GEARS Takes a Look Inside a Lenco Racing Transmission

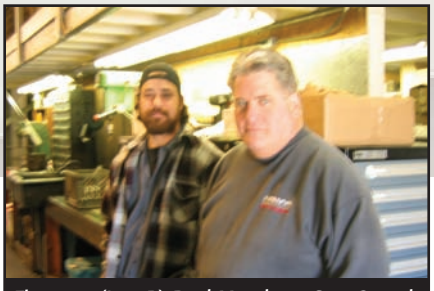

Figure 1: (L to R) Paul Mendoza, Gary Sumek

Here at *GEARS Magazine,* we work hard to provide our readers with information that can be useful every day in the shop environment. But once in a while, something so unusual comes our way that we just have to share it with you, even though it's not something you're likely to use very often… if at all.

While we were gathering information for the performance issue of *GEARS,* we got a chance to check out a racing transmission, versions of which have been around for over 35 years. The Lenco transmission is widely used in drag racing in many classes. Any of you who've watched drag racing on TV have seen the in car camera views of a driver pulling one lever after another to upshift during the race. We wanted to get inside one of those units and see what makes them shift.

When we called Lenco to make arrangements to check out their facility, we were invited to come down for a special tour. When we arrived, Gary Sumek, president of Lenco and Paul Mendoza, one of the rebuilders (figure 1) welcomed us with open arms. Paul was building a 5-speed CS2 model while we were there, we were able to get some pictures to include here. As Paul was building it, he and Gary demonstrated how it worked in detail. It was really easy to see what separates these units from other racing transmissions.

The transmission is made up of multiple sections. Each section is a separate 2-speed transmission and, with the exception of ratios, each section of the transmission contains an identical set of parts (figure 2): low gear (reduction) and high gear (1:1 ratio). When these sections are stacked together, they create a transmission with more speeds. If two sections are stacked together, you'd have a 3-speed. Three sections make a 4-speed and four sections make a 5-speed (figure 3).

So let's look at this 5-speed CS2 model. There's a wide variety of ratios available for these sections, but we've chosen this example:

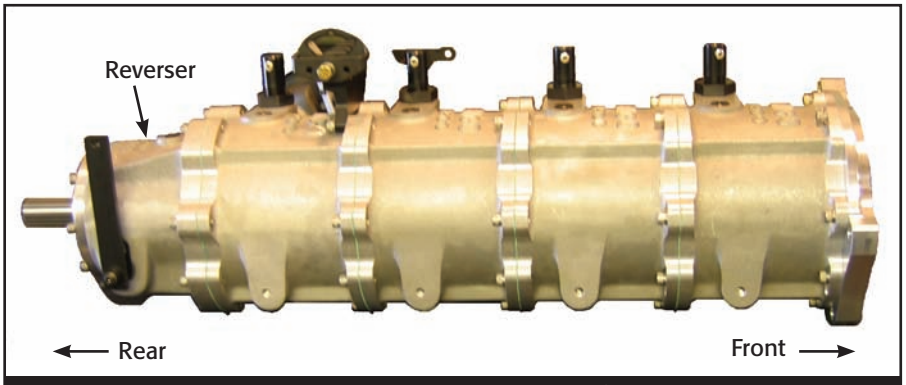

Figure 3: Lenco CS2 5 Speed

Gear	1st Case		2nd Case		3rd Case		4th Case		
1st	1.48:1	X	1.30:1	X	1.26:1	X	1.20:1	=	2.91:1
2nd	Upshifted		1.30:1	X	1.26:1	X	1.20:1	=	1.97:1
3rd	Upshifted	X	Upshifted	X	1.26:1	X	1.20:1	=	1.51:1
4th	Upshifted	X	Upshifted	X	Upshifted	X	1.20:1	=	1.20:1
5th	Upshifted	X	Upshifted	X	Upshifted	X	Upshifted	=	1.00:1

Note: When upshifted, the ratio of that case section is 1.00:1.

Figure 4

Each section is a separate 2-speed transmission and, with the exception of ratios, each section of the transmission contains an identical set of parts

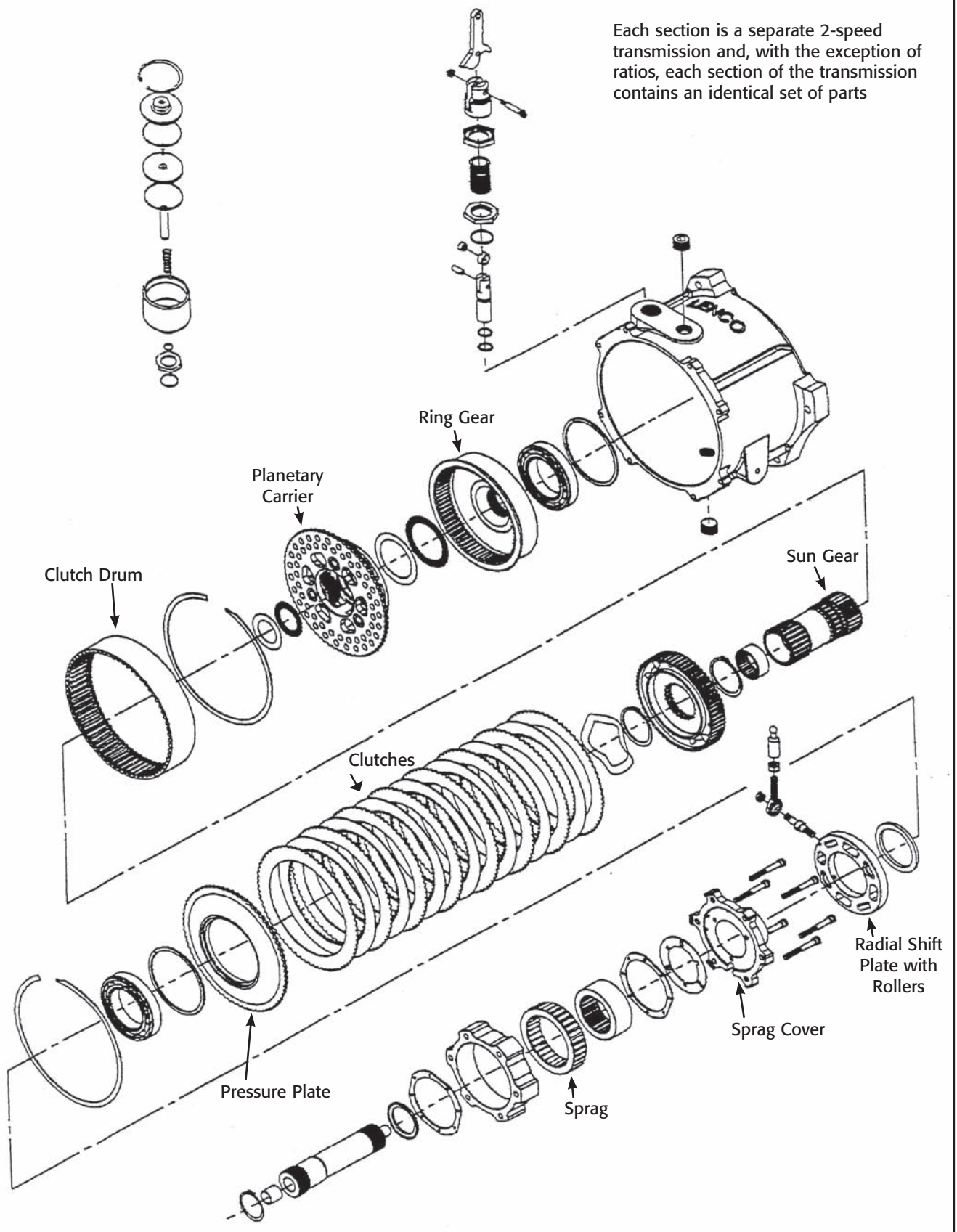

Figure 2

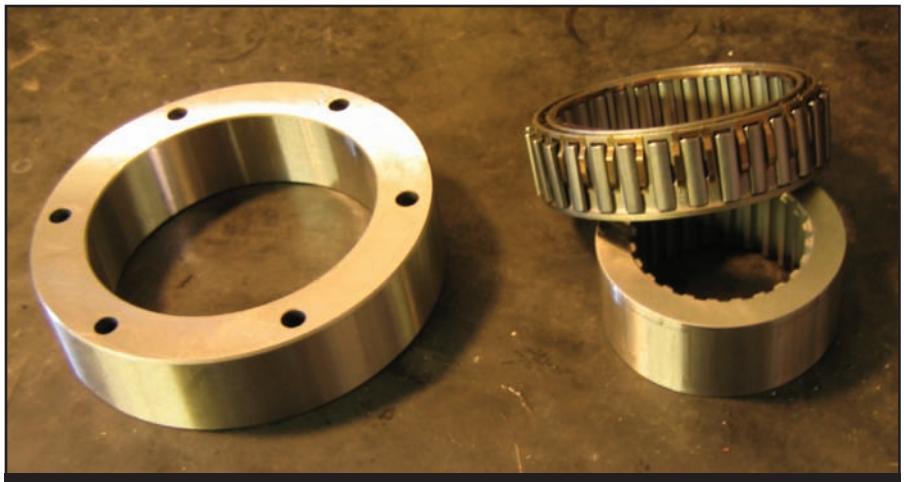

Figure 5A

Figure 5B

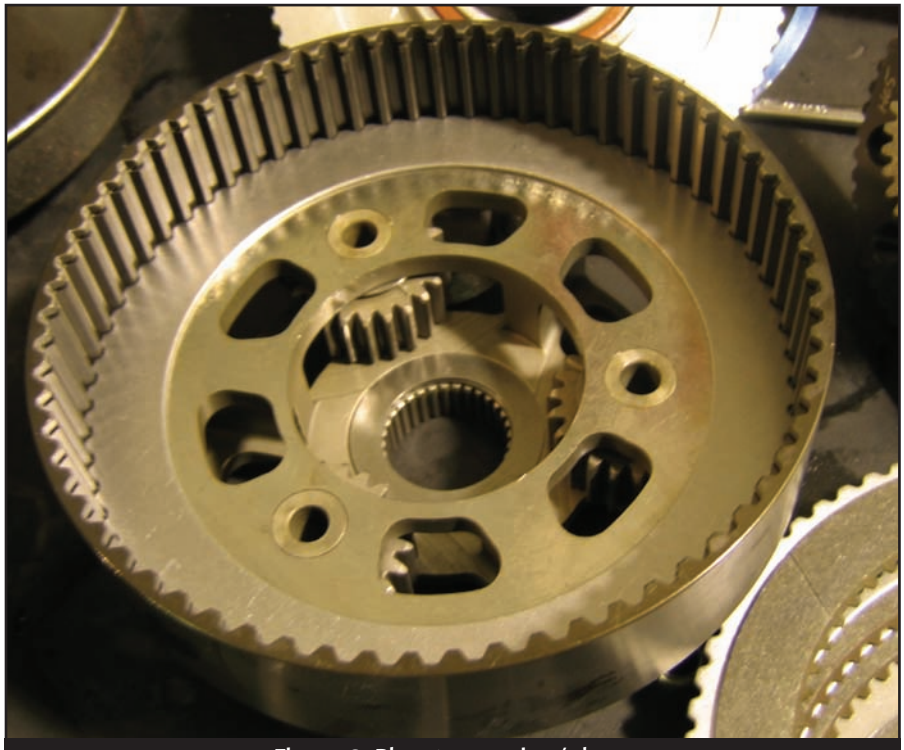

Figure 6: Planetary carrier / drum

To understand the powerflow of this transmission, think of each section as a simple 2-speed.

1st case section: 1.48:1
2nd case section: 1.30:1
3rd case section: 1.26:1
4th case section: 1.20:1

When you upshift a case section, that section shifts into high gear (1.00:1). In first gear each case section is in reduction, providing whatever ratios they contain. So, to determine the ratio of 1st gear, you'd multiply the ratios of each individual case section. In this example, 1st gear ratio would be 2.91:1 (1.48 x 1.30 x 1.26 x 1.20).

When you upshift the first case section, that section goes to a 1:00:1 ratio, which creates 2nd gear. The ratio of 2nd gear in this example would be 1.97:1 (1.00 x 1.30 x 1.26 x 1.20). See the shift chart to find the ratios of all gears (figure 4).

Theoretically you could shift these sections in any order you chose, but it would put extra load on the clutches during a shift. Here's why:

If the engine was delivering 3000 horsepower to the input shaft of the front case section, the output shaft of the front case section would deliver 1.48 times that horsepower to the input shaft of the second case section. It would deliver 1.30 times *that* number to the third case section and so on. With that in mind, the fourth case section would have 7273 horsepower transferred to the input shaft! Because these units are shifted by a clutch pack, it's much easier to upshift at 3000 hp than 7273. That's the primary reason these transmissions are shifted from front to back.

That's how they operate: Now let's take a look at the mechanics of it all. To understand the powerflow of this transmission, think of each section as a simple 2-speed. The ring gear is the input, the planet carrier is the output, and the sun gear is the holding member in low. The sun gear is held stationary to the case by a very large sprag (figure 5A & 5B). Because it's using a sprag, there's no engine braking when it's in reduction.

The clutch pack is loaded into the planetary carrier (figure 6) and then the sun gear, pressure plate and pressure plate bearing are placed on top and held in by a snap ring (figure 7). When this clutch pack is applied, the clutches lock the sun gear to the planetary carrier to achieve a 1.00:1 ratio. When this happens, the sprag freewheels.

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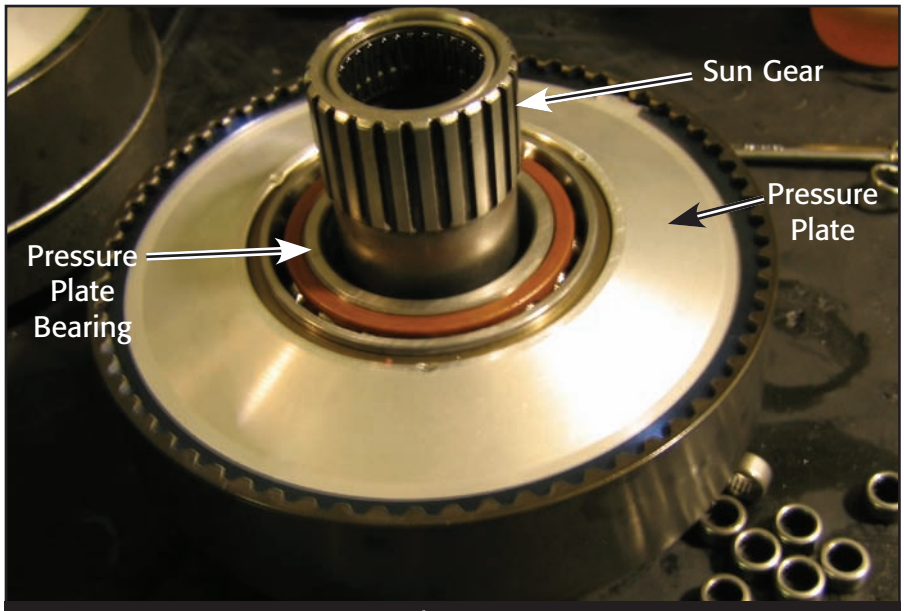

Figure 7

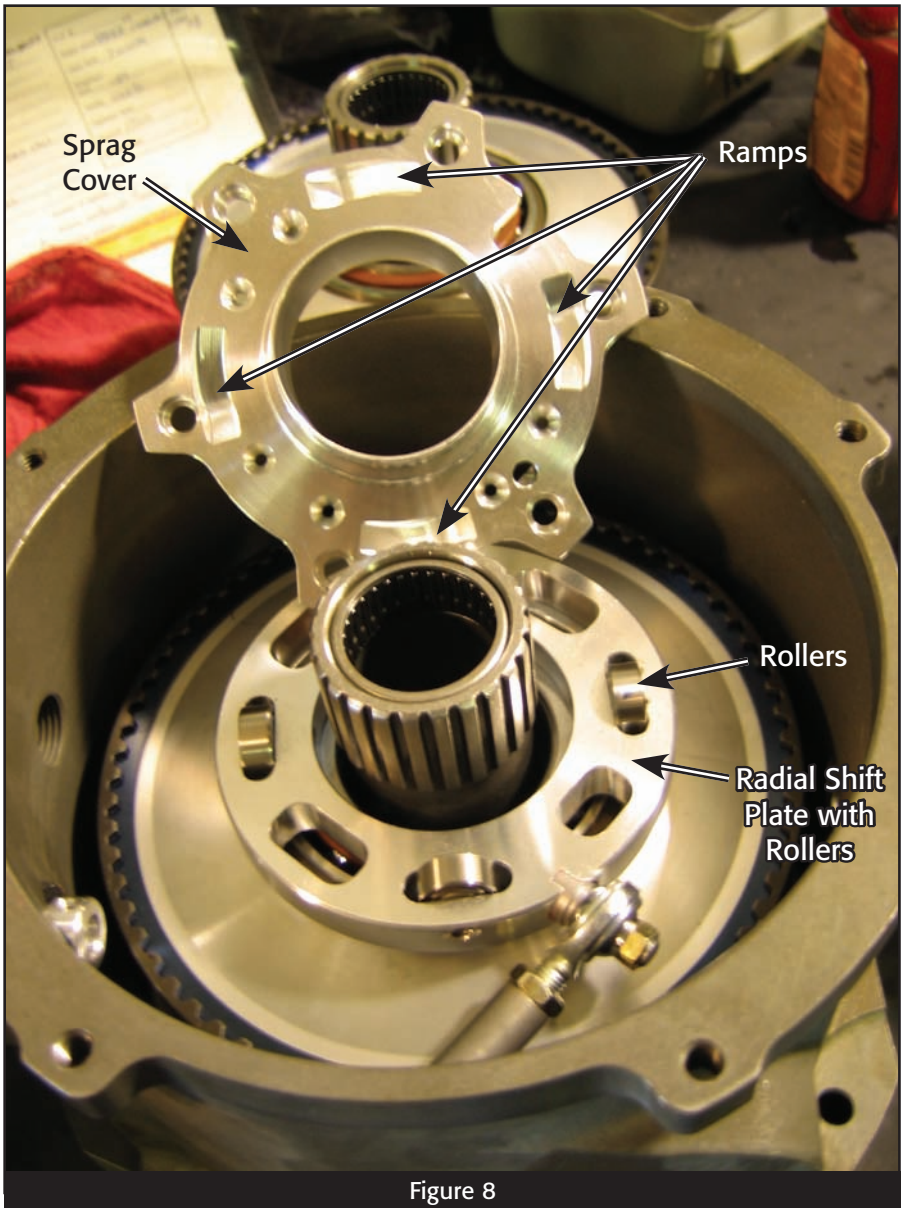

Figure 8

Figure 9

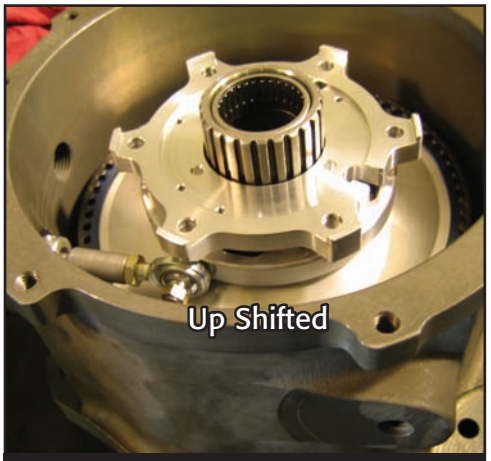

Figure 10

At this point, the case section will have engine braking. But keep in mind that if any case section is in low, the transmission won't provide engine braking because of the sprag. So the only time this transmission creates engine braking is when all of the transmission case sections are upshifted. In this example, that would be 5th gear.

The next thing you may be asking is how do they apply the clutch? In our opinion, this is the coolest part of the whole transmission. On top of the pressure plate bearing sits what's called a radial shift plate with rollers; on top of that sits the sprag cover with small ramps for the rollers to ride up and down (figure 8).

Before the shift rod is pushed inward, the radial shift plate rollers sit deep in the sprag cover ramps (figure 9). When the shift rod is pushed into the transmission, it rotates the radial shift plate in a way that forces the rollers up the ramp. This makes the whole assembly grow in length as they separate (figure 10). Because the sprag cover is

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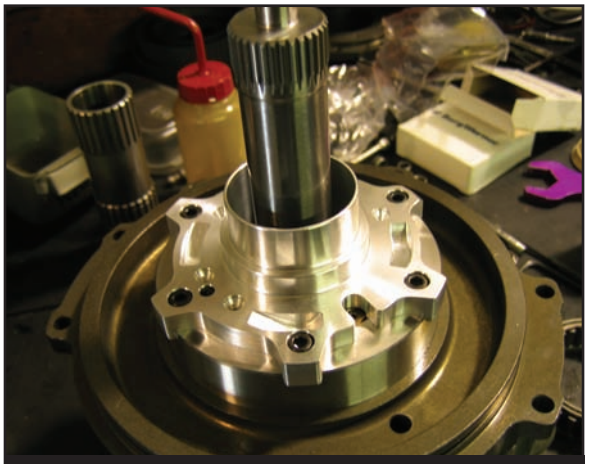

Figure 11

Figure 12

Because the sprag cover is bolted to the sprag (figure 11), this separation forces the pressure plate to apply the clutch pack mechanically.

bolted to the sprag (figure 11), this separation forces the pressure plate to apply the clutch pack mechanically.

For reverse there's a reverse planetary assembly (figure 12) located in a housing bolted to the back of the transmission. A coupler supplies forward, neutral and reverse (figure 13).

The other thing we found fascinating about the Lenco transmission is that, except for the clutches, bearings and bolts, all parts are manufactured at Lenco. We got to tour the machine shop and witness firsthand how each part was produced on CNC machines. The cases are cast at another company, but the raw castings are still machined by Lenco

A coupler supplies forward, neutral and reverse.

Figure 13

(figure 14). All steel parts, such as shafts and gears, are sent out to be heat treated after they're machined. Figure 15 shows a stack of ring gears before they machine the teeth.

We hope you enjoyed reading about the Lenco transmission as much as we enjoyed touring their facility. We want to thank Greg Sumek, Paul Mendoza and all the rest of the people at Lenco for spending the time to show us their factory, and to explain how their transmission works.

Figure 14

Figure 15