BACKHOE VALVE OPERATION

The backhoe valve is referred to as an "open center, parallel circuit, valve." As the name implies, the valve has one circuit clear through the center of the valve (Circuit 1A). It has a tributary circuit running parallel to it that dead ends against the end section (circuit 1B), see Figures 5 and 6.

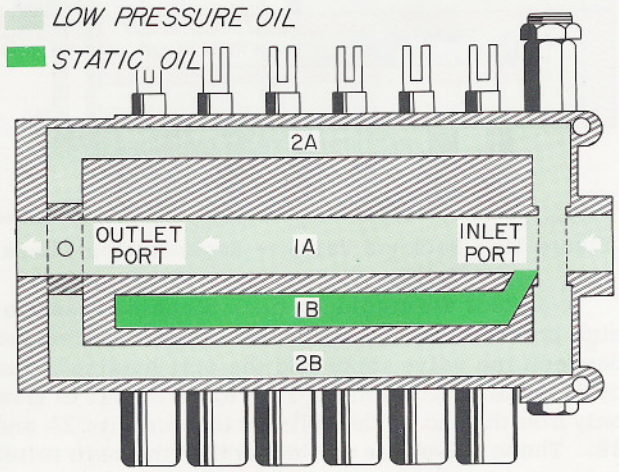

Figure 5 - Backhoe Valve Circuits

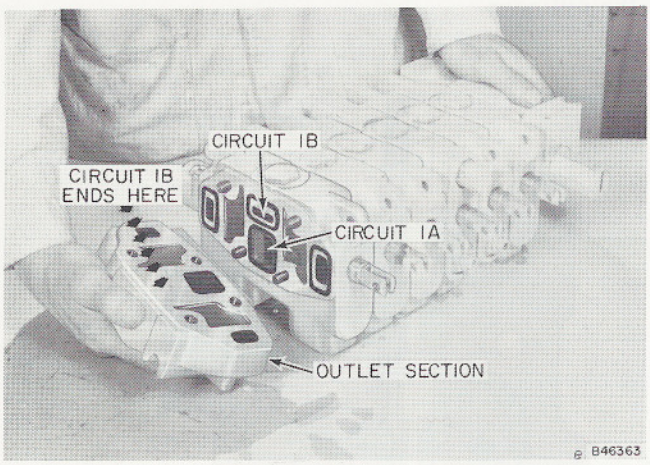

Figure 6 - Backhoe Valve Circuits

The open center parallel circuit valve provides oil to each valve section through circuits 1A and 1B. When a spool is actuated, circuit 1A is blocked off to the following sections. However, circuit 1B is also charged with oil and supplies oil to each succeeding valve section, see Figure 7.

When succeeding spools are pulled, the cylinder with the least resistance will move first and continue to move until it meets more resistance than other cylinders that are actuated. When spools are open to cylinders of the same resistance, both cylinders will move. Example: The stabilizers spools are at opposite ends of the backhoe valve bank. When both spools are pulled, both stabilizers will retract at the same time. However, if a man stands on one stabilizer pad, the opposite cylinder will move until it bottoms out. Then, the remaining cylinder will retract.

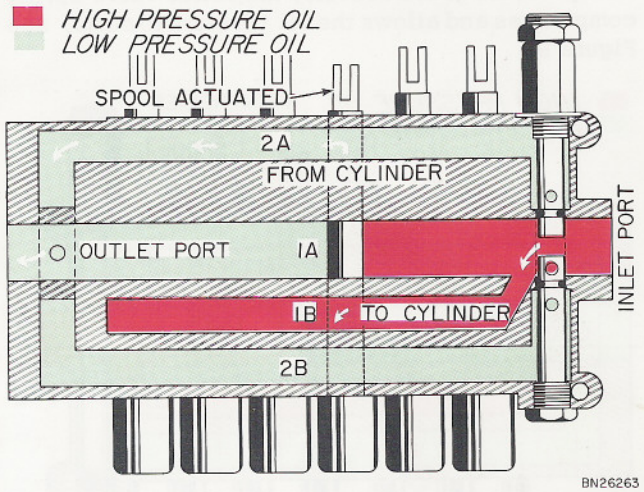

Figure 7 - Backhoe Valve Oil Flow Spool Actuated

MAIN RELIEF VALVE AND REGENERATION CIRCUIT

The valve has an additional circuit — the relief valve (Circuit 2A) and regeneration circuit (Circuit 2B), see Figure 8.

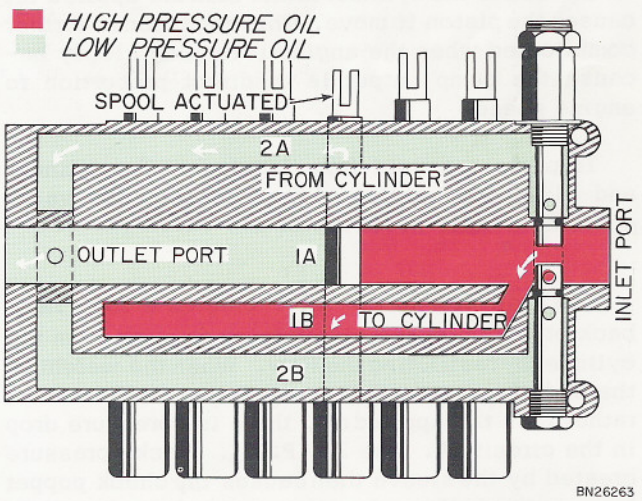

Figure 8 - Main Relief Valve and Regeneration Check Valve Circuit

When a spool is actuated in either direction, the oil is diverted out through a port of the valve to operate a cylinder as follows. Circuit 1A is closed by the spool and the oil from the pump flows through circuit 1B and out a port of the valve to the cylinder. If the valve continued to receive oil from the pump and the cylinder was unable to move (bottomed or held by a load), some part of the hydraulic system would break.

To prevent this, a relief valve circuit (Circuit 2A) has been added to the valve. When the pressure of the oil being supplied by the pump reaches the specified pressure (1800 P.S.I.), the relief valve spring compresses and allows the oil to return to sump, see Figure 9.

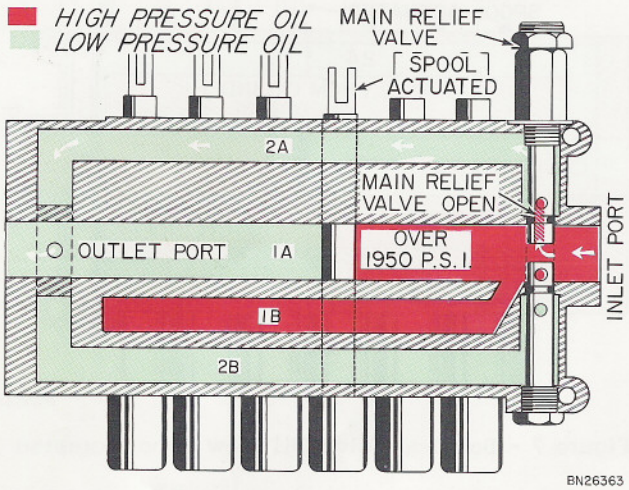

Figure 9 - Backhoe Valve — Main Relief Valve Circuit

When a cylinder is being actuated, oil from the opposite end is being returned via the relief valve circuit (2A) or the regeneration circuit (2B). If the cylinder movement on the applied side is faster than the pump can keep up with, a void is created in the applied side. This condition occurs when a weight on the end of the cylinder rather than the applied oil causes the piston to move. This condition is further complicated when the engine is running slowly because the pump output is in direct proportion to engine speed.

To prevent a void from forming in the cylinder and slowing the action of the Backhoe, the valve contains a built-in restrictor and check valve.

The restrictor in the valve creates a 200 P.S.I. back pressure on the oil returning to sump from the cylinder by restricting the flow. When the weight on the end of the cylinder causes the piston to move rather than the applied oil, there is a pressure drop in the circuit 1A. The 200 P.S.I. back pressure created by the sleeve then causes the check poppet to unseat and allows the oil returning from the cylinder to flow into circuit 1A to augment the pump output, see Figure 10.

HIGH PRESSURE SECONDARY RELIEF VALVES FOR DIGGING CYLINDERS

As one of the digging cylinders is actuated (boom, crowd, or bucket) when digging, "mechanical" pressure may be applied against one or both of the other cylinders. "Mechanical" pressure is created by the piston being forced against a solid column of oil when the spool is in neutral.

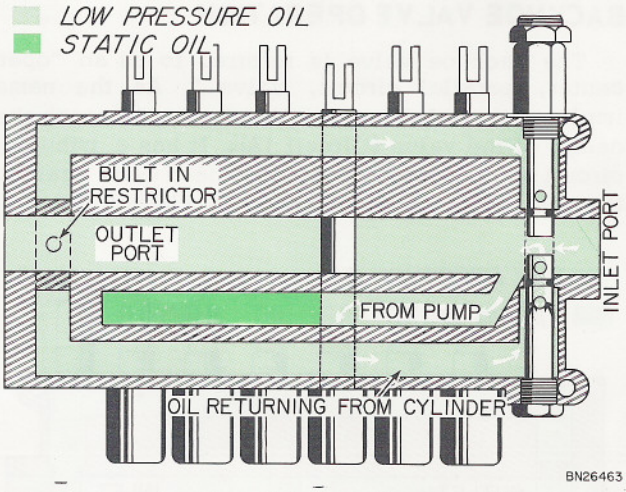

Figure 10 - Backhoe Valve — Regeneration Check Valve

To protect the digging cylinders against damage, high pressure secondary relief valves are located between the valve spool and the port leading to the cylinder to be protected. They allow the oil to flow only from the end of the cylinder into circuits 2A and 2B. These valves are set higher than the main relief valve and have a small orifice which allows the oil to bleed off slowly to prevent a sudden collapse of the cylinder.

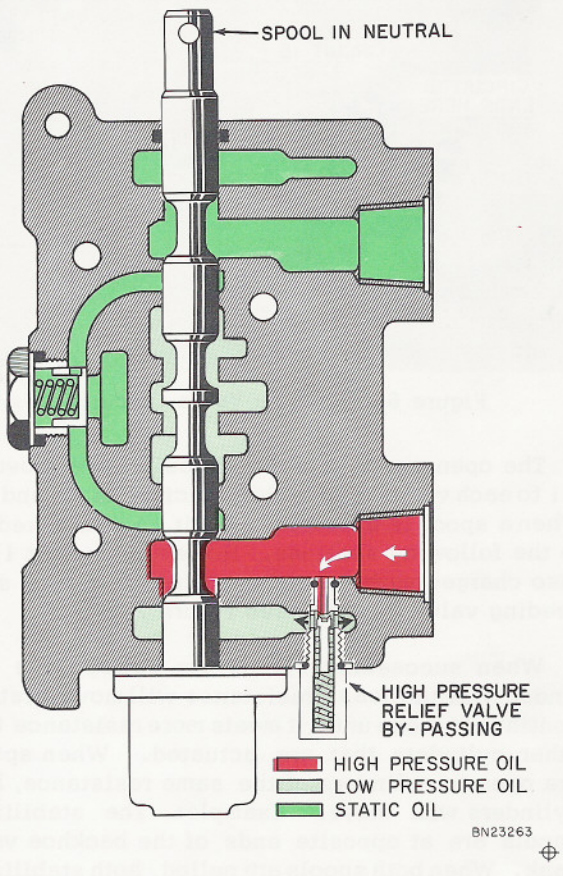

Figure 11 - High Pressure Secondary Relief Valve Actuated

LOW PRESSURE SECONDARY RELIEF VALVE FOR BOOM DOWN PRESSURE

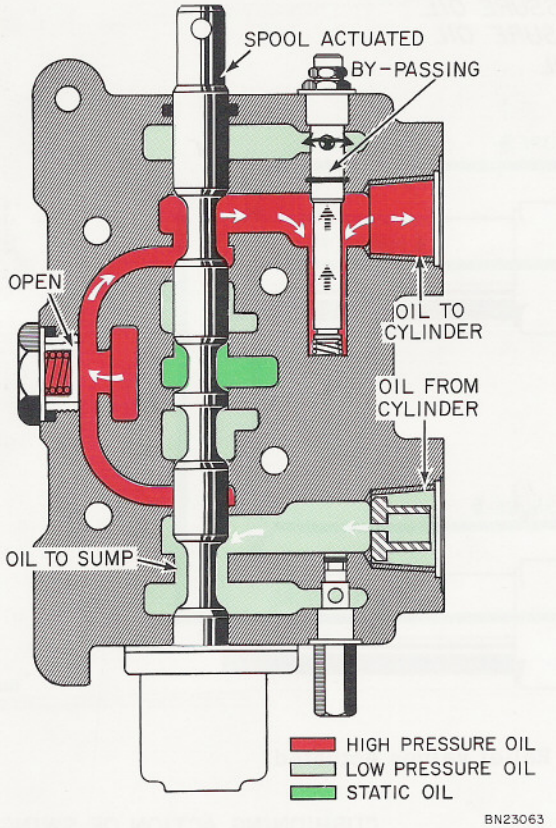

Figure 12 - Low Pressure Secondary Relief Valve Actuated

This relief valve has a dual-purpose: (1) While the boom is being lowered under hydraulic pressure, the relief valve will open when the specified pressure is reached, thus protecting Backhoe from damage; (2) As the dipper arm and bucket are being retracted while digging, under certain operating conditions pressure will be placed on the boom, tending to force it upward. The same relief valve will open, allowing the boom to raise.

LOW PRESSURE SWING CRISS-CROSS RELIEF VALVES

As the boom is swung from side to side and the control pedal is returned to neutral, the relief valve will open, allowing oil to transfer to the opposite swing circuit and avoiding abrupt stopping of boom. When the boom is swung against the stops with the control pedal held down or when excessive force is applied against the direction of the swing, these relief valves will by-pass, diverting oil back to the sump, see Figure 14.

HIGH PRESSURE SWING RELIEF VALVES

Under certain conditions, the geometry of the swing cylinders is such, that as the boom is swung from side to side and the pedal is returned to neutral position, more oil is displaced by one cylinder. The relief valve then opens allowing excess oil to return to sump through circuit 2A and 2B, see Figure 15.

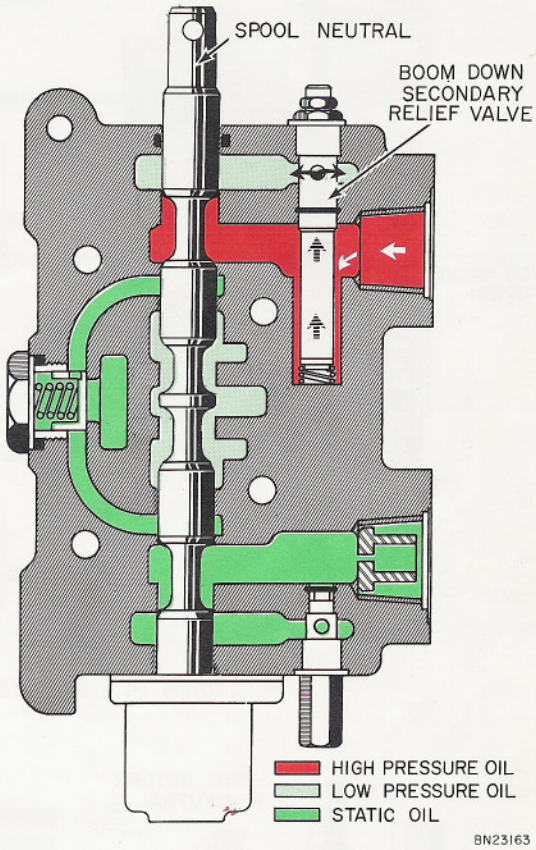

Figure 13 - Low Pressure Secondary Relief Valve Actuated

LOAD CHECK VALVES

As a spool is actuated slightly, "feathered", the load may tend to force oil out of the applied side of the cylinder because the pressure supplied by the pump is not as great as that created by the load. To eliminate this, each spool has a load check valve. This is a one-way check valve which permits oil from the pump to flow into the cylinder, but keeps the oil from the applied side of the cylinder from flowing back through the valve, see Figure 12.

BACKHOE SWUNG TO LEFT WITH
SWING TOWER AGAINST STOPS

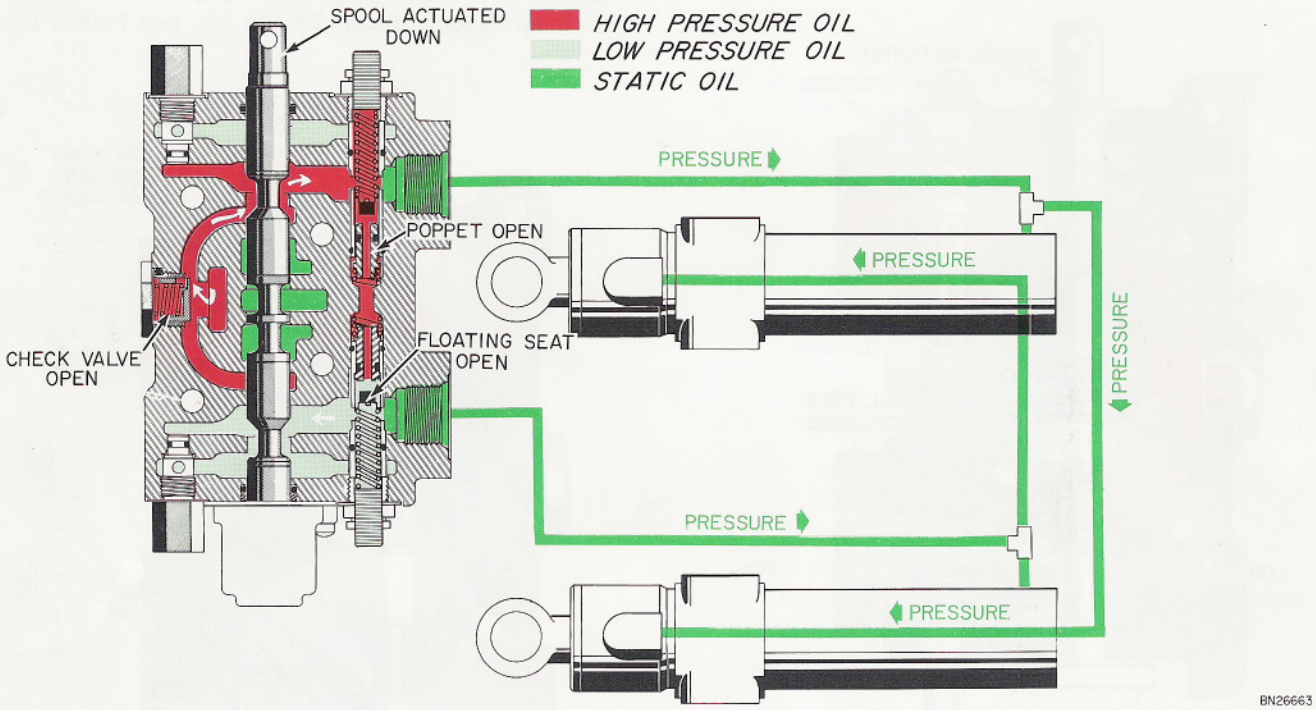

Figure 14 - Swing Criss-Cross Relief Valves Actuated

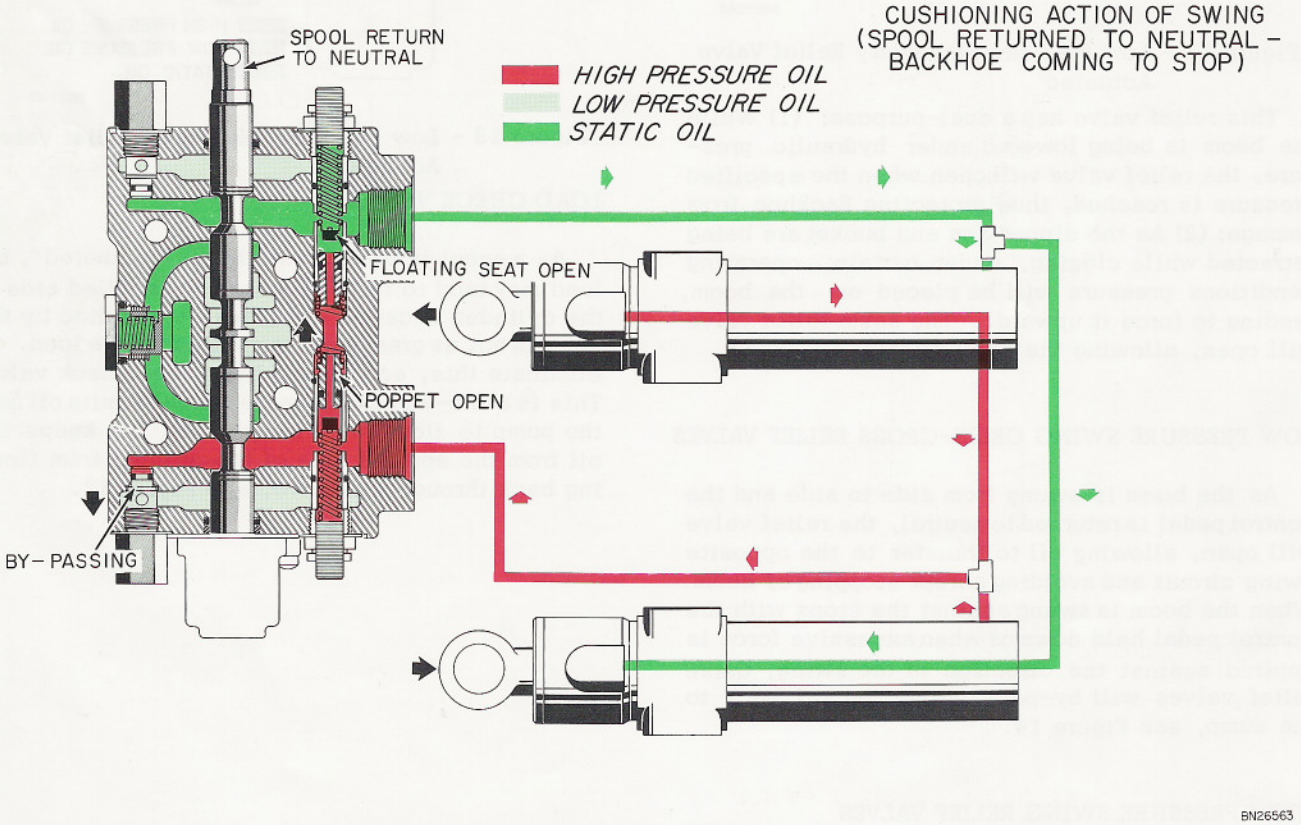

Figure 15 - Swing High Pressure Relief Valves Actuated