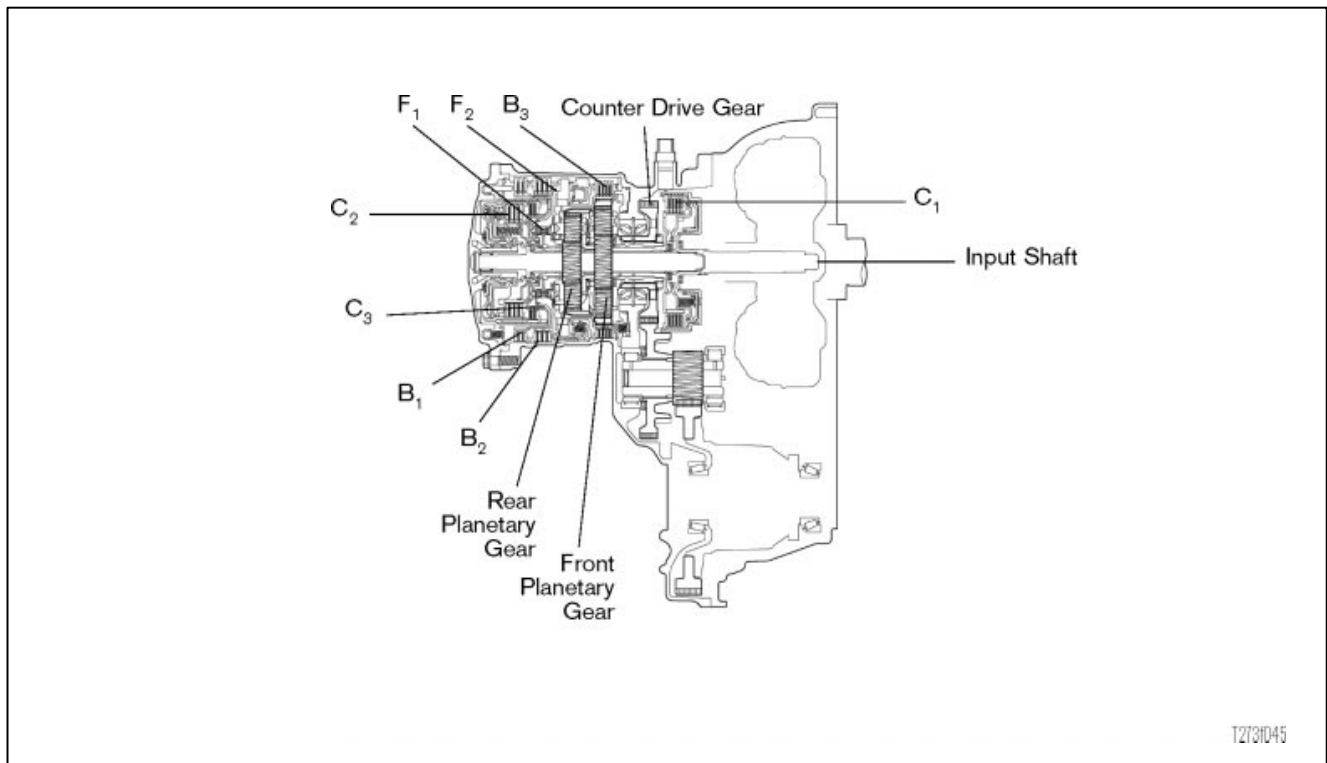


## Section 2

# U-Series Transaxles



- Lesson Objectives**
1. Explain the unique difference between the U-series planetary gear set and the Simpson planetary gear set.
  2. Describe the primary difference in power flow between the U-240 and U-341 transaxles.
  3. Given the Clutch/Brake Designation Chart, differentiate the names for clutches based on the transmission model.
  4. Given the Clutch Application Chart and the power flow model, identify the planetary gear components held for each gear range.



**Notes**

A large grid area for taking notes, consisting of a 30x30 grid of small squares.

## Transaxle Overview

The U-Series automatic transaxles are compact, lightweight, electronically controlled, four speed transmissions introduced in model year 2000 Echos and Celicas. The counter drive gear assembly is located in front of the planetary gear sets rather than behind them as in the earlier transaxle models which contributes to the compact, lightweight design.

The transmission's planetary gear design is a unique departure from the familiar Simpson planetary gear design used in all previous Toyota transmissions. The Simpson planetary gear design uses two planetary gear sets with a common single sun gear for first, second, third and reverse gears. The U-series departs from this design with two planetary gear sets with separate sun gears.

**U-341E** The U-341E gets four forward gears and one reverse gear from this compact design. Additionally, ring gears and planetary carriers of the two planetaries are connected.

### U-341E Planetary Gear Unit

The U-Series transaxles has two planetary gear sets and separate sun gears. Additionally, ring gears and planetary carriers of the two planetaries are connected.

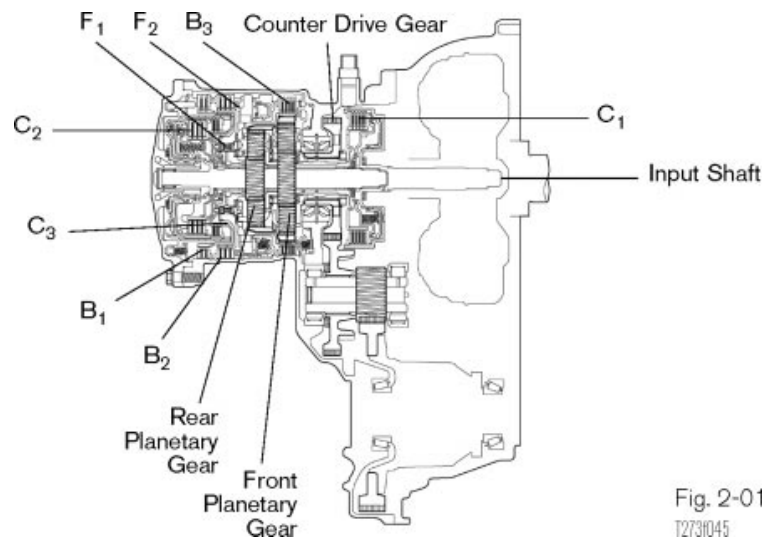


Fig. 2-01  
T2731045

The front planetary ring gear is connected to the rear planetary carrier. They are held to the case in the counterclockwise direction by the *No. 2 one-way clutch (F2)* and held in both directions by the *1st and reverse brake (B3)*. The rear planetary carrier can be driven by the intermediate shaft through the *direct clutch (C2)*

The front planetary carrier is connected to the rear planetary ring gear. The carrier is also connected to the counter drive gear providing output torque. The rear sun gear is connected to the intermediate shaft through the *reverse clutch (C3)* or to the transmission case through the *O/D & 2nd brake (B1)* or *2nd brake (B2)* and *No. 1 one-way clutch (F1)*.

**U-341E  
Power Flow Model**

The front planetary ring gear is connected to the rear planetary carrier. The front planetary carrier is connected to the rear planetary ring gear.

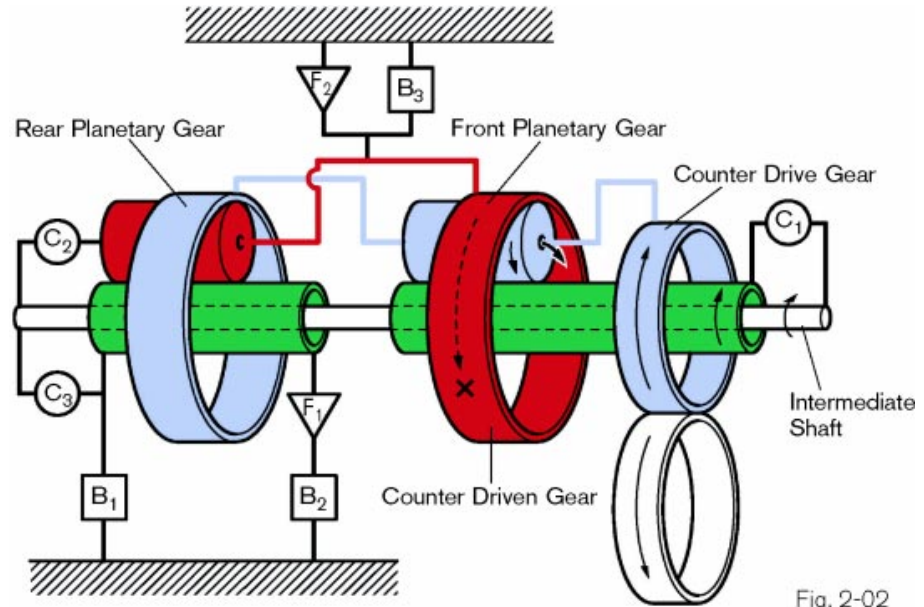


Fig. 2-02  
T2731046

**U-240E** The U-240E has a similar planetary gear configuration to the U-341E which provides three forward gears and reverse gear. But similar to the A-240 transmission, it provides an additional planetary gear set on the counter shaft which operates in an underdrive mode until 4th gear, when it provides direct drive.

**U-240E  
Planetary Gear Unit**

The U-240E transaxle provides an additional planetary gear set on the counter shaft which operates in an underdrive mode

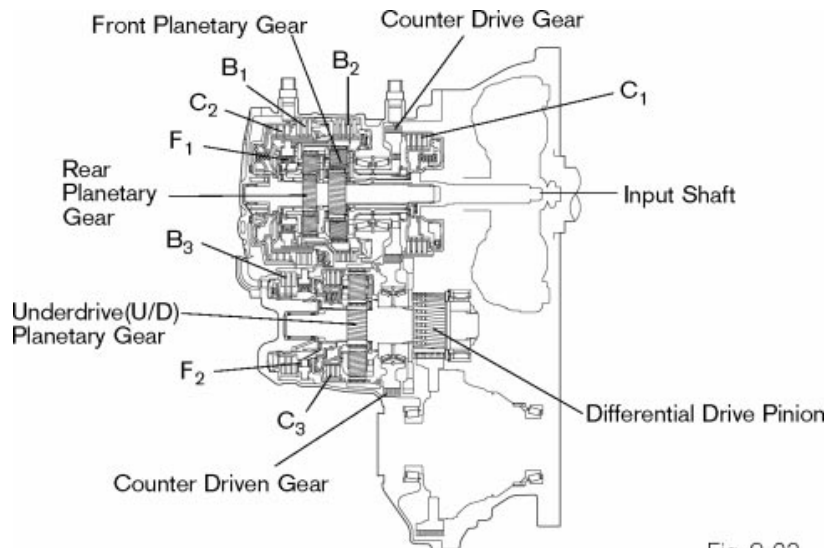
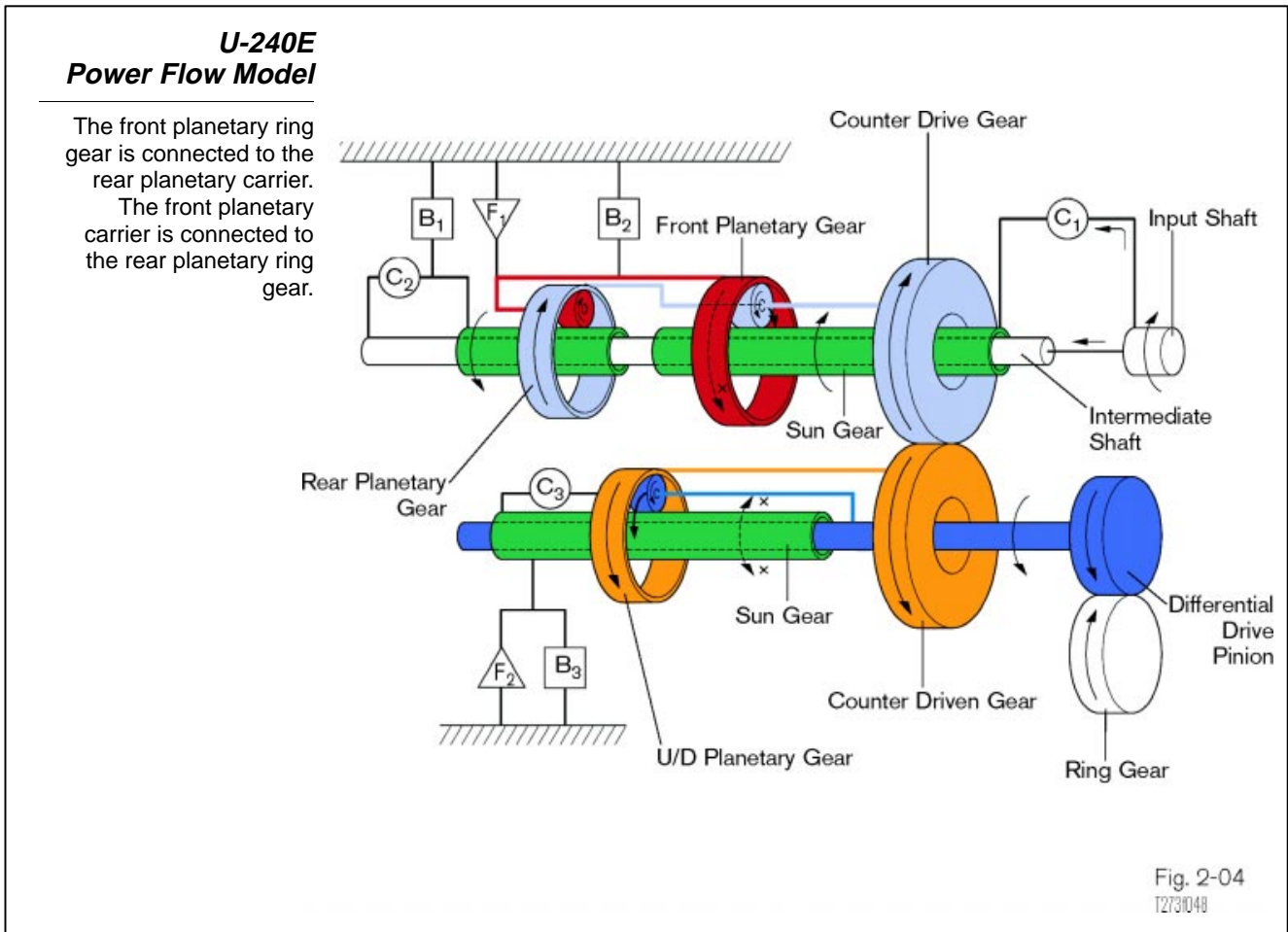


Fig. 2-03  
T2731047

The front planetary ring gear and the rear planetary carrier are held to the case in the counterclockwise direction by the *No. 1 one-way clutch* (F1) and held in both directions by the *1st and reverse brake* (B2). The

rear sun gear can be driven by the intermediate shaft through the *direct clutch* (C2)

The front planetary carrier and the rear planetary ring gear are connected to the counter drive gear providing output torque. The rear sun gear is connected to the intermediate shaft through the *direct clutch* (C2) or to the transmission case through the *2nd brake* (B1).



**Clutch/Brake Designation** The alphanumeric clutch designations (i.e. C1, B1, F1, etc.) have shared a common identifying name and function throughout the transmission model lines for many years. However, the U-series transaxles changed the identifying name as indicated in the shaded boxes in the chart below. For example, B2 has been known as the *2nd brake*, but is called *1st and reverse brake* in the U-240E and *2nd brake* in the U-341E.

**Clutch/Brake Designation**

The shaded cells in the chart below indicate departures from the familiar designations.

	A-140, A-540, A-340, A-240	U-140, U-240	U-341
<b>C0</b>	O/D Direct Clutch		
<b>C1</b>	Forward Clutch	Forward Clutch	Forward Clutch
<b>C2</b>	Direct Clutch	Direct Clutch	Direct Clutch
<b>C3</b>	U/D Clutch (A-240)	U/D Direct Clutch	Reverse Clutch
<b>B0</b>	O/D Brake		
<b>B1</b>	2nd Coast Brake	2nd Brake	O/D and 2nd Brake
<b>B2</b>	2nd Brake	1st and Reverse Brake	2nd Brake
<b>B3</b>	1st and Reverse Brake	U/D Brake	1st and Reverse Brake
<b>F0</b>	O/D One-Way Clutch		
<b>F1</b>	No. 1 One-Way Clutch	No. 1 One-Way Clutch	No. 1 One-Way Clutch
<b>F2</b>	No. 2 One-Way Clutch	U/D One-Way Clutch	No. 2 One-Way Clutch
<b>F3</b>	U/D One-Way Clutch (A-240)		

Fig. 2-05  
T2731049

**Clutch/Brake Function** The clutches and brakes hold specific components of the planetary gear sets. The chart on the following page identifies the specific components for each of the U-series transmissions. Using this chart, the clutch application chart and the planetary gear model will assist you in understanding power flow through the transaxles.

**Clutch Application Charts** Although the U-240 and the U-341 planetary gear configuration is similar, control of planetary components by the holding devices is different as reflected by the clutch application charts. As stated earlier, the clutch application charts and the planetary gear models are your key to diagnosis and pinpointing the problem component.

**Clutch/Brake Function**

The chart identifies the specific components that each holding device connects to for each of the U-series transmissions.

	<b>Clutch Name (U-240/U-341)</b>	<b>U-240</b>	<b>U-341</b>
<b>C1</b>	Forward Clutch	Connects input shaft and front planetary sun gear.	Connects intermediate shaft and front sun gear.
<b>C2</b>	Direct Clutch	Connects intermediate shaft and rear planetary sun gear.	Connects intermediate shaft and rear planetary carrier.
<b>C3</b>	U/D Direct Clutch/Reverse Clutch	Connects U/D sun gear and U/D planetary carrier.	Connects intermediate shaft and rear sun gear.
<b>B1</b>	2nd Brake/O/D & 2nd Brake	Prevents rear planetary sun gear from turning either clockwise or counterclockwise.	Prevents rear planetary sun gear from turning either clockwise or counterclockwise.
<b>B2</b>	1st and Reverse Brake/2nd Brake	Prevents rear planetary carrier and front planetary ring gear from turning either clockwise or counterclockwise.	Prevents outer race of F1 from turning either clockwise or counterclockwise thus preventing the rear sun gear turning counter-clockwise.
<b>B3</b>	U/D Brake/1st and Reverse Brake	Prevents U/D sun gear from turning either clockwise or counterclockwise.	Prevents rear planetary carrier and front planetary ring gear from turning either clockwise or counterclockwise.
<b>F1</b>	No. 1 One-Way Clutch	Prevents rear planetary carrier and front ring gear from turning counterclockwise.	When B2 is operating, this clutch prevents rear sun gear from turning counterclockwise.
<b>F2</b>	U/D One-Way Clutch/No. 2 One-Way Clutch	Prevents U/D planetary sun gear from turning clockwise.	Prevents rear planetary carrier and front planetary ring gear from turning counterclockwise.

Fig. 2-06  
T2731050

### **U-Series Clutch Application Charts**

Control of planetary components by the holding devices differs as reflected by these clutch application charts.

U-240 Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
P	Park								
R	Reverse								
N	Neutral								
D	1st								
	2nd								
	3rd								
	O/D								
2	1st								
	2nd								
L	1st								

U-341 Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
P	Park								
R	Reverse								
N	Neutral								
D	1st								
	2nd								
	3rd								
	O/D								
2	1st								
	2nd								
L	1st								

Fig. 2-07  
T2731051/T2731052

**U-341E Transaxle** The U-341E transaxle power flow will introduce you to the U-series planetary gear operation.



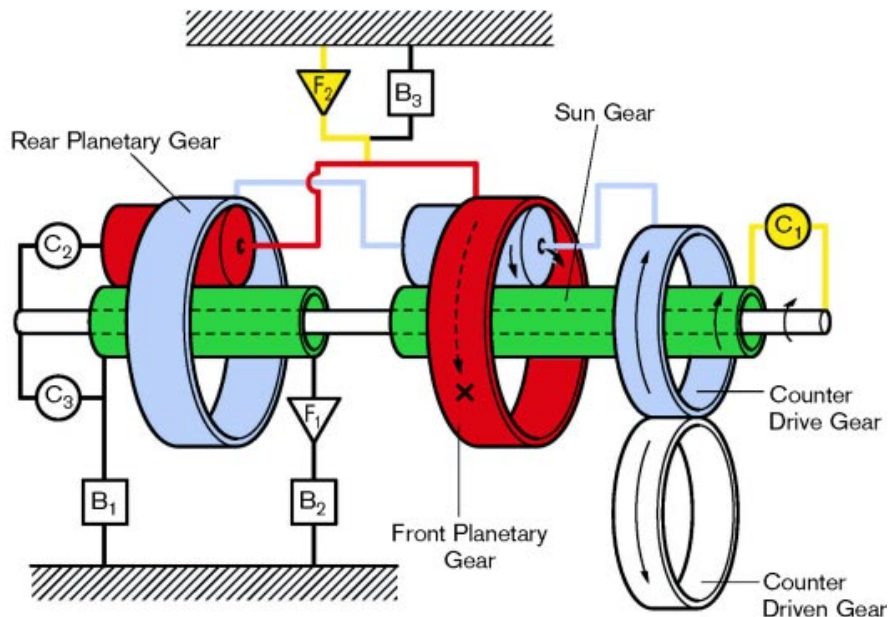
**D-Range First Gear**

First gear uses the front planetary gear set only. The *forward clutch* (C1) is applied in all forward gears except overdrive. It connects the intermediate shaft to the front planetary sun gear. The *No. 2 one-way clutch* (F2) prevents the front planetary ring gear from rotating counterclockwise by holding it to the transmission case. When the ring gear is held and the sun gear is driven, it causes the planetary gears to rotate at a reduced speed in the same direction as the sun gear. The front planetary carrier is connected to the counter drive gear which drives the differential ring gear through the counter driven gear.

To provide engine braking on deceleration, the *1st and reverse brake* (B3) is applied when the gear selector is placed in the L position. B3 is a parallel holding device to F2 and prevents the planetary carrier from turning either clockwise or counterclockwise. So if slippage occurs in drive first gear, but holds in low, F2 is likely slipping.

**U-341E First Gear Power Flow**

The forward clutch (C1) is applied in all forward gears except overdrive and connects the intermediate shaft to the front planetary sun gear.



U-341 Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
N	Neutral								
D	1st								
	2nd								
L	1st								

Fig. 2-08  
T273H053/T273H054

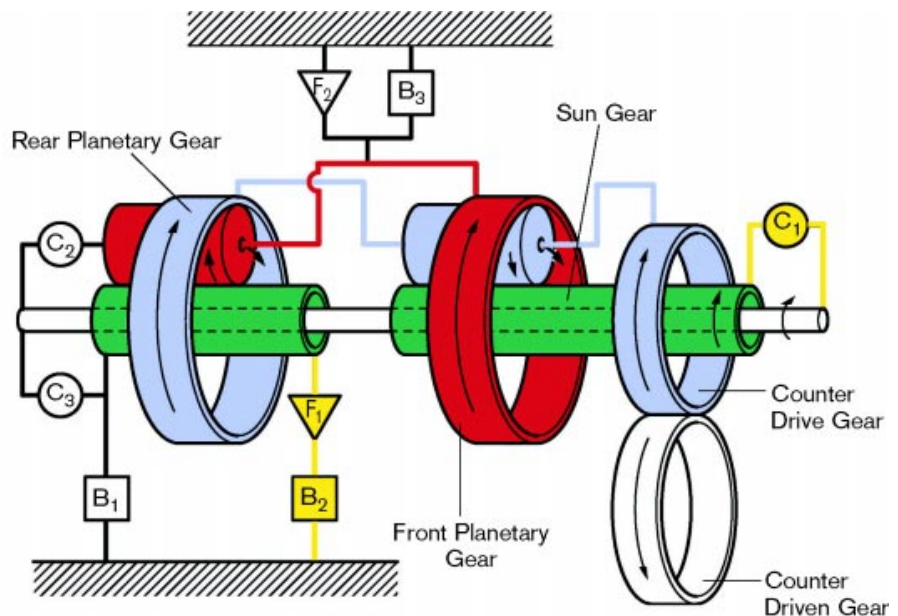
**D-Range Second Gear**

Second gear uses both the front and rear planetary gear sets. Since second gear builds on first gear, it will help to check out the dynamics of the rear planetary gear set in first gear. In first gear the front sun gear drives the planetary gears against a stationary ring gear, causing the planetary carrier to drive the counter drive gear. The front planetary carrier is connected to the rear ring gear causing the planetary gears to rotate and drive the sun gear, but since it is not held or connected to another member, it idles.

When second brake is applied for second gear, the rear sun gear (which had been idling) is held, causing the rear planetary carrier, driven by the rear ring gear, to drive the front ring gear. As the front ring gear is driven clockwise, the front planetary carrier rotates at a faster speed than first gear.

**U-341E Second Gear Power Flow**

When B2 is applied for second gear, the rear sun gear (which had been idling) is held, causing the rear planetary carrier, driven by the rear ring gear, to drive the front ring gear. The front planetary carrier, rotates at a faster speed than first gear.



U-341 Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
D	1st								
	2nd								
2	2nd								

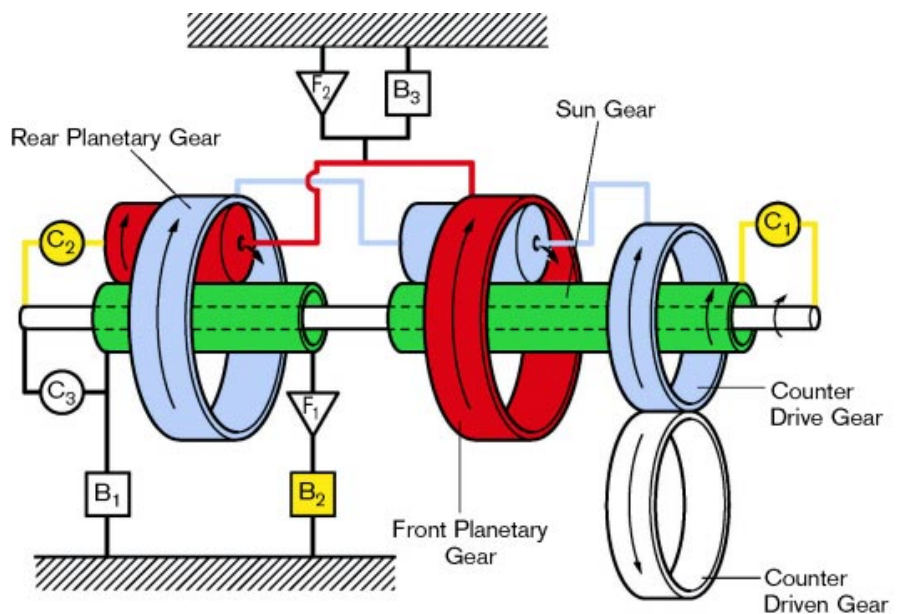
Fig. 2-09  
T2731055/T2731056

To provide engine braking on deceleration, the *overdrive and 2nd brake* (B1) is applied when the gear selector is placed in the 2-range position. B1 is a parallel holding device to F1 and B2 and prevents the planetary carrier from turning either clockwise or counterclockwise. So if slippage occurs or the transmission remains in first gear in an automatic upshift to second gear, but holds in 2-range, F1 or B2 is likely slipping.

**D-Range Third Gear** Third gear uses both the front and rear planetary gear sets to provide a direct drive. The *forward clutch* (C1) is connected to the front planetary sun gear and intermediate shaft. When the upshift to third gear occurs, the *direct clutch* (C2) is applied, connecting the intermediate shaft to the rear planetary carrier. Both planetary gear sets rotate as a unit driving the counter drive gear. The *No. 1 one-way clutch* (F1) releases the rear sun gear as the unit begins to rotate.

**U-341E Third Gear Power Flow**

When the upshift to third gear occurs, the direct clutch (C2) is applied connecting the intermediate shaft to the rear planetary carrier.



U-341 Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
D	2nd								
	3rd								

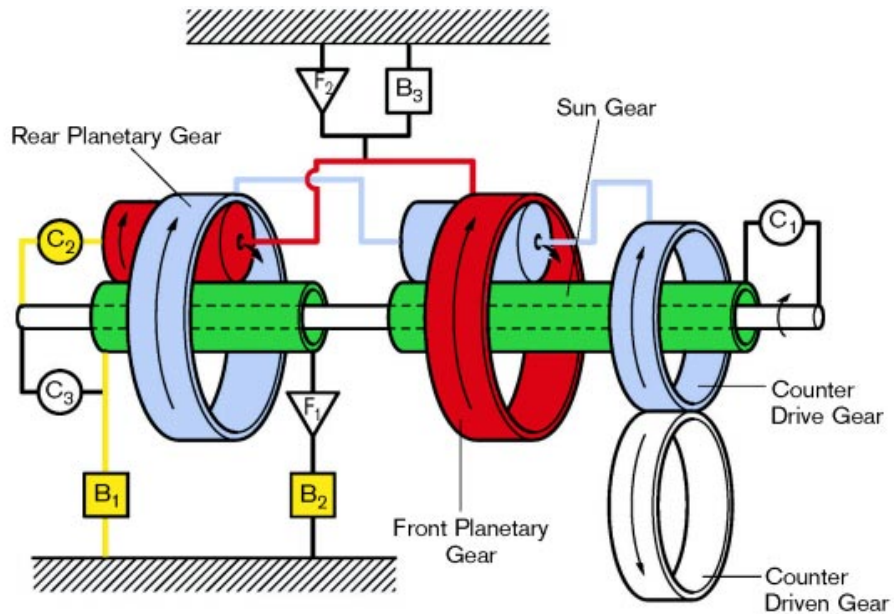
Fig. 2-10  
T2731057/T2731058

**D-Range Fourth Gear** Fourth gear uses the rear planetary gear set only. The *overdrive and 2nd brake* (B1) is applied as the *forward clutch* (C1) is released. When C1 releases, the front sun gear is released but the *direct clutch* (C2) continues to connect the intermediate shaft and the rear planetary carrier. The *overdrive and 2nd brake* (B1) holds the rear sun gear to the transmission case. The planetary carrier causes the pinions to walk around the sun gear and causes the rear ring gear to turn at an overdrive speed. The rear ring gear is attached to the front planetary carrier and drives the counter drive gear.

Since B1 holds the rear sun gear from rotating clockwise or counterclockwise, this gear position should also have engine braking on deceleration. If B1 slips, allowing the rear sun gear to rotate clockwise, the carrier would not drive the ring gear and engine speed will flare.

**U-341E Fourth Gear Power Flow**

When fourth gear is applied the overdrive and 2nd brake (B1) is applied as the forward clutch (C1) is released.



U-341 Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
D	3rd	■	■			⊗			
	O/D		■		■	⊗			

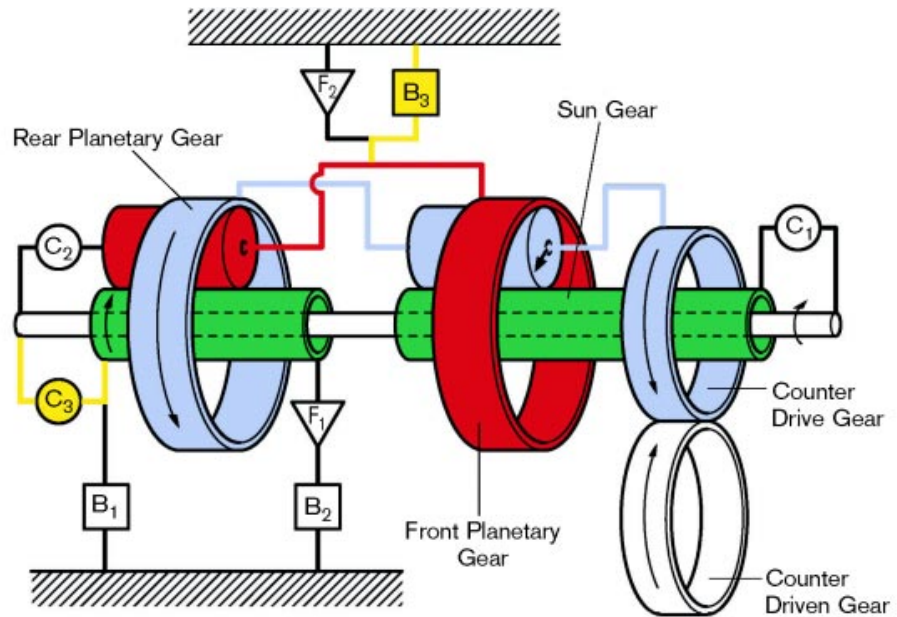
Fig. 2-11  
T2731059/T2731060

**Reverse Gear** Reverse gear uses the rear planetary gear set only. The *1st and reverse brake* (B3) connects the rear planetary carrier to the transmission case. The *reverse clutch* (C3) connects the intermediate shaft to the rear sun gear. With the input torque delivered to the sun gear and the planetary carrier being held stationary, the planetary gears change the direction of input torque and drives the ring gear in the opposite direction of the sun gear. The rear ring gear connects to the front planetary carrier and drives the counter drive gear.

Since C3 is applied in reverse only, if slippage occurs, placing the transmission in low gear to apply B3. If no slippage occurs while decelerating in low, C3 is faulty.

**U-341E Reverse Gear Power Flow**

The 1st and reverse brake (B3) connects the rear planetary carrier to the case while the reverse clutch (C3) connects the intermediate shaft to the rear sun gear.



U-341 Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
P	Park								
R	Reverse								
N	Neutral								

Fig. 2-12  
T2731061/T2731062

**U-240E Transaxle** The U-240E uses the same basic planetary gear design as the U-341E, however, holding devices are different and fourth gear or overdrive is accomplished through a third planetary gear set. The third planetary gear set operates in an underdrive mode until fourth gear, when it operates as a direct drive.

The following section will deal with the power flow, identifying holding devices, component operation and diagnosing certain holding device operations. Since the third planetary gear set operates in underdrive in first, second, third, and reverse it will be covered in first gear only.

**D-Range First Gear** First gear uses the front planetary gear only. The *forward clutch* (C1) is applied in all forward gears including overdrive. It connects the intermediate shaft to the front planetary sun gear. The *No. 1 one-way clutch* (F1) prevents the front planetary ring gear from rotating counterclockwise. When the ring gear is held and the sun gear is driven, it causes the planetary carrier to rotate at a reduced speed in the same direction as the sun gear. The planetary carrier is connected to the counter drive gear which provides turning torque to the underdrive planetary gear set.

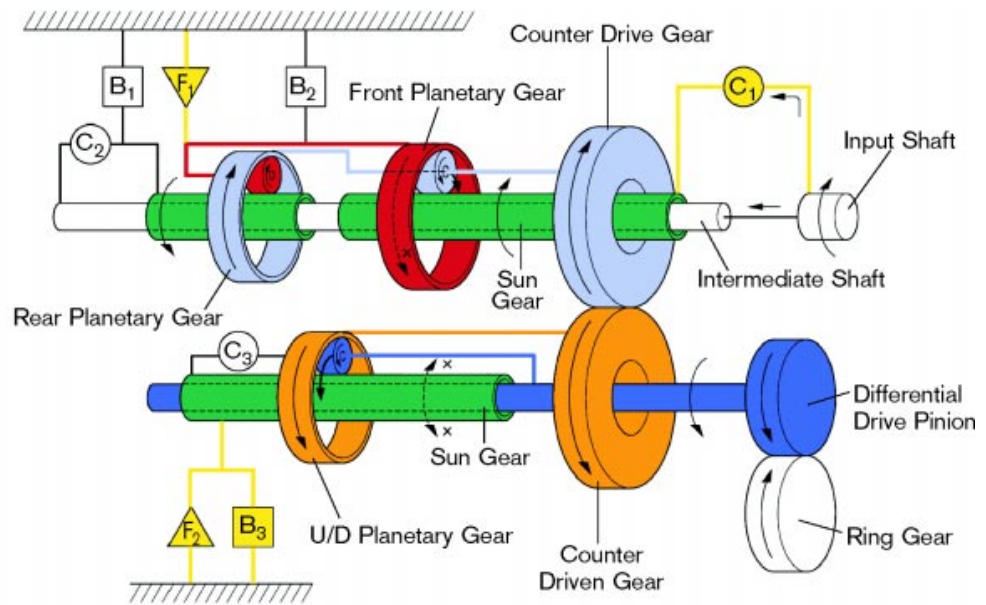
**Underdrive Operation** The ring gear of the underdrive planetary gear set receives input torque from the counter driven gear. The output shaft is connected to the planetary carrier and drives the differential drive pinion and ring gear. In first, second, and third gear the *underdrive brake* (B3) and the *underdrive one-way clutch* (F2) hold the sun gear to the transmission case. With the sun gear held, and the ring gear driven, the planetary carrier rotates at a lower speed than the ring gear.

**Low Range First Gear** To provide engine braking on deceleration, the *1st and reverse brake* (B2) is applied when the gear selector is placed in the L position. B2 is a parallel holding device to F1 and prevents the planetary carrier from turning either clockwise or counterclockwise. If slippage occurs in drive first gear, but holds in low, F1 is likely slipping. If slippage occurs in reverse, check for engine braking in low to verify if B2 is functioning properly.



**U-240E First Gear Power Flow**

When the front ring gear is held and the sun gear is driven, it causes the planetary gear to rotate at a reduced speed in the same direction as the sun gear.



U-240 Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
N	Neutral								
D	1st								
L	1st								

Fig. 2-13  
T2731083/T2731084

**D-Range Second Gear**

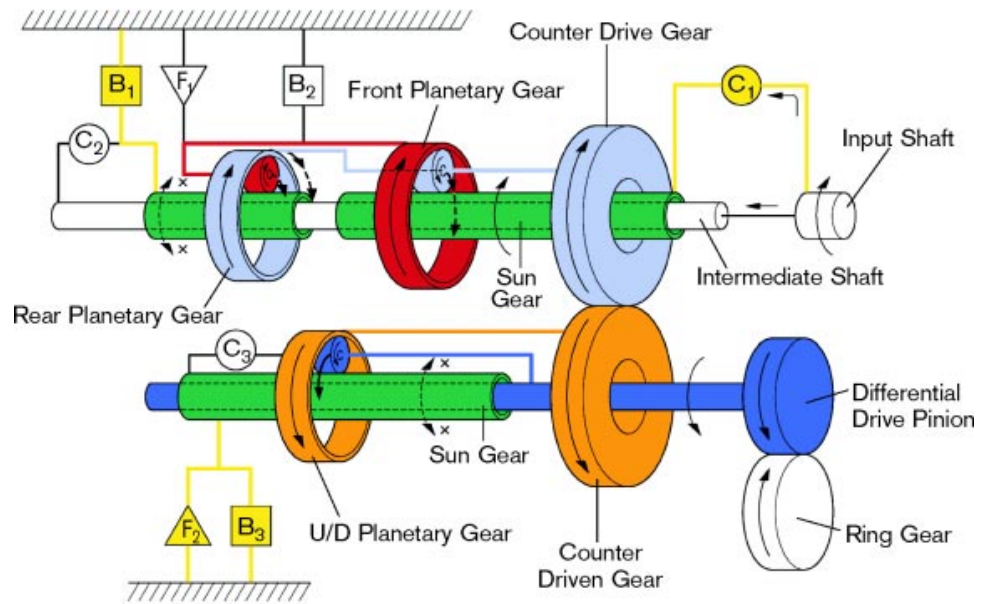
Second gear uses both the front and rear planetary gear sets. Since second gear builds on first gear, it will help to check out the dynamics of the rear planetary gear set in first gear. In first gear the front sun gear drives the front planetary gears against a stationary front ring gear, causing the planetary carrier to drive the counter drive gear. The front planetary carrier is connected to the rear ring gear causing the rear planetary gears to rotate and drive the rear sun gear. Since the sun gear is not held or connected to another member, it idles.

When the 2nd brake (B1) is applied for second gear, the rear sun gear is held causing the rear planetary carrier, driven by the rear ring gear, to drive the front ring gear. As the front ring gear is driven clockwise, the front planetary carrier rotates at a faster speed than first gear. The underdrive planetary gear set remains in underdrive just like first gear.

Engine braking on deceleration is accomplished whenever B1 is applied as it holds the sun gear directly and prevents it from turning either clockwise or counterclockwise. If slippage occurs or the transmission remains in first gear in an automatic upshift to second gear, B1 is likely slipping.

**U-240E Second Gear Power Flow**

When B1 is applied for second gear, the rear sun gear (which had been idling) is held, causing the rear planetary carrier, driven by the rear ring gear, to drive the front ring gear. The front planetary carrier rotates at a faster speed than first gear.



U-240 Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
N	Neutral								
D	1st								
	2nd								
2	1st								
	2nd								

Fig. 2-14  
T273RD65/T273RD66

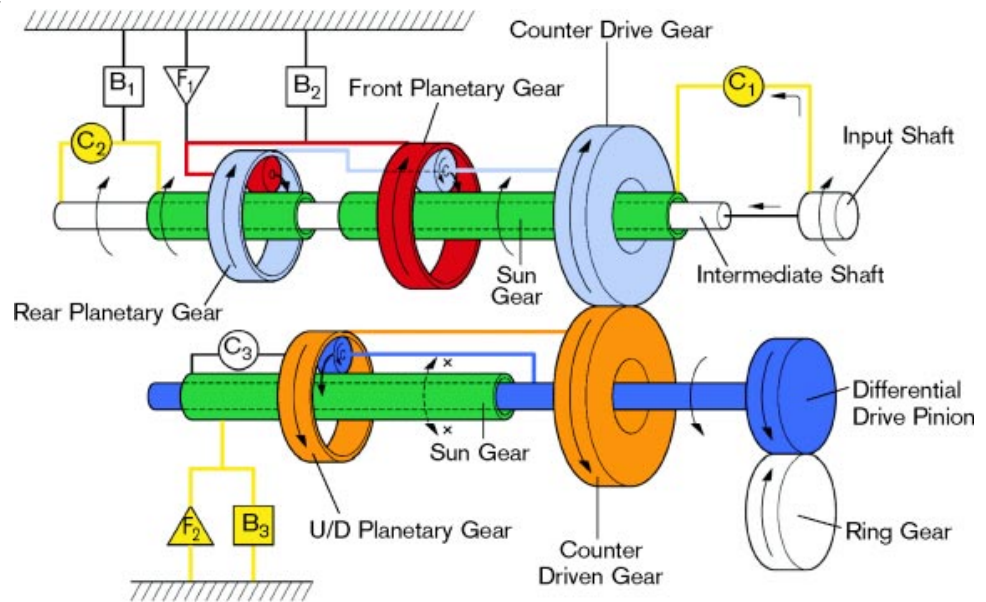


**D-Range Third Gear** Third gear uses both the front and rear planetary gear sets to provide a direct drive. The *forward clutch* (C1) is connected to the front planetary sun gear and input shaft. When the upshift to third gear occurs, the *2nd brake* (B1) releases as the *direct clutch* (C2) is applied connecting the intermediate shaft to the rear sun gear. Because the two planetary gear sets are connected through the planetary carriers and ring gears, both planetary gear sets rotate as a unit driving the counter drive gear. The underdrive planetary gear set remains in underdrive just like first and second gears.

B1 is applied during second gear and is released when the upshift to third gear occurs. Because B1 releases, the transmission does not remain in second if C2 does not apply. Instead, slippage and engine flare will occur if C2 fails.

**U-240E Third Gear Power Flow**

When the upshift to third gear occurs, the 2nd brake (B1) releases as the direct clutch (C2) is applied connecting the intermediate shaft to the rear sun gear.



U-240 Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
D	2nd								
	3rd								

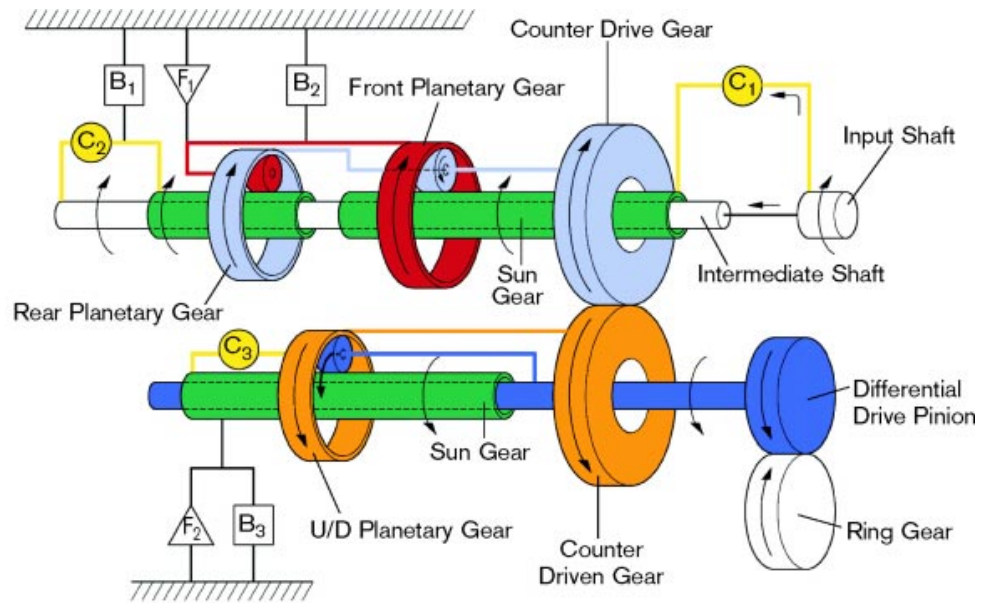
Fig. 2-15  
T2731067/T2731068

**D-Range Fourth Gear**

The upshift from third gear to fourth gear occurs in the underdrive unit which operates in underdrive in all gears except fourth. The upshift occurs when the underdrive unit shifts into direct drive. In fourth gear the *forward clutch* (C1) connects the front planetary sun gear and intermediate shaft. The *direct clutch* (C2) is applied, connecting the intermediate shaft to the rear sun gear and both planetary gear sets rotate as a unit driving the counter drive gear. The counter driven gear drives the underdrive planetary ring gear. When the upshift occurs, the *underdrive brake* (B3) releases the sun gear as the *underdrive clutch* (C3) applies connecting the sun gear to the planetary carrier. When two components of a planetary gear set are connected, the result is direct drive.

**U-240E Fourth Gear Power Flow**

The upshift to fourth occurs when the underdrive unit shifts into direct drive.



U-240 Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
	3rd								
	O/D								

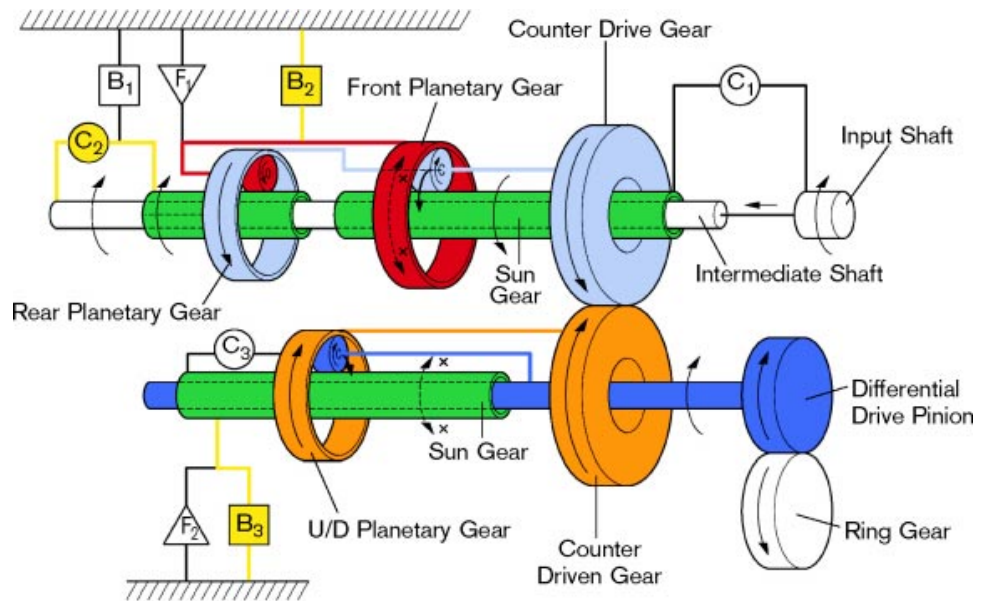
Fig. 2-16  
T2731069/T2731070

**Reverse Gear** Reverse gear uses the rear planetary gear set only. The *1st and reverse brake* (B2) connects the rear planetary carrier to the transmission case. The *direct clutch* (C2) connects the intermediate shaft to the rear sun gear. With the input torque delivered to the sun gear and the planetary carrier being held stationary, the planetary gears change the direction of input torque and drives the ring gear in the opposite direction of the sun gear. The rear ring gear connects to the front planetary carrier and drives the counter drive gear.

If slippage occurs in reverse, place the transmission in low gear to apply B2. If no slippage occurs while decelerating in low, C2 is likely at fault. Although C2 is applied in 3rd and O/D, slippage is less likely to be detected as the vehicle is in motion when the upshifts occur. In reverse, the engine must overcome the inertia of a vehicle at rest with a high amount of torque. If slippage occurs in reverse and there is no engine braking in low, B3 is the likely fault.

**U-240E Reverse Gear Power Flow**

The 1st and reverse brake (B2) connects the rear planetary carrier to the case. The direct clutch (C2) connects the intermediate shaft to the rear sun gear driving the ring gear in the opposite direction.



U-240 Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	F1	F2
P	Park								
R	Reverse								
N	Neutral								

Fig. 2-17  
T2731071/T2731072



**Notes**

A large grid area for taking notes, consisting of a 30x40 grid of small squares.