TRANSMISSION AND TORQUE CONVERTER TROUBLESHOOTING

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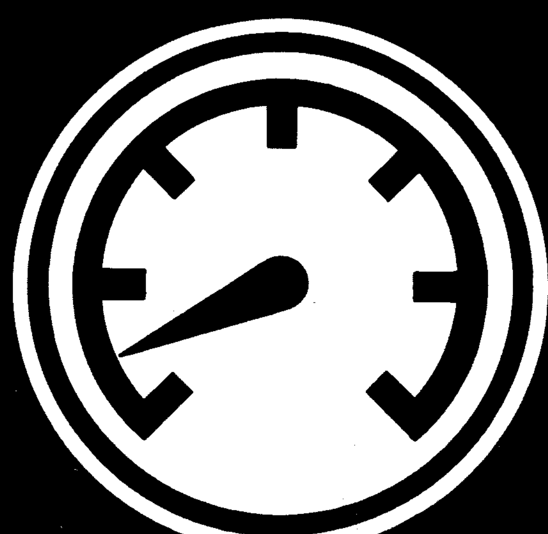
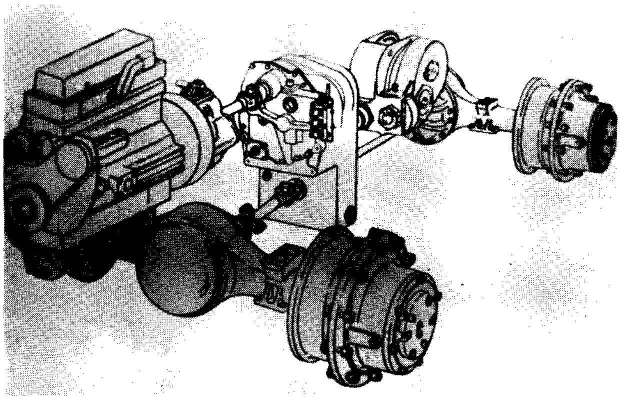


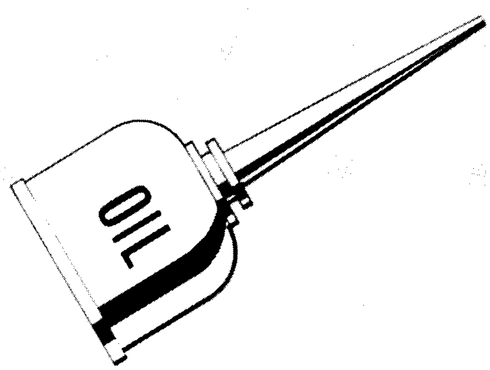
CLARK

Michigan Company

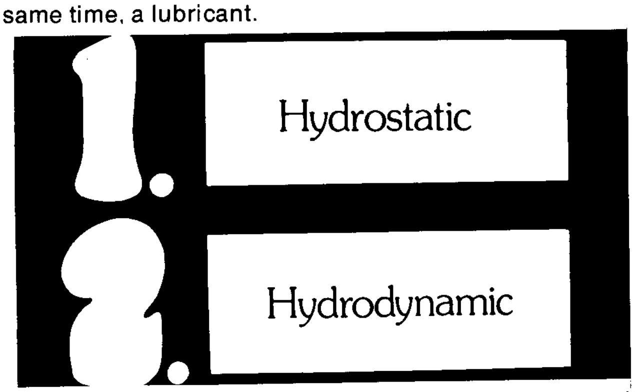
CLARK TRANSMISSION & TORQUE CONVERTER TROUBLESHOOTING THEORY MANUAL



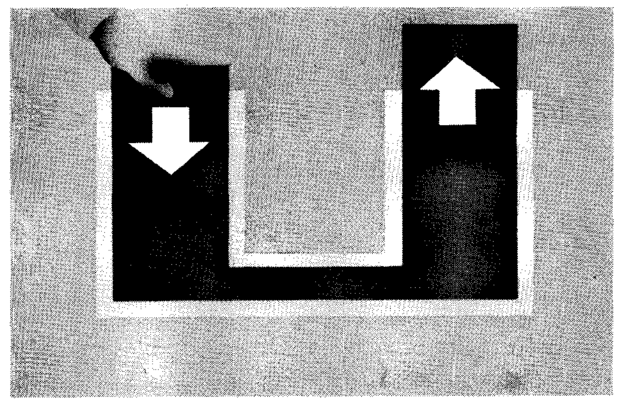
Most of us know about the parts, the engine, the torque converter, the transmission, axles, wheels, booms, buckets, and winches. But often we forget the basics of how they work together and why they are put together the way they are. We want to get down to basics again, and explore the function of one major part of the power train. The Hydraulic System.



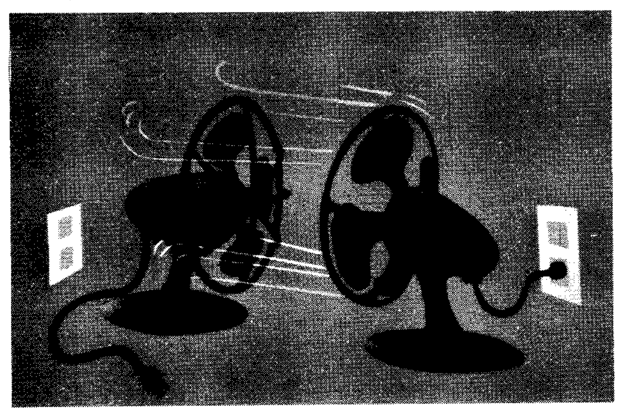
A hydraulic system of any kind is designed to utilize fluid to transmit power from one source to another, to perform useful work. Oil is the fluid most commonly used because it is practically non-compressible and it is at the same time, a lubricant.



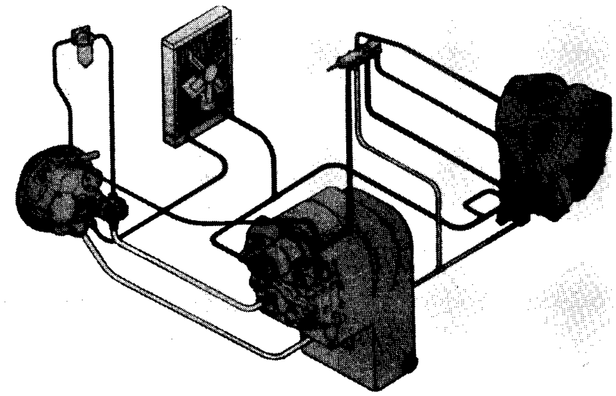
A hydraulic system simply is the use of fluid to transmit hydrostatic or hydrodynamic energy.



The principle of hydrostatic energy is that a confined liquid will transmit pressure and is used for transmission and implement controls.

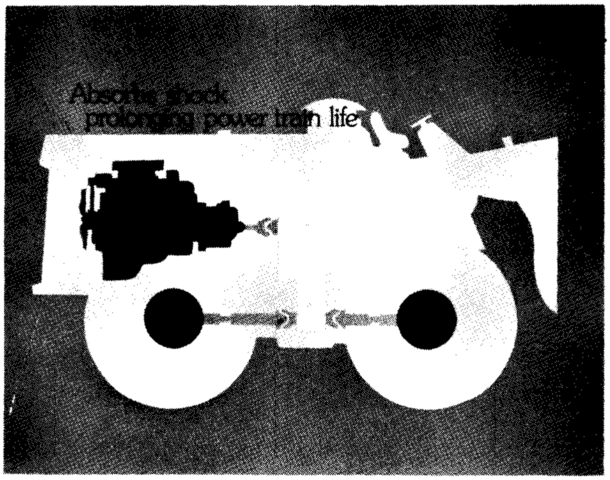


Hydrodynamic systems work on the principle that a fluid in motion has force. For instance, if you look at two fans facing each other and one is plugged in, the other is not, you would see that the electrically driven blades were forcing air toward the blades of the unplugged fan. This flow of air has force which makes the blades of the unplugged fan rotate.

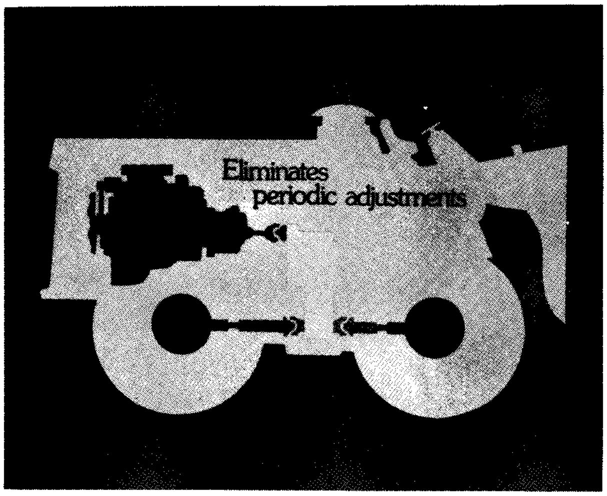


Hydraulics is one of the most efficient, versatile, and simple ways of transmitting power known to man.

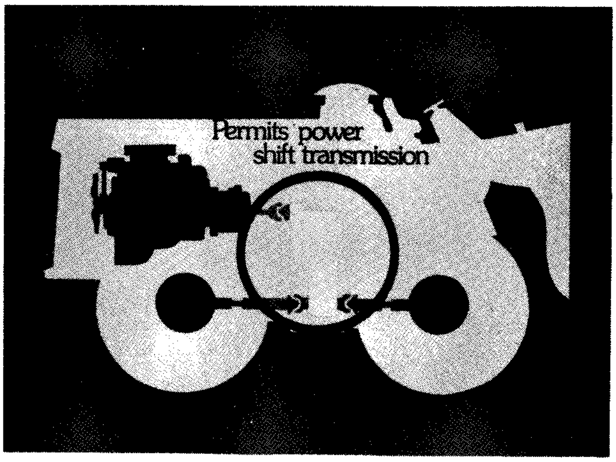
1.5M 849 CGAC



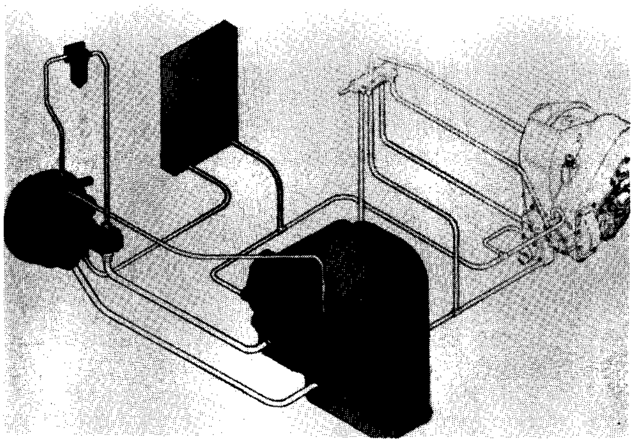
They absorb shock between the source of power, the engine, and the other mechanical drive line components. This prolongs powertrain life.



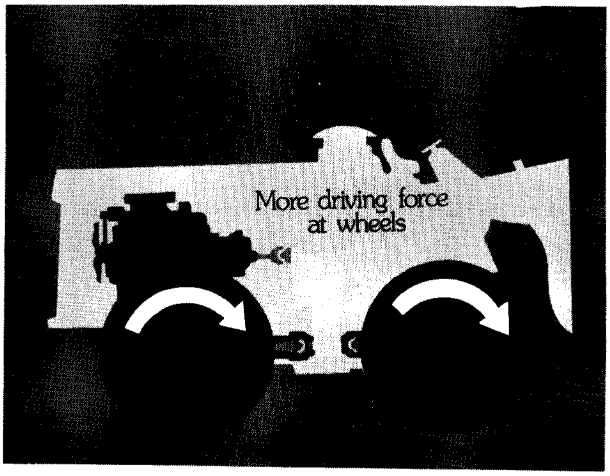
They eliminate periodic adjustments.



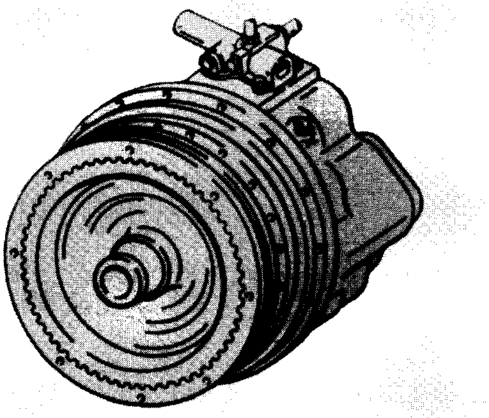
Hydraulics also allows the use of a powershift transmission which can permit quick gear changing even under load.



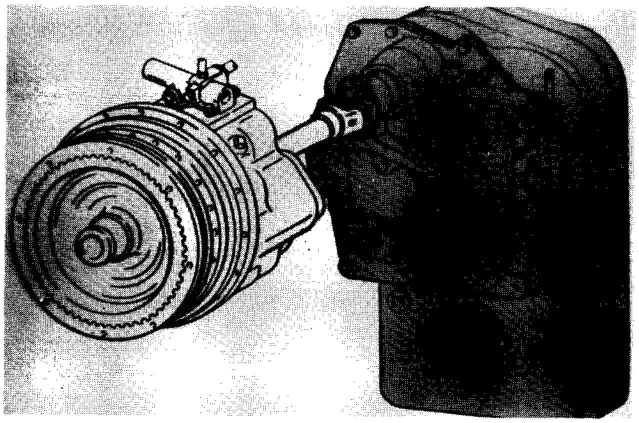
Here is a converter and transmission hydraulic system.



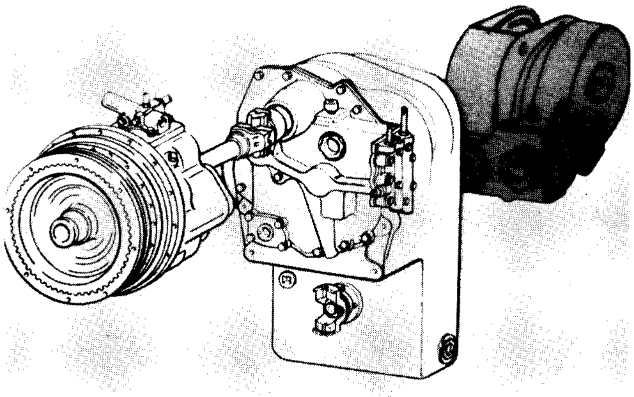
They multiply torque and deliver power smoothly which results in more driving force at the wheels.



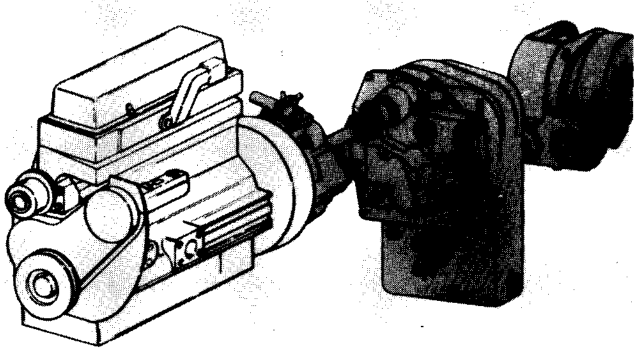
The main components are the torque converter,



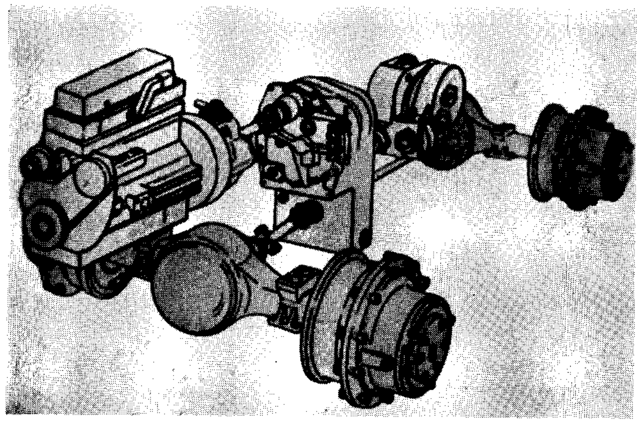
The transmission,



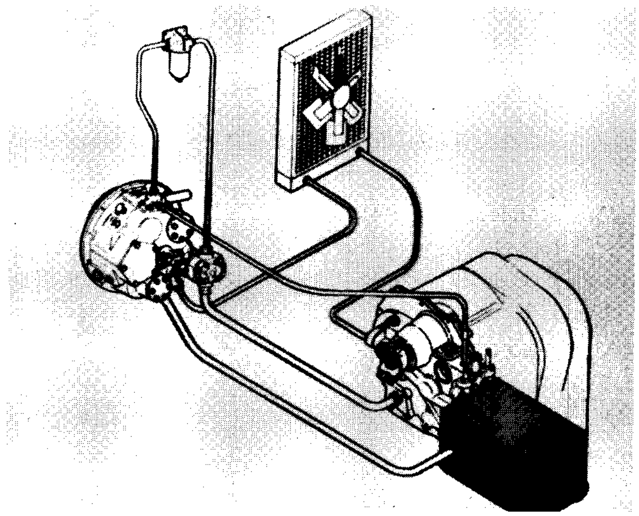
The winch (where applicable),



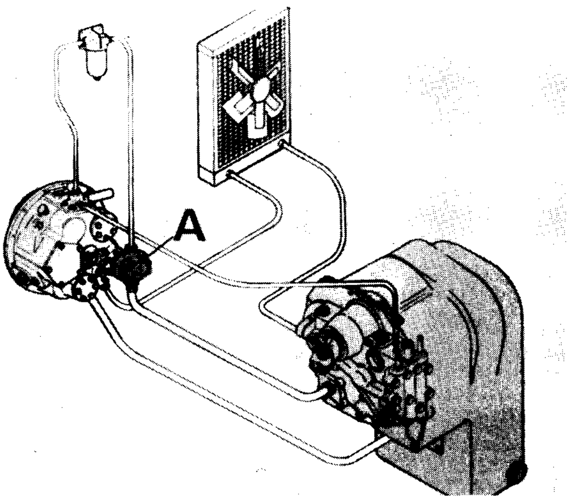
the engine (although not part of the hydraulic system, is the main source of power),



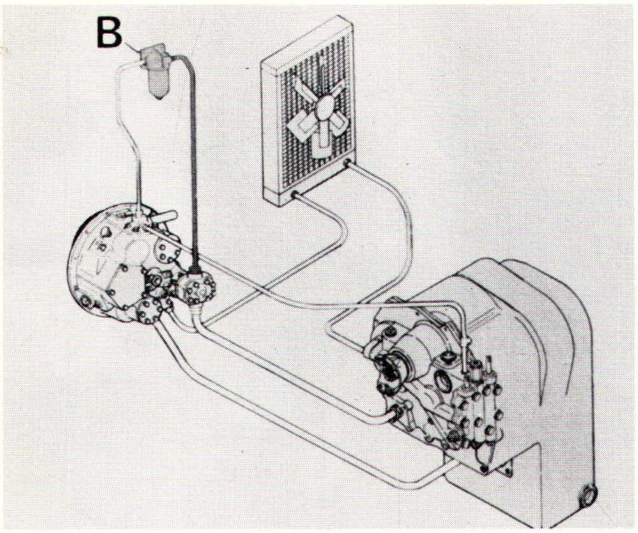
and the axles (again not part of the hydraulic system), completes the power transfer.



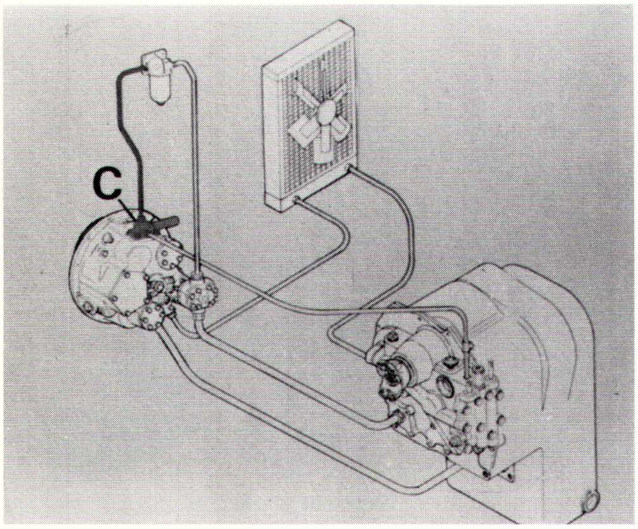
The supply of hydraulic fluid for this system is the sump, located in the transmission.



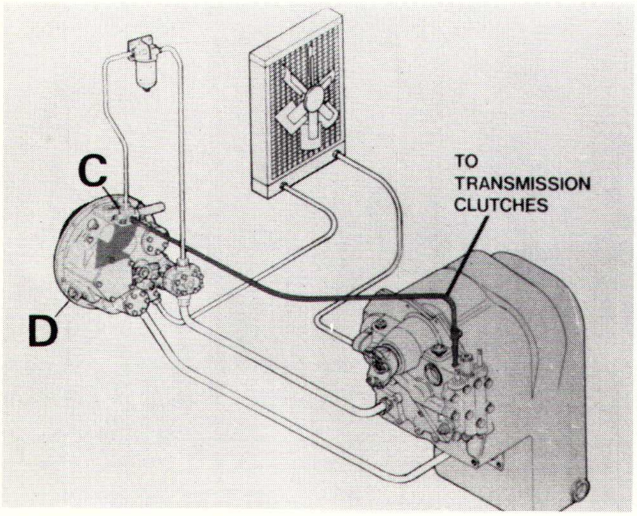
A charging pump "A," is used to deliver oil flow through the system.



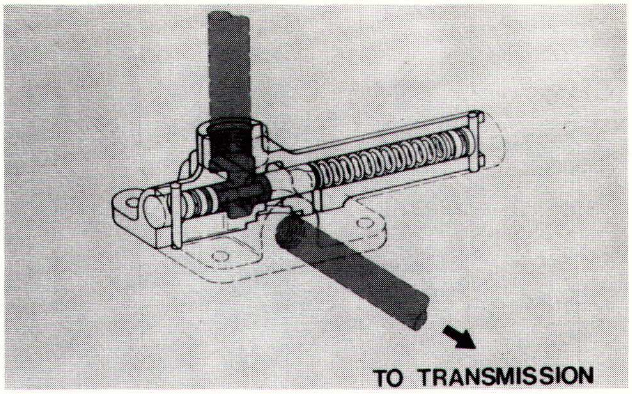
From the pump, the flow of oil is directed to a filter "B," which removes impurities from the fluid.



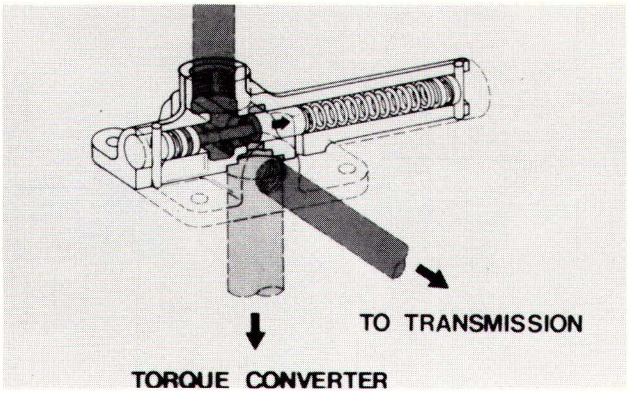
From here, it moves to the pressure regulating valve "C."



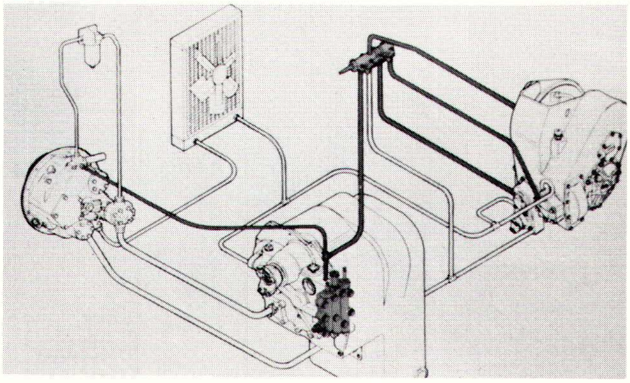
The transmission clutches and the torque converter "D."



The pressure regulating valve consists of a hardened valve spool operating in a closely fitted bore. Oil entering the transmission from the charging pump must pass through the regulating valve. After passing through the valve, it will supply a speed clutch and stop.

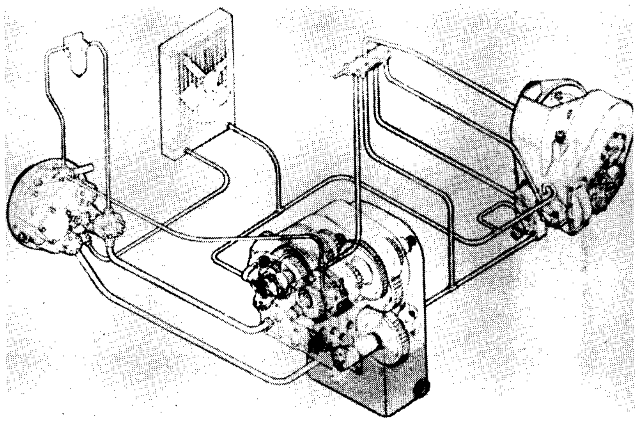


When oil flow is stopped at the clutch, pressure builds and oil flows through a passage behind the spool forcing the spool to move against the spring. As the spool shifts, it opens a port which allows the excess oil to charge the torque converter. This all happens within a fraction of a second. The spring which is holding tension against the spool is what regulates clutch pressure in the transmission.

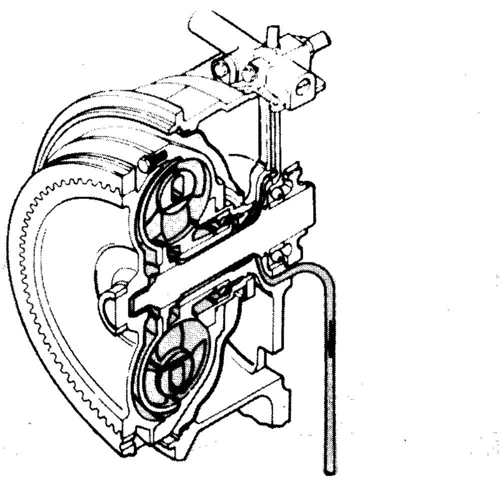


The oil flow from the regulating valve to the transmission and where applicable, winch clutches, is under pressure.

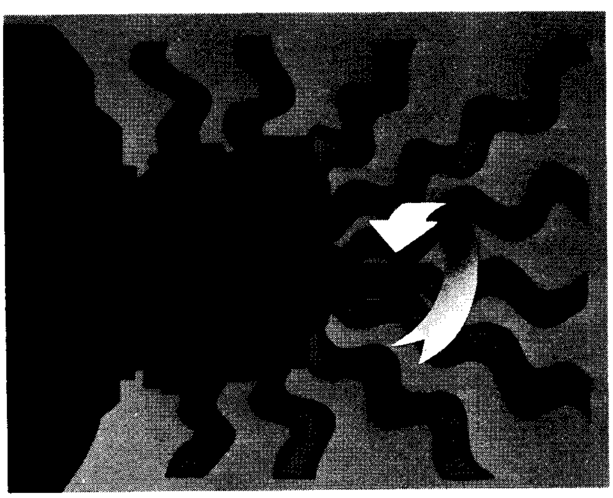
This oil goes through the transmission clutch and/or winch clutch control valve and when the control valve spools are operated, activates the desired clutches.



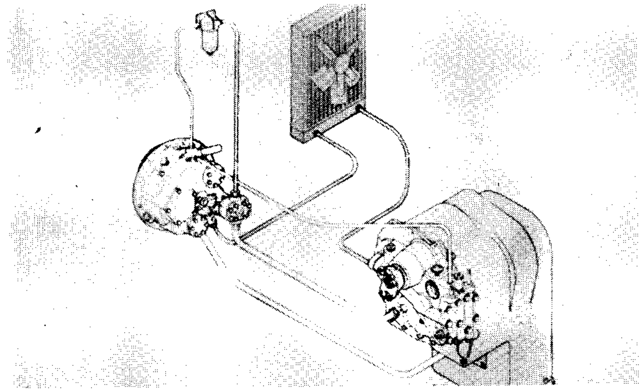
Once pressurized, oil is redirected by means of the control valve spools from one clutch to another, or to neutral, the oil in the disengaged clutches drains back into the sump.



The oil from the regulating valve charging the torque converter is at low pressure, and travels through the impeller, turbine and stator

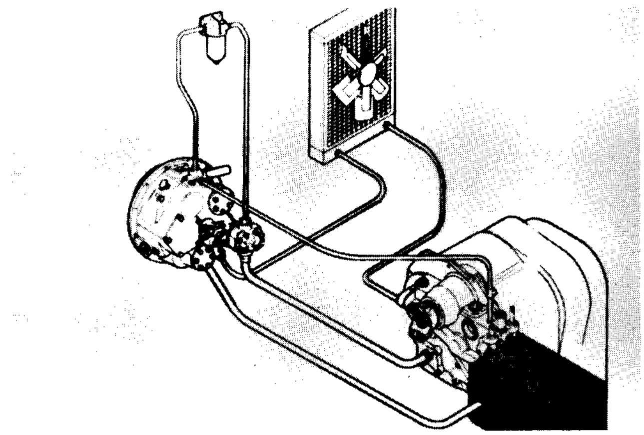


where friction creates heat.



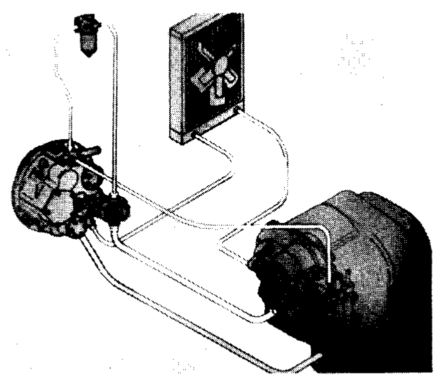
The oil is then passed, still at low pressure, back to the transmission sump by way of an oil cooler and lube distributor.

The cooler brings the oil back to normal operating temperature.



Leakage oil in the converter housing drains by gravity back to the transmission sump.

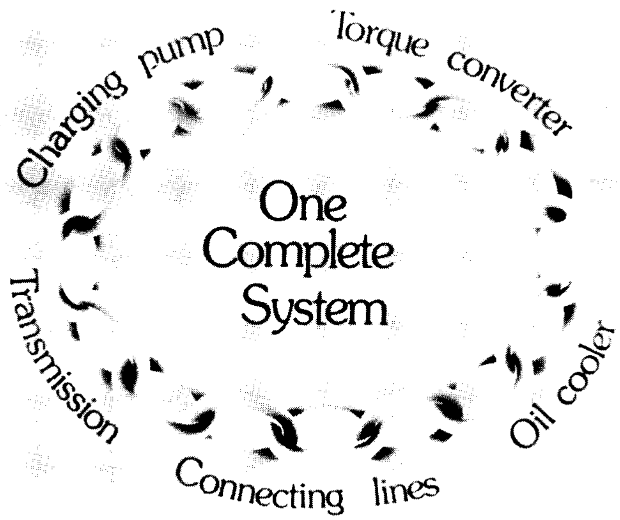
This converter leakage is the oil required to lubricate the necessary gears and bearings within the converter itself.



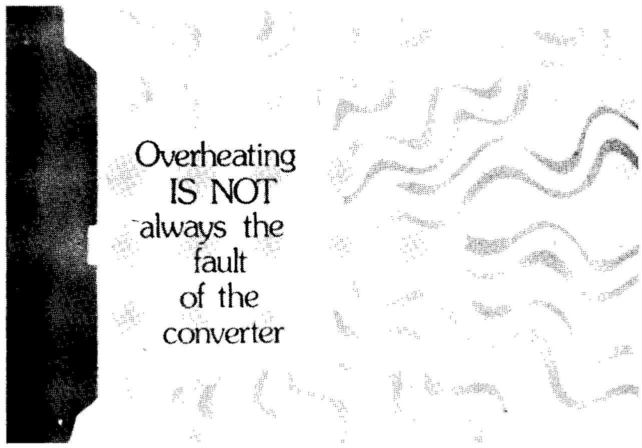
This oil after lubricating the gears, etc., flows to the bottom of the converter housing and then returns to the transmission sump through a drain line.

Throughout the system dependent on its component configuration, there are safety, relief, and regulating valves designed to create back pressure for certain functions and to relieve excessive pressure in the system.

CAUTION: A relief valve is a safety device. Raising relief pressure above specification is not safe.

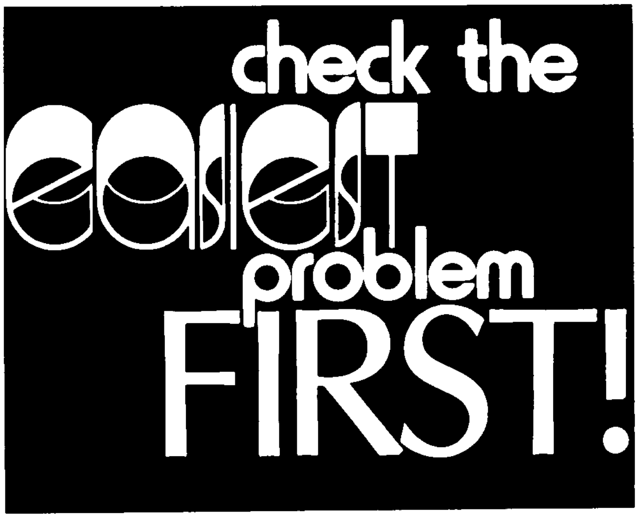


Because the converter charging pump, filter, torque converter, transmission, connecting lines, and valves are one complete system, a fault in any one component can cause a problem to appear in another component.



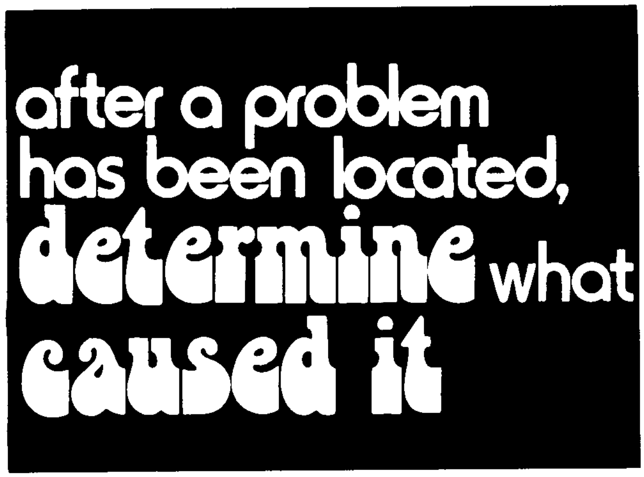
Problem solving has no rigid rule for solution, however, there is a definite method by which to locate or zero in on the cause. The remedy can only be made after the cause has been identified.

When we investigate an overheating converter, we don't confine our investigation to the converter alone. We must consider all other possibilities as well.



Use the troubleshooting guide and schematics in the various service manuals to help locate a problem.

Know what the problem is before disassembling any component.



INSPECTION REPORT

MODEL ______________________ SERIAL NUMBER ______________________

TRANSMISSION MODEL ______________________ SERIAL NUMBER ______________________

CONVERTER MODEL ______________________ SERIAL NUMBER ______________________

CONVERTER OIL TEMPERATURE ______________________

NOTE: All pressure checks, except clutch pressure, to be taken with transmission in neutral.

CLUTCH PSI (KG/CM^2) @ IDLE ______________________

SPEEDS: LO-LO ________ 1st ________ 2nd ________ 3rd ________

4th ________ 5th ________ 6th ________ 7th ________

8th ________ Rev. ________

CONVERTER "IN" PSI (KG/CM^2) @ 2000 RPM ______________________

*CONVERTER "OUT" PSI (KG/CM^2) @ 2000 RPM ______________________

CONVERTER LEAKAGE GPM @ 2000 RPM ______________________

*COOLER "IN" PSI (KG/CM^2) @ 2000 RPM ______________________

COOLER "OUT" PSI (KG/CM^2) @ 2000 RPM ______________________

*NOTE: On converters with no downstream regulator, converter "out" will be the same as cooler "in" except for 5 PSI (.35 KG/CM^2) drop in the connecting line. Measure whichever is easier.

COOLER DROP PSI (KG/CM^2) ______________________

NOTE: To calculate cooler drop: Subtract cooler "out" PSI from cooler "in" PSI
or
Subtract cooler "out" PSI from converter "out" PSI
then
Subtract 5 PSI (.35 KG/CM^2)

LUBE PSI (KG/CM^2) @ 2000 RPM & HIGH FREE IDLE ______________________

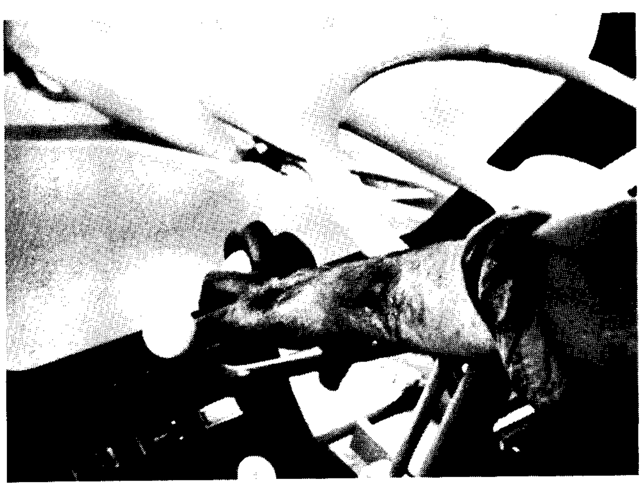
MAIN RELIEF PSI (KG/CM^2) @ IDLE ______________________

ENGINE RPM @ IDLE ________ @ STALL ______________________

MODEL AND SERIAL NUMBERS

It is necessary to know the machine and component model and serial numbers so that correct specifications can be located. These numbers are stamped on a plate and mounted on the case of the component.

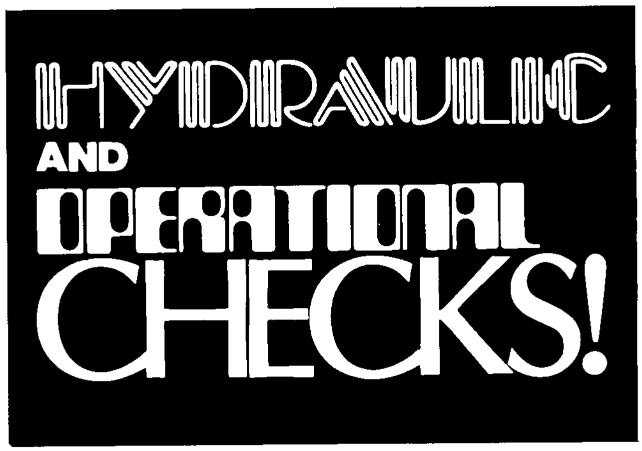
MECHANICAL CHECKS



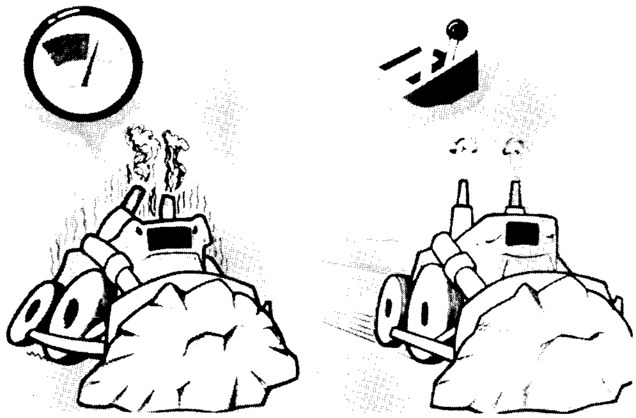
Make sure all control linkage is connected and adjusted properly. Check shift levers and rods for binding or restrictions in travel that would prevent full engagement.

NOTE: All testing must be done with transmission and converter system at operating temperature — (180° — 200° F.)

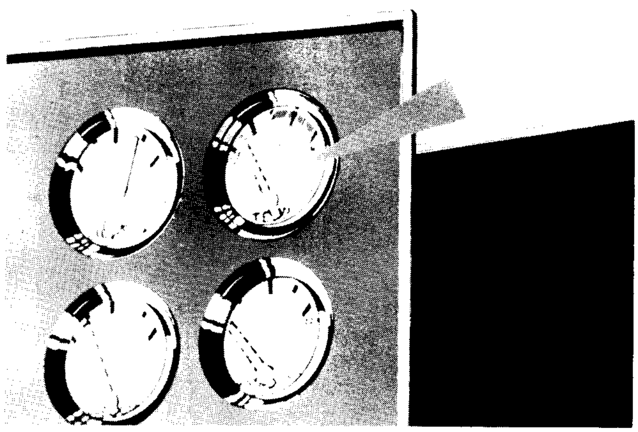
HYDRAULIC AND OPERATIONAL CHECKS



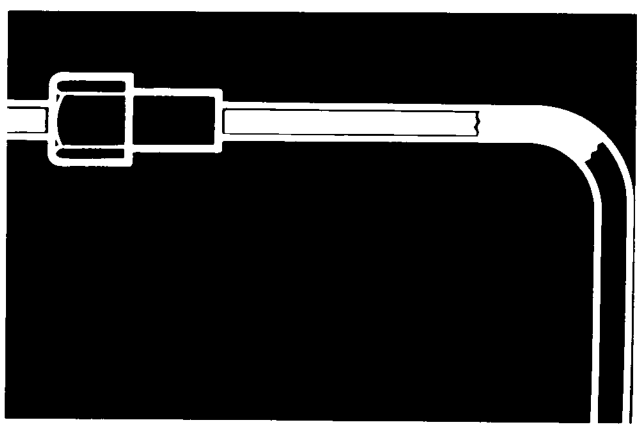
1. Check the oil level.



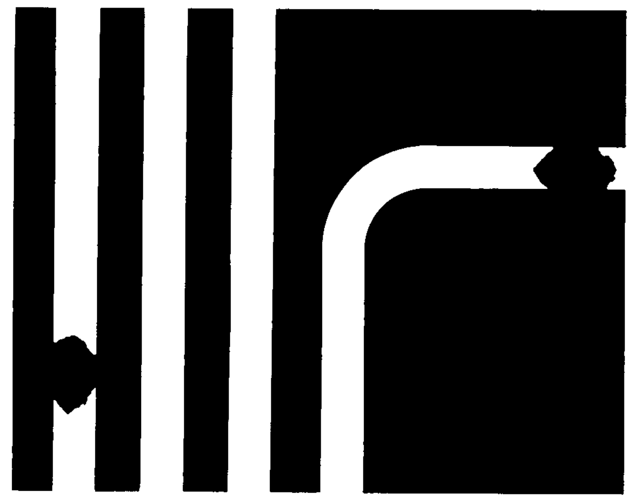
2. Make sure the machine is not being operated in too high a gear ratio.



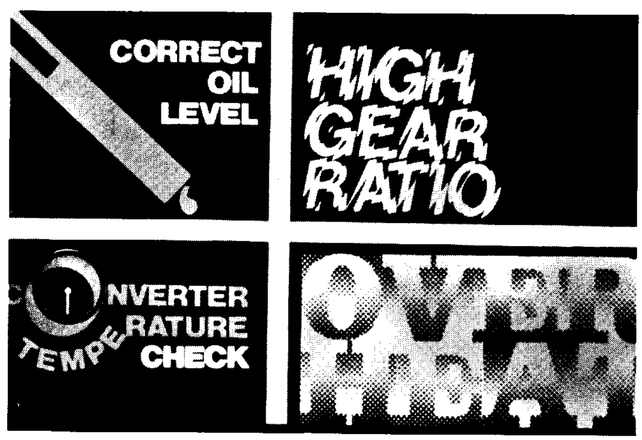
3. Check converter temperature gauge.
4. Engine for overheating.
5. Excessive leakage in the transmission.
6. Excessive leakage in the converter.



7. Plugged return drain line.



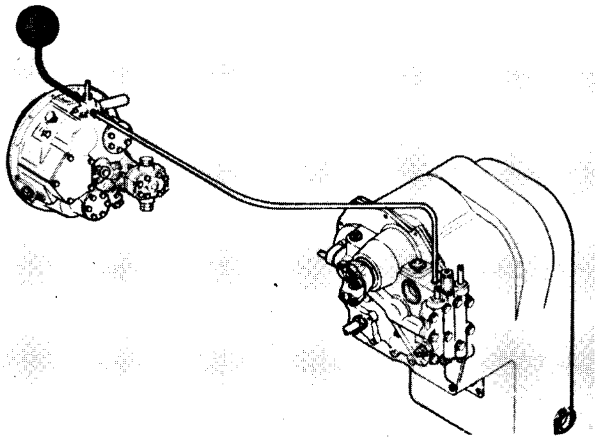
8. Low converter charging pump flow.
9. Restricted oil cooler or cooler line.



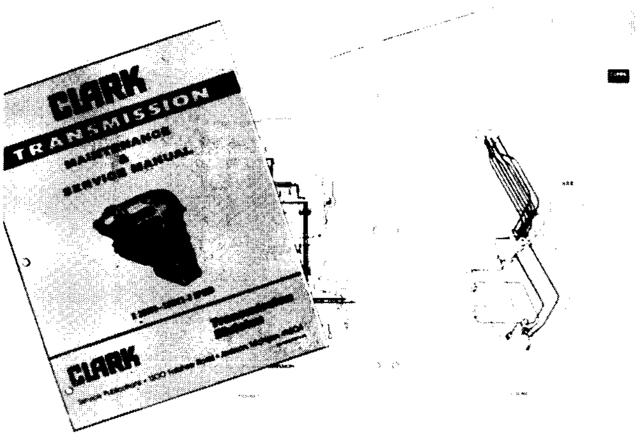
10. Engine stall speed.

It's easy for us to say to make all these checks, and some of them are quite straight forward and easy, but there are some that require further explanation. Obviously, you can check and if necessary, fill the system with oil to the correct level, and you will at a glance be able to determine whether or not the machine is being operated in too high a gear ratio. But, don't overlook these checks, or take them for granted, just because they're simple. The same goes for checking the converter temperature gauge, or engine overheating. Remember, by making these simple checks first, it could save you headaches later.

TRANSMISSION CLUTCH PRESSURES



To check the clutch pressure, install a gauge of at least 400 PSI capacity.



Refer to the applicable transmission and converter schematic drawing for the machine to determine the location of the port.

Measure and record the clutch pressure in each gear forward, and one gear in reverse. Compare the clutch pressure readings with the specifications given for each machine.

5 PSI (.35 kg/cm^2) VARIATION

Clutch pressure must be within specifications and there should be no more than 5 PSI variation between clutches. Clutch pressure must be measured at idle.

PROBLEM: LOW CLUTCH PRESSURE in ALL GEARS

Probable Causes:

1. Low oil level.
2. A leaking or plugged suction line.
3. Faulty clutch pressure regulating valve.
4. Faulty charging pump.

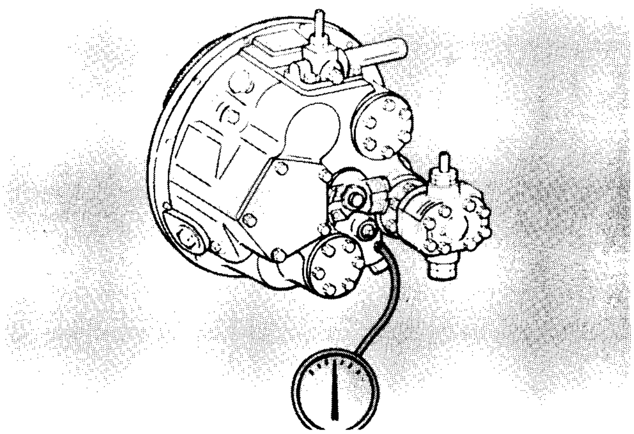
PROBLEM: LOW CLUTCH PRESSURE in one or more gears but NOT all gears

Probable Causes:

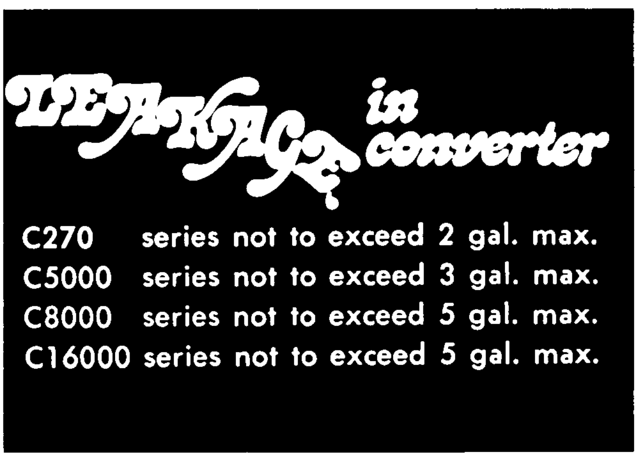
1. Leaking clutch sealing rings.
2. Worn or broken sealing rings on the clutch support or clutch shaft.
3. Bleed ball in the clutch drum could be stuck open.
4. Faulty control cover.
5. Leaking internal plumbing.

CONVERTER LEAKAGE

All converters have to have a certain amount of leakage to lubricate the bearings and gears inside the converter. Excessive leakage will cause problems.



Pressure checks on the converter system can give an indication of converter leakage.

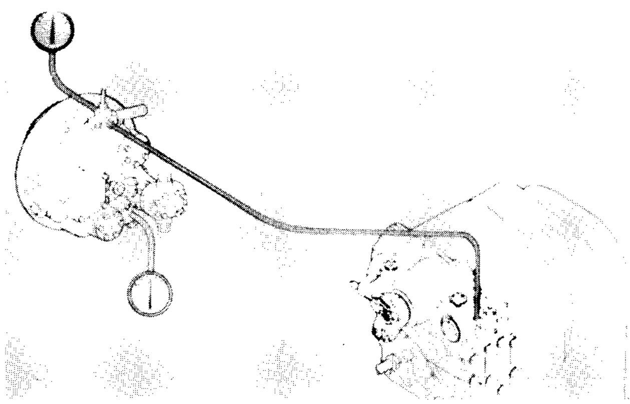


If leakage is suspected, a leakage check should be made.

1. Disconnect the converter drain line at the transmission. Add an extension to the line so that leakage can be safely measured without working under a running machine.
2. Accelerate the engine to 2000 RPM with the transmission in neutral.
3. Measure the amount of flow from the drain line for 15 seconds. Multiply the quantity of fluid collected in 15 seconds by 4. This equals the gallons per minute leakage from the converter.
4. Compare with the specification listed for each converter in the applicable service manual.

CONVERTER PRESSURE CHECKS

Converter pressures, in conjunction with converter leakage is a good indication of the condition of the charging pump and converter.

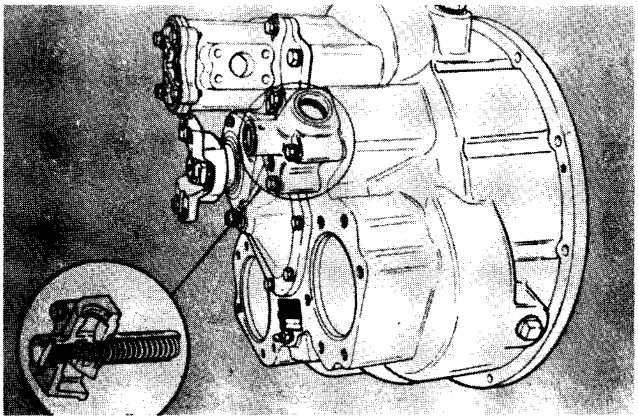


To measure converter pressures, install a 160 PSI hydraulic gauge in the "in" or "out" port. (Refer to the transmission and converter schematic diagrams for the location of these ports. Measure the converter pressures at 2000 RPM with the transmission in neutral position.

CONVERTER OUT PRESSURE

On converters with no downstream regulator, converter "out" pressure will read the same as the cooler in pressure with the exception of approximately 5 PSI drop in the connecting line.

On converters equipped with a downstream regulator, the converter "out" pressure must be taken at the port on the downstream regulator valve.

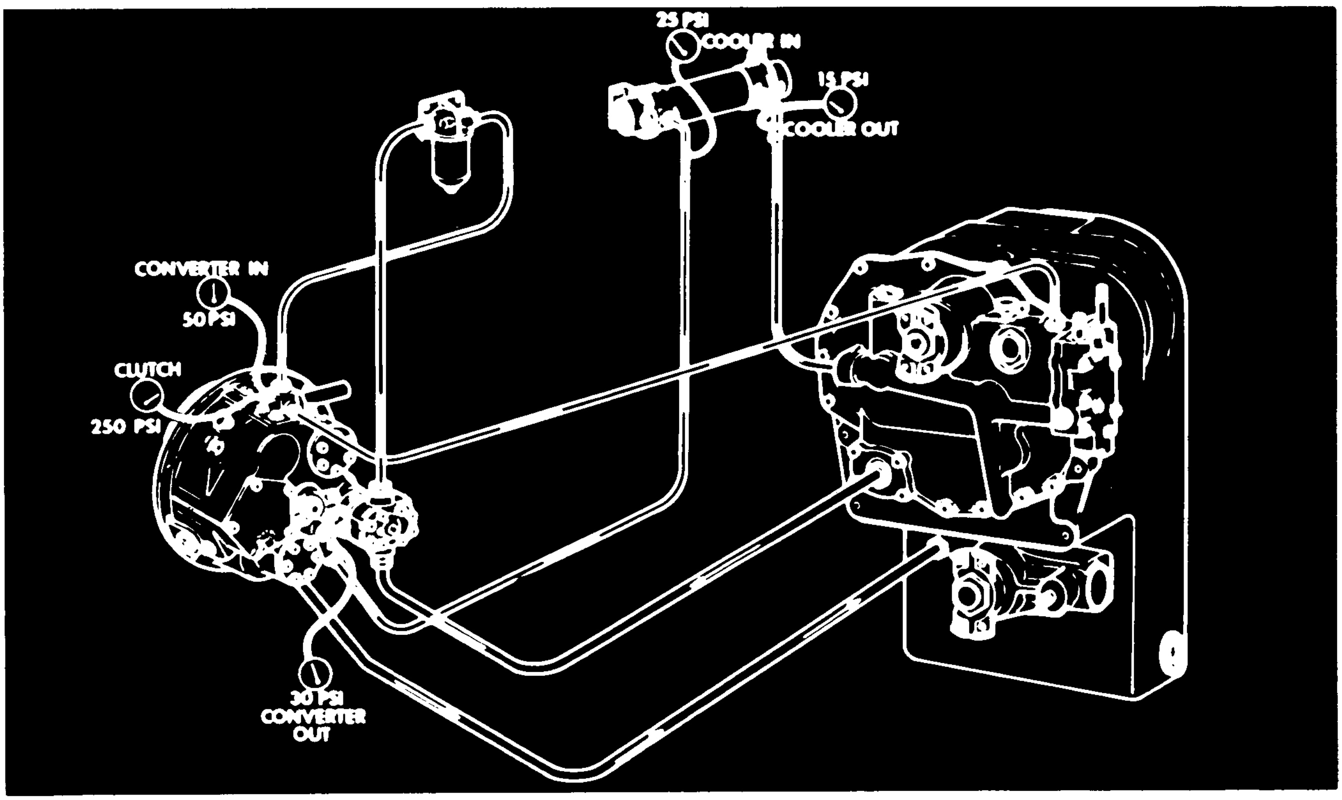


The purpose of the downstream regulator valve is to maintain back pressure within the converter to keep it full of oil. In smaller systems, such as the C270, the back pressure from the cooler and lube system is sufficient. The downstream regulator creates approximately 60 PSI of back pressure within the converter.

Converter "in" pressure at 2000 RPM in neutral is an indication of the pressure caused by the converter and the downstream regulator. If a downstream regulator is not used, the converter "in" pressure is an indication of back pressure caused by the converter, cooler, connecting lines, and lubrication system of the transmission.

SYSTEMS WITHOUT DOWNSTREAM REGULATOR

This is an example of a typical converter system without a downstream regulator such as a C270, but this is only an example. You must refer to the specifications of each machine.



Problem: Low "in" or "out" pressure with normal converter leakage.

Probable Causes:

1. Low oil level
2. Leaking or plugged suction line
3. Faulty charging pump

Problem: High "in" and "out" pressure at 2000 RPM.

Probable Causes:
1. Plugged oil cooler
2. Restriction in the lines to and from the cooler
3. Restriction in the transmission lube system

Problem: High "in" pressure, low "out" pressure and normal or excessive leakage.

Probable Cause:
1. Restricted oil flow inside the torque convertor.

Problem: Low "in" or "out" pressure at 2000 RPM and excessive converter leakage.

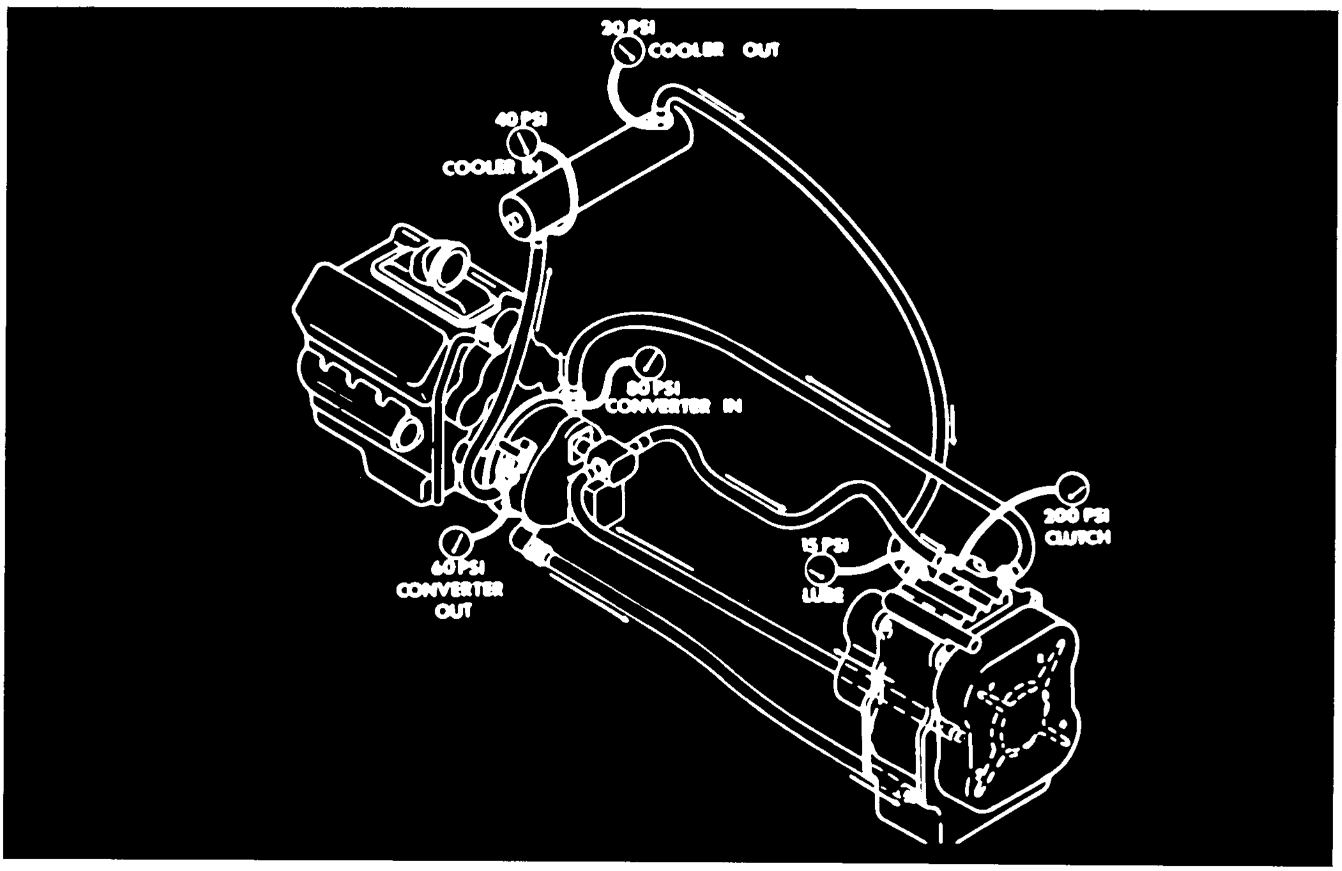
Probable Causes:
1. Worn sealing rings in the converter
2. Faulty safety by-pass valve (only on units with internal safety valve)
3. Cracked converter members (this will cause leakage from the flywheel housing)

Problem: Leakage from the flywheel housing and normal or low pressure.

Probable Causes:
1. Worn or damaged oil baffle o'ring
2. Impeller hub oil seal or o'ring
3. Cracked converter members

SYSTEMS WITH DOWNSTREAM REGULATING VALVE

This is an example of a typical converter system with a downstream regulator, but only an example. Again, you must refer to the specifications for each machine.



Problem: Low converter pressure at 2000 RPM taken at either the "in" port or the port on the downstream regulator valve, and normal converter leakage.

Probable Causes:
1. Low oil level
2. Leaking or plugged suction line
3. Faulty downstream regulator valve
4. Faulty charging pump

Problem: High pressure at the "in" port, normal or low pressure at the downstream regulator valve.

Probable Causes:
1. Plugged cooler
2. Restriction in the lines to and from the cooler
3. Restriction in the transmission lube system
4. The downstream regulator spool stuck closed

Problem: High pressure at the in port, normal or low pressure at the downstream regulator valve.

Probable Causes:
Restriction to flow inside the torque converter

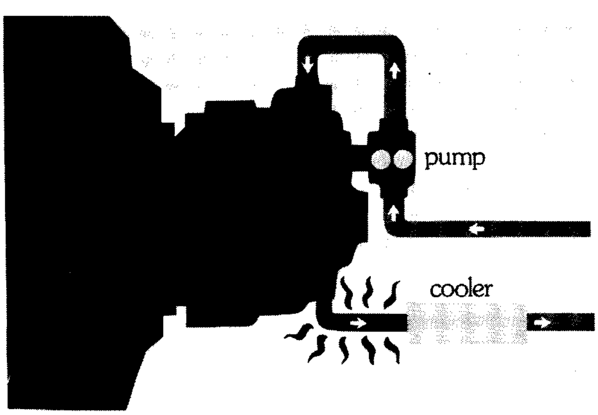
Problem: Low pressure at either port at 2000 RPM and excessive converter leakage.

Probable Causes:
1. Worn or broken sealing rings in the converter
2. Cracked converter members causing flywheel housing leakage

Problem: Leakage from the flywheel housing and normal or low pressure.

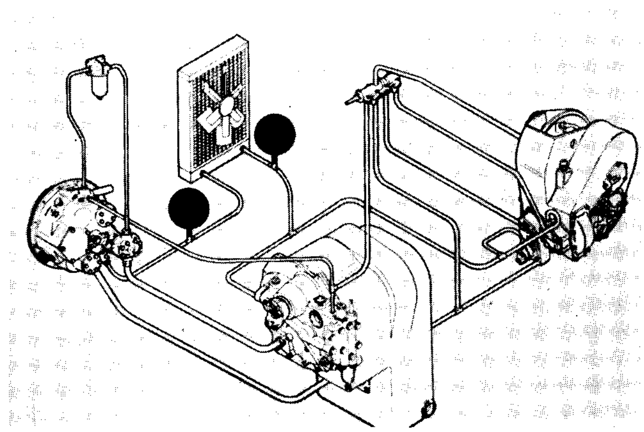
Probable Causes:
1. Worn or damaged oil baffle o'ring
2. Impeller hub oil seal or o'ring
3. Cracked converter members

OIL COOLER



The cooler is designed to get rid of the excess heat created by the converter. The cooler is one of the most important components in the converter system and probably the most neglected.

If the cooler becomes partially plugged, the flow through the cooler will be restricted causing overheating of the converter and transmission and possible damage to both. Machine manufacturer manuals list a normal pressure drop across the cooler which is the amount of restriction designed into it. They also list a maximum cooler drop. When the drop across the cooler reaches maximum, it must be thoroughly cleaned or replaced.



To measure and calculate the cooler pressure drop:

1. Install gauges of at least 100 PSI in the inlet port of the cooler and the outlet port of the cooler.
2. Accelerate the engine to 2000 RPM with transmission in neutral.
3. Read the "in" pressure and "out" pressure and record each.
4. Subtract the "out" pressure from the "in" pressure. The difference is the pressure drop caused by restriction in the cooler.

Compare these figures with the manufacturer's machine specifications.

Examples of the different methods of calculating cooler drops:

1.	40 PSI	(2.8)	Cooler "in"
	−20 PSI	−(1.4)	Cooler "out"
	20 PSI	(1.4)	Cooler drop

2.	45 PSI	(3.15)	Converter "out"
	−5 PSI	−(.35)	Connecting line
	40 PSI	(2.80)	Cooler "in"
	−20 PSI	−(1.40)	Cooler "out"
	20 PSI	(1.40)	Cooler drop
3.	40 PSI	(2.80)	Cooler "in"
	−15 PSI	−(1.00)	Lube pressure
	25 PSI	(1.80)	Cooler Drop and 1 Line
	−5 PSI	−(.35)	Drop for 1 Line
	20 PSI	(1.45)	Cooler Drop

ENGINE RPM AND STALL SPEEDS

Stall speeds are measured to determine the condition of the engine.

The engine horsepower is carefully matched to the requirements of the powertrain and hydraulic system. When an operator complains of a machine having no power, it must be determined if the problem is located in the engine, powertrain, or hydraulic system. The stall speeds are listed by the manufacturer for each machine. It is important to note that some stall speeds are measured with only the converter loading the engine, and some are measured with both the converter and main hydraulics loading the engine. To measure stall speeds on the equipment which does not require main hydraulics to load the engine:

1. Check all fluid levels and fill if necessary.
2. Install a test tachometer on the engine.
3. Lower all implements and/or attachments to the ground.
4. Securely block the wheels.
5. Set the parking brake.
6. Place the transmission control levers in highest forward gear.
   NOTE: If the machine is equipped with a declutch, do not disengage the transmission when checking stall speeds.
7. Accelerate the engine to approximately ¾ throttle until the converter temperature reaches 180° F.
8. When the converter temperature reaches 180° F., then accelerate the engine to full throttle and read the stall RPM on the tachometer.
9. Compare the stall RPM with the manufacturer's specifications.

To measure stall speeds on equipment that uses the main hydraulic pump in addition to the converter to load the engine:

1. Check all fluid levels and fill if necessary.
2. Install a test tachometer on the engine.
3. Install a 3000 PSI capacity hydraulic gauge in the main hydraulic valve gauge port.
4. Lower all implements and/or attachments to the ground.
5. Securely block the wheels.
6. Set the parking brake.
7. Place the transmission control levers in the highest forward gear.
   NOTE: If the machine is equipped with a declutch, do not disengage the transmission when checking stall speeds.
8. Warm the hydraulic fluid to 150° F.
9. Accelerate the engine to approximately ¾ throttle, until the converter temperature reaches 180° F.
10. Accelerate to full throttle.
11. Pull the main hydraulics over relief.
12. Read the stall RPM on the tachometer and the relief pressure on the hydraulic gauge.
13. Compare the stall RPM and relief pressure with the specification listed in the applicable machine manual.
    NOTE: The main relief pressure must be correct to measure the correct stall RPM. If the relief pressure is high, the stall RPM will be low, because the engine is loaded more. If the relief pressure is low, the stall RPM will be high.

CAUTION!!! FULL THROTTLE STALL SPEEDS FOR AN EXCESSIVE LENGTH OF TIME WILL OVERHEAT THE CONVERTER.

LOW STALL SPEEDS

STALL SPEED problems

The following could cause low stall speeds:

1. Plugged air cleaners.
2. Accelerator linkage not functioning properly.
3. High altitudes.
4. Dirty fuel filters.
5. Restriction in the exhaust.
6. Faulty injectors or nozzles.
7. Incorrect fuel adjustment.
8. Low compression.

In general, when the stall speed is low, there is a problem in the engine that must be corrected before further checks can be made in the transmission and converter circuit, or in the hydraulic circuit.

HIGH STALL SPEED

Causes of high stall speed:

1. Slipping clutch.
2. Cavitating converter.

In general, when the stall speed is high, there is a problem in the converter and transmission circuit, and it will be necessary to troubleshoot the system. There is no mystery to solving problems, there is only good sense that begins with "LOOK FOR THE OBVIOUS FIRST."

If the problem is high stall speed, it could be caused by:

1. A slipping clutch.
2. A cavitating converter.

In general, when the stall speed is high, there is a problem in the converter and transmission circuit, and it will be necessary to troubleshoot the system. There is no mystery to solving problems, there is only good sense that begins with, "Related Components Must Have Related Checks."

SERVICING THE MACHINE AFTER COMPONENT OVERHAUL

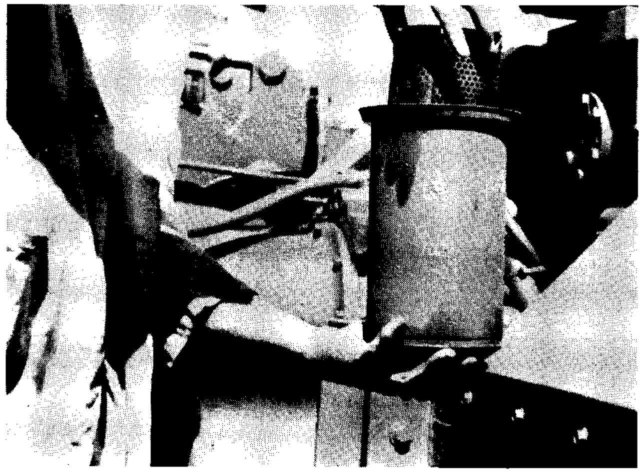
Now, let's look at the final step. Servicing the machine after component overhaul.

After an overhauled component has been installed in the machine, the torque converter, transmission, oil cooler, filter, and connecting hydraulic system, must be thoroughly cleaned. This can be accomplished in several ways and a degree of judgement must be exercised as to the method employed.

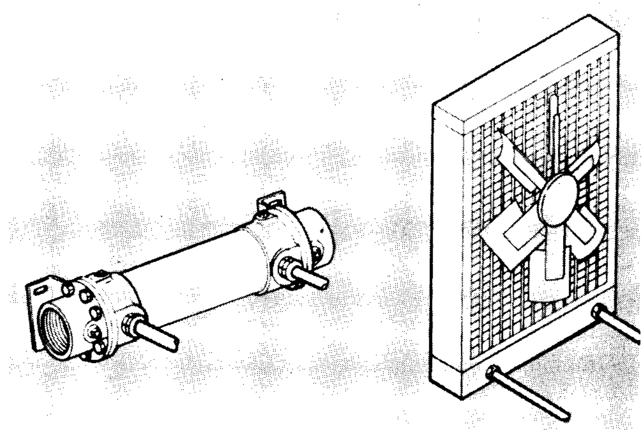
The following are considered the minimum steps to be taken:

Drain the entire system thoroughly.

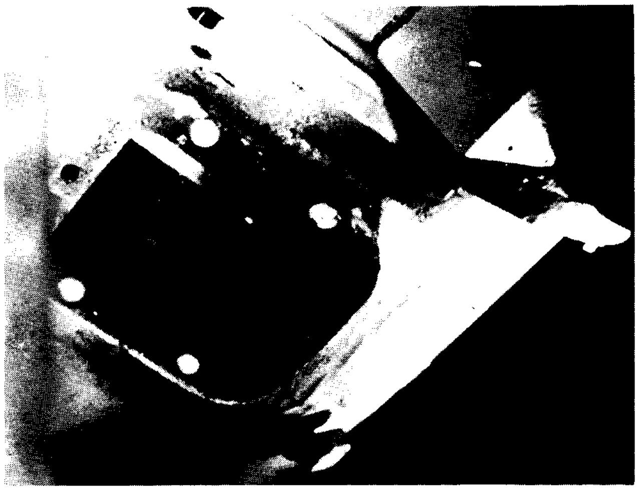
Disconnect and clean all hydraulic lines. Where feasible, hydraulic lines should be removed from the machine for cleaning.



Replace oil filter elements. Cleaning out the filter cases thoroughly.



The oil cooler must be thoroughly cleaned. The cooler should be back-flushed with oil and compressed air until all foreign material has been removed. Flushing in the direction of the normal oil flow will not adequately clean the cooler. If necessary, the cooler and/or radiator assembly should be removed from the machine for cleaning using oil, compressed air, and a steam cleaner for that purpose. DO NOT use flushing compounds for cleaning purposes.

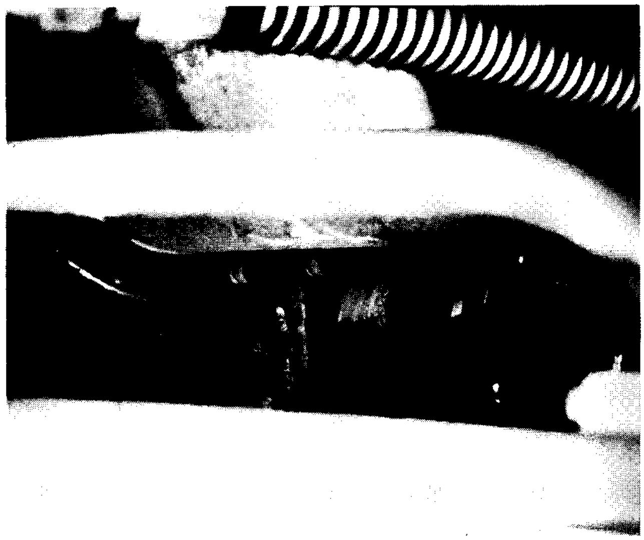


Remove the bottom drain cover and the plug from the torque converter and inspect the interior of the converter housing, the gears, etc.

If the presence of considerable foreign material is noted, it will be necessary that the converter be removed, disassembled, and cleaned thoroughly. It is realized this entails extra labor, however, such labor cost is minor compared to cost of difficulties which can result from presence of such foreign material in the system.

Reassemble all components, and use only the type of oil recommended in the lubrication section of the applicable manual.

Fill the system through the filler opening until the fluid comes up to the low mark on the transmission dipstick.



NOTE: If there is no dipstick, or if the dipstick is not accessible, oil level check plugs are provided. Remove the lower check plug and fill until the oil runs from the lower oil hole. Replace the filler and level plug.

Run the engine for two minutes at 500 to 600 RPM to prime the torque converter and hydraulic lines. Recheck the level of fluid in the system with the engine running at idle 500 to 600 RPM. Add the quantity necessary to bring the fluid level to the low mark on the dipstick or until oil runs freely from the lower oil level check plug hole. Install the oil level plug or dipstick. Recheck with hot oil 180° F. to 200° F.

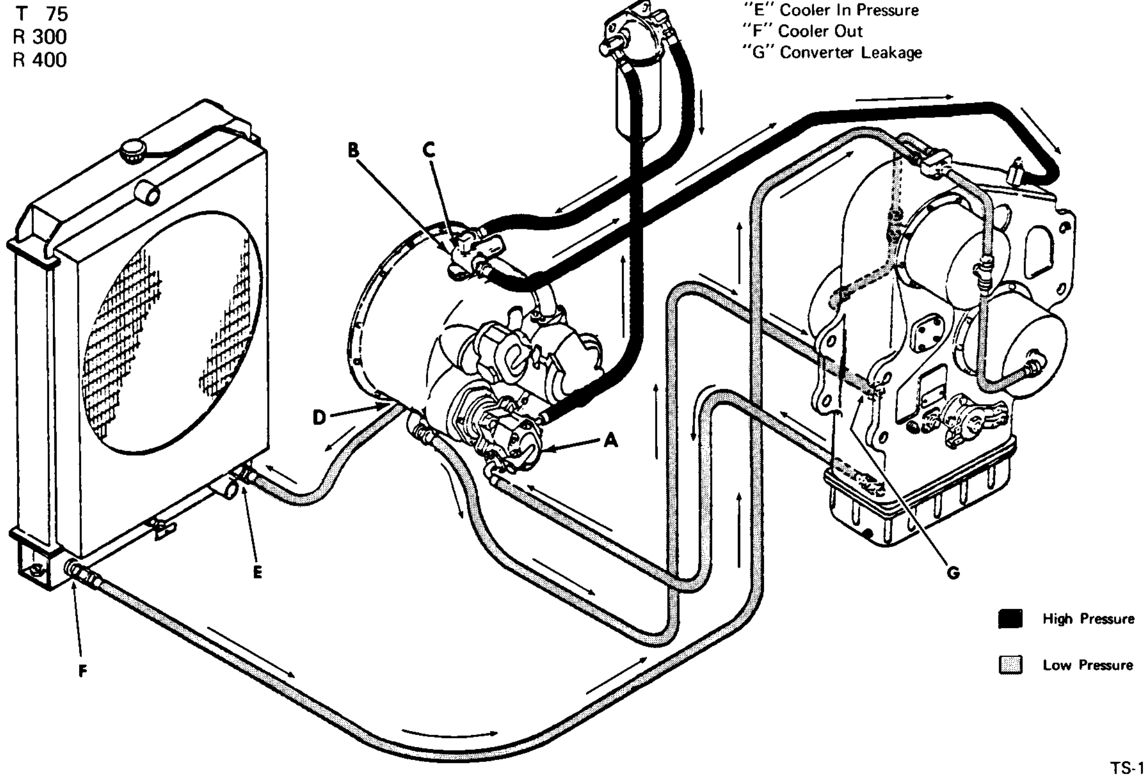
Bring the oil level to the full mark on the dipstick, or until it runs freely from the upper oil level plug.

Finally, recheck all drain plugs, lines, connections, etc., for leaks, and tighten where necessary.

CONVERTER
C270

TRANSMISSION
T 75
R 300
R 400

"A" Pump Outlet
"B" Clutch Pressure
"C" Converter In Pressure
"D" Converter Internal or Out Pressure
"E" Cooler In Pressure
"F" Cooler Out
"G" Converter Leakage

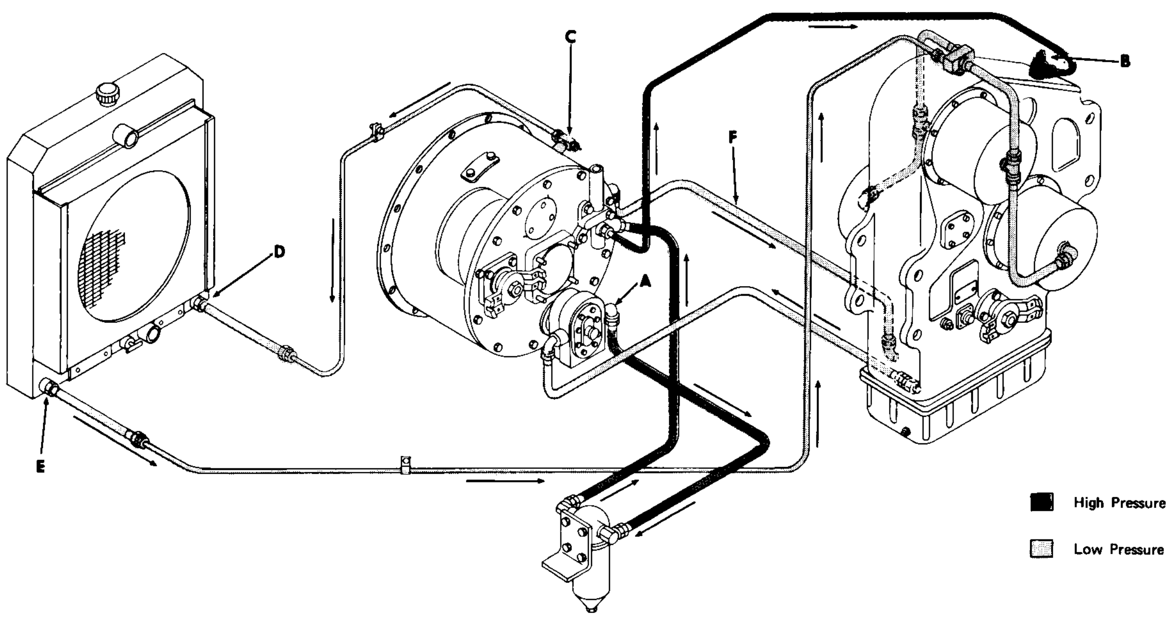


TS-10539

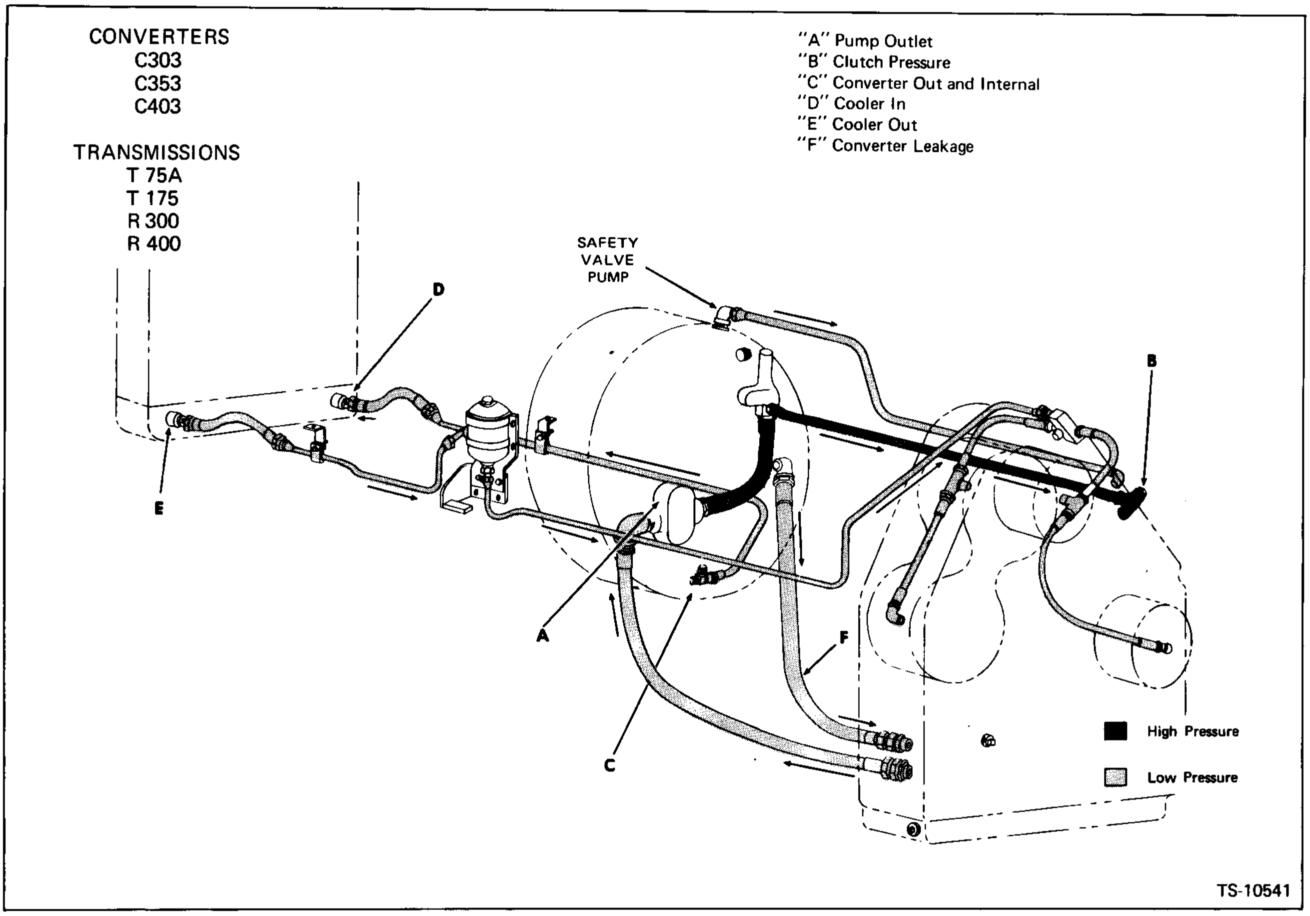
CONVERTER
C404

TRANSMISSIONS
T 175
R 400

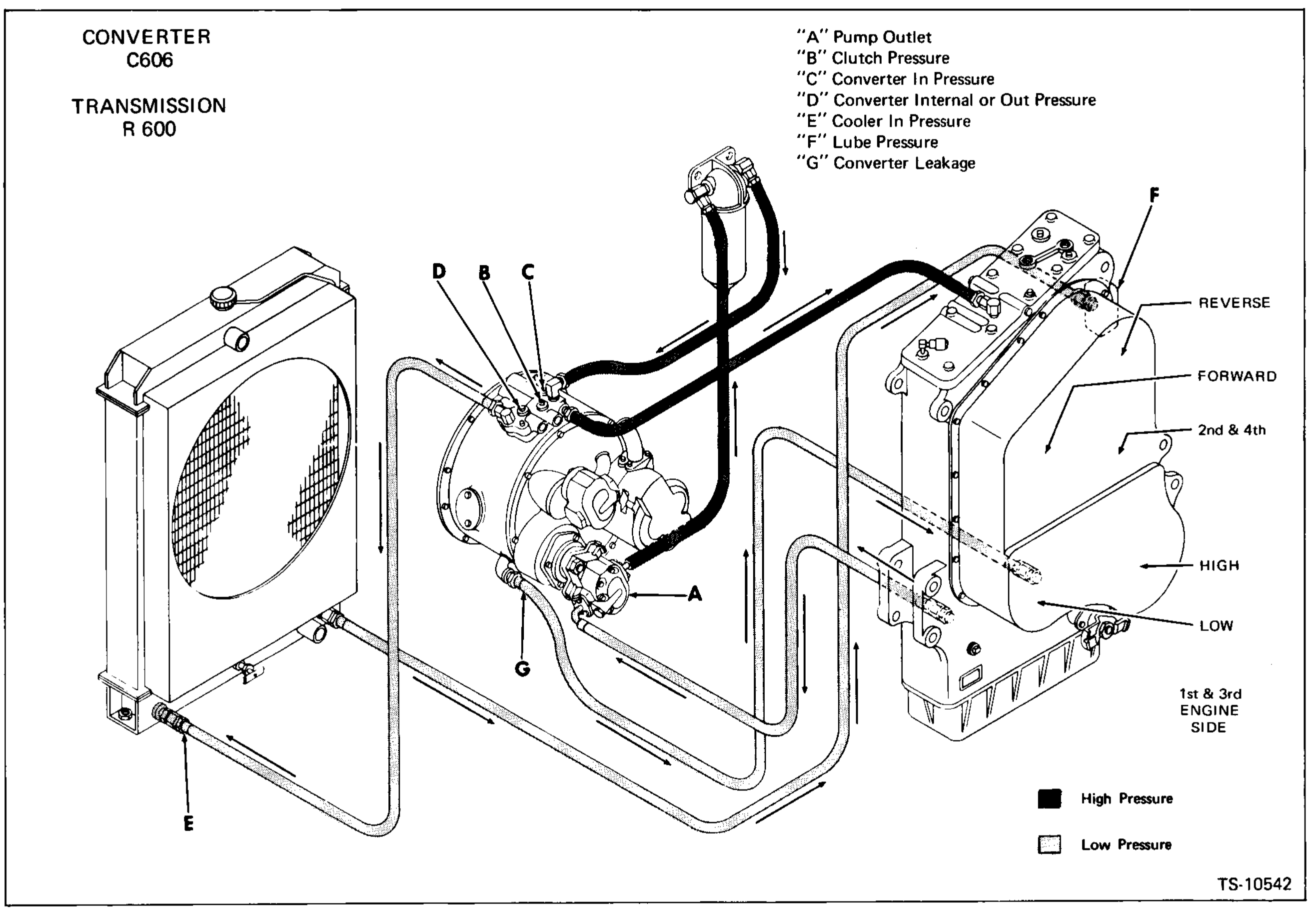
"A" Pump Outlet
"B" Clutch Pressure
"C" Converter Out and Internal
"D" Cooler In
"E" Cooler Out
"F" Converter Leakage



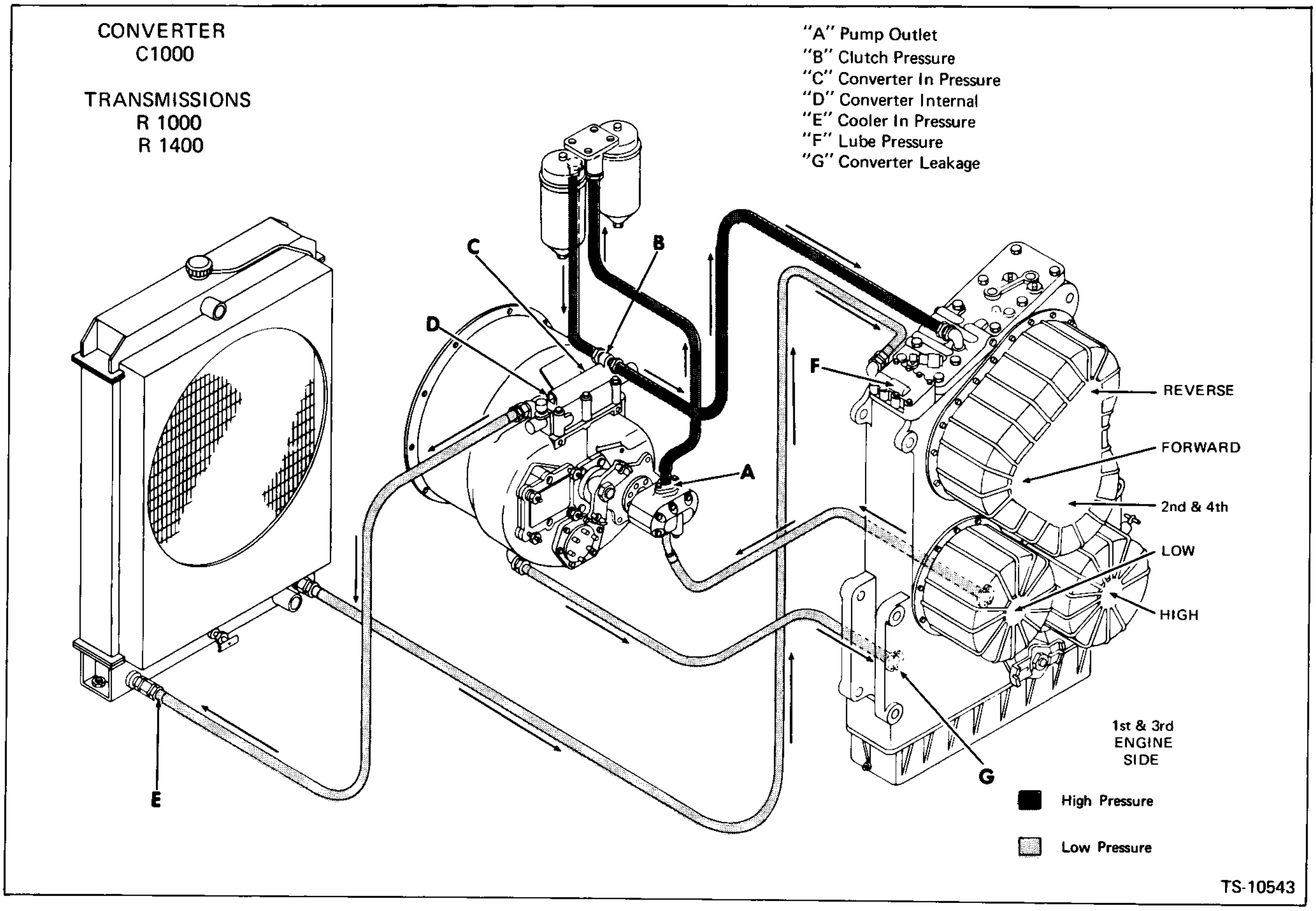
TS-10540

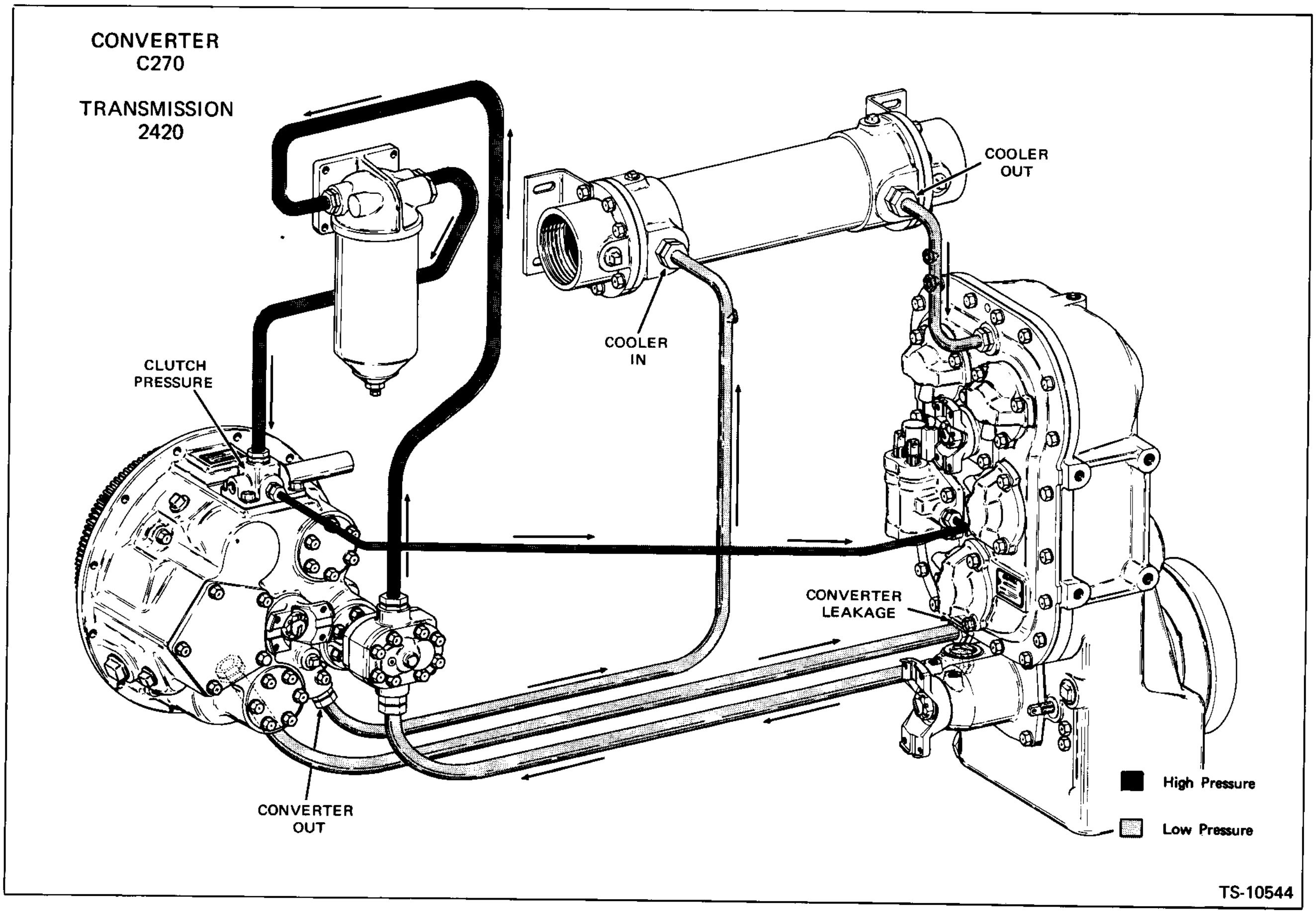


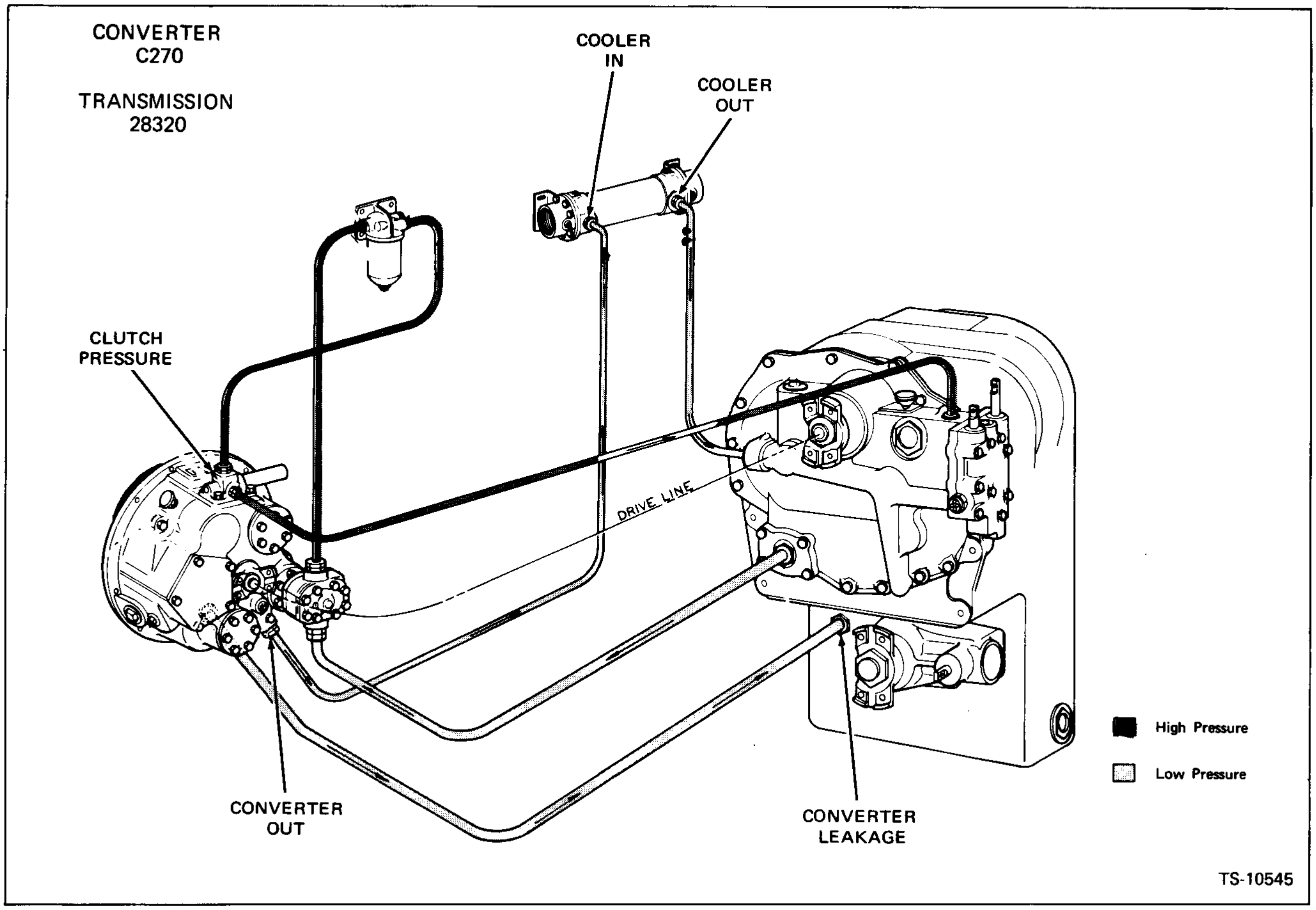
CONVERTERS
C303
C353
C403
TRANSMISSIONS
T 75A
T 175
R 300
R 400
"A" Pump Outlet
"B" Clutch Pressure
"C" Converter Out and Internal
"D" Cooler In
"E" Cooler Out
"F" Converter Leakage
SAFETY VALVE PUMP
D
B
E
A
F
C
High Pressure
Low Pressure
TS-10541

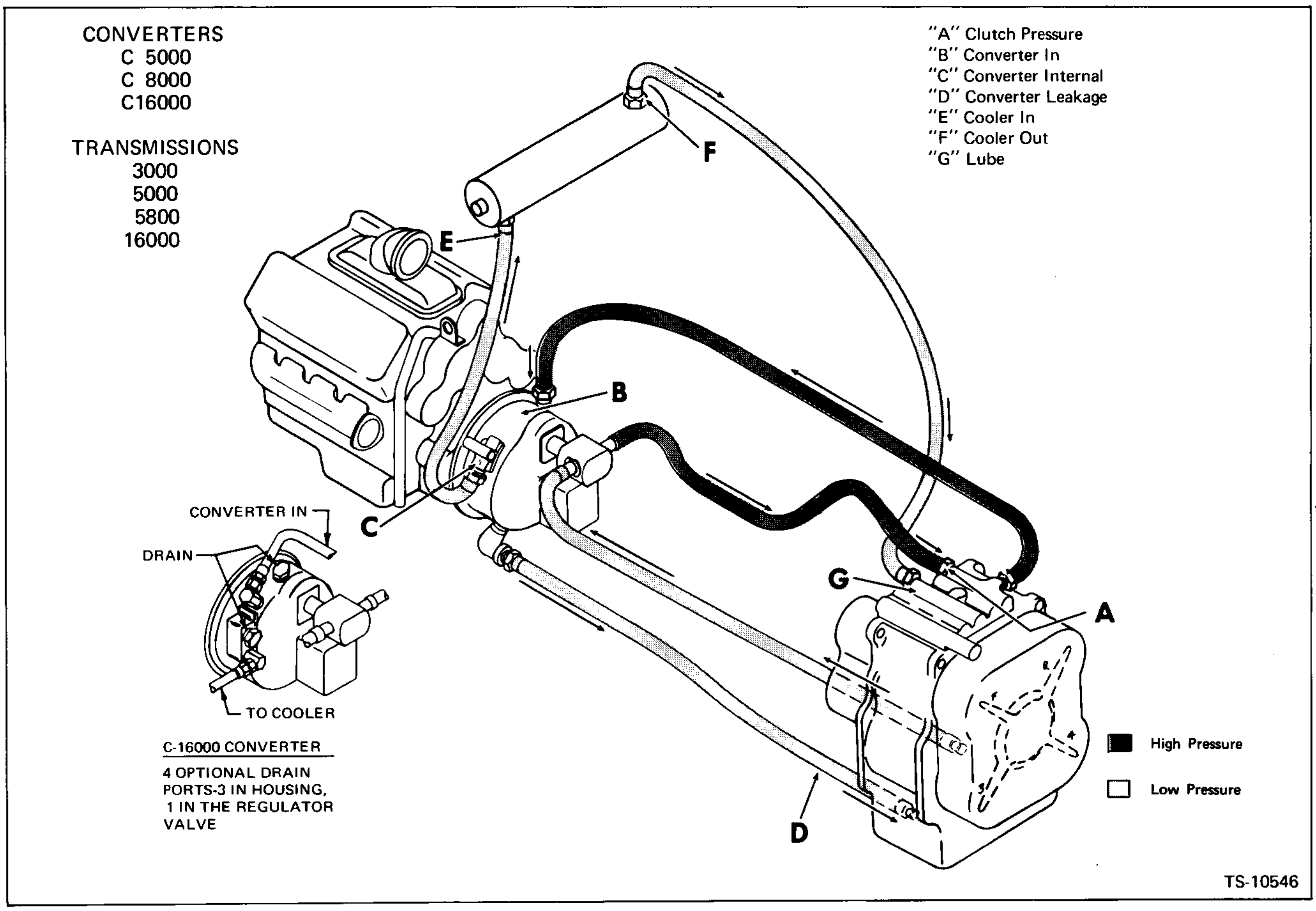


CONVERTER
C606
TRANSMISSION
R 600
"A" Pump Outlet
"B" Clutch Pressure
"C" Converter In Pressure
"D" Converter Internal or Out Pressure
"E" Cooler In Pressure
"F" Lube Pressure
"G" Converter Leakage
F
D
B
C
REVERSE
FORWARD
2nd & 4th
HIGH
LOW
A
G
1st & 3rd ENGINE SIDE
E
High Pressure
Low Pressure
TS-10542


CONVERTER
C1000
TRANSMISSIONS
R 1000
R 1400
"A" Pump Outlet
"B" Clutch Pressure
"C" Converter In Pressure
"D" Converter Internal
"E" Cooler In Pressure
"F" Lube Pressure
"G" Converter Leakage
C
B
D
F
A
REVERSE
FORWARD
2nd & 4th
LOW
HIGH
1st & 3rd
ENGINE
SIDE
G
E
High Pressure
Low Pressure
TS-10543


CONVERTER
C270
TRANSMISSION
2420
COOLER
OUT
COOLER
IN
CLUTCH
PRESSURE
CONVERTER
LEAKAGE
CONVERTER
OUT
High Pressure
Low Pressure
TS-10544


CONVERTER
C270
TRANSMISSION
28320
COOLER IN
COOLER OUT
CLUTCH PRESSURE
DRIVE LINE
CONVERTER OUT
CONVERTER LEAKAGE
High Pressure
Low Pressure
TS-10545


CONVERTERS
C 5000
C 8000
C16000
TRANSMISSIONS
3000
5000
5800
16000
"A" Clutch Pressure
"B" Converter In
"C" Converter Internal
"D" Converter Leakage
"E" Cooler In
"F" Cooler Out
"G" Lube
A
B
C
D
E
F
G
CONVERTER IN
DRAIN
TO COOLER
C-16000 CONVERTER
4 OPTIONAL DRAIN PORTS-3 IN HOUSING, 1 IN THE REGULATOR VALVE
High Pressure
Low Pressure
TS-10546

TRANSMISSION CLUTCH SHIFT PATTERNS

T75, T175, R300, R400 and 2000 Transmissions

Gears ↓	Mechanical Shift Lo	Mechanical Shift Hi	Clutches Lo	Clutches Hi	Clutches For		Clutches Rev
1	●	○	●	○	●	or→	○
2	●	○	○	●	●	or→	○
3	○	●	●	○	●	or→	○
4	○	●	○	●	●	or→	○

RF600 and R1000 Transmission

Gears ↓	Clutches A	B	C	D	For		Rev
1	○	●	●	○	●	or→	○
2	●	○	●	○	●	or→	○
3	○	●	○	●	●	or→	○
4	●	○	○	●	●	or→	○

28320 and HR28320 Transmissions

Gears ↓	Clutches Lo	2nd	3rd	For		Rev
1	●	○	○	●	or→	○
2	○	●	○	●	or→	○
3	○	○	●	●	or→	○

28420 Transmissions

Gears ↓	Clutches Lo	2nd	3rd	4th	For		Rev
1	●	○	○	○	●	or→	○
2	○	●	○	○	●	or→	○
3	○	○	●	○	●	or→	○
4	○	○	○	●	●	or→	○

28520 and HR28520 Transmissions

Gears ↓	Clutches Lo-Lo	Lo	2	3	4	For		Rev
Lo-Lo	●	●	○	○	○	○		○
1	○	●	○	○	○	●	or→	○
2	○	○	●	○	○	●	or→	○
3	○	○	○	●	○	●	or→	○
4	○	○	○	○	●	●	or→	○

3400, 4400, 5400 and 8400 Transmissions

Gears ↓	Clutches 1	2	3	4	For		Rev
1	●	○	○	○	●	or→	○
2	○	●	○	○	●	or→	○
3	○	○	●	○	●	or→	○
4	○	○	○	●	●	or→	○

3500 Transmission

Gears ↓	Clutches Lo-Lo	1	2	3	4	For		Rev
Lo-Lo	●	●	○	○	○	○		○
1	○	●	○	○	○	●	or→	○
2	○	○	●	○	○	●	or→	○
3	○	○	○	●	○	●	or→	○
4	○	○	○	○	●	●	or→	○

5800, 8800 and 16800 Transmissions

Gears ↓	Clutches 1	2	3	4	Low For		Hi For	Rev
1	●	○	○	○	●	or	→ ○ →	○
2	●	○	○	○	○		●	○
3	○	●	○	○	●	or	→ ○ →	○
4	○	●	○	○	○		●	○
5	○	○	●	○	●	or	→ ○ →	○
6	○	○	●	○	○		●	○
7	○	○	○	●	●	or	→ ○ →	○
8	○	○	○	●	○		●	○

Note: In reverse only 4 speeds can be engaged

5900 and 8900 Transmissions

Gears ↓	Clutches Lo-Lo	1	2	3	4	Low For		Hi For	Rev
Lo-Lo	●	●	○	○	○	○		○	○
1	○	●	○	○	○	●	or	→ ○ →	○
2	○	●	○	○	○	○		●	○
3	○	○	●	○	○	●	or	→ ○ →	○
4	○	○	●	○	○	○		●	○
5	○	○	○	●	○	●	or	→ ○ →	○
6	○	○	○	●	○	○		●	○
7	○	○	○	○	●	●	or	→ ○ →	○
8	○	○	○	○	●	○		●	○

Note: In reverse only 4 speeds can be engaged

Black dots indicate clutches which are applied for each gear ratio.