6. Position the selector lever in the disengaged, lower position. Ensure the transfer case actuating lever is in the disengaged position. Adjust the cable locknuts so that when the selector lever is operated the lever does not hit the console lower panel in either the engaged or disengaged position.

7. Tighten the locknuts to the specified torque, see "Specifications" – Chapter 5.

PART 7

STEERING AND FRONT AXLE

Chapter 5
TROUBLE SHOOTING, SPECIFICATIONS AND SPECIAL TOOLS

A. TROUBLE SHOOTING – STEERING

PROBLEM	POSSIBLE CAUSES	REMEDY
No steering or excessive effort required to steer	1. Incorrect oil level in reservoir	1. Fill with the correct grade and quantity of oil
	2. Air in system	2. Check for loose connections or damaged tubing. Purge system of air
	3. Pump relief valve faulty	3. Check system pressure
	4. Worn pump	4. Inspect and repair
	5. Leaking power cylinder	5. Inspect and repair
	6. Damaged valve spool	6. Inspect and replace
	7. Broken or damaged steering column	7. Inspect and replace
	8. Damaged or worn metering element	8. Inspect and replace

PROBLEM	POSSIBLE CAUSES	REMEDY
Steering wanders	1. Excessive play in steering linkage ball joints	1. Inspect and replace
	2. Leaking power cylinder	2. Inspect and repair
	3. Control valve spool sticking or worn	3. Inspect and replace
	4. Weak or broken torsion bar	4. Inspect and repair
	5. Incorrect valve spool shimming adjustment	5. Check and adjust
	6. Damaged or worn metering element	6. Inspect and replace
Front wheels surge when steering	1. Leaking power cylinder	1. Inspect and repair
	2. Control valve spool sticking	2. Inspect and repair
	3. Weak or broken torsion bar	3. Inspect and replace
	4. Damaged or worn metering element	4. Inspect and replace
Noisy Pump	1. Incorrect oil level in reservoir	1. Fill with the correct grade and quantity of oil
	2. Air in system	2. Check for loose connections or damaged tubing. Purge system of air
	3. Water in oil	3. Drain and renew the oil

B. SPECIFICATIONS – STEERING

POWER STEERING MOTOR

Type	Hydrostatic
Steering Wheel Turns Lock to Lock	
Two Wheel Drive Axle	4.1
Four Wheel Drive Axle – Left Turn	3.1
Four Wheel Drive Axle – Right Turn	3.75
Upper Cover Shim Sizes	0.0025 in (0.064 mm) 0.005 in (0.127 mm) 0.010 in (0.254 mm) 0.030 in (0.762 mm)

POWER STEERING PUMP

Type	Gear
Pump Output at 1000 rev/min	3.0 Imp. Gal/min 3.6 U.S. Gal/min 13.6 Litres/min
Pump Output at 2200 rev/min	6.6 Imp. Gal/min 7.9 U.S. Gal/min 29.9 Litres/min
Relief Valve Pressure	1850 ± 50lbf/in² at 1100 rev/min 128 ± 3.5 bar
Shim Thickness	Pressure Change
0.010 in (0.25 mm)	66 – 74 lbf/in² (4.54 – 5.10 bar)
0.015 in (0.38 mm)	99 – 110 lbf/in² (6.82 – 7.58 bar)

OIL SPECIFICATION

Fill with the correct grade, quantity and type of oil as specified in the relevant Operators Manual.

STEERING MOTOR AND PUMP TORQUE SPECIFICATIONS

	Nm	Kgfm	lbf.ft.
Steering Wheel Retaining Nut	54	5.5	40
Steering Motor Securing Bolt	18	1.8	13
Steering Tube to Motor Connections	31	3.2	23
Steering Motor Upper Cover Bolts	27	2.8	20
Steering Motor End Cover Bolts	23	2.3	17
Steering Pump Retaining Bolts	31	3.2	23
Steering Pump Through Bolts	36	3.6	26
Steering Pump Reservoir Bolt	16	1.6	12
Steering Pump Drive Gear Securing Nut	42	4.3	31
Steering Pump Relief Valve	42	4.3	31

C. SPECIFICATIONS – TWO WHEEL DRIVE FRONT AXLE

DIMENSIONS AND ADJUSTMENTS

Wheel Tread Width (fixed)		
Ford 455C	62 in	(1575 mm)
Ford 555C and 655C	70 in	(1778 mm)
Toe-in	0 – 0.25 in	(0 – 6 mm)

GREASE

Grease with the correct grade as specified in the relevant Operators Manual.

FRONT TYRE PRESSURES AND PERMISSIBLE LOADS (two wheel drive)

The following charts give the carrying capacity of the **axle** at the tyre pressures indicated.

Tyre size	Ply rating	Inflation Pressures in Bar											
		1.5	1.7	1.9	2.1	2.2	2.4	2.6	2.8	3.0	3.3	3.6	3.9
		Permissible Load Capacity Per Axle (kg)											
9.00 – 16	10	1360	1480	1600	1700	1750	1850	1940	2030	2110	2240	2360	2490
11L – 16	10	1400	1480	1620	1720	1790	1880	2000	2080	2210	2340	2460	–

Tyre size	Ply rating	Inflation Pressures in lbf/in²											
		22	25	28	30	32	35	38	41	44	48	52	57
		Permissible Load Capacity Per Axle (lb)											
9.00 – 16	10	2298	3262	3527	3747	3858	4078	4276	4475	4651	4938	5202	5489
11L – 16	10	3086	3262	3571	3791	3946	4144	4409	4585	4872	5158	5423	–

TWO WHEEL DRIVE FRONT AXLE – TORQUE SPECIFICATIONS

	Nm	Kgfm	lbf.ft.
Oscillation Bearing Cap Bolts	510	52.0	376
Spindle Locking Pin Nut	50	4.9	37
Spindle Dust Seal Bolts	46	4.7	34
Track Control Rod Ball Joint to Steering Cylinder	465	47.0	340
Track Control Rod Ball Joint Nut to Spindle Arm	385	40.0	285
Steering Cylinder Locking Plate Bolts	145	15.0	105
Front Wheel Nuts – 2WD	176	17.9	130

D. SPECIFICATIONS – FRONT WHEEL DRIVE AXLE AND TRANSFER GEAR ASSEMBLY

FRONT AXLE TYPE
Carraro heavy duty, centre driven, double reduction (crown wheel and pinion plus planetary hubs)

STEERING TURN ANGLE
(Dependent on track setting) 50°

AXLE OSCILLATION ANGLE
12°

OVERALL WIDTH
(Wheel mounting flange) 1884 mm (74.2 in)

FRONT AXLE RATIOS

	Ford 455C	Ford 555C/655C I.S.O.	Ford 555C/655C N.A.S.O.
Overall:	10.33:1	16:1	14.3:1
Crown Wheel and Pinion	1.72:1	2.67:1	2.383:1
Planetary Hubs	6:1	6:1	6:1
Matching Transfer Gear Assembly	0.735:1	1.037:1	1.037:1

OIL CAPACITIES

Hub (each			
Litres	1	1	1
Imp. Pints	1.76	1.76	1.76
U.S. Pints	2.10	2.10	2.10
Axle Differential			
Litres	6.5	6.5	6.5
Imp. Pints	11.4	11.4	11.4
U.S. Pints	13.6	13.6	13.6

CLEARANCES AND ADJUSTMENTS

Front Wheel Toe-in	0 – 4.0 mm (0.16 in)
Axle Hub Bearing Rolling Resistance	Non-adjustable, pre-set
Axle Shaft End Float	Non-adjustable, pre-set
Swivel Bearing Pre-Load	0.2 – 0.4 mm (0.008 – 0.016 in) Adjustable by shims of:- 0.10 mm (0.0040 in) 0.19 mm (0.0076 in) 0.35 mm (0.0140 in)
Drive Pinion Bearing Rolling Resistance (see text)	9.2 – 13.7 daN (21 – 31 lbf) (9.5 – 14.0 kgf)
Pinion to crown Wheel Backlash	0.15 – 0.25 mm (0.006 – 0.010 in)
Pinion to Crown Wheel Bevel Distance (see text)	Adjustable by shims 2.5 mm – 3.4 mm in steps of 0.1 mm (0.10 in – 0.136 in in steps of 0.004 mm)
Differential Bearing Rolling Resistance (see text)	Drive Pinion Bearing Rolling Resistance plus 3.1 – 4.7 daN (7.0 – 10.6 lbf) (3.2 – 4.8 kgf)

LUBRICANTS

Fill with correct grade, quantity and type of oil as specified in the relevant Operator's Manual.

GREASE FITTINGS

Grease with the correct grade as specified in the relevant Operator's Manual.

THREAD SEALANT

To Ford Specification – ESK-M4G247-A2 (Loctite 243 or 542).
Crown wheel retaining bolts, planetary shaft cover screw heads.

To Ford Specification ESE-M4G203-A2 (Loctite 270/271).
Axle support pillar retaining bolts.

DOWEL FIXATIVE ADHESIVE

To Ford Specification – SPM-2G9120-A (Loctite 638).
Differential support housing to axle casing dowel.

FLANGE SEALANT (FACE-TO-FACE SEALANT)

To Ford Specification ESK-M4G269-A (Loctite Superflex Silicone, Loctite 518 or Silastic 732).

Planetary carrier to hub housing, differential support housing to axle casing and pinion oil seal housing.

WEAR RING RETAINER

To Ford Specification ESK-M4G269-A (Loctite 518).
Hub seal wear ring.

TRANSFER GEAR ASSEMBLY

TYPE — Rear axle centralized mounting with dog type non-slip clutch. Mechanically engaged and released.

	Ford 455C	Ford 555C/655C (All)
TRANSFER GEAR ASSEMBLY RATIO	0.735:1	1.037:1
Drive Pinion Teeth	25	28
Idler Gear Teeth	38	33
Driven Gear Teeth	34	27

ACTUATING LEVER DETENT ADJUSTMENT

Adjust until effort required to activate lever when measured with a spring balance is equivalent to 12 kgf (26 lbf).

OIL CAPACITY

Transfer Case — Lubricated by Rear Axle Oil.

Increase in Rear Axle Oil Capacity with Transfer Case Installed

Litres	1.0
Imp. Pints	1.7
U.S. Pints	2.1

SEALANT

To Ford Specification SJ-M4G9102-A (Loctite 573).
Detent adjustment screw and detent shaft blanking plug.

TORQUE SPECIFICATIONS
FWD AXLE

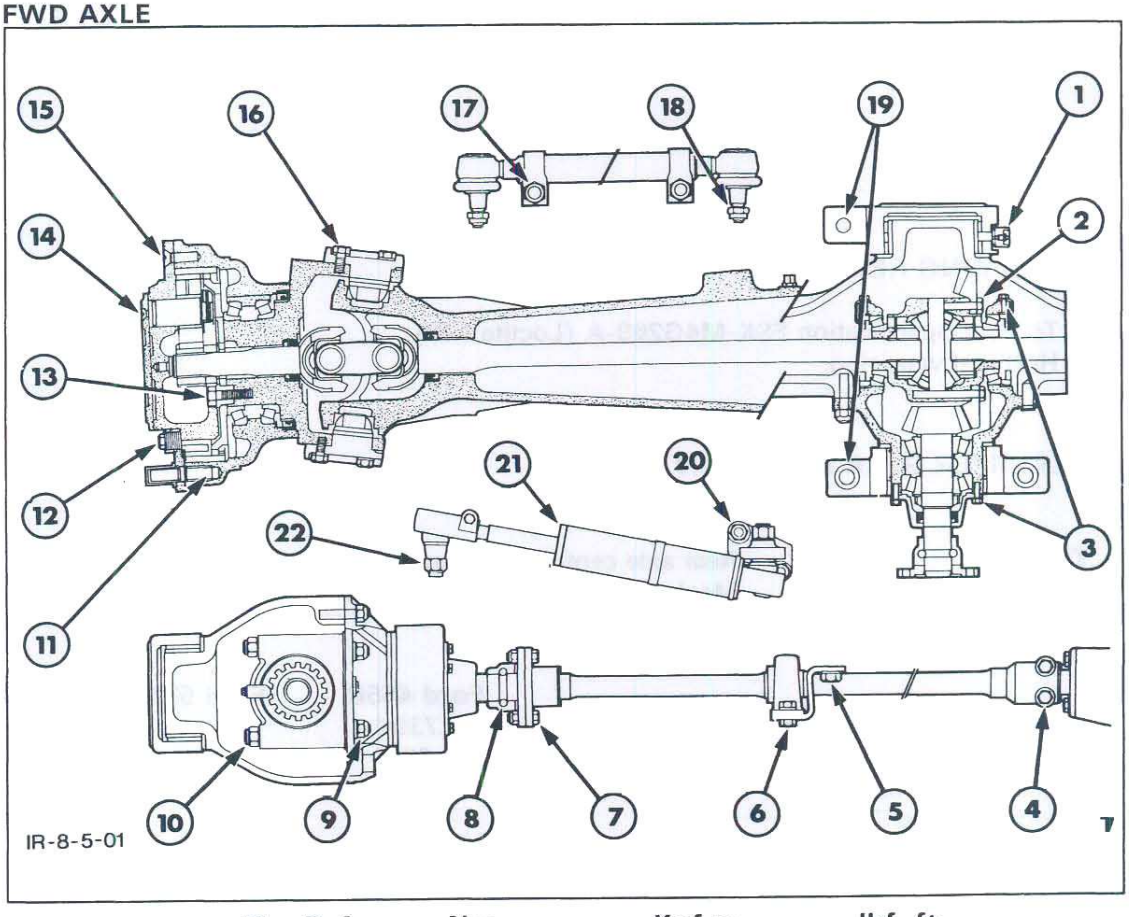
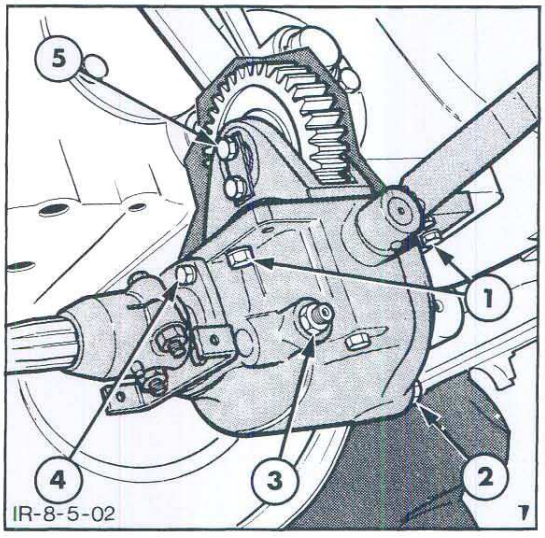


Fig. Ref.	Nm	Kgf.m	lbf. ft
1	70	7	51
2	70	7	51
3	10	1	7
4	57	5.8	42
5	352	35.9	260
6	57	5.8	42
7	57	5.8	42
8	56	5.7	41
9	100	10.2	74
10	156	15.9	115
11	70	7	51
12	40	4.1	30
13	250	25.4	184
14	34	3.5	25
15	80	8.2	59
16	137	13.8	100
17	70	6.9	50
18	140	14.1	102
19	515	53	380
20	240	24	177
21	258	26.3	190
22	300	30.4	220
Front Wheel Nuts – FWD	270	27.5	200

TORQUE SPECIFICATIONS
TRANSFER GEAR ASSEMBLY

Fig Ref.	Nm	Kgf.m	lbf.ft
1	48	4.9	35.5
2	60	6.0	44.0
3	87	8.8	64.0
4	24	2.4	17.5
5	24	2.4	17.5



E. SPECIAL TOOLS

Fixture – Crown Wheel and Pinion Bevel Setting	FT.3135	4775
Oil Seal Installer – Axle Shaft (Swivel Casing)	FT.3162	307972
Oil Seal Installer – Axle Shaft (Centre Casing)	FT.3162	307972
Oil Seal Installer – Differential Pinion	FT.3162	307972
Bushing Installer – Axle Shaft (Swivel Casing)	FT.3164	307974
Bushing Installer – Axle Shaft (Centre Casing)	FT.3165	307975
Wrench – Differential Pinion Bearing Nut	FT.3168	307978
Steering Cylinder 'C' Spanner	FT.8554	–
Driver Handle	550	–
Slide Hammer	943	9507
Slide Hammer Puller	943S	9567
Puller Attachment	951	9190
Slide Hammer	954C	9508
Puller	1003	9516

PART 8
HYDRAULIC SYSTEM, CONTROLS AND FRAME

Chapter 1
HYDRAULIC CIRCUITS

Chapter 2
RESERVOIR, FILTER AND OIL COOLER

Chapter 3
HYDRAULIC PUMP

Chapter 4
BACKHOE HYDRAULIC CONTROL VALVE ASSEMBLY

Chapter 5
SIDESHIFT BACKHOE HYDRAULIC CLAMPING SYSTEM

Chapter 6
LOADER HYDRAULIC CONTROL VALVE ASSEMBLY

Chapter 7
SWING SYSTEM, HYDRAULIC CYLINDERS AND FLOW RESTRICTOR VALVES

Chapter 8
BACKHOE FRAME, BOOM, DIPSTICK AND BUCKETS, CONTROL SYSTEM, HOSES AND TUBES

Chapter 9
LOADER FRAME, BUCKETS, CONTROL SYSTEM, HOSES AND TUBES

Chapter 10
HYDRAULIC TROUBLE SHOOTING AND PRESSURE TESTING

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SPECIFICATIONS AND SPECIAL TOOLS

PART 8
HYDRAULIC SYSTEM, CONTROLS AND FRAME

Chapter 1
HYDRAULIC CIRCUITS

A. HYDRAULIC CIRCUITS — GENERAL INTRODUCTION

The Ford 455C, 555C and 655C Industrial Tractors may be equipped with a front end heavy duty industrial loader and a powerful rear mounted excavator/backhoe. In some marketing areas the unit may be available without the rear mounted backhoe.

This PART of the Repair Manual embraces all aspects of the loader/backhoe hydraulic system, the loading and 'digging' elements the supporting framework and control systems.

Section B of this chapter describes in detail the layout of the hydraulic system of a combined backhoe/loader unit. Where a backhoe is not fitted to a particular unit, that part of the circuit will not be applicable.

The following chapters in this PART describe the function and overhaul of each major area of the backhoe/loader unit. Study of each chapter content listings will identify where each component is described and overhauled. It is strongly recommended that before any overhaul or repair procedures are commenced, the 'Description and Operation Sections' be understood. Where applicable, before any hydraulic component is removed or adjusted, the appropriate pressure test or flow test should be performed and the result analysed. An understanding of why and how a particular component functions will greatly speed repair times and reduce the possibility of unnecessary dismantling.

Any reference to left and right are as viewed from behind the machine, except for the backhoe. Left and right for the backhoe are as viewed from the backhoe operating position.

Ford 455C, 555C and 655C loader/backhoes employ a single hydraulic system which operates both the backhoe and loader elements of the tractor.

Figure 1 illustrates the major components of the hydraulic circuit which comprise of a hydraulic reservoir, oil cooler, pump, filter and directional control valves. The hydraulic cylinders utilised in the circuit are illustrated in separate schematic diagrams for the loader and backhoe sections of the system.

Each of the following numbered paragraphs relate directly to the key numbers in Figure 1 and give a brief description of the function of each major component.

1. The removable hydraulic reservoir is located in the front radiator shell and has a capacity of 5.4 Imp. Galls (6.5 US Galls. 24.5 Litres). The reservoir provides a storage head of oil to the pump and by virtue of its position ensures the pump is always supplied with an unrestricted supply of oil aided by gravity. A breather system in the top of the reservoir allows venting of the hydraulic oil to atmosphere and the condensing recovery of any vapours.

2. The hydraulic gear type pump is driven at engine speed by a double universal jointed shaft, direct from the engine front crankshaft pulley and is a single element fixed displacement unit.

   Displacement for the pump used in each model at 2200 engine rev/min. at 180°F (82°C) is as follows:–

   Ford 455C
   21.6 Imp. Gal/min. (25.4 US Gal., 98 Ltr./min).

   Ford 555C/655C
   25.5 Imp. Gal/min. (30.6 US Gal., 116 Ltr./min).

   The pump draws oil from the reservoir and converts the engine rotational energy into fluid energy which is at a later stage converted to a straight line or lateral energy, having been routed by connecting pipework to a hydraulic cylinder.

3. The loader main control valve is also a stack type open centre valve which normally contains two spool sections but can be supplemented with a third spool section if a hydraulic bucket or auxiliary equipment is fitted.

   This valve controls the lifting and lowering of the loader arms and the dump and rollback of the bucket. The third spool section where fitted operates the jaws on the multi-purpose hydraulic bucket or alternatively any auxiliary equipment that may be installed. Actuation of all three sections of the loader control valve is achieved by the use of a single hand operated lever.

   Oil flow through the valve sections is designed to give priority to the bucket cylinder over the lift cylinder and ensures optimum breakout forces are achieved during operation.

   The loader valve receives oil from the hydraulic pump which passes through the open centre gallery to the power beyond port which if the loader control valve is in neutral (i.e. no cylinders working) will carry the entire flow to the backhoe valve. If the loader cylinders are working exhaust oil from these cylinders is returned to the reservoir through the exhaust port in the inlet end cover.

4. The power beyond tube routes the pump flow after passing through the centre of the loader main control valve directly to the backhoe control valve.

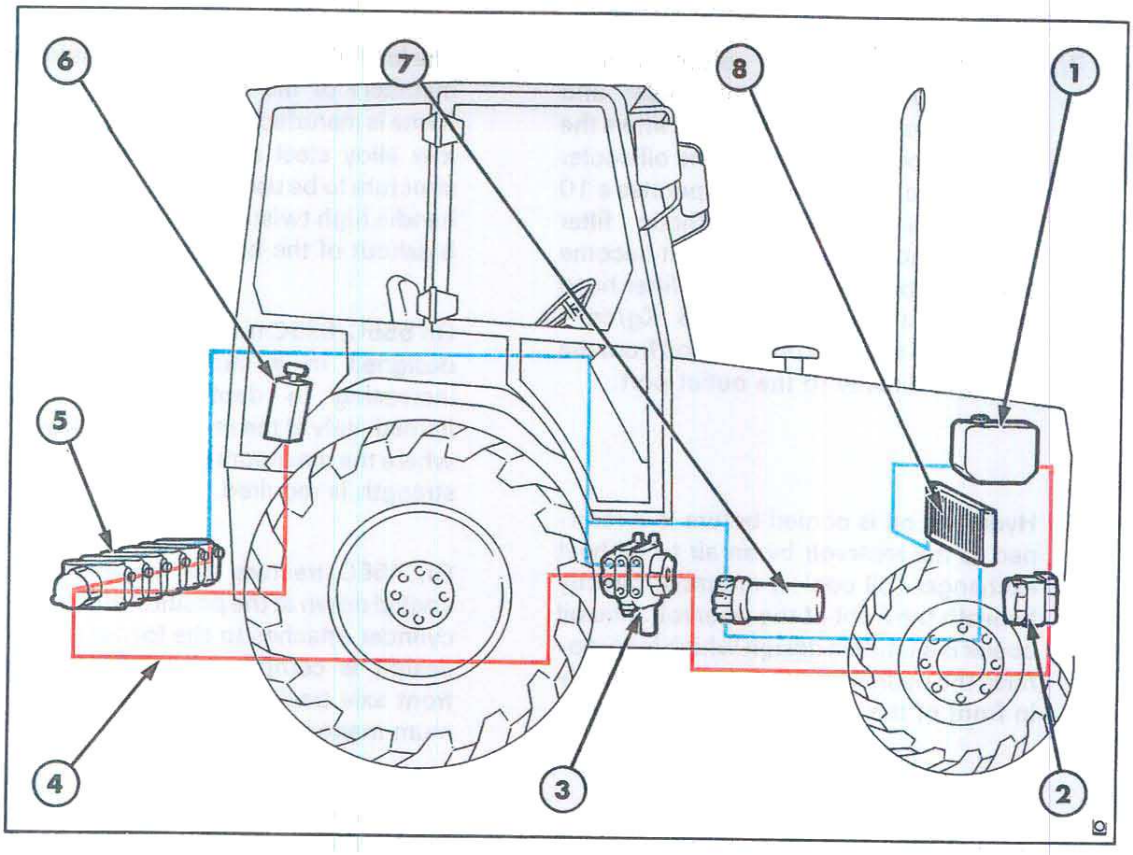

Figure 1
Hydraulic Components and Circuit Schematic

Pump Oil
1. Reservoir
2. Hydraulic Pump
3. Loader Main Control Valve
4. Power Beyond Tube

Return to Reservoir Oil
5. Backhoe Main Control Valve
6. Clamp Control Valve (Side Shift Units Only)
7. Filter
8. Oil Cooler

5. The backhoe main control valve is a stack type open centre valve, normally containing six spool sections. It can be supplemented by an additional section if an extendible dipperstick or auxiliary equipment is fitted. This valve controls the placement of the stabilisers and the control of the backhoe digging elements. Manual control of the valve spools is normally achieved by a two-lever system, plus an additional two levers for stabiliser control. An optional four lever control system is however available where required and can be supplied as a dealer installed option.

   When an extendible dipstick is fitted a foot operated control is utilised.

   System pump pressure oil is supplied directly to the inlet port of the valve from the 'power beyond' port of the loader valve. Exhaust oil from the backhoe valve assembly and working cylinders is returned to the reservoir through the single outlet port in the outlet end cover and is termed the return to reservoir or dump port.

6. The clamp cylinder control valve used on sideshift models is housed in the backhoe control console and directs oil flow to the sideshift carriage clamp cylinders.

7. A hydraulic full flow return filter is situated between the oil cooler and backhoe main control valve and filters the oil before being returned to the oil cooler and reservoir. The filter incorporates a 10 micron throw away synthetic filter element and should the element become blocked a bypass valve in the filter head operates at a 50lbf/in² (3.5 Kg/cm²) differential pressure diverting oil from the filter and directly to the outlet port.

8. Hydraulic oil is cooled before it is returned to the reservoir by an air to oil heat exchanger (oil cooler) mounted directly beneath the front of the reservoir. The oil cooler is a tandem design which incorporates the hydraulic oil cooler immediately in front of the transmission oil cooler.

Figure 2 illustrates the major components and loader lift and bucket circuits linked schematically to the loader main control valve. Each of the numbered paragraphs that follow relate directly to the key numbers in the illustration. The illustration shown is that for 555C/655C tractors. On 455C vehicles, the loader arm is angled downwards at the point where the lift cylinder attaches to the arm and is the optimum design for these tractors which incorporate a narrow 62 inch (1575 mm) front axle tread width.

1. The idler and bucket attaching links extend the length of the bucket cylinders and maintain certain mechanical advantages during maximum bucket movement.

2. The loader bucket features a standard bucket with full width cutting edge. An optional multi-purpose bucket is available on tractors installed with the third spool on the loader control valve.

3. The loader frame is pivoted on the vertical members of the subframes. The loader frame is manufactured from high strength low alloy steel allowing a light strong structure to be used with the capability to handle high twisting loads should corner breakout of the bucket occur.

   On 555C/655C tractors the loader arm is designed in a straight taper section increasing in depth to the section immediately at the rear of the torsion tube where the maximum bending and torsion strength is required.

   On 455C tractors the loader arms are angled down at the position where the lift cylinder attaches to the loader arm. This design is compatible with the narrow front axle track width and enables optimum manoeuvreability of the vehicle.

   The main subframes are firmly attached to both the vertical and horizontal planes of the rear axle shaft housings and attached to the front axle support casting in the vertical plane only. This allows loader forces to be absorbed by the subframe and rear axle whilst allowing the engine and transmission to be protected from loader compressive forces.

4. The double acting loader lift cylinders control the lifting and lowering of the loader arms. Each cylinder is linked hydraulically so that both cylinders apply equal forces to the lift arms.

5. The loader main control valve regulates the flow of oil to the loader lift and bucket cylinder. If a multi-purpose hydraulic bucket or auxiliary equipment is fitted a third section is added to the control valve.

6. The bucket cylinders control the roll angle of the bucket. As with the lift cylinders, each cylinder is connected hydraulically so that equal forces are applied by both cylinders.

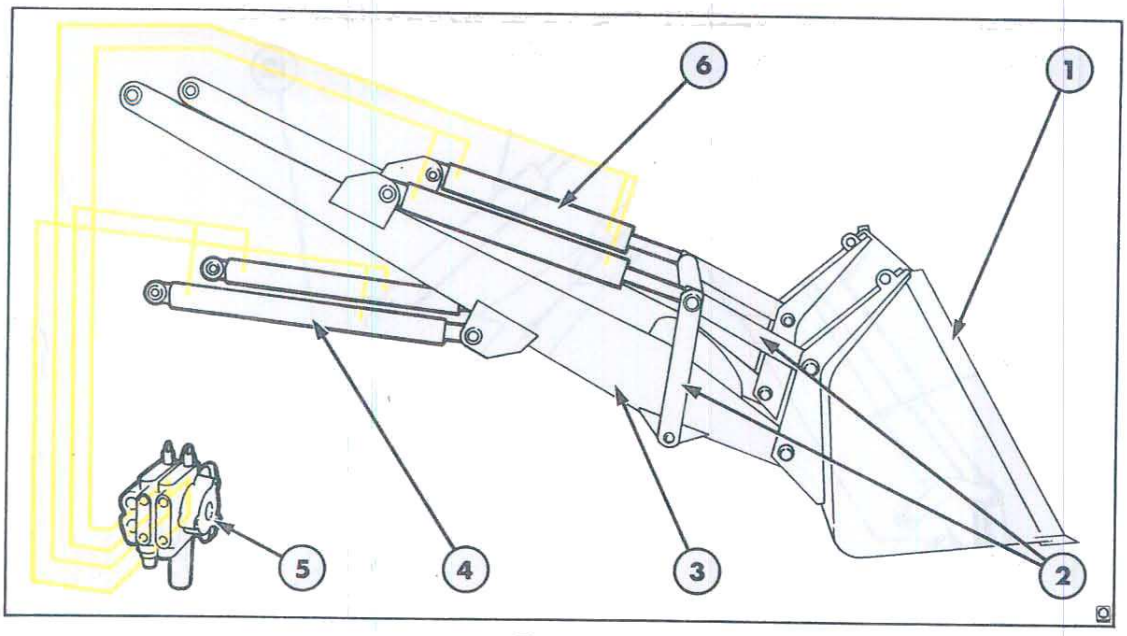

Figure 2
Loader Assembly and Hydraulic Circuit Schematic

Element Operating Oil
1. Loader Bucket
2. Idler and Bucket Attaching Links
3. Loader Frame
4. Loader Lift Cylinder
5. Loader Main Control Valve
6. Bucket Cylinder

Figure 3 shows the major components and backhoe digging and slewing circuits linked to the backhoe main control valve. Each of the numbered paragraphs that follow relate directly to the key numbers in the illustration.

1. The mainframe is bolted to the subframe and supports the backhoe digging elements. The illustration represents a side shift model and, as its name suggests, allows the digging elements, which on this model are attached to the mainframe through a movable carriage, to shift side to side to enable parallel digging to a wall or fence for example. A second type, termed the centre pivot, has a different mainframe and again as the name suggests, pivots about the centre only. The side shift design is not available on 455C loader/backhoe tractors.

2. The carriage, on the side shift models only, is hydraulically clamped to the mainframe by four single acting small cylinders. The carriage carrying the swing post and digging elements can be transported across the mainframe by releasing the clamp cylinders and actuating the digging elements at right angles to the mainframe.

3. The swing post, dependent on model design (side shift or centre pivot) is pinned to the carriage or in the vertical plane and carries the base of the boom horizontally pivoted at its lower level. At the upper level the lift cylinder is attached. The distance between each pivot provides sufficient mechanical advantage to raise and lower the boom at maximum and minimum travels.

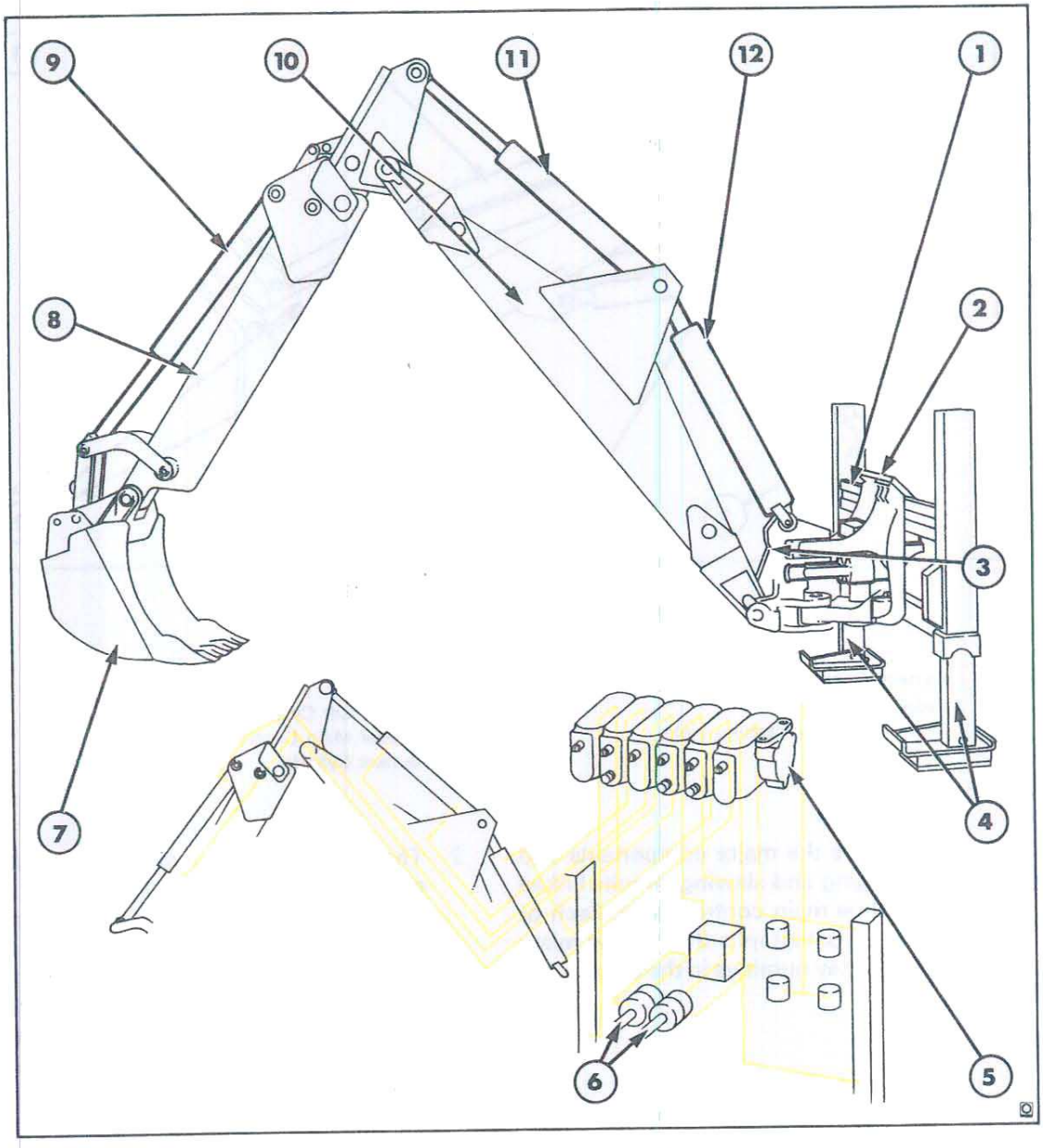

Figure 3
Backhoe Assembly and Hydraulic Circuit Schematic (side shift shown)

Element Operating Oil

1. Mainframe
2. Carriage
3. Swing Post
4. Stabilisers
5. Backhoe Main Control Valve
6. Swing Cylinders
7. Bucket
8. Dipstick
9. Bucket Cylinder
10. Boom
11. Crowd Cylinder
12. Lift Cylinder

4. Two extendible stabilisers, vertically mounted on sideshift models, are each actuated by a double acting hydraulic cylinder. When the backhoe is operated for digging operations these stabilisers are lowered to the ground to support the backhoe mainframe.

5. The backhoe main control valve directs oil flow to the swing, stabiliser and digging elements of the backhoe.

6. Two swing cylinders control the rotation of the swing post and digging elements. Each cylinder operates directly on the swing post and both are interconnected hydraulically so that as one cylinder retracts under hydraulic power, the other cylinder is extended.

7. The bucket is shaped for optimum filling and penetration. Dependent on the nature of the work, bolt-on teeth can be added to increase penetration.

8. The dipstick pivots on the boom and allows the bucket to move within an area around the boom. A special extendible dipstick as shown in Figure 3, can be specified which telescopes, so altering the length of the dipstick.

9. The bucket cylinder controls the bucket rotation. Mechanical advantages are maintained by links attached to the bucket, and dependent on bucket size, the mechanical advantage can be varied by changing the link attachment point to the bucket.

10. The boom is pivoted on the swing post and raises and lowers the dipstick and bucket. Attached to the boom are the hydraulic oil feed tubes for the crowd and bucket cylinders and optional extendible dipstick.

11. The crowd cylinder controls the position of the dipstick and bucket relative to the boom. It is attached to the boom using the same pin as the rod end of the lift cylinder. In effect, this commonisation of pivot reduces the loadings at the centre of the boom during certain digging operations.

12. The lift cylinder raises and lowers the boom. As previously stated, it is attached to the boom using the same pin as the base of the crowd cylinder.

Figure 4 and 5 shows the complete hydraulic circuit in schematic form. Note that the centre pivot model in schematic form has slight differences in the swing circuitry. These differences are fully detailed in Chapter 7.

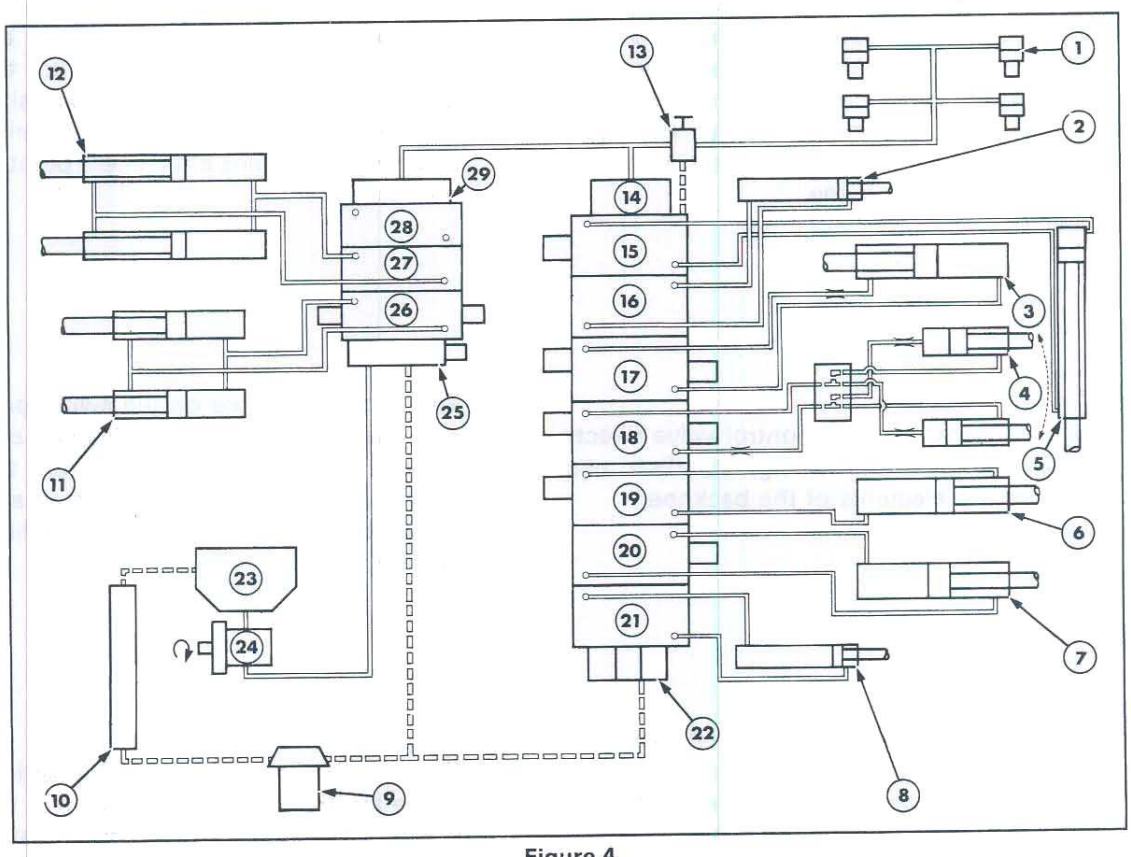

Figure 4
Hydraulic Circuit Schematic – Sideshift

1. Clamp System
2. Stabiliser
3. Backhoe Lift Cylinder
4. Backhoe Swing Cylinders
5. Extendible Dipstick Cylinder
6. Backhoe Bucket Cylinder
7. Backhoe Crowd Cylinder
8. Stabiliser Cylinder
9. Filter
10. Oil Cooler
11. Loader Bucket Cylinders
12. Loader Lift Cylinders
13. Clamp Valve
14. Inlet End Cover (Backhoe Control Valve)
15. Extendible Dipstick Valve Section
16. Stabiliser Valve Section
17. Lift Valve Section
18. Swing Valve Section
19. Bucket Valve Section
20. Crowd Valve Section
21. Stabiliser Valve Section
22. Outlet End Cover (Backhoe Control Valve)
23. Reservoir
24. Pump
25. Inlet End Cover (Loader Control Valve)
26. Bucket Valve Section
27. Lift Valve Section
28. Auxiliary Valve Section
29. Outlet End Cover (Loader Control Valve)

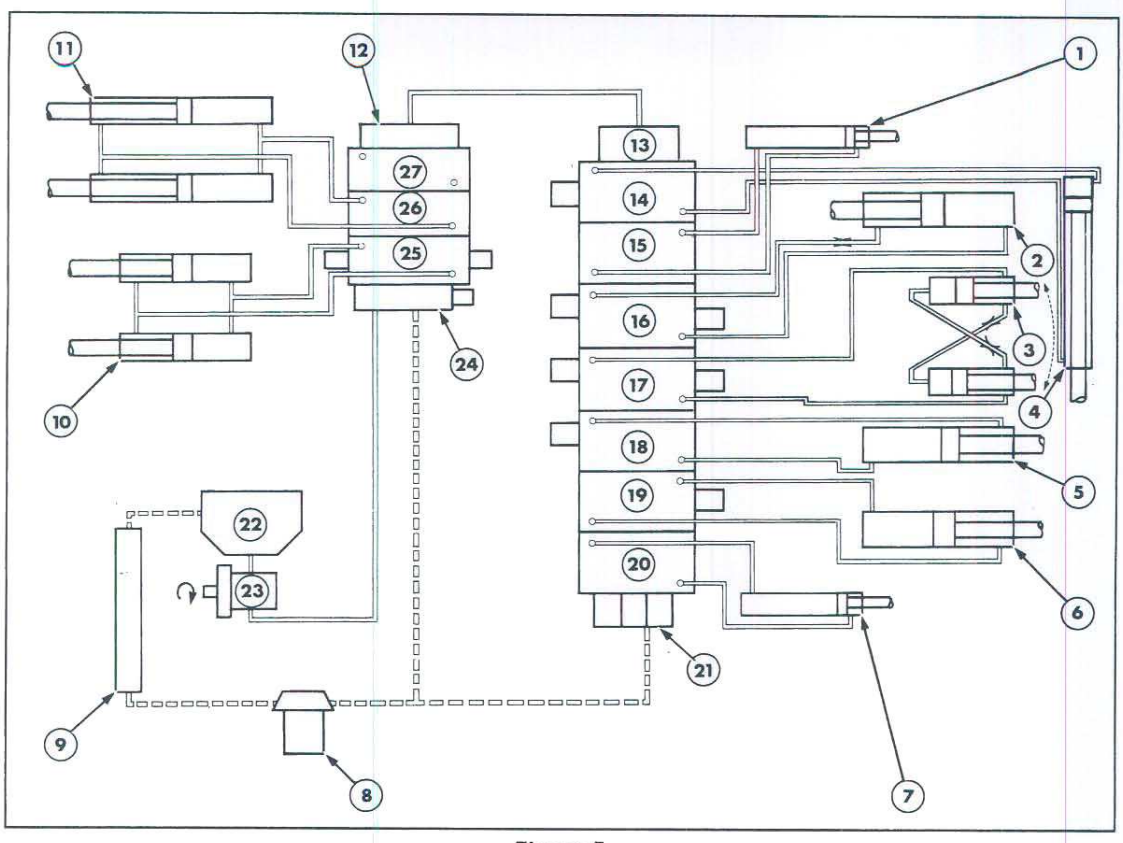

Figure 5
Hydraulic Circuit Schematic – Centre Pivot

1. Stabiliser Cylinder
2. Backhoe Lift Cylinder
3. Backhoe Swing Cylinders
4. Extendible Dipstick Cylinder
5. Backhoe Bucket Cylinder
6. Backhoe Crowd Cylinder
7. Stabiliser Cylinder
8. Filter
9. Oil Cooler
10. Loader Bucket Cylinders
11. Loader Lift Cylinders
12. Outlet End Cover (Loader Control Valve)
13. Inlet End Cover (Backhoe Control Valve)
14. Extendible Dipstick Valve Section
15. Stabiliser Valve Section
16. Lift Valve Section
17. Swing Valve Section
18. Bucket Valve Section
19. Crowd Valve Section
20. Stabiliser Valve Section
21. Outlet End Cover (Backhoe Control Valve)
22. Reservoir
23. Pump
24. Inlet End Cover (Loader Control Valve)
25. Bucket Valve Section
26. Lift Valve Section
27. Auxiliary Valve Section

PART 8
HYDRAULIC SYSTEM, CONTROLS AND FRAME

Chapter 2
RESERVOIR, FILTER AND OIL COOLER

A. RESERVOIR, FILTER AND OIL COOLER – DESCRIPTION AND OPERATION

DESCRIPTION AND OPERATION

The flow of hydraulic oil is filtered, cooled and returned to the hydraulic oil reservoir after passing through the hydraulic system. The filter is a full flow return system mounted on the right hand subframe, Figure 1.

A 10 micron, throw away synthetic filter element is used to filter the oil before returning to the oil cooler and reservoir, Figure 2.

If the filter element becomes partially blocked through neglect, a by-pass valve operating at a 50 lbf/in² (3.5 kg/cm²) differential pressure diverts oil from the filter directly to the outlet port, thus protecting the filter casing, Figure 2.

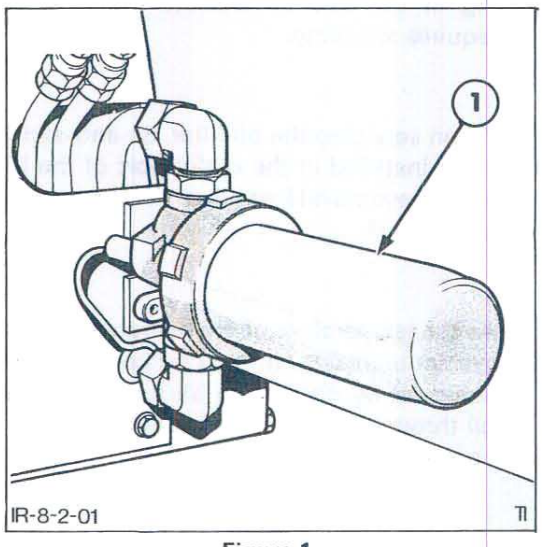

Figure 1
Hydraulic Oil Filter

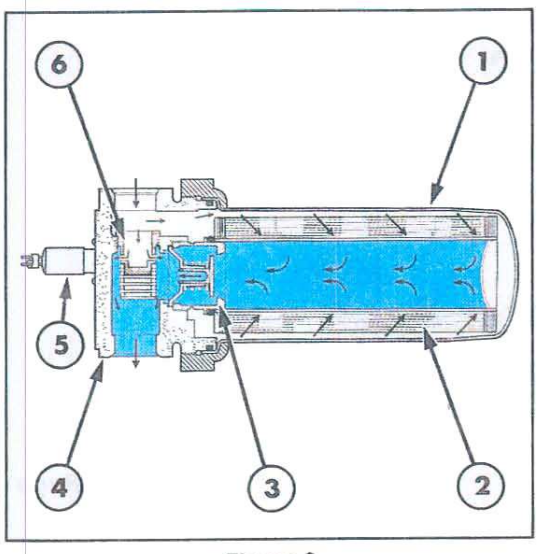

Figure 2
Oil Filter By-Pass Valve Operation

Return Pressure Oil

Return to Reservoir Oil

1. Filter Casing
2. Element
3. Anti Syphon Valve
4. Filter Head
5. Pressure Differential Switch
6. By-Pass Valve

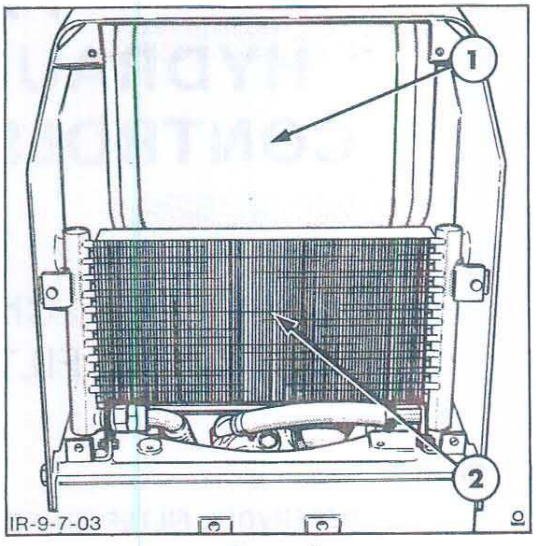

Figure 3
Oil Cooler and Reservoir Installation

1. Reservoir
2. Oil Cooler

In conjunction with the by-pass valve system, an electrical pressure differential switch located in the head of the filter is activated at a differential pressure of 35 lbf/in² (2.5 kg/cm²) and displays a warning in the cab to indicate that the filter requires servicing.

When servicing the oil filter, an anti-syphon valve installed in the outlet port of the filter head prevents oil loss when the filter element is removed.

As the temperature of the hydraulic oil in the system increases, it must be cooled. This is achieved by circulating all hydraulic return oil through an air to oil heat exchanger (oil cooler), Figure 3.

The air drawn by the engine fan passes over the oil cooler fins and cools the oil.

Oil after passing through the oil cooler port outlet is returned to the hydraulic reservoir located in the front shell above the hydraulic pump. The reservoir provides a storage head of oil to the pump and by virtue of its position ensures the pump is always supplied with an unrestricted supply of oil, aided by gravity.

The reservoir has a capacity of 5.4 Imp. Galls. (6.5 U.S. Galls./24.5 ltrs.) and a drain plug located on its lower surface.

An oil diffuser baffle within the reservoir directs circulating oil to the outer walls to aid cooling and prevent vortexing. A wire mesh screen installed in the reservoir outlet port prevents any contaminant passing through the pump and into the hydraulic system. A breather system incorporated in the top of the reservoir consists of a spacer located under a cover which allows venting directly to the atmosphere and the recovery of any condensing vapours. The hydraulic system oil level is checked with a dipstick attached to the filler cap.

B. RESERVOIR – OVERHAUL

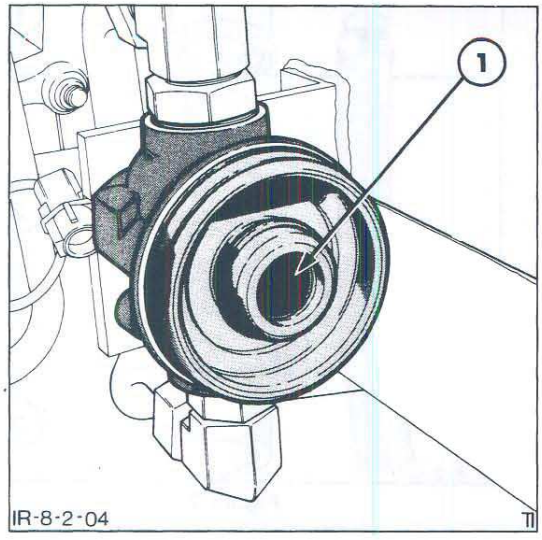

Figure 4
Hydraulic Filter Anti Syphon Valve

1. Anti Syphon Valve

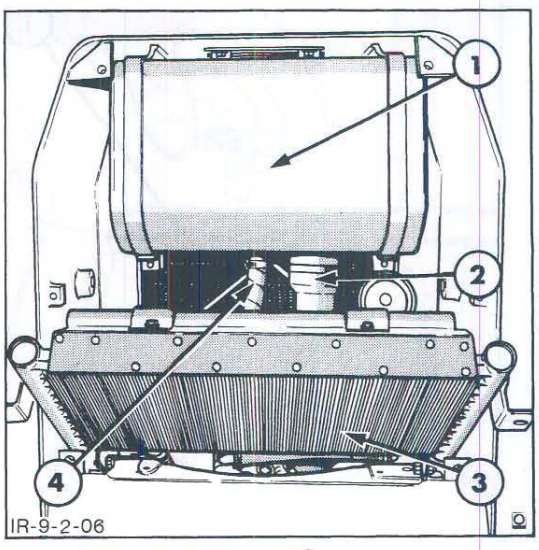

Figure 5
Oil Cooler – Tilted Forward

1. Reservoir
2. Reservoir to Pump Hose
3. Oil Cooler
4. Return to Reservoir Hose

WARNING: *Ensure the backhoe is supported in the transport position or resting on the ground and the loader is resting on the ground prior to commencing overhaul.*

REMOVAL

1. Run the engine until the hydraulic oil is warm.

2. Unscrew the filter casing retaining ring and remove the casing. Pull the element from the housing.

3. Position a suitable container beneath the filter head and drain the hydraulic oil from the system by pressing the anti-syphon valve open, refer to Figure 4.

4. Remove the radiator grille securing bolts and withdraw the grille.

5. Remove the two upper oil cooler retaining bolts and tilt the cooler forward, Figure 5.

6. Remove the reservoir drain plug and allow the small quantity of oil remaining in the reservoir to drain into a suitable container.

7. Loosen the hose clips securing the feed and return hoses on the reservoir. Disconnect and plug the hoses to prevent the entrance of foreign matter.

8. Support the reservoir and loosen the bolts which clamp the reservoir support straps.

9. Remove the horn then ease the straps off the brackets and lift the reservoir from the vehicle.

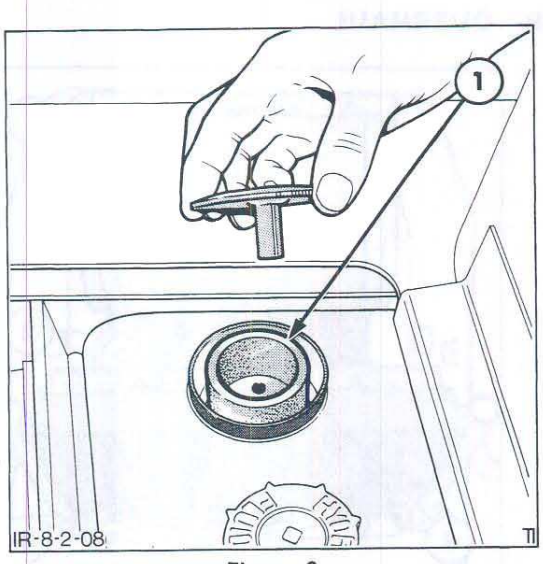

Figure 6
Reservoir Breather

1. Spacer

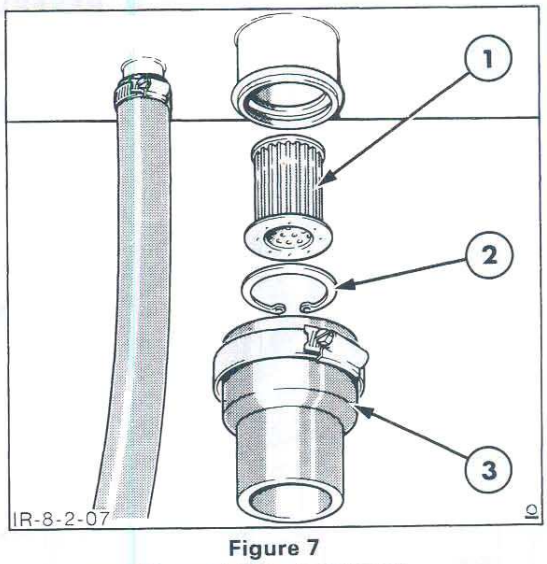

Figure 7
Reservoir Filter Installation

1. Wire Mesh Filter
2. Snap Ring
3. Reservoir to Pump Hose

INSPECTION AND REPAIR

1. Remove the cover from the breather located adjacent to the filler cap in the top of the reservoir and discard the spacer. Refer to Figure 6.

2. Remove the snap ring retaining the wire mesh screen located in the outlet port of the reservoir and withdraw the screen, Figure 7. Wash the screen in a suitable solvent.

3. Thoroughly wash and clean the interior of the reservoir and ensure that all contaminants have been removed. Invert the reservoir and allow to drain until dry.

4. Install a new breather beneath the breather cover.

5. Position the wire mesh filler in the base of the reservoir and secure in position with the snap ring.

6. Examine the reservoir hoses for damage and replace as necessary.

INSTALLATION

Installation of the reservoir follows the removal procedure in reverse.

When installing the reservoir, observe the following requirements:

- Examine the oil cooler and radiator for oil contamination and remove any such contaminants with a suitable solvent. Oil on the cooler and/or radiator fins will catch dirt and block the radiator fins causing overheating.

- Fill the reservoir with the correct grade and quality of oil, see 'Specifications' – Chapter 11.

- Upon completion of the installation, start and idle the engine for several minutes. Examine hose and tube connections for hydraulic leaks.

- With the engine switched off, the loader resting on the ground and the backhoe in the transport position, check the oil level with the combined filler cap/dipstick, Figure 8. If necessary, add hydraulic oil as required.

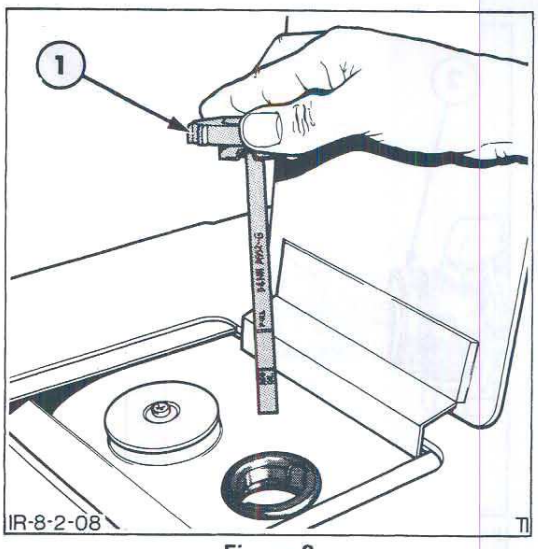

Figure 8
Reservoir Hydraulic Oil Dipstick

1. Dipstick

C. FILTER – OVERHAUL

WARNING: *Ensure the backhoe is supported in the transport position or resting on the ground and that the loader is resting on the ground or supported by the safety support prior to commencing overhaul.*

REMOVAL

NOTE: *The filter element can be removed with the filter body in situ on the unit.*

1. Run the engine until the hydraulic oil is warm.

2. Remove the cab step plate and disconnect the connector for the electrical pressure differential warning switch, Figure 9.

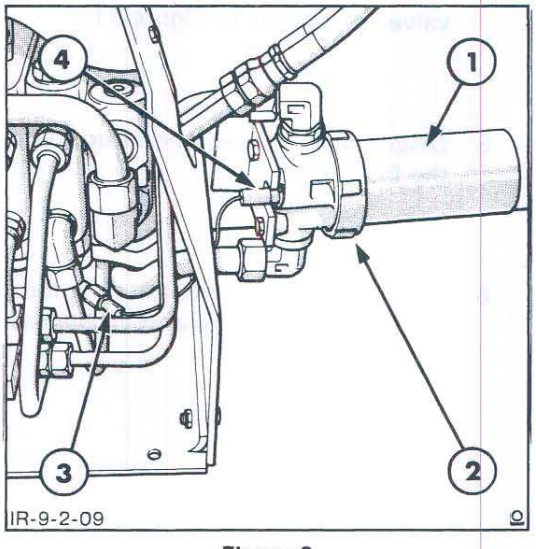

Figure 9
Hydraulic Oil Filter Installation

1. Filter Casing
2. Retaining Ring
3. Electrical Connector
4. Warning Switch

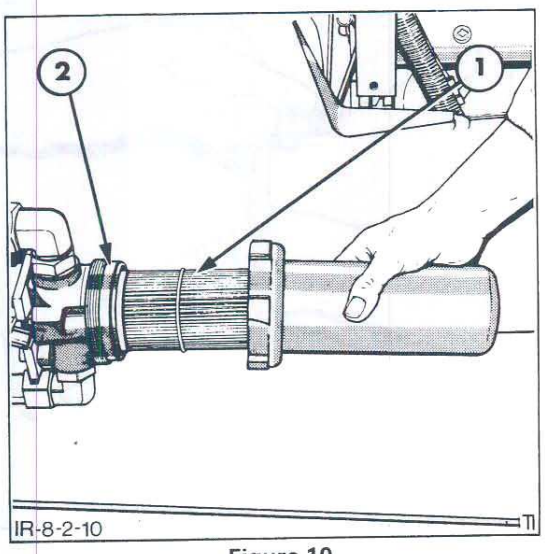

Figure 10
Removing Filter Element

1. Filter Element
2. 'O' Ring Seal

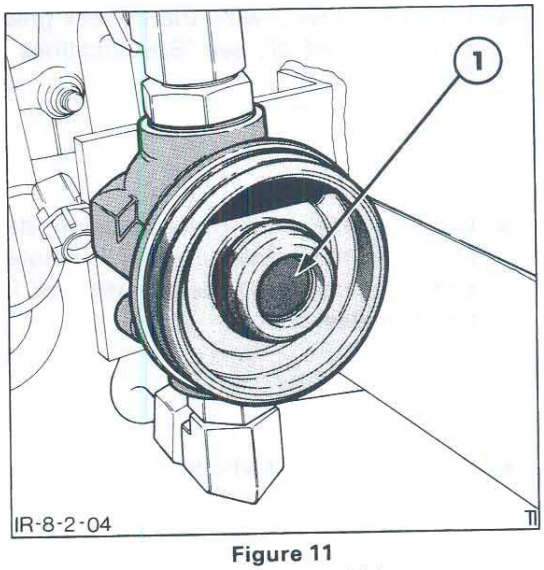

Figure 11
Filter Anti Syphon Valve

1. Anti Syphon Valve

3. Unscrew the filter casing retaining ring and remove the casing. Pull the filter element from the housing, Figure 10.

4. Position a suitable container beneath the filter head and drain the hydraulic oil from the system by pressing the anti-syphon valve open, refer to Figure 11.

5. Disconnect the feed and return tubes to the filter head.

6. Remove the three bolts securing the filter head to the subframe and lift the assembly from the unit.

DISASSEMBLY

1. Remove the flow and return elbow fittings from the filter head.

2. Remove the two screws securing the electrical pressure differential switch and withdraw the switch from the head, Figure 12.
3. Unscrew and remove the by-pass valve from the filter head.

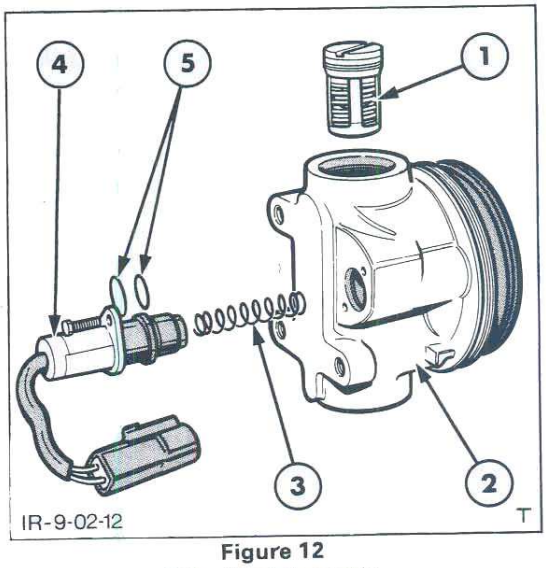

Figure 12
Filter Head Assembly

1. By-Pass Valve
2. Filter Head
3. Spring
4. Pressure Differential Switch
5. 'O' Ring Seals

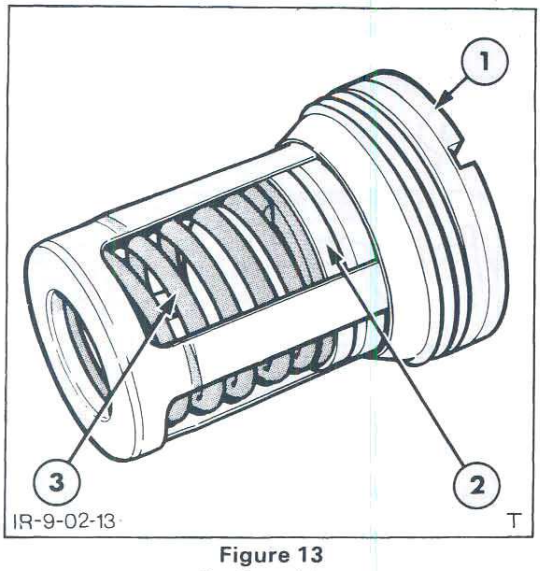

Figure 13
By-Pass Valve

1. Valve Body
2. Valve
3. Spring

INSPECTION

1. Thoroughly wash the filter assembly in a suitable solvent and allow to dry.

2. Ensure the by-pass and anti-syphon valves move without sticking or binding, refer to Figures 11 and 13. This can be ascertained by pushing each valve against their spring assemblies and comparing the pressure with that of a new item. Should the condition of the antisyphon valve be in doubt it will be necessary to install a new filter head. The by-pass valve can be replaced as an individual item.

3. Examine the 'O' ring seals on the pressure differential switch and replace if damaged. Replace the switch assembly if defective.

4. Examine the filter housing assembly for damage and replace as necessary.

RE-ASSEMBLY

1. Position the by-pass valve in the filter head and tighten securely.

2. Install the pressure differential switch and retain in position with the two screws.

3. Replace the 'O' ring seal on the filter head.

INSTALLATION

1. Installation follows the removal procedure in reverse. During installation, observe the following:-

- Install a new filter element.

- Replace the 'O' rings on all O.R.S. ('O' ring seal) fittings which have been disconnected.

- Tighten all bolts and fittings to the specified torque, see 'Specifications' – Chapter 11. Do not overtighten O.R.S. fittings as damage to the 'O' ring seals will occur.

2. Fill the reservoir with the specified grade of hydraulic oil, see 'Specifications' – Chapter 11.

3. Start and idle the engine for several minutes and examine the tube connections for hydraulic leaks.

4. With the engine switched off, the loader resting on the ground and the backhoe in the transport position, check the reservoir oil level with the combined filler cap/dipstick. If necessary add hydraulic oil as required.

D. OIL COOLER – OVERHAUL

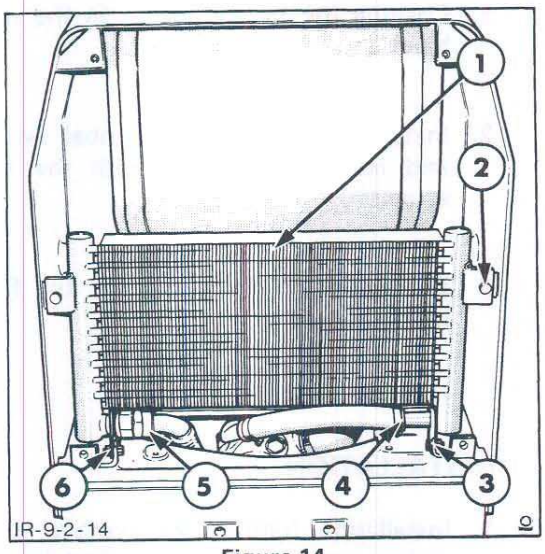

Figure 14
Oil Cooler Installation

1. Oil Cooler
2. Upper Retaining Bolt
3. Pivot Bolt
4. Hydraulic Cooler Outlet Hose
5. Hydraulic Cooler Inlet Hose
6. Pivot Bolt

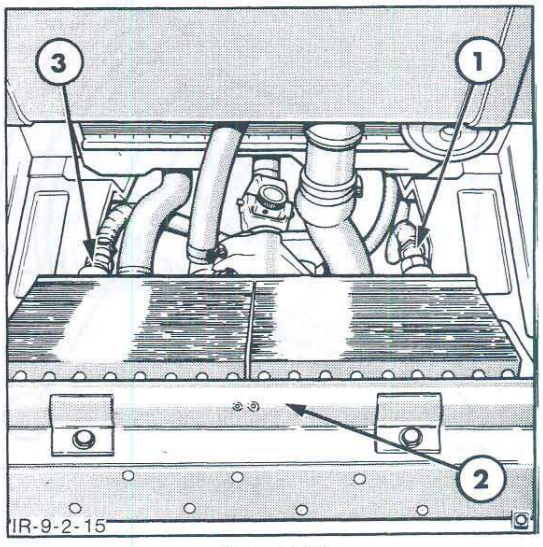

Figure 15
Transmission Oil Cooler Connections

1. Transmission Cooler Hose
2. Oil Cooler Assembly
3. Transmission Cooler Hose

WARNING: *Ensure the backhoe is supported in the transport position or resting on the ground and that the loader is resting on the ground prior to commencing overhaul.*

REMOVAL

1. Run the engine until the hydraulic oil is warm.
2. Unscrew the filter casing retaining ring and remove the casing. Pull the element from the housing.
3. Position a suitable container beneath the filter head and drain the hydraulic oil from the system by pressing the anti-syphon valve open, refer to Figure 11.
4. Remove the radiator grille securing bolts and withdraw the grille.
5. Loosen the cooler inlet hose, remove the cooler upper retaining bolts and tilt the cooler forward, Figure 14.
6. Disconnect the transmission oil cooler connections, Figure 15, taking care to collect the oil discharged from the cooler into a suitable container.
7. Disconnect the hydraulic oil cooler inlet and outlet connections.
8. Remove the oil cooler pivot bolts, spacers and washers and lift the cooler assembly from the vehicle.
9. Plug all hoses and tubes to prevent the entrance of foreign matter into the hydraulic system.
10. Separate the hydraulic and transmission coolers by removing the four attaching bolts.

INSPECTION

1. Wash the oil cooler assembly exterior to loosen any dirt and foreign material and thoroughly clean the fin area.

2. Inspect the fins for damage, straightening any fins that are bent.

3. If oil leakage was evident before removal, establish the leakage area by restricting the oil cooler outlet port, while at the same time pressurising the inlet port with an air line and immersing the cooler in water. The presence of air bubbles indicates the location of any leaks. Do not use a pressure in excess of 25 lbf/in² (1.7 bar, 1.8 kgf/cm²).

4. Repair all leaks prior to installation.

INSTALLATION

1. Installation of the oil cooler follows the removal procedure in reverse.

   During installation, observe the following:

- Replace the 'O' rings on all O.R.S. fittings disconnected during overhaul.
- Tighten all bolts and fittings to the specified torque, see 'Specifications' – Chapter 11. Do not overtighten the O.R.S. fitting as damage to the 'O' ring seal will occur.

2. Fill the reservoir with the correct grade of hydraulic oil, see 'Specifications' – Chapter 11.

3. Start and idle the engine for several minutes and examine the tube connections for hydraulic leaks.

4. With the engine switched off, the loader resting on the ground and the backhoe in the transport position, check the reservoir oil level with the combined filler cap/dipstick. If necessary, add hydraulic oil as required.

5. Check the oil level in the transmission and add oil as necessary. See relevant transmission sections of the Repair Manual for checking oil level and specified oil.

PART 8

HYDRAULIC SYSTEM, CONTROLS AND FRAME

Chapter 3
HYDRAULIC PUMP

A. HYDRAULIC PUMP – DESCRIPTION AND OPERATION

The Ford 455C, 555C and 655C Industrial tractors utilize a new gear type hydraulic pump. Displacement for the pump used in each model at 2200 engine rev/min. at 180°F (82°C) is as follows:–

Ford 455C 21.6 Imp Gal/min. (25.9 US Gal, 98 ltr/min)

Ford 555C/655C 25.5 Imp Gal/min. (30.6 US Gal, 116 ltr/min).

The pump is mounted in the front axle support and driven by a double universally jointed driveshaft connected to the engine crankshaft pulley, Figure 1.

The driveshaft flange bolts directly to the engine crankshaft pulley while the pump drive end has a splined coupler which prevents end thrust from damaging the pump. There are grease fittings on each of the pump driveshaft universal joints.

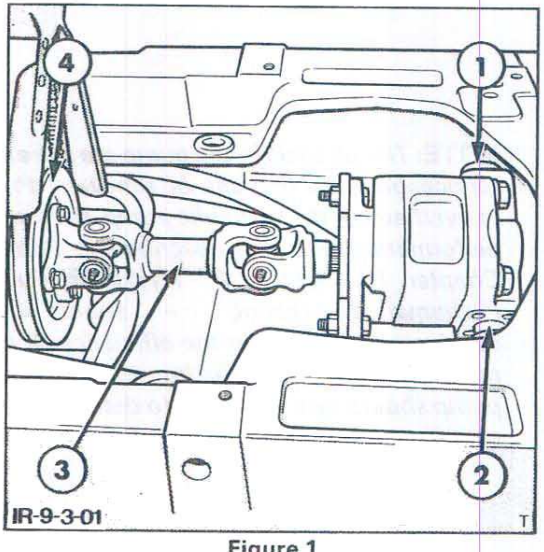

Figure 1
Hydraulic Pump Installation

1. Pump Inlet Port
2. Pump Outlet Port
3. Driveshaft
4. Crankshaft Pulley

Hydraulic oil is supplied to the pump by gravity feed from the hydraulic oil reservoir, through a pipe which connects to the intake port in the pump cover. A set of spur gears, housed in the body of the pump and driven by the driveshaft, supply oil to the hydraulic system circuit.

Oil entering the pump fills the spaces between the teeth of the revolving gears and is then carried around within the pump body to a point where the teeth of the two gears come into mesh, Figure 2. As the oil cannot pass back between the gears it is forced out of the pump body through the outlet port in the pump cover.

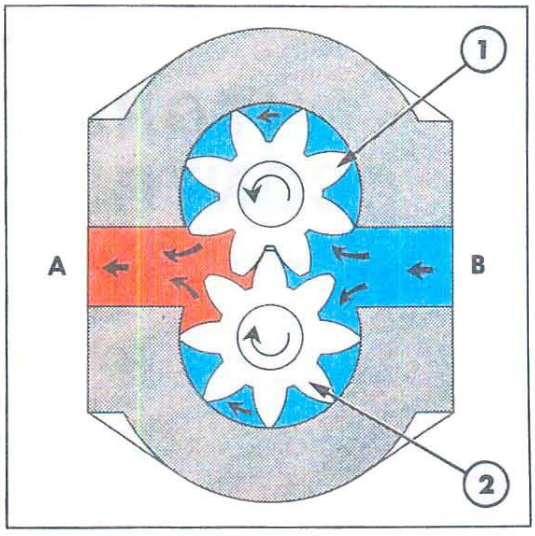

Figure 2
Oil Flow in Hydraulic Gear Type Pump

Pressure Oil Suction Oil

A. To Hydraulic Circuit B. From Reservoir
1. Driven Gear 2. Drive Gear

B. HYDRAULIC PUMP – OVERHAUL

NOTE: *The oil seals in the pump are the only serviceable parts that can be renewed. Prior to overhauling the hydraulic pump, the pump performance test – as described in Part 8, Chapter 10, Section E "Hydraulic Pump Performance Testing" – should be conducted to ascertain the efficiency of the pump. If the efficiency is less than 80% the pump should be dismantled to determine the cause.*

WARNING: *Ensure the backhoe is supported in the transport position or resting on the ground and the loader is in the raised position and supported by the loader safety support prior to commencing overhaul.*

REMOVAL

1. Remove the hydraulic oil filter element on the right-hand side of the Unit and drain the hydraulic oil into a suitable container by depressing and holding in the anti-syphon valve, Figure 3.

IMPORTANT: *Do not operate the engine with hydraulic reservoir drained otherwise damage to the pump will result.*

2. Remove the front grille securing bolts and withdraw the grille.

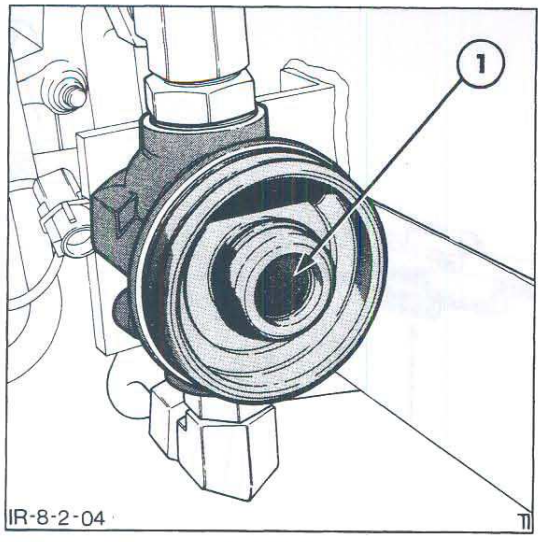

Figure 3
Hydraulic Oil Filter Anti-Syphon Valve

1. Anti-Syphon Valve

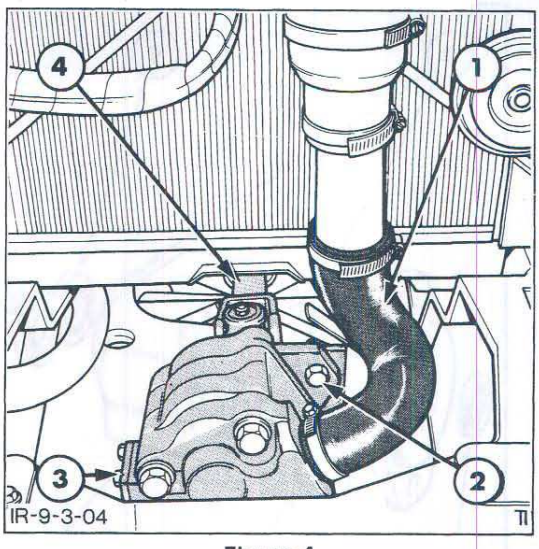

Figure 4
Hydraulic Pump Hose Connections

1. Pump Intake Hose
2. Pump Securing bolt
3. Pump Outlet fitting
4. Driveshaft

3. Remove the oil cooler as detailed in Chapter 2 of this Part.

4. Remove the sound insulation panels where fitted to expose the pump.

5. Clean the area around the pump with a suitable solvent and dry thoroughly.

6. Cycle the loader and backhoe control valves to relieve the hydraulic system of all pressure.

7. Disconnect the reservoir to pump intake hose at the pump connection, refer to Figure 4.

8. Remove the four bolts securing the pump outlet tube fitting to the pump assembly.

9. Remove the pump securing bolts and slide the pump from the driveshaft.

10. Plug all open lines and ports to prevent the entry of foreign matter.

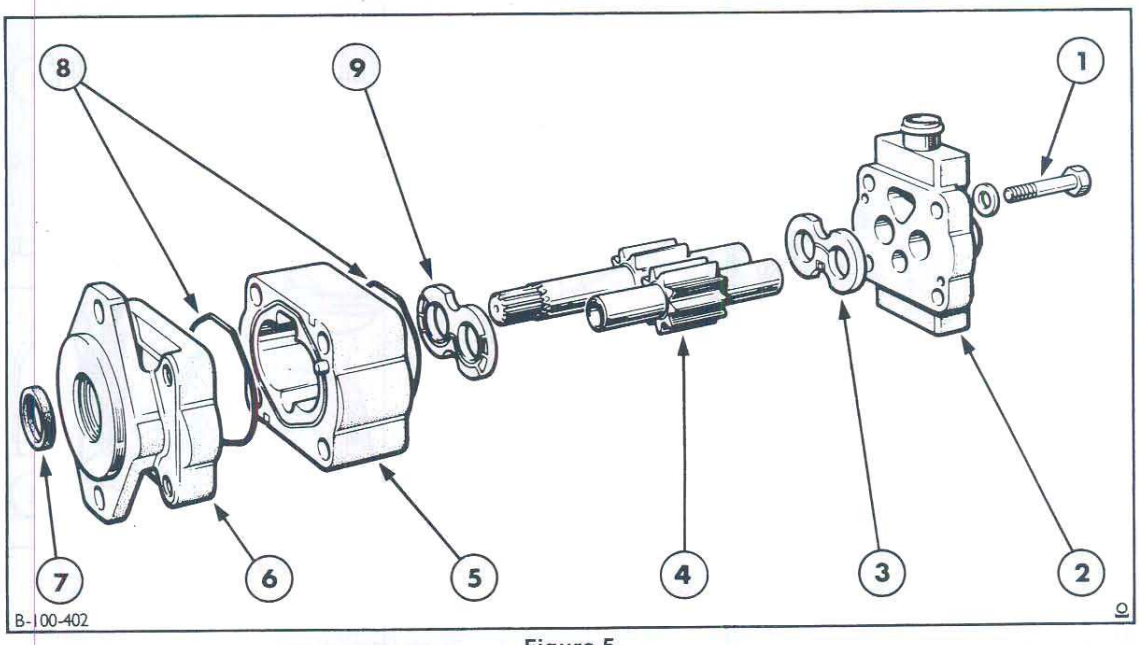

Figure 5
Hydraulic Pump Assembly

1. Tie Bolt
2. Rear Cover
3. Wear Plate
4. Gear Assembly
5. Pump Body
6. Front Cover
7. Shaft Seal
8. Square Section Seals
9. Wear Plate

DISASSEMBLY

With reference to Figure 5.

1. Using a suitable marker pen, draw a line along the total length of the pump body to aid re-assembly.

2. Remove the pump body securing bolts and lift the front cover from the pump assembly.

3. Note the orientation of the wear plate prior to further disassembly. Remove the wear plate and withdraw the gears from the body of the pump.

4. Remove the pump centre section and wear plate from the rear cover, again noting the orientation of the wear plate to aid re-assembly.

5. Prise the square section seals from either side of the pump body.

6. Remove the oil seal from the drive gear shaft bore in the front cover of the pump.

INSPECTION

NOTE: *The only parts replaceable in the pump assembly are the oil seals and wear plates. If unacceptable wear is identified in the pump then a replacement pump must be installed.*

1. Wash all parts in a suitable solvent and dry with a clean, lint-free cloth.

2. Examine the centre section for gear track wear. Light gear track wear is acceptable providing the efficiency of the overhauled pump is greater than 80%.

3. Inspect the bearing surfaces in the front and rear covers for wear.

4. Examine the gears for scored or worn side faces and journals, damaged teeth and surface cracks. Slight wear and scoring on the journals may be erased by mounting between lathe centres and polishing with 'O' grade emery paper lubricated with paraffin.

5. Examine the wear plates for excessive wear.

6. Inspect the pump body for external damage and cracks.

RE-ASSEMBLY

Re-assembly of the hydraulic pump follows the disassembly procedure in reverse.

On re-assembly, observe the following requirements:–

- Lubricate all parts with hydraulic oil.
- Install a new seal kit and coat the drive gear shaft seal with petroleum jelly to prevent damage by the shaft during re-assembly.
- Ensure that the pump body and original wear plates, if replaced, are re-assembled in the same orientation as removed.

INSTALLATION

Installation of the hydraulic pump follows the removal procedure in reverse.

During installation, observe the following requirements:–

- Tighten all bolts to the specified torque, see 'Specifications' – Chapter 11.
- Fill the reservoir with the specified grade and quantity of oil, see 'Specifications' – Chapter 11.
- If applicable, check the transmission oil level and replace any oil lost during oil cooler removal with the specified grade of oil. Refer to relevant section of the Operator's Manual.
- Upon completion of the installation, start and idle the engine for several minutes. Examine hose and tube connections for hydraulic leaks.
- Check the efficiency of the overhauled pump by conducting the pump performance test as described in Part 8, Chapter 10, Section E "Hydraulic Pump Performance Testing". If the efficiency of the overhauled pump is less than 80% then the pump must be replaced for a new unit.
- With the engine switched off, the loader resting on the ground and the backhoe in the tranport position, check the oil level in the reservoir with the combined filler cap/dipstick. If necessary, add hydraulic oil as required.

C. HYDRAULIC PUMP DRIVE SHAFT – OVERHAUL

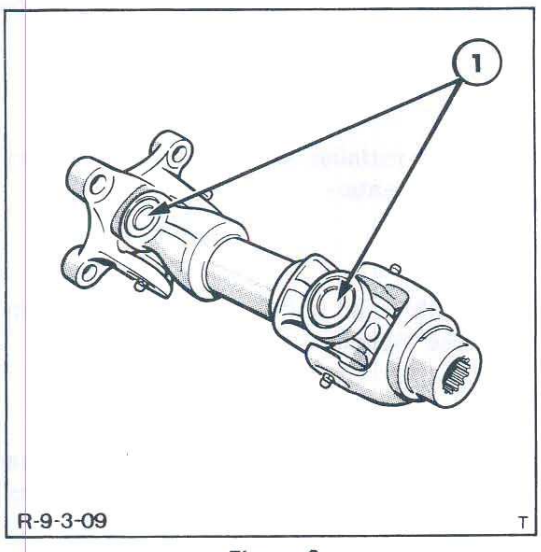

Figure 6
Driveshaft Assembly

1. Driveshaft Couplings

REMOVAL

1. Remove the hydraulic pump as detailed in Section B, "HYDRAULIC PUMP OVERHAUL".

2. Remove the left-hand engine side panel and the four driveshaft flange bolts securing the driveshaft to the crankshaft pulley. Withdraw the driveshaft from the front of the unit.

INSPECTION

1. Inspect the driveshaft couplings for wear, Figure 6. If the couplings are worn they can be replaced using conventional overhaul procedures.

INSTALLATION

Installation of the driveshaft follows the removal procedure in reverse. During installation observe the following requirements:–

- Lubricate the grease fittings on the driveshaft using the specified grade of grease see 'Specifications' – Chapter 11.

- Tighten all bolts to the specified torque, see 'Specifications' – Chapter 11.

- Check the transmission oil level and replenish with the specified grade of oil, see relevant section of the Operator's Manual.

- Fill the hydraulic reservoir with the correct grade of hydraulic oil, see 'Specifications' – Chapter 11. Start and idle the engine for several minutes and examine all connections for hydraulic leaks.

- With the engine switched off, the loader resting on the ground and the backhoe in the transport position, re-check the reservoir oil level with the combined filler.

PART 8

HYDRAULIC SYSTEM, CONTROLS AND FRAME

Chapter 4
BACKHOE HYDRAULIC CONTROL VALVE ASSEMBLY

A. BACKHOE CONTROL VALVE ASSEMBLY – DESCRIPTION AND OPERATION

The backhoe main control valve assembly directs oil flow to the backhoe digging and stabiliser elements and incorporates various valves protecting the circuits and assisting their function.

The valve assembly is a stack type made up of six sections – or seven when an extendible dipstick is specified – an inlet end cover and an outlet end cover, Figure 1. The whole assembly is pulled together with the three tie rods. Section sealing is maintained by precision ground surfaces and external leakage is prevented by a large 'O' ring surrounding all internal galleries.

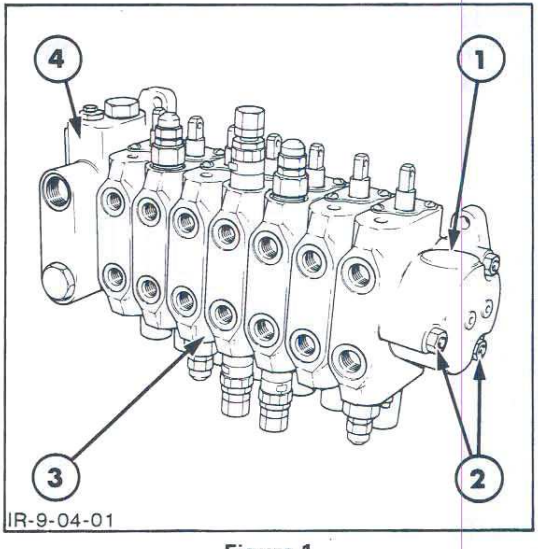

Figure 1
Backhoe Control Valve Assembly

1. Inlet End Cover
2. Tie Rods
3. Valve Sections
4. Outlet End Cover

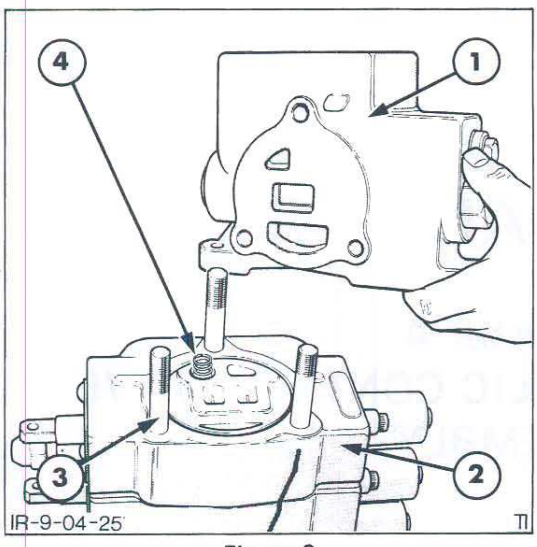

Figure 2
Load Check Valve Location

1. Outlet End Cover
2. Control Valve Section
3. Tie Rod
4. Load Check Valve and Spring

The sections contain manually operated control spools which are spring centred back to the neutral position. The spool directs the flow of high pressure oil to its particular circuit. Each circuit contains a single spring loaded load check valve to check the flow of oil from either cylinder port to the valve pressure passage.

The load check valves, Figure 2, are located between each section and are not externally accessible. To gain access to each valve segment it is necessary to remove the control valve assembly from the unit and separate each section after removing the tie rod securing nuts.

Each section, except the stabiliser sections, contain one or two circuit relief valves (dependent on circuit) to protect their respective circuits against pressure over-loading during actual digging operations.

The relief valves incorporated in each circuit are either direct acting or pilot operated with anti-cavitation feature dependant on circuit or model as follows:

Direct Acting Relief Valves

Extendible Dipstick Cylinder	Piston End
Lift Cylinder	Rod End
Bucket Cylinder*	Rod End
Crowd Cylinder*	Piston End

Pilot Operated Relief Valves With Anti-Cavitation Feature

Lift Cylinder	Piston End
Swing Cylinder	Piston End
Swing Cylinder	Rod End

* On 455C and 555C units less extendible dipstick and not marketed in Scandanavia pilot operated with anti-cavitation feature relief valves are fitted.

On Ford backhoe/loaders the main pump system oil flow passes through the loader valve prior to flowing through the power beyond port and on to the backhoe control valve inlet end cover port.

The outlet end cover contains the return oil port which returns low pressure oil or exhausting oil back to the reservoir.

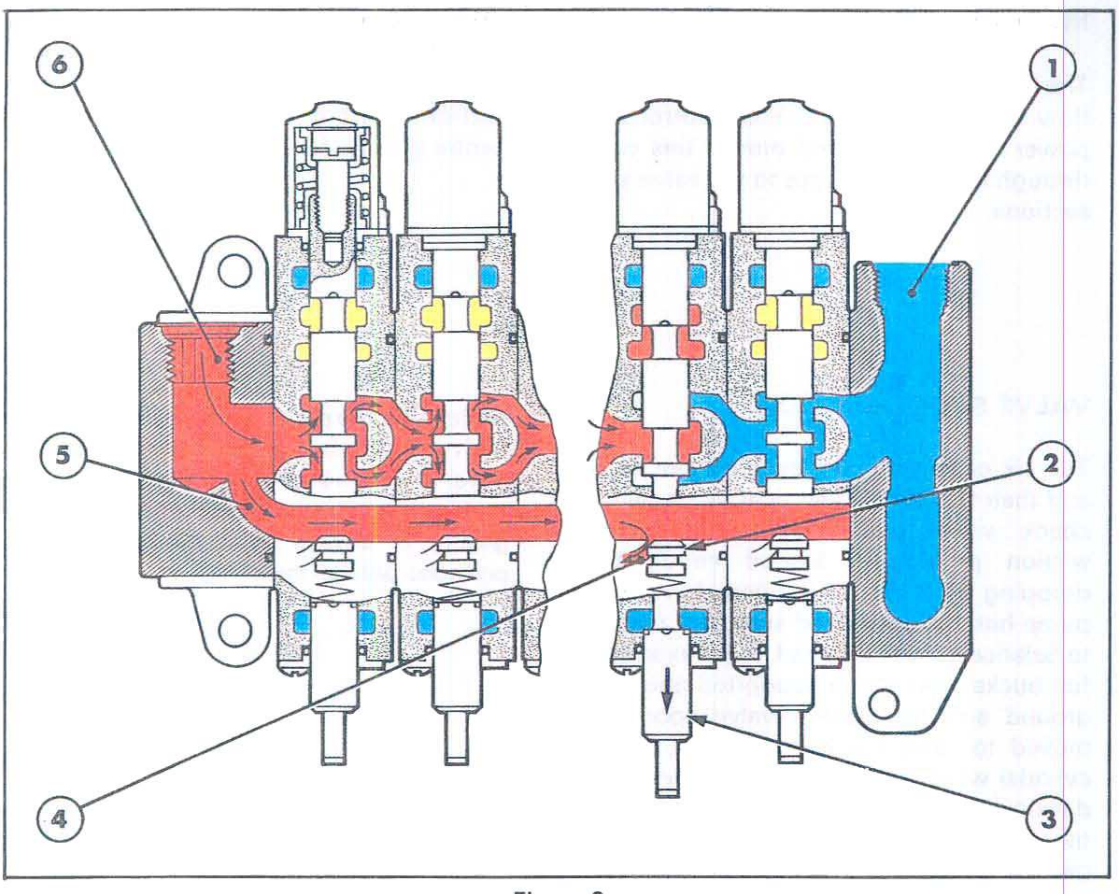

Figure 3
Open Centre and Parallel Gallery Oil Flow

Pump Pressure Oil | Trapped Oil | Static/Return to Reservoir Oil

1. Outlet End Cover – Exhaust Port
2. Load Check Valve
3. Spool in Operating Position
4. Oil Gallery to Operating Element
5. Parallel Gallery
6. Inlet End Cover Port

The valve assembly has an open centre gallery extending from the inlet end cover the the outlet end cover. When the intermediate sections are all in neutral, pump oil enters at the inlet end cover port and flows through the open centre gallery to the exhaust port in the outlet end cover, refer to Figure 3.

A parallel gallery extends from the inlet end cover but terminates at the outlet end cover, both the parallel and open centre galleries are connected in the inlet end cover.

The element exhaust gallery (not shown in Figure 3) carries both cylinder and circuit relief valve exhaust oil. This gallery extends from the inlet end cover to the outlet end cover where it merges with the open centre exhaust gallery.

The following sub-headings expand in detail the function of each of the main control valve assembly components. Reference to Figure 3 will aid explanation.

INLET END COVER

The inlet end cover receives the full pump oil flow output from the loader control valve power beyond port and directs this oil on through internal passages to the valve spool sections.

VALVE SPOOL SECTION

The six or seven spool sections are similar and their function is identical. A single load check valve positioned between each section protects a loaded circuit from dropping if the spool is opened when the pump has not developed sufficient pressure to balance or raise the load. If, for example, a full bucket was being supported above the ground and the control valve spool was moved to raise the boom higher, the lift cylinder would not raise until the pump had developed sufficient pressure to first, balance the pressure already existing in the lift circuit caused by the loaded bucket and then, unseat the check valve when the developed pressure exceeded the existing circuit pressure. If this valve was not incorporated a situation would exist where loads would initially drop before moving in the desired direction. This would lead to a non-precision digging cycle.

Figure 4 illustrates the oil flow through a typical valve section with two pilot operated anti-cavitation circuit relief valves and when the valve spool is in neutral. The following paragraph briefly describes the function of each gallery followed by a description of oil flow through the valve.

Galleries 'C', 'D' and 'E' provide a staggered open centre gallery (with the spools in neutral) for the pump oil which enters at the inlet end cover, to flow past all spools to the return to reservoir port in the outlet end cover.

When two or more valve sections are placed together gallery 'D' of the previous section aligns with galleries 'C' and 'E' of the next section thus producing the staggered open centre gallery, Refer to Figure 3.

Gallery 'G', the parallel gallery, is linked to the high pressure pump flow from the inlet end cover and runs straight through each section terminating at the outlet end cover. This gallery is always at pump pressure and provides parallel spool operation.

Gallery 'H' in each section is looped to either side of the control spool and allows pump oil flow to be routed to either end of the spool and on to the outlet or cylinder dependent on spool movement.

Galleries 'A' and 'F' route the oil flow to the cylinder via the external hoses and tubes.

Exhaust gallery 'B' runs straight through each section from the inlet to outlet end covers. Return oil from the cylinders and circuit relief valves flows along this passage to the outlet end cover.

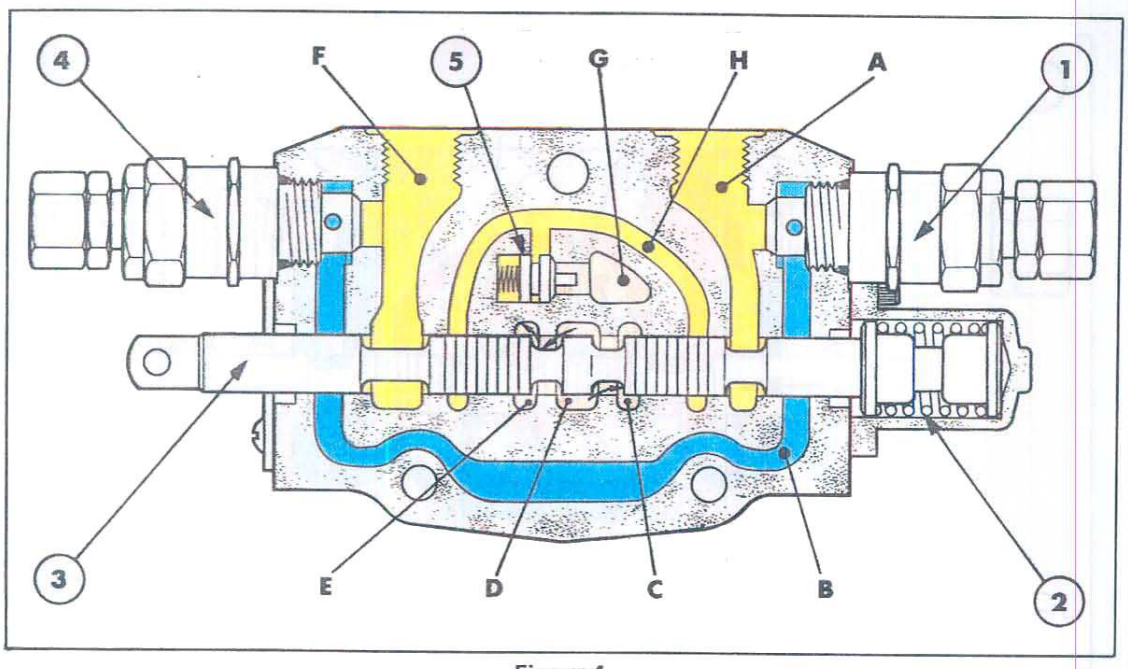

Figure 4
Control Valve Section – Neutral Position

Pump Pressure Oil

Trapped Oil

Reservoir Return Oil

1. Circuit Relief Valve
2. Centring Spring
3. Control Spool
4. Circuit Relief Valve
5. Check Valve

A. Cylinder Port
B. Exhaust Gallery
C. Open Centre Gallery
D. Open Centre Gallery

E. Open Centre Gallery
F. Cylinder Port
G. Parallel Gallery
H. Supply Gallery

Oil flow through the valve with the control spool in neutral is as follows:

Oil entering from the inlet valve cover to the valve section, Figure 4, is present at the open centre galleries 'C', 'D' and 'E' and also in the high pressure parallel gallery 'G'. Providing the spool sections are all in neutral, the oil in gallery 'G' is static.

Oil flowing through the open centre galleries 'C', 'D' and 'E' continues through each section to the outlet end cover and leaves through the return to reservoir port.

Providing the spool remains in neutral oil in the cylinder ports 'A' and 'F' is static as it is trapped between the cylinder and control valve spool. Similarly, oil in the exhaust gallery 'B' is static, providing all sections of the main control valve are in neutral.

There is no connection or outlet to the reservoir whilst all sections are in neutral unless some external force has caused a circuit relief valve to relieve pressure in a particular circuit. If this is the case then oil will be discharged into gallery 'B'.

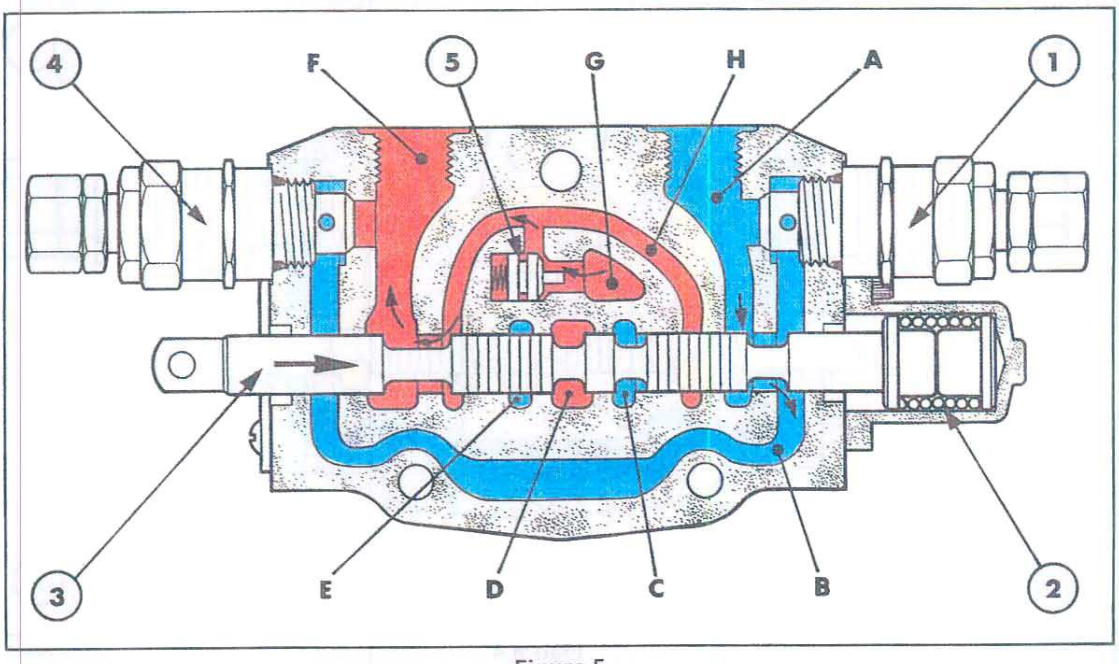

Figure 5
Control Valve Section – Operating Position

Pump Pressure Oil

Reservoir Return Oil

1. Circuit Relief Valve
2. Centring Spring
3. Control Spool
4. Circuit Relief Valve
5. Check Valve

A. Cylinder Port
B. Exhaust Gallery
C. Open Centre Gallery
D. Open Centre Gallery

E. Open Centre Gallery
F. Cylinder Port
G. Parallel Gallery
H. Supply Gallery

When the control spool in a valve section is moved to activate a cylinder, Figure 5 shows the spool moved to the right, the centre lands of the control spool prevent oil flow through the open centre gallery 'C' 'D' and 'E'. With the open centre gallery blocked pump pressure builds up in the parallel gallery 'G'. When pump pressure exceeds the residual cylinder pressure in gallery 'H' and the spring pressure of the section load check valve the valve unseats allowing pump oil to flow from gallery 'G' through the load check valve, into gallery 'H' and then to the cylinder port 'F'.

At the right hand end of the spool exhaust oil from the opposite end of the operating element cylinder flows through port 'A' into the exhaust gallery 'B' and then to the outlet end cover.

Because the pressure in gallery 'G' has to exceed the residual cylinder pressure and load check valve spring pressure the system guarantees that, if for example the valve section which raises the boom is operated, when pump pressure generation is slow or when the engine is idling with a full load suspended with the digging elements in full reach the boom will not drop but will be held in position until sufficient pump pressure to exceed the cylinder residual pressure has been generated.

When the control spool in a valve section is moved in the opposite direction i.e. moved to the left a reversal of the oil flow takes place.

Controlled feathering action of each section spool is achieved by the incorporation of four small notches in the spool 'land'. As the spool is moved the notches meter a small amount of oil slowly pressurising the system before the entire load uncovers the passage and allows full flow. Easing the spool through its first stage of travel provides pinpoint movement needed for accurate control.

If during operation of an element which is not protected by an individual circuit relief valve and the hydraulic system is overloaded, excess pressure created will unseat the system relief valve in the 'loader valve' inlet end cover. Pump oil will flow through the system relief valve and exhaust into the return to dump port and back to the reservoir.

OUTLET END COVER

Within the outlet end cover on all 655C units and 555C/455C units with extendible dipstick are four special purpose valves incorporated within its casting and separate the exhaust gallery from the return to reservoir exit port. These valves are termed the regenerative check valve, backpressure valve, pilot valve and unload valve, Figures 6 and 7.

These valves are so designed to provide optimum digging performance at low pump flows, and relieving back pressures at higher pump flows, so releasing pump power demands on the engine.

On 455C and 555C units less extendible dipstick the outlet end cover contains no valves and provides direct porting of hydraulic oil to reservoir.

These four valves operate only when a backhoe cylinder is being moved and return oil is being exhausted from the cylinder. The conditions under which the cylinder may be operated will determine which of the valves will function and are:-

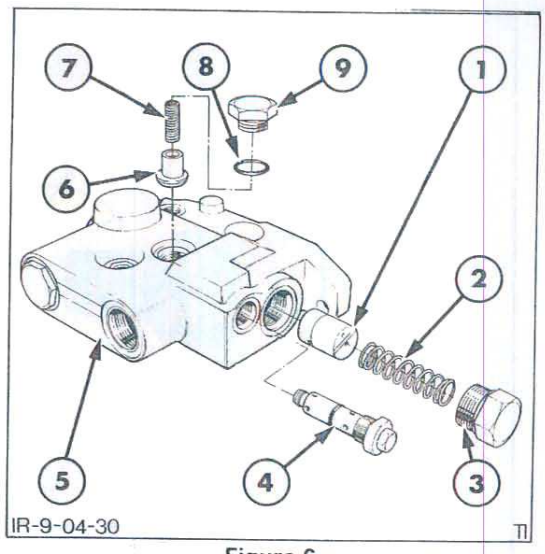

Figure 6
Outlet End Cover – Component Identification

1. Backpressure Valve Assembly
2. Spring
3. Plug
4. Unload Valve
5. Outlet End Cover
6. Regenerative Check Valve
7. Spring
8. O Ring
9. Plug

1. A "fast drop" condition whereby the system pressure is rapidly lowered as the element drops and the exhaust pressure rapidly rises as the exhausting oil attempts to quickly return to the reservoir – in this instance the regenerative check valve functions.

2. A "no load" of "light load" condition where the pump system pressure is less than 900 lbf/in² (62 bar) but greater than the existing return to sump line pressure – in this instance, the backpressure and backpressure pilot valves function.

3. A "medium" or "heavily loaded" condition where the cylinder operation exceeds 1000 lbf/in² (70 bar) pressure – in this instance the unload and backpressure valves function.

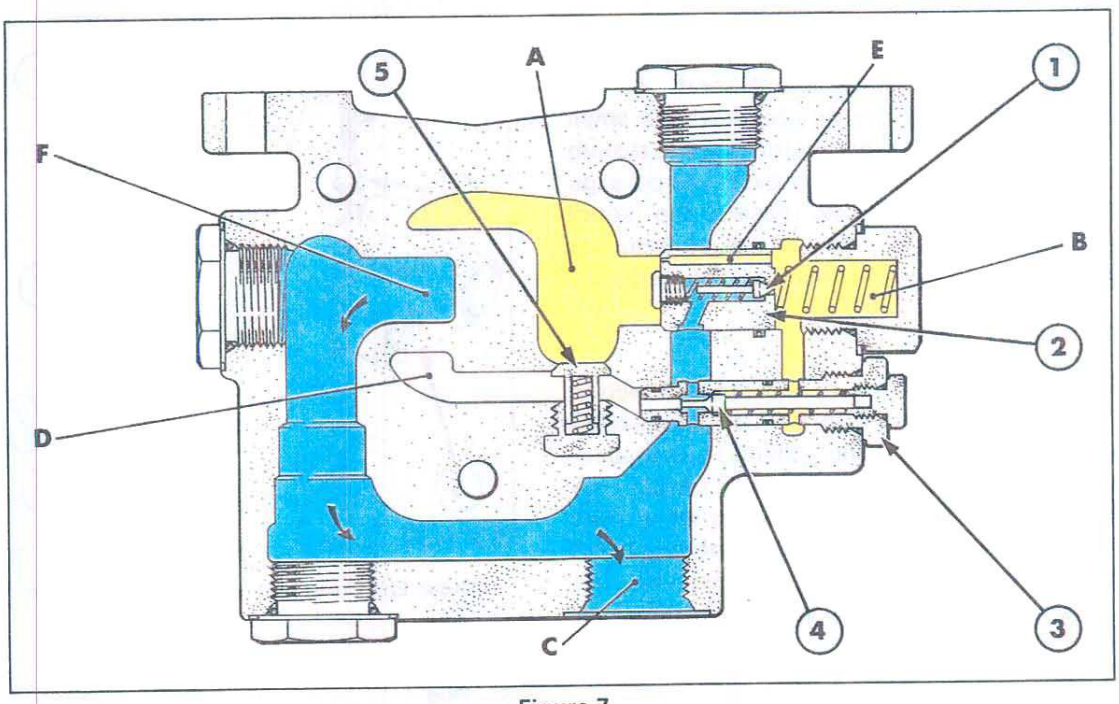

Figure 7
Outlet End Cover – Neutral Condition

Pump Pressure Oil
Trapped Oil
Return to Reservoir Oil

1. Backpressure Pilot Valve
2. Backpressure Valve
3. Backpressure Unload Valve Body
4. Backpressure Unload Valve
5. Regenerative Check Valve

A Control Valve Exhaust Gallery
B Backpressure Valve Gallery
C Return to Reservoir Port
D High Pressure Parallel Gallery
E Backpressure Valve Pressure Sensing Gallery
F Open Centre Gallery

Figure 7 shows a sectioned view of the outlet end cover with the various valves positioned as if the main control valve spool sections were all in neutral. For illustration purposes the regenerative check valve has been repositioned. Normally this valve enters the end cover from the end face.

With the engine running and the backhoe in neutral, the pump oil flow passes through the staggered open centre galleries in the spool sections and passes unrestricted to the return to reservoir port.

Gallery 'A' is the control valve exhaust gallery which in neutral, contains static oil. Gallery 'D' is the end of a parallel gallery and in neutral contains static oil at pump oil pressure, maintaining the regenerative check valve in the seated position. With no oil flow in gallery 'A' the backpressure valve remains closed.

In the "fast drop" condition, for example when the digging elements are lowered rapidly into a trench, the lift cylinder piston end is being supplied with pump oil flow, but the demand is so great that if engine speed is not at maximum or the control lever is not feathered, the pump will be unable to maintain the cylinder piston end full of oil and will cause a "void". In this instance the high pressure gallery 'D', Figure 8, has dropped to a pressure level lower than that in the exhaust gallery 'A'. The now higher pressure level of gallery 'A' is able to lift the regenerative check valve off its seat against the light retaining spring and allow oil to transfer from the exhaust gallery 'A' into the high pressure gallery 'D' and in effect allows oil to transfer from the rod end of the lift cylinder to the piston end, complementing the pump supply.

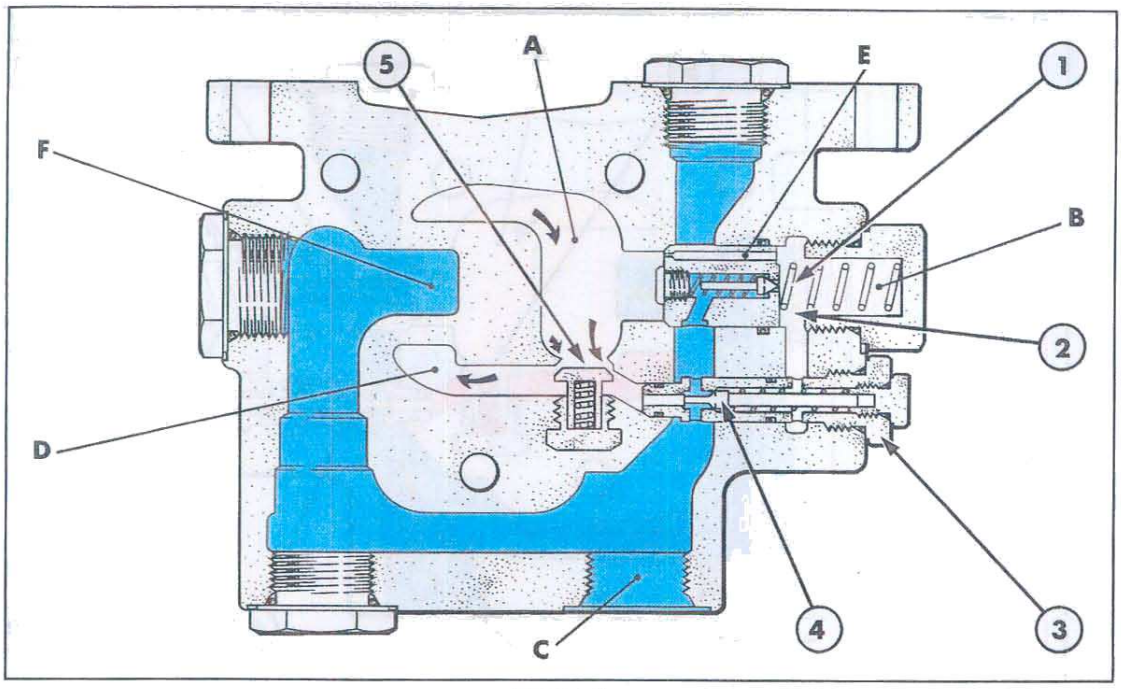

Figure 8
Regeneration Check Valve Operation

Cylinder Exhaust Oil | Cylinder Supply Oil | Return to Reservoir Oil

1. Backpressure Pilot Valve
2. Backpressure Valve
3. Backpressure Unload Valve Body
4. Backpressure Unload Valve
5. Regenerative Check Valve

A Control Valve Exhaust Gallery
B Backpressure Valve Gallery
C Return to Reservoir Port
D High Pressure Parallel Gallery
E Backpressure Valve Pressure Sensing Gallery
F Open Centre Gallery

In the "no load" or "light load" condition the backpressure valve provides backpressure of 250 lbf/in² (17.5 bar) in the exhaust gallery 'A', which is in addition to the natural backpressure in the return to reservoir line.

This backpressure complements the function of the regenerative check valve, provides more positive cylinder control and aids the anti-cavitation function on those circuit-relief valves incorporating the anti-cavitation feature. The operating sequence of the backpressure valve which is controlled by a pilot relief valve (backpressure relief valve) is as follows:

When a cylinder is operated the returning or cylinder exhaust oil passes from the control valve spool section to the exhaust gallery 'A'. Oil in gallery 'A' cannot pass unrestricted to the reservoir return port 'C' without opening the backpressure valve which requires 250 lbf/in² (17.5 bar) opening pressure and consequently creates the backpressure in gallery 'A'.

Exhaust oil in the gallery 'A' initially acts on the face of the backpressure valve which is held on its seat by a spring. Oil is bled through orifice 'E' in the backpressure valve to the rear of the valve and due to the similar surface areas, equalises the pressure differential with the spring maintaining the valve in the closed position.

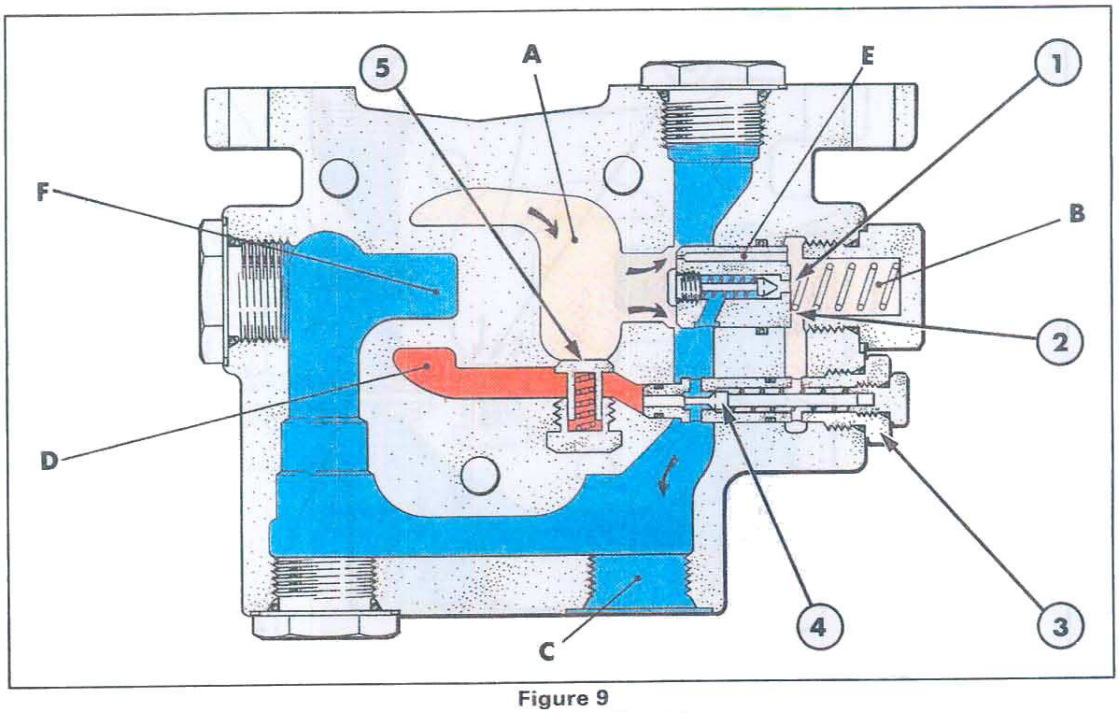

Figure 9
Backpressure Valve Operation

Pump Pressure Oil
Backpressure Oil
Return to Reservoir Oil

1. Backpressure Pilot Valve
2. Backpressure Valve
3. Backpressure Unload Valve Body
4. Backpressure Unload Valve
5. Regenerative Check Valve

A Control Valve Exhaust Gallery
B Backpressure Valve Gallery
C Return to Reservoir Port
D High Pressure Parallel Gallery
E Backpressure Valve Pressure Sensing Gallery
F Open Centre Gallery

As the pressure of the totally restricted oil flow from 'A' rapidly increases the oil acting on the face of the pilot valve overcomes the pilot valve spring and escapes into the return to reservoir port 'C'.

This small oil flow reduces pressure at area 'B' and allows the pressure acting on the face of the backpressure valve to move the valve to the right and open up the exhaust gallery 'A' to the return to reservoir port 'C', Figure 9. The backpressure is maintained at this high level until the pressure in the high pressure gallery 'D' reaches 1000 lbf/in² (70 bar).

In the "medium" or "heavy loaded" condition, natural reservoir pressure is sufficient to complement the anticavitation functions of those valves incorporating the anti-cavitation feature and the preservation of the 250 lbf/in² (17.5 bar) higher backpressure becomes unnecessary and wasteful due to the power demand required to do this. For example, if the pump (and its power source – the engine), has to exert energy into the crowd cylinder during bucket filling it would also have to exert energy in overcoming the 250 lbf/in² (17.5 bar) pressure increase necessary to exhaust the oil from the opposite end of the cylinder. If this 250 lbf/in² (17.5 bar) pressure were reduced then the power saving would be available for the bucket filling cycle. Therefore, an unload valve is provided to fulfil this function.

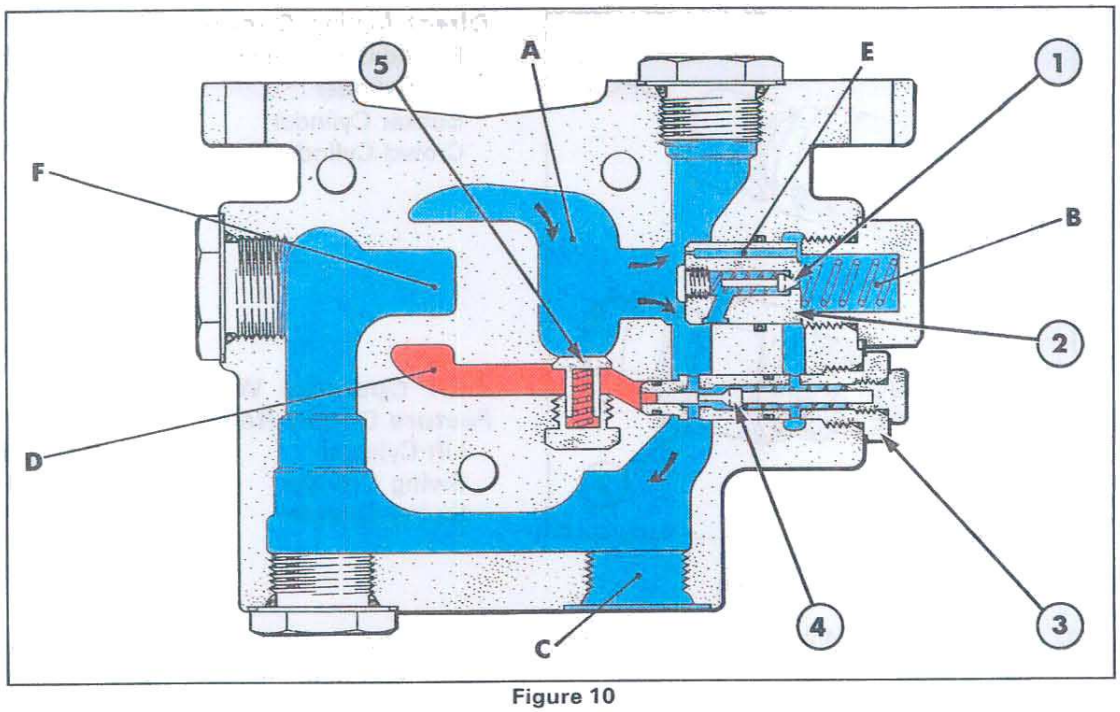

Figure 10
Backpressure Unload Valve Operation

Pump Pressure Oil

1. Backpressure Pilot Valve
2. Backpressure Valve
3. Backpressure Unload Valve Body
4. Backpressure Unload Valve
5. Regeneration Check Valve

Return to Reservoir Oil

A Control Valve Exhaust Gallery
B Backpressure Valve Gallery
C Return to Reservoir Port
D High Pressure Parallel Gallery
E Backpressure Valve Pressure Sensing Gallery
F Open Centre Gallery

Figure 10 illustrates the situation where medium to heavy loaded digging conditions occur.

The high pressure parallel gallery 'D' is at a working pressure greater than 1000 lbf/in² (70 bar). This pressure acts on the actuator portion of the unload valve and pushes the unload valve off its seat. This unseating action allows the backpressure which was acting on the rear side of the backpressure valve in area 'B' to escape across the open unload valve seat and into return to reservoir port 'C'.

The relief of backpressure immediately causes an unbalanced situation and the backpressure valve opens. The exhaust oil pressure in gallery 'A' is now able to relieve to the return reservoir port 'C' without reaching the 250 lbf/in² (17.5 bar) above return to reservoir pressure. In effect, with the unload valve being operated by the high pressure, the backpressure valve can now be opened by a much lower order of exhaust gallery pressure than was possible in the no load or light load digging condition. It should be noted that there is no oil path between the parallel high pressure gallery 'D' and the return to reservoir port 'C'.

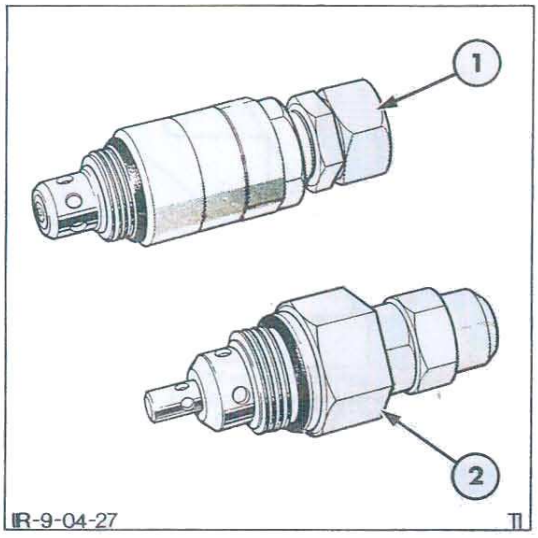

Figure 11
Circuit Relief Valves

1. Pilot Operated With Anti-cavitation Feature Relief Valve
2. Direct Acting Relief Valve

CIRCUIT RELIEF VALVES

Circuit relief valves are incorporated in those circuits which will through normal digging operations be subjected to unavoidable overload.

Two types of circuit relief valve are incorporated in the valve spool assembly, either direct acting or pilot operated with anti-cavitation function and are adjustable within a predetermined range, Figure 11.

Figure 12 illustrates the placement of the valves in the spool sections (circuits) of a typical valve assembly. The type of valves installed in each circuit of the 455C, 555C and 655C model range is as follows:

Direct Acting Circuit Relief Valves

Extendible Dipstick Cylinder	Piston End
Lift Cylinder	Rod End
Bucket Cylinder*	Rod End
Crowd Cylinder*	Piston End

Pilot Operated With Anti-cavitation Feature Circuit Relief Valves

Lift Cylinder	Piston End
Swing Cylinder	Piston End
Swing Cylinder	Rod End

* On 455C and 555C units less extendible dipstick and not marketed in Scandanavia, pilot operated with anti-cavitation feature relief valves are installed.

Each valve is identified with its particular pressure setting. On pilot operated with anti-cavitation relief valves the pressure setting is marked on a steel band attached to the body and on direct acting valves the pressure setting is stamped on the valve end cap.

NOTE: *It is important that only a valve of the correct pressure setting be used in a particular circuit. The use of a valve with a higher pressure setting than specified could cause structural damage to the backhoe.*

Anti-cavitation feature circuit relief valves are positioned in circuits subject to voiding conditions and permit the transfer of oil from the high pressure side of a cylinder to the low pressure (void) end of the cylinder. This is a condition which occures when a cylinder is subjected to shock forces which cause the pressure side circuit relief valve to operate.

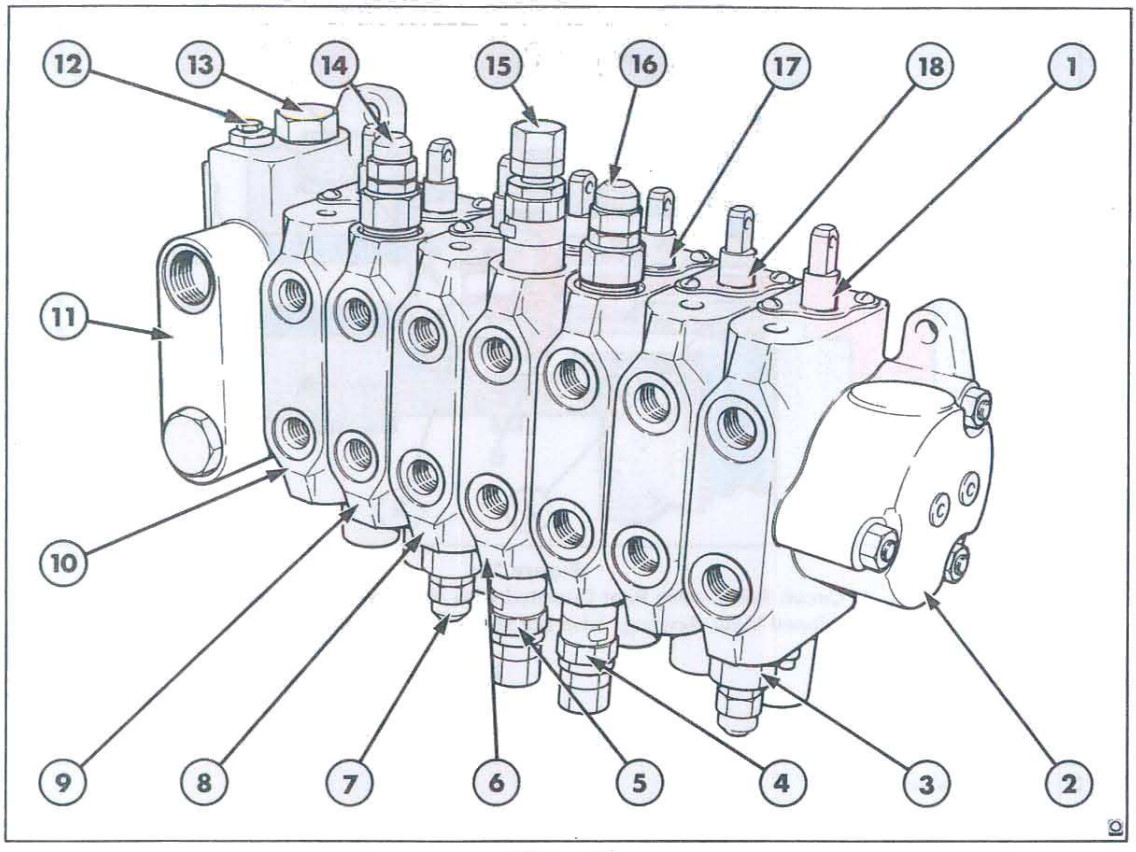

Figure 12
Backhoe Control Valve Assembly

1. Extendible Dipstick Control Valve Section
2. Inlet End Cover
3. Direct Acting Circuit Relief Valve – Extendible Dipstick Piston End
4. Anti-cavitation Circuit Relief Valve – Lift Cylinder Piston End
5. Anti-cavitation Circuit Relief Valve – Swing Cylinder
6. Swing Cylinders Control Valve Section
7. Direct Acting Circuit Relief Valve – Bucket Cylinder Rod End
8. Bucket Cylinder Control Valve Section
9. Crowd Cylinder Control Valve Section
10. Stabiliser Cylinder Control Valve Section
11. Outlet End Cover
12. Backpressure Unload Valve
13. Backpressure Valve
14. Direct Acting Circuit Relief Valve – Crowd Cylinder Piston End
15. Anti-cavitation Circuit Relief Valve – Swing Cylinder
16. Direct Acting Circuit Relief Valve – Lift Cylinder Rod End
17. Lift Cylinder Control Valve Section
18. Stabiliser Cylinder Control Valve Section.

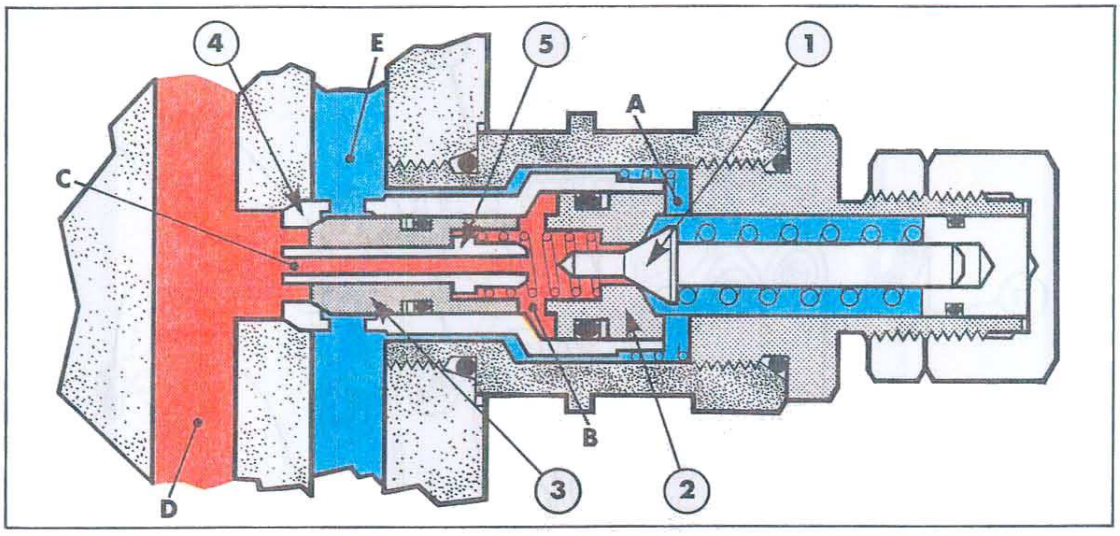

Figure 13
Circuit Relief Valve Pilot Operated with Anti-Cavitation Feature
Sectioned View showing Valve not subjected to Overload conditions

High Pressure Oil

Exhaust/Reservoir Oil

1. Pilot Valve
2. Pilot Valve Body
3. Poppet Valve
4. Sleeve Poppet
5. Piston

Illustrated in Figure 13 is a sectional view of a circuit relief valve with anti-cavitation components. Operation of the valve is as follows:- High pressure oil from an overloaded cylinder circuit is present in galley 'D' and acts on the faces of the poppet and passes through the hollow piston to area 'B'. The pressure acting on the rear face of the poppet valve and piston, and the side faces of the sleeve poppet (anti-cavitation component), maintain the poppet valve seated against its seat on the sleeve poppet, and in turn the force exerted by the poppet valve on the sleeve poppet, plus the pressure acting on the back side of the sleeve poppet, keeps this component firmly seated on the seat machined in the valve spool section. Pressure in area 'B' also acts on the pilot valve, but until a certain level of pressure (setting level) is reached, the pilot valve cannot be moved against the pilot valve spring retaining force.

As the pressure level rises to the set level the force of pressure will overcome the pilot valve spring and lift the pilot valve off its seat, Figure 14.

Oil in area 'B' can now flow to area 'A', past the sleeve poppet shoulders into exhaust gallery 'E'. As the oil flows there is an immediate pressure drop in area 'B' and the holding pressure on the rear of the poppet valve is reduced. The piston and poppet valve move toward the pilot valve and open the high pressure gallery 'D' to the low pressure gallery 'E'. The piston moving toward the pilot contacts the tip of the pilot valve, Figure 15 and prevents high pressure oil refilling the area 'B'. Note that the outer sleeve poppet remains seated, held in this position by its spring.

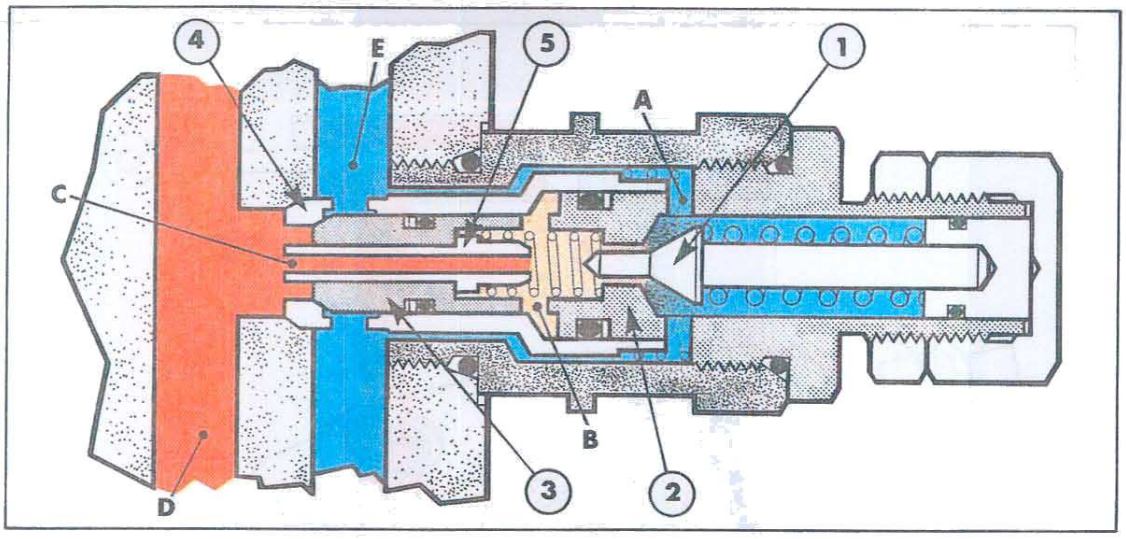

Figure 14
Circuit Relief Valve Pilot Operated with Anti Cavitation Feature
Sectioned View – showing Valve with Initial Pilot Valve Opening

High Pressure Oil | Reduced Pressure Oil | Exhaust/Reservoir Oil

1. Pilot Valve
2. Pilot Valve Body
3. Poppet Valve
4. Sleeve Poppet
5. Piston

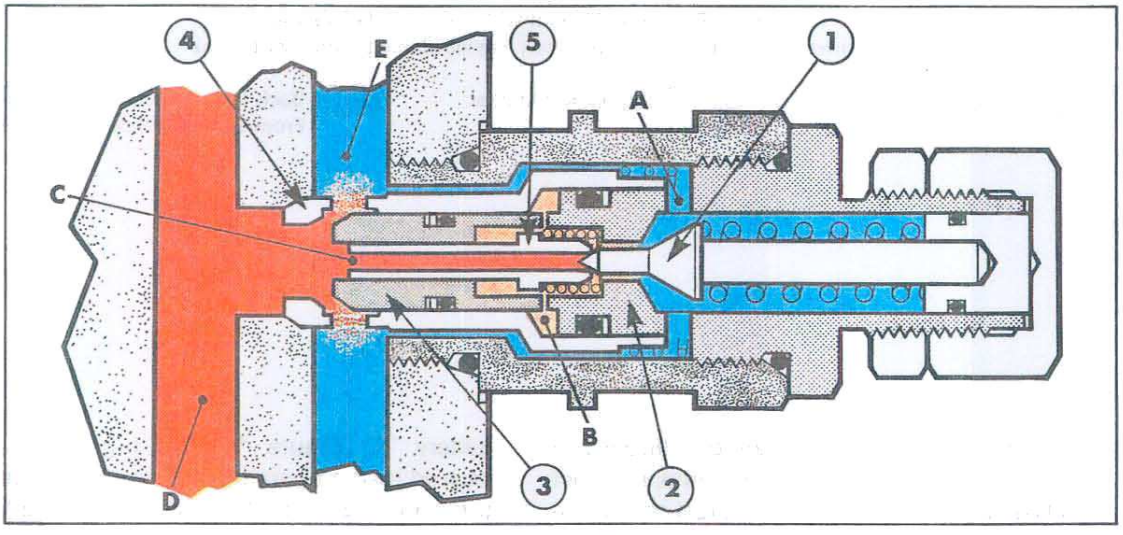

Figure 15
Circuit Relief Valve Pilot Operated with Anti Cavitation Feature
Sectioned View – showing Valve fully relieving High Pressure Oil

High Pressure Oil | Reduced Pressure Oil | Exhaust/Reservoir Oil

1. Pilot Valve
2. Pilot Valve Body
3. Poppet Valve
4. Sleeve Poppet
5. Piston

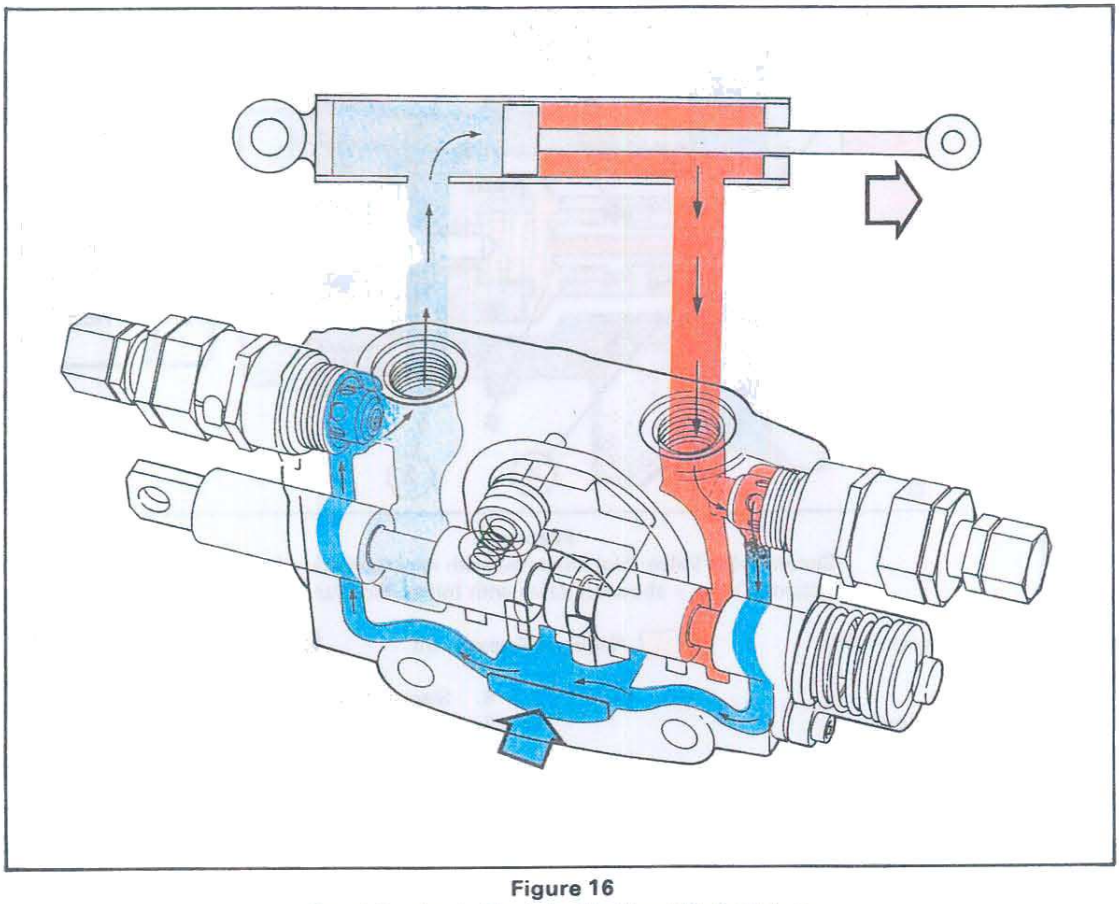

Figure 16
Spool Section in Neutral with Circuit Relief Valves
showing Circuit Relief and Circuit Replenishment (Anti-cavitation)

High Pressure Oil | Supply to Cylinder | Backpressure Feed/Exhaust Oil From Opposite Side of Cylinder

When, for example, the swing cylinder rod end circuit relief valve has operated, in effect oil has been removed from the rod end of the cylinder, the cylinder piston extended and a deficiency or void created in the piston end of the cylinder, Figure 16. This oil is automatically replenished by the anti-cavitation device incorporated in the circuit relief valve in the opposite port to the high pressure. Gallery 'D' in Figure 17 has the void condition present shown in Figure 16, but gallery 'E', Figure 17 has high pressure caused by the operating circuit relief valve in the opposite port. Oil pressure from gallery 'E' acts on the sleeve poppet outer shoulder whilst at the same time the void or suction in gallery 'D' is sensed in area 'B'. These forces cause the sleeve poppet to move off its seat against its light spring and the piston spring and allow oil under pressure in gallery 'E' to pass into gallery 'D' and remove the void created in the piston end of the swing cylinder.

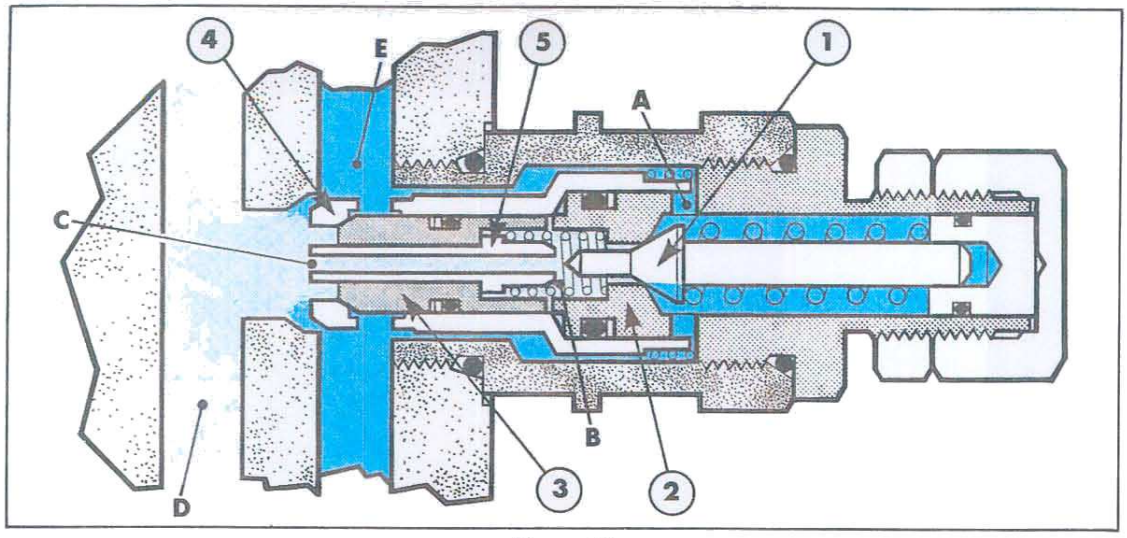

Figure 17
Circuit Relief Valve – Sectioned View
– showing Circuit Replenishment (Anti-cavitation) within Circuit Relief Valve

Exhaust/Reservoir Oil

Cylinder Re-supply Oil

1. Pilot Valve
2. Pilot Valve Body
3. Poppet Valve
4. Sleeve Poppet
5. Piston

Figure 18 illustrates the internal components of a direct acting circuit relief valve in normal operating mode. High pressure oil from an overloaded cylinder circuit is present at gallery 'A' and acts on the face of the relief valve poppet. When the overloaded cylinder pressure exceeds the relief valve setting the poppet moves rearwards against the spring which holds the poppet on its seat. Oil in area 'A' can now flow past the nose on the poppet and into exhaust gallery 'B' relieving the excess pressure in the overloaded cylinder, Figure 19.

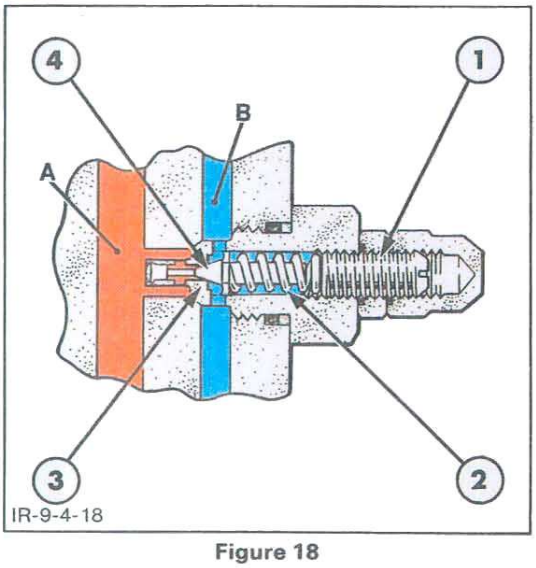

Figure 18
Direct Acting Circuit Relief Valve
Valve not subjected to overload conditions

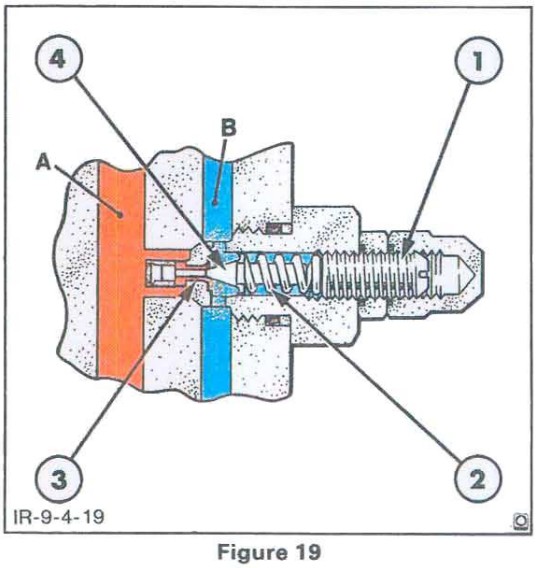

Figure 19
Direct Acting Circuit Relief Valve
Valve subjected to overload conditions

High Pressure Oil

Exhaust/Reservoir Oil

1. Valve Pressure Adjusting Screw
2. Spring
3. Relief Valve Seat
4. Relief Valve Poppet

B. BACKHOE CONTROL VALVE – OVERHAUL

Removal of the circuit relief valves can be achieved without removing the complete control valve from the mainframe. Ensure before removing any one of these valves that the backhoe elements are positioned so that no movement will be possible when the circuits are opened, and that all residual pressures have been removed by moving each of the control levers in all directions.

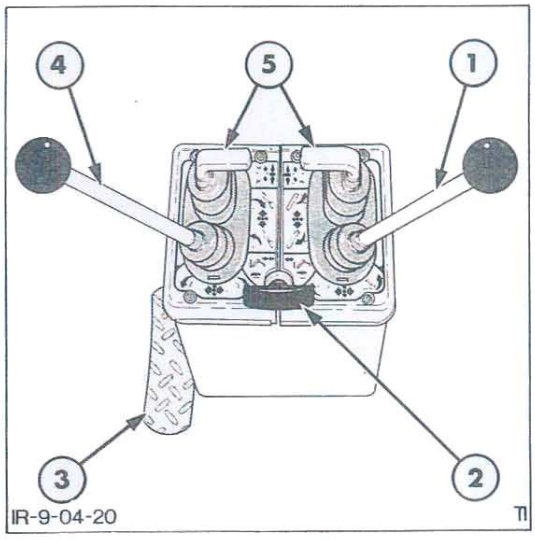

Figure 20
Backhoe Control Console – Sideshift

1. Right-Hand Control Lever
2. Swing Frame Clamp Lever
3. Extendible Dipstick Pedal
4. Left-Hand Control Lever
5. Stabiliser Control Levers

CONTROL VALVE ASSEMBLY – REMOVAL

Sideshift Models

1. Position the unit on a hard level surface.

2. Lower the stabilisers and offset the swing frame to the maximum left or right offset. Position the digging elements so that the crowd and bucket cylinders are fully retracted and the bucket is resting on the ground.

3. Stop the engine and relieve any residual pressures in the excavator and loader circuits by moving all control levers throughout all planes of movement.

4. Where fitted remove the extendible dipstick control pedal, Figure 20, by removing the pedal pivot mounting bracket bolts below the cab floor and disconnecting the linkage beneath the pedal.

5. Identify and tag the positions of all the hydraulic hoses and tubes attached to the valve assembly.

6. Disconnect the inlet hose to the valve assembly, refer to Figure 21.

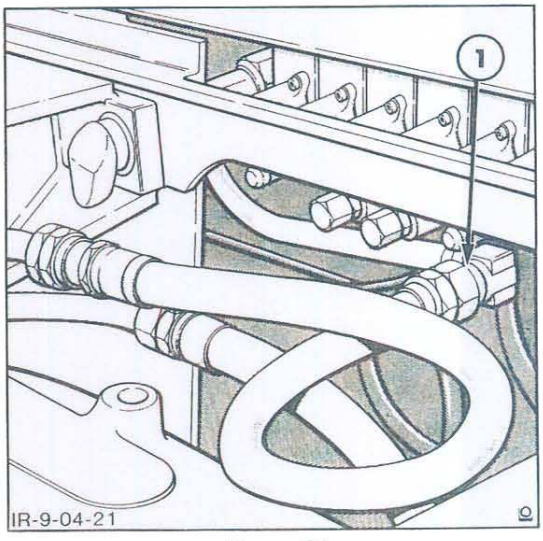

Figure 21
Backhoe Control Valve Inlet Hose Viewed Through Cab Floor

1. Inlet Hose Connection

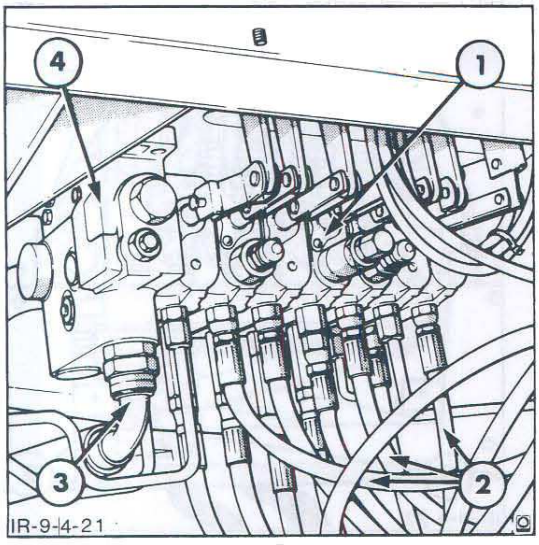

Figure 22
Backhoe Control Valve Installation
Sideshift Units

1. Control Valve
2. Element Hoses
3. Exhaust Tube
4. Outlet End Cover

7. Disconnect the exhaust tube from the valve assembly, Figure 22.

8. Disconnect all remaining hoses from the valve assembly.

9. Remove the stabiliser steel tubes.

10. Disconnect the control lever linkage bellcranks from each section of the valve assembly.

11. Using suitable supporting equipment such as jacks or an adapted lever system, support the weight of the control valve and remove the retaining nuts and bolts from the floor plate.

12. Carefully lower and remove the control valve assembly from the vehicle.

Centre Pivot Models

1. Position the unit on a hard level surface.

2. Lower the stabilisers and position the digging elements so that the crowd and bucket cylinders are fully retracted and the bucket is resting on the ground in line with the vehicle.

3. Stop the engine and relieve any residual pressures in the excavator and loader circuits by moving all control levers throughout all planes of movement.

4. On with cab units, open the rear window.

5. Remove the rear floor mat.

6. Remove the plastic cover on the backhoe control console and disconnect the transport lock linkage at the console.

7. Remove the floor cover plate immediately behind the control console.

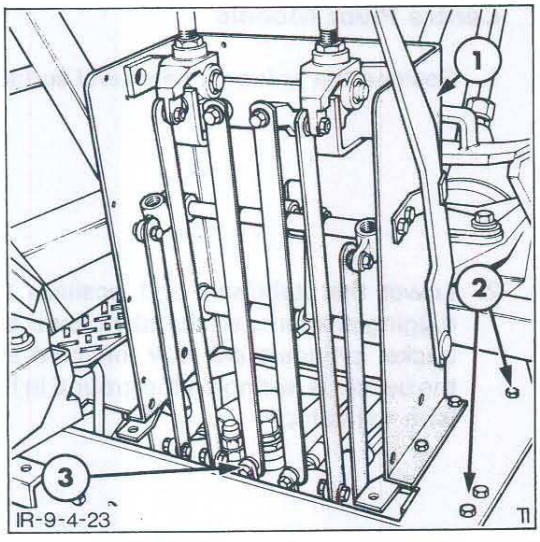

Figure 23
Backhoe Control Lever Linkage
Centre Pivot Units

1. Control Console
2. Base Plate Securing Bolts
3. Linkage Attaching Point

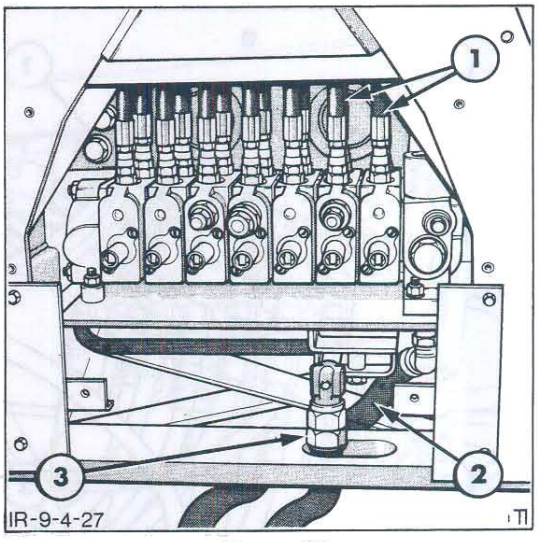

Figure 24
Backhoe Valve Hoses
Centre Pivot Units

1. Valve to Element Hoses
2. Valve Exhaust Hose
3. Valve Inlet Hose

8. Disconnect the control valve operating linkage where it attaches to each control valve, Figure 23. On units installed with extendible dipstick, similarly disconnect the pedal linkage from the valve.

9. Remove the bolts securing the base plate on which the console is mounted and lift the console and plate from the vehicle.

10. Identify and tag the positions of all hydraulic hoses attached to the valve assembly.

11. Disconnect the inlet and exhaust hoses to the valve assembly, Figure 24.

12. Disconnect all remaining hoses from the valve assembly.

13. Position a suitable sling or chain around the valve assembly and mounting plate and using a suitable hoist, positioned through the rear window on cab models, support the weight of the valve assembly.

14. Remove the bolts securing the valve assembly mounting plate to the mainframe and using the hoist, lift the valve and mounting plate assembly from the mainframe and through the rear window.

15. Separate the control valve from the mounting plate.

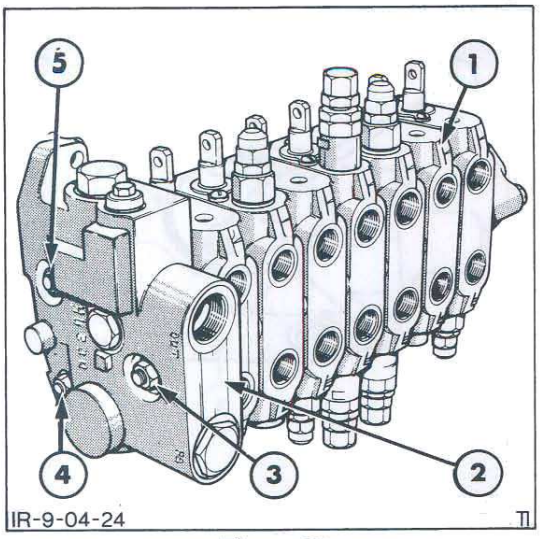

Figure 25
Control Valve Assembly

1. Valve Section
2. Outlet End Cover
3. Tie Rod (1/2" – 20)
4. Tie Rod (7/16" – 20)
5. Tie Rod (7/16" – 20)

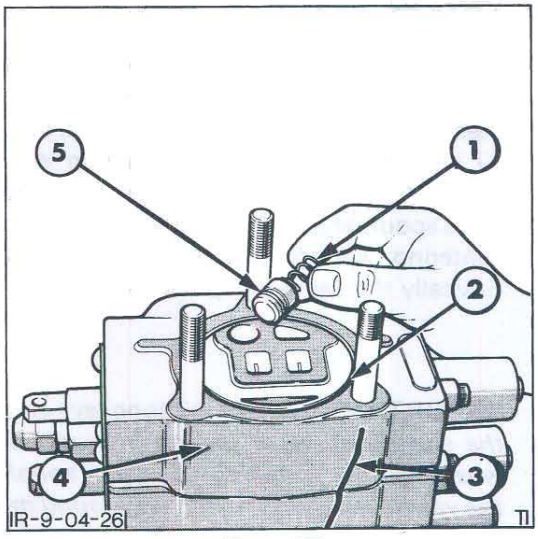

Figure 26
Removing Load Check Valve

1. Check Valve Spring
2. 'O' Ring Seal
3. Diagonal Alignment Line
4. Valve Section
5. Check Valve Poppet

DISASSEMBLY

The valve spools are selectively fitted to their respective sections, and are not serviced separately. If a spool, centring mechanism or valve section requires replacement, the complete section must be renewed. All other components are service separately. Due to the selective fitting of the spool to the valve section it is important that the spool and its section are kept in order so that the spool can be reinstated in its original bore.

Equally important is the installation of plugs in the ports of the valve assembly to prevent the entry of dirt and foreign material.

Before any disassembly, the valve should be thoroughly cleaned externally with a suitable solvent.

1. Using a marker pen, draw a diagonal line down the back of the valve chest to ensure each valve is replaced in the correct order during re-assembly.

2. Remove the nuts from the tie rods on the outlet end cover end as shown in Figure 25.

3. Separate the control valve by removing one section at a time, beginning with the outlet end cover. After removing a section remove the check valve spring and poppet and the large 'O' ring seal, Figure 26. Place the sections on a clean surface in order of removal.

Valve Sections

All of the valve sections are basically identical in construction. However, not all these sections use circuit relief valves. Figure 27 illustrates a typical valve section with a single direct acting relief valve. All control valve spools are removed from the valve body centering spring end first and contain basically the same components.

IMPORTANT: *Identify the spool eye end to the end of the valve section from which it was removed. Installing the valve spool in the valve section the wrong way round must be avoided.*

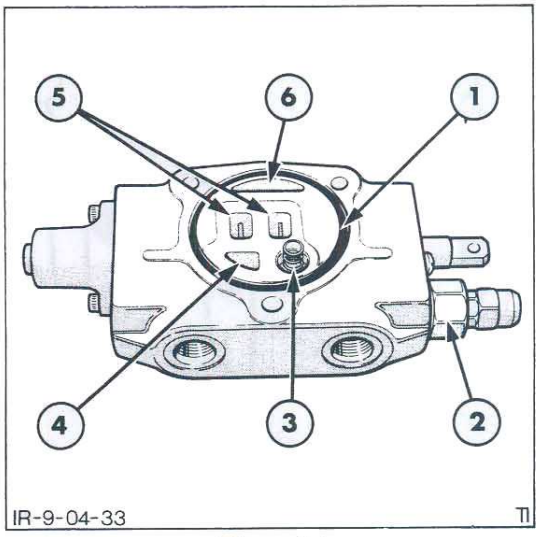

Figure 27
Backhoe Valve Section

1. O Ring Seal
2. Circuit Relief Valve
3. Load Check Valve
4. Parallel Gallery
5. Open Centre Gallery
6. Exhaust Gallery

1. Where fitted remove the circuit relief valve(s).

2. Remove the centring spring cap retaining screws and remove the cap, Figure 28.

3. Withdraw the spool and centring spring assembly from the valve section.

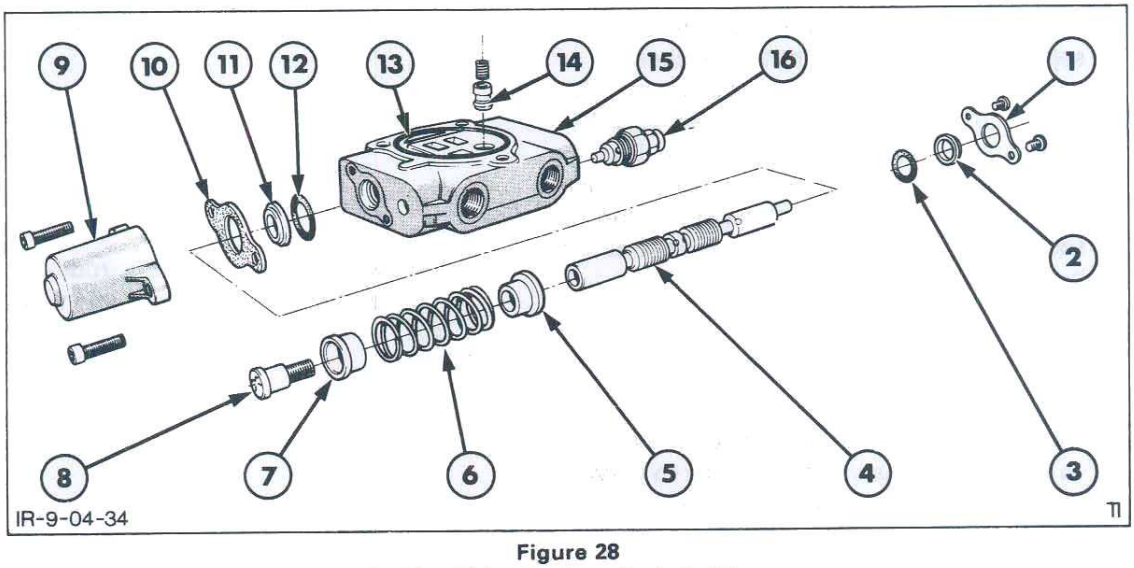

Figure 28
Backhoe Valve Section – Exploded View

1. Seal Plate
2. Wiper Seal
3. 'O' Ring
4. Spool
5. Spring Seat
6. Centring Spring
7. Spring Seat
8. Centring Spring Screw
9. Spool Cap
10. Seal Plate
11. Wiper Seal
12. 'O' Ring
13. 'O' Ring
14. Load Check Valve
15. Valve Section
16. Circuit Relief Valve

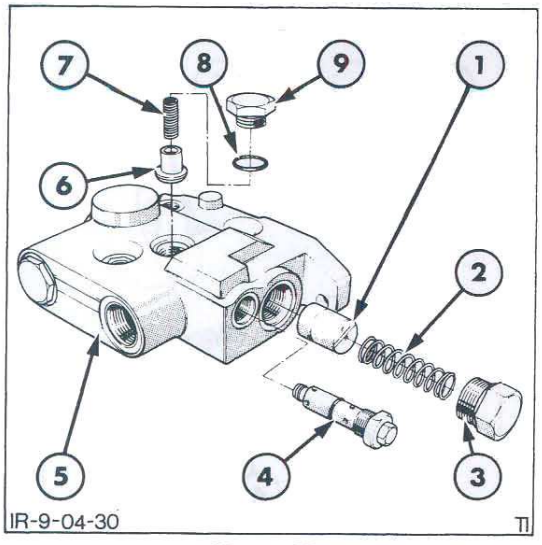

Figure 29
Outlet End Cover-Exploded View

1. Backpressure Valve
2. Spring
3. Plug
4. Unload Valve
5. Outlet End Cover
6. Regenerative Check Valve
7. Spring
8. 'O' Ring
9. Plug

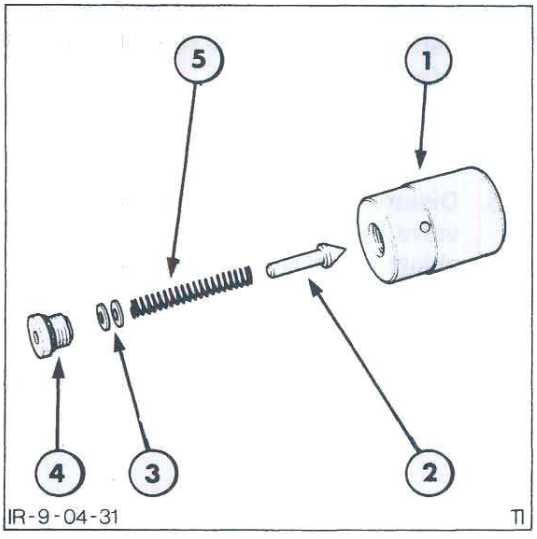

Figure 30
Back pressure Valve – Exploded View

1. Valve Body
2. Pilot Valve
3. Shims
4. Plug
5. Spring

4. Remove the seal plate retaining screws, seal plate, wiper seal and 'O' ring seal from the spool eye end of the valve housing.

5. Remove the rear plate, wiper seal and 'O' ring seal from the centring spring end of the valve housing.

6. Clamp the eye end of the spool in a vice and unscrew the centring spring retainer and remove the spring seats and spring.

Inlet End Cover

There are no components in the inlet end cover and therefore, requires no disassembly.

Outlet End Cover

The following disassembly procedure applies to outlet end covers installed on all 655C units and 555C/455C units with extendible dipstick. The outlet end cover installed on 555C/455C units less extendible dipstick does not contain any valves.

1. Using a 1" box spanner, remove the regenerative check valve plug, spring and valve, refer to Figure 29.

2. Remove the backpressure valve by removing the plug and spring.

NOTE: *The backpressure valve may be withdrawn from the outlet end cover by inserting a suitable threaded rod into the hole in the centre of the valve assembly.*

3. Remove the plug from the end of the backpressure valve and withdraw the shims, spring and backpressure pilot valve from the valve body, Figure 30.

4. Remove the backpressure unload valve, refer to Figure 29.

5. Disassemble the backpressure unload valve by removing the end plug, spring shims, poppet rod and poppet, Figure 31.

6. Remove the remaining plug in the end cover and discard all 'O' ring seals.

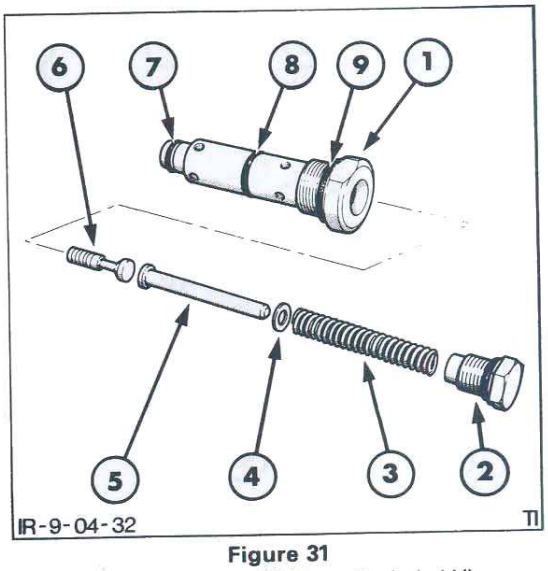

Figure 31
Backpressure Unload Valve – Exploded View

1. Valve body
2. Plug and 'O' Ring
3. Spring
4. Shim
5. Poppet Rod
6. Poppet
7. 'O' Ring and Back Up Ring
8. 'O' Ring
9. 'O' Ring

INSPECTION

Before inspecting parts, thoroughly clean all components in a suitable solvent, flush all passages in the valve sections and dry using compressed air.

Spool and Valve Sections

1. Inspect the spools and the spool bores in the valve sections for scratches, wear and damaged lands. If the spools are badly scratched and worn or the lands damaged, a complete new valve section should be installed as the spools are matched to the bores.

2. Check the centring spring for cracks and overall length by comparing it with a new "stock" spring. Install new springs where necessary.

3. Check the spool wiper seals for wear or damage.

4. Install new seals where required.

5. Install new 'O' ring seals.

Circuit Relief Valves

The circuit relief valves are serviced as assemblies. The assembled units are pre-set for pressure. However, they should be pressure tested after installation on the unit. External 'O' rings and back-up rings are serviced individually.

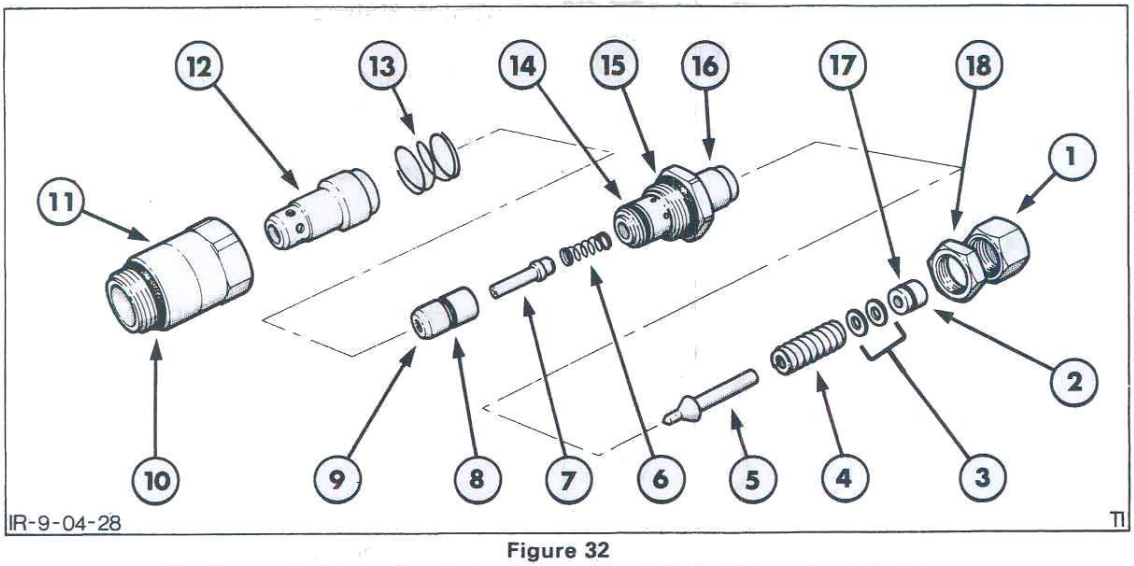

Figure 32
Pilot Operated with Anti-cavitation Feature Circuit Relief Valve – Exploded View

1. Adjusting Cap
2. Adjusting Plug
3. Shim(s)
4. Spring
5. Pilot Valve
6. Spring
7. Piston
8. 'O' Ring and Back-Up Ring
9. Poppet Valve
10. 'O' Ring
11. Body
12. Sleeve Poppet
13. Spring
14. 'O' Ring and Back-Up Rings
15. 'O' Ring
16. Fitting
17. 'O' Ring
18. Locknut

Pilot Operated With Anti-Cavitation Feature Relief Valves

With a small soft rod, depress the sleeve poppet fully into the body. When the rod is quickly removed, the sleeve poppet should snap back to the extended position. Repeat this procedure for the poppet and piston. If any of these items fail to snap back to the extended position disassemble the valve, Figure 32.

1. Check all 'O' rings and back-up rings for wear, damage or swelling. Mating parts must move freely with the 'O' rings and back-up rings installed.

2. Inspect the inside of the sleeve poppet for evidence of wear caused by the poppet 'O' ring and back-up ring. A slight groove may cause the poppet to stick open when operating under pressure, yet the poppet may move freely when depressed by hand.

3. Inspect the ground seating surface of the piston for nicks or excessive wear. The piston should be free of nicks and abrasion.

4. Inspect the pilot valve seat in the valve housing and the seat on the pilot valve. These seats should indicate a complete seating surface.

5. Visually inspect the springs for "setting" by comparing their lengths with a new stock item.

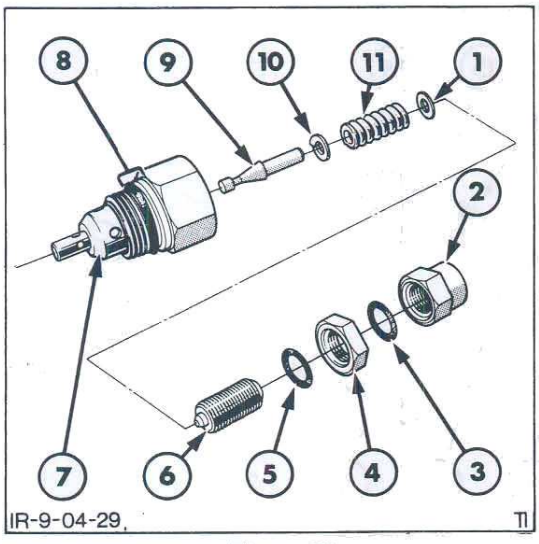

Figure 33
Direct Acting Circuit Relief Valve – Exploded View

1. Shim
2. Security Cap
3. 'O' Ring
4. Locknut
5. 'O' Ring
6. Adjusting Screw
7. Housing
8. Quad and 'O' Ring Seal
9. Poppet
10. Spring Seat
11. Spring
12. Shim

Direct Acting Relief Valves

If the operation of a direct acting relief valve is in question disassemble the valve, Figure 33.

1. Check all 'O' rings and back-up ring for wear damage or swelling.

2. Inspect the seating surface of the poppet and valve housing. The seat should indicate a complete seating surface.

3. Visually inspect the poppet return spring for damage and compare its length with a new stock item.

Check Valves

Check valve malfunction is usually the result of foreign material lodging between the seat and check valve. The spring may also be damaged. Refer to Figure 34.

1. Examine the seat surface for dirt or metal particles and check that the seating surfaces are free of nicks or scratches.

2. Minor nicks and scratches can be removed by using a fine lapping compound. Care must be exercised to prevent the lapping compound from entering and remaining in the valve body.

Regenerative Check Valve

Malfunctioning of the regenerative check valve is usually caused by foreign material lodging between the seat and poppet. Refer to Figure 35.

1. Examine the seating surfaces for dirt and metal particles, nicks or scratches.

2. Minor scratches and nicks can be removed by using a fine lapping compound. Exercise care to prevent the lapping compound from entering and remaining in the outlet end cover.

3. Install a new 'O' ring seal on the valve plug.

Backpressure Valve

1. Inspect the seats for nicks or scratches. Minor nicks or scratches can be removed with a fine lapping compound. Care must be taken to prevent the lapping compound from entering and remaining in the outlet end cover.

2. Check the backpressure valve and its bore for scratches and wear or a groove worn by the 'O' ring located in the bore of the end cover. The inner relief valve components are not serviced separately, replace the valve assembly if necessary.

3. Check the spring for "setting" by visually comparing it to a new spring. Install a new spring if necessary.

4. Renew the end plug 'O' ring seal.

Backpressure Unload Valve

NOTE: *Individual parts, except for external 'O' rings and seals are not serviced. The valve is serviced as a pre-set assembly.*

1. Inspect the seats for nicks and scratches. Minor nicks and scratches can be removed with a fine lapping compound; however, care must be taken to prevent the lapping compound from entering and remaining in the outlet end cover.

2. Check the spring for "setting" by visually comparing it with a spring taken from a new "stock" valve. If spring is "set" renew the valve assembly.

3. Remove all 'O' rings and the back-up ring. Replace with new parts.

RE-ASSEMBLY

Pilot Operated With Anti-Cavitation Feature Circuit Relief Valves

NOTE: *Individual parts except for the two external 'O' rings are not serviced. The valves are serviced as pre-set assemblies.*

With reference to Figure 32.

1. Install new 'O' rings on the valve body and over the large threaded diameter of the housing.

2. Insert the piston into the poppet and place the small spring onto the end of the piston. The diameter of the spring is smaller at one end than the other and the smaller diameter must locate on the piston.

3. Slide the poppet assembly into the sleeve.

4. Position the large spring over the sleeve and insert the sleeve assembly into the valve body.

5. Assemble the housing to the body ensuring that both the piston and sleeve springs are correctly located in the housing. Tighten the body and housing thread to the specified torque, see "Specification" – Chapter 11.

6. Insert the pilot valve, spring, shims and adjusting plug, into the housing and retain with the locknut and adjusting cap.

7. Set the valve to the correct pressure setting as detailed in "Hydraulic Trouble Shooting and Pressure Testing" – Chapter 11.

NOTE: *The valve must not be set outside the specification stamped on the tag wrapped around the body of the valve.*

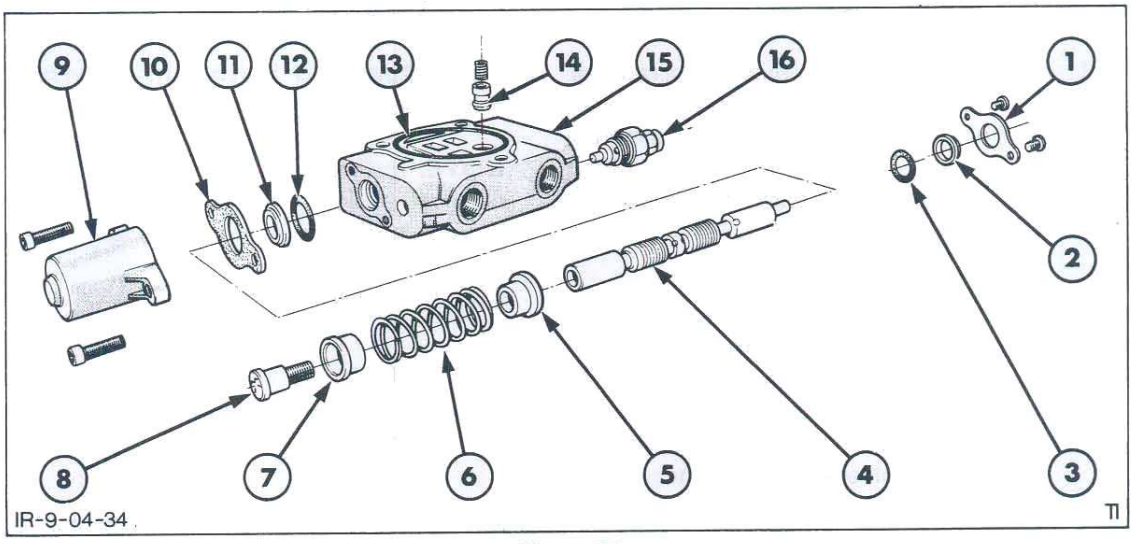

Figure 34
Backhoe Valve Section – Exploded View

1. Seal Plate
2. Wiper Seal
3. 'O' Ring
4. Spool
5. Spring Seat
6. Centring Spring
7. Spring Seat
8. Centring Spring Screw
9. Spool Cap
10. Seal Plate
11. Wiper Seal
12. 'O' Ring
13. 'O' Ring
14. Load Check Valve
15. Valve Section
16. Circuit Relief Valve

Direct Acting Circuit Relief Valves

With reference to Figure 33

1. Position the spring seat onto the poppet ensuring that the concave side of the seat is positioned towards the nose on the poppet.

2. Insert the poppet into the valve housing and locate the spring and shim over the stem of the poppet.

3. Install new 'O' ring seals in the locknut and end cap. Screw the adjusting plug into the housing and retain in position with the locknut.

4. Install a new quad and 'O' ring seal onto the housing ensuring that the quad seal is adjacent to the shoulders of the housing.

5. Set the valve to the correct pressure setting as detailed in "Hydraulic Trouble Shooting and Pressure Testing" – Chapter 10.

Valve Section Spools

With Reference to Figure 34

1. Lubricate the spool with hydraulic oil and insert the eye end of the spool into the valve section. Do not force the spool, use a slight twisting motion which will aid assembly.

2. Install a new 'O' ring seal and wiper seal and then install the seal plate on the centring spring end.

3. Install the centring spring and its seats and install the spring retaining bolt.

NOTE: *Apply 2 drops of Loctite 270 to the retaining screw thread and tighten to the torque specified in "Specifications" – Chapter 11.*

4. With the 'O' ring and wiper seals fully seated in the valve section, align the seal plate and install the end cap and its retaining screws. Tighten the screws to the specified torque, see "Specifications" – Chapter 11.

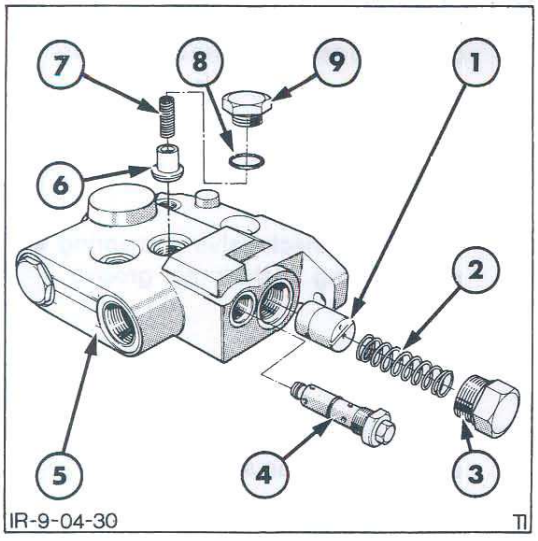

Figure 35
Outlet End Cover – Exploded View

1. Backpressure Valve
2. Spring
3. Plug
4. Unload Valve
5. Outlet End Cover
6. Regenerative Check Valve
7. Spring
8. 'O' ring
9. Plug

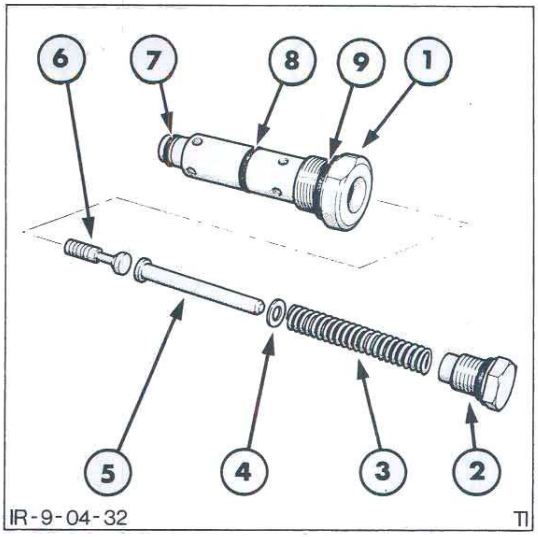

Figure 36
Backpressure Unload Valve – Exploded View

1. Valve Body
2. Plug
3. Spring
4. Shim
5. Poppet Rod
6. Poppet
7. 'O' Ring and Back-up Ring
8. 'O' Ring
9. 'O' Ring

5. Install a new 'O' ring seal and wiper seal on the eye end of the spool and insert them into the recess in the valve section. Secure the seal plate with the two screws. Tighten these screws to the specified torque, see "Specifications" – Chapter 11.

Outlet End Cover

With reference to Figure 35

1. Install the back-up ring and then the 'O' ring seal on the small end of the unload valve body. Install the other two 'O' ring seals on the larger diameters of the body.

2. Into the unload valve body install the poppet, the poppet rod, spring, shims (where fitted), the plug and 'O' ring, Figure 36, tightening the plug to the specified torque. See "Specifications" – Chapter 11.

3. Install the unload valve assembly in the outlet end cover and tighten to the specified torque. See 'Specifications' – Chapter 11.

4. Install the backpressure valve poppet, spring, shims (where fitted), and the plug and 'O' ring into the relief valve body, Figure 37. Tighten the plug to the specified torque, see "Specifications" – Chapter 11.

5. Install the 'O' ring in its groove around the backpressure valve bore in the outlet end cover.

6. Install the backpressure and relief valve assembly into the outlet end cover and replace the spring, plug and its 'O' ring seal. Tighten the plug to the specified torque, see "Specifications" – Chapter 11.

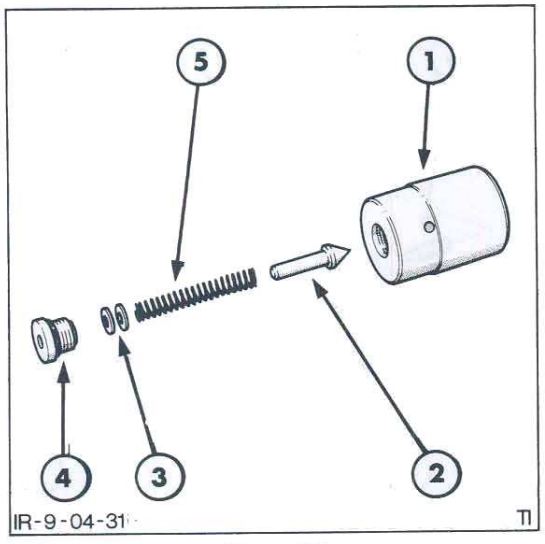

Figure 37
Backpressure Valve – Exploded View

1. Valve Body
2. Pilot Valve
3. Shims
4. Plug
5. Spring

7. Install the regenerative check valve poppet and spring in the outlet end cover. Install the plug and 'O' ring seal. Tighten the plug to the specified torque, see "Specifications" – Chapter 11.

Valve Sections

The order of placement of each section should be the same as was noted before separation – refer to Figure 38.

1. Install a nut on one end of each of the tie rods and insert the tie rods into the inlet end cover.

NOTE: *The two tie rods farthest from the cylinder outlet ports (nearest base) have $^{7}/_{16}$" – 20 thread ends. The other tie rod has a $^{1}/_{2}$" – 20 thread end. Ensure these rods are installed in this way.*

2. Install a new 'O' ring on the inlet end cover and assemble the appropriate valve section on the tie rods.

3. Install the check valve and spring and a new 'O' ring in the outer groove.

4. Install the other valve sections and outlet end cover in the same manner.

5. Install the nuts on the tie rod ends. Tighten the nuts of the tie rods to the specified torque, see "Specifications" – Chapter 11. Note that there are two torque figures, one for the $^{7}/_{16}$" and one for the $^{1}/_{2}$" diameter threads.

INSTALLATION

Installation of the backhoe control valve follows the removal procedure in reverse. Ensure all hose and tube connections are returned to their original positions following the identification made before removal.

Replace all seals disturbed during the overhaul.

Pressure test and adjust any component that had been overhauled as detailed in Chapter 10.

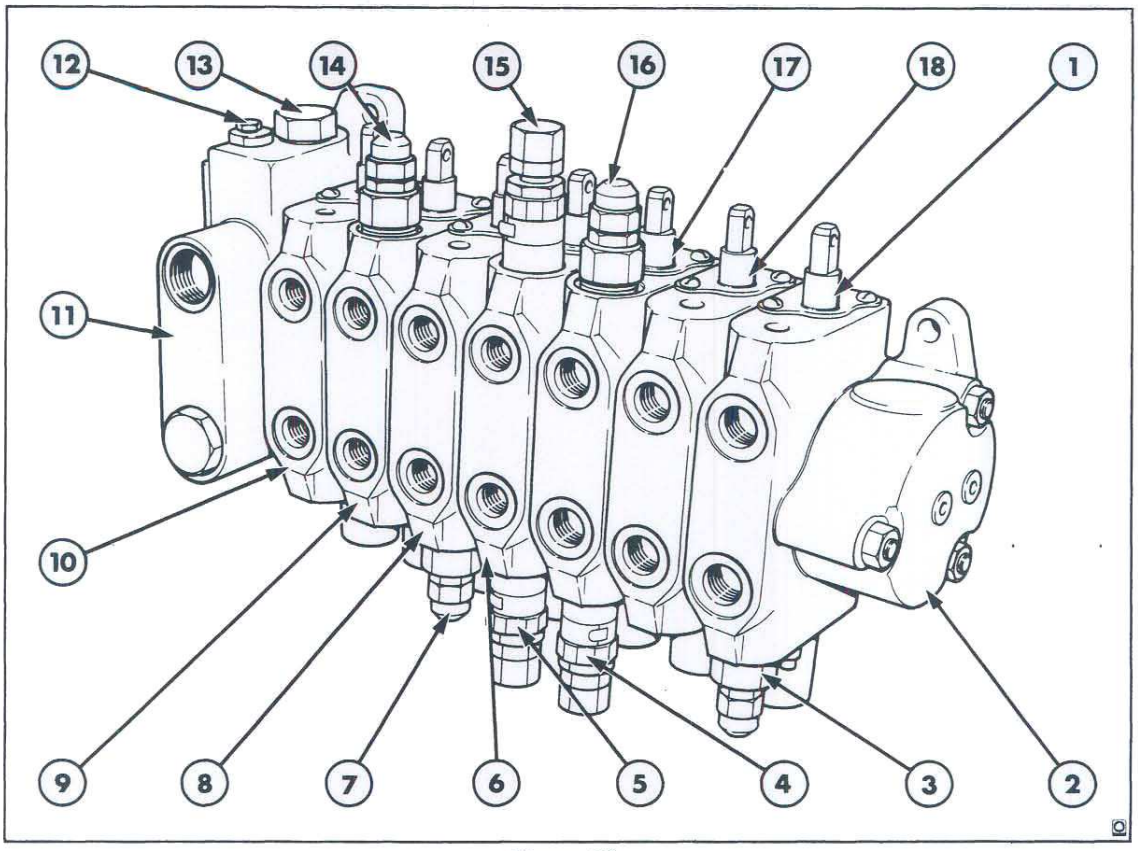

Figure 38
Backhoe Control Valve Assembly

1. Extendible Dipstick Control Valve Section
2. Inlet End Cover
3. Direct Acting Circuit Relief Valve – Extendible Dipstick Piston End
4. Anti-cavitation Circuit Relief Valve – Lift Cylinder Piston End
5. Anti-cavitation Circuit Relief Valve – Swing Cylinder
6. Swing Cylinders Control Valve Section
7. Direct Acting Circuit Relief Valve – Bucket Cylinder Rod End
8. Bucket Cylinder Control Valve Section
9. Crowd Cylinder Control Valve Section
10. Stabiliser Cylinder Control Valve Section
11. Outlet End Cover
12. Backpressure Unload Valve
13. Backpressure Valve
14. Direct Acting Circuit Relief Valve – Crowd Cylinder Piston End
15. Anti-cavitation Circuit Relief Valve – Swing Cylinder
16. Direct Acting Circuit Relief Valve – Lift Cylinder Rod End
17. Lift Cylinder Control Valve Section
18. Stabiliser Cylinder Control Valve Section

PART 8

HYDRAULIC SYSTEM, CONTROLS AND FRAME

Chapter 5
SIDESHIFT BACKHOE HYDRAULIC CLAMPING SYSTEM

A. SIDESHIFT HYDRAULIC CLAMPING SYSTEM – DESCRIPTION AND OPERATION

On sideshift Units the swing post and carriage on which the backhoe boom is attached can be variably positioned on the backhoe frame to suit digging requirements. To prevent movement of the carriage during digging operations the carriage is hydraulically clamped to the frame by four single acting cylinders positioned at each corner of the frame.

The two lower clamp cylinders are, located between the carriage and lower clamp cylinder bellcrank, Figure 1. When pressurised, the cylinder housing forces against the bellcrank causing the bellcrank to pivot and clamp the carriage against the backhoe frame bottom rail.

The upper clamp cylinders are similarly located between the carriage and backhoe frame top rail and when pressurised clamp the carriage plate to the top rail.

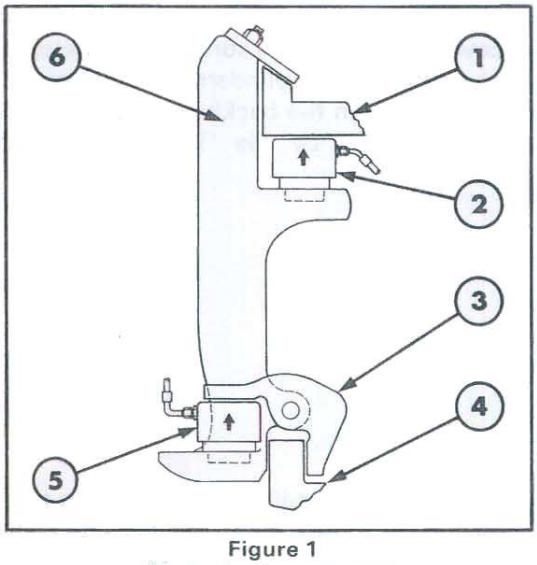

Figure 1
Hydraulic Clamp System

1. Backhoe Frame Top Rail
2. Upper Clamp Cylinder
3. Lower Clamp Cylinder Bellcrank
4. Backhoe Frame Bottom Rail
5. Lower Clamp Cylinder
6. Swing Frame

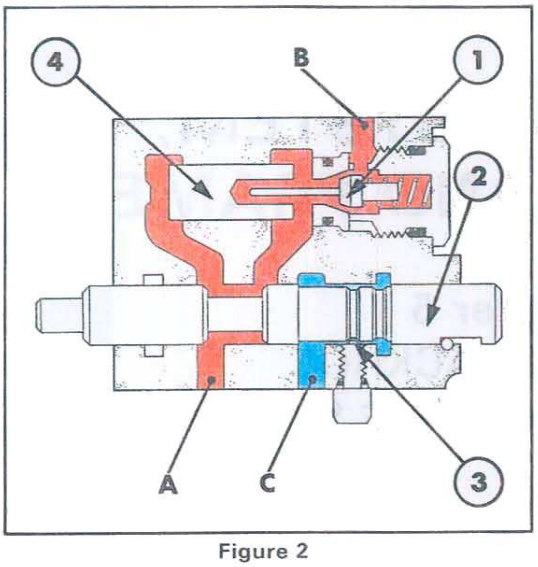

Figure 2
Control Valve Clamp Oil Flow

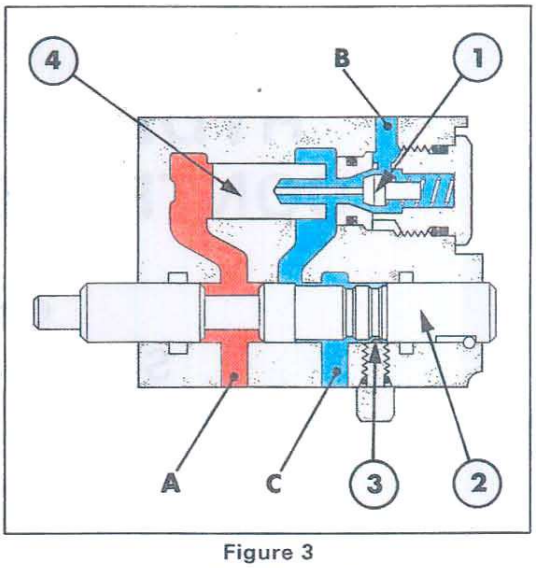

Figure 3
Control Valve Release Oil Flow

Pump Pressure Oil

1. Check Valve
2. Control Spool
3. Detent
4. Unload Valve

Return Oil

A. Pressure Port
B. Clamp Cylinder Port
C. Reservoir Return Port

Hydraulic oil feed for the clamping system is supplied at pump pressure from the inlet end cover of the backhoe control valve assembly and routed to the cylinders via a control valve housed within the backhoe control console and operated by the 'T' handle on the console.

When the 'T' handle is pushed down to the 'clamp' position, the spool in the valve allows oil at pump pressure to flow through the pressure port and check valve to the clamp cylinder port, Figure 2. However, to ensure that the oil pressure directed to the valve is sufficient to lock the carriage to the mainframe, it is necessary to operate the backhoe controls, creating a subsequent rise in pump pressure.

To maintain the clamping force of the cylinders when the backhoe controls are returned to neutral and pump pressure drops, the spring loaded check valve re-seats and maintains the clamping pressure in the cylinders.

With the 'T' handle raised to the "release" position, the control valve spool is shifted to prevent oil flow to the check valve and clamp cylinder port and allows pump pressure oil to be directed to the unload valve, Figure 3. As the backhoe controls are operated and pump pressure increases, the unload valve moves forward and unseats the check valve, allowing the clamping cylinder oil to return to the reservoir, releasing the pressure on the clamping cylinders.

B. SIDESHIFT HYDRAULIC CLAMPING SYSTEM – OVERHAUL

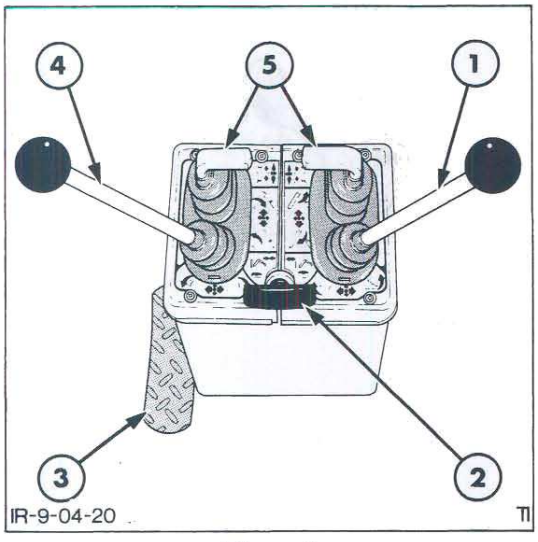

Figure 4
Backhoe Control Console

1. Right Hand Control Lever
2. Swing Frame Clamp Lever
3. Extendible Dipstick Pedal
4. Left Hand Control Lever
5. Stabiliser Levers

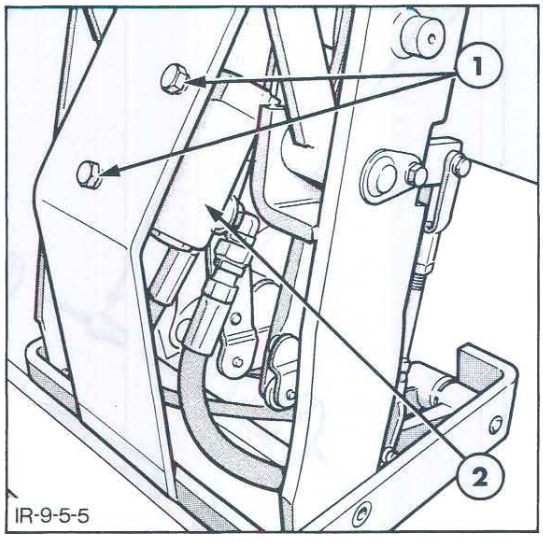

Figure 5
Clamp Control Valve Installation

1. Retaining Bolts
2. Control Valve

CONTROL VALVE

REMOVAL

1. Release the oil pressure on the clamping cylinders by pulling up the 'T' handle on the control console, Figure 4, and retracting the stabiliser leg until the system relief valve operates.

2. Unscrew the control lever knobs and remove the top cover.

3. Using a suitable pin punch, drive the retaining pin from the clamp lever 'T' handle and remove the handle.

4. On units installed with extendible dipstick remove the control pedal attaching nuts beneath the vehicle floor to allow movement of the pedal for access to the right hand control console lower attaching screw.

5. Remove the backhoe control levers and top and side covers to expose the control mechanism.

6. Identify and disconnect the hoses at the control valve.

7. Remove the two bolts securing the valve to the control console, Figure 5, and withdraw the valve.

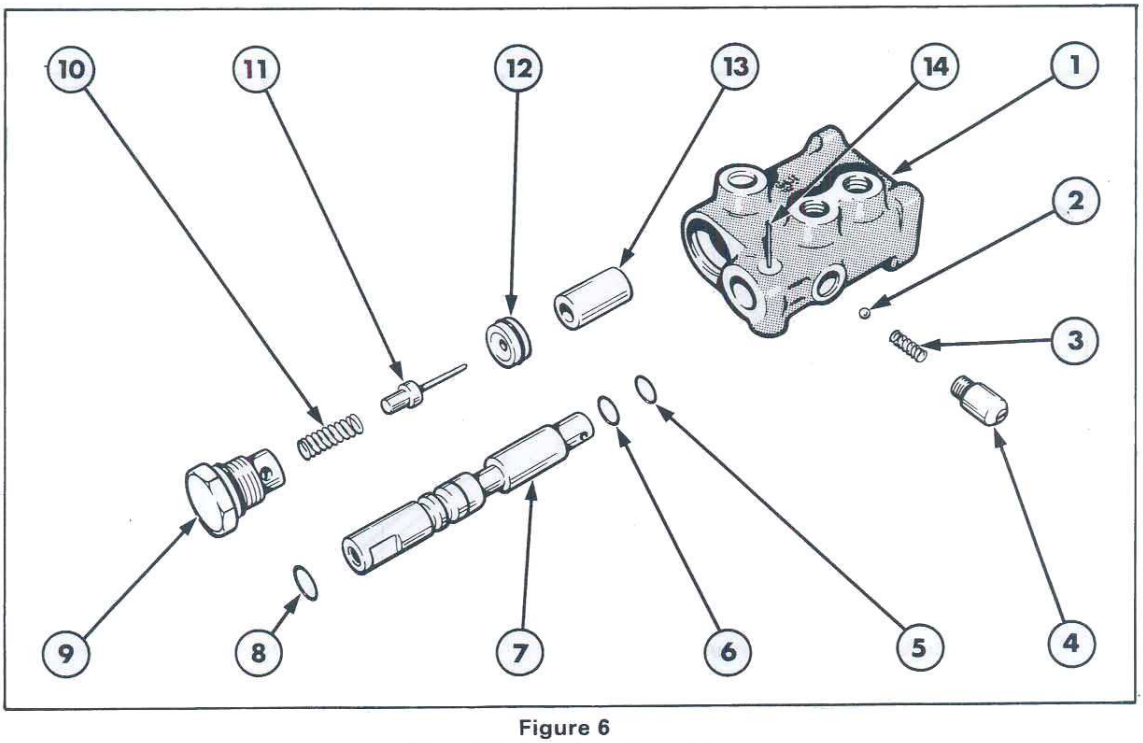

Figure 6
Clamp Control Valve Assembly

1. Body
2. Detent Ball
3. Spring
4. Plug
5. Back-up Washer
6. 'O' Ring
7. Spool
8. 'O' Ring
9. Plug
10. Spring
11. Check Valve
12. Seat and 'O' Ring
13. Unload Valve
14. Roll Pin

DISASSEMBLY

With reference to Figure 6.

1. Remove the spool detent plug and withdraw the spring and steel ball.

2. Press the roll pin from the valve housing and remove the spool.

3. Remove the two 'O' rings and back-up washer from the spool bore.

4. Remove the check valve plug, withdraw the spring and check valve.

5. Remove the check valve seat and unload valve from the valve casting.

INSPECTION

1. Thoroughly wash all components and air dry.

2. Inspect the valve casting and spool for wear or damage. If the spool or casting is damaged, a new valve assembly should be installed.

3. Replace all seals in the valve and examine the check valve seat. Check the valve assembly and the unload valve for wear or damage, replacing damaged components as necessary.

RE-ASSEMBLY AND INSTALLATION

Reassembly and installation of the valve assembly follows the removal and disassembly procedure in reverse. During reassembly observe the following requirements:

- Lubricate all components with hydraulic oil prior to re-assembly, see 'Specifications' – Chapter 11.

- Tighten the spool detent plug and check valve retaining plug to the specified torque, see 'Specifications' – Chapter 11.

CLAMPING CYLINDERS – REMOVAL

1. Park the Unit on a firm level surface, position the carriage in the centre of the frame with the dipstick parallel to the centre line of the Unit, retract the crowd cylinder and lower the dipstick to the ground.

2. Release the pressure on the clamping cylinders by pulling up the 'T' handle on the control console and retracting the stabiliser leg until the system relief valve operates.

3. Lower Clamping Cylinder Removal:

- Disconnect the feed hose to the cylinder being removed and cap the exposed ends.

- Remove the bolt securing the clamping cylinder bellcrank pivot pin. Withdraw the pin and remove the bellcrank. Refer to Figure 7.

- Using a suitable drift, drive the clamping cylinder from the backhoe carriage.

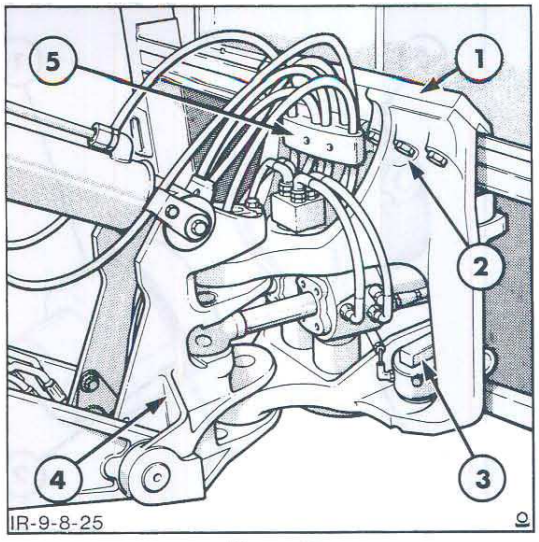

Figure 7
Carriage and Swing Post Assembly

1. Carriage Retaining Plate
2. Carriage Retaining Bolt (6 off)
3. Lower Clamp Cylinder Bellcrank
4. Swing Post
5. Carriage Hose Clamp

4. Upper Clamping Cylinder Removal:

- Support the carriage using a suitable sling and hoist.

- Remove the six carriage plate retaining bolts and remove the plate.

- Using the boom and dipstick operating elements carefully lower and tilt the carriage forwards to enable access to the upper clamp cylinders.

- Disconnect the feed hose to the cylinder being removed and cap the exposed end.

- Using a suitable drift, drive the clamping cylinder from the backhoe carriage.

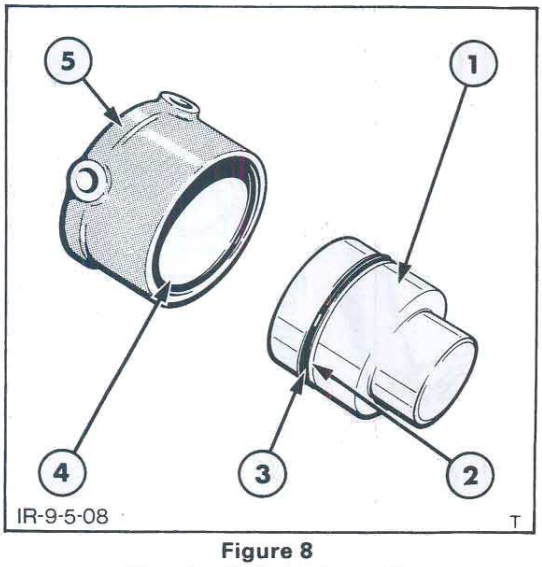

Figure 8
Clamping Cylinder Assembly

1. Piston
2. Sealing Ring
3. Seal
4. Dust Seal
5. Cylinder Housing

DISASSEMBLY

1. Withdraw the piston from the cylinder housing.

2. Remove the seal and sealing ring from the piston, and the dust seal from the cylinder housing, Figure 8.

INSPECTION

1. Thoroughly clean the cylinder housing and piston and air dry. Examine both components for wear or damage.

2. Replace the seal and sealing ring.

3. Examine the lower clamping cylinder pivot arms and pins for wear and replace as necessary.

REASSEMBLY AND INSTALLATION

1. Reassembly and installation of the clamping cylinders follows the removal and disassembly procedure in reverse. During reassembly, observe the following requirements:

- Lubricate the clamp cylinder components with hydraulic oil prior to reassembly, see 'Specifications' – Chapter 11.

- Tighten the carriage plate retaining bolts to the correct torque, see 'Specifications' – Chapter 11.

- Operate the clamping system and check for hydraulic leaks.

PART 8
HYDRAULIC SYSTEM, CONTROLS AND FRAME

Chapter 6
LOADER HYDRAULIC CONTROL VALVE ASSEMBLY

A. LOADER HYDRAULIC CONTROL VALVE ASSEMBLY – DESCRIPTION AND OPERATION

The loader control valve used on Ford 455C, 555C and 655C Units is a stacked type valve assembly comprising of two or three valve sections positioned between an inlet and outlet end cover, Figures 1 and 2.

The third valve section is incorporated when a multi-purpose hydraulic bucket is required. To accommodate the extra length of the valve assembly with a third section, the shape of the outlet end cover, is changed in order that the assembly can still be mounted in the same location on the subframe as the two section valve.

Oil supply to the valve is direct from the hydraulic pump and enters the valve sections through the inlet end cover which also contains the main system relief valve.

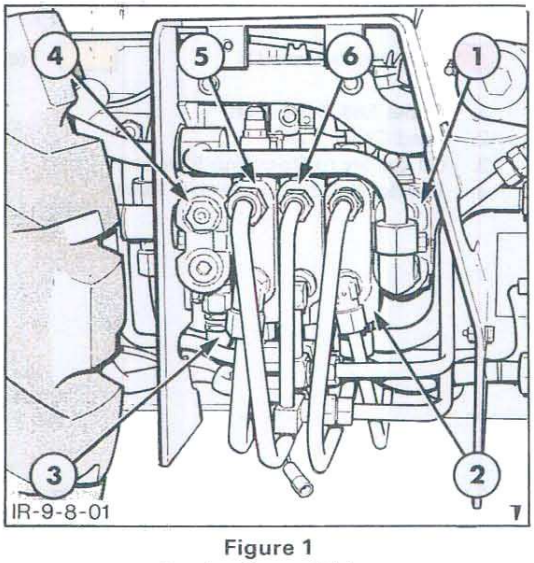

Figure 1
Loader Control Valve

1. Outlet End Cover
2. Auxilary Hydraulic Bucket Valve Section
3. Main System Relief Valve
4. Inlet End Cover
5. Loader Bucket Valve Section
6. Loader Lift Valve Section

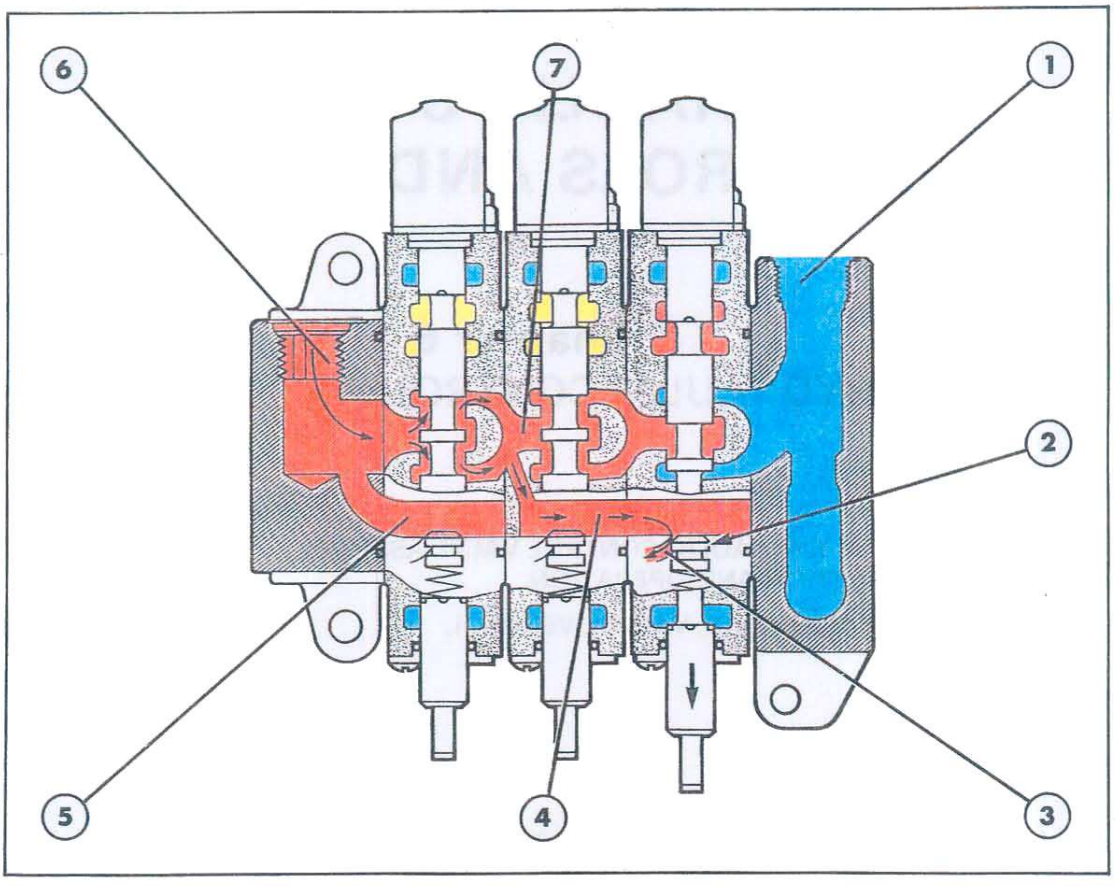

Figure 2
Open Centre and Parallel Gallery Oil Flow

Pump Pressure Oil Trapped Oil Return and Power Beyond Oil

1. Outlet End Cover Port
2. Load Check Valve
3. Oil Gallery to Operating Element
4. Parallel Gallery (Loader Lift Valve)
5. Parallel Gallery (Loader Bucket Valve)
6. Inlet End Cover Port
7. Open Centre Gallery

Each valve section contains manually operated control spools which are spring centred back to the neutral position. Each spool directs the flow of high pressure oil to its particular circuit and a single spring loaded check valve located between each valve section prevents the flow of oil from either cylinder port to the valve pressure passage. Figure 2.

The valve assembly contains four main oil galleries which operate as follows:-

A staggered open centre gallery extends from the inlet end cover to the outlet end cover. When all valve sections are in the neutral position, the pumped oil flows un-interrupted through the staggered open centre gallery to the outlet end cover and on to the backhoe valve assembly.

Two parallel galleries, one for the loader lift valve section and a second gallery for the loader bucket and multi-purpose (auxiliary) bucket section direct pump pressure oil to the operating element whenever a valve section is operated, Figure 2.

It can be seen from Figure 2 that the parallel gallery for the loader bucket section is connected directly to the inlet end cover and terminates at the mating face of the loader lift valve section. Whenever the loader bucket valve spool is operated, causing the free flow of oil through the open centre gallery to be interrupted by the lands on the spool, pump oil pressure increases in the parallel gallery where it can be directed to operate the loader bucket elements.

The parallel gallery for the loader lift and auxiliary valves is supplied with oil through an oil passage which connects to the inlet side of the open centre gallery of the loader lift valve section. This second parallel gallery terminates at the outlet end cover which will allow pump pressure to increase in this gallery whenever the loader lift or auxiliary valve section spools are operated.

This principal of two, parallel galleries utilised on the loader valve section should not be confused with the single parallel gallery system used on the backhoe valve assembly.

The element exhaust gallery (not shown in Figure 2) carries both cylinder and circuit relief valve exhaust oil. This gallery extends from the outlet end cover to the inlet end cover where it is connected to the exhaust oil return tube which carries oil directly to the reservoir.

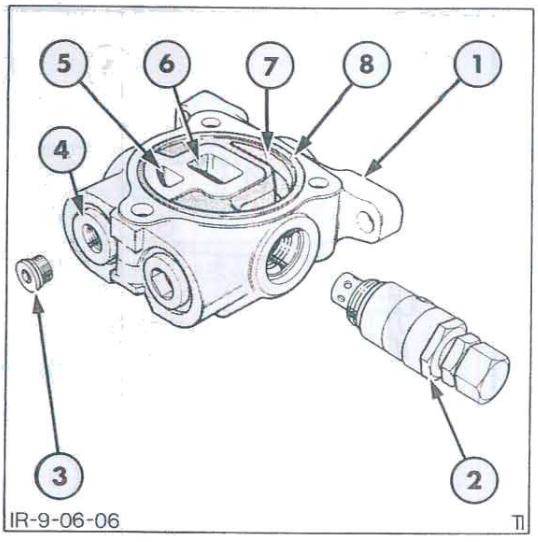

Figure 3
Inlet End Cover

1. Housing
2. Main System Relief Valve
3. Test Port Plug
4. Test Port
5. Parallel Gallery (Loader Bucket)
6. Open Centre Gallery
7. Exhaust Gallery
8. O Ring Seal

Oil flow through each section of the loader valve assembly is as follows and reference to Figure 2, in conjunction with the illustrations for each section of the loader valve, will aid understanding of the principals of operation.

INLET END COVER

The inlet end cover, Figure 3, receives main system oil direct from the hydraulic pump and directs the oil through the staggered open centre gallery of each valve section. A parallel gallery in the end cover also connects to the bucket cylinder valve section and upon operation of the bucket valve spool, allows pressurised oil to flow through this gallery and past the bucket spool check valve from where it is directed to the appropriate end of the bucket cylinders. Refer to LOADER BUCKET VALVE SECTION for operation of loader valve.

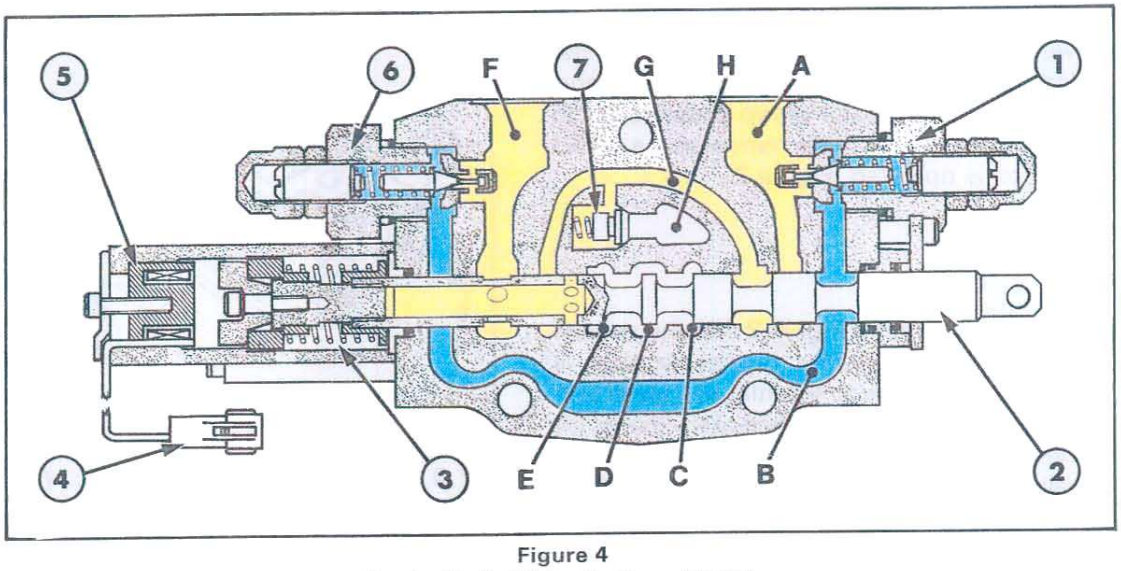

Figure 4
Loader Bucket Valve Section – Neutral

Pump Pressure Oil Trapped Oil Return to Reservoir Oil

1. Circuit Relief Valve
2. Spool
3. Spring Centring Mechanism
4. Return to Dig Connector
5. Electromagnet
6. Circuit Relief Valve
7. Load Check Valve

A Cylinder Feed and Return Gallery
B Exhaust Gallery
C Open Centre Gallery to Next Section
D Open Centre Gallery from Pump
E Open Centre Gallery to Next Section
F Cylinder Feed and Return Gallery
G Interconnecting Gallery (supply)
H Parallel Gallery

Oil exhausting from any cylinder in the loader returns to reservoir through the exhaust gallery in the inlet end cover which interconnects with the element exhaust galleries in each loader valve section, Figure 4.

LOADER BUCKET VALVE SECTION: NEUTRAL POSITION

With reference to Figure 4.

Oil flow from the inlet end cover enters the open centre gallery 'D' and flows through the staggered galleries 'C' and 'E', which align with the corresponding gallery 'D' of the next valve section.

As each section in the control valve assembly has similar 'C', 'D' and 'E' galleries and providing all control valve spools are in neutral, the oil flow through these passages is unrestricted and exits from the outlet end cover where it flows to the backhoe control valve assembly.

With the control valve spool in neutral oil in cylinder ports 'A' and 'F' is static and trapped between the cylinder and spool.

LOADER BUCKET VALVE SECTION: RETRACTING (ROLL BACK)

With reference to Figure 5.

When the bucket section spool is moved to the full roll back (cylinder retracted) position, continued oil flow through the open centre galleries 'C' and 'E' is prevented.

As oil pressure in the blocked open centre gallery increases pressure similarly, increases in gallery 'H' which is supplied with oil from the parallel gallery in the inlet end cover.

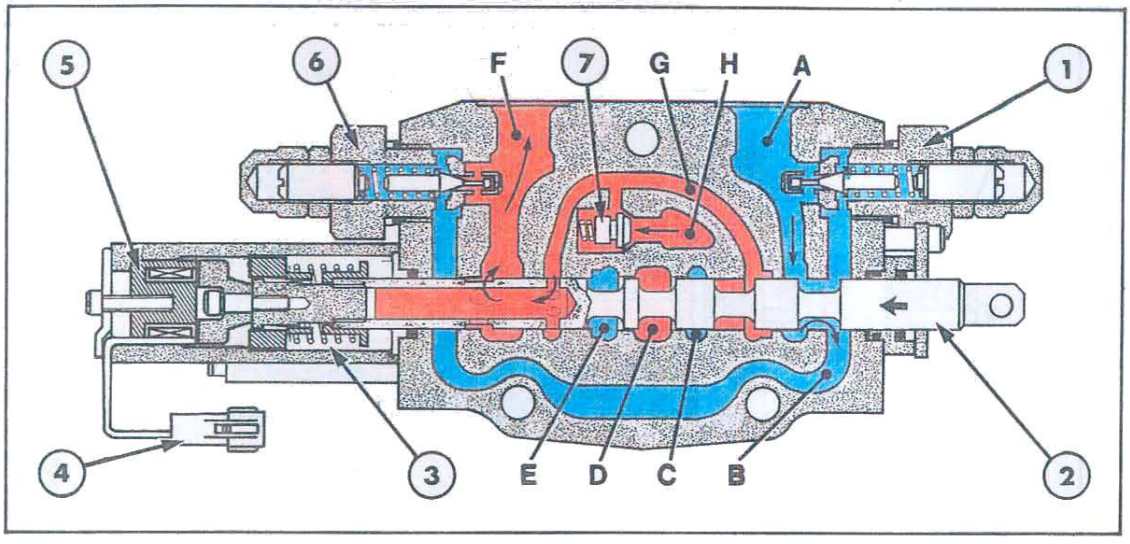

Figure 5
Loader Bucket Valve Section – Retracting (Roll Back)

Pump Pressure Oil

Return to Reservoir Oil

1. Circuit Relief Valve
2. Spool
3. Spring Centring Mechanism
4. Return to Dig Connector
5. Electromagnet
6. Circuit Relief Valve
7. Load Check Valve

A Cylinder Feed and Return Gallery
B Exhaust Gallery
C Open Centre Gallery to Next Section
D Open Centre Gallery from Pump
E Open Centre Gallery to Next Section
F Cylinder Feed and Return Gallery
G Interconnecting Gallery (Supply)
H Parallel Gallery

The oil pressure generated in gallery 'H' unseats the load check valve and oil flows along gallery 'G' into port 'F' to retract the bucket cylinder.

At the opposite end of the spool, this spool movement has opened port 'A' to the exhaust gallery 'B', allowing the oil in the opposite end of the bucket cylinder to be returned to reservoir through the interconnected exhaust galleries.

It should be noted that the parallel gallery 'H' terminates at the rear face of the loader bucket valve section and consequently if the bucket spool is fully activated to the cylinder retract (roll back) position then operation of other elements on the vehicle is not possible.

Operation of other elements is only possible when the bucket spool is feathered.

On Ford 555C and 655C Units an electrically operated detent is incorporated in the return spring housing of the valve section.

When the control valve operating lever is moved from the bucket dump position to the cylinder retract (bucket roll back) position, the spool is held by the electromagnet until the loader bucket has returned to the desired pre-set operating position. When the bucket reaches the pre-set position, the microswitch on the bucket cylinder is operated, which de-activates the electronic detent allowing the spool to automatically return to the neutral position.

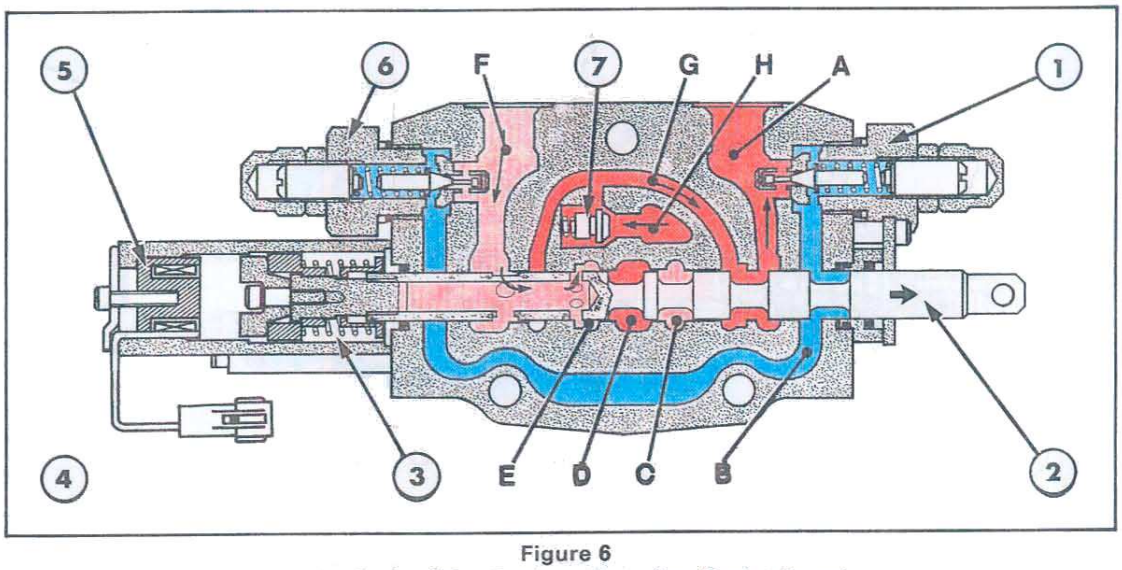

Figure 6
Loader Bucket Valve Section – Extending (Bucket Dump)

Pump Pressure Oil Regenerative Oil Return to Reservoir Oil

1. Circuit Relief Valve
2. Spool
3. Spring Centring Mechanism
4. Return to Dig Connector
5. Electromagnetic Detent
6. Circuit Relief Valve
7. Load Check Valve

A Cylinder Feed and Return Gallery
B Exhaust Gallery
C Open Centre Gallery to Next Section
D Open Centre Gallery from Pump
E Open Centre Gallery to Next Section
F Cylinder Feed and Return Gallery
G Interconnecting Gallery (Supply)
H Parallel Gallery

LOADER BUCKET VALVE SECTION: EXTENDING (Bucket Dump)

With reference to Figure 6.

When the bucket spool section is moved to the extend (bucket dump) position, continued oil flow through the open centre galleries 'C' and 'E' is prevented. As with the valve section in the retract position, oil pressure in the blocked open centre gallery increases with a similar increase in pressure in the parallel gallery.

The oil pressure generated in 'H' unseats the load check valve and oil flows along gallery 'G' into port 'A' to extend the bucket cylinder.

At the opposite end of the spool the movement of the spool to the extend position allows the exhaust oil in port 'F' to flow through the centre of the spool to the staggered open centre gallery 'E'. The exhaust oil flowing into gallery E can now be used as the pressure supply for operating the loader lift at the same time as the loader bucket is dumping the spoil. The exhausting oil is therefore being used as a regeneration oil supply.

It should be remembered, that the parallel gallery in the loader control valve assembly terminates at the rear face of the bucket cylinder valve section, thus preventing operation of other elements of the loader/backhoe when the loader bucket spool is in the retract (roll back) position.

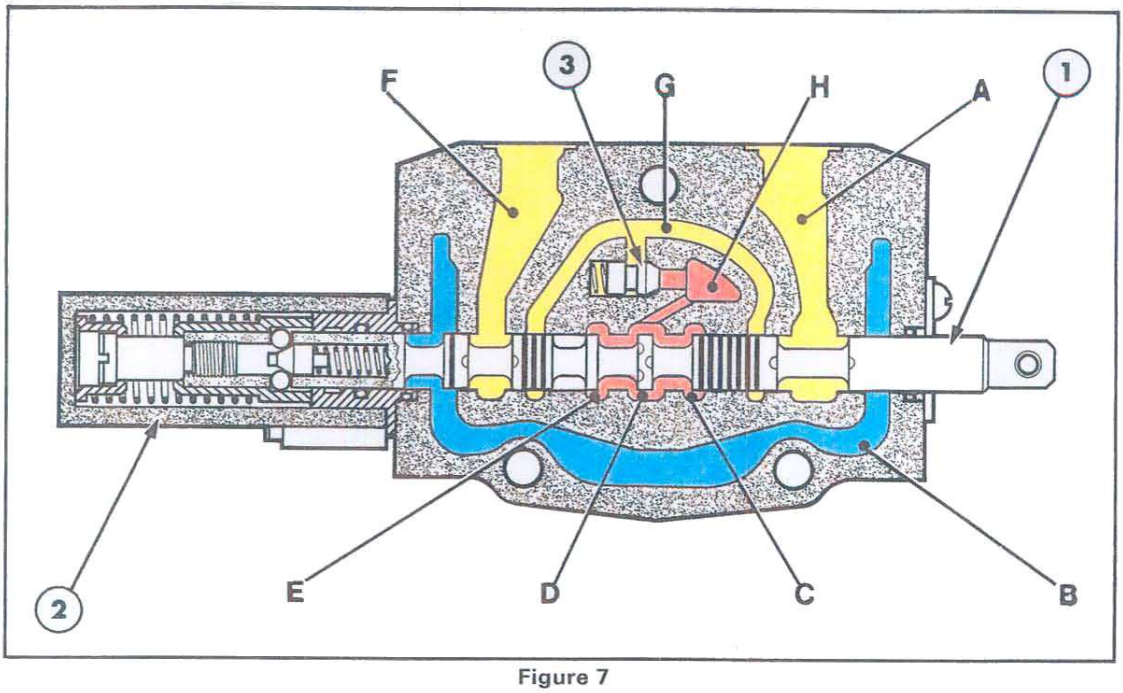

Figure 7
Loader Lift Valve Section – Neutral

Pump Pressure Oil | Trapped Oil | Return to Reservoir Oil

1. Spool
2. Spring Centring and Detent Mechanism
3. Load Check Valve

A Cylinder Feed and Return Gallery
B Exhaust Gallery
C Open Centre Gallery to Next Section
D Open Centre Gallery from Pump
E Open Centre Gallery to Next Section
F Cylinder Feed and Return Gallery
G Interconnecting Gallery (Supply)
H Parallel Gallery

LOADER LIFT VALVE SECTION – NEUTRAL

With reference to Figure 7.

Providing the bucket valve section is in either the neutral or feathered condition, oil flowing through the open centre gallery continues its passage through galleries 'C', 'D' and 'E' to the next valve section (multi-purpose/auxiliary), where fitted and on to the outlet end cover.

Oil in the cylinder ports 'A' and 'F' is static and trapped between the cylinder and spool. Similarly, oil in the parallel gallery 'H' which is fed directly through an interconnecting gallery from the staggered open centre gallery in this valve section, is also static as flow to galleries 'A' or 'F' is prevented by the lands, on the section spool.

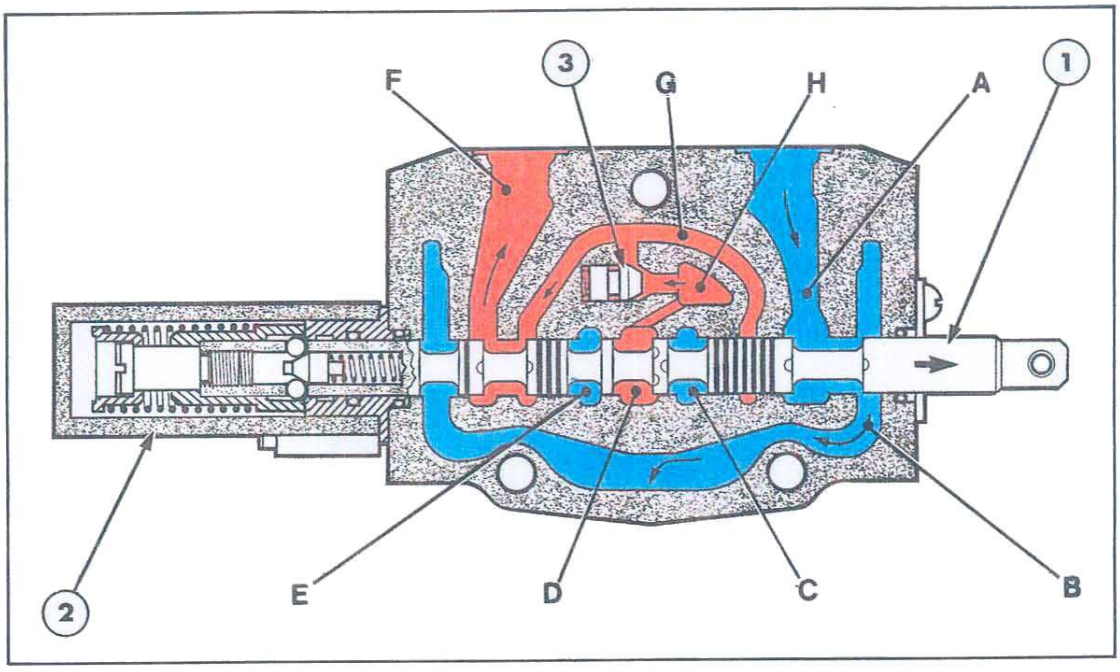

Figure 8
Loader Lift Valve Section – Cylinder Retract (Lower)

Pump Pressure Oil

Return to Reservoir Oil

1. Spool
2. Spring Centring and Detent Mechanism
3. Load Check Valve

A Cylinder Feed and Return Gallery
B Exhaust Gallery
C Open Centre Gallery to Next Section
D Open Centre Gallery from Pump
E Open Centre Gallery to Next Section
F Cylinder Feed and Return Gallery
G Interconnecting Gallery (Supply)
H Parallel Gallery

LOADER LIFT VALVE SECTION – CYLINDER RETRACT (LOWER)

With reference to Figure 8.

When the lift valve section spool is moved to the lower position oil flow through the staggered open centre galleries 'B' and 'C' is prevented and oil flow is transferred through a passage connecting gallery 'A' and parallel gallery 'H'. As parallel gallery 'H' terminates at the outlet end cover pressure increases in the parallel gallery and unseats the load check valve allowing oil to flow along gallery 'G' and into port 'F' to retract the lift cylinder. At the opposite end of the spool the spool movement has opened port 'A' to the exhaust gallery 'B' allowing the oil in the opposite end of the lift cylinder to be returned to the reservoir through the interconnecting exhaust galleries.

Movement of the spool in the opposite direction (cylinder extending) reverses the flow of oil to and from either end of the cylinder. Figure 9.

LOADER LIFT VALVE SECTION – FLOAT

With reference to Figure 10.

When the loader lift control lever is pushed fully forward the spool in the valve section is locked in a mechanical detent which allows oil displaced from one end of the cylinder to circulate to the other.

In this situation, the loader cylinder is free to float allowing the bucket to follow the contours of the ground.

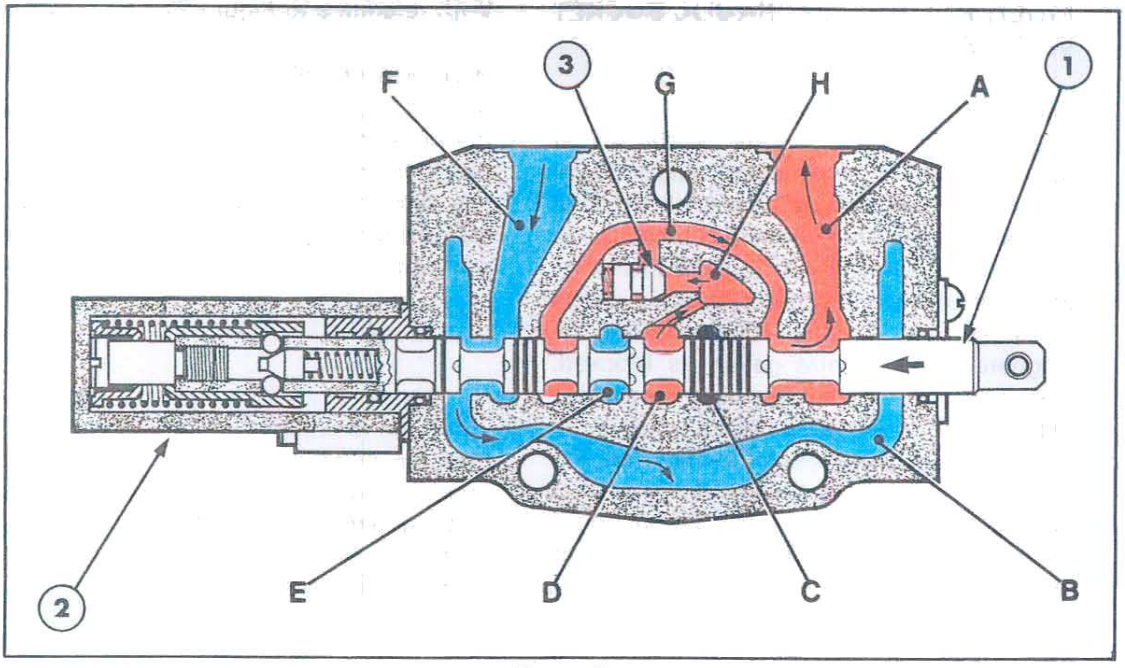

Figure 9
Loader Lift Valve Section – Cylinder Extending (Raise)

Pump Pressure Oil
Return to Reservoir Oil

1. Spool
2. Spring Centring and Detent Mechanism
3. Load Check Valve

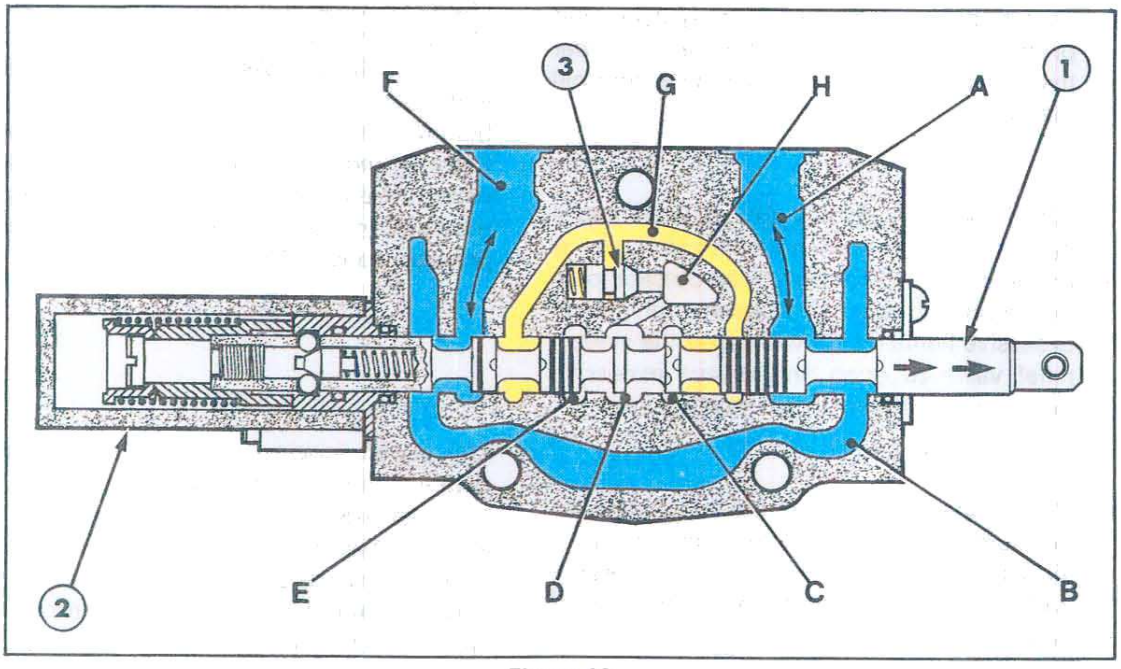

Figure 10
Loader Lift Valve Section – Float Position

Pump Pressure Oil
Trapped Oil
Return to Reservoir Oil

1. Spool
2. Spring Centring and Detent Mechanism
3. Load Check Valve

MULTI-PURPOSE HYDRAULIC BUCKET VALVE SECTION

The multi-purpose valve section where fitted operates in a similar manner to the loader bucket valve section but is not equipped with an electrically operated detent or circuit relief valves. The parallel gallery in the section is linked to the parallel gallery of the loader lift valve hence when the control spool is moved out of the neutral position oil flow along the staggered open centre gallery is blocked, creating an increase in pressure in the parallel gallery. The increase in pressure unseats the check valve allowing oil to flow to either the rod or piston end of the hydraulic bucket cylinder (or auxiliary equipment), dependant on whether the valve is in the extend or retract position.

SYSTEM RELIEF VALVE OPERATION

The system relief valve located in the inlet end cover is positioned between the open centre gallery and exhaust gallery and protects both the backhoe and loader hydraulic system from excessive internal pressures.

When the valve spools are actuated and a cylinder reaches the end of its stroke or is restricted from movement by an outside force or object the system pressure may reach excessive limits which will cause the system relief valve to open and relieve excessive pressure/oil flow to the exhaust gallery.

Under operating conditions where excess pressure occurs in circuits protected by individual circuit relief valves the excess pressure will be relieved through the appropriate relief valve in the circuit.

The system relief valve installed on Ford 455C, 555C and 655C Units is pilot operated and operation of the valve is as follows:-

With reference to Figure 11

High pressure oil in an overloaded system is present in gallery 'D' and acts on the faces of the poppet and passes through the hollow piston to area 'B'. The pressure acting on the rear face of the poppet valve, and piston maintains the poppet valve in the closed position.

Pressure in area 'B' also acts on the pilot valve but until a certain level of pressure (setting level) is reached the pilot valve cannot be moved against the pilot valve spring retaining force.

As the pressure level rises to the set level the force of pressure will overcome the pilot valve spring and lift the pilot valve off its seat, Figure 12. Oil in area 'B' can now flow to area 'A', past the sleeve poppet shoulders into exhaust gallery 'E'. As the oil flows there is an immediate pressure drop in area 'B' and the holding pressure on the rear of the poppet valve is reduced. The piston and poppet valve move toward the pilot valve and open the high pressure gallery 'D' to the low pressure gallery 'E'.

The piston moving toward the pilot valve contacts the tip of the pilot valve, Figure 13, and prevents high pressure oil refilling the area 'B'. It will be noted that the components of the system relief valve are identical to the pilot operated relief valve with anti-cavitation feature, however, the inlet end cover casting material holds the sleeve poppet in a fully retracted position which enables the valve to operate with the pilot operated feature but without the anti-cavitation facility.

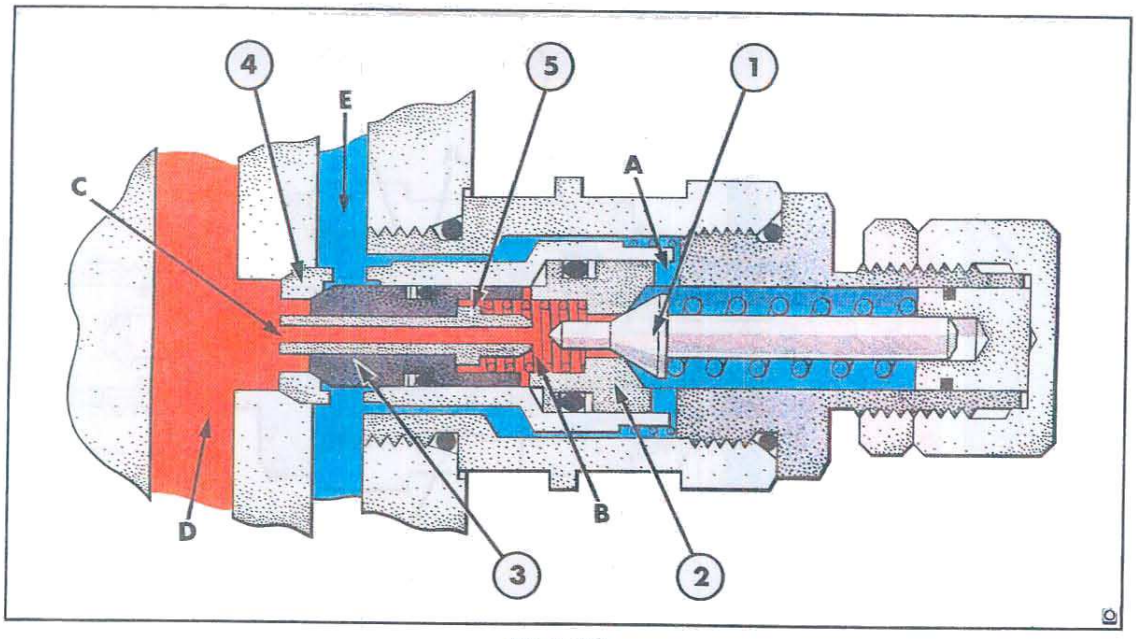

Figure 11
System Relief Valve – Sectioned View showing Valve not subjected to Overload conditions

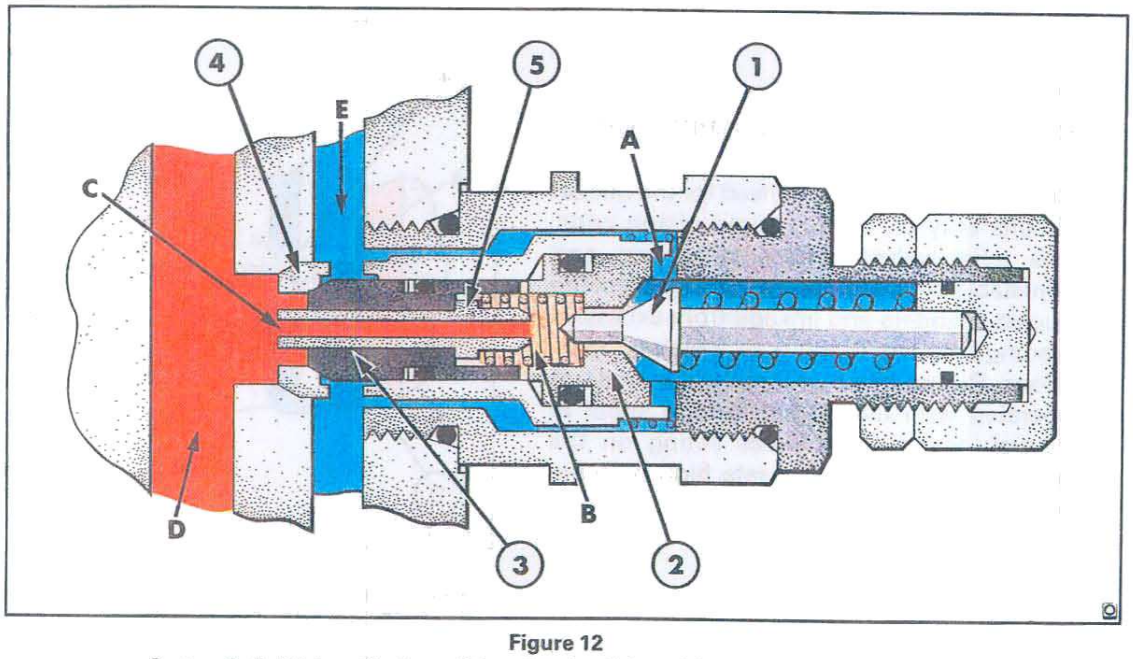

Figure 12
System Relief Valve – Sectioned View showing Valve with Initial Pilot Valve Opening

High Pressure Oil Reduced Pressure Oil Exhaust/Reservoir Oil

1. Pilot Valve
2. Pilot Valve Body
3. Poppet Valve
4. Sleeve Poppet
5. Exhaust/Reservoir Oil

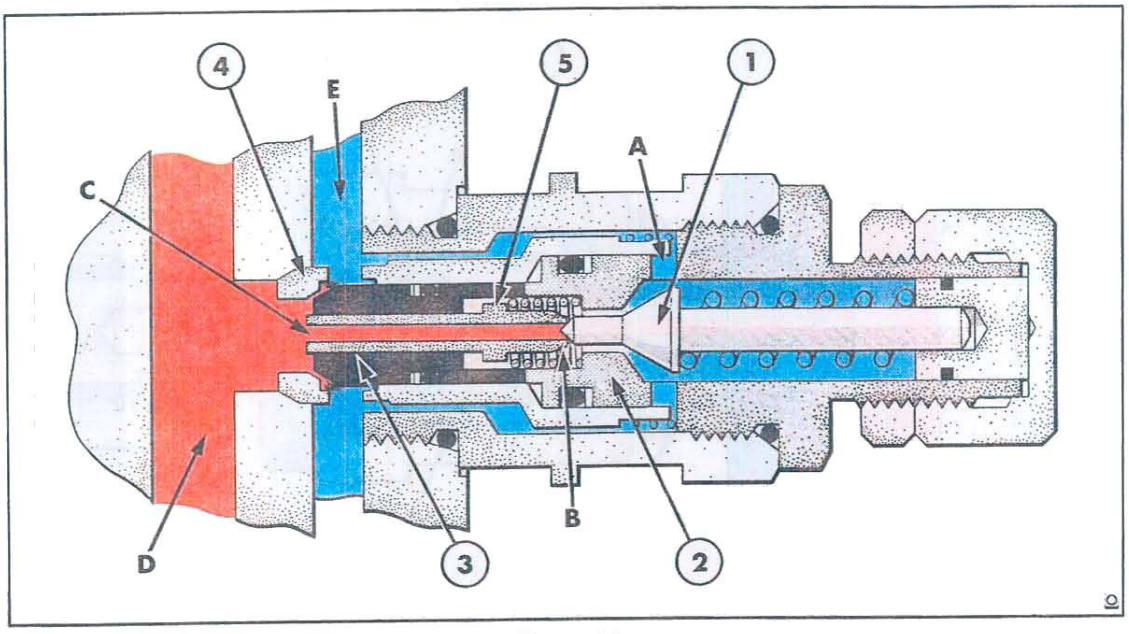

Figure 13
Circuit Relief Valve – Sectioned View showing Valve fully relieving High Pressure Oil

High Pressure Oil | Reduced Pressure Oil | Exhaust/Reservoir Oil

1. Pilot Valve
2. Pilot Valve Body
3. Poppet Valve
4. Sleeve Poppet
5. Piston

CIRCUIT RELIEF VALVE OPERATION

Circuit relief valves are utilised for the bucket circuits only on both rod and piston ends. The relief valves are direct acting and adjustable by shims. They serve to protect the bucket cylinders and linkage from excessive loadings during digging or grading operations. During these operations the loader is operated with the bucket section spool in neutral, any outside forces acting on the bucket cylinder would create high pressure within one end of the cylinder.

If an obstruction is encountered, for example during grading, and the generated pressure in the cylinder exceeds the circuit relief valve setting, the valve will open and allow oil in cylinder port 'A' to flow to exhaust gallery 'B', Figure 14. This will then protect the cylinder and linkage from damage.

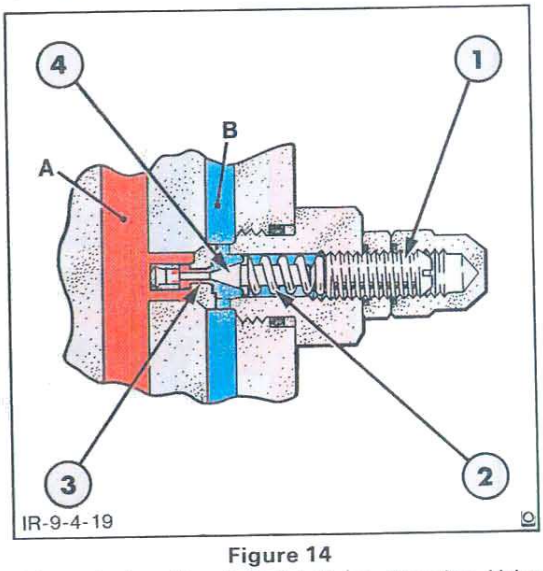

Figure 14
Direct Acting Circuit Relief Valve Showing Valve Subjected to Overload Conditions

High Pressure Oil | Exhaust/Reservoir Oil

1. Valve Pressure Adjusting Screw
2. Spring
3. Relief Valve Seat
4. Relief Valve Poppet

B. LOADER CONTROL VALVE – OVERHAUL

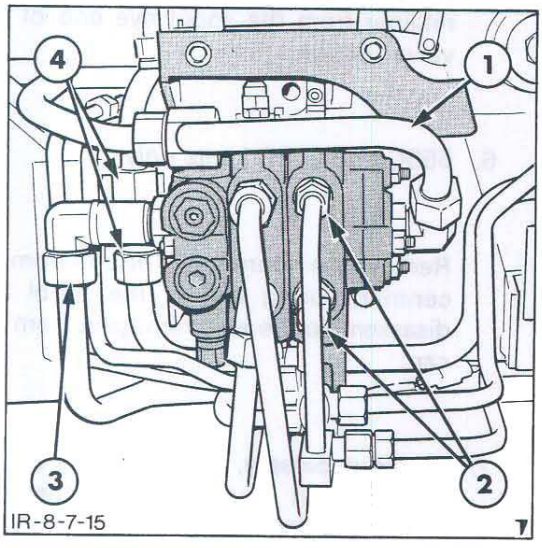

Figure 15
Loader Control Valve Tube Connections

1. Power Beyond
2. Cylinder Feed and Return
3. Inlet
4. Return to Reservoir

REMOVAL

1. Lower the loader to the ground. Retract the backhoe lift cylinder and position the dipstick in the vertical plane with the base of the bucket positioned firmly on the ground.

2. Stop the engine and relieve any residual pressures in the backhoe and loader circuits by moving all control levers throughout all planes of movement.

3. Disconnect the battery.

4. Remove the vehicle steps and sheet metal surrounding the control valve.

5. On 555C and 655C vehicles, disconnect the return to dig connector on the bucket valve section.

6. Disconnect and remove the tubing directly connected to each loader valve section, Figure 15.

7. Disconnect and remove the power beyond tube connected to the outlet end cover.

8. Disconnect the inlet tube and return to reservoir tubes at the inlet end cover.

9. Disconnect the control valve linkage at each valve section.

10. Remove the four bolts securing the valve assembly to the loader subframe and withdraw the assembly from the vehicle.

DISASSEMBLY

The valve spools are selectively fitted to the respective sections and are not serviced separately. If a spool or valve section requires replacement, the complete section must be renewed.

Equally important is the installation of plugs in the ports of the valve assembly to prevent the entry of dirt and foreign material.

Before any disassembly, the valve should be thoroughly cleaned externally with a suitable solvent.

1. To aid re-assembly use a suitable marker pen to draw a diagonal line across the face of the valve sections.

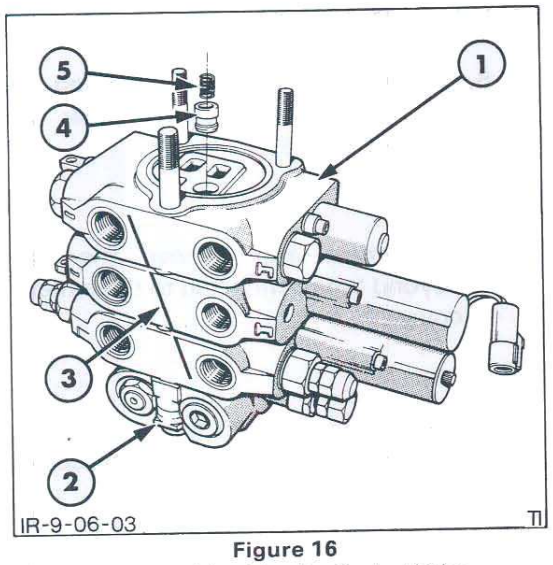

Figure 16
Disassembly of Loader Control Valve

1. Valve Section
2. Inlet End Cover
3. Diagonal Alignment Line
4. Check Valve Poppet
5. Check Valve Spring

2. Remove the nuts from the tie rods on the outlet end cover.

3. Separate the control valve by removing one section at a time, beginning with the outlet end cover. After removing a section remove the check valve spring and poppet, Figure 16. Place the sections on a clean surface in the order of removal.

LOADER BUCKET VALVE SECTION

With reference to Figure 17.

1. Remove the circuit relief valves.

2. Remove the centring spring cap retaining screws and remove the cap.

3. Withdraw the spool and centring spring assembly from the valve section.

4. Remove the retainer and 'O' ring seal from the centring spring end of the valve section.

5. Remove the seal plate retaining screws, seal plate, spacers, wiper seal 'O' ring and retainer from the spool eye end of the valve section.

6. 555C and 655C Units only:

   Remove the return to dig button from the centring spring end of the spool and disassemble the electromagnet from the cap.

7. Where necessary, clamp the eye end of the spool in a vice and unscrew the centring spring retainer and separate the spring and spring seats from the spool.

LOADER LIFT VALVE SECTION

With reference to Figure 18.

1. Remove the centring spring cap retaining screws and remove the cap.

2. Withdraw the spool and centring spring assembly from the valve section.

3. Remove the retainer and 'O' ring seal from the centring spring end of the valve section.

4. Remove the seal plate retaining screws, seal plate, wiper seal and 'O' ring from the spool eye end of the valve section.

5. Where necessary clamp the eye end of the spool in a vice and unscrew the centring spring assembly, taking care to retrieve the detent balls, poppet and spring from within the end of the spool.

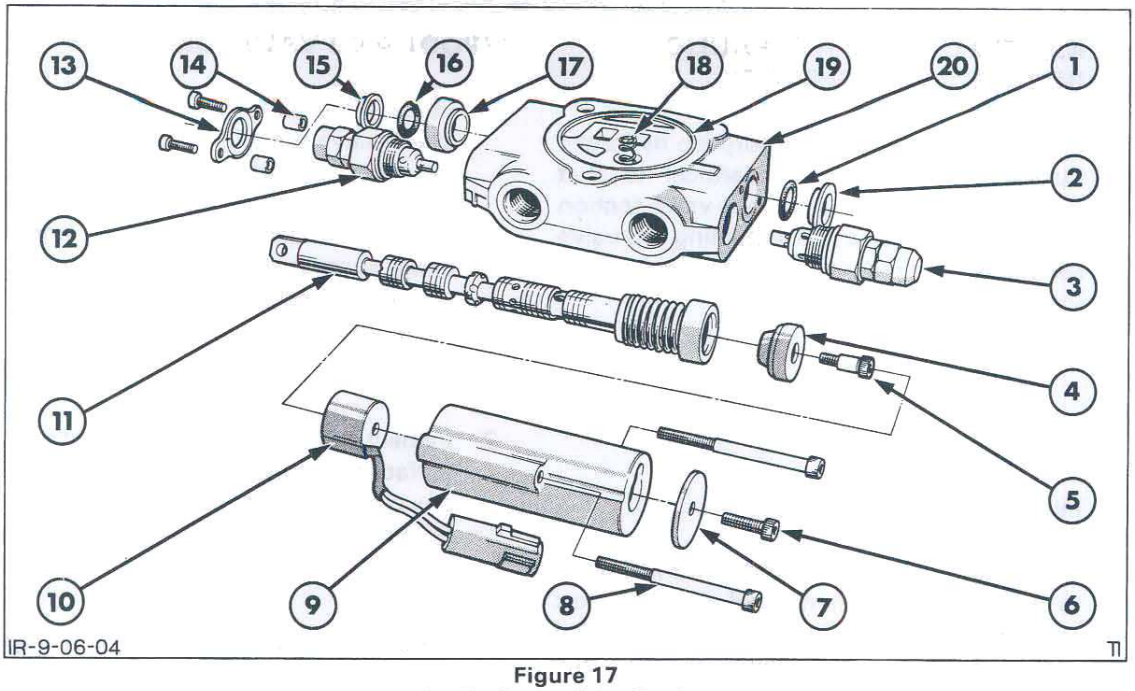

Figure 17
Loader Bucket Valve Section

1. 'O' Ring
2. Retainer
3. Circuit Relief Valve
4. Return to Dig Button
5. Screw
6. Screw
7. Washer
8. Screw
9. Cap
10. Electromagnet
11. Spool Assembly
12. Circuit Relief Valve
13. Seal Plate
14. Spacer
15. Wiper Seal
16. 'O' Ring
17. Retainer
18. Check Valve and Spring
19. 'O' Ring
20. Valve Housing

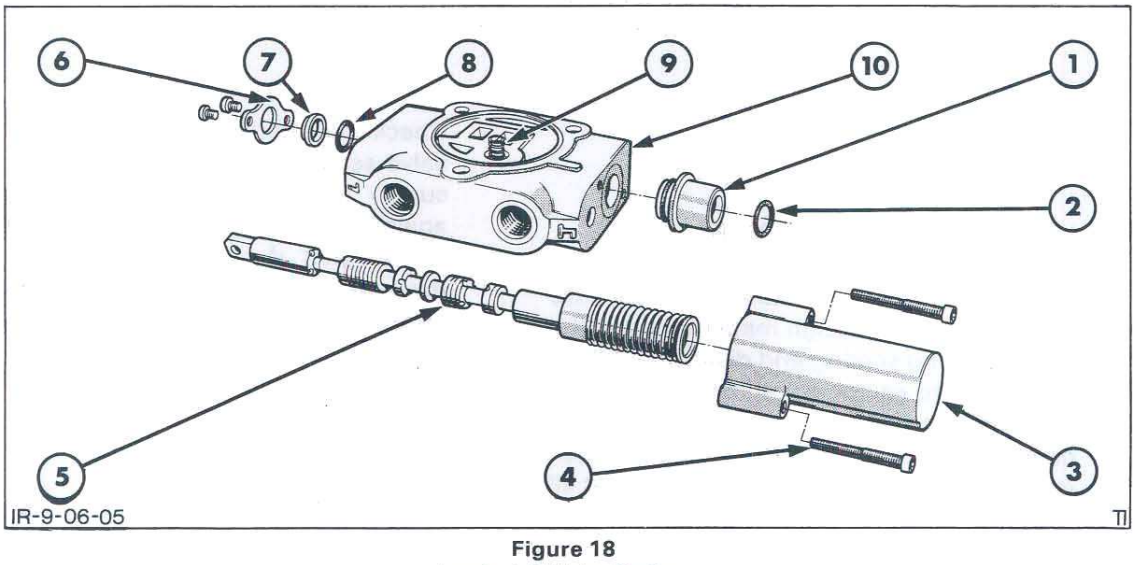

Figure 18
Loader Lift Valve Section

1. Retainer
2. 'O' Ring
3. Cap
4. Screw
5. Spool Assembly
6. Seal Plate
7. Wiper Seal
8. 'O' Ring
9. Check Valve and Spring
10. Valve Housing

MULTI-PURPOSE HYDRAULIC BUCKET VALVE SECTION

Disassembly of the multi-purpose hydraulic bucket valve section is identical to that described for a typical backhoe valve section and where reference in overhauling this valve section is required, refer to Chapter 4 of this Part.

INLET END COVER

Disassembly of the inlet end cover is limited to removal of the system relief valve test port plugs and the large 'O' ring valve section face seal. No further explanation on this component is therefore required.

OUTLET END COVER

There are no components in the outlet end cover and therefore requires no disassembly.

INSPECTION AND REPAIR

The majority of valve failures occur because of dirt and other foreign matter entering the valve, causing scoring and distortion. Minor imperfections can be corrected by using fine abrasive emery cloth, or fine lapping compound. Exercise extreme care when abrasive materials are used to assure that all particles are removed from the valve body.

Before inspecting parts, thoroughly clean all components in a suitable solvent, flush all passages in the valve sections and dry using compressed air.

SPOOL AND VALVE SECTIONS

1. Inspect the valve body bores and load check valve seats for evidence of scoring or other distortion, paying particular attention to the condition of the highly finished surfaces in the spool bores. If deep scores, casting impefections, or serious pitting is observed, discard the valve section.

2. Inspect the spools for wear, badly fitted surfaces, distortion and other damage. If any of these defects are apparent, discard the valve section and its matched spool.

   Remove any paint or rust from the highly finished surface of the spool with fine abrasive.

3. Inspect the centring spring components for cracks, burrs or damage. Discard any parts which are damaged.

4. 555C and 655C Units only:

   Check the electromagnet on the bucket valve section by applying a 12 volt DC supply and placing the electromagnet against the return to dig button. Replace the magnet if it does not develop a magnetic field and hold the button securely.

SYSTEM AND CIRCUIT RELIEF VALVES

The system and circuit relief valves are serviced as assemblies.The assembled units are pre-set for pressure. However, they should be tested prior to installation on the unit. External 'O' rings and back-up rings are serviced individually.