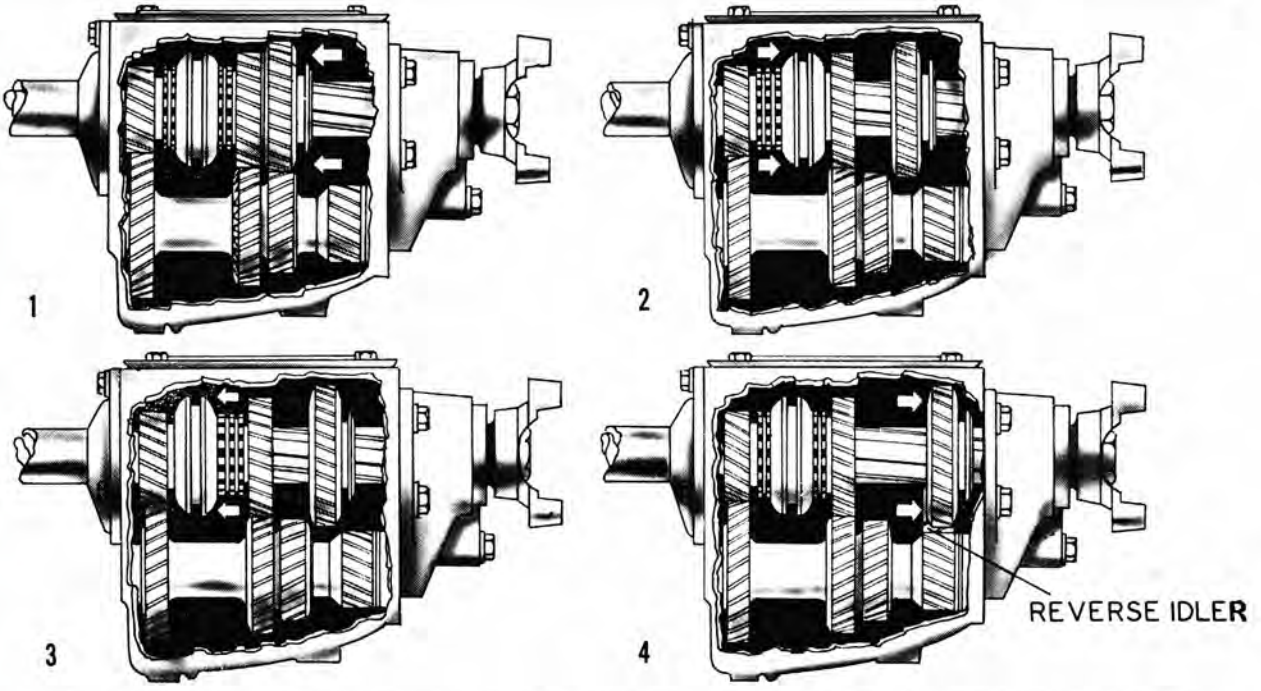
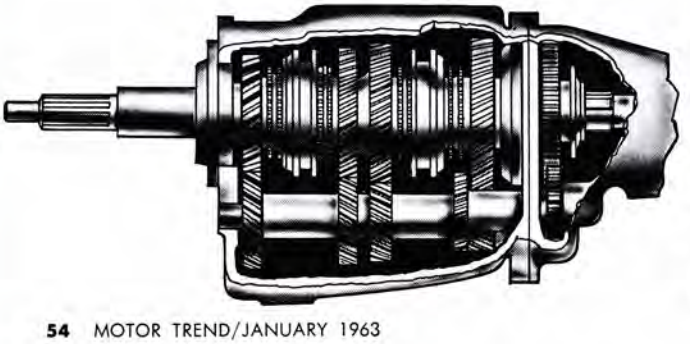
Know Your Car Part Two

TRANSMISSIONS and DRIVE LINES



Any automotive transmission provides a way of varying engine speed in relation to the speed of the rear wheels. The idea is to take advantage of the best engine power output in relation to the speed and/or load of the vehicle. The three-speed manual gearbox shown here involves a method of engaging gears on different shafts while they're spinning. To align these gears so they can mesh without clashing, a synchro sleeve is used. Fig. 1 represents first gear in most three-speed boxes (except the '63 Ford). First doesn't use synchro--the low and reverse gears are moved forward to engage countershaft low gear. To shift to second, Fig. 2, synchro moves back and engages second gear, which has been free-wheeling on the mainshaft. High gear, Fig. 3, disengages second, which free-wheels while the sleeve slides forward to the main drive pinion, locking to the mainshaft straight through the transmission. Reverse gear, Fig. 4, neutralizes synchro, reverse/low sliding gear goes back, engages reverse idler pinion with rear gear cluster.

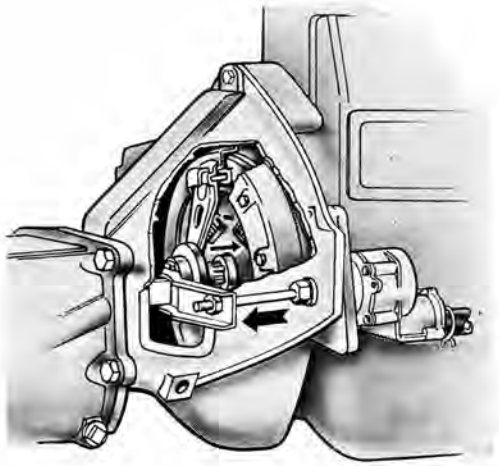


Domestic four-speed manual transmission is similar in operation to three-speed, but it has two sets of synchro rings. These provide clash-less shifting in all gears. Reverse is selected by engaging sliding gear on transmission tailshaft with reverse idler gear in rear case.

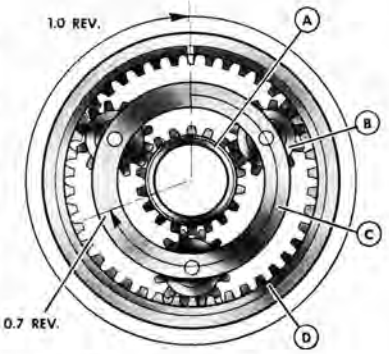
The purpose of this series is to help you understand the workings of 1963 cars. Our first installment dealt with engines, valve arrangements, carburetors, and electrical systems. These six pages, Part Two, cover transmissions and drive lines. In future issues, we'll explain differentials, suspensions, and body structures. While we've tried to keep our illustrations and text as simple as possible, the explanations assume some mechanical knowledge on your part. Still, we're confident that MOTOR TREND's readers can understand and benefit from this series. If you missed Part I, see the back-issue information on page 59.

by Robert Temple

Drawings by the author



(RIGHT) Overdrive is a small two-speed transmission behind the regular gearcase. It provides additional engine-to-drive-line ratios. By using concentric planetary gearsets, ratio changes can be made by holding sun gear (A) while power from engine goes to planet gears (B) through carrier (C), allowing driveshaft to turn faster than the mainshaft.



(LEFT) E-Stick transmission by American motors isn't really a transmission but an automatic clutch-engaging device combining a three-speed gearbox. The clutch operates by engine oil pressure, which actuates a servo piston in the clutch housing. As oil pressure increases, hydraulic linkage pushes clutch bearing assembly against fingers, forcing the pressure plate forward. This provides no-clutch-pedal driving, but still means gears have to be shifted by hand.

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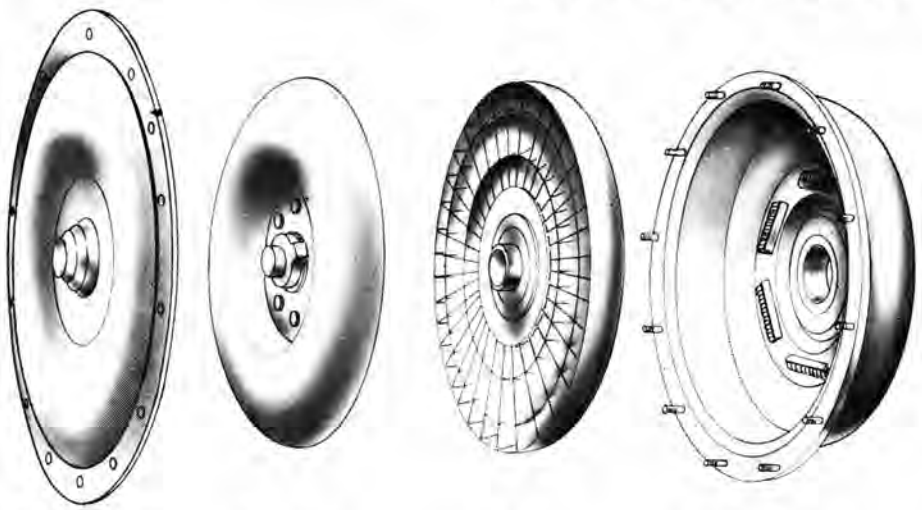
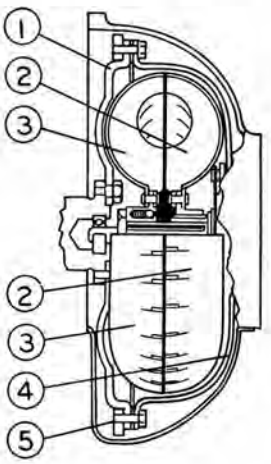
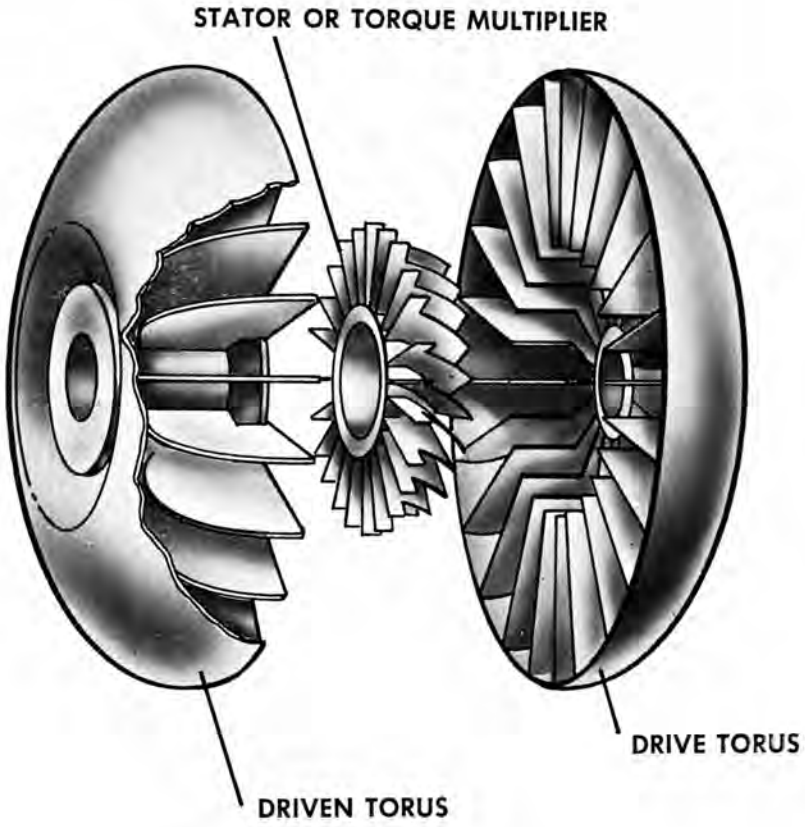
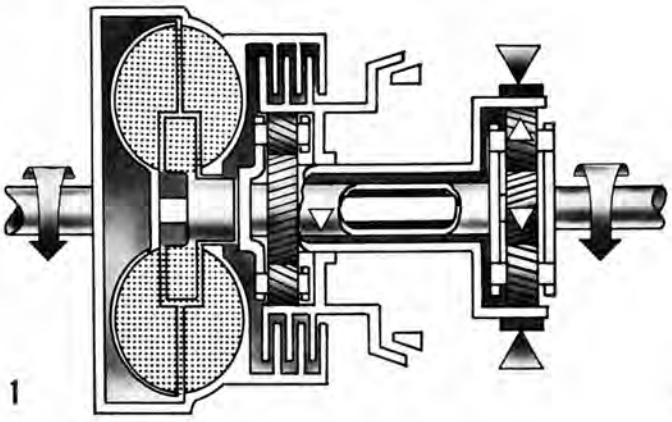




An automatic transmission doesn't use a friction clutch to connect it to the engine. Power is transmitted by either a fluid coupling or a torque converter. Four major members make up a fluid coupling (shown), one of which is the engine flywheel. A torus cover fastens to the flywheel and houses the drive torus, a disc with flat, straight, perpendicular vanes radiating from hub. Opposing this is a similarly vaned driven torus, bolted to main transmission shaft. The entire assembly is filled with oil, and as the engine rotates the driving torus, oil goes around with it. At low speeds there's time for the oil to escape from between the drive and driven torus blades, allowing slippage; but as engine speed increases, less oil escapes and eventually both members are at almost the same speed.

General Motors' Hydra-Matic three-speed has a third member in the fluid coupling to give a multiplication of torque. This third member, called a stator, has inclined vanes to direct oil flow from driven to drive torus at accelerated speed. This gives additional rotational boost within the unit. It also functions as one of the transmission clutches by valving oil to and from it during the shifting sequence. The transmission, below, is in first gear when the coupling is filled with oil. The rear band is engaged, and the front clutch and reverse band are disengaged. In second gear, the coupling is emptied, front clutch and rear band applied, cone reverse clutch engaged. Third shows a filled coupling, front clutch only applied. For reverse, reverse cone clutch is applied.

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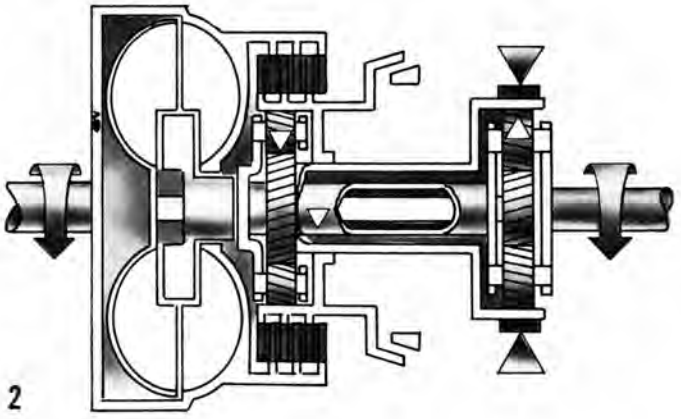
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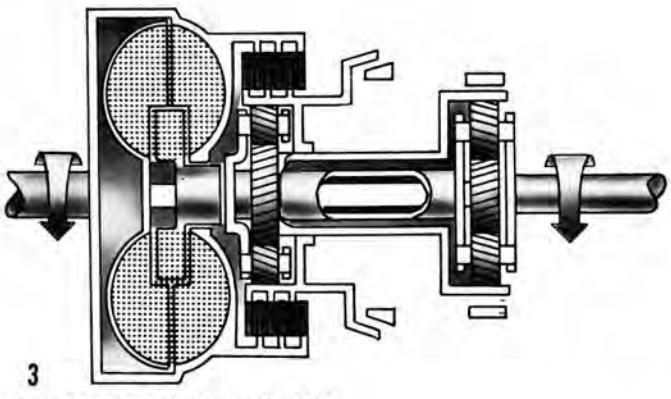
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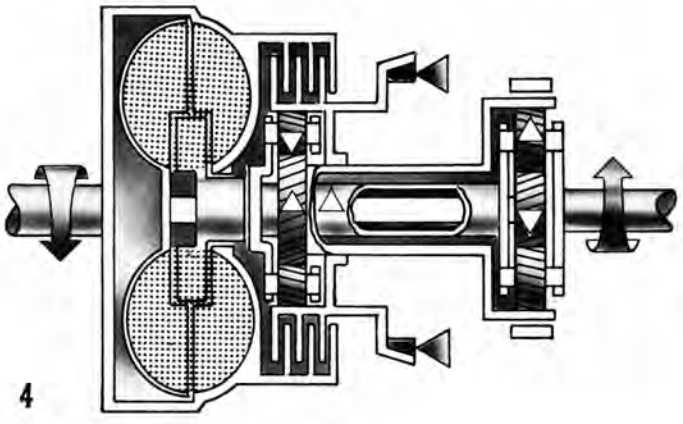
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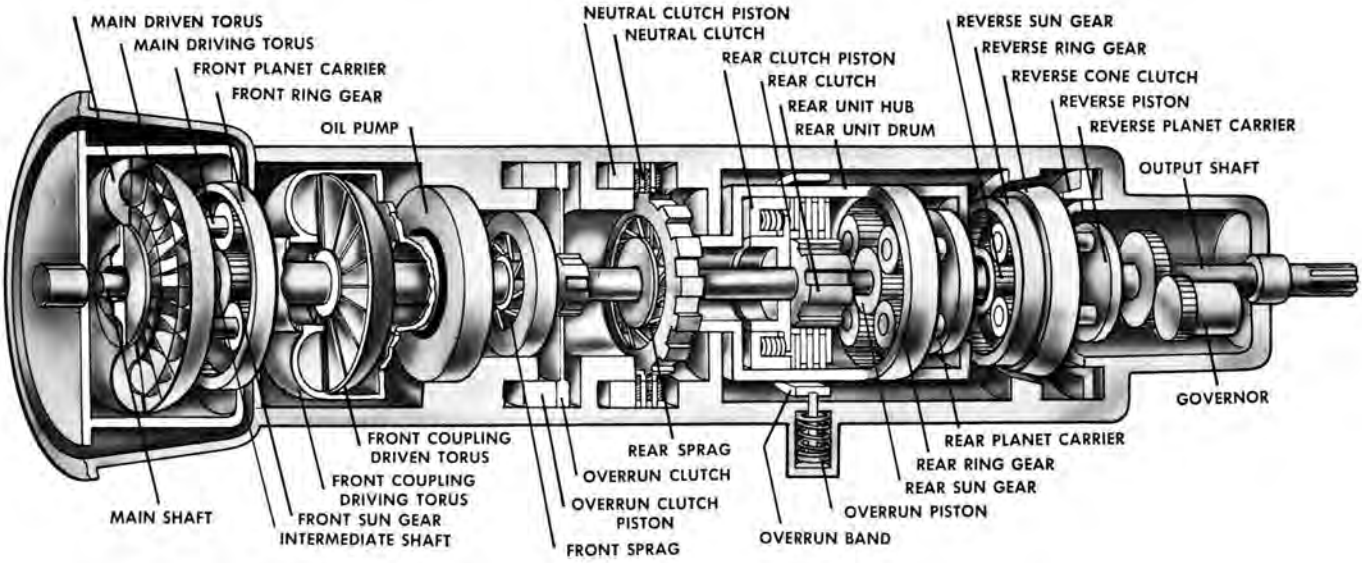

Four-speed Hydra-Matic is quite complicated to explain in simple terms. Chart shows shifting sequence of the complex hydraulic-mechanical transmission. Basically, the unit consists of a main fluid coupling and a control coupling which fills and empties. Three planetary gearsets, three plate clutches, a band, a cone clutch, and two sprag assemblies combine to form a four-speed forward and one-speed reverse transmission.

TRANSMISSION OPERATION FOR EACH SELECTOR SETTING

DRIVE RANGE	SPEED	FRONT UNIT			REAR UNIT				REVERSE UNIT	
		CONTROLLED COUPLING	FRONT SPRAG CLUTCH	OVERRUN CLUTCH	NEUTRAL CLUTCH	REAR SPRAG CLUTCH	REAR CLUTCH	OVERRUN BAND	REVERSE CONE CLUTCH	PARKING PAWL
PARK		REDUCTION			NEUTRAL				IDLING	
		EMPTY	ON	OFF	OFF	ON	OFF	OFF	OFF	ON
NEUTRAL		REDUCTION			NEUTRAL				IDLING	
		EMPTY	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF
DR. 4		REDUCTION			REDUCTION				IDLING	
	1	EMPTY	ON	OFF	ON	ON	OFF	OFF	OFF	OFF
		DIRECT DRIVE			REDUCTION				IDLING	
	2	FULL	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF
		REDUCTION			DIRECT DRIVE				IDLING	
	3	EMPTY	ON	OFF	ON	OFF	ON	OFF	OFF	OFF
		DIRECT DRIVE			DIRECT DRIVE				IDLING	
	4	FULL	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF
DR. 3		REDUCTION			REDUCTION				IDLING	
	1	EMPTY	ON	ON	ON	ON	OFF	OFF	OFF	OFF
		DIRECT DRIVE			REDUCTION				IDLING	
	2	FULL	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF
		REDUCTION							IDLING	
	3	EMPTY	ON	ON	ON	OFF	ON	OFF	OFF	OFF
LO		REDUCTION			REDUCTION				IDLING	
	1	EMPTY	ON	ON	ON	ON	OFF	ON	OFF	OFF
		DIRECT DRIVE			REDUCTION				IDLING	
	2	FULL	OFF	OFF	ON	ON	OFF	ON	OFF	OFF
REVERSE					NEUTRAL				REDUCTION	
		EMPTY	ON	OFF	OFF	ON	OFF	OFF	ON	OFF

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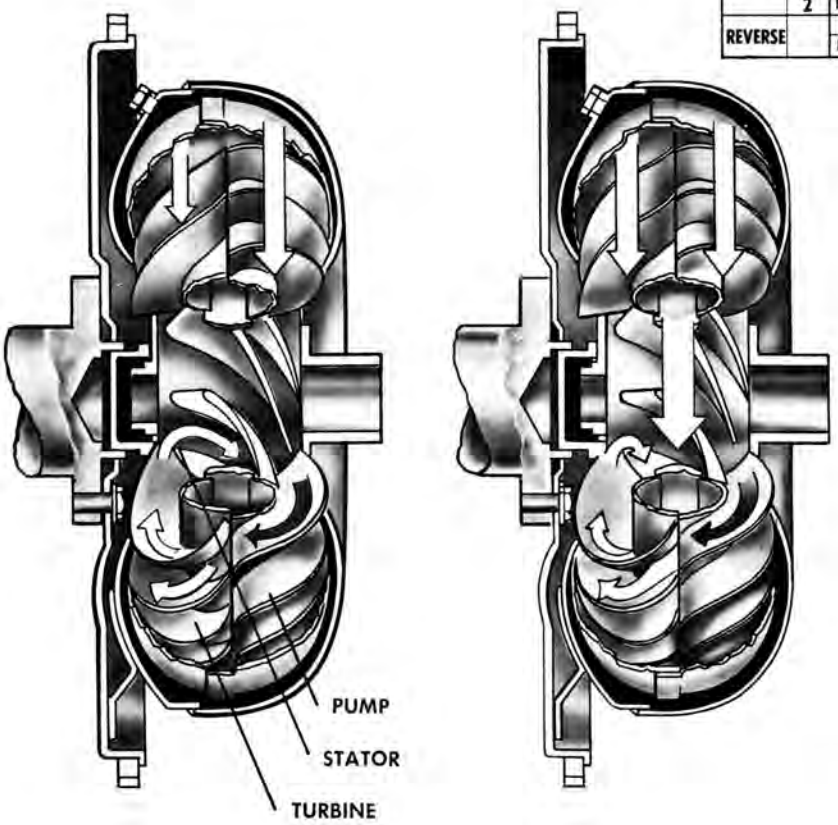
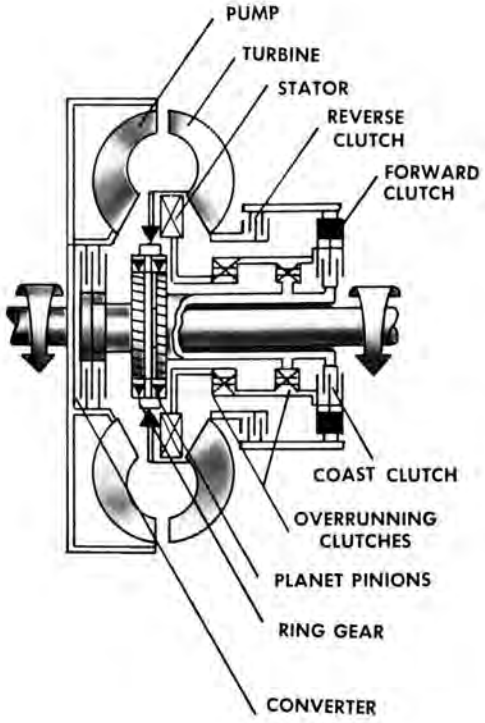
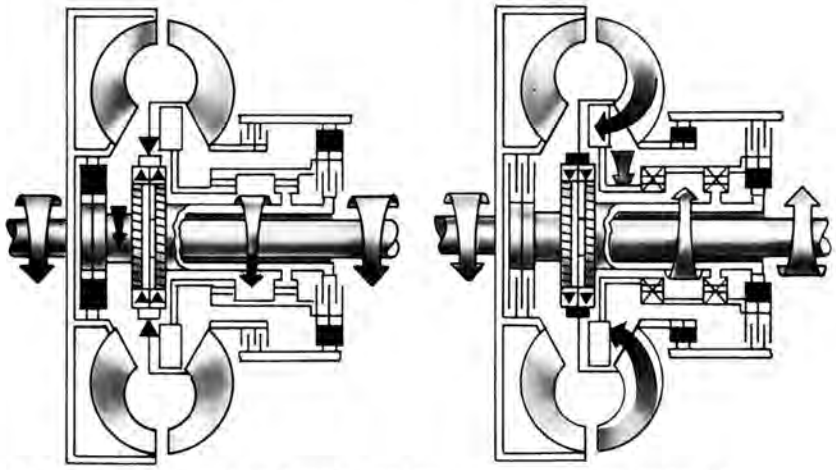
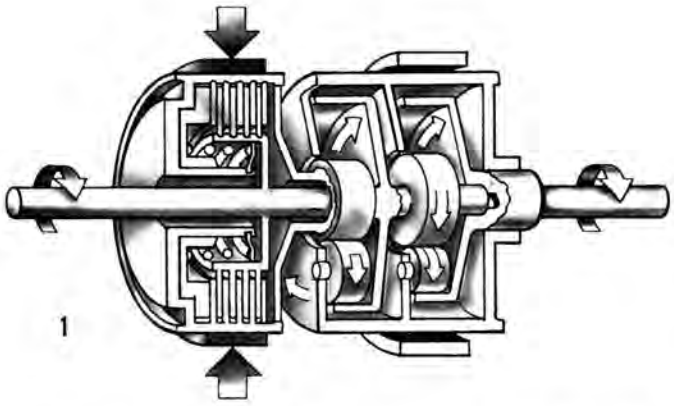


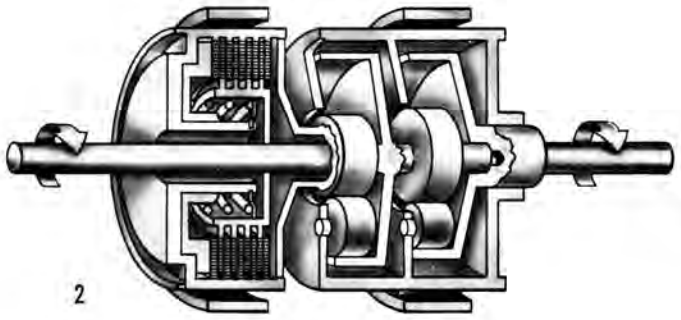
A basic torque converter has three members: the "driver" or pump, the "driven" or turbine, and the reaction unit or "stator." The latter works against the case of the transmission through an overrunning clutch. In use, oil flows from pump vanes as the engine accelerates, causing the turbine to rotate in the same direction. The turbine vanes carry oil around to the stator, which is being held by the overrunning clutch. Vanes on the stator redirect the oil against the rear side of the pump vanes, resulting in an added push or torque multiplication.

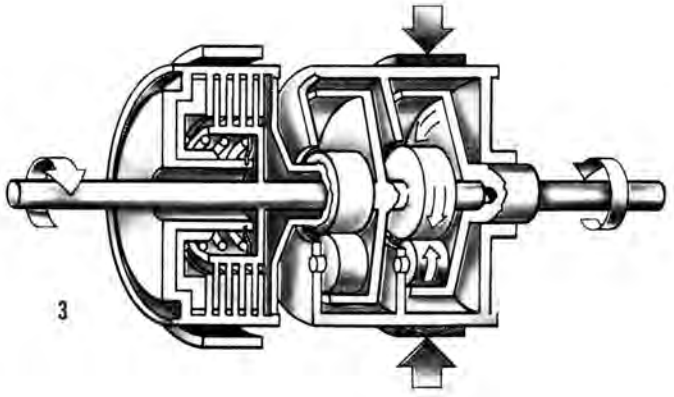




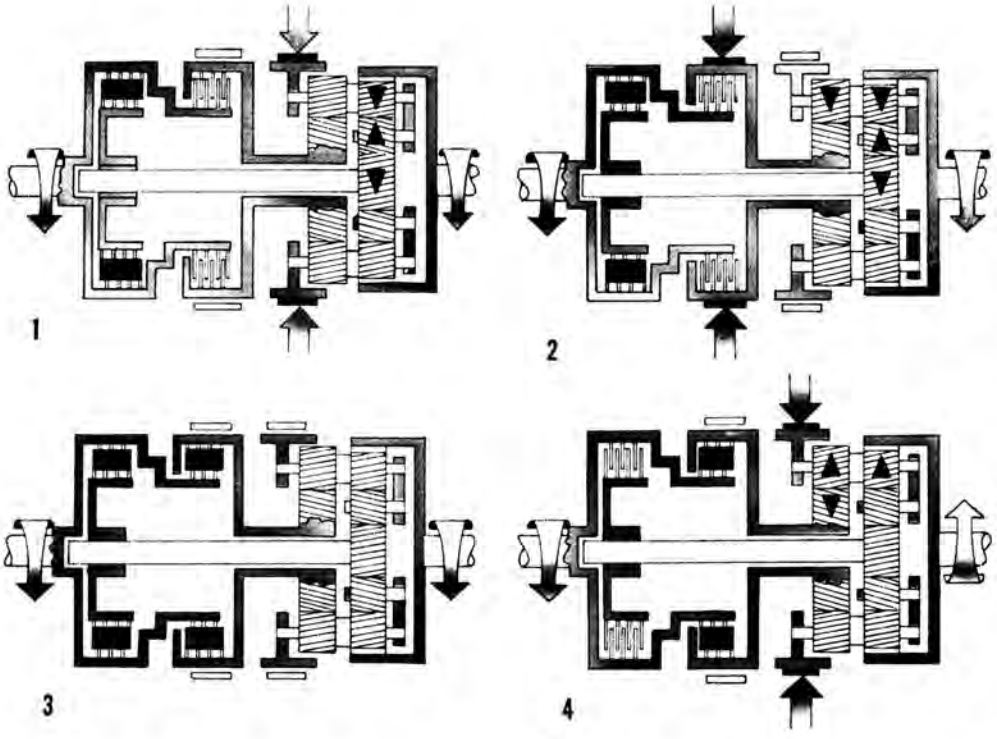
Unique Buick Special transmission has converter pump in front, driven directly by flywheel. Within this pump is converter clutch, which drives front sun gear when engaged. Turbine part of converter drives a ring gear common to both front and rear sun gears, and inner half of reversing clutch is fastened to backside of pump and acts against transmission case. In drive range, front clutch engages, locks stator cams and rear sun gear to case. Oil from pump turns turbine, and planet gears walk around rear sun gear. As speed goes up, hydraulic control system engages clutch, and part of engine torque is transmitted to front sun gear; part through torque converter. Reverse is complicated, with clutches letting stator turn in a direction opposite to the engine's rotation.



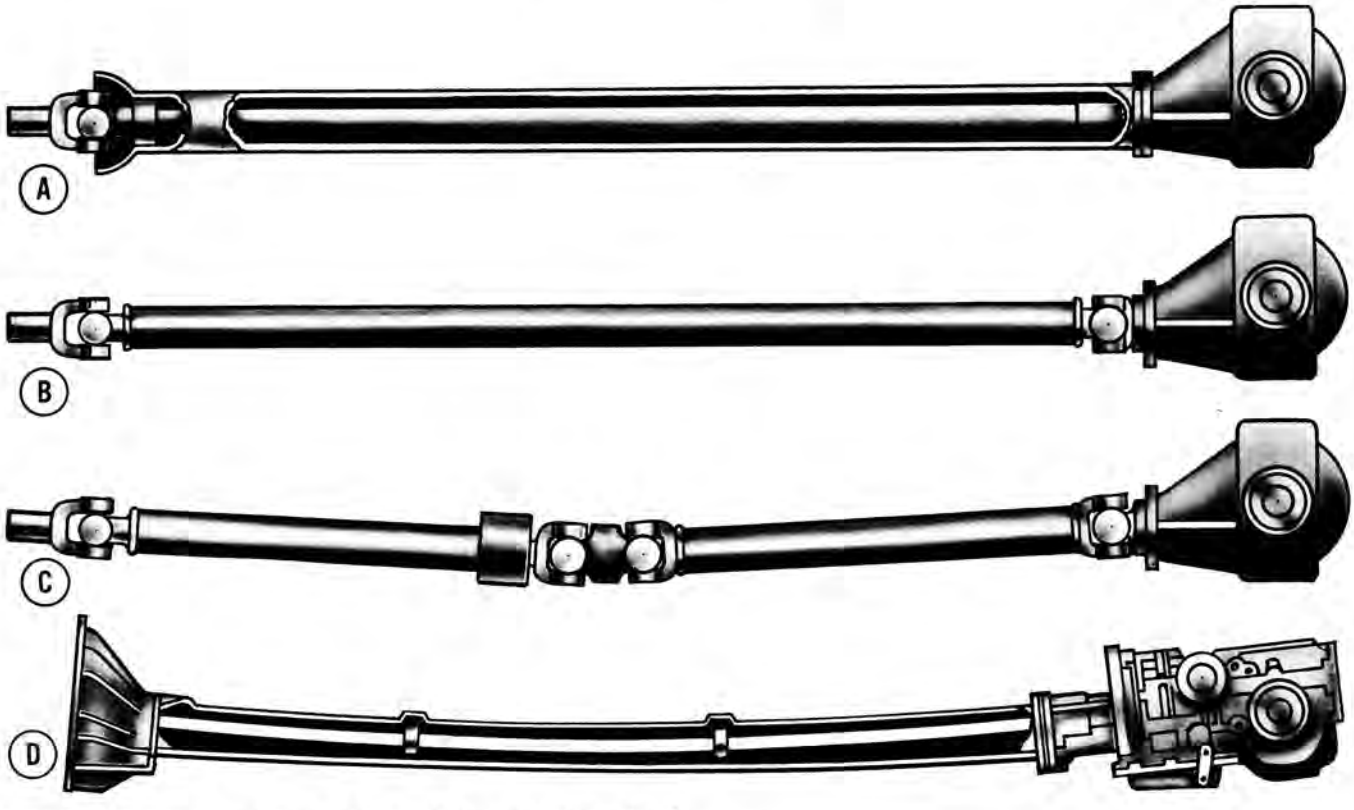




Chrysler's Power-Flite is a two-speed torque converter with two planetary gearsets: the front for high, low, and kick-down; rear set for reverse. Low, Fig. 1, shows front band applied, front sun gear stationary, rear band and clutch disengaged. Direct drive, Fig. 2, has front and rear bands released, direct clutch engaged. Both planetary gearsets tend to cancel each other, and complete assemblies rotate together as single unit directly through transmission. Reverse, Fig. 3, has rear band engaged, direct clutch and front band released, while rear band holds planet carrier drum stationary and forces rear planet gears to act as idlers and revolve in opposite direction—turning rear ring gear and output shaft in reverse direction.



Three-speed automatics using torque converter have two planetary gearsets, two bands, and two clutches. First gear, Fig. 1, shows front clutch and band engaged, rear ones free, while second, Fig. 2, clutch and band engagement is reversed. High gear, Fig. 3: front and rear clutches are on while bands are released. Reverse uses rear clutch and band while others are disengaged. Regulating sun gearsets by bands and clutches gives a positive shift feeling and good manual control for this gearing system.



Four basic drive methods are used for front-engined, rear-wheel-driven cars. The torque-tube drive has a shaft inside a tube that bolts securely to the differential with a ball joint connection to the transmission. Open shaft uses U-joints at each end, has splined connection to allow for suspension movement. Split shaft is essentially two open shafts joined at the center by a constant-velocity U-joint mounted on the frame. Lower floor pans are possible with this type of drive because only the rear half moves up and down with the differential. Flexible shaft is another means of lowering car's floor. Shaft isn't bent, but is held in a sag position by frame-mounted bars, which prevent whip.

NEXT MONTH

Next month, MOTOR TREND plans to bring you detailed explanations of various 1963 cars' suspension systems, differentials, steering mechanisms, and body constructions. Be sure to get your copy. For those who missed last month's installment, back numbers are still on hand. Ask for the December, 1962, issue, and send 50¢ to: Back Issues Dept., MOTOR TREND, 5916 Hollywood Blvd., Los Angeles 28, Calif.