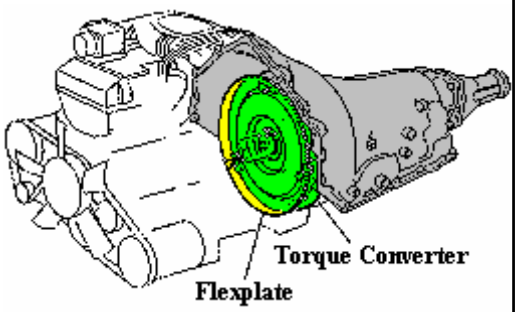
Torque Converters

Function

The torque converter connects and transfers power from the engine's crankshaft to the transmission input shaft. It can act as a clutch to stop this power flow when the vehicle stops. The converter can also multiply torque to improve vehicle performance.



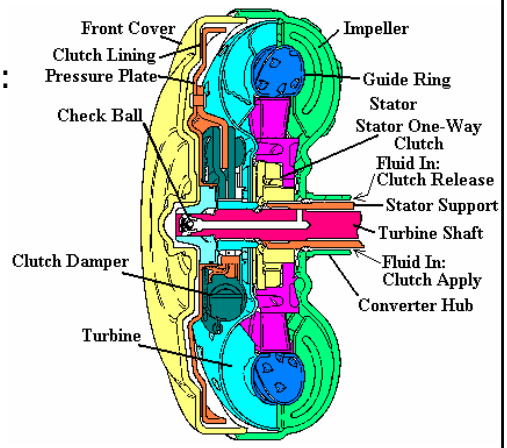
Internal Components

Modern lockup converters have four major internal components:

An impeller,
A turbine,
A stator, and
A clutch plate with lining.

Other minor components complete the converter.

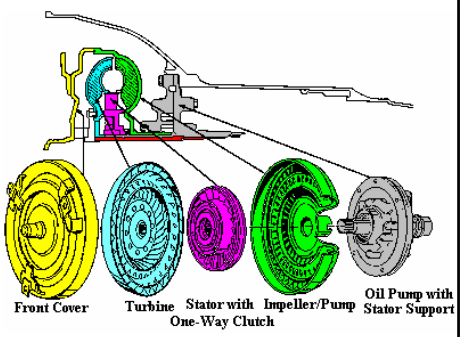
Older converters had three major elements.



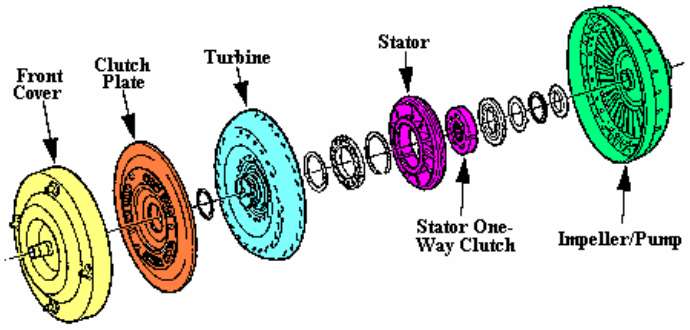
Three Element Converters

These non-lockup converters had a turbine, stator, and impeller. Some manufacturers call the impeller a pump.

Three elements converters were used with most automatic transmissions until the late 1970s.



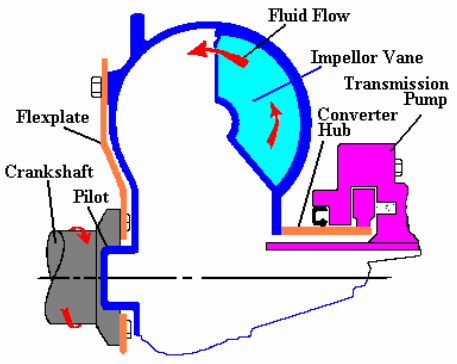
Four Element Converters



Modern lockup converters add a fourth element: the clutch plate to be used with the turbine, stator, and impeller

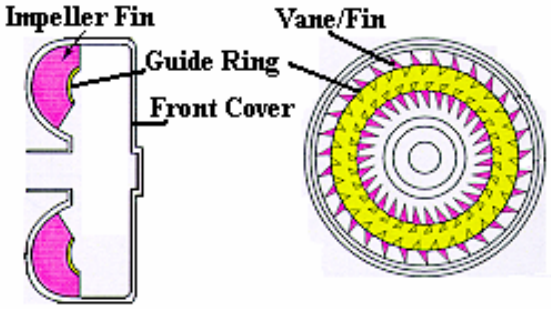
Impeller

The converter housing with the impeller fins is attached to the flexplate that is bolted to the engine crankshaft. A pilot at the front of the converters fits into a recess in the crankshaft so they will be centered to each other. The converter hub at the rear drives the transmission pump



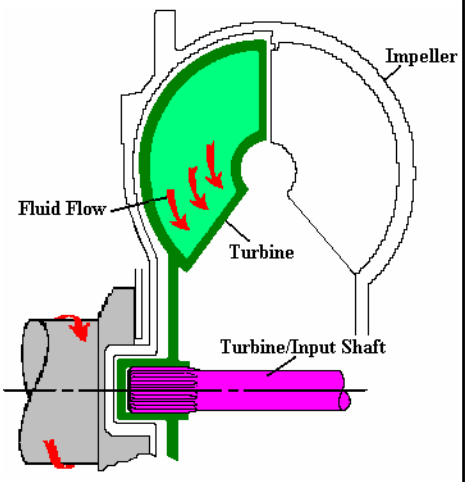
Impeller Construction

The impeller fins are attached to the transmission end of the converter housing. A fluid guide ring is attached to the inner-most edge of the fins.

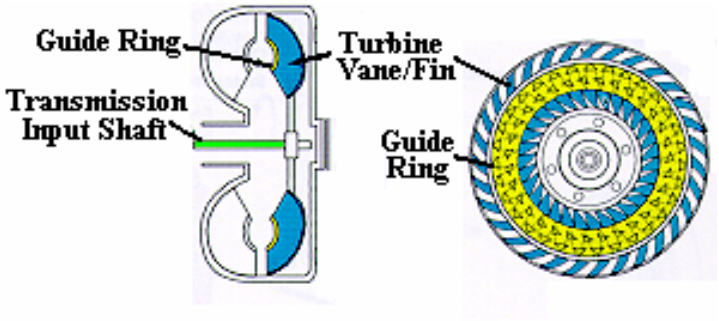


Turbine

The turbine also has fins, and these face the impeller. The transmission input/turbine shaft is connected to the center of the turbine by a set of splines.



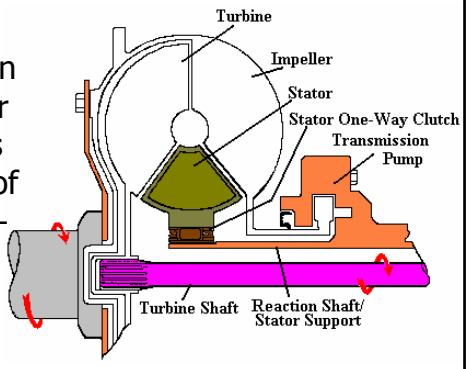
Turbine Construction



Like the impeller, the turbine has a set of fins with a guide ring attached to it.

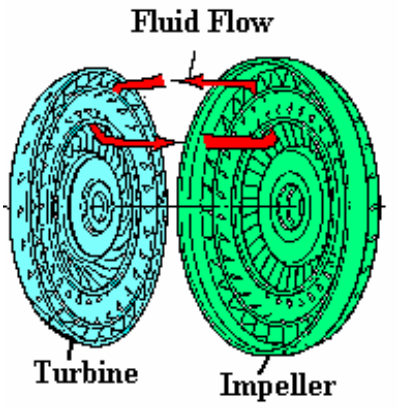
Stator

The stator can be a stationary member. It has fins and a portion of the fluid guide ring. The stator also has a one-way clutch that is connected to the reaction shaft of the transmission pump. The one-way clutch allows the stator to rotate freely in the direction of engine-rotation, but prevents rotation in the opposite direction.



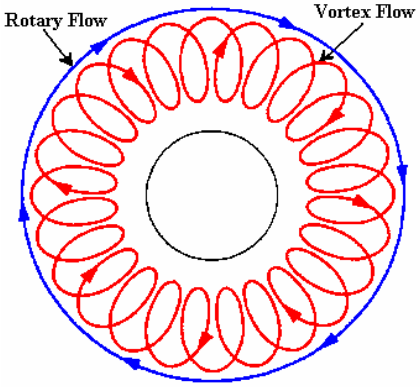
Fluid Flow

When the engine is running, fluid that is thrown outward from the impeller and enters the turbine. This is called vortex flow, and it is used to transfer power from the impeller to the turbine.



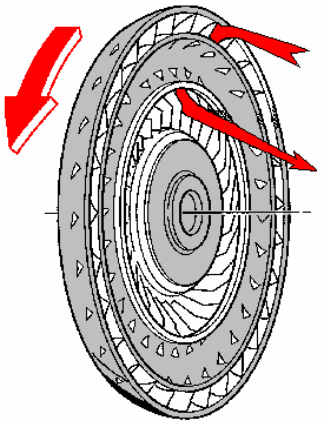
Rotary and Vortex Flow

Vortex flow occurs when the impeller is turning faster than the turbine. Rotary flow occurs because the impeller is spinning. These flows drive the turbine and the transmission.



The Need For a Stator

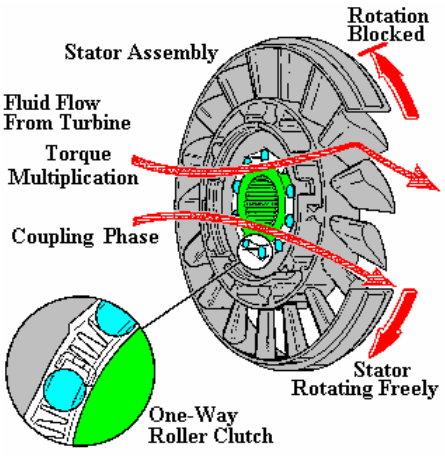
Fluid leaving the impeller is traveling in a clockwise direction, the same as the engine. When it strikes a stationary or slower moving turbine, it will bounce back and travel in a counterclockwise direction. This flow direction is the wrong way, and it will try to slow down the impeller.



Stator Operation

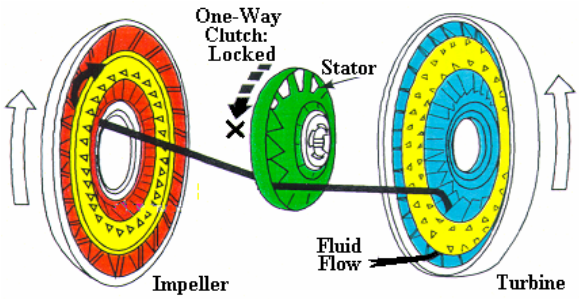
During low turbine speeds, the fluid flow strikes the inside of the stator fins. This locks the one-way clutch, and the stator fins turn the fluid flow in the direction of impeller rotation.

At higher turbine speeds, fluid flow strikes the back of the stator fins, and the stator rotates along with the turbine and impeller. This is the Coupling Phase.



Animation: TC Operation

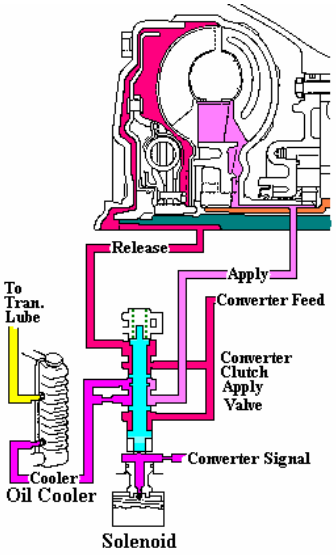
Torque Multiplication



Torque multiplication is accomplished by the stator turning the fluid flow from the turbine. The left over energy in this flow is returned to the impeller. This energy adds to the energy being put into the fluid from the engine.

Cooler Flow

The action inside a converter heats the fluid. The fluid leaving the converter is routed to the cooler in the radiator and then it returns to the lubrication passages in the transmission. The converter clutch apply valve will reverse the fluid flow in the converter to apply the converter clutch.



The Need for a Converter Clutch

Converter efficiency at stall is 0% and this efficiency increases to about 90% during the coupling phase. Slippage still occurs. A torque converter clutch (TCC) stops that slippage.