems are not intended for continuous use.

Dual Braking System

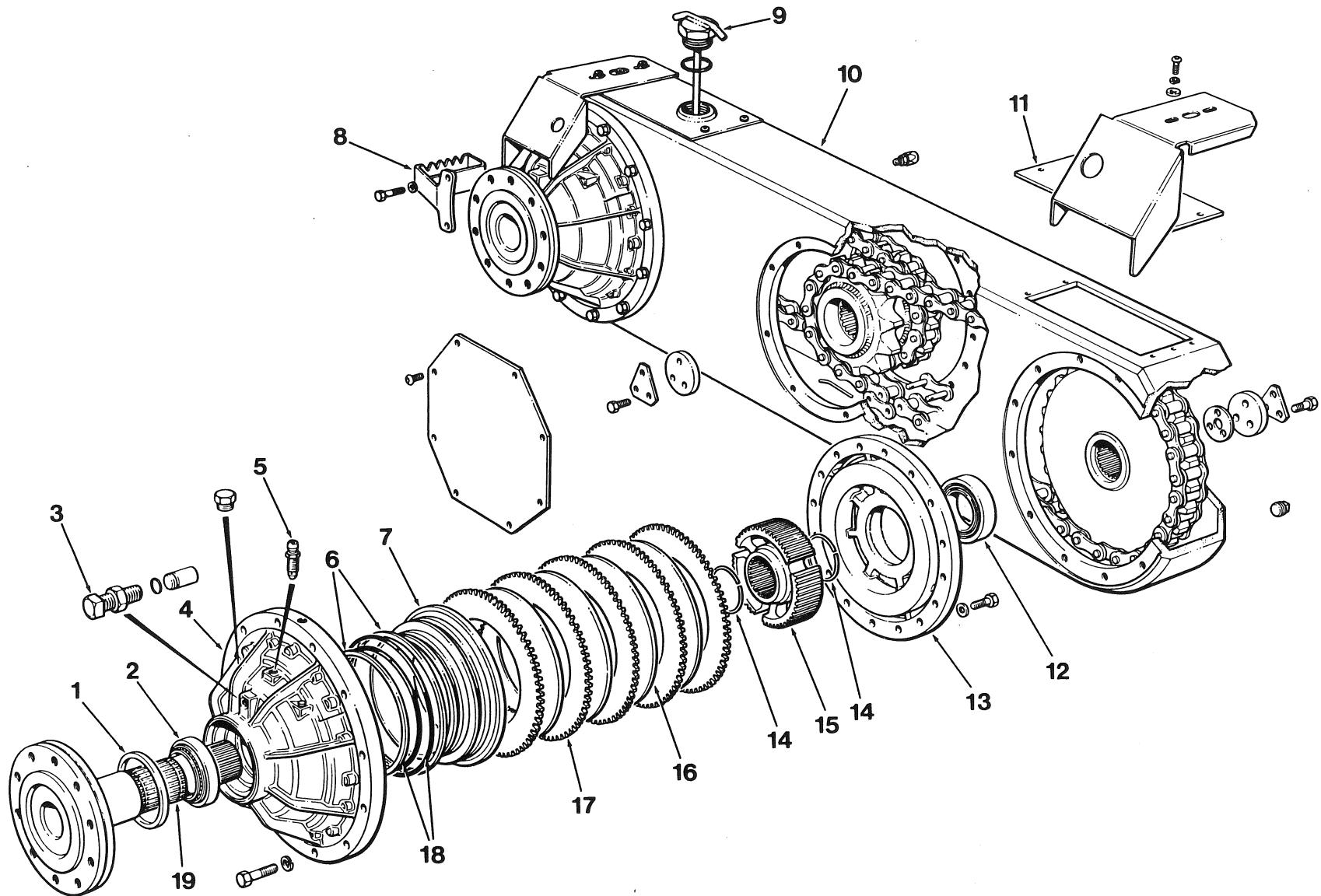
All models are equipped with four wheel dual brake system as standard equipment.

The dual braking system provides reduced braking capability in the event of a brake line rupture or other failure in one circuit.

Each of the two circuits function on one front, and opposite rear driven wheels. Should one circuit fail, there is braking on both sides of the machine and it remains effective on all four drive wheels through the tandem chains.

If the system is functioning on only one of the two circuits, the operator is alerted by a brake warning light and alarm, energized when the brake pedal is depressed.

Refer to Shop Manual for specifications.



LEGEND

- | | |
|---------------------------------|----------------------|
| 1. Oil Seal | 11. Inspection Cover |
| 2. Bearing | 12. Bearing |
| 3. Piston Travel Limiting Screw | 13. Inner Housing |
| 4. Outer Housing | 14. Snap Ring |
| 5. Bleeder Screw | 15. Hub |
| 6. Back-up Rings | 16. Friction Disc |
| 7. Piston | 17. Reaction Plate |
| 8. Level Check Plug | 18. O-Rings |
| 9. Filler Plug | 19. Axle |
| 10. Tandem | |
-

The Champion Oil Disc Brake System consists of four brake units, a hydraulic brake booster with an integrated electric back-up pump, a master cylinder with reservoir and flexible hydraulic brake lines.

The hydraulic brake booster multiplies the braking effort of the pressed brake pedal and transfers it to the master cylinder. Refer to "Service Brakes Hydraulic Circuit" page 53 for information about the master cylinder and booster assembly.

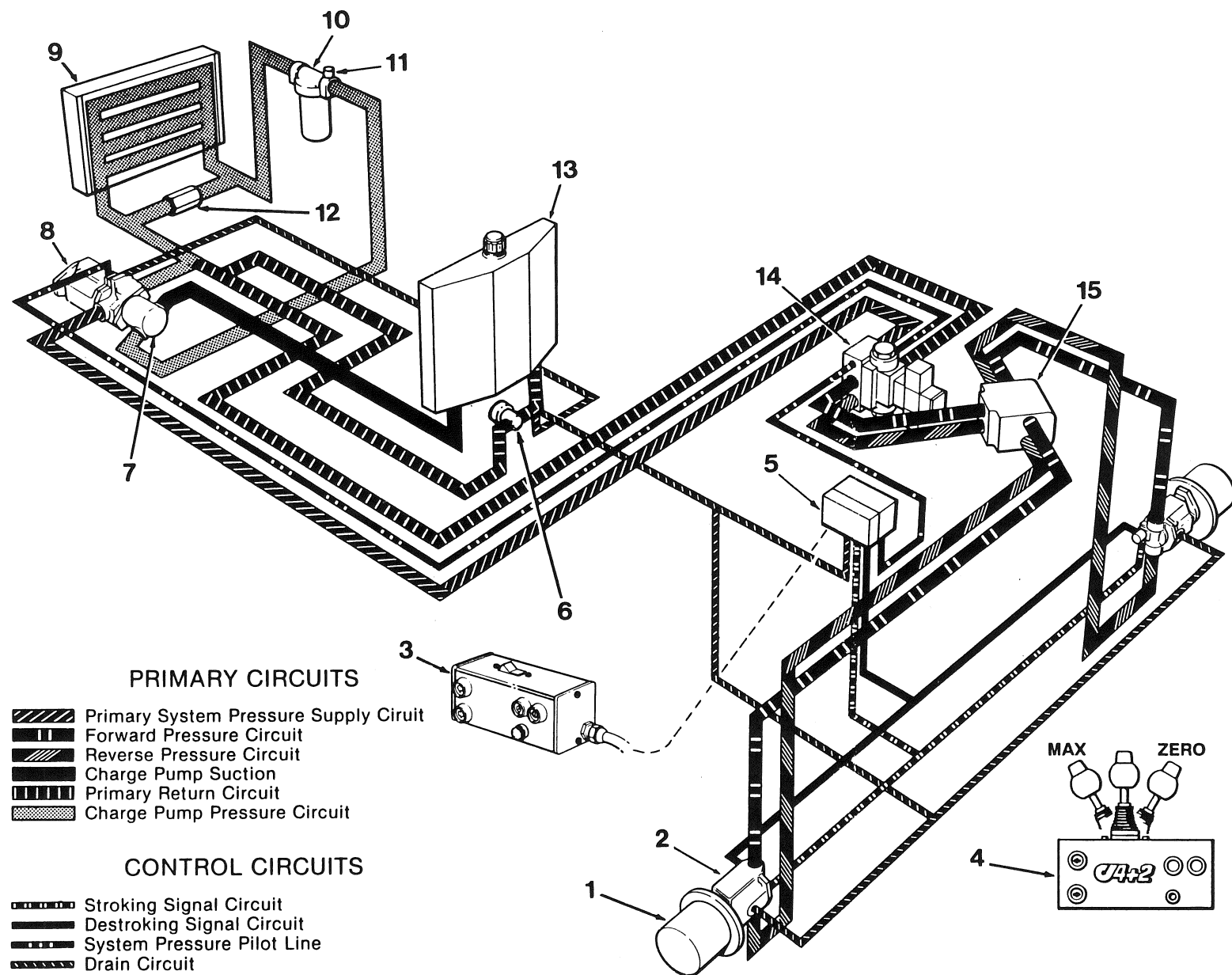
The Oil Disc Brake units are supplied with application fluid from the dual circuit master cylinder. Each of the two outlet ports on the master cylinder use a "T" fitting, connected to flexible brake hoses that divide the apply fluid in a diagonal pattern to the four brake units.

The application fluid enters the brake unit at the top of the brake housing. In the piston chamber, the fluid moves the piston away from the "piston travel limiting screw" toward the friction disc and reaction plate assembly. As the piston compresses the plates and discs together, the tandem oil is forced out of the friction disc grooves. Braking action results as the friction discs contact the reaction plates.

The friction discs are splined to a hub that is splined to the axle shaft. The wheel and tire assembly is bolted to the axle shaft. In an emergency stop situation, with the brake pedal pressed at full force, the friction disc and reaction plate assembly will lock up.

To release the brakes, lift the foot off the brake pedal. The apply fluid pressure will vent to the master cylinder reservoir. The grooves in the rotating friction discs allow the tandem oil to pass between the stationary reaction plates and friction discs. This allows the plates and discs to separate slightly moving the piston toward the "piston travel limiting screw". Once the piston releases its clamping force, the discs, hub, axle, wheel and tire rotate freely.

Refer to the Operator's Manual for more information.
Refer to the Shop Manual for specifications.



LEGEND

- | | |
|---|------------------------------------|
| 1. Planetary Reduction
Wheel Hub | 7.Charge Pump |
| 2. Wheel Motor | 8.Main System Pump |
| 3. Control Box -
Simplified Controls | 9.Oil Cooler |
| 4. Control Box -
Phase II | 10.Filter |
| 5. Motor Control Valve | 11.Charge Pressure
Sending Unit |
| 6. Oil Temperature
Sending Unit | 12.Check Valve |
| | 13.AWD Reservoir |
| | 14.Selector Valve |
| | 15.Flow Divider |
-

OVERVIEW

All Wheel Drive (AWD) is a hydrostatic assist system used in the front wheels to increase tractive effort and steering control in slippery conditions. The front wheels are driven by variable displacement motors driving through double reduction planetary hubs. A variable displacement, piston pump supplies power to the motors. The AWD hydraulic system contains its own reservoir, oil cooler, filter, pumps and motors. It is completely separate from all other hydraulic systems on the grader. AWD is available in all forward speeds except 8th and all reverse speeds. The control box turns the AWD system on and off and has several lights that indicate forward or reverse activation, excessive oil temperature and low charge pressure.

CIRCUIT

The charge pump supplies cool, filtered oil to the system and keeps the closed loop charged under low pressure to prevent cavitation. It draws its fluid from the system reservoir. The charge pump also makes up for a controlled amount of leakage in the hydraulic components which is necessary for lubrication as well as oil used in the control circuit. The main pump provides high pressure for the AWD system. Exiting from the main pump, the oil flows to the selector valve (for directional control), to the flow divider valve (for limited slip differential control) and on to the wheel motors. Oil from the motors is returns through the flow

divider and selector valves to the inlet of the main hydraulic pump. The motor control valve regulates stroke and destroke pressures which control the power output of the wheel motors. If the control is in the off position, a small amount of oil is directed at low pressure to provide cooling and lubrication for the wheel motors.

CONTROLS

PHASE II

When the control lever is in its rearward ZERO position it is off. As the control lever is moved forward, stroke pressure increases. Stroke pressure is regulated by a force motor on the motor control valve. The force motor controls the opening of a variable drain orifice. As the hand controller is moved toward the MAX. position, applied voltage to the force motor increases. This decreases the orifice size and raises stroke pressure. Pressure switches on the transmission inform the control box which direction and gear have been selected.

SIMPLIFIED CONTROLS

Effective at S/N 21572, the AWD control system was redesigned to utilize the transmission controller and to simplify the system. The stroke pressure is controlled by a simple on/off switch on the control box. This activates a solenoid valve and a pressure reducing valve on the motor control valve. The transmission controller was modified to provide an additional wire that is used to turn AWD on in gears 1 through 7 forward. The back-up alarm circuit is used for controlling reverse. This eliminates all pressure switches on the transmission.

HIGH TORQUE

Effective at S/N 22101, the AWD system was modified to increase tractive effort to the front wheels.

- main pump flow increased to 30 gpm from 25
- maximum system pressure increased to 3500 psi from 3200
- planetary reduction ratio was increased to 30:1 from 26:1

