700 SERIES GRADER

Series III

Service Training Manual

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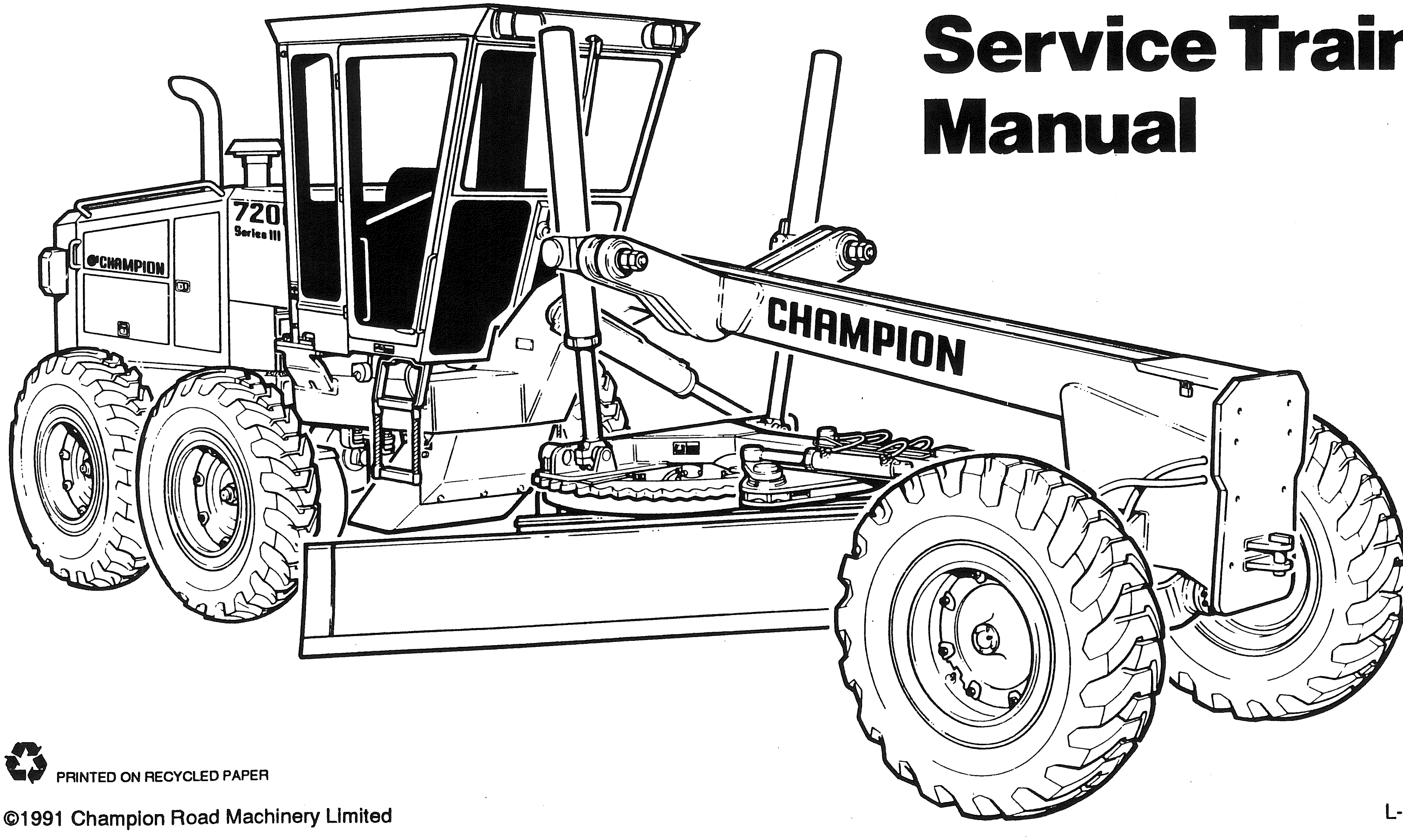

L-5003-01 (10/91)

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The following abreviations 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

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.

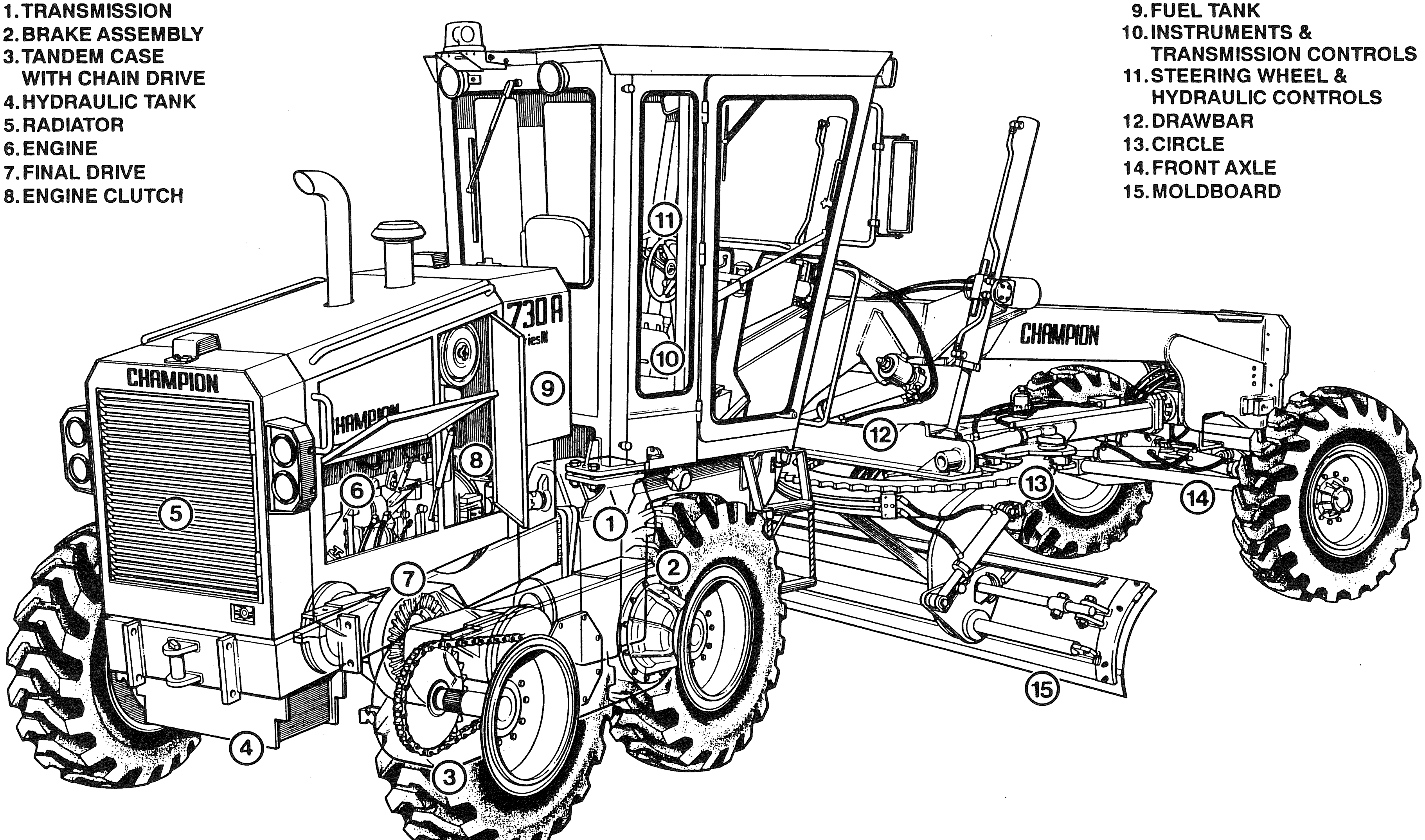
REFER TO THE SHOP MANUAL FOR SAFETY WARNINGS, SPECIFICATIONS, SPECIAL TOOLS AND CORRECT SERVICE PROCEDURES. ALWAYS READ AND UNDERSTAND THE SAFETY WARNINGS AND OPERATING PRECAUTIONS FOUND IN THE GRADER OPERATOR'S MANUAL BEFORE ATTEMPTING TO OPERATE ANY MOTOR GRADER.

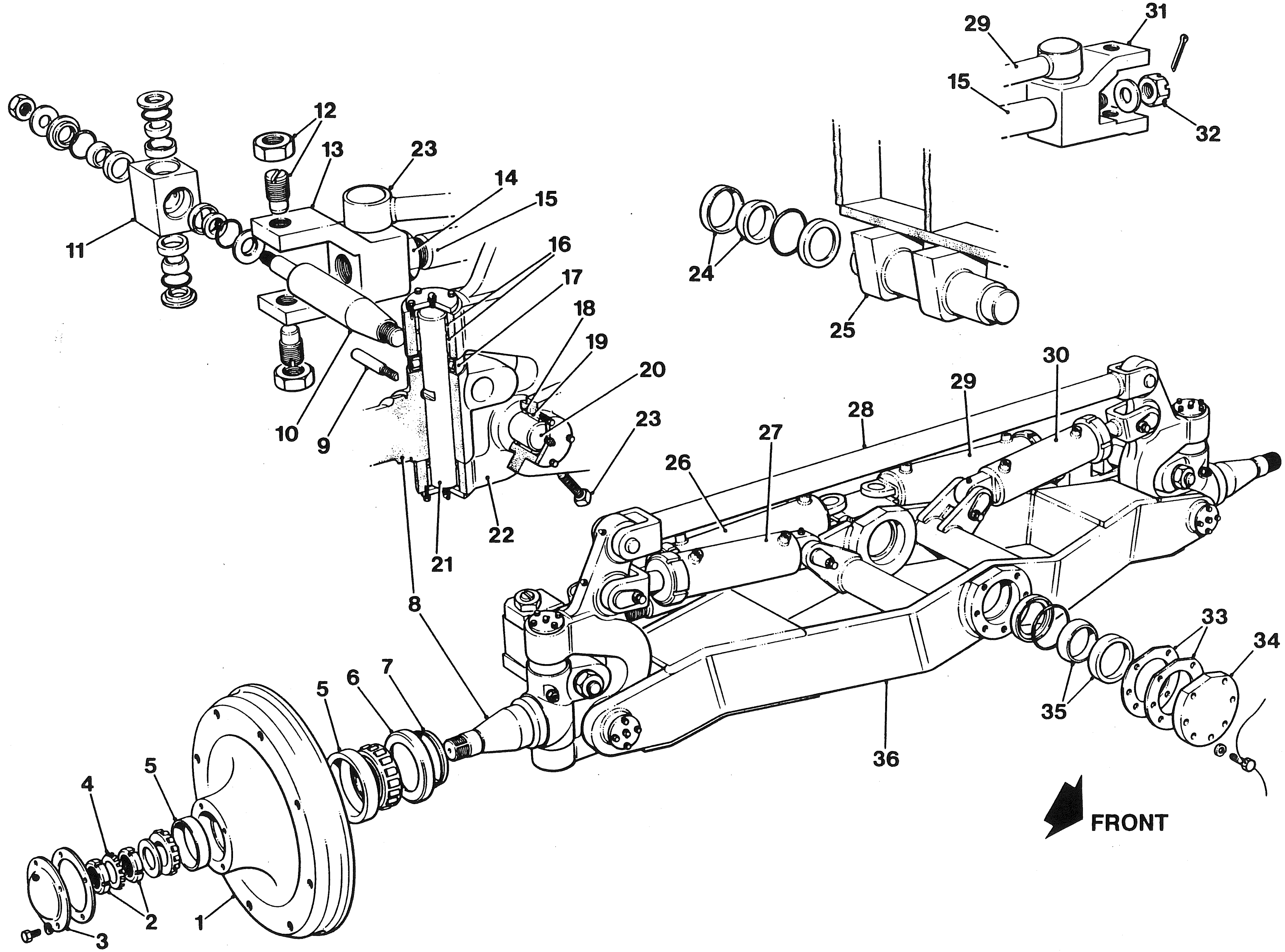
This manual generally applies to **Series III** motor graders **S/N 20605 and up**. However, most principles presented apply to earlier machines also.

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

1. TRANSMISSION
2. BRAKE ASSEMBLY
3. TANDEM CASE WITH CHAIN DRIVE
4. HYDRAULIC TANK
5. RADIATOR
6. ENGINE
7. FINAL DRIVE
8. ENGINE CLUTCH
9. FUEL TANK
10. INSTRUMENTS & TRANSMISSION CONTROLS
11. STEERING WHEEL & HYDRAULIC CONTROLS
12. DRAWBAR
13. CIRCLE
14. FRONT AXLE
15. MOLDBOARD

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35
36
FRONT

LEGEND

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

** Optional on some models.*

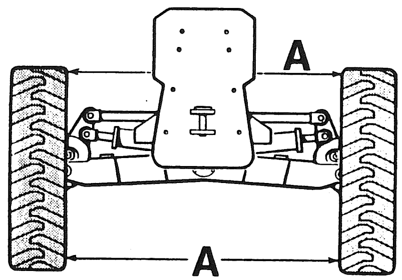
The front axle of a motor grader must perform several functions: **steering, oscillation** and **front wheel lean.** It must also have the ability to carry heavy front mounted attachments. The Champion front axle is designed to provide long life with minimum maintenance.

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

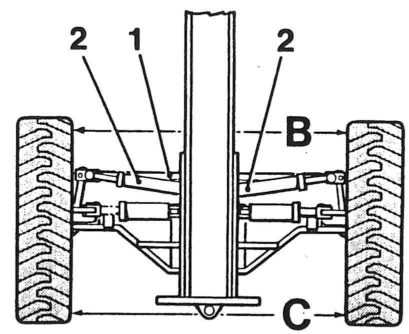
Steering is accomplished by the spindle pivoting on the king pin, through the action of the two hydraulic steering cylinders. The drag link makes both sides turn together. The toe-in is adjusted by loosening the lock nut on the right-hand yoke and turning the drag link. See page 9 for details. Front wheel lean is accomplished by pivoting the knuckle/spindle assembly on the knuckle pivot pin. 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, in that it allows 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 ditch cutting applications. Axle pivot preload is increased by removing shims.

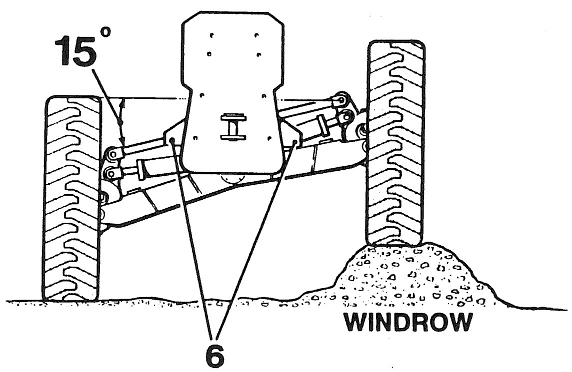
Under most applications, the front axle requires greasing only once a week. Champion recommends the front wheels be lifted off the ground at every fourth greasing. Place a suitable safety stand under the nose plate before greasing. Always increase the greasing intervals if operating in extremely dusty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



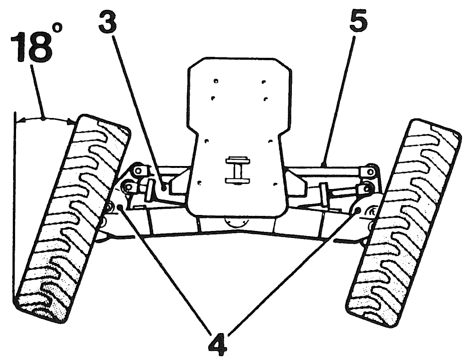
CAMBER



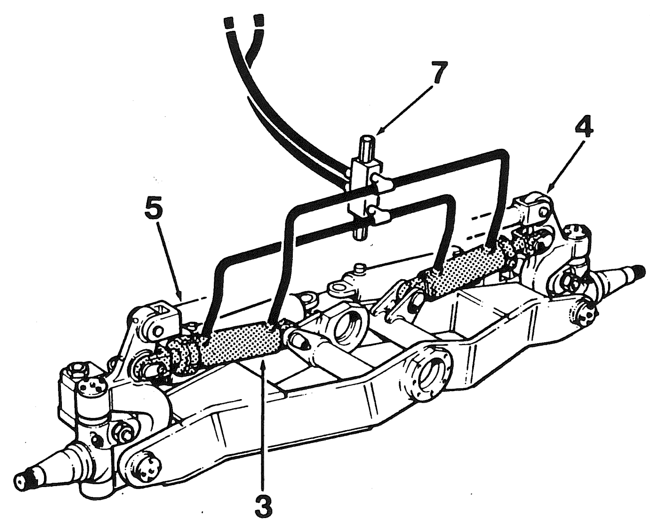
TOE-IN



OSCILLATION



WHEEL LEAN



LEGEND

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

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, (except All Wheel Drive models where **0** toe-in is specified) dimension **B** is 1/2" - 5/8" larger than dimension **C**. 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. But more importantly the toe-in puts a small compression load on the steering linkage. This reduces the pounding of the pivot points as the grader works and also increases component life.

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.

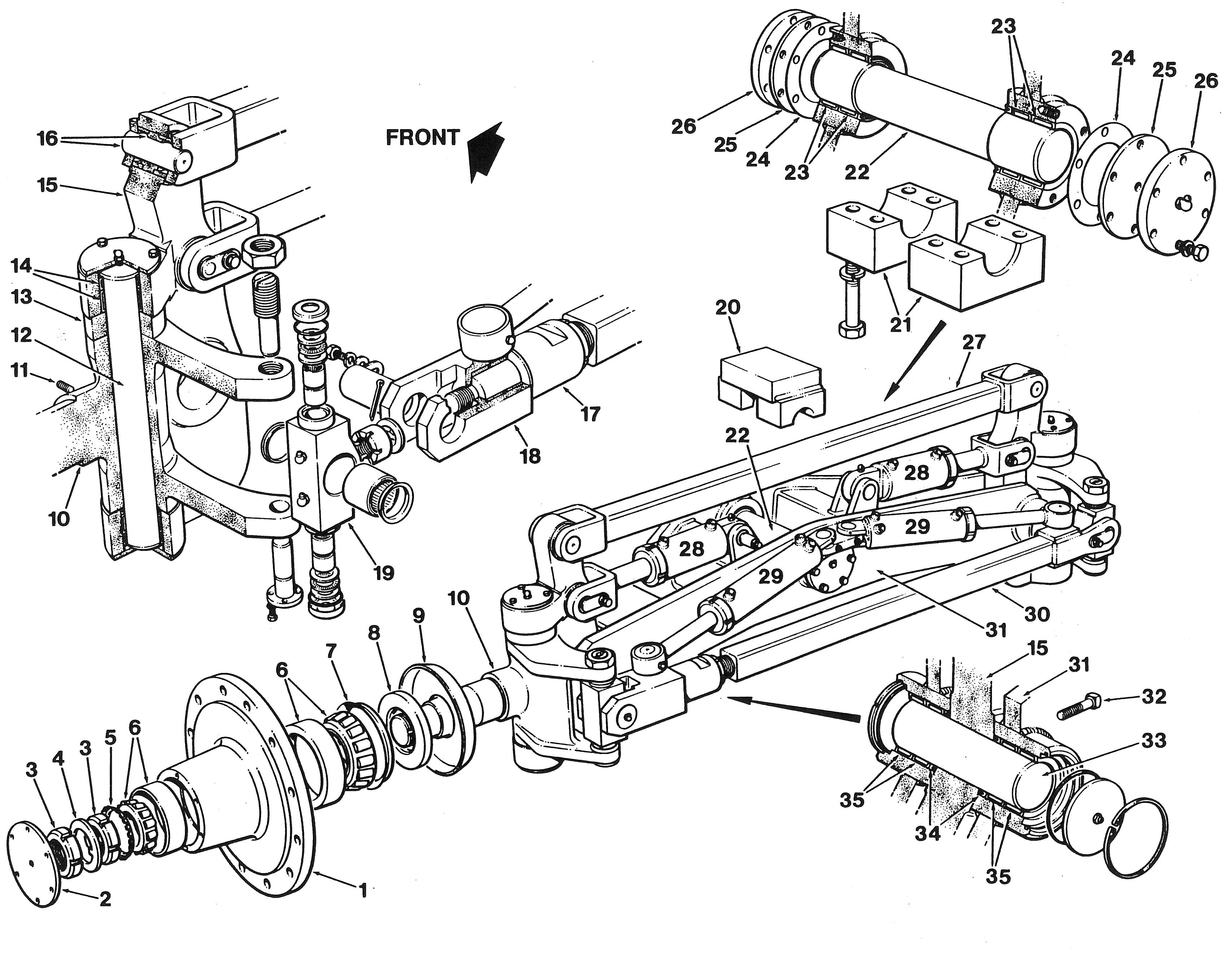
2. Place the grader in the service position. Mark an **X** on each tires' inside side wall parallel with the spindle at the tires' front. Measure the distance **C**, between the two tires at the **X** marks.

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.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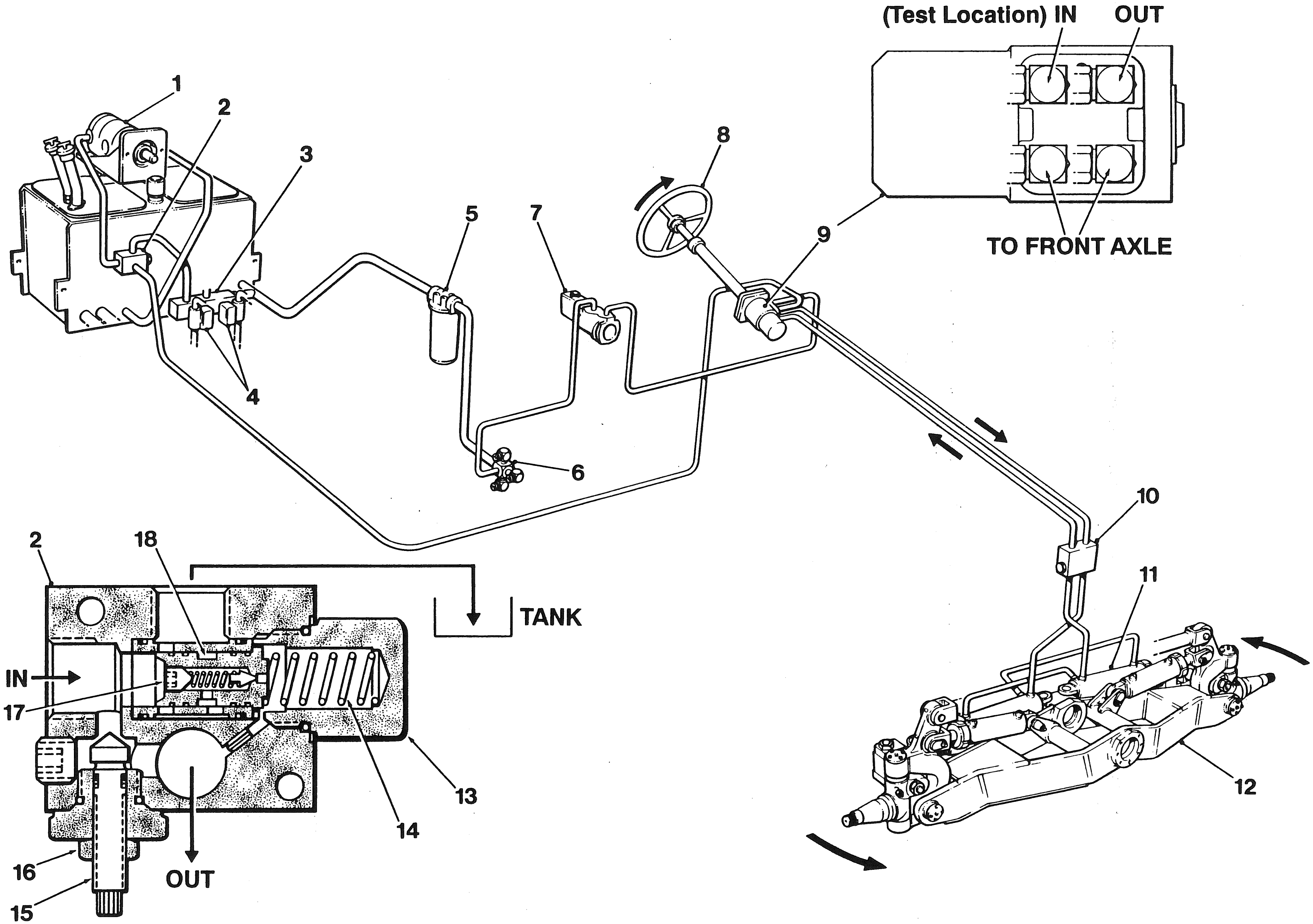
LEGEND

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

Models 780/780A front axle performs all of the same functions as the standard front axle. 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 the 780/780A applications. This axle has wider spacing (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.


(Test Location) IN
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TANK
IN
OUT

LEGEND

1. Transmission/Steering Pump
2. Priority Flow/Relief Valve Assembly
3. Manifold Return Block (Reference only)
4. Main System Relief Valves (Reference only)
5. Return Line Filter
6. 5 Way Connector
7. Clutch Master Cylinder Booster Assembly
8. Steering Wheel
9. Steering Valve - Open Centre
10. Cushion Valve
11. L.H. Steering Cylinder
12. Axle
13. Spring Cap
14. Balance Spring
15. Flow Adjustor
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 consistant 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 5 way connector, 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 performs two important functions:

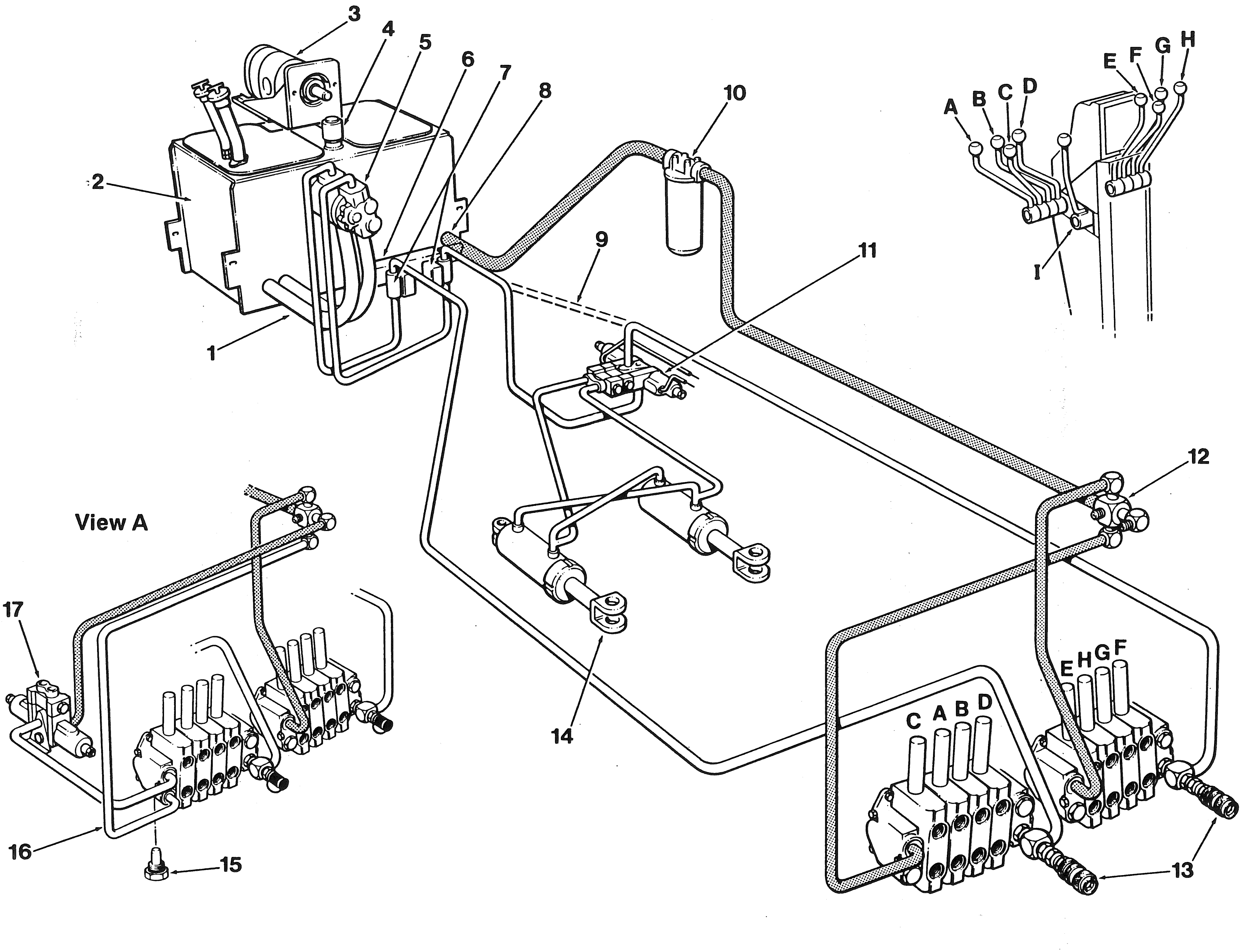
1. It prevents shock forces to the steering valve if for instance a front wheel drops into a hole.
2. It also becomes a bypass valve allowing oil to return to the steering valve, if the operator continues to turn the steering wheel after the wheels reach lock. The cushion valve is actually two valves in one housing. See page 17.

NOTE: Do not continue to turn the steering wheel after the wheels reach turning lock. This prevents unnecessary stress to the steering components.

The system is protected by a relief valve (set at 2300 ±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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LEGEND

1. Dual Suction Lines
2. Hydraulic Tank
3. Transmission/Steering Pump (Reference only)
4. Breather
5. Main Hydraulic Pump
6. Relief Valve Manifold Block
7. Relief Valve
8. Tank Return
9. Rigid Frame Bypass
10. Return Line Filter
11. Articulation Valve
12. 5 Way Connector
13. Quick Coupler Test Ports
14. Articulation Cylinders

VIEW 'A'

Front Mounted Attachment Circuit

15. Power Beyond Plug
16. Drain Line
17. Attachment Valve

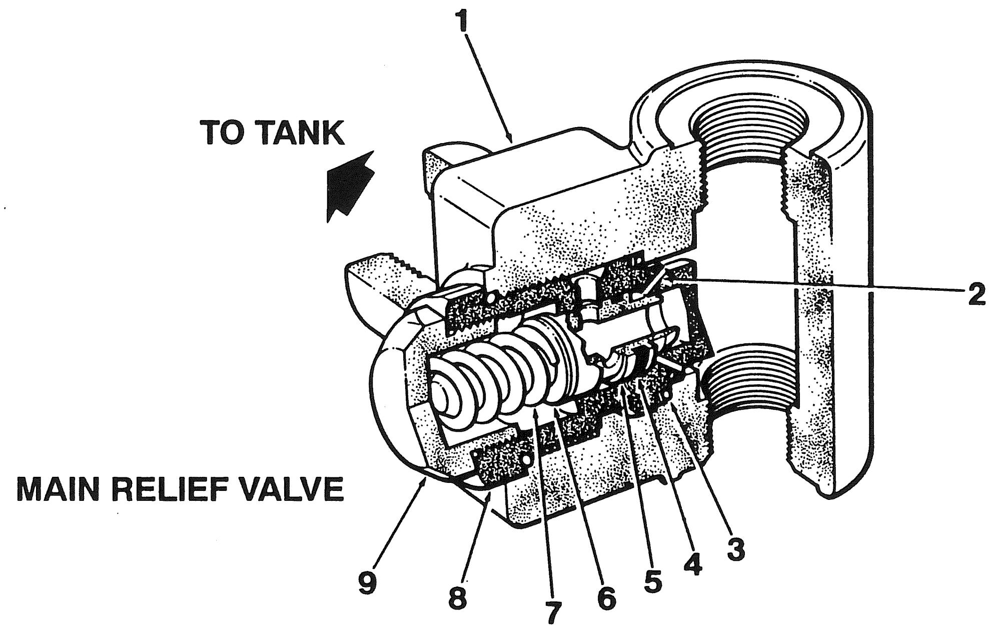
Champion motor graders use two main hydraulic systems. This twin flow hydraulic system uses separate gear pumps, relief valves and open centre manifold control valves for each side. Both main hydraulic pumps are contained in a single housing mounted to the engine's accessory drive. Each section has its own suction line and is protected by a separate relief valve set at 2100 $\pm$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 5 way connector, 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. 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 cylinders diagonally powered, providing even articulation speed left or right of centre.

Special consideration must be given when connecting additional solenoid valves to the manifolds, whether they are 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.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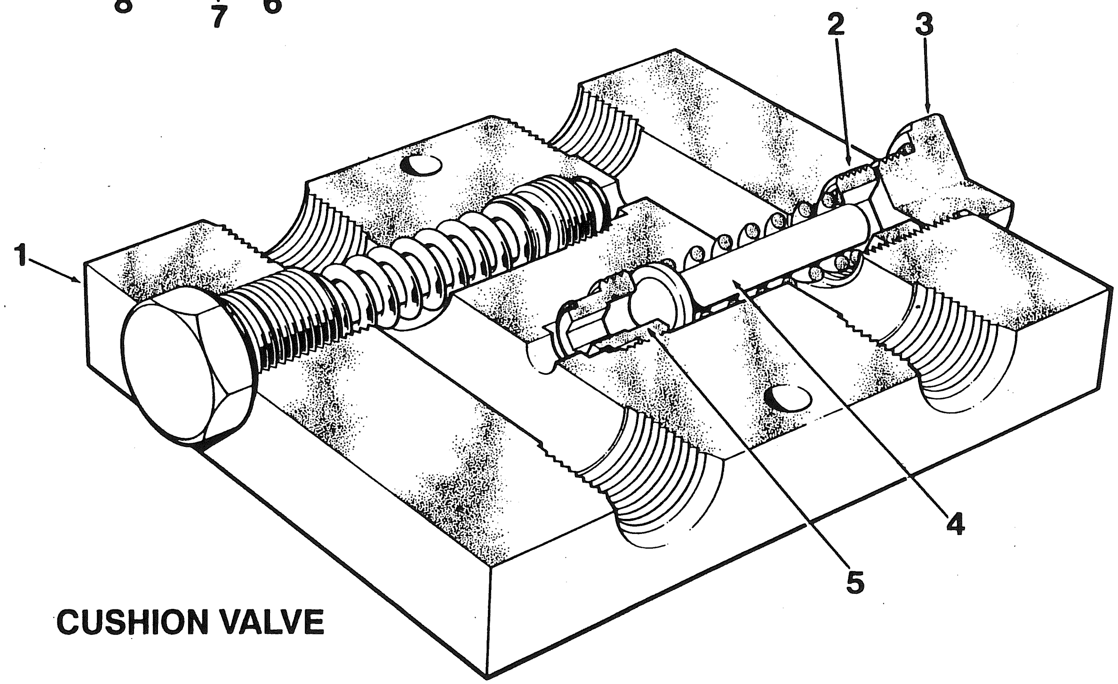
MAIN RELIEF VALVE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CUSHION VALVE

LEGEND
Main Relief Valve
1. Valve Body
2. Valve Seat
3. O-Ring and Back-up Washer
4. Poppet Seal
5. Poppet
6. Shims
7. Spring
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 $\pm$100 psi (e.g. when a cylinder is bottomed out), the valve poppet moves off its seat, opening a passage directly into the hydraulic tank.

To check relief valve operation:

A) Install a 0-3000 psi gauge into one of the test port quick couplers located on the inlet to the manifold valve.

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.

LEGEND
Cushion Valve
1. Body
2. Adjustment Screw
3. O-Ring Cap
4. Poppet
5. Poppet Seat

Cushion valves are used in the steering and circle turn systems.

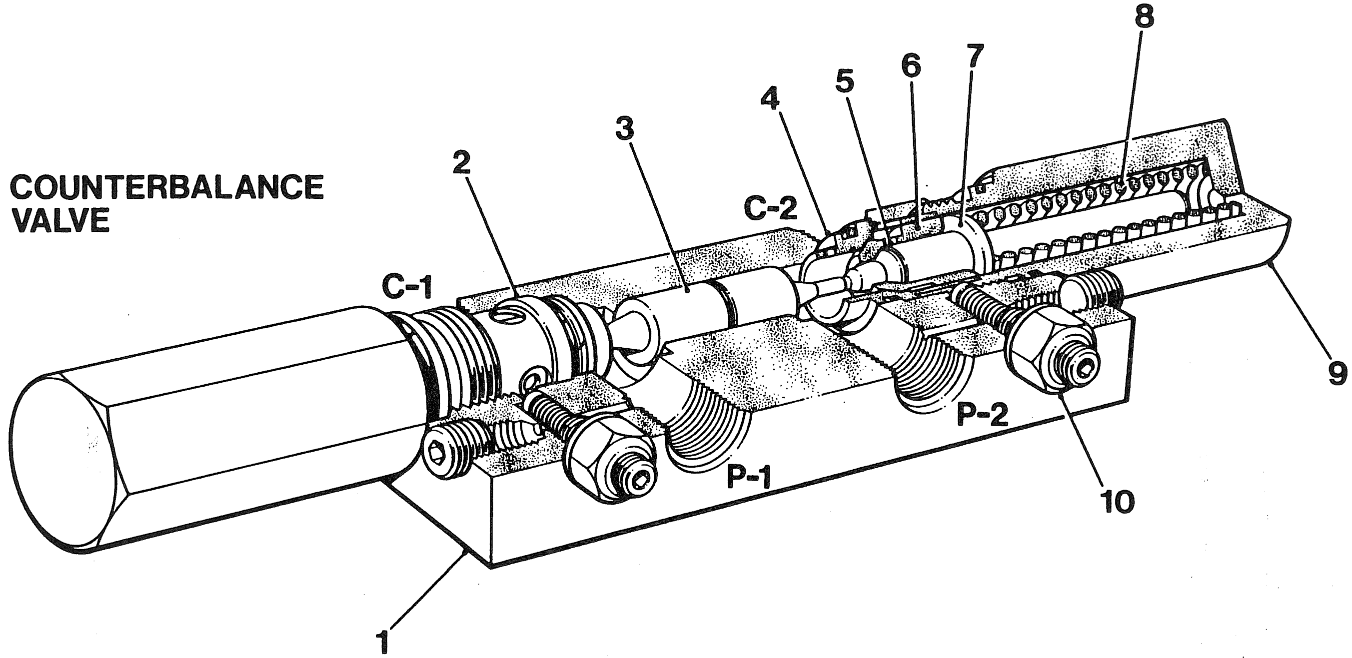
The cushion valve is actually two resetable relief valves in one body, protecting both sides of the same circuit from high pressure spikes created by shock loads. Under these conditions, a small amount of oil is vented across the valve to the opposite side of the same circuit, hence the common name of cross-over relief valves. During normal operation, oil flows straight through the valve and the poppets remain closed.

Whenever the moldboard first strikes an immovable object the pressure spike created is vented to the opposite low pressure side. The internal valve porting prevents the circle from suddenly turning.

The circle cushion valve setting is 2200 $\pm$100 psi cracking. Because this is higher than the main relief, the valve cannot be checked by using the grader's hydraulic system. It must be removed and checked with a hand pump. For more information on the steering cushion valve see page 13.

NOTE: The adjustment is on the opposite side to the side being tested.

Refer to the Shop Manual for specifications.


COUNTERBALANCE
VALVE
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C-2
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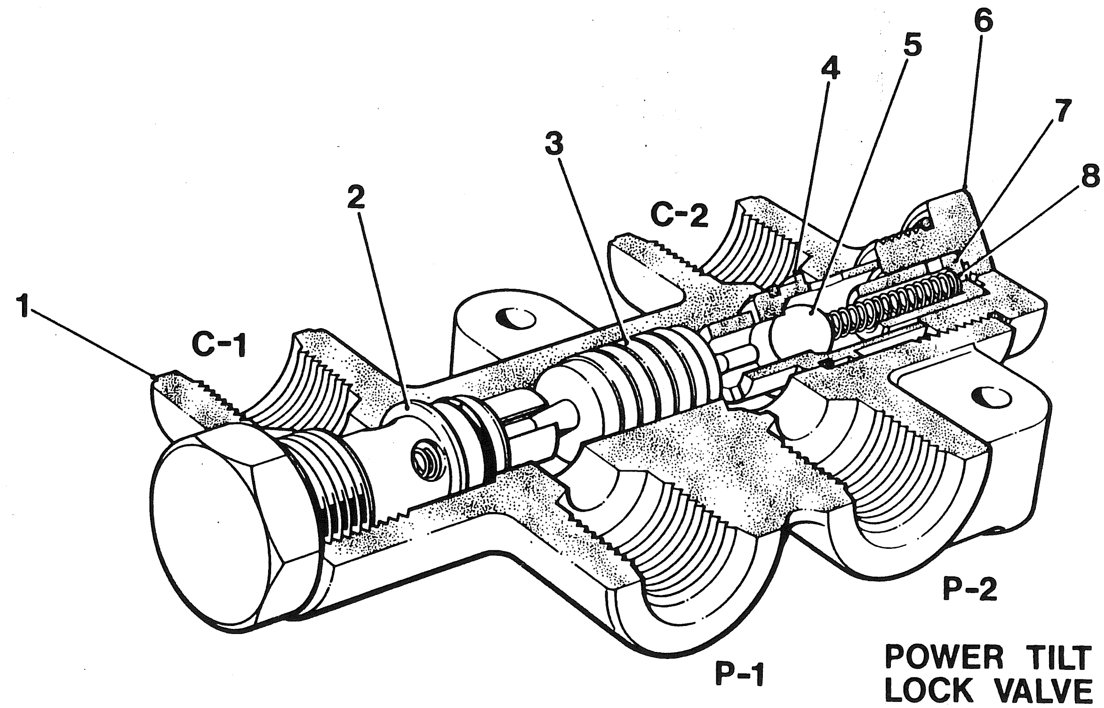
C-1
C-2
P-1
P-2
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POWER TILT
LOCK VALVE

LEGEND

Counterbalance Valve

1. Valve Body
2. L.H. Check Valve Assembly
3. Pilot Piston
4. R.H. Check Valve Seat
5. R.H. Poppet
6. R.H. Check Poppet
7. R.H. Spring Seat
8. R.H. Spring
9. R.H. End Cap
10. R.H. Thermal Relief Assembly

NOTE: L.H. and R.H. are for purposes of explanation only. L.H. Components are identical to the R.H.

The **counterbalance valve** is a pilot operated check valve found in the hydraulic blade lift, leaning wheel, and the moveable point blade lift system lock circuit. It is used to lock oil into the cylinder and prevent drift. It also prevents blade lift cylinder cavitation when lowering the drawbar from the carry position.

Oil pressure directed to **P-2** pushes the R.H. check poppet against the spring and oil is free to flow into the cylinder. Oil exiting the opposite end of the cylinder enters at **C-1**, but is trapped by the L.H. check poppet. This creates back pressure between **C-2** and **P-2**. The pilot piston is then pushed across to the L.H. poppet which is moved off its seat and oil is free to flow out **P-1**. If the cylinder is to move in the opposite direction, the process is reversed. The poppet assembly is tapered to allow smooth, accurate hydraulic control of these circuits. Two thermal reliefs in the valve allow for thermal expansion inside the cylinders. If this expansion causes cylinder pressures to exceed 3000 psi, a small amount of oil is bypassed around the check poppets and vented to the manifold port **P-1** or **P-2**. Champion does not recommend removal or adjustment of the thermal relief valve assemblies.

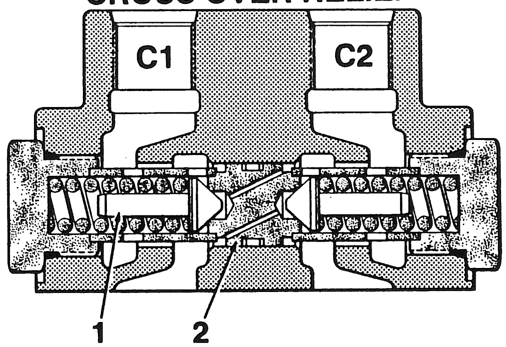
LEGEND

Power Tilt Lock Valve

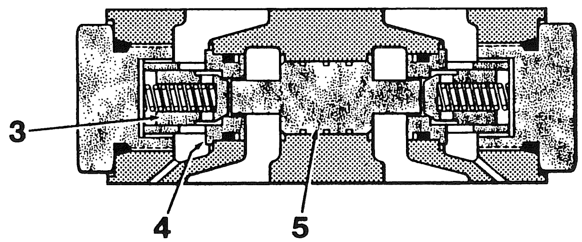
1. Valve Body
2. L.H. Check Valve
3. Pilot Piston
4. R.H. Check Valve Seat
5. R.H. Check Ball
6. R.H. O-Ring Cap
7. R.H. Spring Seat
8. R.H. Spring

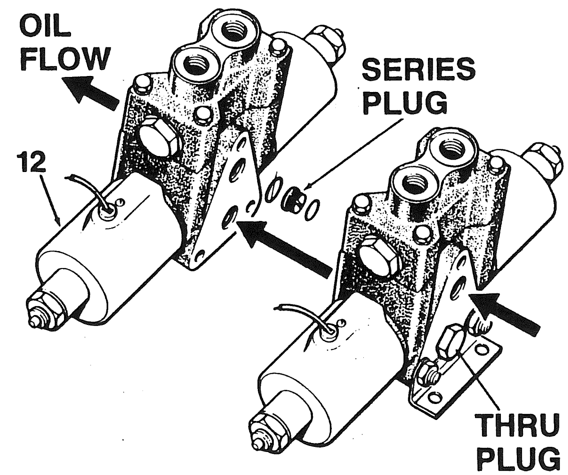
The **power tilt lock valve** is a pilot operated check valve, used on all twin hydraulic cylinder moldboard tilt installations. It is used to prevent moldboard drift under load. Oil entering the valve at **P-2** unseats the R.H. check ball and flows to the cylinder. At the same time the pilot piston moves to the left unseating the L.H. check ball and allows oil leaving the cylinder to exit at **P-1**. When the manifold control valve is in neutral, both check valves are closed, locking the oil in both ends of the cylinder.

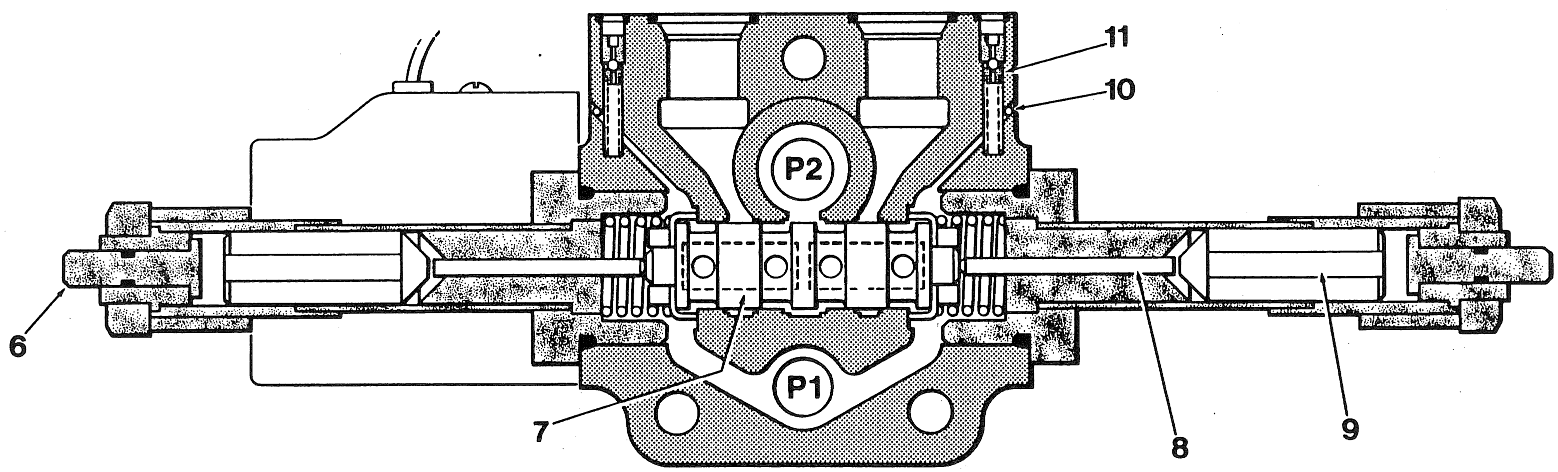
CROSS OVER RELIEF



LOCK VALVE







DIRECTIONAL WITH INTEGRAL
THERMAL RELIEF VALVES

LEGEND

1. Poppet
2. Crossover poppet seat
3. Check Poppet
4. Lock Valve Cage
5. Pilot Piston
6. Manual override Plunger
7. Spool
8. Pin
9. Plunger
10. Plug
11. Thermal Relief Assembly
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, the spool is centered, (both solenoids de-energized) 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 is reversed). Since these valves are also 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. This lock valve operates similar to the power tilt lock valve in that 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

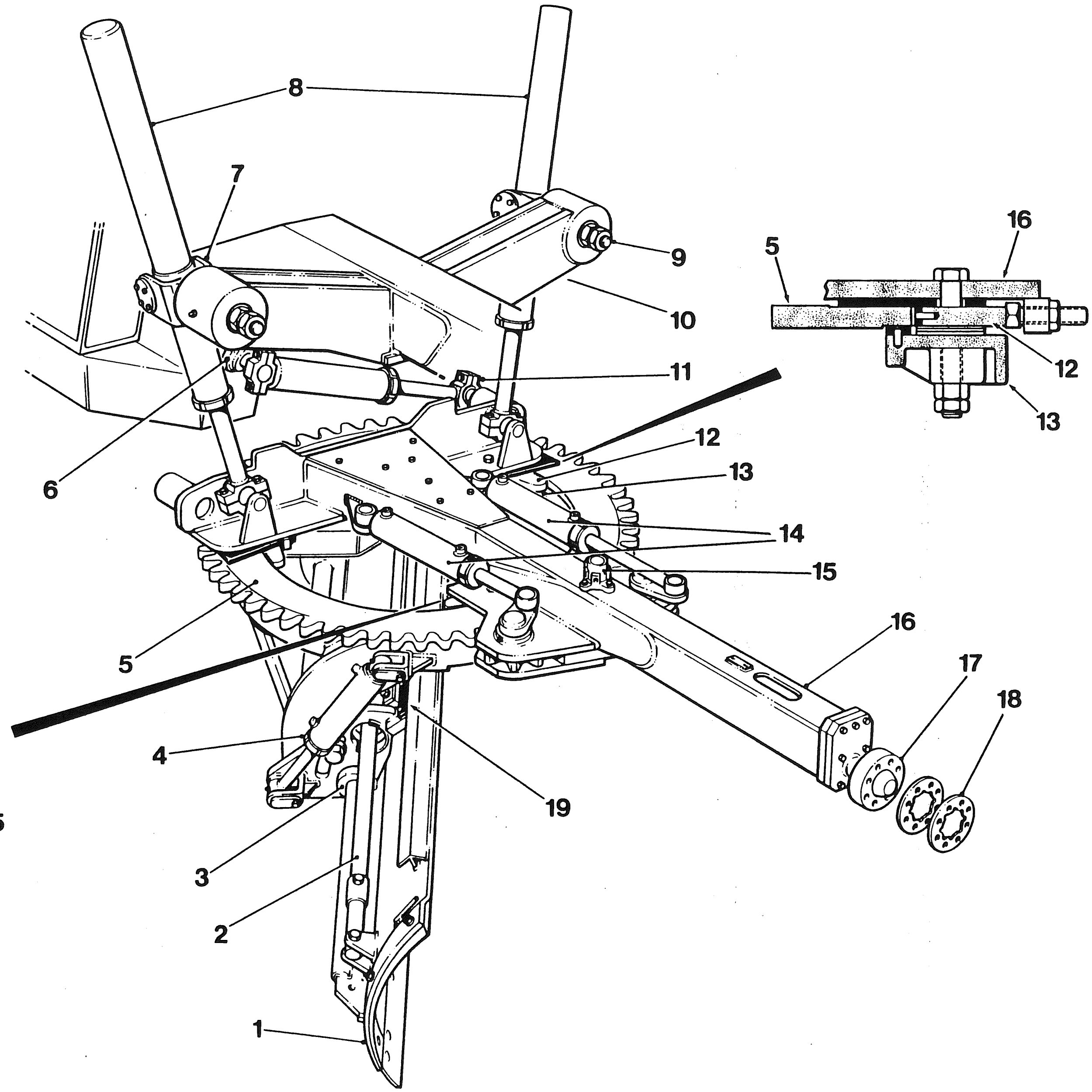
If a shock load occurs, the high pressure oil is transferred to the low pressure side, reducing the stress on other components. The relief setting of 3100 psi is shim adjustable. This valve section is similar in operation to the cushion valve discussed on Page 17.

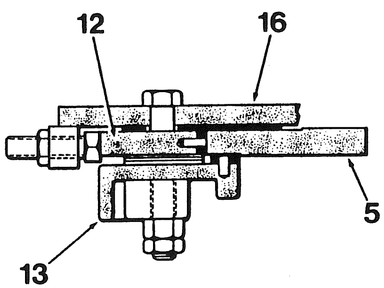
LOCK VALVE SECTION

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 interchangability.





Duramide components shown in solid black

LEGEND

1. Moldboard
2. Slide Shift Cylinder
3. Lower Slide Casting
4. Power Tilt Cylinder *
5. Circle
6. R.H. Shift Cylinder Anchor
7. Stirrup
8. Blade Lift Cylinders
9. Stirrup Nut/Lock Nut
10. Fixed Point Hi-Lift Arm
11. Circle Shift Cylinder
12. Guide Plate - with Duramide
13. Clamp Plate - with Duramide
14. Circle Turn Cylinders
15. Timing Valve
16. Drawbar
17. Drawbar Ball Stud
18. Ball Stud Shims
19. Upper Slide Bearing 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 750 thru 780A use the heavy duty circle moldboard blade lift assembly. Its' heavier construction is required for the mining and forest industry applications. In addition, 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 of this assembly. Carefully follow the lubrication chart and Operator's Manual to perform these tasks.

Duramide circle support bearings are standard on all models except models 710 thru 720A, where they are available optionally. Duramide's non-metalic composition provides reduced maintenance, long life, and an easier turning circle. Duramide assemblies can be easily interchanged with metalic components with the benefit of retaining the same set up procedures.

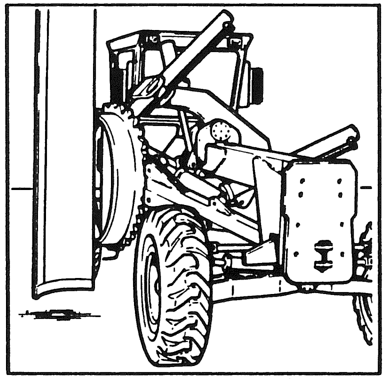
A properly adjusted circle has the front guide plate(s) tight against the circle. The two rear guide plates must have .040" - .080" clearance to the circle.

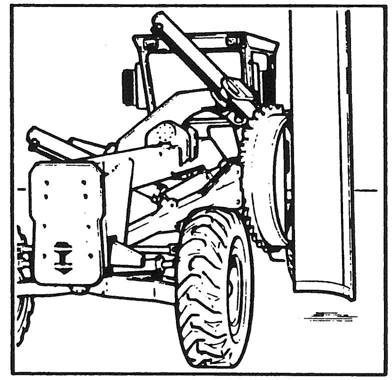
To keep the blade properly adjusted, all excessive 'free play' must be taken out of the assembly. This may be done by removal of shims from between the guide and clamp plates, drawbar ball stud, and cylinder ball caps. **NOTE:** Ball caps are a matched set and cannot be interchanged or reversed. Excessive 'free play' of the moldboard affects blading tolerance. It may be removed from the slide rails by replacing slide castings and/or shimming 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. After seating the stirrup shank bearing, back off the nut and tighten to 50 ft.lbs. Tighten the locknut to 400 ft.lbs. while holding the first 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 metalic 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.

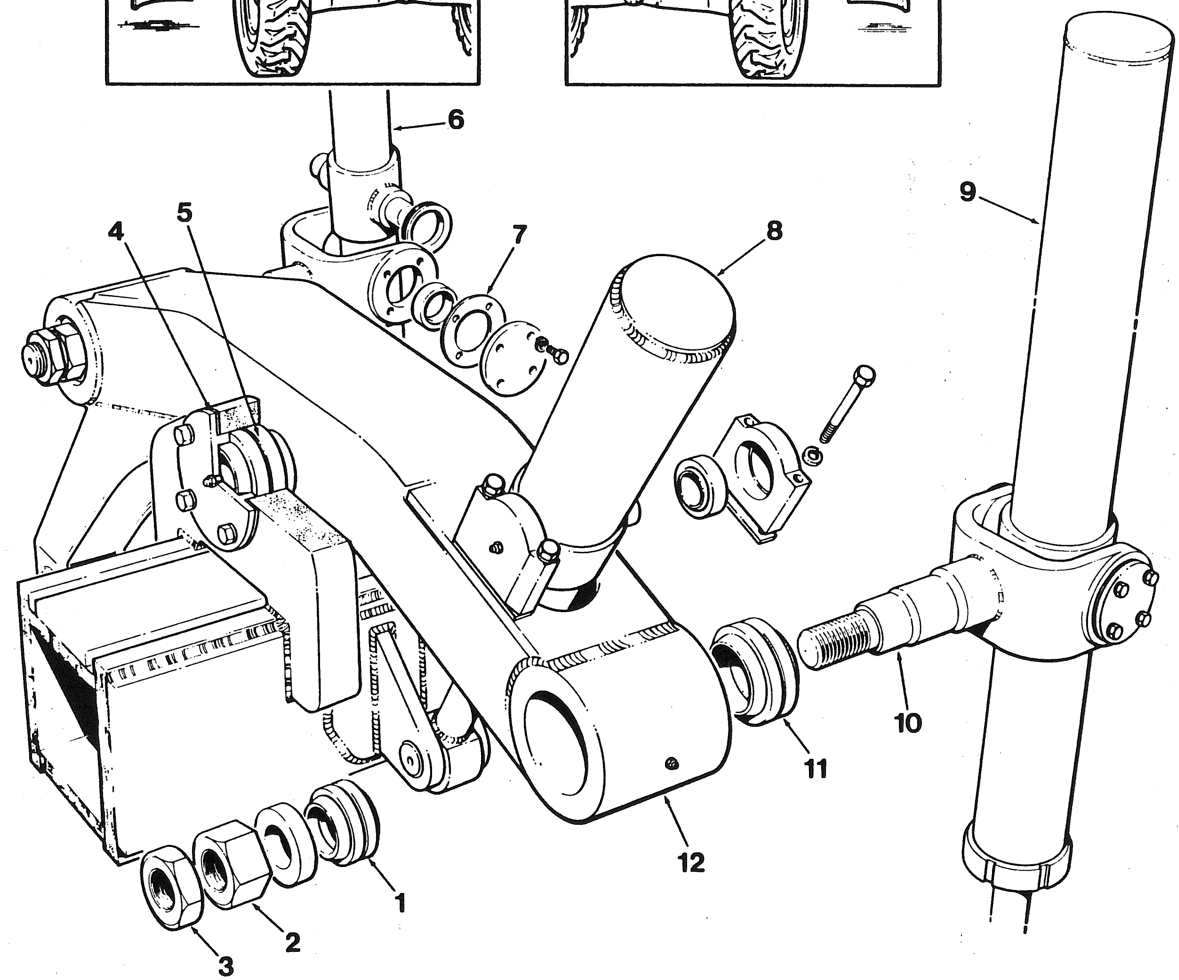
Refer to the Shop Manual for specifications.

90°/90° LEFT





90°/90° RIGHT



LEGEND

1. Bushing
2. Adjusting Nut
3. Lock Nut
4. Shims
5. Bushing
6. L.H. Blade Lift Cylinder
7. Shims
8. Lock Cylinder
9. R.H. Blade Lift Cylinder
10. Stirrup Yoke
11. Bushing
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 750 thru 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 movement.

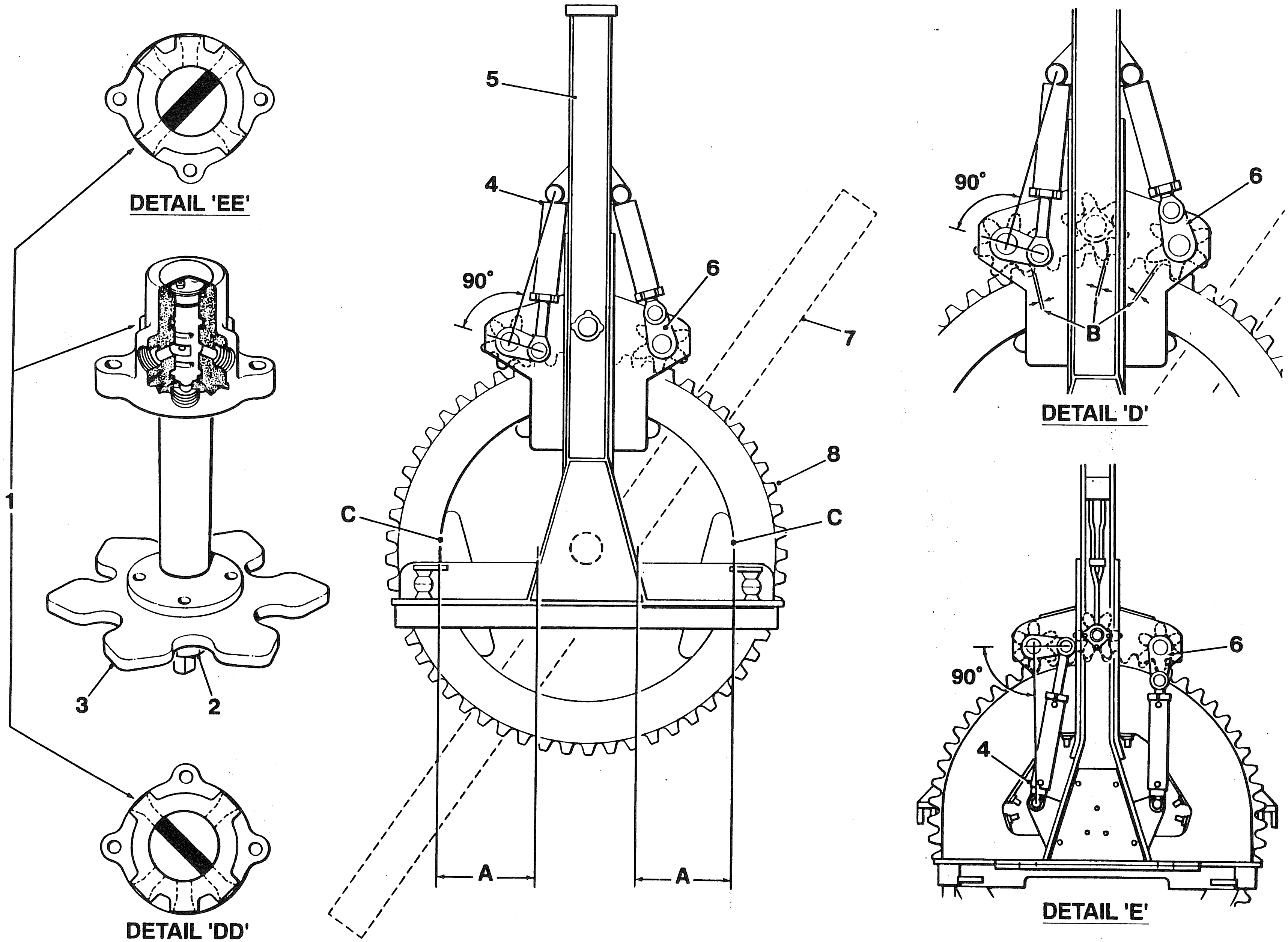
The Circle Side Shift Cylinder is mounted directly between the circle drawbar and the over frame arm. Functioning similarly to other fixed or moveable point blade lift systems, the circle side shift provides lateral movement of the circle. However, the circle side shift on Champion's Moveable Point Blade 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.


DETAIL 'EE'
1
2
3
DETAIL 'DD'
5
4
90°
6
7
8
C
C
A
A
90°
6
B
DETAIL 'D'
6
90°
4
DETAIL 'E'

LEGEND

1. Circle Timing Valve
2. Timing Shaft Lock Nut
3. Timing Valve Pinion
4. L.H. Circle Turn Cylinder
5. Drawbar
6. R.H. Circle Turn Crank
7. Moldboard
8. Circle

- **A** Centering Dimension
- **B** Tooth Clearance
- **C** Horizontal Clearance
- **D** Forward Mounted Circle Turn Cylinders
- **DD** Cross Section of Valve Showing Blocked Forward Left Port
- **E** Rear Mounted Circle Turn Cylinders
- **EE** Cross Section of Valve Showing Blocked Forward Right Port

The Champion grader uses two hydraulic cylinders to turn the circle. In conjunction with the timing valve 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" back lash clearance is between the drive pinion and circle teeth, as indicated by dimension **B.**

B) **Older 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

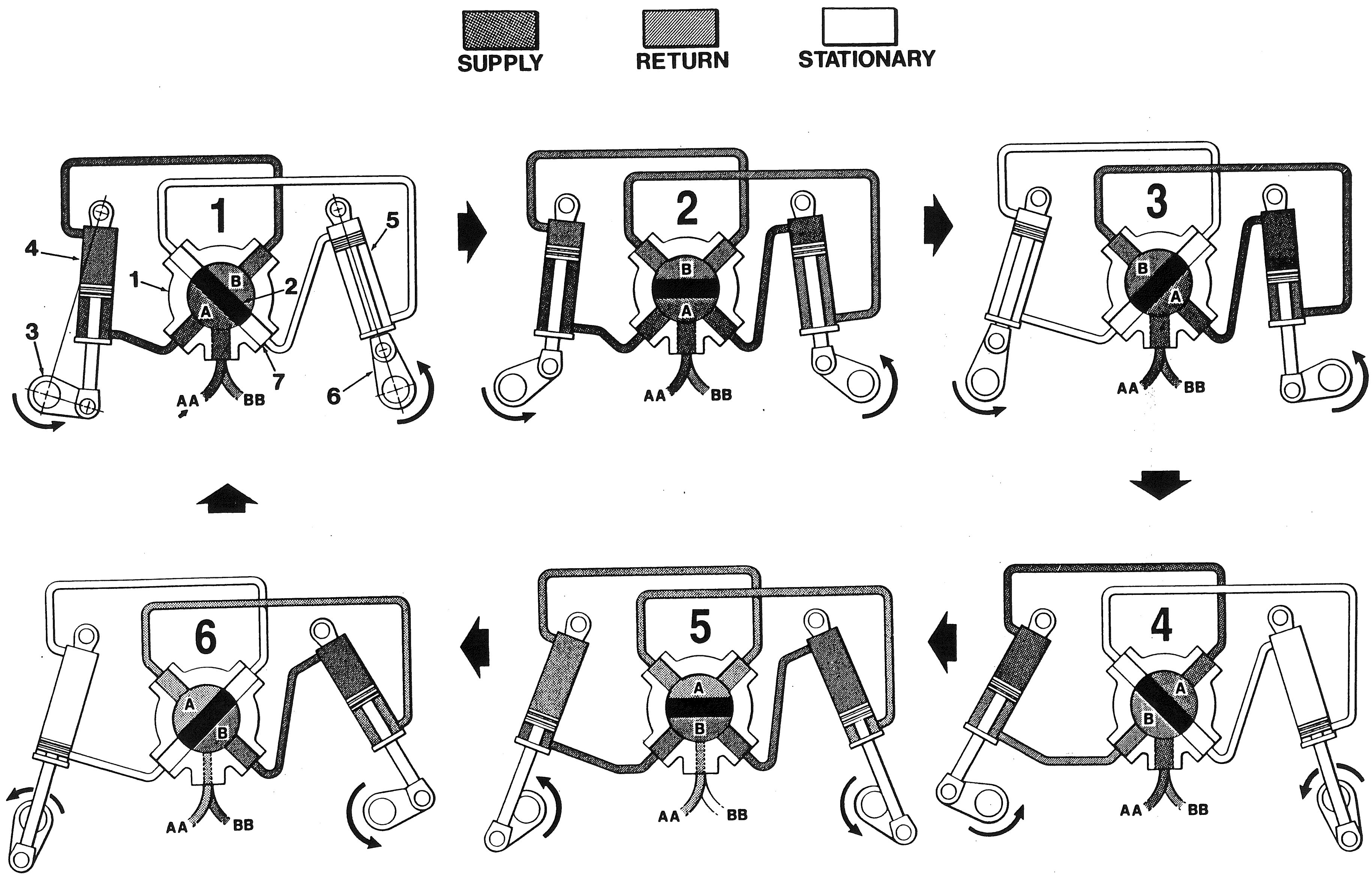
Fully retract the right hand cylinder so that a straight line intersects all three pivot points. Ensure the left-hand cylinder and crank is towards the drawbar. Position the cylinder so that a straight line, drawn between the centre of the cylinder anchor and the centre of the crank shaft will form a 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 forward left-hand port on the timing valve on forward mounted circle turn cylinders. See detail **DD**. On rear mounted circle turn cylinders use the forward right port. See detail **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
1
2
3
4
5
6
7
A
B
AA
BB

LEGEND

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

To enable us 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**.

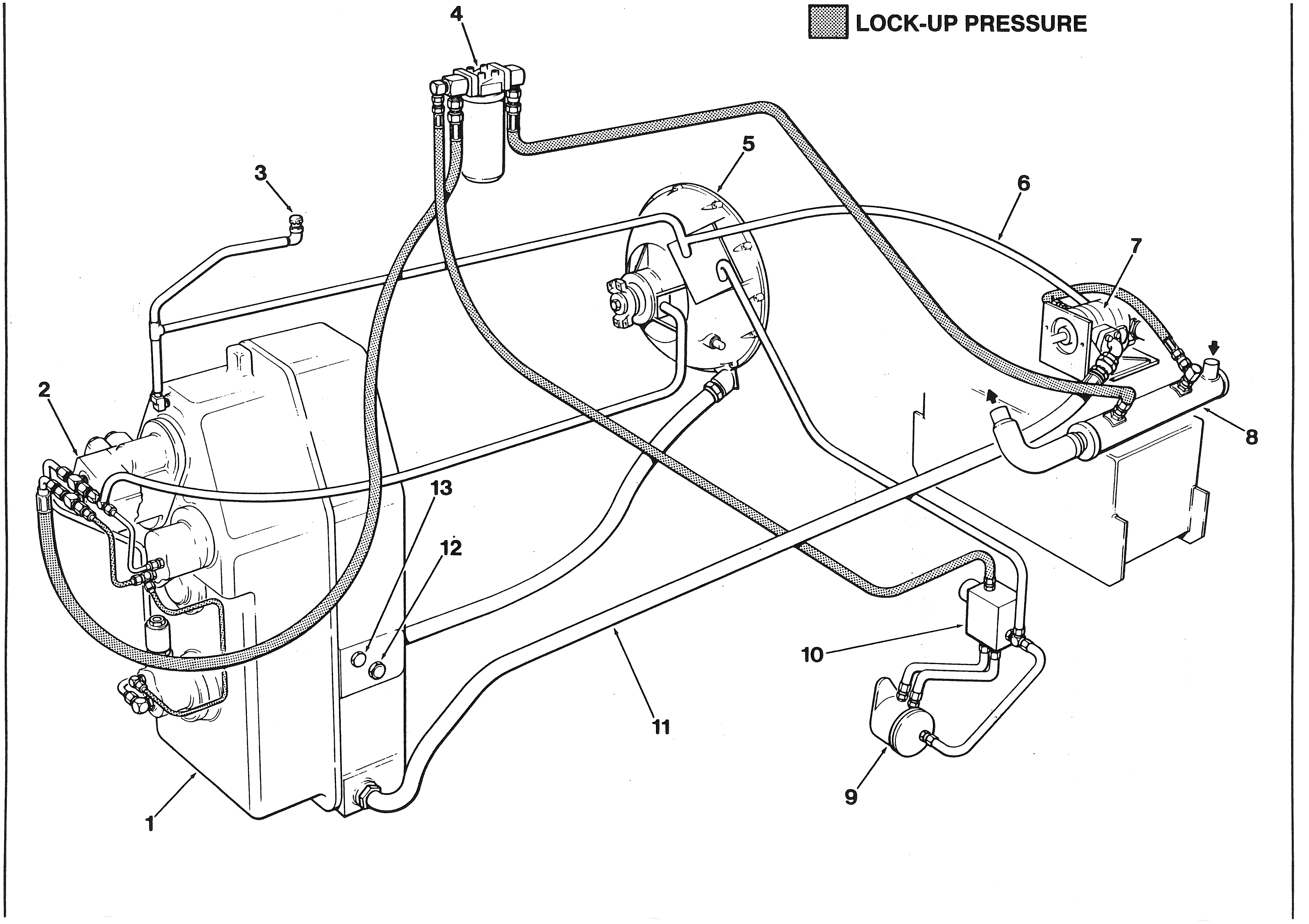
In diagram **1**, the cylinders and timing valve are in the circle timing position. The R.H. cylinder is fully retracted and momentarily cannot provide any useful force. The L.H. cylinder is half way through its stroke, in fact at the maximum torque angle, and is capable of turning the circle (under 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.


LOCK-UP PRESSURE
1
2
3
4
5
6
7
8
9
10
11
12
13

LEGEND

1. Model 8400 Transmission
2. Transmission Pressure Regulating Valve - 2 stage
3. Transmission/Clutch Breather
4. Transmission Oil Filter
5. Clutch Housing
6. Transmission/Steering Pump Vent
7. Transmission/Steering Pump
8. Transmission Oil to Water Cooler
9. Lock/Unlock Final Drive Shift Cylinder
10. Lock/Unlock Final Drive Control Valve
11. Suction Line
12. Fluid Level Sight Glass
13. Transmission Filler Plug

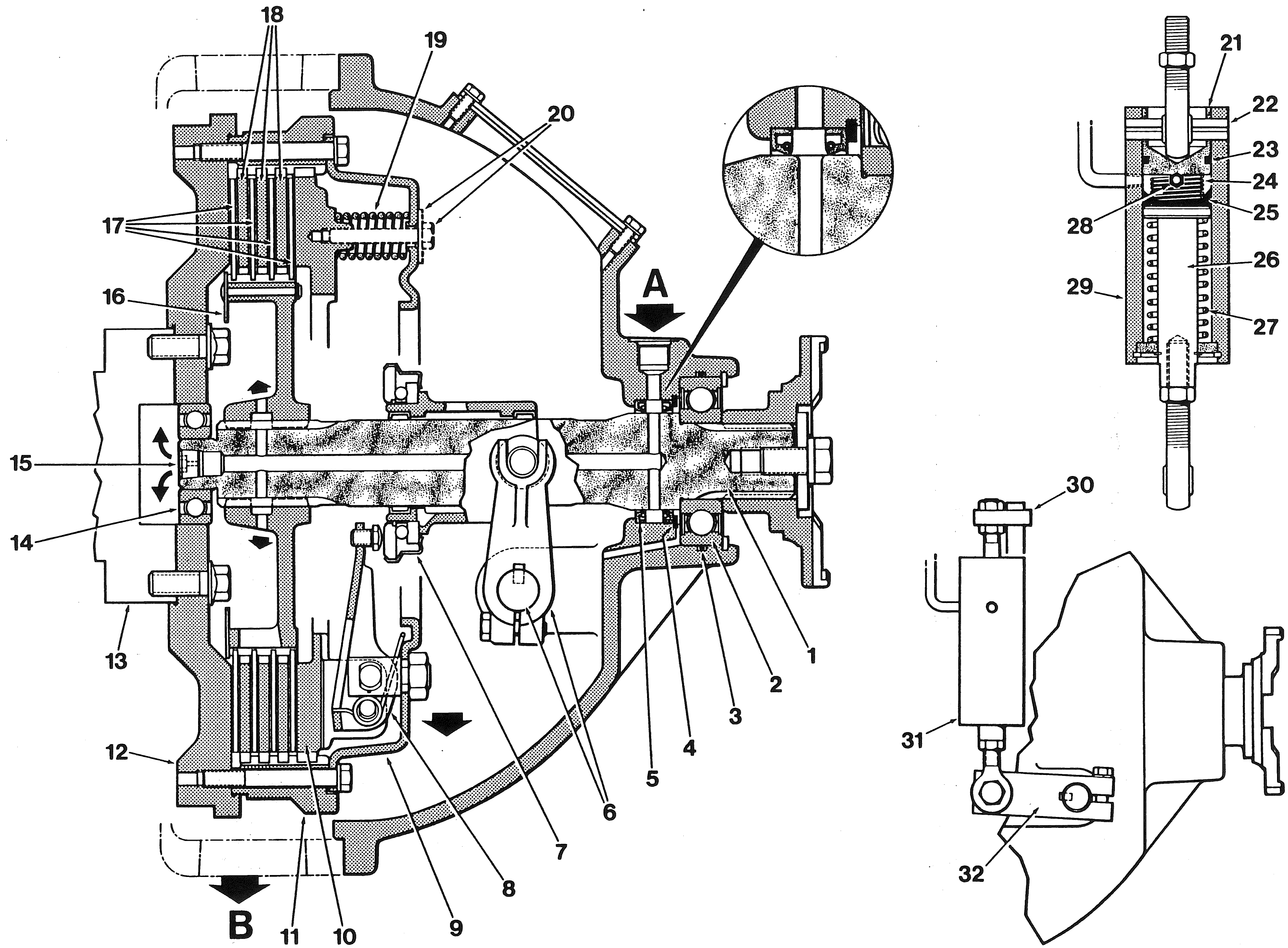
Oil is supplied to the transmission and engine clutch by the transmission supply pump. The pump is driven from the engine's crankshaft and is located below the radiator. This oil is completely separate from the hydraulic system oil. The oil is drawn from the transmission to the pump directly, without passing through a strainer. Oil leaving the pump enters an oil-to-engine coolant, bundle-type cooler. This type of heat exchanger not only provides cooling to the transmission, but also provides a more consistant temperature, regardless of ambient temperatures. Cold coolant exiting the radiator passes through the cooler and enters the engine's water pump.

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

The pressure regulating valve is mounted on the front of the transmission. It is a two stage design. Oil first enters the lock-up section where oil pressure is controlled for use in the transmission clutch lock-up circuit. The remainder and majority of the oil enters the lube section where oil pressure in the lube circuit is controlled.

Lubrication oil is used to cool and lubricate both the transmission and the engine clutch. Lubrication oil then drains back into the transmission sump.

Lock/Unlock final drives are standard equipment on all Champion motor graders. This feature is operator selected through a solenoid controlled valve. Transmission lock-up pressure affects the shift.


18
19
20
21
22
23
24
25
26
27
28
29
17
16
A
15
14
13
12
1
2
3
4
5
6
7
8
9
10
11
B
30
31
32

LEGEND

Clutch Assembly

1. Clutch Shaft
2. Clutch Shaft Bearing
3. O-Ring
4. Snap Ring
5. Spring Lip Seals (Qty.2)
6. Cross Shaft and Yoke
7. Throw-out Bearing
8. Clutch Finger (Qty.3)
9. Backing Plate
10. Pressure Plate
11. Adaptor-Drive Ring
12. Flywheel
13. Crank Shaft
14. Pilot Bearing
15. Orifice Plug
16. Oil Deflector and Clutch Hub
17. Fricton Plates (Qty.4)
18. Steel Spacers (Qty.4)
19. Clutch Spring
20. Caging Cap Screw and Washer (for clutch assembly servicing only)

Slave Cylinder Assembly

21. Cylinder Head
22. Roll Pin
23. O-Ring
24. Spring
25. Piston Cup
26. Piston
27. Return Spring
28. Bleeder Screw
29. Barrel
30. Bracket
31. Shift Cylinder Assembly
32. Cross Shaft Arm

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

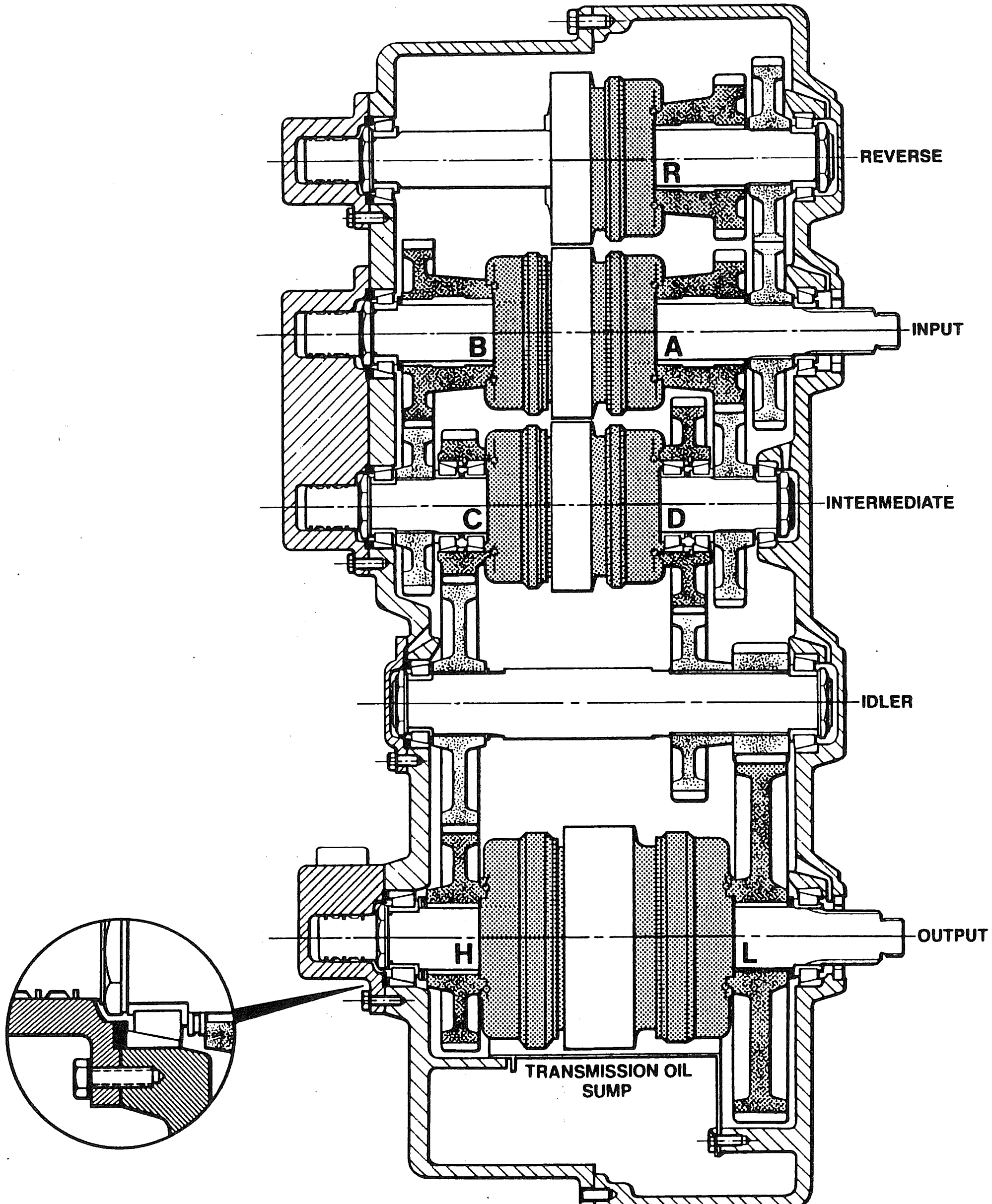
The engine clutch is hydraulically operated by a master cylinder/slave cylinder circuit. When the operator depresses the clutch pedal, hydraulic pressure from the steering circuit assists the master cylinder piston to move. The displaced brake fluid from the master cylinder causes the slave cylinder to extend, and the cross shaft to turn, pushing the yoke against the throw-out bearing. The throw-out bearing moves towards the direction of the flywheel and the clutch fingers. This action pulls the pressure plate away from the flywheel, thereby releasing the clutch driven members.

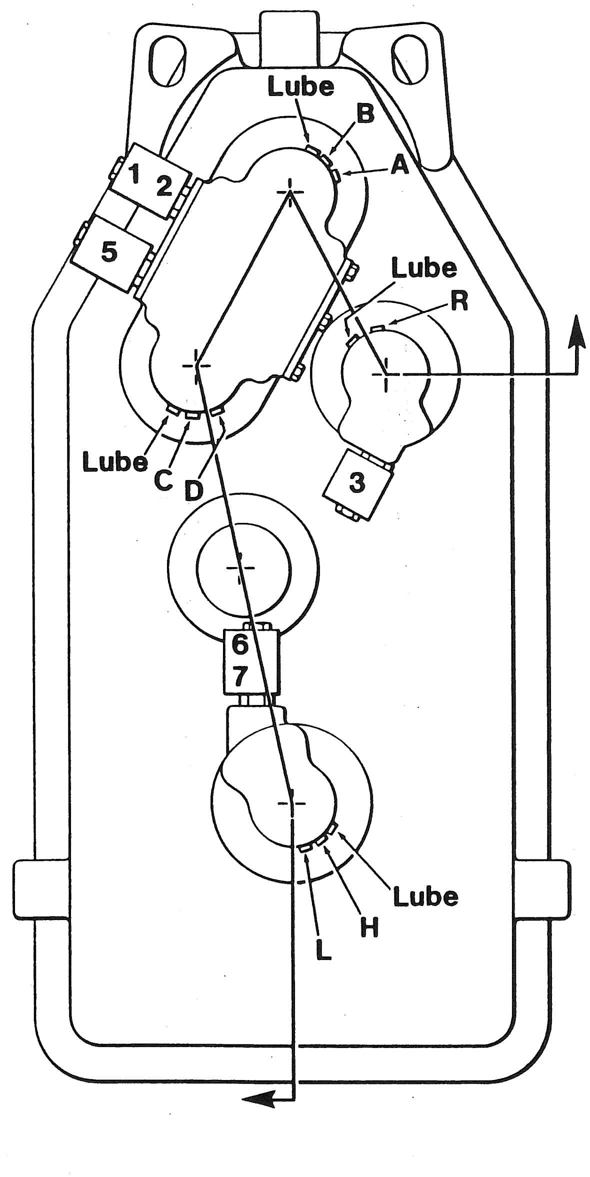
Oil is used to cool the friction and steel plates and lubricate the bearings. The oil from the transmission lube circuit enters at Point **A** (shown on top for illustrating purposes only). The oil is directed into the clutch shaft by the two spring lip seals. The clutch shaft bearing is sealed and requires no lubrication. Some oil flows through the 3/32" orifice plug to lubricate the pilot bearing. The majority of the oil collects in the clutch hub where under centrifugal force, it flows through the clutch pack members, providing a cooling effect. The throw-out bearing is splash lubricated. All oil drains back to the clutch sump and then to the transmission at point **B**.

ADJUSTMENTS

Check the clutch slave cylinder adjustment once a week. Since the cross shaft arm and yoke have the same effective length, the distance the slave cylinder can be extended until a resistance is felt, is the same as the clearance between the throw-out bearing and the adjustment screws on the clutch fingers. The specified clearance is .150". As the clutch plates wear through normal use, this clearance gets smaller. Adjustments can be made at either end of the slave cylinder. Since the slave cylinder is hydraulic, a bleeder screw is provided. Always remember to check clutch pedal linkage free play as well.

Refer to the Shop Manual for specifications.


REVERSE
R
INPUT
B
A
INTERMEDIATE
C
D
IDLER
OUTPUT
H
L
TRANSMISSION OIL
SUMP


Lube
B
A
1
2
5
Lube
R
Lube
C
D
3
6
7
Lube
H
L

OVERVIEW

The 8400 transmission was introduced in 1984. It was developed to provide an 8-speed forward, 4-speed reverse, full powershift transmission for grader applications. It is simple in operation and construction making 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 have to be disturbed.

There are no linkages in the transmission control system to adjust or wear. Shifting is accomplished by an electronic controller and four solenoid valve cartridges.

The transmission was also 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 the input shaft speed.

CONSTRUCTION

The cast iron housing is vertically split to ease assembly and disassembly. This allows for complete access to all seven clutch packs and the idler shaft. **R** (reverse) **A**, **B**, **C**, and **D** clutch packs are 5 1/4" in diameter. **H** (high) and **L** (low) clutch packs are 6 5/8" in diameter. Each of the five shafts is supported by tapered roller bearings that control end thrust created by the helical gearing. Each shaft has between .002" and .007" end float adjustable by shims and piloted in counter-bores in the collector caps.

OPERATION

To provide power flow through the transmission, either forward or reverse, three of the seven clutch packs must be locked up (engaged). The following chart shows clutch packs lock-up vs. speed. Understanding the sequence of clutch pack engagement will help to troubleshoot hydraulic and mechanical problems.

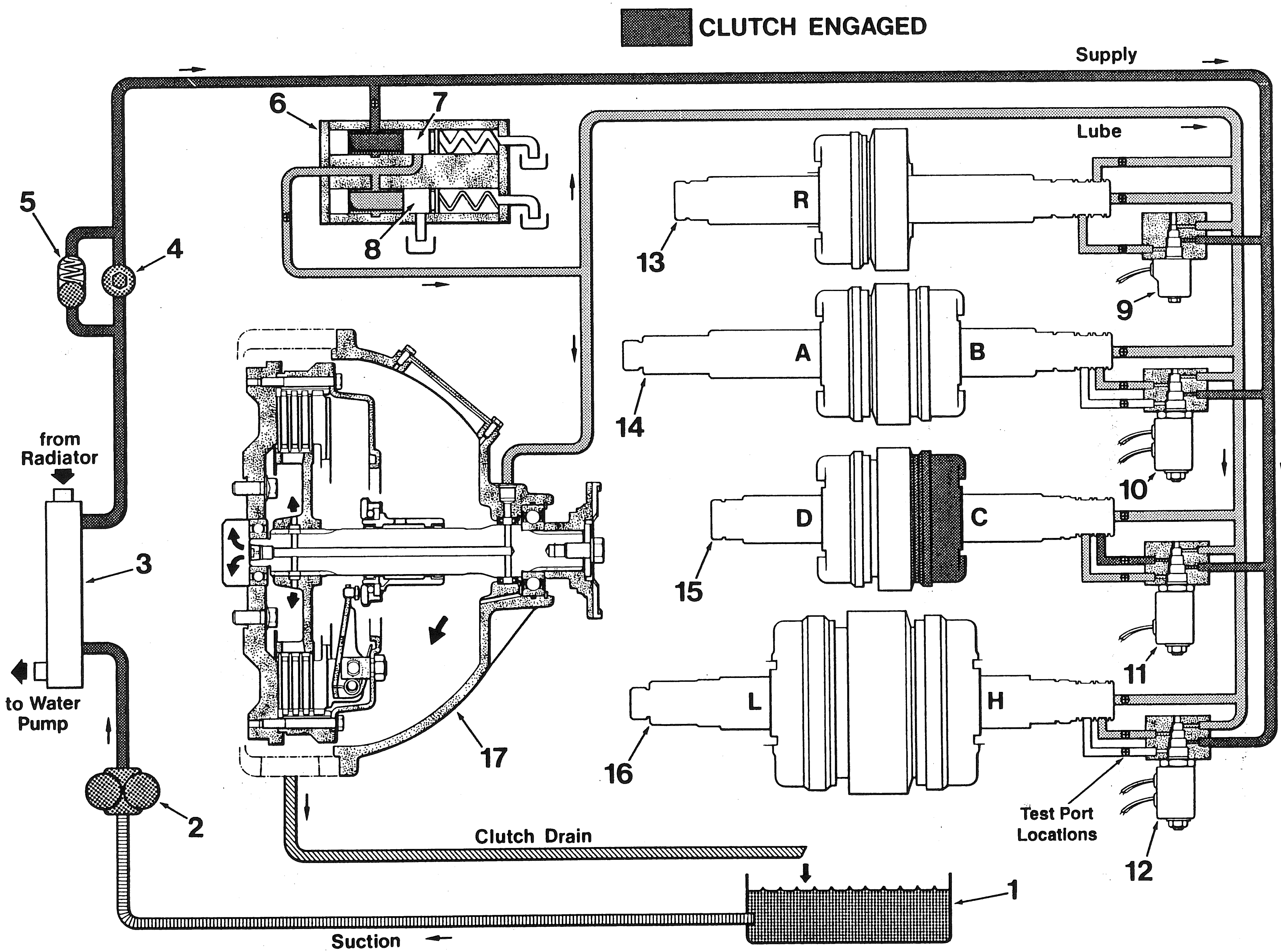
GEAR	FORWARD CLUTCH PACKS	REVERSE CLUTCH PACKS	GEAR RATIO
1	A C L	1 R C L	7.317:1
2	B C L		5.236:1
3	A D L	2 R D L	3.777:1
4	B D L		2.703:1
5	A C H	3 R C H	1.913:1
6	B C H		1.369:1
7	A D H	4 R D H	.987:1
8	B D H		.707:1
N	C	N C	

NOTE:

1. **C** Clutch pack is engaged in neutral
2. This transmission has two forward clutch packs; **A** and **B**. It is also a High/Low range design - but as this is automatically shifted, it is not considered as such.
3. Gear ratios holds true for all models except 780/780A which has slightly faster reverse speeds due to different tandem sprocket ratios.

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 righ-hand illustration shows the location of the cutting plane, pressure test ports and the four solenoid cartridge valves.

MODEL 8400 TRANSMISSION OIL CIRCUIT - Neutral



LEGEND

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

The 8400 transmission was developed to be a simple, efficient, full powershift transmission with a simple hydraulic circuit. The following pages describe this circuit and show several shift engagements.

As explained earlier, transmission oil is drawn from the transmission sump by the pump and passes through the cooler and filter assemblies.

Oil is then directed to the transmission pressure regulator valve body. Inside this valve body are two spools. The first sets main transmission pressure. This spool has two springs and is shim adjustable to maintain transmission lock-up pressure to 215-235 psi *. At the regulated pressure the spool moves back against its' springs to open a passage to the lubrication circuit and lube pressure spool. Should a maximum lubrication pressure of 25 psi be reached, this spool valve will uncover a passage to sump. This valve has one spring and also is shim adjustable. Minimum lube pressure is 5 psi.

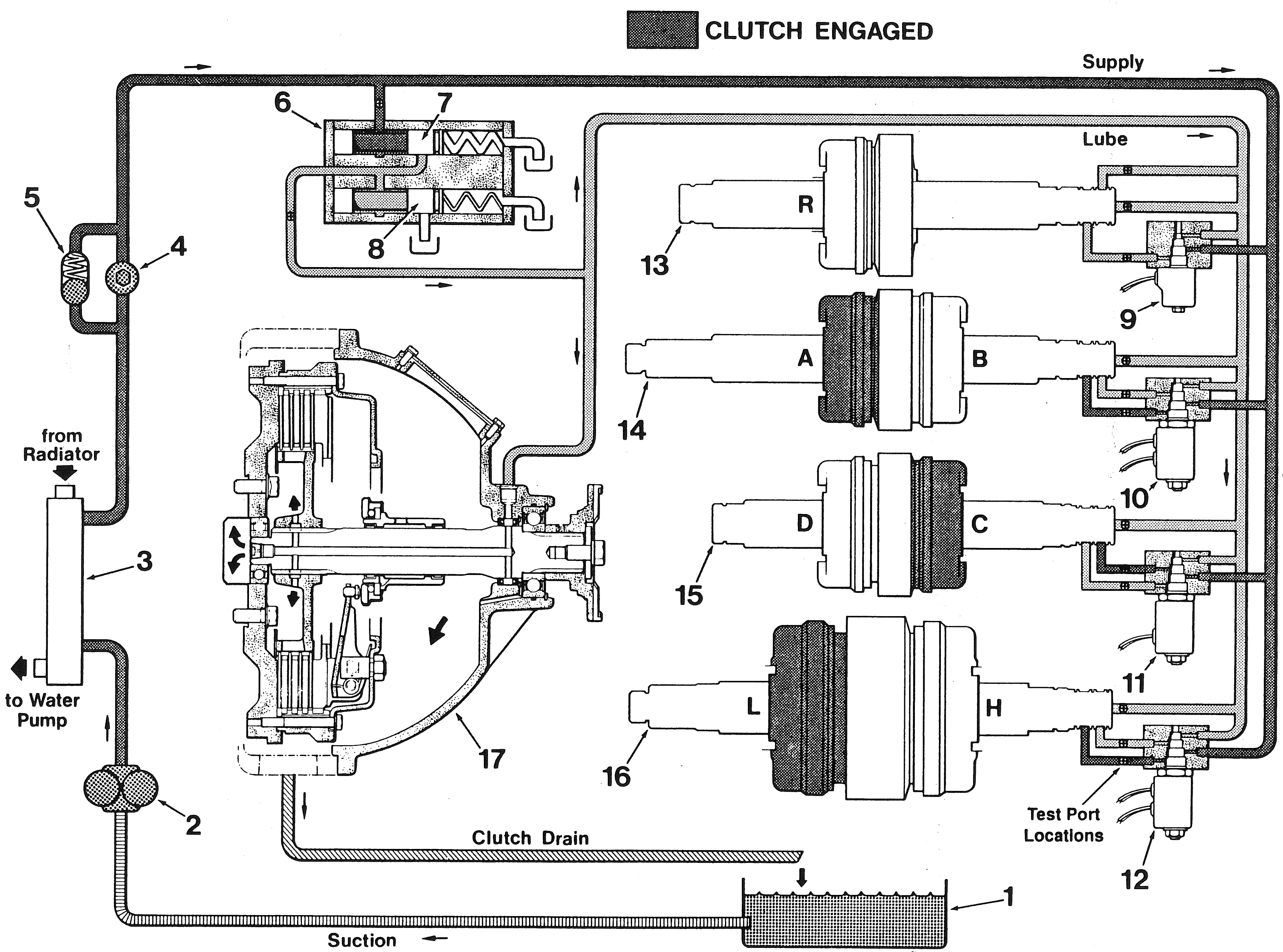
NOTE: for ease of discussion the regulator valve assembly has been illustrated upside down.

Whenever the engine is running, lubrication oil goes through the centre of each clutch shaft. From this central drilled passage, oil lubricates and cools the clutch bearings and clutch plates, and then drains back to sump. Lubrication oil also goes to lubricate and cool the engine clutch. This oil drains back to the sump. Whenever the transmission is in neutral or if a clutch pack is not applied, the solenoid valves direct lubrication oil pressure to fill each clutch pack. This ensures rapid clutch pack lock-up.

Lock-up pressure oil is directed to the four solenoid valves, which are actuated by the transmission controller in the cab. With the exception of the **C** Clutch, the solenoids block the oil pressure to the packs until energized. The **C** clutch pack is always engaged, even in neutral, until the controller energizes the **D** solenoid, and the **D** clutch locks up. When the operator moves the shift lever out of neutral, the electronic controller completes the circuit to ground, energizing the appropriate solenoids, depending upon the gear the operator selects, directing lock up oil pressure to the correct clutch packs.

** Starting at grader **S/N 20265** and up, the transmission is assembled using sintered, bronzed-faced friction discs having lock-up pressure between 215-235 psi. On graders with the model 8400 transmission prior to **S/N 20265** fiber composite friction plates with lock-up pressure of 165-185 psi were installed.*

Refer to the Shop Manual for specifications.



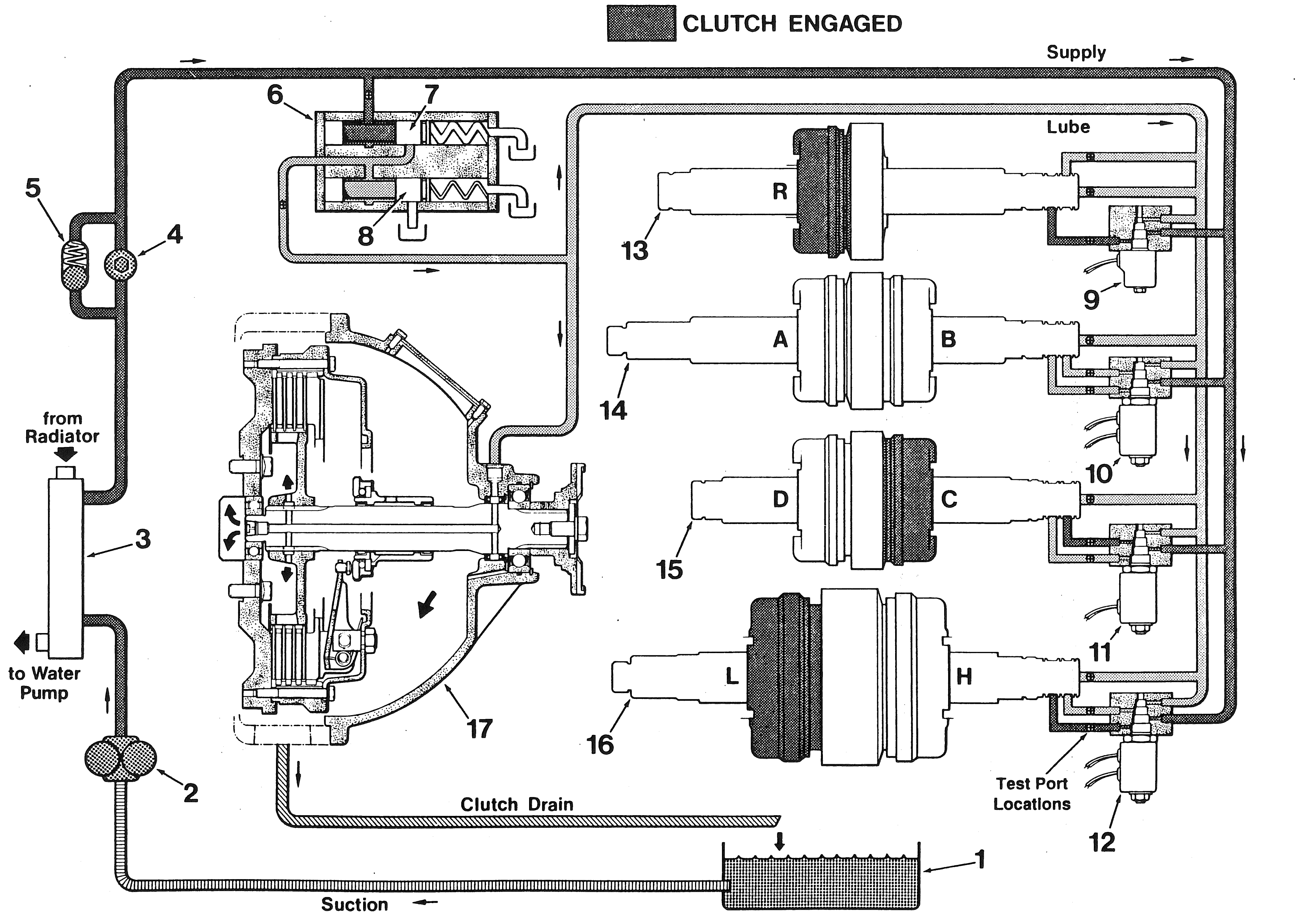
CLUTCH ENGAGED
Supply
Lube
6
7
8
5
4
from Radiator
3
to Water Pump
2
1
Suction
Clutch Drain
17
R
13
A
B
14
D
C
15
L
H
16
9
10
11
12
Test Port Locations

LEGEND

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

To obtain first forward, the operator moves the controller lever to indicate **1** on the display. With the mode lever in forward the controller energizes the **A** coil of the **A/B** solenoid to direct oil to the **A** clutch pack, and at the same time the **L** coil of the **L/H** solenoid to direct oil to the **L** (low) clutch pack. This combination of clutches **A C L**, provides the lowest overall gear ratio available and results in first forward speed. Remember **C** clutch is always engaged unless **D** clutch is required.

When the operator wishes to operate in eighth gear, he pulses or pushes the pulser lever forward to move up in speed, realizing he can only increase one gear at a time or sequentially shift. For example, the controller automatically selects the correct solenoids for the particular gear selected. When the indicator shows **8** and the mode lever is in forward, the controller energizes the **B** coil of the **A/B** solenoid, **D** solenoid, and the **H** coil of the **L/H** solenoid. This allows lock-up pressure to the **B D H** clutch packs and engages them. With **B D H** clutches locked, the transmission is in its highest gear ratio.



CLUTCH ENGAGED
Supply
Lube
6
7
8
5
4
R
13
9
A
B
14
from Radiator
D
C
10
15
3
to Water Pump
L
H
11
16
17
2
Test Port Locations
12
Clutch Drain
1
Suction

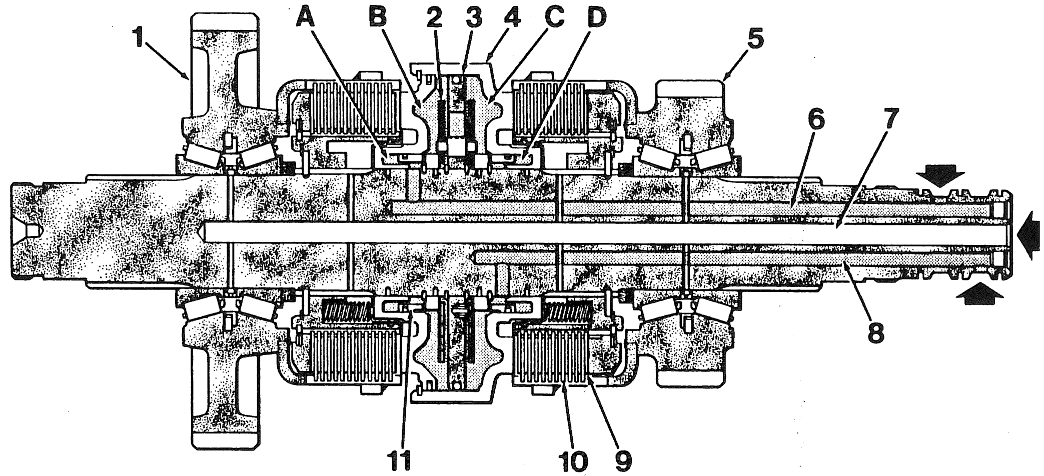
LEGEND

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

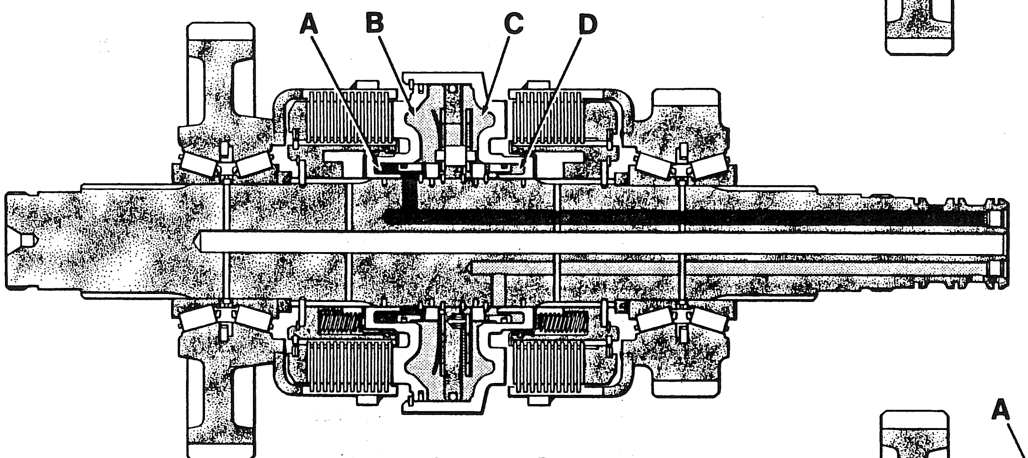
Whenever the transmission is in reverse the digital display will show a "–" in front of the digit. For example, when first reverse is selected by the operator the display will show **–1**. The controller selects the **R** solenoid to direct lock-up pressure to the reverse clutch pack. It also selects the **L** coil of the **L/H** solenoid which supplies oil to the low clutch pack. The **C** clutch is also engaged and this provides the lowest possible reverse speed of **R C L**. Power flow must travel through one extra shaft (5 in total) when in reverse compared to forward (only 4). This provides the directional change required.

When making a direction change the operator should disengage the engine clutch, bring the grader to a complete stop, then move the mode lever to the opposite direction position, and when it is safe, slowly release the clutch. This ensures smooth, safe directional changes. The controller will automatically select the closest corresponding speed in the opposite direction according to the chart:

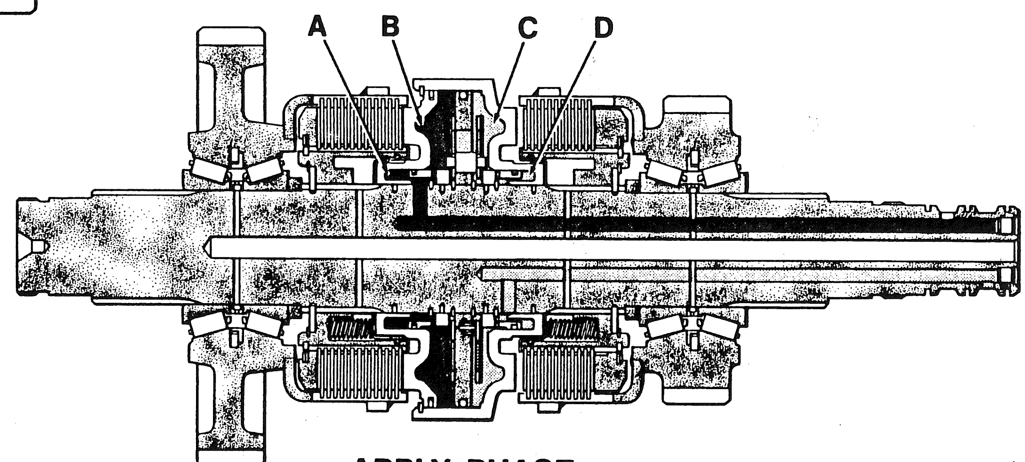
Forward	Reverse
1	-1
2	
3	-2
4	
5	-3
6	
7	-4
8	



NEUTRAL PHASE



TRAVEL PHASE



APPLY PHASE

LUBE PRESSURE

LOCK-UP PRESSURE

LEGEND

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

A. High Gear Accelerator Piston Cavity
B. High Gear Lock-up Cavity
C. Low Gear Lock-up Cavity
D. Low Gear Accelerator Piston Cavity

The hydraulic clutch pack consists of one set of sintered, bronzed-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 are positioned in the pack so that two of the same type are not located side by side. By squeezing these discs together, we can effectively connect or lock the gear to the shaft. To perform this function, a hydraulic cylinder assembly is used. The operation of the assembly is detailed below.

NEUTRAL PHASE

Lube oil is fed by separate lube passages to both sides of the clutch pack while the transmission is in neutral. At this time, the double clutch pack is in neutral phase. Oil at lube pressure, flows down the centre passage through cross drillings to lubricate the bearings and to cool the clutch discs in both packs.

TRAVEL PHASE

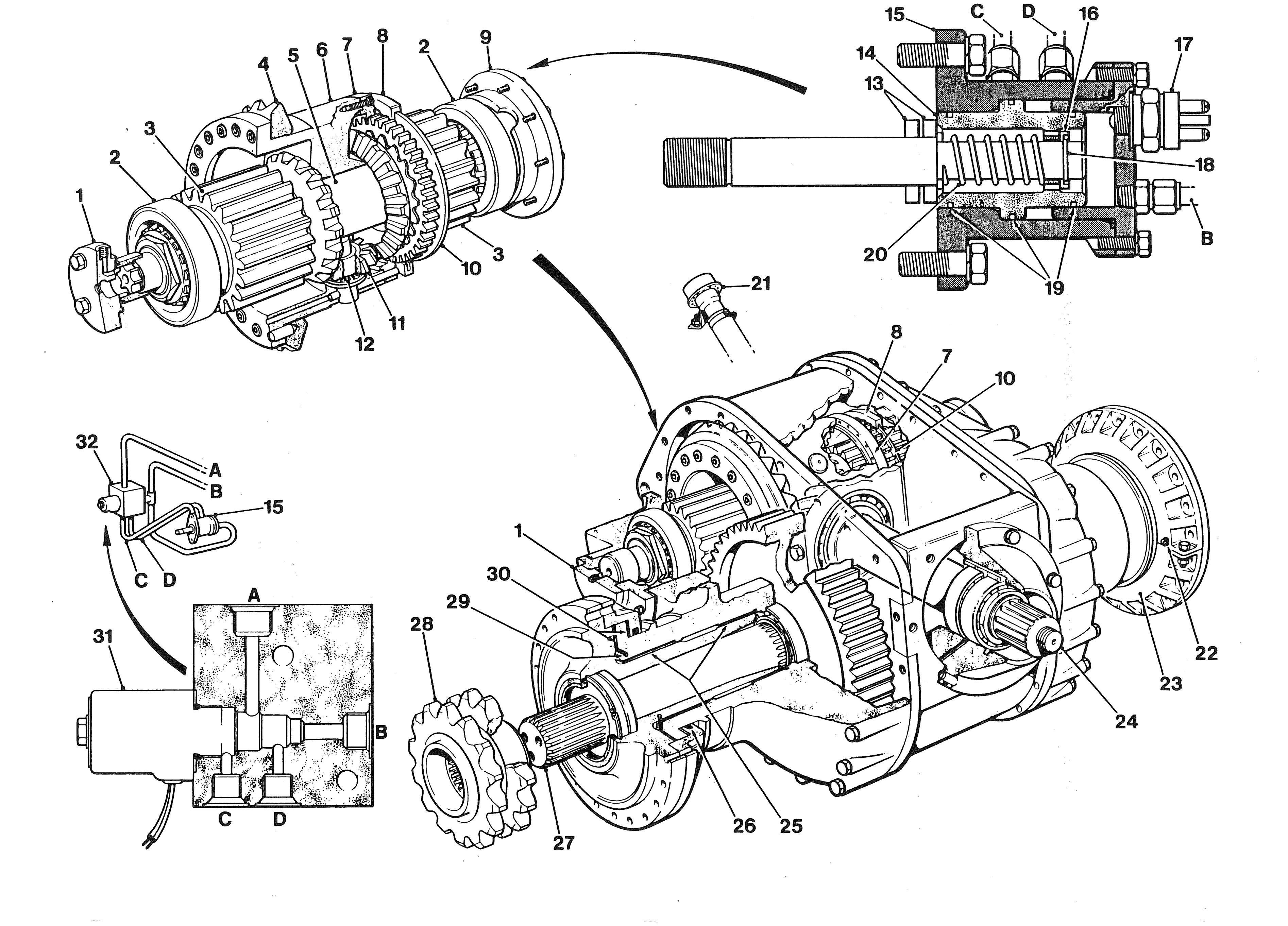
The travel phase begins when the solenoid valve is energized to engage high clutch. This delivers lock-up pressure oil down the top passage. Lube oil is fed down the centre and bottom passages. Lock-up oil enters the area known as the accelerator piston cavity. As pressure builds within this cavity, the lock-up piston, which is the outer housing, begins to move to the left. At the same time, the guide pin is pushed by the accelerator piston and holds the disc valve open on the right side of the separator plate allowing oil to transfer through into the lock-up cavity. This transfer of oil ensures the high gear lock-up piston cavity is quickly filled with oil.

APPLY PHASE

At the end of the travel phase, the disc valve closes and pressure builds within the lock-up piston cavity due to lock-up oil pressure entering via a small drilling in the accelerator piston. The clutch pack will remain applied as long as lock-up oil pessure 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 principle 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 dependant upon the difference. Conversely, too high of an apply force can lead to friction disc damage.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A
B
C
D

LEGEND

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

A - Pressure
B - Drain
C - Unlock Port
D - Lock Port

The double reduction final drive is Bsed on models 740 thru 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.

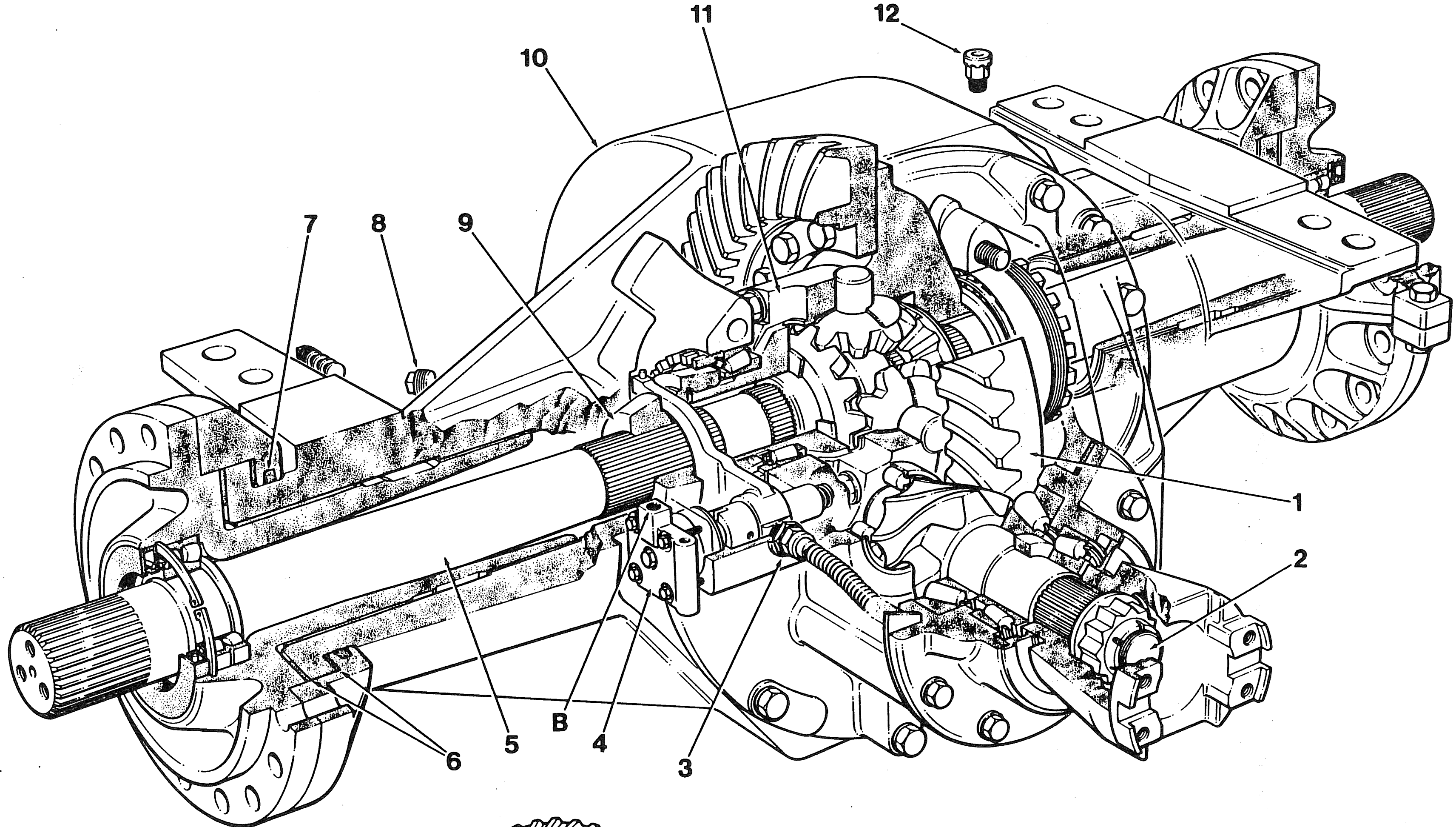
To lock or unlock the differential an electric solenoid is controlled by a switch on the right-hand cab door post. Energizing the solenoid directs transmission lock-up oil pressure to port **C** on the cylinder body. This pulls the shift fork to unlock the spider pinions, disengaging the shift clutch 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 30.

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.



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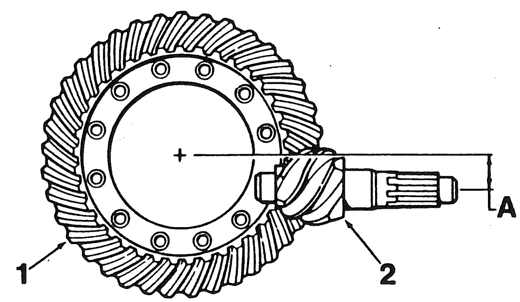

A
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LEGEND

1. Ring Gear
2. Pinion Shaft/Gear
3. Lock/Unlock Indicator Switch
4. Shift Cylinder
5. R.H. Axle Shaft
6. Thrust Plates
7. Seal
8. Level Check Plug
9. Shift Collar
10. Final Drive Housing
11. Differential Housing
12. Breather

A. Hypoid Gear Offset
B. Shift Cylinder Pressure Port

The Single Reduction SR30 Final Drive is used on models 710 thru 720A graders and the Single Reduction SR40 Final Drive is used on models 730/730A 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.

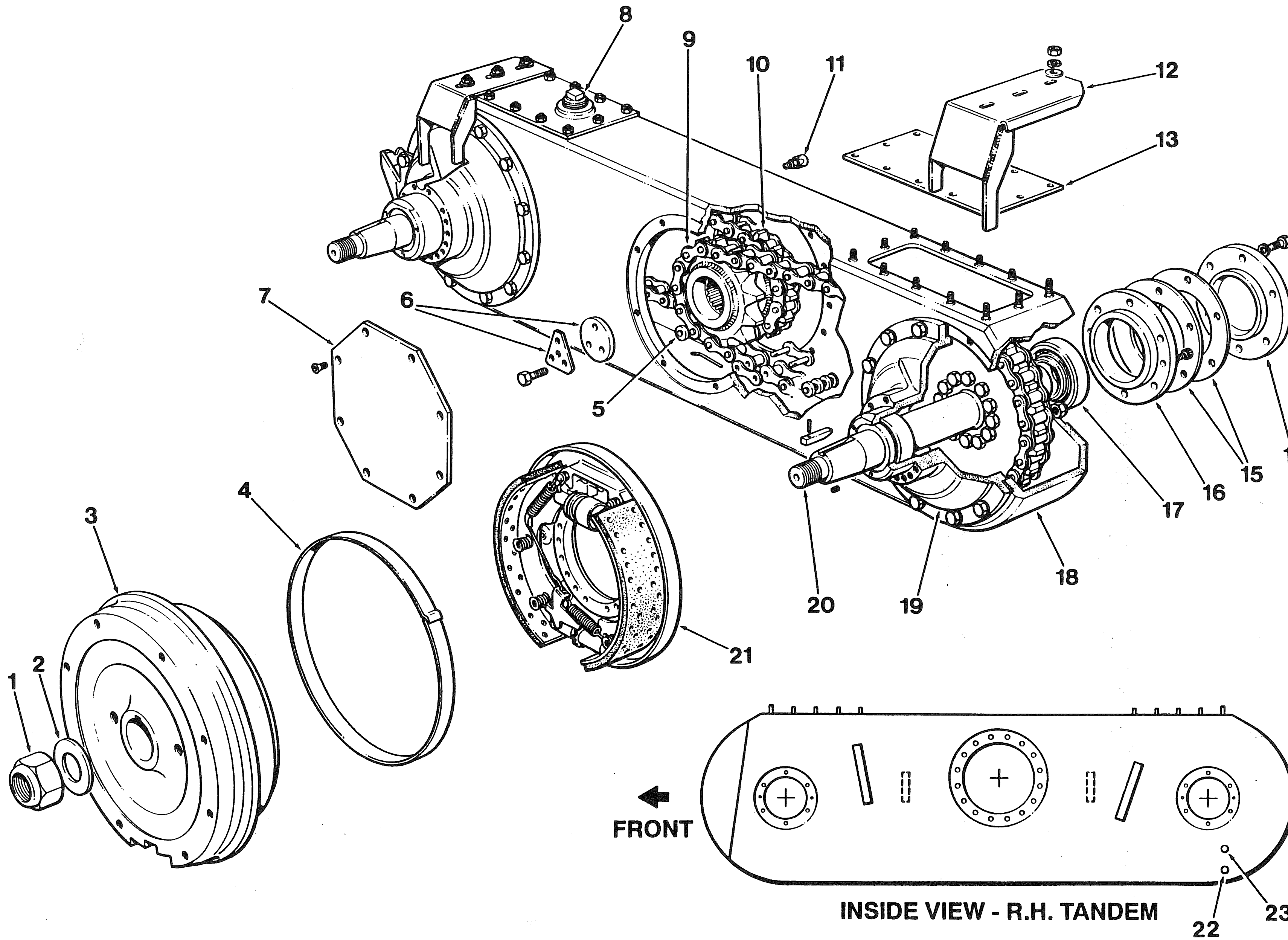
Both SR final drives feature differential lock/unlock as standard equipment. The differential lock is operated by a hydraulic actuated shift cylinder assembly that is mounted on the differential housing assembly. An electric switch on the right-hand cab post is activated to lock or unlock the differential. 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. Check lubricant level weekly or after 50 hours of operation. First lubricant change at 100 hours use, then every 1000 hours thereafter.

Refer to the Shop Manual for specifications.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INSIDE VIEW - R.H. TANDEM

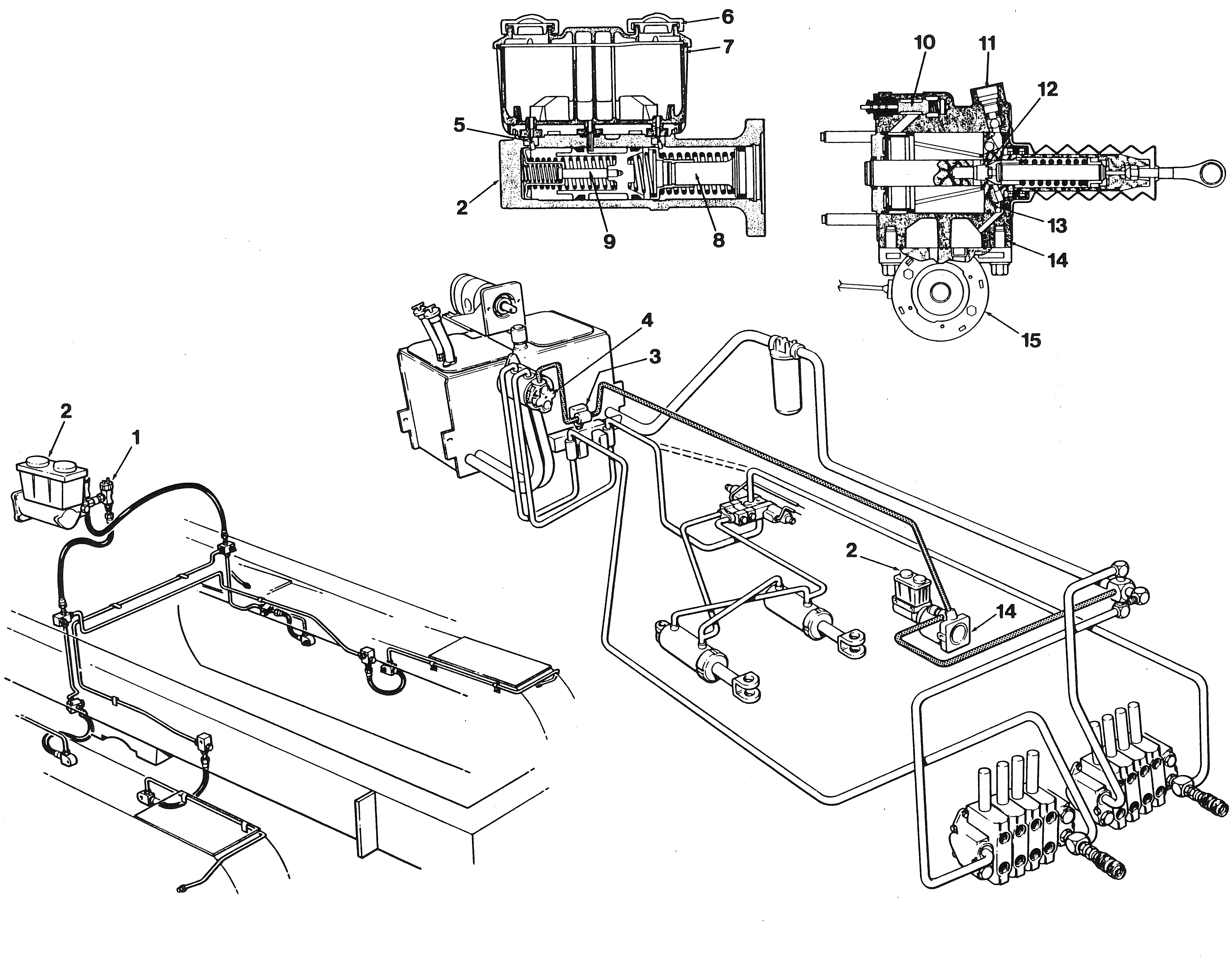
LEGEND

1. Wheel Nut
2. Washer
3. Wheel
4. Brake Band Seal
5. Magnetic Plug
6. Retainer Washer and Lock Plate
7. Inspection Cover
8. Filler Plug
9. Chain
10. Drive Sprocket
11. Breather
12. Brake Line Guard
13. Inspection Plate
14. Bearing Cap
15. Shims
16. Bearing Flange
17. Inner Bearing
18. Tandem Case
19. Bearing Housing
20. Stub Axle and Key
21. Drum Brake Assembly
22. Drain Plug
23. Oil Level Plug - Drum Brakes

Each tandem assembly divides the power flow from a single floating drive axle to two tandem mounted axles and drive wheels. The tandem case is fabricated from steel plate and is robotically welded. The inner tandem wall is 1" thick and together with two internal plates provide exceptional strength and rigidity. This allows accurate machining in a single jig, eliminating misalignment of the stub axles, chains and tires.

The shim pack under the stub axle inner bearing cap should be gauged so that a definite preload is felt when you turn the sprocket by hand. No provision is made for tightening the chains. A certain amount of slack is required and a slight rubbing of the chain on the bottom of the tandem case is normal and no cause for concern. However, a chain which has excessive slack and appears to require tightening may have a pitch of more than 2" (1.75" for models 710/710A). If this is the case, it should be replaced, as continued use will cause undue wear on the sprockets. Consult the Operator's Manual for the correct lubricant type and level on drum brake equipped graders. The lubricant change interval is every 2000 hours or 12 months which ever comes first. The tandem oil level should be checked weekly or every 50 hours whichever comes first. When checking the level ensure the grader is on level ground.

Refer to the Shop Manual for specifications.



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LEGEND

1. Brake Light Switches
2. Master Cylinder
3. Relief Valve
4. Hydraulic Pump - Third Section
5. Compensator Valve
6. Cap
7. Reservoir
8. Secondary Piston
9. Primary Piston
10. Flow Switch
11. Inlet
12. Orifice
13. Power Piston
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 e.g. steering. The brake hydraulic circuit also has its own relief valve, identical to the main hydraulic system relief valves, set to relieve 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

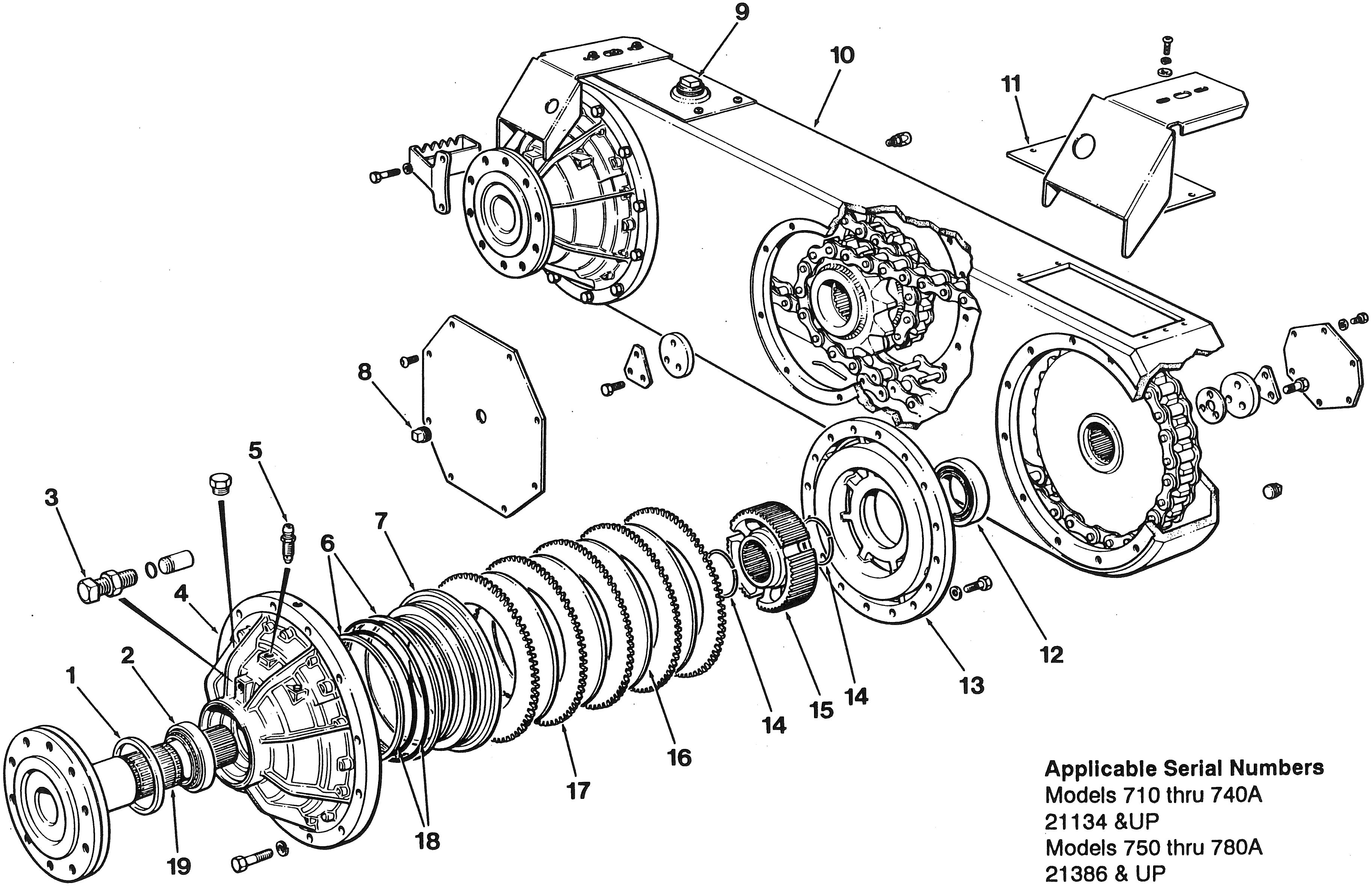
All models are equipped with four wheel dual brake system as standard equipment.

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.



Applicable Serial Numbers
Models 710 thru 740A
21134 &UP
Models 750 thru 780A
21386 & UP

LEGEND

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

The Champion Oil Disc Brake System consists of four brake units, a hydraulic brake booster with an integrated back-up electrick 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 50 for information about the master cylinder and booster assembly.

The Oil Disc Brake units are supplied with apply 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.

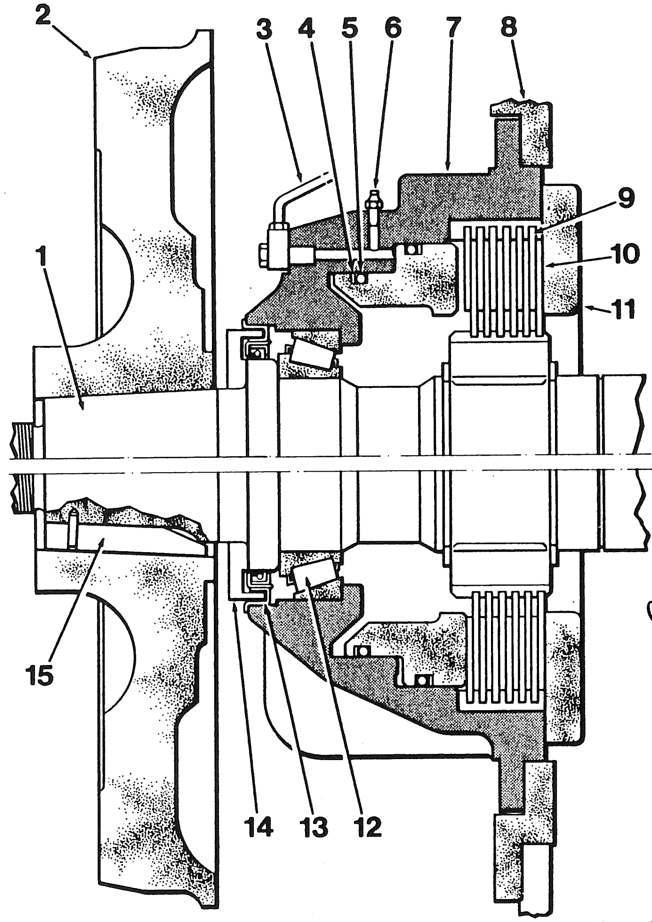
The apply fluid enters the brake unit at the top of the brake housing. In the piston chamber, the fluid moves the piston away from the "piston travel limiting screw" toward the friction disc and reaction plate assembly. As the piston compresses the plates and discs together, the tandem oil is forced 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. The wheel and tire assembly is bolted to the axle shaft. In a emergency stop situation, with the brake pedal pressed at full forc e, the friction disc and reaction plate assembly will lock up.

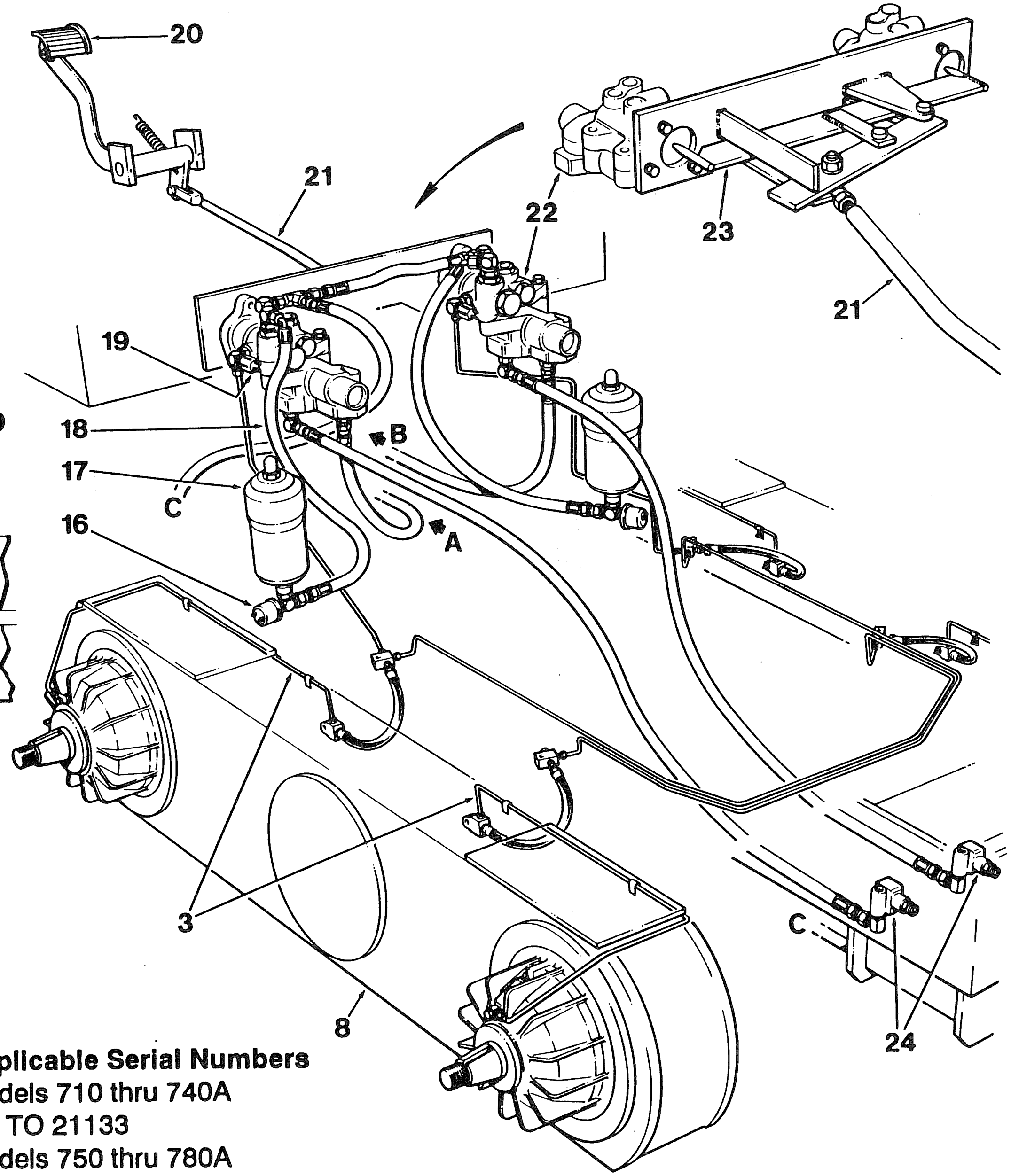
To release the brakes, lift the foot off the brake pedal. The apply fluid pressure will vent to the master cylinder reserv oir. The grooves in the rotating friction discs allow the tandem oil to pass between the stationary reaction plates and friction discs. This allows the plates and discs to separate 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.

BRAKE NOT APPLIED



BRAKE APPLIED



Applicable Serial Numbers
Models 710 thru 740A
UP TO 21133
Models 750 thru 780A
UP TO 21385

LEGEND

1. Stub Axle
2. Wheel
3. Hydraulic Brake Line
4. Back-Up Ring
5. O-Ring
6. Bleeder Screw
7. Brake Housing
8. Adaptor Ring/Tandem
9. Reaction Plate
10. Friction Disc
11. End Plate
12. Axle Bearing
13. Seal
14. Guard
15. Key
16. Pressure Sender-Warning
17. Accumulator
18. Hose
19. Pressure Sender-Brake Light
20. Brake Pedal
21. Linkage Rod
22. Brake Valve
23. Walking Beam
24. Main Hydraulic System Relief Valves (Reference only)

A Supply to L.H. Manifold Valve
B Supply to R.H. Manifold Valve
C Return to Tank

Champion's oil disc brake system is comprised of two separate braking systems. Through this design, cross-over braking is accomplished by connecting the **Left Front** tandem wheel and the **Right Rear** tandem wheel to the same brake circuit. This provides effective braking on all 4 wheels if in the unlikely event that one system is inoperative. A warning light and alarm energizes when a malfunction occurs.

The brake pedal is connected by a linkage rod to a walking beam. The walking beam pushes the activating plunger of two hydraulic brake valves mounted to the rear of the cab.

Each brake system works indentically, we will describe the operation of only the **left-hand** brake valve and circuit.

The brake valve consists of two parts:
1) The charging section on the bottom, and
2) The activation section on the top.

The charging section maintains 1200-1500 psi hydraulic pressure in the accumulator at all times. As the brake valve is in series with the main hydraulic system, a small amount of oil is directed to the accumulator. When the pressure reaches 1500 psi, charging stops and all oil flows to the main hydraulic manifold. As the brake pedal is depressed, oil is routed from the accumulator to the oil disc brake assemblies. When applying the brakes, oil pressure to the brake assemblies increases proportionately to brake pedal pressure. The higher the pedal force, the higher the apply pressure (up to a maximum of 900 psi brake line pressure), resulting in higher braking forces. When the brake pedal is released the actuation section directs oil from the brake circuit to the hydraulic tank.

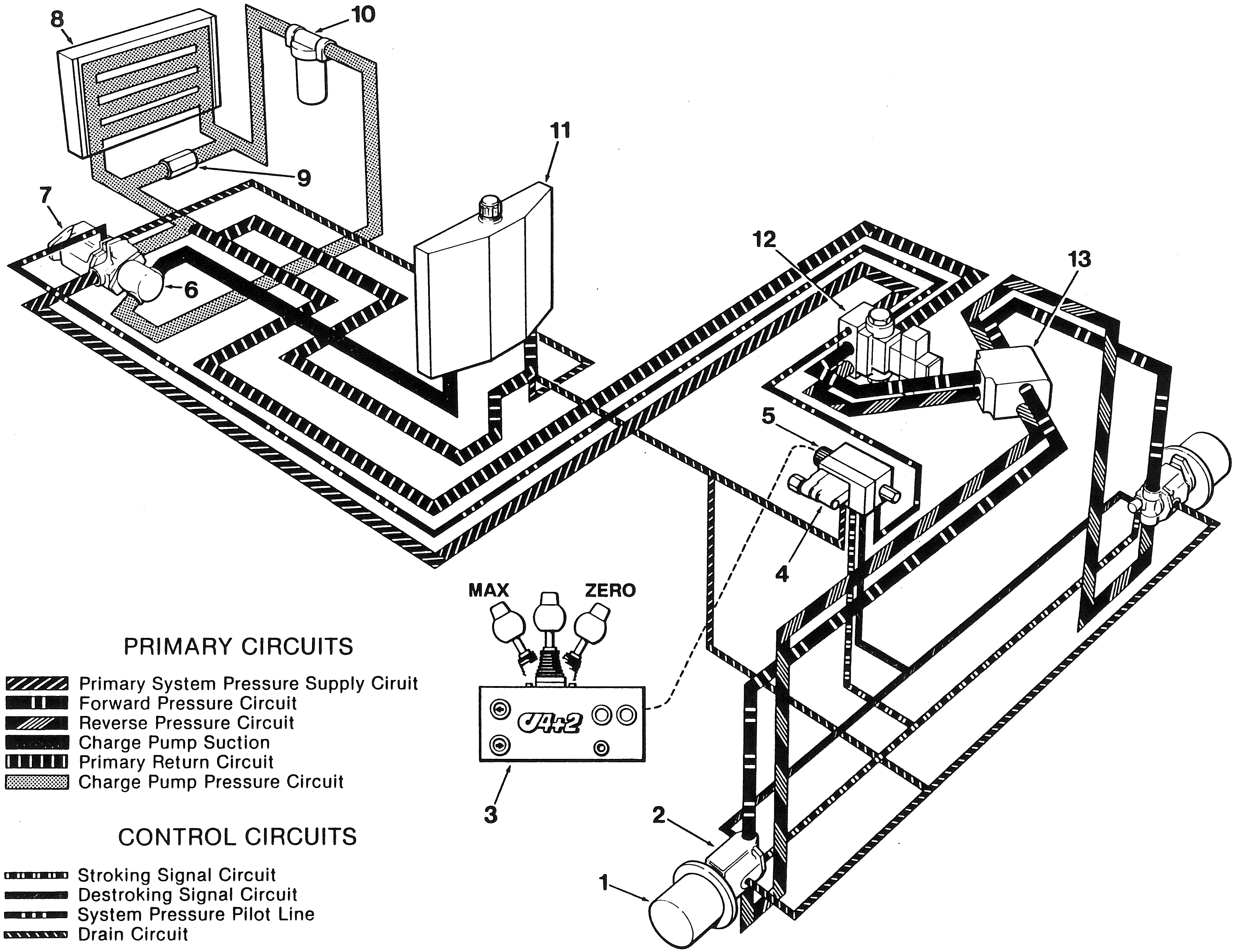
Subsequent brake applications are supplied with oil pressure from the accumulators. Each brake application reduces accumulator pressure. When 1200 psi is reached, the charging section directs main hydraulic system oil flow to the accumulators until 1500 psi is reached. As long as the engine is running, this cycle of charging takes place as required by brake applications.

If the accumulator recharge circuit fails, for example, due to a stalled engine or hydraulic system failure etc., a sending unit on the outlet of the accumulator causes a warning light and alarm to energize when pressure drops below 1050 psi. Remember, maximum brake line pressure is 900 psi, once apply pressures fall below this, braking ability is reduced.

In order for the brake system to function correctly, the accumulators contain a pre-charge of dry nitrogen of 500 psi.

The oil disc brake assembly is half submerged in tandem oil for cooling purposes. As this is a 'wet type' braking system, tandem oil type and level is critical to braking performance.

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



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PRIMARY CIRCUITS
Primary System Pressure Supply Ciruit
Forward Pressure Circuit
Reverse Pressure Circuit
Charge Pump Suction
Primary Return Circuit
Charge Pump Pressure Circuit
CONTROL CIRCUITS
Stroking Signal Circuit
Destroking Signal Circuit
System Pressure Pilot Line
Drain Circuit

LEGEND

1. Planetary Reduction Wheel Hub
2. Wheel Motor
3. Hand Controller (Located in Cab)
4. Motor Control Valve Assembly
5. Force Motor
6. Charge Pump
7. Main System Pump
8. Oil Cooler
9. Check Valve
10. Filter
11. A.W.D. Reservoir
12. Selector Valve
13. Flow Divider

All Wheel Drive (A.W.D. or 4+2) is used to increase tractive effort and steering control in slippery conditions. The front wheels are driven by a variable displacement, piston-type, hydrostatic pump and a variable displacement motor in each wheel, driving through planetary hubs. Hydraulics for the A.W.D. system are completely separate from all other systems. A.W.D. operates in all forward speeds except eighth and all reverse speeds.

Oil is drawn from the A.W.D. reservoir by the charge pump. It then goes through the A.W.D. cooler and 6-micron, cartridge type filter. Both have bypass valves to permit cold, stiff oil to bypass.

Cooled, filtered oil then flows to the primary hydraulic pump. If the control lever is in its rearward **ZERO** position, a small amount of oil is directed, at low pressure to provide cooling and lubrication for the wheel motors. As the control lever is moved forward, the stroke pressure increases to control the power output of the wheel motors.

Stroke pressure is regulated by the force motor which is basically a variable drain orifice. As the hand controller is moved toward the **MAX** position, applied voltage to the force motor increases, decreasing the orifice size, thus raising stroke pressure.

Oil from the motors is returned to the primary hydraulic pump to be 'reused'. This creates a 'closed-loop' circuit. The charge pump makes up for controlled leakage used for lubrication, and when increased volume is required because of changing conditions.

The planetaries reduce motor speed and increase torque at the wheel. They run in SAE 80W/90 gear oil which should be changed after the first 100 hours of operation and then every 1000 hours or annually (whichever comes first). The planetaries may be manually disengaged for extended roading or if service is required.

The A.W.D. system uses separate hydraulic fluid which should be replaced annually or every 2000 hours. The filter change is every 1000 hours.

The hand controller has several indicator lights in addition to the control lever. The lights indicate; forward, reverse, excessive oil temperature, and low charge pressure.

Further information on specific components may be found in the A.W.D. section of the Shop Manual and in the All Wheel Drive Service Video Tapes.