Tech Sez:

SUCCESS OF A NEW UNIT IS YOUR BABY!!

Did you ever stop to think just how important your job as a mechanic is to the reputation of our cars? You haven't? Well, let's talk about it for a minute.

Sure, the engineers and the designers and a lot of other folks have spent a lot of time and money making our cars the best that money can buy. Take this new engine-fed torque converter, for example. It's one of the newest features. But ... how good a job you do on servicing this unit, how well you understand how it operates, and what you can do to keep it operating efficiently can mean the success or failure of this or any other unit. You—the mechanic—are one of the team that makes, and keeps, our cars right up at the top of the "preferred" list when people start talking about buying an automobile.

That's why you'll like this reference book on the new engine-fed torque converter. We're going to give you the story on how the unit operates, how to drain and refill the system and—But wait a minute, let's take a look at the index and get the complete story.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERAL</td>
<td>4</td>
</tr>
<tr>
<td>DETAILED DESCRIPTION</td>
<td>5</td>
</tr>
<tr>
<td>OPERATION</td>
<td>9</td>
</tr>
<tr>
<td>OIL CAPACITY AND WEIGHT</td>
<td>10</td>
</tr>
<tr>
<td>OIL PUMPS—6- and 8-CYLINDER CARS</td>
<td>11</td>
</tr>
<tr>
<td>SERVICE DIAGNOSIS</td>
<td>13</td>
</tr>
<tr>
<td>EXCESSIVE SLIPPAGE</td>
<td>13</td>
</tr>
<tr>
<td>LEAKAGE</td>
<td>15</td>
</tr>
<tr>
<td>MAINTENANCE</td>
<td>16</td>
</tr>
<tr>
<td>DRAINING AND REFILLING</td>
<td>16</td>
</tr>
<tr>
<td>OIL FILTER REPLACEMENT</td>
<td>17</td>
</tr>
<tr>
<td>REMOVING THE TORQUE CONVERTER</td>
<td>17</td>
</tr>
<tr>
<td>INSTALLING THE TORQUE CONVERTER</td>
<td>19</td>
</tr>
<tr>
<td>SERVICING THE TORQUE CONVERTER</td>
<td></td>
</tr>
<tr>
<td>HOUSING ASSEMBLY</td>
<td>22</td>
</tr>
<tr>
<td>ASSEMBLING THE CONVERTER</td>
<td></td>
</tr>
<tr>
<td>HOUSING ASSEMBLY</td>
<td>25</td>
</tr>
</tbody>
</table>
GENERAL

There are two types of torque converters being used in our cars. The integral pump type was described in Volume 5, No. 1. This book will describe the other type, generally identified as the "engine-fed" torque converter.

The converter unit consisting of the impeller, the turbine and the stators is the same in both converters. The differences in external appearance are the presence of cooling fins welded to the rear face of the converter unit of the engine-fed design, and the fact that the ring gear is mounted on the converter unit instead of on a flexible plate.

The engine-fed torque converter receives its oil supply from the engine. The system, including the engine and the torque converter, holds thirteen quarts of oil. The engine oil pump pumps the oil into the converter, where it is maintained at a pressure of about twenty pounds. When the pressure exceeds twenty pounds, a pressure regulator valve is forced off its seat, allowing the oil to return to the engine oil pan.
DETAILED DESCRIPTION

The converter unit is bolted to the crankshaft, and is enclosed in a magnesium housing. Between the housing and the rear face of the engine block is a cast-iron adapter plate. This plate contains oil passages which register with the inlet and outlet openings in the block and with the oil passages in the housing. The oil outlet hole in the engine block is at the rear end of the main oil gallery.

Rear of 6-cylinder engine

Adapter for 6-cylinder engine

Rear of 8-cylinder engine

Adapter for 8-cylinder engine
From there oil passes through the adapter plate, into a passage in the converter housing, and into the converter. Returning from the converter, oil flows through return passages in the housing and in the adapter plate, and enters the engine through another opening in the rear face of the engine block. Seals located at these openings prevent oil leakage between the engine block, adapter, and torque converter housing.

In the hub portion of the reaction shaft is a diagonally drilled metering orifice which controls the flow of oil to the converter and also helps to maintain engine oil pressure to the bearings. In the shaft portion of the reaction shaft are two holes through which oil flows into the converter unit.

The shaft portion of the turbine shaft, which rotates within the reaction shaft, is provided with two oil rings and two sets of oil holes. One hole, located near the forward end of the shaft, allows oil to flow from the converter into a larger, centrally drilled hole in the shaft. Two holes, drilled in the rear end of the shaft, allow the oil to pass into the oil return passage in the housing.
Oil rings are installed in grooves located near the rear and central portion of the shaft. The portion of the outside of the shaft located between the oil rings is undercut to provide a cavity for oil as it enters the shaft from the engine.

STUDY THESE PICTURES CAREFULLY!
The oil pressure regulator valve consists of a steel plug pressed into the rear end of the shaft, a twenty-pound coil spring, and a steel ball. The ball is located forward of the spring and is held against its seat by spring pressure.
OPERATION

When the engine is started, oil is fed to the rear end of the engine main oil gallery. From the gallery it passes through the oil entry hole in the rear face of the cylinder block and into the oil passage in the adapter. From this point, the oil then flows into the converter housing and through another drilled passage to the hub section of the housing.

Here the oil enters the metering orifice drilled in the flange of the reaction shaft. This orifice meters the flow of oil into the converter. The inner part of this orifice is of smaller diameter than the outer or entry portion.

After leaving the orifice, the oil flows into the cavity between the reaction shaft and the turbine shaft, provided by the undercut and oil rings on the shaft portion of the turbine shaft. The oil then flows forward and passes into a drilled hole in the shaft portion of the reaction shaft which provides a passage into the torque converter.

After the oil has circulated through the converter it leaves on its return trip to the engine, through a hole drilled near the forward end of the turbine shaft. Oil flow is then rearward, through the centrally drilled passage in the turbine shaft, to the regulator valve at the rear end of the passage.

When the oil pressure exceeds twenty pounds per square inch, the ball is pushed off its seat and the oil is allowed to flow into other drilled passages in the rear end of the turbine shaft, just beyond the rear oil ring. From this point the oil circulates around the turbine shaft bearing and enters the oil return passage in the housing. Oil then flows through the adapter and into the engine through the return passage.
When the oil returns to the engine, it enters a vertically positioned pipe located at the rear end of the oil pan. This pipe extends almost to the bottom of the pan.

By passing the oil into the oil pan by this means, foaming is eliminated. This method also prevents extreme fluctuation in oil level.

**OIL CAPACITY AND WEIGHT**

The total capacity of the combined engine, the engine oil filter and torque converter oil system is thirteen quarts. However, if the filter is not changed at the time of oil change the capacity of the system is one quart less—or twelve quarts. The oil filter and its lines hold approximately one quart of oil.

The same weight of oil specified for the engine is used with the combined engine and converter system. Detergent or non-detergent oil can be used safely.
OIL PUMPS, SIX- AND EIGHT-CYLINDER CARS

Remember, we said that the oil pump, in addition to supplying oil to the engine, also kept the torque converter full all the time, under a pressure of about twenty pounds. So, let's take a look at the oil pump.

The engine oil pump on the eight-cylinder jobs is located in the engine oil pan, and contains a combination pressure regulator and internal by-pass valve. This is to permit the by-passed oil to be recirculated in the system instead of being returned to the oil pan.
On the six-cylinder jobs the pump is *externally* mounted, and incorporates a by-pass valve in the pump cover. This by-pass valve likewise permits re-circulation of the oil within the pump, rather than allowing that oil to be returned to the oil pan.

![Oil Re-circulates Within Pump](image)

On six-cylinder models, equipped with the engine-fed torque converter, the regulator valve in the side of the block insures lubrication to the main oil gallery when the filter is clogged.
SERVICE DIAGNOSIS

To produce the maximum efficiency, the oil pressure in the converter must be maintained to a pressure of at least twenty pounds per square inch. So, if any excessive slippage occurs, indicated by poor acceleration and high engine speed, it could be due to loss of this oil pressure within the converter.

EXCESSIVE SLIPPAGE—This condition can be checked by comparing the performance of the car against that of other cars equipped with this type torque converter.

Loss of oil pressure could be caused by foreign matter being on the regulator valve seat in the turbine shaft, preventing the ball from seating properly; or it might be caused by a broken regulator valve spring. Either of these conditions could cause slippage within the converter.
To correct the cause of excessive slippage we would have to disassemble everything down to the regulator valve in order to replace the spring. This would mean removing the transmission and the clutch to get at the end of the turbine shaft, which contains the regulator valve.

Slippage may sometimes be encountered in cars which have been left standing for several days. During that inactive period some oil is apt to drain out of the converter and back into the engine. Then, when the car is driven, a slight whirring noise, coupled with slippage, will occur for a few moments until the converter again fills up with oil. This is a normal reaction, and there is nothing to worry about. If the owner will let the engine run at fast idle for two or three minutes before driving the car, the excessive slippage will never be noticed.

However, a constant slipping condition would indicate leakage past the regulator valve ball, a broken pressure regulator spring or, perhaps, in some cases, may be traced to clutch slippage.
LEAKAGE AT "O" RINGS—You'll find "O" rings between the engine and the adapter and between the adapter and the torque converter housing. In addition, small aligning sleeves located between the housing and the adapter help to hold the "O" rings in place.

If those "O" rings are not properly installed you might get an external oil leak—or an internal leak. An external leak might show up between the engine and the adapter plate, coming from the "O" ring between the adapter and the engine, or from one of the plugs in the converter housing oil passage.

If oil is found in the torque converter housing or the clutch housing it may be coming from the "O" rings between the adapter plate and the housing, from the converter hub seal or the rear main bearing. These leaks would be classified as internal leaks.

Oil in the clutch housing could be from the pressure regulator valve plug or from the turbine shaft seal.
MAINTENANCE

DRAINING and REFILLING—The oil change frequency is twice a year, spring and fall, or as seasonal temperatures require.

CHANGE TWICE A YEAR

SPRING   FALL

When draining the oil from the system it is necessary to drain the engine and the converter separately. To drain the converter, remove the plate at the bottom of the housing. Then revolve the converter until the drain plug is at the lowest point. Remove the plug and allow the oil to drain. Since the converter is a sealed unit it will take a few minutes for all the oil to drain out.

CAUTION: The oil is apt to be pretty hot, so take care not to be burned when you remove the plug.

After all the oil has drained out, install the plug, using a new gasket. Tighten the plug to a torque reading of forty-five to fifty foot-pounds.
OIL FILTER REPLACEMENT—Because of the large quantity of oil used in the combined oiling system and the need for keeping the oil as clean as possible, the oil filter element must be replaced at least every five thousand miles. If the car is operated in extremely dusty territory or in stop-and-go driving, or short runs in cold weather, it may be necessary to change the filter element more frequently. However, it usually is not necessary to change the oil except as the seasons change—twice a year.

 REMOVING THE TORQUE CONVERTER—Suppose, for example, that we find an external leak at one of the “O” rings between the adapter plate and the engine. This means that we have to remove everything right down to the engine itself. Here’s what we must do in order to replace this leaking “O” ring.

First, we must remove the transmission. Then drain the oil from the converter into a clean container. Save this oil, because it can be used again when the job is completed. While the oil is draining from the converter a number of other jobs may be completed. You can remove the clutch linkage and the rear engine-support-to-crossmember bolts, as well as the starting motor.
The engine rear mountings are formed in the clutch housing, and since the clutch housing will have to be removed for this service operation, some method of supporting the engine will have to be used. For that purpose the Engine Support Fixture (Tool C-3082) is used. Insert the fixture hooks securely into holes on either side of the frame member. Then adjust the support fixture side members so that the engine is supported on the flat bolting surfaces of the oil pan. When you have done this you can raise the engine enough to remove the weight from the crossmember so that it can be removed.

Now, lower the engine below normal position and remove the clutch-housing-to-converter-housing bolts so that the clutch housing can be removed.

Now, before you go any further, reinstall the drain plug in the converter, using a new gasket.

The next step is to remove the bolts holding the converter housing to the converter adapter plate. Remember that two of these bolts are installed from the engine side of the plate. These are located on the lower right side of the adapter plate.
A word of caution about removing the converter housing from the adapter plate. It is doweled to the adapter, and you should use care in removing the housing. Do not hammer or pry on the housing to remove it.

**NOTE:** The oil inlet and outlet ports in the converter housing contain thin-wall seal aligning sleeves. As these sleeves are pressed into the converter housing, care must be taken that they are not damaged.

There is a dust shield on the adapter plate which must be removed. After this metal dust shield is removed the converter may be removed from the crankshaft, using the Fluid Drive Stud Nut Wrench (Tool C-589). Now remove the remaining bolts in the adapter plate and remove the adapter plate from the engine block. Be careful in removing the adapter plate from the block; do not hammer or pry on the plate or on the block.

**INSTALLING THE TORQUE CONVERTER**—Before you replace the adapter plate, clean the rear face of the engine block as well as the mating surface on the forward side of the adapter plate to remove all burrs and rough spots.

Then clean the recesses for the “O” ring seals in the rear face of the engine block. Use a small quantity of grease to hold the “O” rings in position. Whenever the converter unit is disassembled, the “O” rings are disturbed, always replace these rings with new ones.

Now you are ready to install the adapter plate to the engine block. Tighten all bolts evenly, torqueing them to forty-five foot pounds. Before you install the converter assembly on the
crankshaft, be certain that the mating surfaces of the crankshaft and the converter are clean and free of burrs, to eliminate the possibility of converter runout. Tighten the converter-to-crankshaft nuts evenly and thoroughly, using Wrench (Tool C-589).

Clean the mating surfaces of the adapter plate and the converter housing to remove any burrs or roughness present. Be sure to clean the "O" ring seal recesses, making sure that the aligning sleeves have not been mutilated. Then install new "O" rings in the recesses.

Now install the converter housing assembly to the adapter plate. Care should be taken when installing the housing that the seal in the hub and the sealing ring on the reaction shaft are properly fitted on the hub of the converter. Use gentle pressure only and do not force.
Watch the aligning dowels as they enter the converter housing, and make sure that the "O" rings and the aligning sleeves are in their proper positions in the converter housing.

Now install the converter-housing-to-adapter-plate bolts, tightening them evenly with a torque wrench to forty-five foot-pounds. Now you are ready to install the clutch housing to the converter housing. Tighten all bolts to twenty-five foot-pounds of torque.

With the engine raised slightly above normal position, install the frame crossmember, the rear engine support cushions and the bolts. Then lower the engine into position and install washers and nuts on the mounting bolts, and tighten.

This leaves us with the transmission and its controls and the drive shaft assembly to install.

When you have completed the installation of the converter, put back the oil you drained out at the beginning of the job. Add the oil to the engine, of course, and then run the engine at fast idle speed so the pump will fill the converter. Check the oil level on the dip stick, and add oil if necessary to bring the level up to the full mark.
SERVICING THE TORQUE CONVERTER HOUSING ASSEMBLY—Suppose, for example, that we have traced a torque converter condition down to the turbine shaft bearing. That would mean that we must service the torque converter housing assembly, where the turbine shaft bearing is found. Here is what we must do in order to replace this bearing.

First, we place the converter housing assembly on a work bench, with the clutch drive plate down, and remove the cap screws from the oil seal retainer, and remove the retainer and seal.

Now, turn two of the seal retainer bolts into the threaded holes in the reaction shaft until the shaft is freed of the housing. With the shaft free from the housing, remove the snap ring from the turbine shaft and install the turbine shaft Puller (Tool C-3182).

NOTE: Be sure that the puller side screws are thoroughly tightened in the housing. The housing is magnesium and damage to the threads may result if screws are not tight. Continue to thread the puller screw against the turbine shaft until the shaft is free of the bearing.
Now, remove the turbine bearing retaining snap ring and install the Turbine Bearing Puller Body (Tool C-3184) through the bearing inner race. Place the cupped portion of the puller centrally over the bearing recess. Install puller nut on threaded shaft and continue to tighten, pulling the bearing from its recess in the housing.

In cases where the converter housing oil seal is believed to be leaking, the seal can be removed by drifting it to the rear of the housing with a blunt drift, being careful not to damage the housing.

There may be instances where a condition, such as lack of converter pressure, has been traced down to the oil pressure regulating valve. To remove the regulator valve, the following steps should be taken: First, screw the threaded section of Puller Screw (Tool C-3179) into the oil control valve plug until it is securely in place.
With the tool in place, install the puller tool cup and nut. Hold the puller screw and continue to thread the nut down on the puller screw until the plug is free of the turbine shaft.

Now invert the turbine shaft and let the regulator valve spring and ball fall out into your hand.

With the valve removed, thoroughly clean the inner diameter of the turbine shaft, using an air hose to blow out the passage. Do not attempt to clean off the seat with anything other than solvent and air. When you have thoroughly cleaned out the passage with air, and the seat is found to be satisfactory, install a complete new regulator valve—valve ball, valve spring and plug—in the counterbore of the turbine shaft. Position the new plug in the turbine shaft and, with Driver (Tool C-3178), drive the valve plug in until the tool bottoms.
If there is any question about the ball seat in the turbine shaft being in good condition, it might be smart to replace the turbine shaft. Incidentally, the turbine shaft is shipped with the regulator ball, spring and plug installed.

NOTE: Use the driver ONLY (Tool C-3178) to drift the valve plug into position. Any other method or tool may position this plug too deep, causing excessive converter oil pressure due to a too tightly compressed regulator valve spring.

In cases where it is necessary to remove and install the pinion shaft pilot bushing in the converter turbine shaft, Remover (Tool C-3185) should be used to pull the bushing. Installer (Tool C-3181) should be used to replace the bushing.

ASSEMBLING THE CONVERTER HOUSING ASSEMBLY — The first step in assembling the converter housing assembly is the installation of the turbine shaft bearing. Start out by
positioning the Bearing Drift Guide (Tool C-3186) on the rear side of the converter housing and start the bearing into its recess in the housing.

![Image of Bearing Drift Guide](image)

Now, with the drift portion of the tool (C-3186), carefully drive on the bearing until it bottoms in its recess in the housing. With the bearing bottomed, install the snap ring. Then turn the housing over and install the oil seal in the rear of the converter housing, using seal Drift (Tool C-3187).

**CAUTION:** Use extreme care in this operation so as not to damage "O" ring seal sleeves on the forward face of the housing.

Our next step is the installation of the turbine shaft in the bearing. We do this by placing the turbine shaft and the clutch drive plate assembly on the bench, with the clutch drive plate down.

Now, take the converter housing and place it over the turbine shaft, making sure that the turbine shaft is entered in the bearing inner race squarely.
With the shaft in place, use Drift (Tool C-3183), and drive down against the bearing inner race until the shaft is bottomed against the bearing.

Now you are ready to install the snap ring. Remember, these are selectively fitted, and the snap ring should fit snugly in the recess to prevent end float of the turbine shaft.

In the installation of the converter impeller hub oil seal, use a blunt drift to drive the oil seal from the seal retainer. After the old seal has been removed, start the new seal into the seal retainer with the sealing lip face of the seal entered first. Be sure to use Drift (Tool C-3180) to drive the seal into position until the drift bottoms on the seal retainer.

When installing the reaction shaft be sure to use a new gasket between the reaction shaft itself and the housing. Bolt holes are positioned so that the reaction shaft can be installed in only one position. In the installation of the shaft, align all of the holes and use two of the bolts as a guide.

With Driver (Tool C-3192), drift the reaction shaft until it bottoms in the housing. Then remove the two guide bolts, install the new gasket and oil seal retainer and install all of the bolts in the oil seal retainer, tightening them to fifteen foot-pounds torque.
TEST YOURSELF
WITH THESE QUESTIONS

1. The metering orifice in the hub of the reaction shaft is there to maintain normal oil pressure in the converter.  RIGHT  □
WRONG □

2. Pressure in the converter is controlled by a ball-type pressure regulator valve.  RIGHT □
WRONG □

3. Oil, in a car equipped with the engine-fed torque converter, should be changed only twice a year.  RIGHT □
WRONG □

4. When changing engine oil in cars equipped with the engine-fed torque converter, it is necessary to drain the torque converter as well as the engine.  RIGHT □
WRONG □

5. Always use a new plug whenever the pressure regulator valve in the reaction shaft is removed.  RIGHT □
WRONG □

6. Oil level for cars equipped with the engine-fed torque converter should be between the add oil and the full mark on the dip stick.  RIGHT □
WRONG □

7. The oil filter should be changed at least every five thousand miles.  RIGHT □
WRONG □

8. The oil pump of the eight-cylinder engine has an internal by-pass valve which permits re-circulation of by-passed oil within the pump.  RIGHT □
WRONG □

9. The oil pump of the six-cylinder engine with torque converter has an internal by-pass valve located in the pump cover.  RIGHT □
WRONG □

10. The regulator valve in the side of the block of six-cylinder engines equipped with the engine-fed torque converter controls lubrication to the engine bearings when the filter is plugged.  RIGHT □
WRONG □