

# Introducing the *Lepelletier* Geartrain



by Dennis Madden

Over the years we've all seen some interesting geartrain arrangements, the most common being Simpson and Ravigneaux. In 1981 GM added an overdrive gearset to the Simpson geartrain and gave us the 200-4R. Soon after, this geartrain setup began showing up in transmissions built by just about every manufacturer on the planet.

We quickly realized that this setup placed a two-speed in front of a three-speed, and that the transmission was actually capable of six speeds forward and two in reverse. In 1995 Ford took advantage of one of these extra gear ranges to create the 5R55E. Ford also uses this setup in the Torqshift, and uses all six forward ratios. The point is, this geartrain is fairly easy to understand, and regardless of whether it's in a Toyota, GM, or anything else, we all know how to figure out what's on when, and how these geartrains create each gear ratio.

Now we're starting to see six-speed transmissions on the horizon and before you know it, those transmissions will find their way into your shop. Just about every auto manufacturer either has a six-speed on the road right now or has plans for it in the near future. One of the first on the scene was ZF, which introduced the

ZF6HP26 in 2001. Rather than add an overdrive gearset in front of a Simpson set, they use a *reduction* gearset in front of a Ravigneaux set.

Called the Lepelletier geartrain (pronounced: La-pelt-e-ay), it was developed by Pierre Lepelletier back in 1990, and first used by ZF in 2001. And just as before, this new geartrain setup quickly found its way into other manufacturer's vehicles, such as GM, Ford, Volkswagen, Volvo... and I'm sure many more to come.

The most common Lepelletier-based transmission you're likely to see is the 6L80, so we'll use this unit to go through the basic apply elements. Keep in mind that other manufacturers use different names for the various apply elements, but all of the transmissions based on this gearset work the same way.

One thing that's nice about the 6L80 is they label each clutch by the gear ranges it's used in. For example, the 3-5 clutch is used in 3<sup>rd</sup> and 5<sup>th</sup>

gear. The 2-6 clutch is used in 2<sup>nd</sup> and 6<sup>th</sup>. It gets a little hairy when it comes to the 1-2-3-4 clutch, but at least you know what it does. ZF uses labels like A, B, C, D and E clutch. A little confusing but it's still the same setup. As we go through the different gears use the illustrations in figures 1 and 2 to help you through the process.

Okay, let's get started. As we said before, the Lepelletier geartrain is a simple planet in front of a Ravigneaux gearset. Having said that, you might be inclined to think it's just a simple planet in front of a four-speed Ravigneaux, capable of eight speeds but only using six, ala 5R55E. Not exactly... but close.

The first thing you need to know is that the planetary gearset in the front doesn't shift! The sun gear is held stationary at all times, splined to the stator support. The input shaft turns the ring gear and the planet is the output and offers a ratio of 1.53:1. The input shaft also turns the Ravigneaux gearset in the

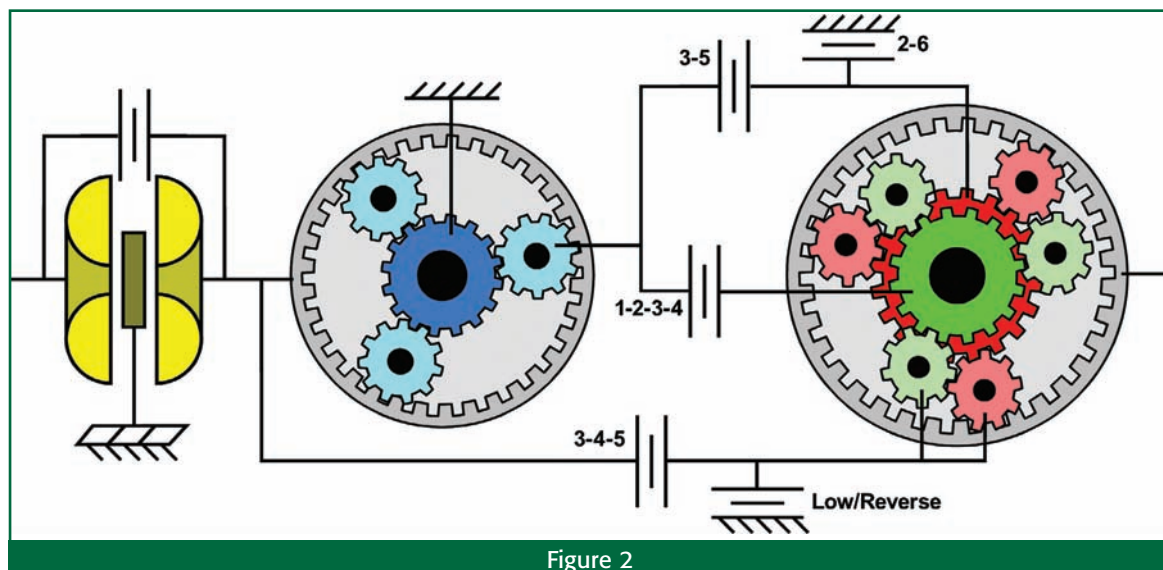


Figure 2



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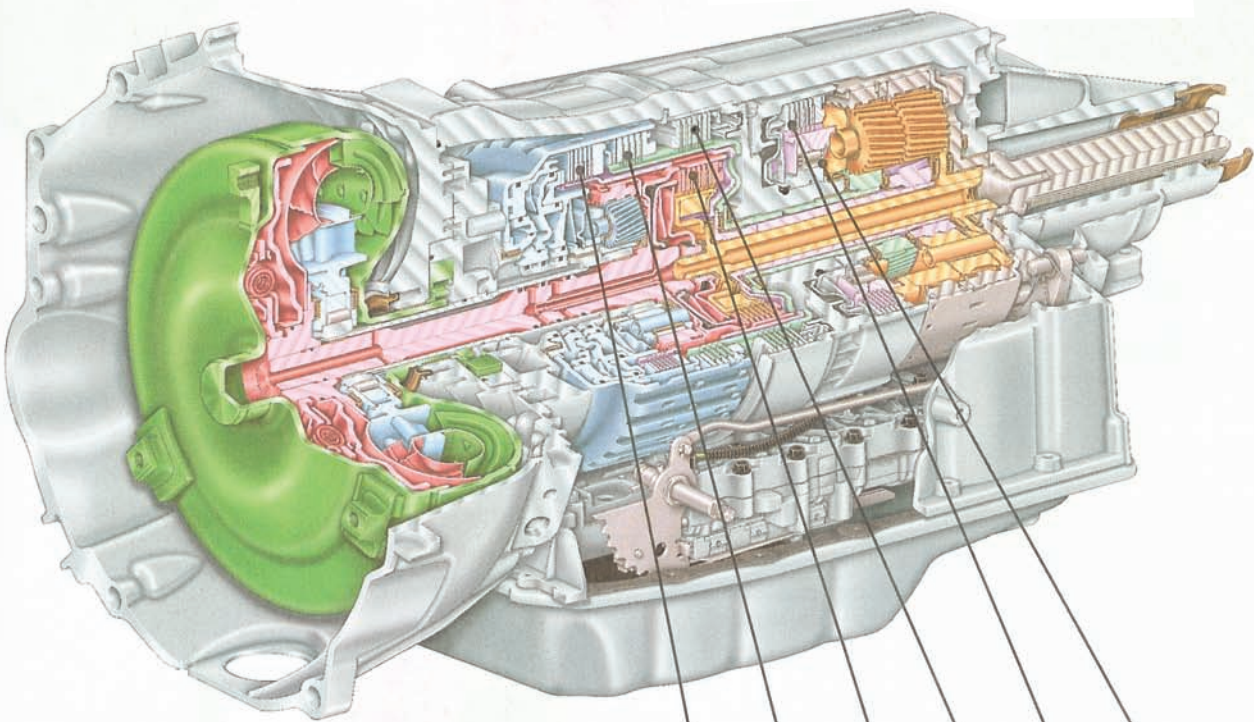
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RANGE	GEAR	SHIFT SOL 1	SHIFT SOL 2	1-2-3-4 CL PC SOL 5 N.L.	2-6 CL PC SOL 4 N.L.	3-5 REV CL PC SOL 2 N.H.	LOW REV 4-5-6 CL PC SOL 3 N.H.	1-2-3-4 CLUTCH	3-5 REV. CLUTCH	4-5-6 CLUTCH	2-6 CLUTCH	LOW & REV. CLUTCH	LOW CLUTCH SPRAG
PARK	P	ON	ON	OFF	OFF	OFF	ON					APPLIED*	
REV	R	ON	OFF	OFF	OFF	ON	ON		APPLIED			APPLIED	
NEU	N	ON	ON	OFF	OFF	OFF	ON					APPLIED*	
D	1st Braking	ON	ON	ON	OFF	OFF	ON	APPLIED				APPLIED	HOLDING
	1st	OFF	ON	ON	OFF	OFF	OFF	APPLIED					HOLDING
	2nd	OFF	ON	ON	ON	OFF	OFF	APPLIED			APPLIED		
	3rd	OFF	ON	ON	OFF	ON	OFF	APPLIED	APPLIED				
	4th	OFF	ON	ON	OFF	OFF	ON	APPLIED		APPLIED			
	5th	OFF	ON	OFF	OFF	ON	ON		APPLIED	APPLIED			
	6th	OFF	ON	OFF	ON	OFF	ON			APPLIED	APPLIED		

NOTE: FOR SHIFT SOLENOIDS 1 AND 2, "ON" = SOLENOID ENERGIZED (PRESSURIZED), "OFF" = SOLENOID DE-ENERGIZED (NO PRESSURE).

NOTE: FOR PRESSURE CONTROL (PC) SOLENOIDS, "ON" = PRESSURIZED, "OFF" = NO PRESSURE.

\* = APPLIED WITH NO LOAD.

Figure 1

back via a clutch, similar to a 4R70W, except it's in front of the planet rather than behind it. Other than that, it's pretty straightforward, so let's get started.

First gear is similar to the 4R70W in that a sprag holds the planet carrier and the small sun gear is the input. The difference is the input first went

through the gear reduction of the front planet, giving it a ratio of 4.03:1.

The shift to second is just like the 4R70W: A clutch stops the large sun

gear from turning. But remember, the input to the small sun gear comes from the front gearset, offering a final ratio of 2.36:1.

If you've guessed that third gear is 1:1, you're almost right. The Ravigneaux gearset in back is turning 1:1; that is, both sun gears are turning at the same speed, so the planet and ring gear do as well — just like the 4R70W. But that front planet is still reducing the input, this time to *both* sun gears. The ratio for third is 1.53:1. Pretty simple huh?

Now it gets a little trickier. Remember the clutch that drives the Ravigneaux gearset? In the 6L80 it's called the 4-5-6 clutch and it applies to shift into 4<sup>th</sup>. The 1-2-3-4 clutch is still turning the small sun gear, but the 3-5 clutch that was turning the large sun gear in 3<sup>rd</sup> releases.

This is somewhat abstract, and the most difficult gear to understand. The standard way to create overdrive is for the input to turn the planet while the sun gear is held stationary. What's different here is that in 4<sup>th</sup> gear we're working with the *small* sun gear not the large one. The small sun gear uses two sets of pinions to transfer power to the ring gear rather than one so holding the small sun gear stationary actually creates a gear *reduction* rather than overdrive. But it's not being held... the front planet turns the small sun gear. And because of this, the ratio *increases*. This is one ratio where you might need to get the parts to help you see how it works. The combined ratio in 4<sup>th</sup> gear is 1.15:1.

5<sup>th</sup> gear simply switches from the small sun gear being turned by the front planet to the large sun gear being turned. In this case though, it follows the normal rule for achieving overdrive: It drives the planet from the input shaft and holds the large sun gear, just like a 4R70w. But since the sun gear is being turned by the front planet instead of being held stationary the front planet is actually *underdriving the overdrive*, so 5<sup>th</sup> gear barely tips in over the 1:1 mark, coming in at 0.85:1.

Sixth gear simply bypasses the front planet altogether. The planet of the Ravigneaux gearset is turning with the input shaft and the large sun gear is held stationary, just like the 4R70W.

The ratio for 6<sup>th</sup> is 0.67:1.

Oh, and by the way, reverse is just like the 4R70W except that — you guessed it — the large sun gear is driven by the front planet.

In the coming years the Lepelletier geartrain will probably become every bit as common as the Simpson and Ravigneaux have been over the past three decades. You'll find it in both front- and rear-wheel drive transmissions. And unlike the 6L80, which uses terms for the clutches that reflect the gear range they're actually used to create, be prepared to see letters (like the ZF) or maybe even terms such as *direct*,

*overdrive* or *rear* to describe the clutches. If Mercedes picks up on it, expect names like K1 and B2. But regardless of the names given to the clutches, the best way to understand this transmission is to think 4R70W.

I'm sure many of you have thought "Hey, if they use a clutch to lock the front planet at 1:1 they could get an extra gear out of this." Actually, they could get several and that's called the Lepelletier 7-speed. Better watch your back: they're already out there!



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