Tractor Model	ST 210 RC 210	ST 220 ST 251 ST 280 ST 310	PT 225 PT 250 PT 270	ST 320 ST 350	ST 225 ST 250 ST 270	PT 350	PTA 270	PTA 297	PTA 251 PTA 280 PTA 310	ST 280 ST 325 With Webster Pump	ST 450 ST 470 (#130)	PTA 280 PTA 325 With Webster Pump	ST 450 (#129)	ST 280 ST 325 With Commercial Pump	PTA 280 PTA 325 With Commercial Pump
Engine Model	Cat 3208	Cummins 855	Cat 3306	Cummins 903	Cat 3306	Cummins 903	Cat 3306	Cummins 903	Cummins 855	Cat 3406	Cummins KTA 1150	Cat 3406	Cat 3408	Cat 3406	Cat 3406
Maximum Pump Output GPM @ Idle No Load	7.1 - 830	11.3 - 830	12.2 - 830	10.5 - 830	12.2 - 830	10.5 - 830	12.2 - 830	10.0 - 830	11.3 - 830	12.4 - 830	15.9 - 830	12.4 - 830	13.9 - 830	12.5 - 830	12.5 - 830
Minimum Pump Output GPM @ Idle No Load	6.4 - 830	10.2 - 830	11.0 - 830	9.5 - 830	11.0 - 830	9.5 - 830	11.0 - 830	9.0 - 830	10.2 - 830	11.2 - 830	14.3 - 830	11.2 - 830	12.5 - 830	11.3 - 830	11.3 - 830
Minimum Pump Output GPM @ Idle 2250 PSI	4.3 - 830	8.5 - 830	9.1 - 830	6.3 - 830	9.1 - 830	6.3 - 830	9.1 - 830	7.5 - 830	8.5 - 830	9.3 - 830	11.9 - 830	9.3 - 830	10.4 - 830	7.5 - 830	7.5 - 830
Maximum Pump Output GPM @ Engine RPM No Load	23.9 - 2800	28.7 - 2100	32.4 - 2200	33.8 - 2600	32.4 - 2200	33.8 - 2600	32.4 - 2200	31.5 - 2600	28.7 - 2100	32.9 - 2100	38.9 - 2100	32.9 - 2100	35.2 - 2100	31.8 - 2100	31.8 - 2100
Minimum Pump Output GPM @ Engine RPM No Load	21.5 - 2800	25.8 - 2100	29.1 - 2200	30.4 - 2600	29.1 - 2200	30.4 - 2600	29.1 - 2200	28.3 - 2600	25.8 - 2100	29.6 - 2100	35.0 - 2100	29.6 - 2100	31.6 - 2100	28.6 - 2100	28.6 - 2100
Minimum Pump Output GPM @ Engine RPM 2250 PSI	19.1 - 2800	22.9 - 2100	25.9 - 2200	27.0 - 2600	25.9 - 2200	27.0 - 2600	25.9 - 2200	25.2 - 2600	22.9 - 2100	26.3 - 2100	31.1 - 2100	26.3 - 2100	28.1 - 2100	25.4 - 2100	25.4 - 2100
Main Relief Valve Setting PSI	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
Secondary Relief Valve	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250
Steering Circuit Relief Valve Setting PSI	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200
Accessory Solenoid Valve Relief Setting PSI	N/A	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Detent Release Setting PSI	2150	2150	2150	2150	2150	2150	2150	2150	2150	2150	2150	2150	2150	2150	2150
Minimum Control Pressure PSI @ Idle	150 - 830	150 - 830	150 - 830	150 - 830	150 - 830	150 - 830	150 - 830	150 - 830	150 - 830	150 - 830	80 - 830	150 - 830	80 - 830	150 - 830	150 - 830
Maximum Control Pressure PSI @ Engine RPM Flow Regulator Set At Maximum Flow	340 - 2800	270** - 2100	350** - 2200	350** - 2600	330** - 2200	460** - 2600	350** - 2200	430** - 2600	390** - 2100	340** - 2100	430** - 2100	450** - 2100	400** - 2100	320** - 2100	435** - 2100
Oil Temperature For All Testing (°F)	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
Reservoir Pressure Relief Setting PSI	5	Atmospheric	5	Atmospheric	Atmospheric	5	5	5	5	Atmospheric	5	5	5	Atmospheric	5
Steering Performance Time @ Seconds To Turn Lock To Lock	5.2 to 6.3	4.5 to 5.4	4.9 to 5.9	4.8 to 5.7	4.4 to 5.2	5.4 to 6.5	4.9 to 5.9	5.7 to 6.9	5.2 to 6.3	4.5 to 5.4	6.5 to 8.0 *See Note	5.0 to 6.0	7.3 to 9.0 *See Note	5.3 to 6.4	5.7 to 6.9
Flow Regulator Adjustment Range GPM Minimum & Maximum	7.2 to 8.8 18 to 22	7.2 to 8.8 18 to 22	7.2 to 8.8 18 to 22	7.2 to 8.8 18 to 22	7.2 to 8.8 18 to 22	7.2 to 8.8 18 to 22	7.2 to 8.8 18 to 22	7.2 to 8.8 18 to 22	7.2 to 8.8 18 to 22	7.2 to 8.8 18 to 22	11.2 to 13.8 22.5 to 27.5	7.2 to 8.8 18 to 22	11.2 to 13.8 22.5 to 27.5	7.2 to 8.8 18 to 22	7.2 to 8.8 18 to 22
Neutral Pressure At Steering Valve Exhaust PSI @ Idle (No Tank Pressure)	2 to 3 - 830	2 to 3 - 830	2 to 3 - 830	2 to 3 - 830	2 to 3 - 830	2 to 3 - 830	2 to 3 - 830	2 to 3 - 830	2 to 3 - 830	2 to 3 - 830	8 to 10 - 830	2 to 3 - 830	7 to 9 - 830	2 to 3 -830	2 to 3 - 830
Neutral Pressure At Steering Valve Exhaust PSI @ Engine RPM (No Tank Pressure)	5 to 7 - 2800	5 to 7 - 2100	7 to 9 - 2200	5 to 7 - 2600	5 to 7 - 2200	8 to 10 - 2600	7 to 9 - 2200	8 to 10 - 2600	7 to 9 - 2100	5 to 7 - 2100	15 to 20 - 2100	8 to 10 - 2100	13 to 18 - 2100	5 to 7 - 2100	8 to 10 - 2100

Figure 1:

***NOTE 1:** On ST 450 and 470 Models, steering performance at low engine speed is influenced by the flow regulator setting for the power brake booster. Ensure the regulator is adjusted according to the brake systems service manual before judging the remainder of the system.*

****NOTE 2:** Control pressures given are for tractors without oil cooling circuits. Cooling circuits will cause control pressures to increase. To overcome the possibility of a false reading, temporarily BY-PASS the cooling circuit according to the tractor's present plumbing arrangement as described below.*

A. On tractors where the flow regulator gives excess flow to the cooler--connect this line to the return manifold during the control pressure test.

B. When the tractor has the cooling circuit fed by the implement control valve exhaust, temporarily remove the check valve and route the exhaust flow into the return manifold.

C. If the tractor is equipped with a flow divider/solenoid valve type cooler, then adapt the inlet line of the flow divider to the flow regulator inlet port during the control pressure test.

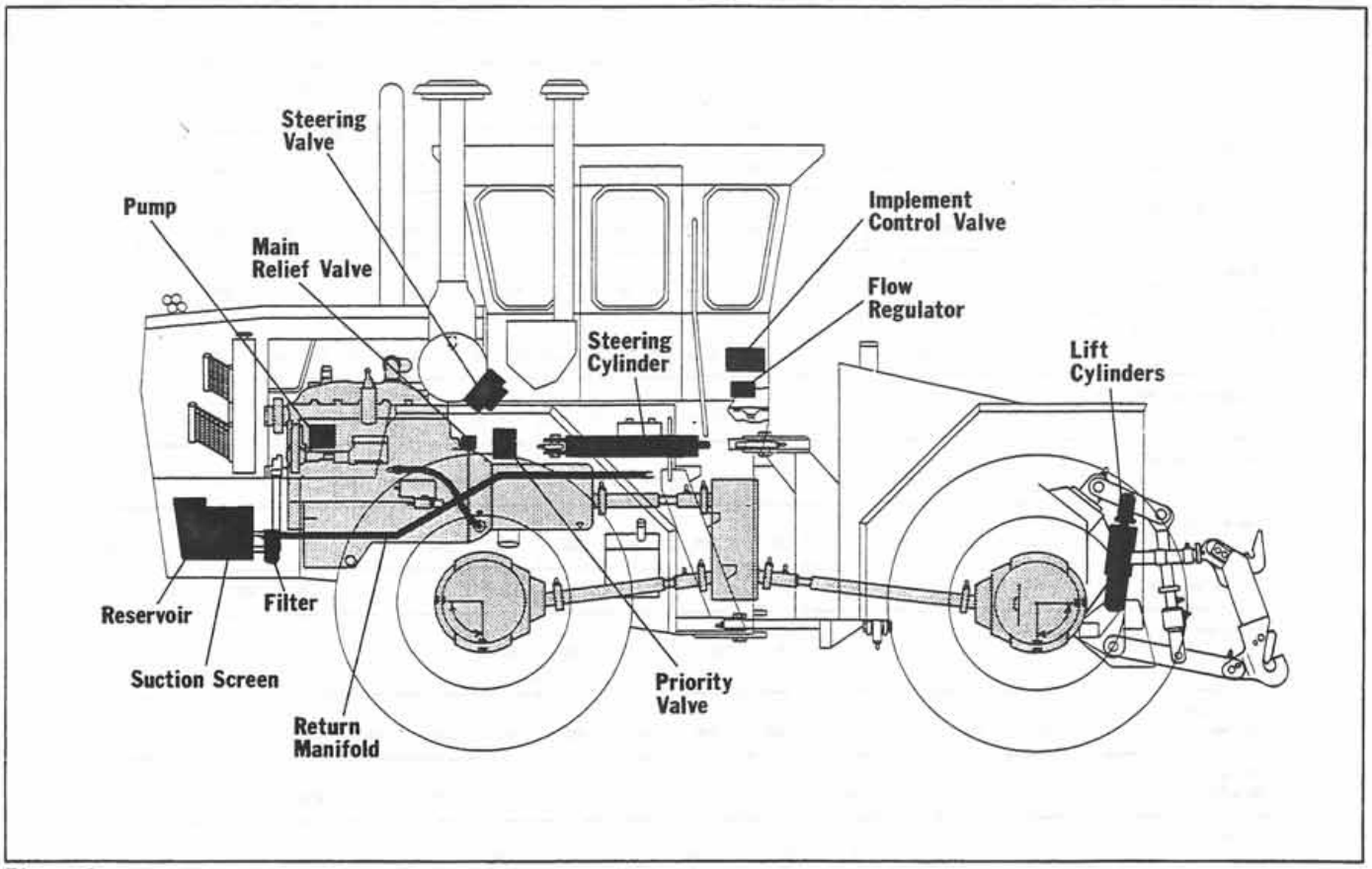

Figure 2:

In comparing hydraulic system performance data among these Steiger Series III tractors, you can see that performance properties such as volume (or flow) are affected by tractor model because of the various engines used. These specifications are to be used when evaluating system performance or used as a guide while troubleshooting performance complaints. As we continue, procedures will be given to show the correct methods to apply the specification data. (See Fig. 1)

Earlier we stated that "it's a good idea to know the system and be ready," and we described the system components in detail to give you a mental picture of system operation. Practical application of your knowledge will depend upon the degree of experience that you as an individual may already have. If you are not already familiar with the component location on the tractor, we suggest that you begin by giving this area some study at your first opportunity. (See Fig. 2)

Figure 3:

A good technician will stop and think as he approaches a malfunctioning hydraulic system. Your thinking processes won't all be alike, but experienced troubleshooters automatically follow some basic information gathering procedures before removing and disassembling components. "WORK SMART, INSTEAD OF HARD" would be a good motto to apply here! The proper approach will control the quality and cost of the job. (See Fig. 3)

Figure 4:

The first logical step, if possible, is to talk to the operator and attempt to determine the area in which the problem exists. Also consider the application the tractor is used in and ask how the operation was before in comparison to its present operation. If possible, have him operate the machine for you or operate it yourself. (See Fig. 4)

Figure 5:

More often than not the system will send out signals in the form of obvious and hidden clues. Your senses of sight, smell, hearing and touch are telling you something, whether you are aware of it or not. Use those senses as tools to help interpret the problem before you resort to the tools in your toolbox! (See Fig. 5)

Visually inspect the entire system. It's worth the small amount of time spent to check reservoir oil levels, condition of the oil during operation, oil color, even leakage or oil stains on painted surfaces. Watch fluid lines also. Check for rubbing, kinks and distortion. Observe hydraulic action. If hoses or cylinders show surging or jerky motion, the origin must be found and remedied. (See Fig. 6)

Figure 6:

Listen to the sounds emitting from the hydraulic system. Make a mental comparison of how the system should sound, or if possible, compare it with a system that is in proper order. You should be listening for shock waves, rattling or a combination of grinding and howling. In certain cases hissing or high-pitched whine can be heard. Most of the time pump starvation, aeration, cavitation, overloading or valve malfunctioning will produce the noises described here. (See Fig. 7)

Figure 7:

Soon after starting a cooled down system, touch various parts of the system to make sure there are no hot spots or abnormal vibration. A restriction or a great pressure drop can cause oil temperatures to rise to a point where oil oxidation occurs, thus reducing the lubricating ability of the oil and hardening of rubber parts. Vibration, on the other hand, can ruin fine mechanical fits designed into the components where sealing is done, and shorten pump life. (See Fig. 8)

Figure 8:

Figure 9:

Smell the hydraulic oil. Try to determine if it is burnt. You may want to compare it with new oil of the same type and brand. (See Fig. 9)

Never make assumptions! Many times the detail that is not investigated is (at least partially) to blame. For example, do not assume that the reservoir has the proper level and type of oil.

The ART of troubleshooting is gradually acquired by following instructions and applying specifications. When following written instructions, don't read past a word you don't understand. Your imagination must be exercised so you can relate the symptom to the cause.

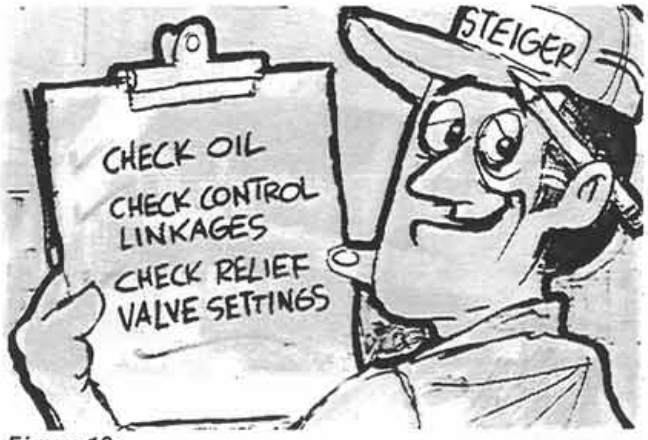

Figure 10:

Make a mental or written list of the possible causes according to the signs you found while inspecting the system. Try to get all the possibilities, since one failure usually leads to another due to the closely interrelated components. But, remember, you should first check those which are most likely and easiest. (See Fig. 10)

By now you should reach a decision based upon analyzing the information you have gathered, then TEST your decision before you begin repairing the system. Try to recognize in which parts of the system that functions were bad. For example, if all functions were faulty, a component common to all parts of the system (such as pump or main relief valve) could be faulty.

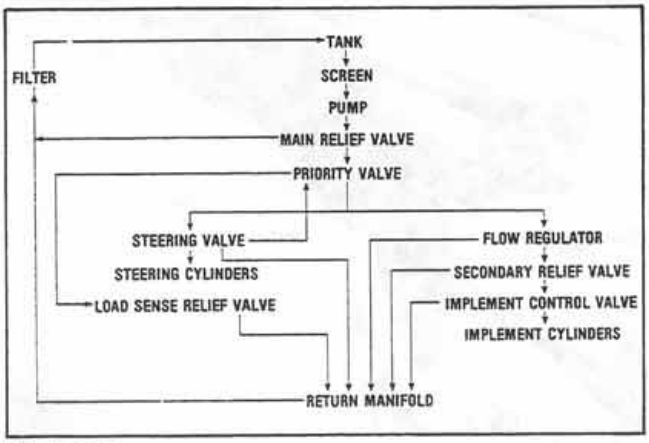

Figure 11:

However, if only a steering or an implement demand is suffering, then it deserves attention first to enable you to narrow your list down to a specific area of the system. (See Fig. 11)

The type of testing required depends upon the symptom. You may have to test each component in the area you believe is at fault, unless you can readily detect the proper cause. It would be impractical here to give every possible symptom and a test procedure for it, so instead test procedures will be given for each major component of the system. (See Fig. 12)

Before you begin any repair or test procedures, observe precautions which can help alert you to potential hazards.

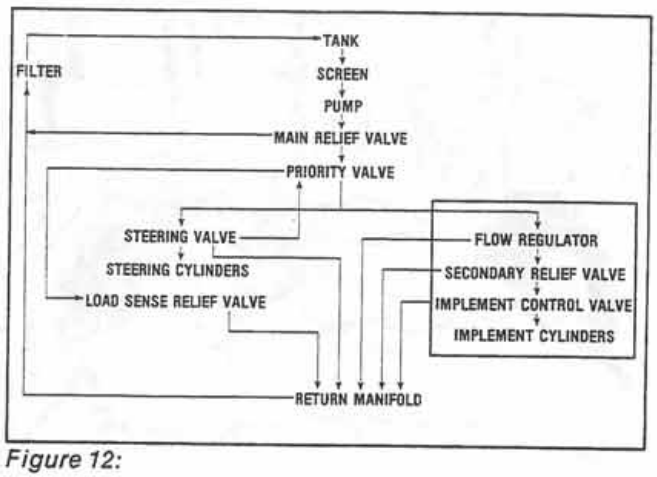

Figure 12:

Ensure proper control by keeping the linkages in proper adjustment. (See Fig. 13)

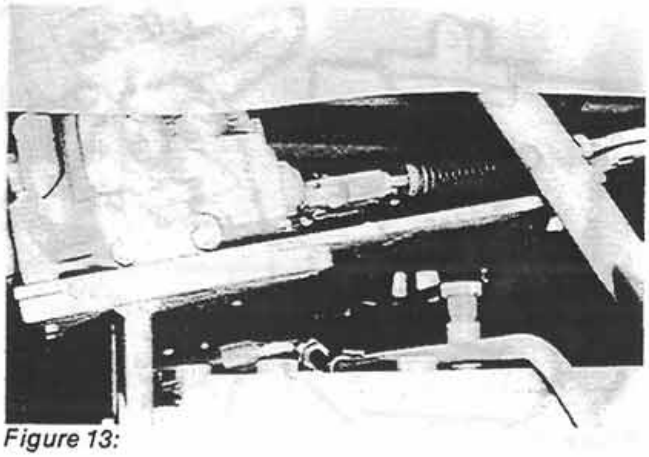
Figure 13:

Be sure all line connections are secure and that lines are not damaged. Fluid leakage is a fire hazard. (See Fig. 14)

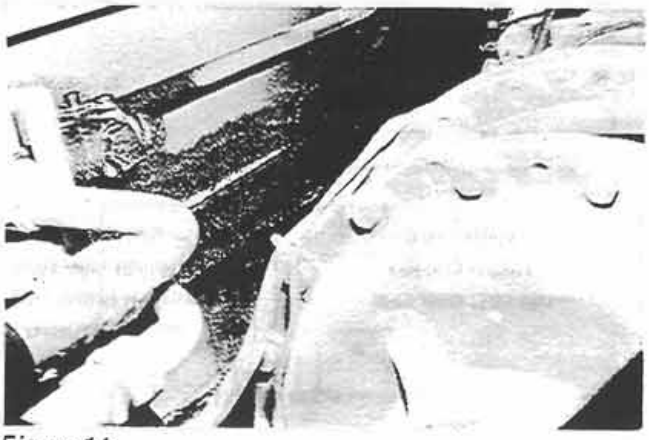
Figure 14:

Figure 15:

CAUTION: Oil escaping under high pressure can cause severe personal injury. Do not weld on any circuit which contains a confined fluid. Use cardboard to locate the leak if it is hard to find.

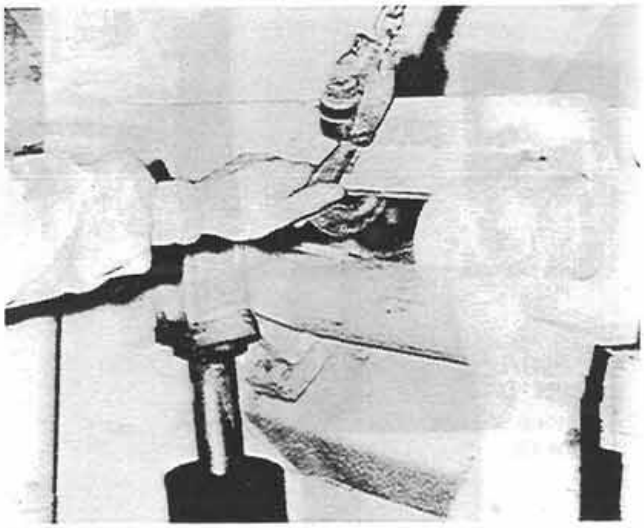

Figure 16:

When removing heavy components for service, provide a good means of support to avoid personal injury or damaged equipment. (See Fig. 16)

Figure 17:

CAUTION: Do not rely upon the hydraulic system to keep equipment raised. Such machinery must be lowered to the ground whenever it is unattended or before performing any service or maintenance.

CAUTION: Exercise caution when disconnecting any oil line. The pressure must be fully relieved to prevent a sudden discharge of oil.

WARNING: Use solvents intended for cleaning purposes when washing parts. Others may be hazardous to health or easily flammable.

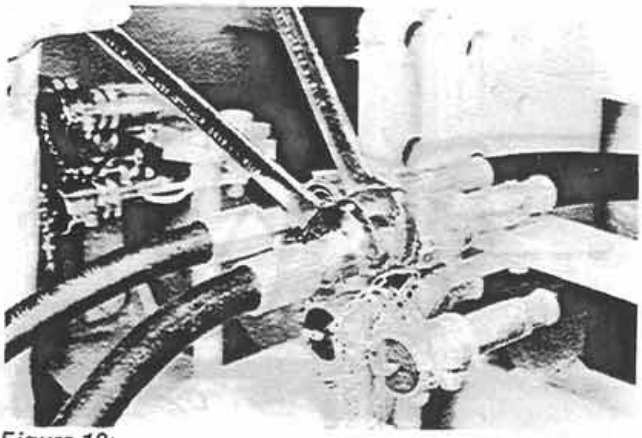

Figure 18:

If known defects exist in the system, correct them before operating the system. (See Fig. 19)

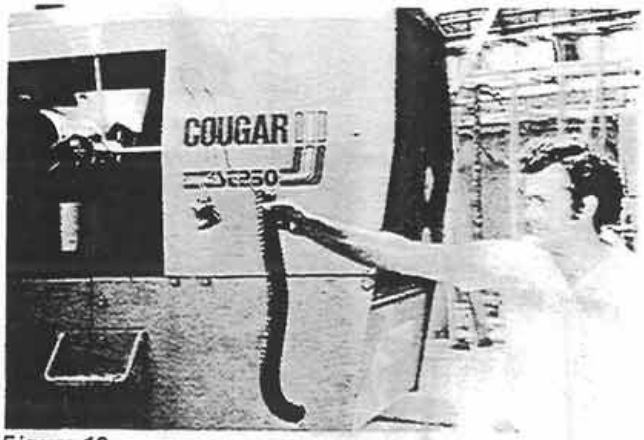

Figure 19:

The testing you do will be with instruments, such as pressure gauges or hydraulic analyzers, which are available in a test kit.

In some cases, however, preliminary operating checks can be effective to find trouble without using test instruments. It is also assumed that if any external leaks are present, they must be repaired before proceeding. (See Fig. 20)

WARNING: During all testing procedures, articulation locks or steering cylinder stops must be installed. Apply the park brake and place chocks under the wheels to prevent tractor movement.

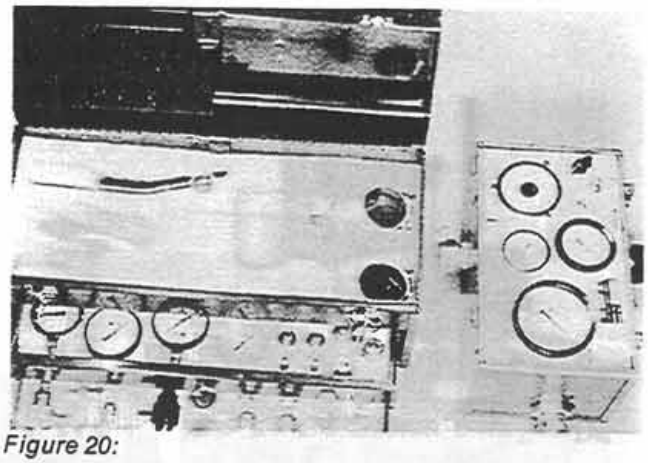

Figure 20:

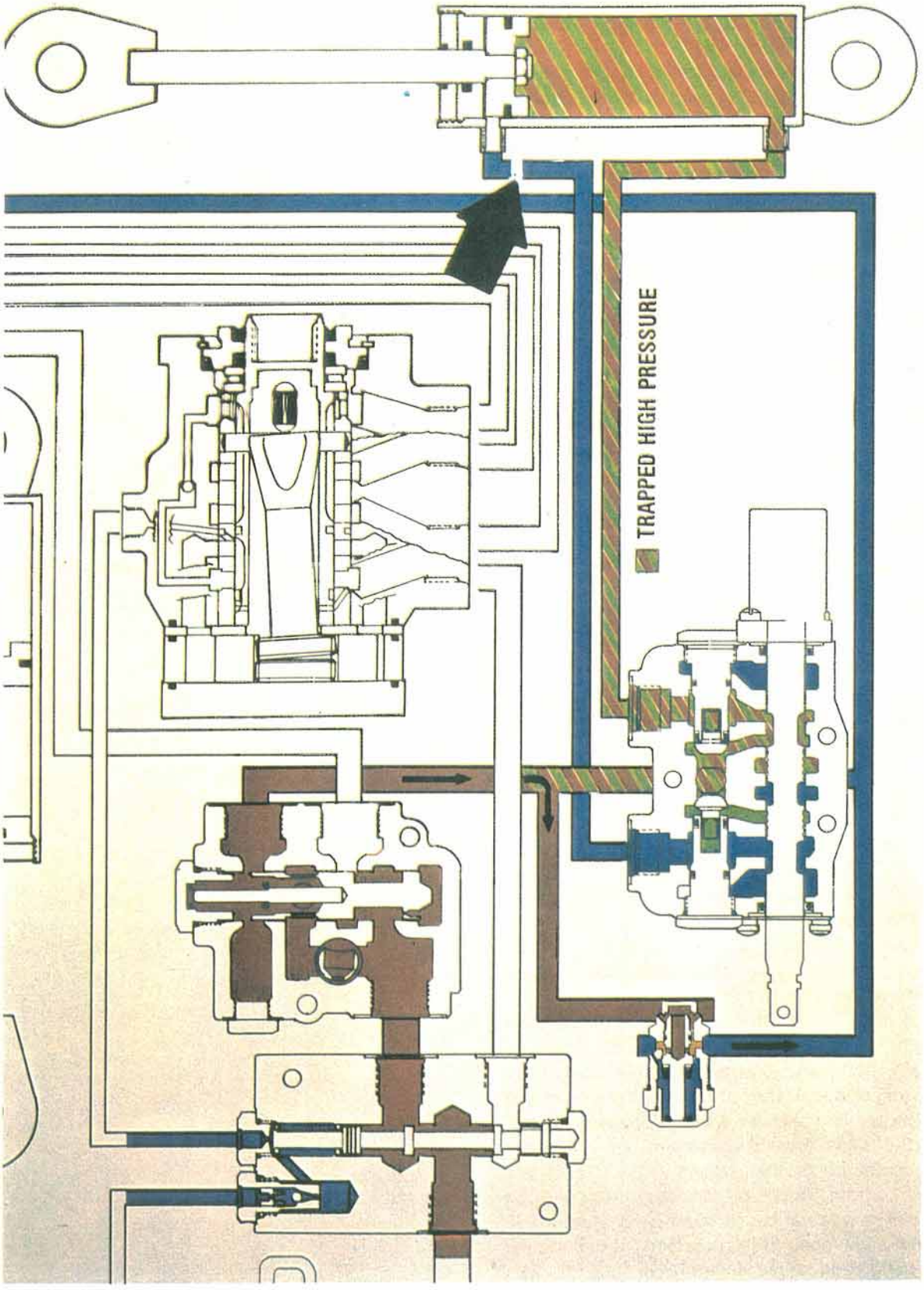

Figure 21:

If the complaint is implement settling toward the ground, the first item to check is the cylinder. On double acting cylinders, fully extend them while they are supporting a load, then stop the engine. Remove the hose from the end of the cylinder, which is not pressurized. Re-start the engine and apply pressure to the cylinder while watching the open port. If oil comes from the port, the piston seal is leaking and must be repaired. If no leakage was noted, retest the cylinder in the opposite direction since it may leak in only one direction at times. (See Fig. 21)

Be aware that merely disconnecting hoses at the quick couplers will not give signs of piston leakage, even if the cylinder is supporting a load. When the male coupler ends are separated from the coupler body, the check ball closes to trap the fluid. Fluid is confined in the cylinder and is theoretically noncompressible, so even if the piston seals leak, the piston rod would support the load. If such a condition exists, very high pressure is developed in both circuits of the cylinder. If these circuits were coupled to the tractor, the control valve section for that cylinder would also see the same pressure. This leads us to the next component. (See Fig. 22)

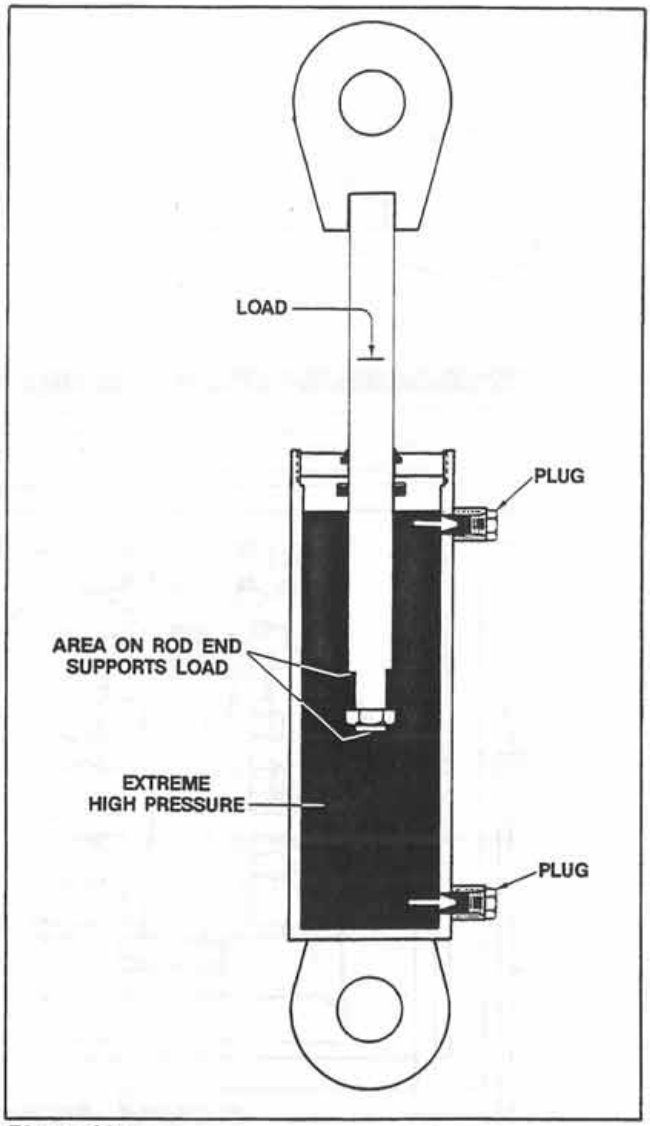

Figure 22:

When the cylinder has passed the previous test but the load still drops, there is leakage within the implement control valve. Usually it is more noticeable when the system has been operating and the oil is warm. Before checking any further, lower the implement to completely remove pressure from the cylinder circuits. On the control valve, remove the affected load check body and inspect the O-rings and back-up rings. If the O-rings are flattened, cracked or have lost their resiliency (or softness), they should be replaced. If the back-up rings are broken or have shrinkage, replace them. If the seals have washed out, or are gone, excessive pressure is the cause; while if they are cracked or brittle, high oil temperatures can be suspected. The original cause must be determined in order to make the repair life satisfactory. If the original parts were still good, reuse is permitted. (See Fig. 23)

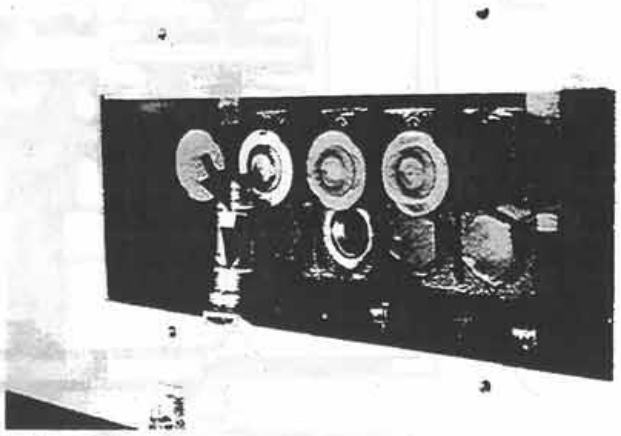

Figure 23:

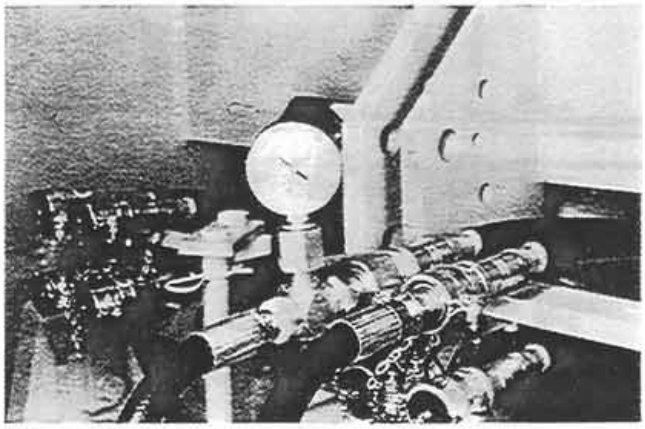

Figure 24:

After reinstalling the load check assembly, prepare for checking spool leakage on the affected valve section. Adapt a 0 to 3000 PSI gauge to the pressurized circuit, start the engine and fully extend the related cylinder to lift the implement off the ground. Then stop the engine and return the spool to neutral. (See Fig. 24)

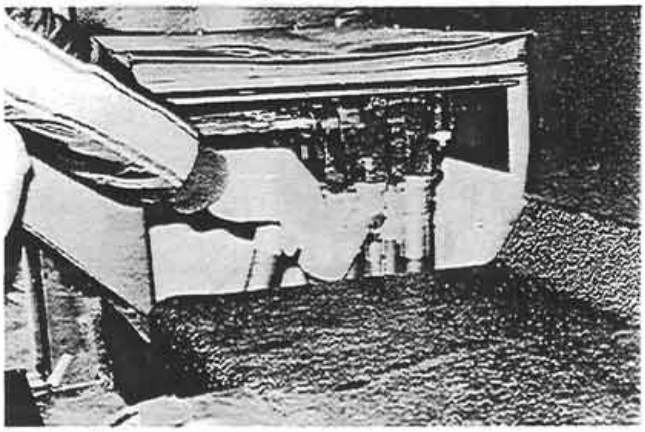

Figure 25:

Disconnect the hose from the return port of the inlet cover and check for leakage AFTER allowing existing oil to drain out. At the same time, observe cylinder movement. (See Fig. 25)

Figure 26:

A maximum spool leakage rate is established at 16 cubic centimeters (CC's) per minute at 1000 PSI pressure with 150 S.U.S. oil. If Steiger Hydraulic Fluid is used, the S.U.S. rating would be approximately 75 at 160°F. This means the fluid is only half as thick, so twice the leakage (or 32 CC's) is permissible. (See Fig. 26)

When the test is completed, connect the return hose to the valve and fully lower the implement. If the valve section had an acceptable leakage rate, it should remain in service. But, if the leakage was beyond specifications, a new valve section should be installed. To determine the cause of excess leakage, pull the spool from the valve body and inspect them both at all their mating surfaces. If the finish of the spool lands and housing bores have scratches, then oil contamination is the cause. (See Fig. 27)

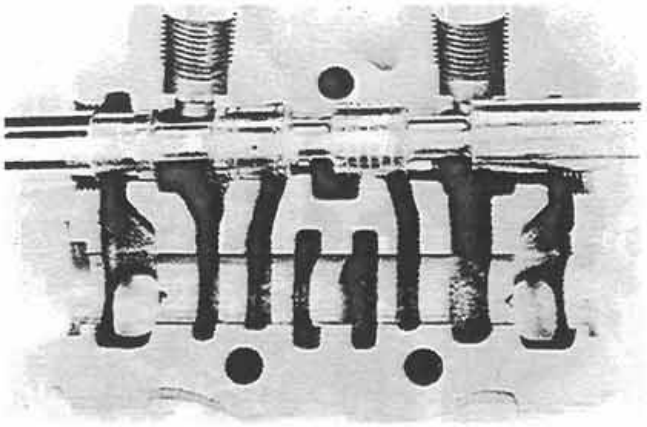

Figure 27:

But when the finishes of both the spool and housing are still good, the housing has been stretched or expanded in all directions because of excessive hydraulic pressure. Maybe a faulty cylinder or misapplication is the real cause. Each spool and housing are a matched set. Re-fitting the housing with another spool is not recommended. Replace as an assembly. (See Fig. 28)

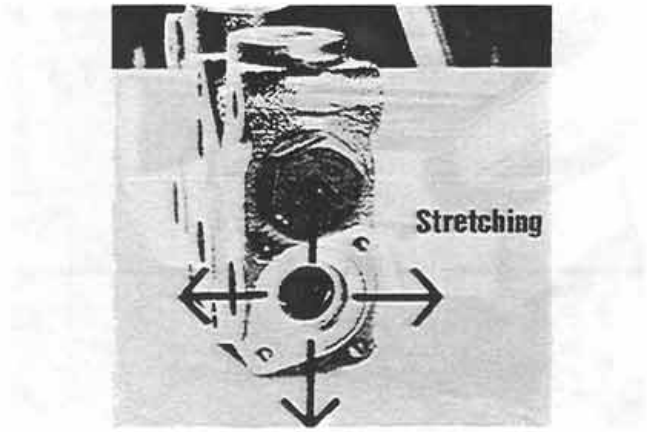

Figure 28:

One non-instrument test can be done on the pump. If engine oil is going into the hydraulic system, or vice versa, seal leakage of the pump drive shaft should be suspected. (See Fig. 29)

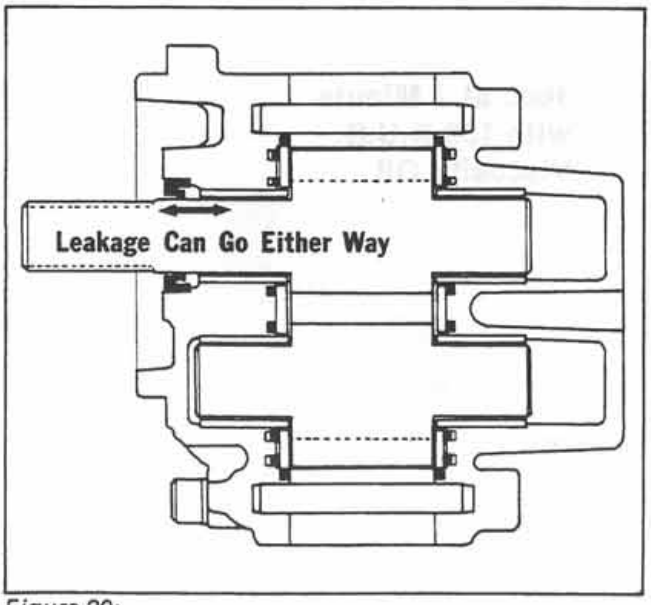

Figure 30: