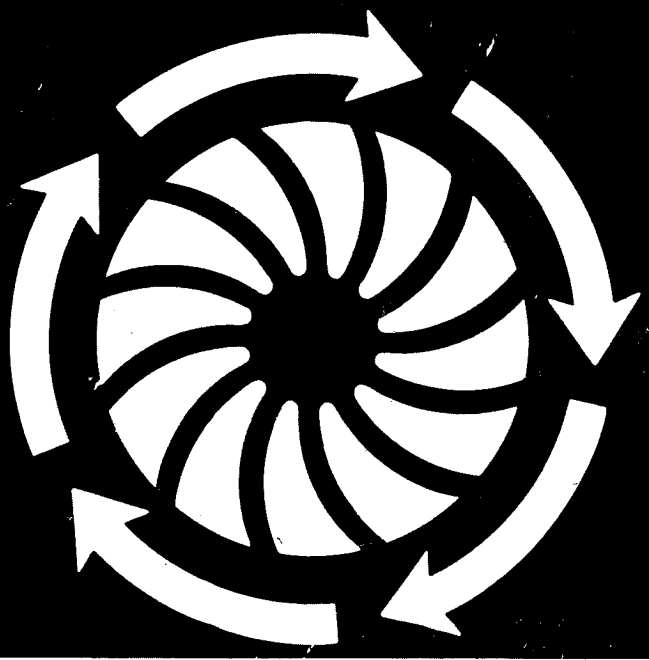
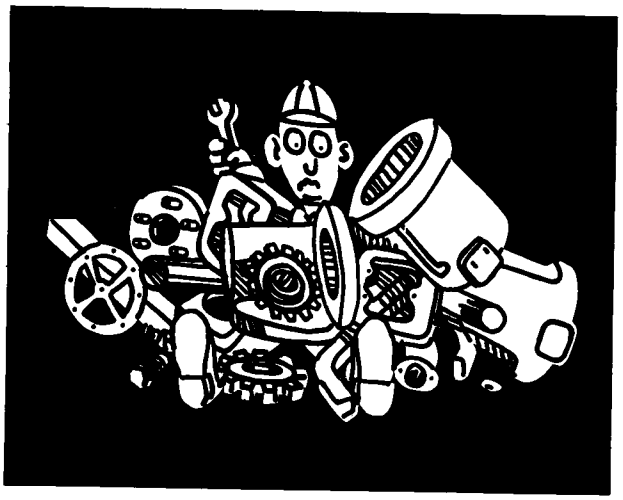
TORQUE CONVERTER THEORY 9008



CLARK
Michigan Company

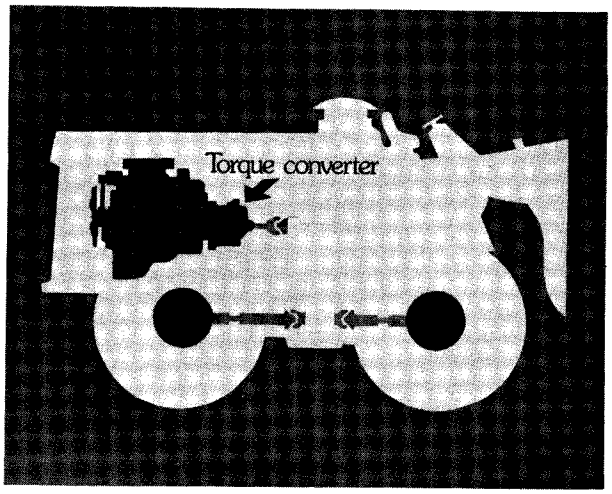
CLARK TORQUE CONVERTERS

Theory of Operation



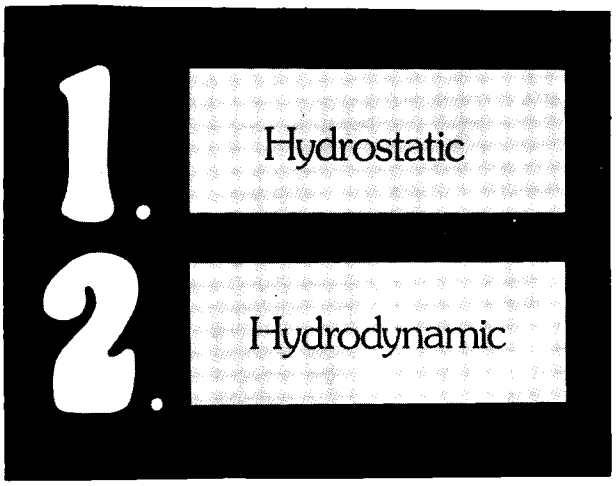
What do you do when your Torque Converter goes "CRUNCH" instead of running properly? Well that depends. It might be a simple repair. . . or you might have to take it apart down to the last washer.

In any case, it's a good thing to know just how a Torque Converter works.



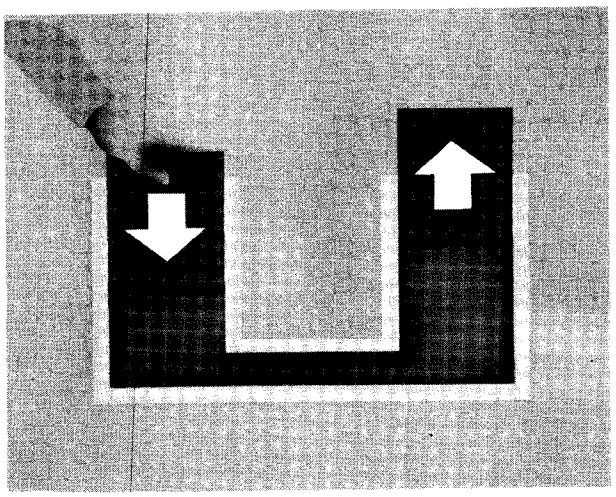
A Torque Converter is a device which transmits force and motion from an engine to a transmission by means of hydraulic oil. There are really only two kinds of systems that transmit energy hydraulically.

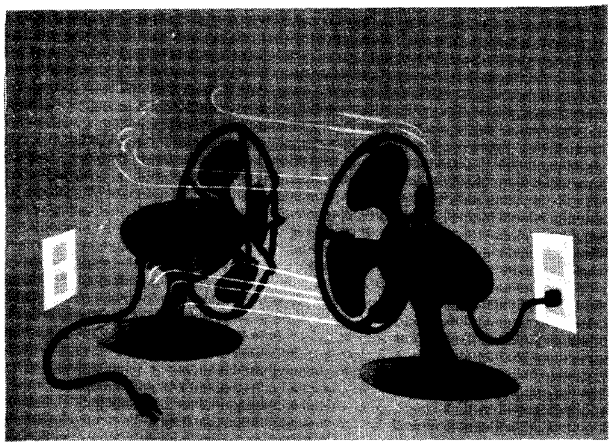
They are called hydrostatic and hydrodynamic systems.



Hydrostatic systems work on the principle that a confined liquid will transmit pressure.

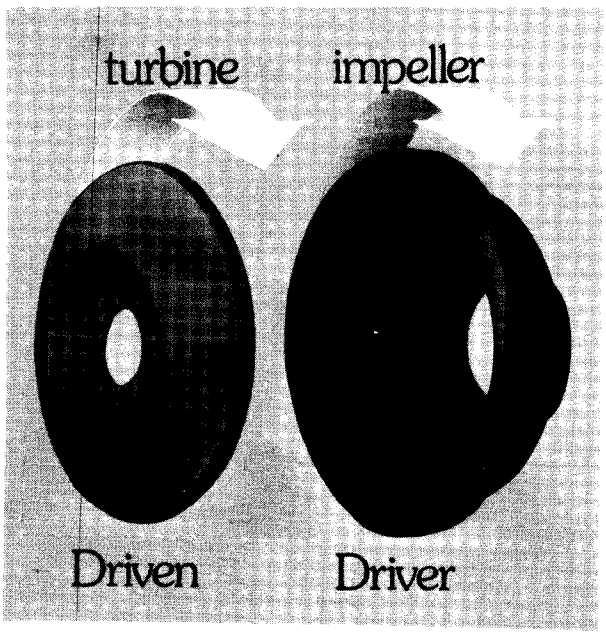
It is the systems used in construction machinery for brakes, steering, implement controls and so on.



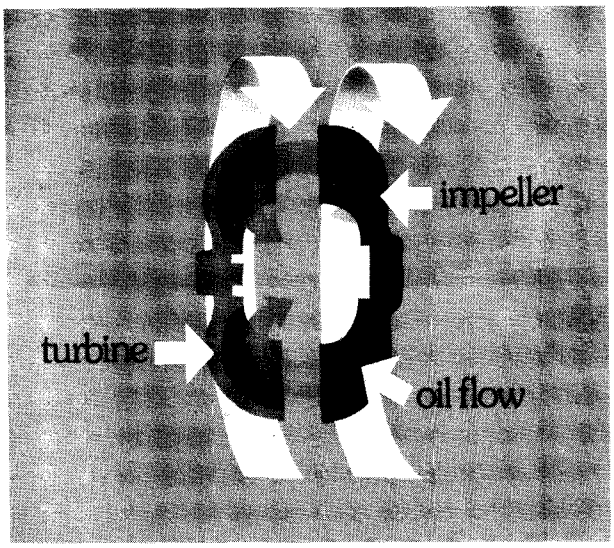


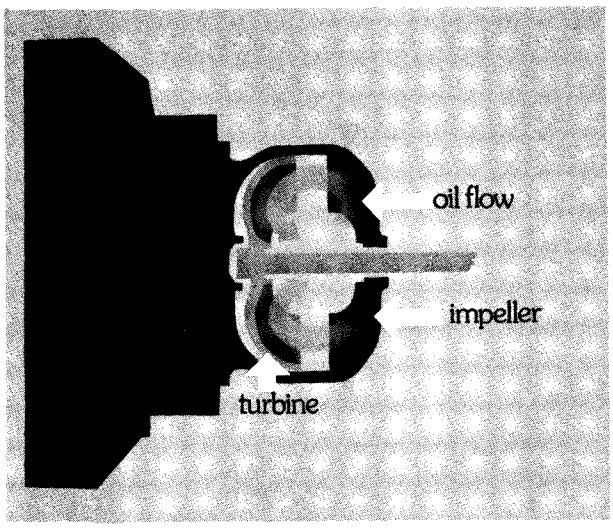
Hydrodynamic systems work on the principle that a fluid in motion has force. For instance if you look at two fans facing each other and one is plugged in and the other isn't, you would see that the electrically driven blades were forcing air toward the blades of the unplugged fan. This flow of air has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

A fluid coupling is something like the two fans. The fan on the right is called an impeller and it is driven by the engine.



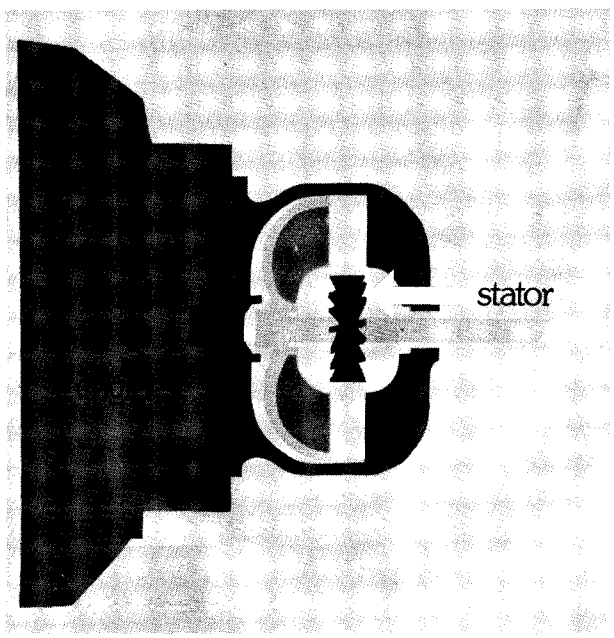
As the impeller rotates, oil in the impeller flows outward because of centrifugal force.



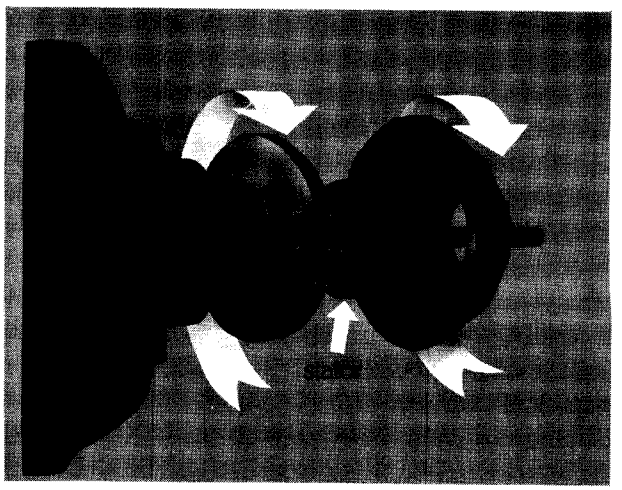


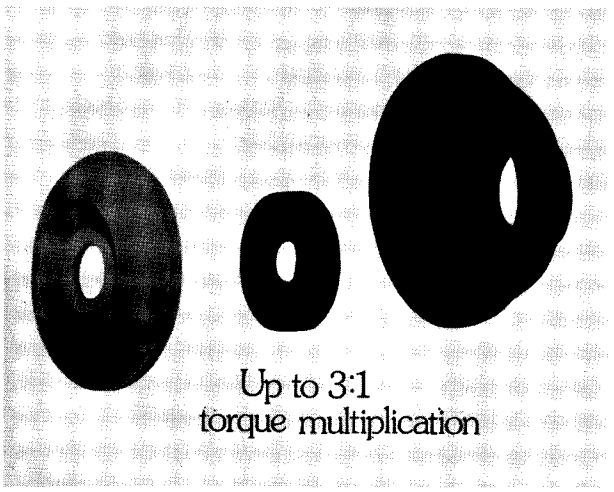
This outward flowing oil leaves the impeller and strikes the blades of the second fan called a turbine, so you can see that it is the force of this flowing oil that causes the turbine to rotate. This fluid coupling is complete and energy is transmitted from one member to the other through oil flow.

A Torque Converter operates on the same principle as the fluid coupling but uses one additional member called a stator.



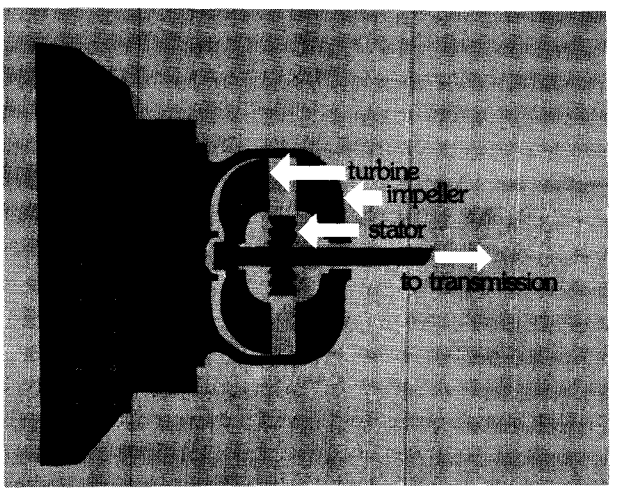
Why a stator you may ask. Well simply to multiply Torque.



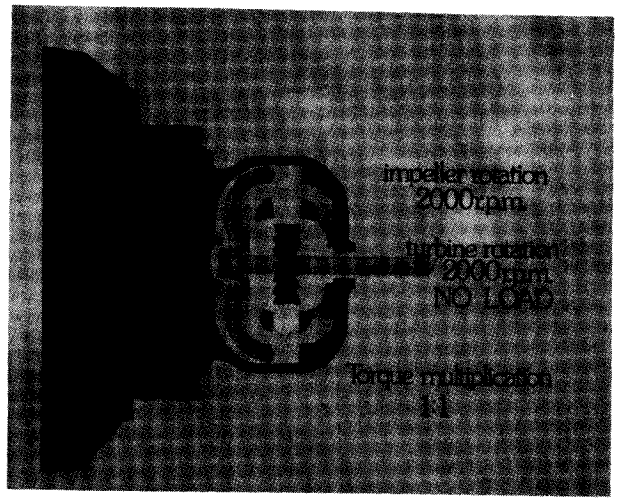


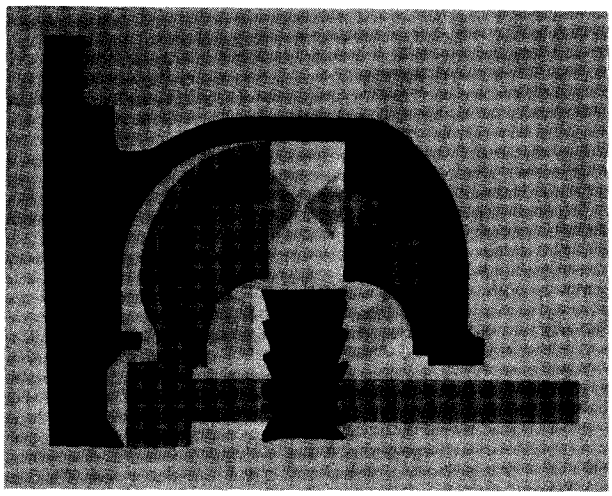
Clark Converters can multiply Torque as much as three-to-one (3 to 1). If the engine develops 100 foot pounds, the converter can increase the Torque to 300 foot pounds all because of the stator. The fluid coupling has no stator and can not multiply Torque.

The impeller is connected to the engine fly wheel and rotates whenever the engine is on. The stator is mounted on a support and does not rotate. The turbine mounted on the turbine shaft is connected to the transmission through gearing and a prop shaft. Here is how these three members the impeller, the turbine and the stator work together to multiply Torque.



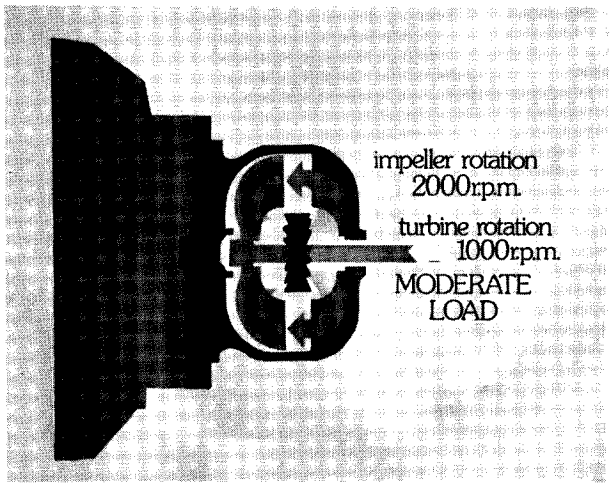
Suppose that your machine is traveling on a smooth flat surface with no load and the engine is turning at 2000 RPM. The impeller, because it is connected directly to the engine, is also turning at 2000 RPM and with no load, the turbine matches that 2000 RPM speed. With the turbine and impeller rotating at the same speed, each create the same centrifugal force.



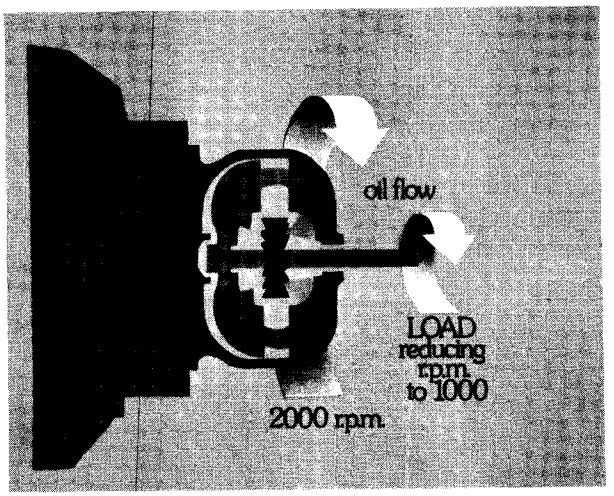


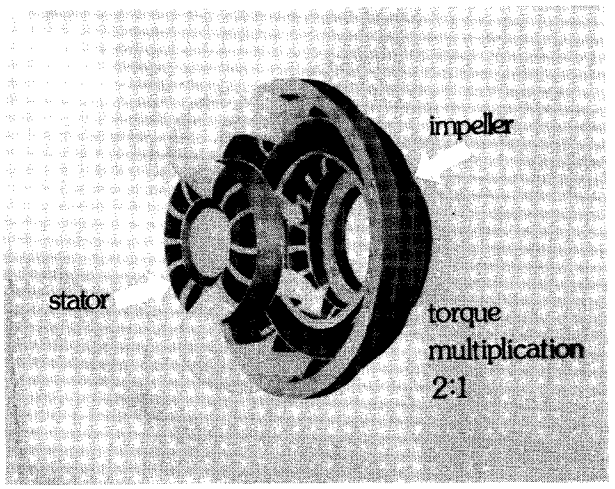
The oil which trys to leave the impeller is counteracted by the oil which trys to leave the turbine. The result is that both members and the oil rotate as one mass.

Now suppose that your machine is placed under a load which reduces the turbine speed to 1000 RPM. The engine and impeller will still turn at 2000 RPM. Now the turbine has only about half the centrifugal force of the impeller. As you can see, this would cause a flow of oil from the impeller through the turbine.



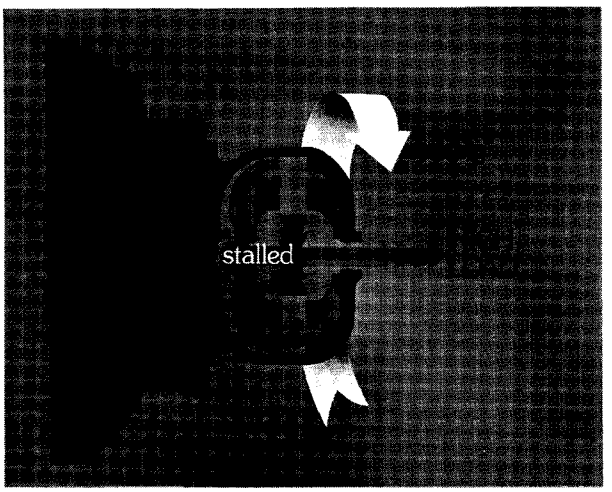
But even after the oil flows through the turbine, it is still moving rapidly and has force. This is where the stator comes in.



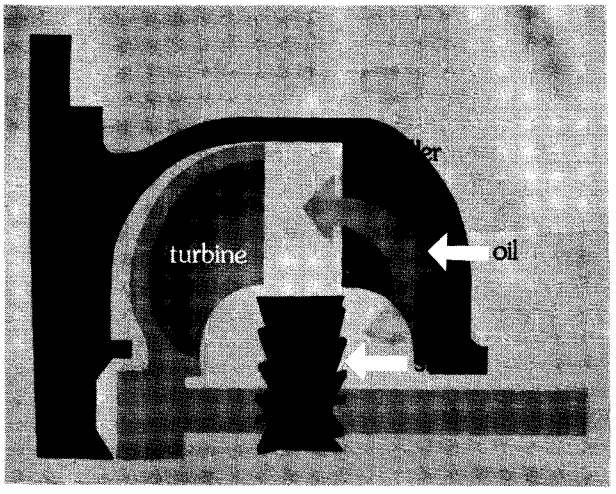


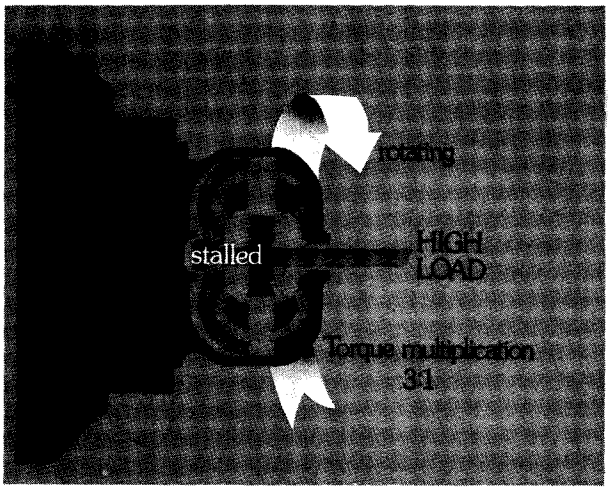
The stator redirects the oil flow so that the oil strikes the blades of the impeller in the same direction as the impeller is rotating and that is what multiples Torque. In this case about two-to-one (2 to 1). Now let us take it one step further.

If enough load is placed on the machine to stall the turbine, the turbine would lose all centrifugal force



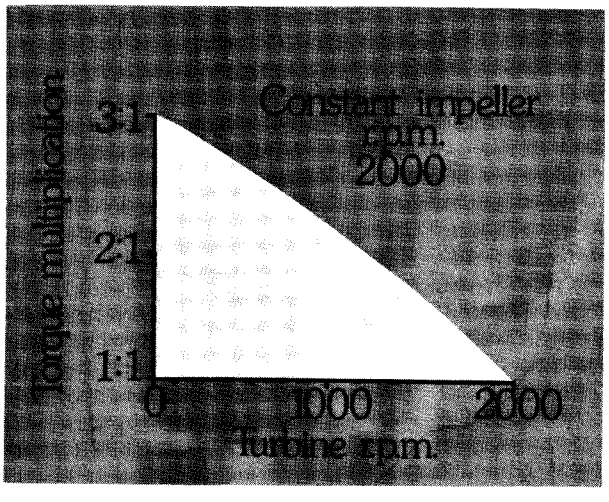
but the impeller would continue to turn at engine speed and would continue to generate centrifugal force.





Because there is more force available in the form of increased oil flow, the Torque multiplication is now about three-to-one (3 to 1). You could sum it up this way.

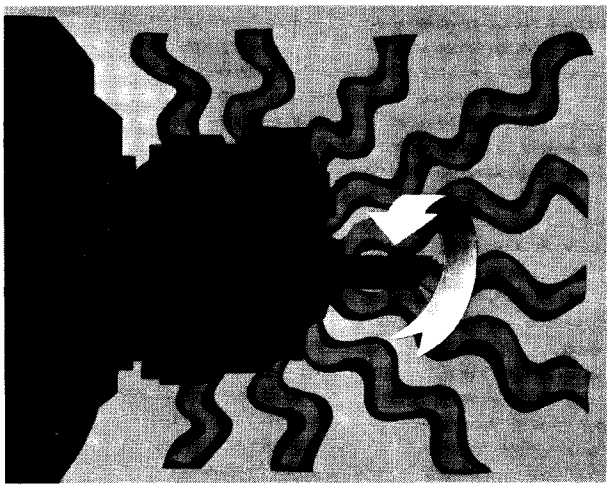
When both members are rotating at the same speed, Torque multiplication is zero "0". When the turbine rotates at half the impeller speed, the Torque is multiplied two-to-one (2 to 1). When the turbine is topped or almost stalled, the Torque is multiplied three-to-one (3 to 1) and this Torque multiplication is infinitely variable between one-to-one (1 to 1) and three-to-one (3 to 1).



Of course, there are other factors that effect Torque multiplication besides the relative speeds of the turbine and impeller – like the number of blades on each of the three members and the angle at which these blades are mounted.

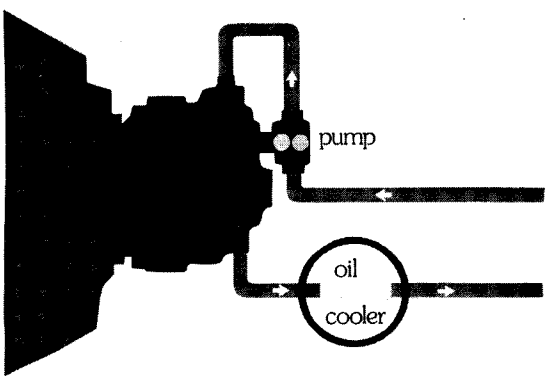
Factors of torque multiplication

1. Relative speeds of impeller and turbine.
2. Number of blades in stator, impeller and turbine.
3. Angle of blades in stator, impeller and turbine.

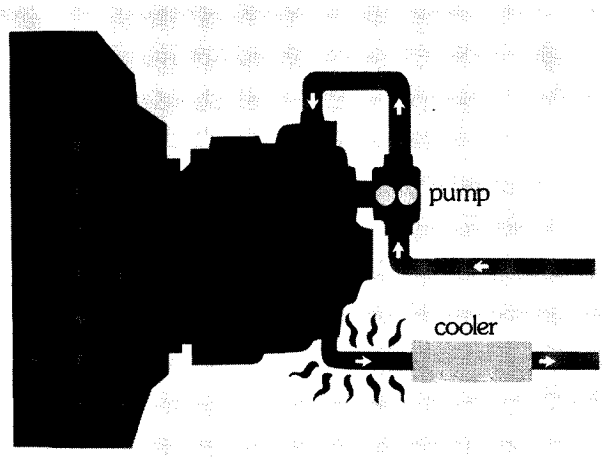


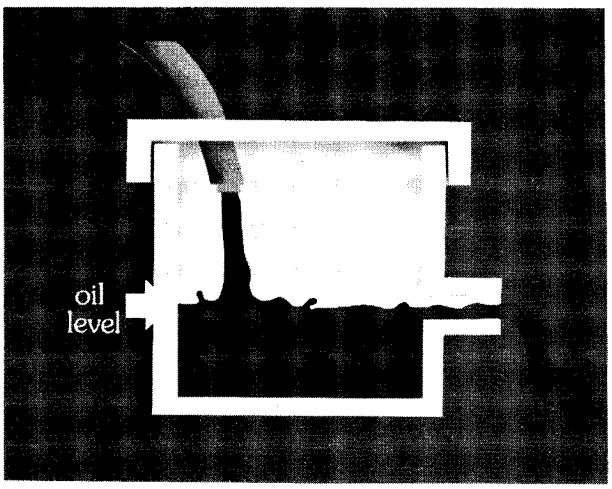
Like all other man-made machinery, the Torque Converter is not 100 per cent efficient. Because the members are not mechanically connected, there is some oil slippage and the result is heat.

By adding a pump and an oil cooler, excess heat caused by lost motion and friction can be removed from the converter. The pump is used to supply the converter with cool filtered oil and to force hot oil from the converter through the oil cooler.



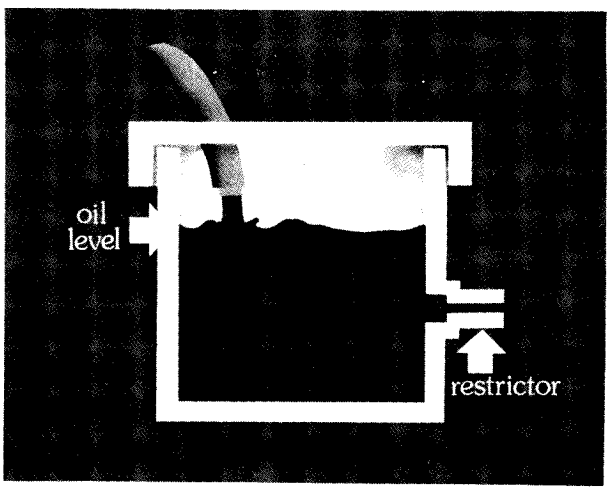
The oil cooler receives hot oil from the converter, cools it and returns it to the system. Coolers also create some back pressure which helps to keep the converter full of oil. To understand how back pressure helps to keep the converter full, consider this example.



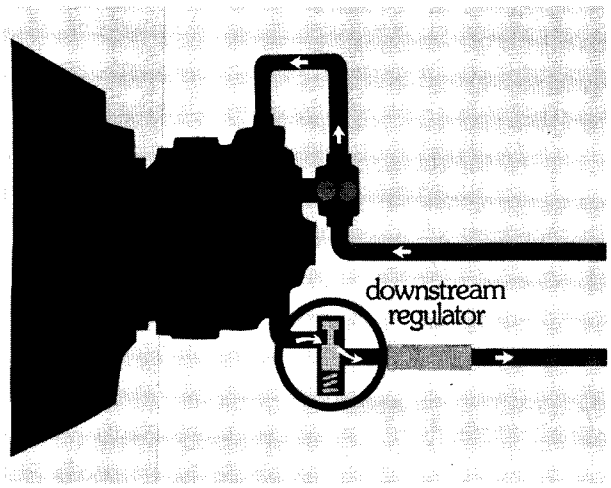


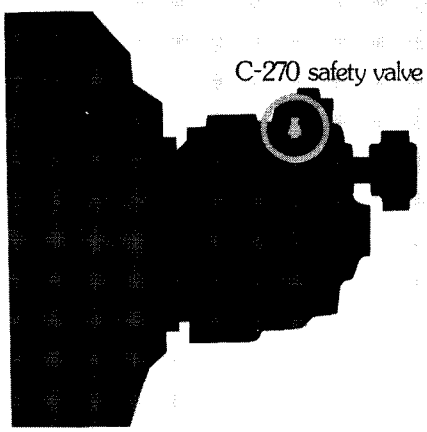
If a container with a drain hole is receiving a constant flow of oil, the level of oil in the container will be near the top of the drain hole.

But if the same container receiving exactly the same amount of flow is fitted with a smaller drain hole, the oil level in the container will be higher. The container can be compared to a Torque Converter and the smaller hole to the restriction caused by the cooler.



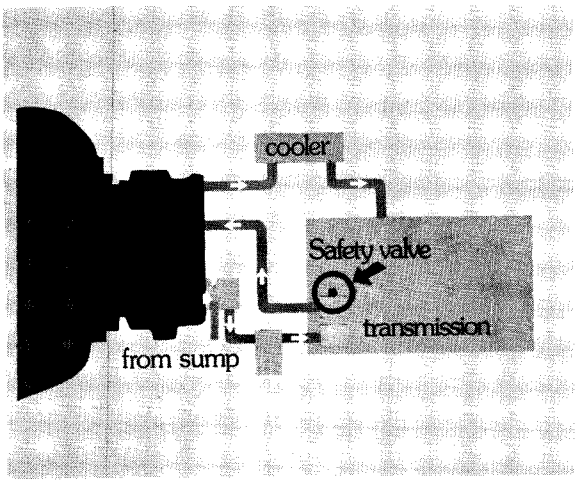
Some converters are also fitted with a down stream regulator valve. The oil leaving the converter must push the down stream regulator spool against a spring. This creates back pressure within the converter and keeps it full of oil.



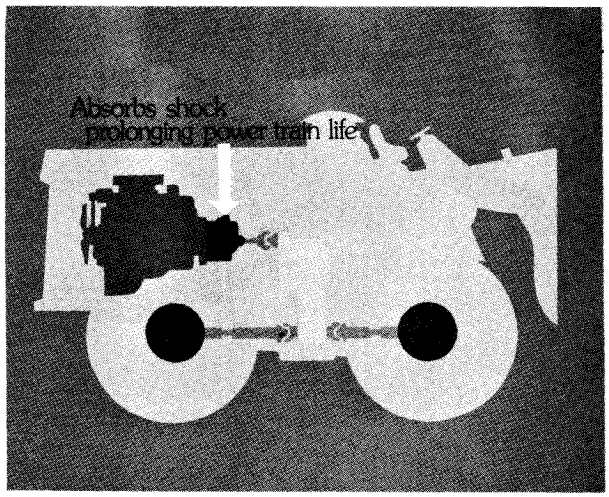


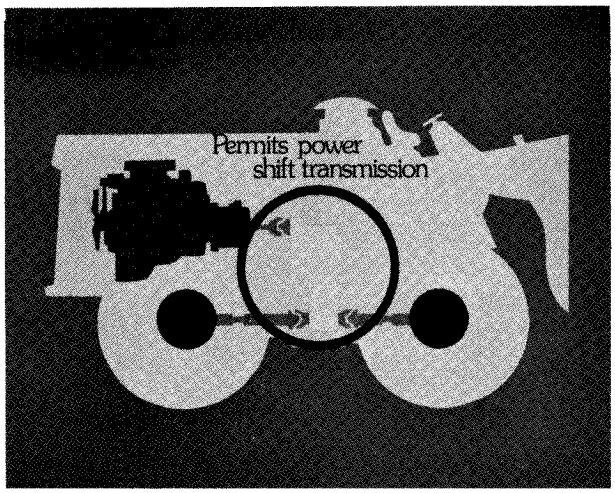
All C270 Converters have a relief valve. If oil flow is restricted, the valve will open to relieve excess pressure.

Other models of Clark Converters do not have pressure relief valves. However, the transmission control valve contains a safety valve which serves exactly the same function.



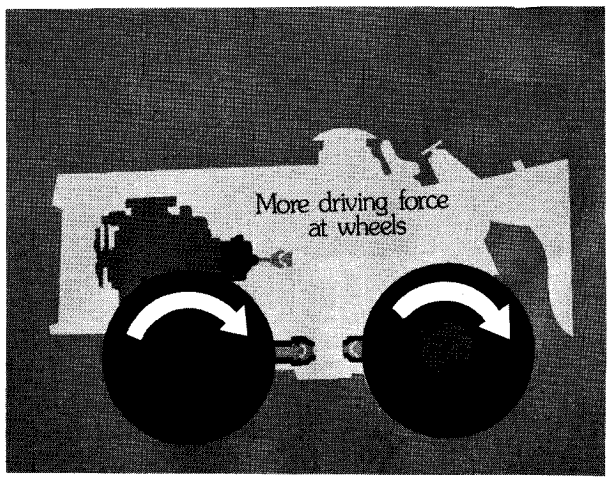
Clark Torque Converters have several advantages. They absorb shock which prolongs power train life.



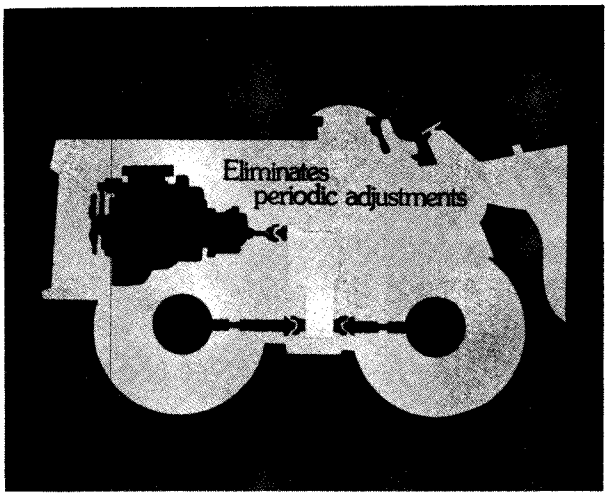


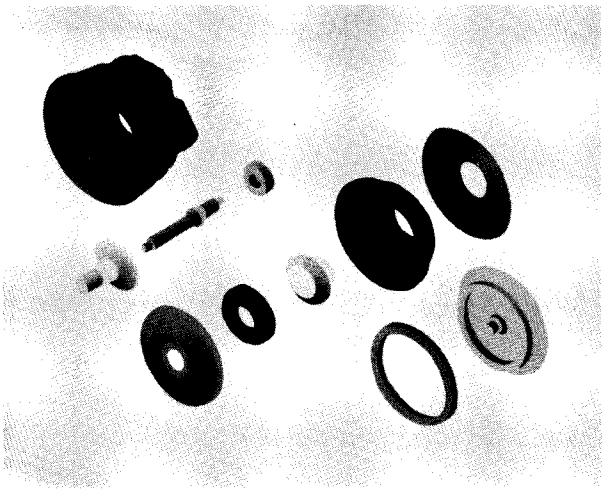
They permit the use of a power shift transmission which can permit quick gear changing even under load.

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



They require no periodic adjustments

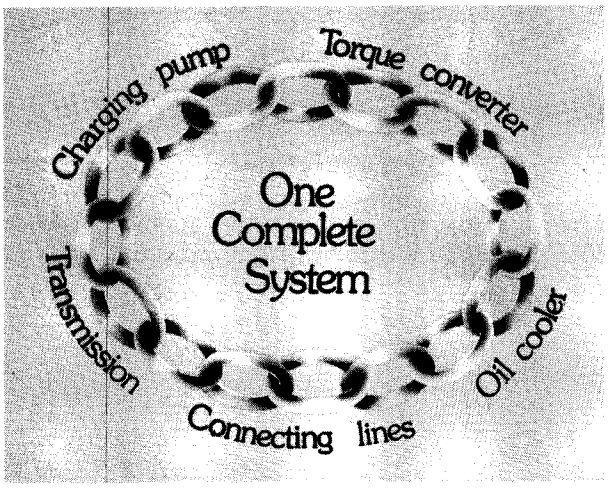




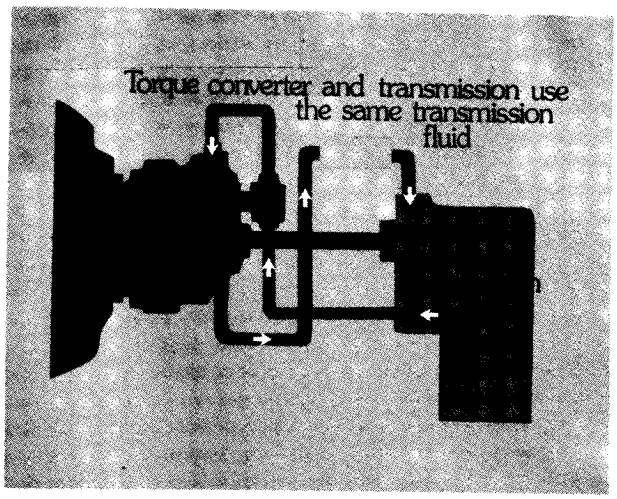
and they do not use complicated components.

Now here are some common Torque Converter problems and trouble-shooting procedures.

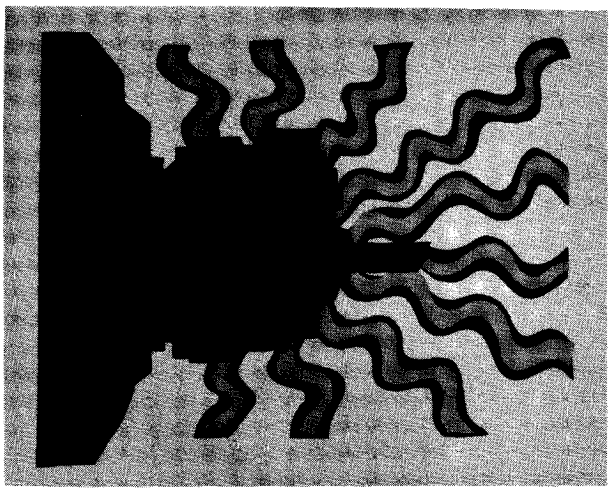
First of all, it is essential to remember that the converter charging pump, the Torque Converter, converter oil cooler, the transmission and the connecting lines must be considered as one complete system. A fault in one component can cause a problem to appear in another component.



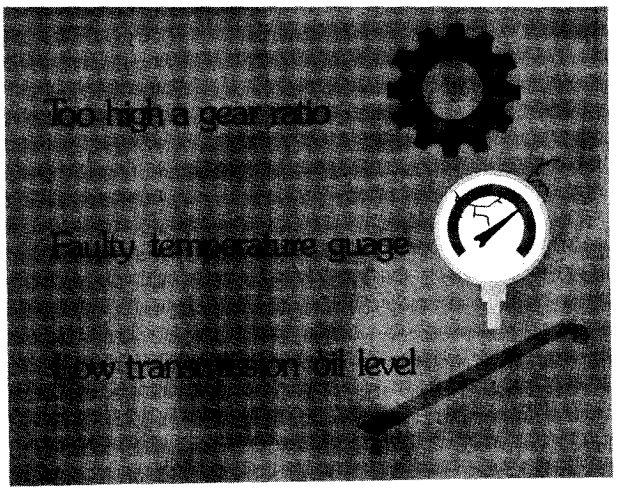
Remember, that related components require related checks.



Remember that the Torque Converter and transmission use the same transmission fluid. Make certain that the transmission fluid used in the machine is as specified in Clark's Operator and Maintenance Manuals and that the transmission oil level is correct.

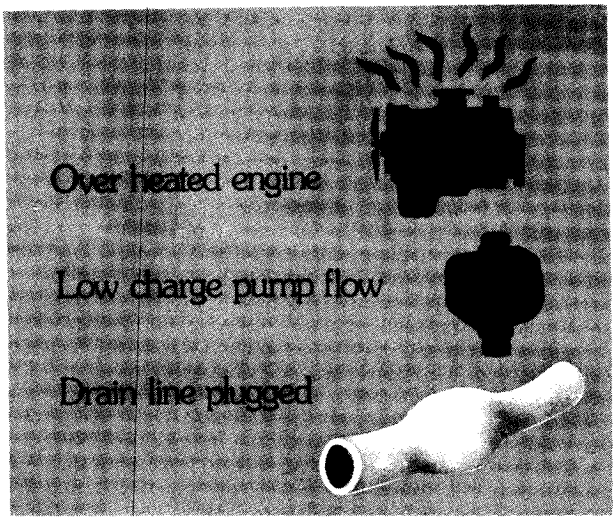


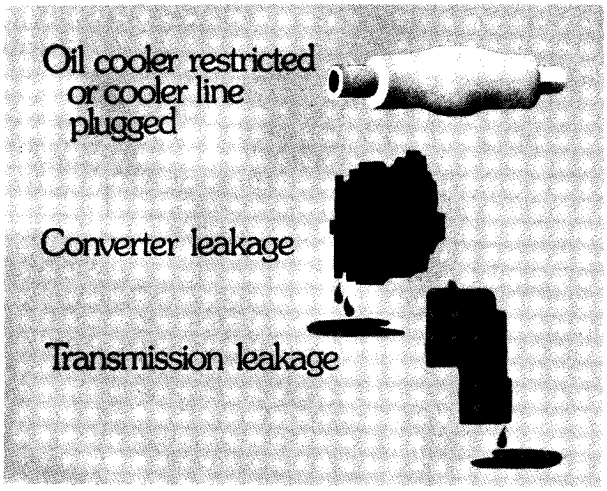
One of the most common problems with a Torque Converter is overheating. There are many causes for an overheating converter several of which are not the fault of the converter. Do not remove the converter and dive into a complete disassembly before checking all the possibilities.



Here are some of the possible causes for an overheating Torque Converter: operating the machine in too high of a gear ratio, a faulty temperature gauge, low oil level in the transmission,

an overheating engine, low charge pump flow, a converter drain line plugged,





a converter oil cooler plugged, a restriction in the cooler lines, excessive converter leakage and excessive transmission leakage.

Before condemning a converter, be sure to install gauges and measure pressures as described in the Maintenance or Shop Manual. Many times a problem which appears to be the fault of the converter is not the converter at all but the fault of a related component.

Always refer to the proper shop manual for specifications and disassembly, assembly procedures.