This reference book explains how the PowerFlite automatic transmission operates mechanically. You'll be surprised to see how easily you can follow the flow of power from the engine through the transmission and out to the rear wheels when you understand how each part operates in each speed range.

The transmission is really quite simple when you break it down into its various units, and study each one separately. Then you'll be able to understand how those units work together to automatically produce different drive ratios.
Now, here’s how the information in this book is arranged.

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A PLANETARY GEAR SET

The PowerFlite automatic transmission, as you know, employs two planetary gear sets. But, before getting into the specific details of the transmission it will be very helpful to review the basic operation of a planetary gear set.

No doubt you will recall that a typical planetary set has a sun gear. Three planet pinions surround that sun gear and are in mesh with it.

Holding those pinions in position is a pinion carrier. Surrounding the carrier, and in mesh with the pinions, is an annulus gear.
A planetary set can be used to increase torque and reduce speed, to transmit torque at a one-to-one ratio, and to reverse the direction of power output.

Increasing torque and reducing the speed is one of the gear combinations needed to move a car away from a standing position.

**SUN GEAR HELD.** Just by way of an example, let's suppose the sun gear in a typical planetary set is *held to prevent it from turning*. Now, if the annulus gear is rotated while the *sun gear is held*, the pinions also rotate.

Since the pinions are mounted in the carrier, they force the carrier to revolve in the same direction as the annulus gear, but at a slower rate of speed. That's how the planetary system gives you the 1.72-to-1 gear ratio for starting, and also for kickdown and low range operations.
CARRIER HELD. Now, suppose that the pinion carrier is held to prevent it from turning, and the sun gear is driven. In this case, the sun gear causes the pinions to rotate in the opposite direction.

When that happens, the pinions apply torque to the annulus gear, and cause it to rotate in a direction opposite to that of the sun gear. And that's the gear combination that provides the reverse action required to back the car.

WHEN NO GEARS ARE HELD. In our typical planetary gear set, let's suppose that nothing is held, but the annulus and sun gears are driven in the same direction. This will provide a 1-to-1 drive through the pinion carrier. In other words, the pinions lock the annulus and sun gears together. The entire planetary set revolves as one unit.
GENERAL DESCRIPTION

The PowerFlite transmission is made up mainly of a multiple-disc-type, hydraulically operated clutch we call a "direct clutch," and two planetary gear sets. The clutch and the planetary gear sets operate in conjunction with each other to provide the various gear ratio combinations. To more clearly understand the relationship of these parts it might be helpful to build up the transmission, starting from the input shaft.

Building up the main mechanical components from the input shaft, as given in this book, isn't standard assembly procedure. But, as you will see, it's the best way to get the power flow story across.

To further clarify our story, let's establish a few simple names for some of the parts. For instance . . . the band which goes around the clutch piston retainer is known as the kickdown band. But as you can see, it is toward the front of the unit. So, let's call it the front band.

The other external band is called the reverse band, because it operates only during reverse. But, since it's at the rear end of the transmission, why not call it the rear band?

Now, as long as we've simplified kickdown and reverse to front and rear bands, let's do the same thing to the two planetary gear sets. Instead of kickdown and reverse, let's just call them the front and rear planetary gear sets.
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Now, as long as we've simplified kickdown and reverse to front and rear bands, let's do the same thing to the two planetary gear sets. Instead of kickdown and reverse, let's just call them the front and rear planetary gear sets.
The PowerFlite unit has two main shafts. There’s the input shaft, which carries engine power into the transmission. Sometimes this input shaft is also called the “turbine shaft.” That’s because it carries the turbine of the torque converter on its forward end.

Secondly, there’s the output shaft. This shaft carries power out of the transmission and drives the rear wheels.

Another mechanical part that may be new to many mechanics is the hydraulically operated clutch. It’s located just ahead of the two planetary gear sets. This clutch itself consists of a piston retainer, a spring-loaded piston, and a hub. In addition, there’s a series of discs and plates.

NOTE: Chrysler and De Soto eight-cylinder models use a clutch with six discs and six plates. The clutch used with all Dodge cars and with Chrysler and De Soto six-cylinder models has five discs and five plates.

All these parts are held in the piston retainer by the front planetary sun gear and a large snap ring.
The clutch hub is splined to the input shaft. The outer part of the clutch, the piston retainer, is attached to the sun gear of the front planetary gear set. Therefore, the clutch has one function only, and that is to lock the front planetary sun gear to the input shaft. The clutch piston is operated hydraulically to engage the clutch. It is released by the spring when the hydraulic pressure is relieved.

When the clutch is engaged, the piston retainer is locked to the hub by means of hydraulic pressure which compresses the discs and plates. Since the front planetary sun gear is attached to this piston retainer, a firm connection is formed between the clutch hub and the sun gear when the discs and plates are pressed together.

To the rear of the clutch are the two planetary gear sets, which we are calling "front" and "rear." The front one, of course, is the one nearest the clutch.
BUILD-UP OF THE TRANSMISSION

Now we're ready to build up the transmission. So, starting with the clutch already assembled, suppose we slide it onto the input shaft so the hub splines mesh with the splines on the shaft.
Next, we’ll slide the front planet pinion carrier over the input shaft. As this is done, notice that the planet pinions mesh with the sun gear attached to the clutch piston retainer. That sun gear, therefore, is part of the front planetary gear set. And that’s how the clutch and the front planetary gear set are related to each other.

The next step in our build-up of the transmission is to slip the front annulus gear over the pinion carrier, so that the annulus gear is now in mesh with the pinions. We now have a complete planetary gear set—a sun gear, planet pinions in a carrier, surrounded by an annulus gear.

Now . . . notice that the front planetary annulus gear also carries a sun gear. So, here’s the beginning of the rear planetary gear set. There’s one point right here which should be called to your attention, and that is that the sun gear of the rear planetary gear set is splined to the input shaft. It is important to remember, because it will help you to understand the flow of power through this transmission.
The next step is to slide the rear planet pinion carrier over the input shaft, and mesh the pinions with the sun gear. The sun gear is connected to the annulus gear of the front planetary gear set, and that's what ties the operation of the front and the rear planetary gear sets together.

The input shaft drives the rear planetary sun gear, and through it, the annulus gear of the front planetary gear set.

Following the installation of the rear planet pinion carrier, complete the build-up of the rear planetary gear set by slipping the annulus gear over the pinion carrier. As you do that, you'd naturally mesh the annulus gear with the pinions.
The *hub* of the rear annulus gear has *internal* splines. Those splines mesh with splines on the output shaft. As a result, the rear annulus gear drives the output shaft.

Continuing with our build-up of the PowerFlite unit . . . we slide the planet pinion carrier *housing* over both carriers. You will notice that each carrier has lugs protruding around the outer edges. Those lugs fit into notches inside the housing.

So, when the pinion carriers rotate, the lugs drive the housing. Therefore, one carrier can't rotate without the other.
To complete our build-up at this point, all we’d have to do is slip the front band over the clutch piston retainer, and slip the rear band over the rear of the carrier housing. The bands are operated by hydraulic pressure through units called servos. Perhaps a brief description of the servo unit will help you to understand how it works.

In short, the servo unit is a hydraulically operated piston in a cylinder. It consists of a piston, spring and other parts operating in a cylinder or bore which is formed as a part of the transmission case. Levers and suitable linkage connect the servo to the band it operates.

There are two servos involved. The front band is operated by the front servo. The rear servo has the job of applying and releasing the rear band.
POWER FLOW

Now that you've got a good idea of the parts involved, and how they fit together . . . suppose we talk about power flow through the transmission. We're concerned only with the mechanical flow of power during each of the forward ranges—and in reverse.
STARTING IN DRIVE RANGE. The selector lever is moved to the "D" position. This moves the manual control valve in the transmission, and causes the hydraulic system to apply the front band around the clutch piston retainer. Applying the front band keeps the sun gear of the front planetary gear set from turning.

Now—since the front sun gear is held from turning, the front planet pinions revolve around it as they are driven by the annulus gear. That, naturally, causes the pinion carrier to revolve.

The front pinion carrier revolves because the pinions go around the stationary sun gear as they are driven by the annulus gear. The front pinion carrier is connected to the carrier housing. As a result, when the carrier revolves it turns the housing.

The sun gear of the rear planetary gear set is splined to the input shaft. So . . . when the input shaft turns, it drives the sun gear, and through it, the annulus gear of the front planetary set.

Since both the front and the rear planetary pinion carriers are connected to the housing, one carrier can't turn without the other. Therefore, both pinion carriers turn, and turn at the same speed.
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Since both the front and the rear planetary pinion carriers are connected to the housing, one carrier can't turn without the other. Therefore, both pinion carriers turn, and turn at the same speed.
POWER FLOW WHEN STARTING IN DRIVE RANGE

Now, let's follow the power flow on through the rear planetary gear set. Power is put into the gear set from two sources: the carrier is driven by the housing, and the sun gear is driven by the input shaft. In relation to the speed of the input shaft, the carrier is being driven at a reduced speed through the front planetary set, and this reduced speed is being transmitted to the rear carrier by the housing. A further reduction is being accomplished in the rear planetary gear set because the sun gear is driven at the same time as the carrier, but at a different speed. Since the carrier pinions are being driven by the sun gear, but are being caused to walk around the sun gear by the movement of the carrier, the pinions are forced to rotate backward on their shafts. But, the forward rotation of the carrier forces the pinions to drive the annulus gear in the same direction, but at a reduced speed. Therefore, the speed reduction through the front gear set, added to the speed reduction through the rear set, equals a total reduction of output shaft to input shaft speed in the ratio of 1.72 to 1.
THE UPSHIFT TO DIRECT DRIVE . . . The power flow follows a different path as the transmission automatically upshifts into Direct Drive. As a matter of fact . . . when car acceleration reaches the point of change from breakaway or starting speed, to driving speed—two things happen.

First . . . oil pressure to the "off" side of the front servo, plus piston spring pressure, causes it to release pressure against the front band. Releasing the front band also releases the front planetary sun gear. So, the sun gear is free to turn.
Secondly . . . oil pressure is directed to the clutch piston. The piston presses the discs and plates together, engaging the clutch. The discs and plates connect the clutch hub with the piston retainer, so the complete clutch operates as a solid unit.

Now . . . you'll remember that the clutch hub is splined to the input shaft. Therefore, the drive through the clutch is from the input shaft—through the hub—through the discs and plates to the piston retainer . . . and, to the front planetary sun gear. In other words, engaging the clutch locks the front planetary sun gear to the input shaft. You can see, therefore, that the front planetary sun gear turns at input shaft speed.

The rear planetary sun gear is splined to the input shaft so it, too, turns at input shaft speed. Since this sun gear is connected to the annulus gear of the front planetary gear set, that annulus gear also turns at input shaft speed. So . . . when the sun gear and annulus gear are both driven at input shaft speed, the pinions of the front planetary are locked between the annulus and sun gears.
This forces the front pinion carrier to turn at input shaft speed. Since both pinion carriers are attached to the housing, both carriers turn at input shaft speed.

**POWER FLOW AFTER UPHSHIFT IN DRIVE RANGE**

With the input shaft driving the rear planetary sun gear, and the housing driving the rear pinion carrier at the same speed, the pinions lock the sun gear to the rear annulus gear, turning it at input shaft speed.

Therefore, the hub of the annulus gear, which is splined to the output shaft, transmits power to the output shaft and drives it at input shaft speed.

In other words . . . there is *direct drive* from the input shaft to the output shaft, by way of the clutch and both planetary gear sets.
POWER FLOW IN REVERSE . . . When the selector lever is put into the "R", or reverse position, oil pressure is routed to the rear servo only, applying the rear band. There is no oil pressure to the clutch or to the front servo. As a result, the clutch and the front band are in their released positions.

Power enters the transmission through the input shaft, which, of course, drives the rear planetary sun gear.
You know that the rear pinion carrier is attached to the housing. And you can see that the housing is kept from turning by the applied rear band. In this case, then . . . the planet pinions rotate backward. And as they rotate backward, they drive the rear annulus gear backward.

The hub of the annulus gear, therefore, turns the output shaft backward at a reduced speed. And, that's how you get a reverse direction of rotation to the propeller shaft, and a speed reduction ratio of 2.39 to 1.

**OPERATION IN NEUTRAL**

Now, in case you are wondering what happens inside the transmission when the selector lever is put into neutral . . . the answer is easy. All the gears are turning because both bands and the clutch are released, but no power is being transmitted to the output shaft. In fact, if you listen closely you may be able to hear the gears spinning while the engine is idling.
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WHEN RECORDING YOUR ANSWERS TO THESE TEN QUESTIONS

The planetary gear sets used by the PowerFlite Automatic Transmission provide a 1.72-to-1 gear ratio for starting, kickdown, and low range.

While the direct clutch is operated hydraulically to engage the clutch, the clutch piston is released by the spring when hydraulic pressure is relieved.

The front planetary gear set annulus gear carries the sun gear for the rear planetary gear set.

The hub of the rear annulus gear is driven by the input shaft.

When the pinion carriers rotate, their lugs drive the carrier housing, so one carrier can't rotate without the other.

The rear, or reverse band is applied and released by the kickdown, or front servo.

In drive range, when the selector lever is moved to the "D" position, the rear band is applied.

When the transmission automatically upshifts into direct drive, oil pressure to the "off" side of the front servo causes it to release the front band.

After the automatic upshift from starting drive, there is direct drive from the input to the output shaft by way of the direct clutch and both planetary sets.

When the selector lever is moved to Reverse position, oil pressure is routed only to the rear servo, causing it to apply the front band around the carrier housing.