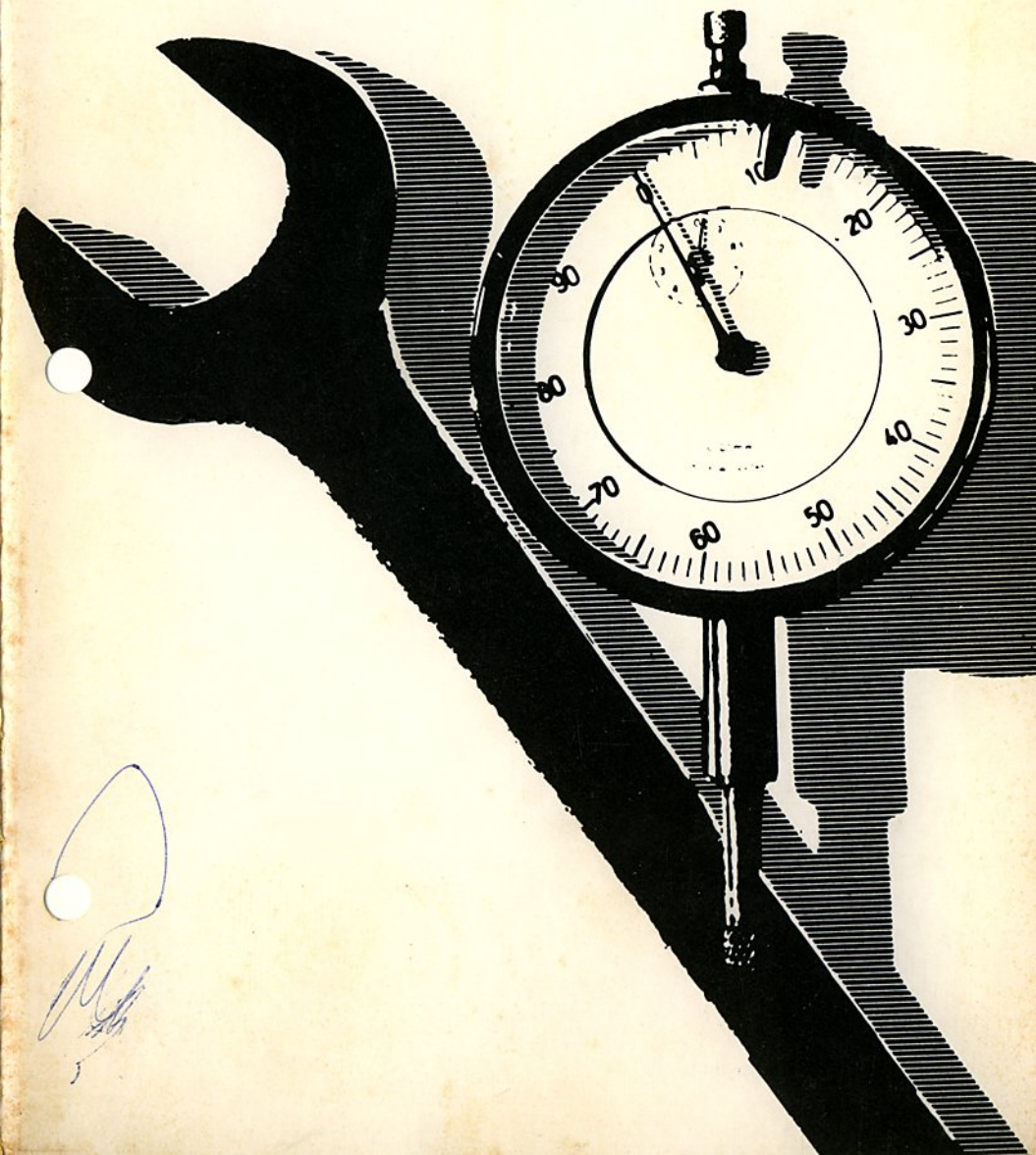
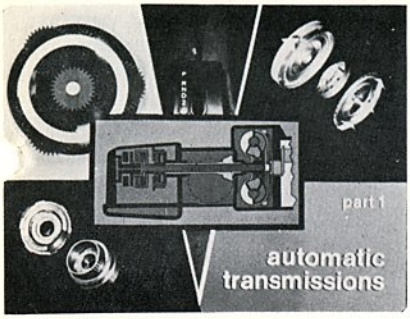
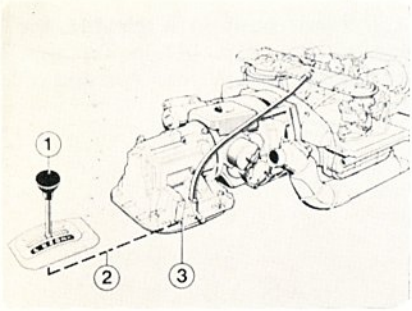
Automatic Transmission Part I

Dealer Level Training

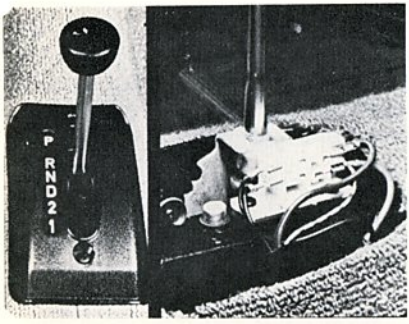




"Automatic Transmission—Part I"

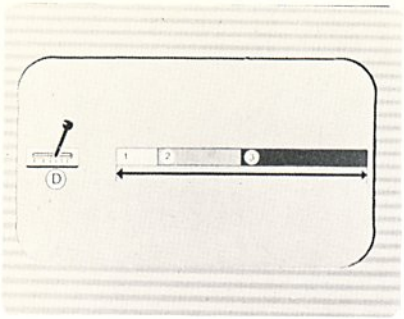


Let's begin where the driver begins—with the selector lever—shown here as number one. Number two is the linkage that connects the selector lever with the trans — mission lever.

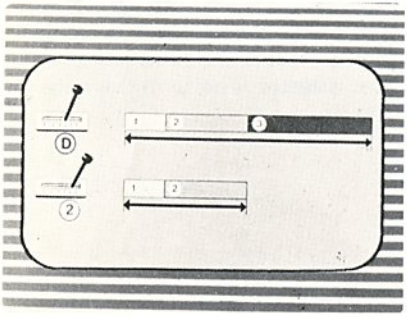


Here the selector lever is in position "N" or neutral. On the right is a combination back-up light, neutral safety switch. Before 1971, the engine could be started only in neutral but since August, 1971 the engine can also be started in "P", the park position.

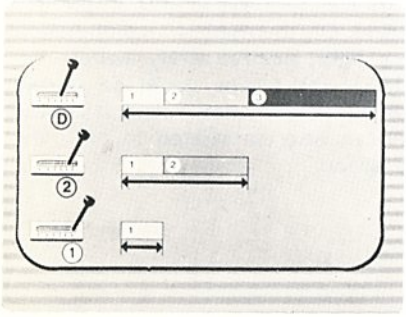
Slamming the shift lever into reverse when the vehicle is moving forward will result in damage to the transmission. So to avoid mishaps, the driver must lift the lever to select reverse or park as illustrated here.



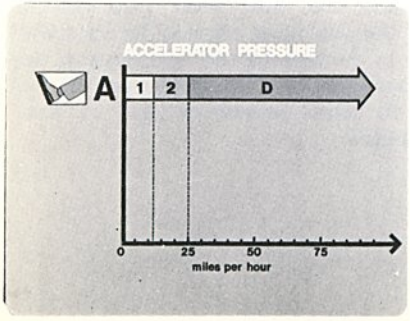
In "D" or drive the transmission automatically shifts into first gear and moves forward, then into second, and as speed increases, into third.



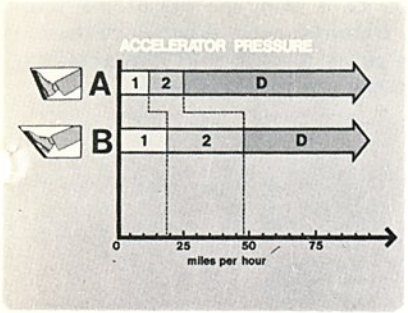
If, the 2nd gear position is selected, the transmission will start off in 1st gear, then shift automatically into 2nd and remain there.



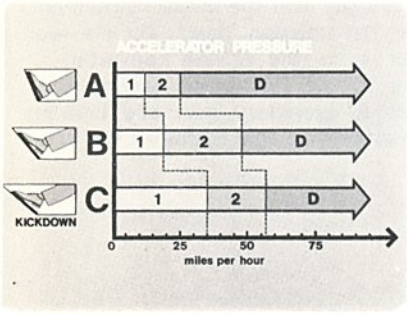
And for maximum braking effect on steep down grades, the 1st gear position can be selected, however 1st gear will remain engaged until manually shifted into 2nd or the Drive gear range.



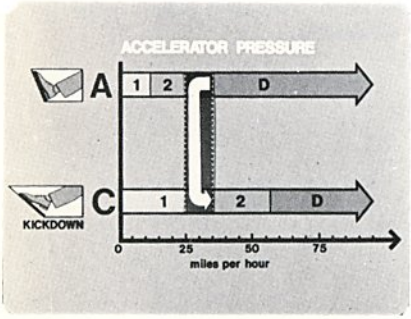
Throttle position is a control factor for shifting. Therefore, a light gradual pressure on the accelerator will cause the transmission to upshift from 1st, to 2nd and then to 3rd at approx. 15 miles per hour.



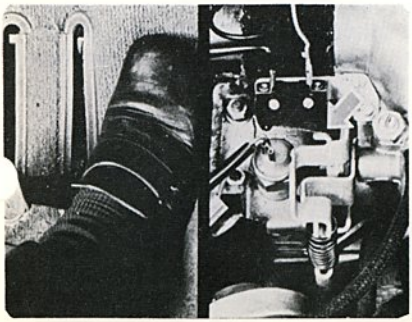
Heavier pressure on the accelerator delays shifting, uses more fuel but increases acceleration by allowing the engine to rev much higher in each gear range.



Full accelerator pressure, pressing the accelerator all the way down to the floor, further delays shifting by engaging "The Kickdown" letting you accelerate even faster.

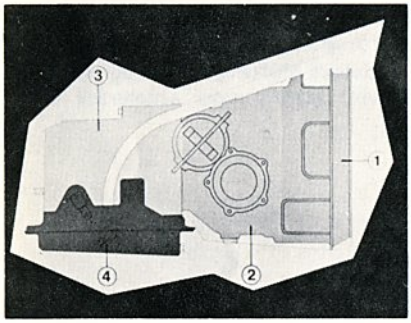


"Kickdown" is used primarily for rapid acceleration at moderate speeds. For example, if you engage "Kickdown" below a speed of approx. 53 mph the transmission will automatically down shift . . . until the pressure on the accelerator pedal is released, or a speed of approximately 55 mph is reached . . . then, it will upshift again automatically.

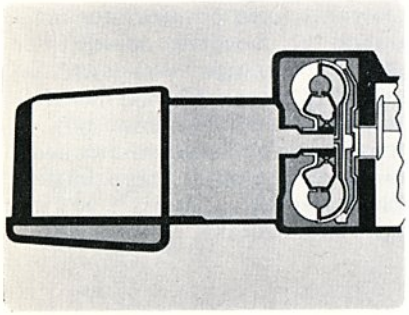


The "Kickdown" switch is located under the gas pedal on Types 2 and 4 and on the throttle lever of Type 3's. In either case, it must be correctly adjusted so it operates neither too early nor late when the accelerator is fully depressed.

As you have seen, shifting of the automatic transmission is directly controlled by the driver through shift lever positions and accelerator pedal pressure.

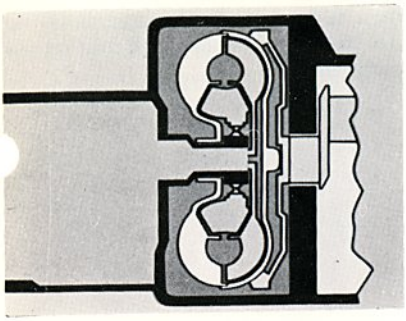


Now let's get into the major components of the transmission itself. At the rear, number 1, is the torque converter . . . number 2, the final drive assembly . . . number 3, planetary gear and clutches and number 4 . . . the hydraulic shift controls.

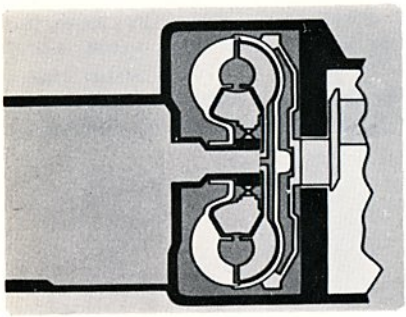


Let's go back and start again with the torque converter

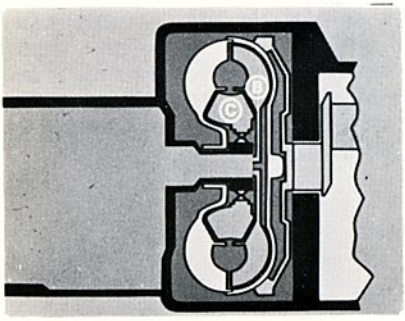
The torque converter uses a special light weight oil called "ATF" Dexron. "ATF" stands for "Automatic Transmission Fluid".



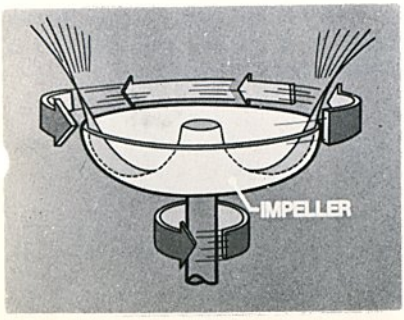
A torque converter serves two functions—first it acts as a hydraulic clutch that transmits engine power or torque to the transmission. Second, it steps up, or multiplies engine torque under certain operating conditions.



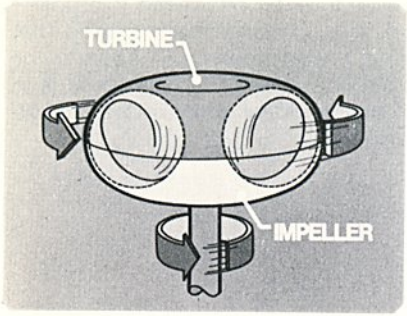
The torque converter is composed of the impeller (A) which is connected to and driven by the engine.



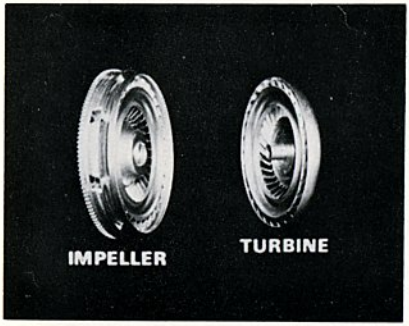
The turbine (B) which drives the transmission, and the stator (C) which is used to multiply torque.



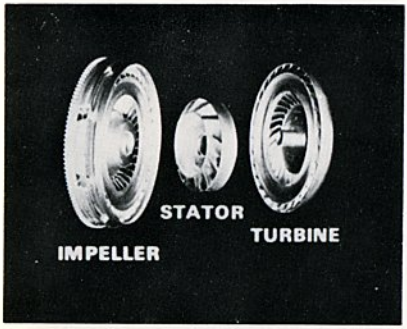
If the impeller were in this position . . . filled with fluid, then spun centrifugal force would cause the fluid to spin out as shown here.



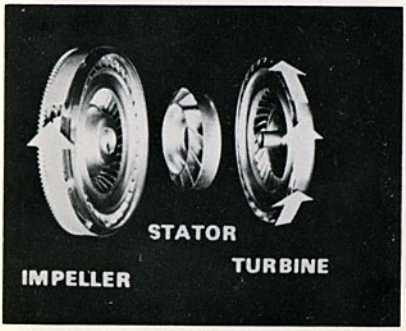
Adding a turbine on top would cause the fluid to follow a circular path and return to the impeller.



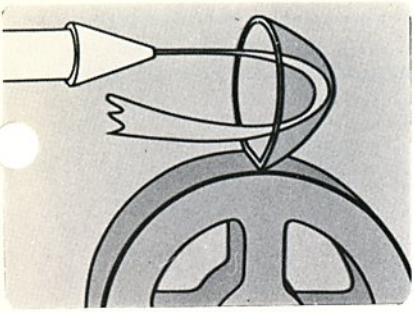
In an actual torque converter, both the impeller and turbine have vanes. Fluid which is guided by the impeller vanes actually drives the turbine by striking its vanes under the pressure of centrifugal force.



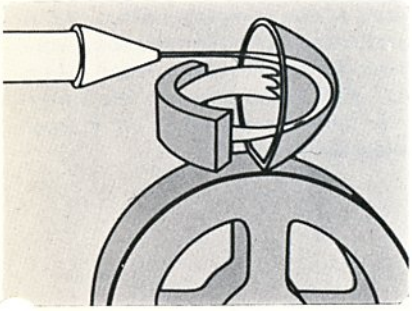
Located between the impeller and turbine is the stator a small wheel-like component. Its job is to redirect the fluid from the turbine back to the impeller. The secret of multiplying torque lies in the design of the stator.



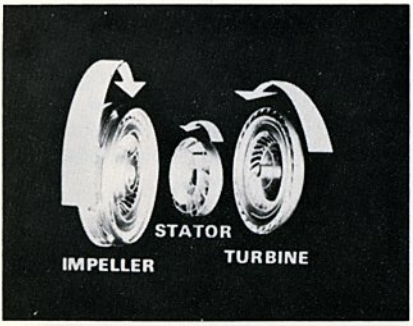
During acceleration, when more torque multiplication is needed, the impeller is driven faster than the turbine.



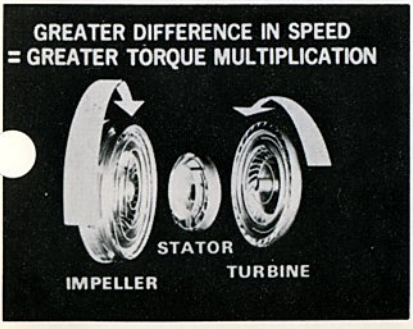
To understand torque multiplication, think of the impeller as a nozzle spraying fluid into this cup on the turbine wheel. Due to its shape the fluid from the impeller is directed out of the turbine cup and a lot of it's force is wasted.



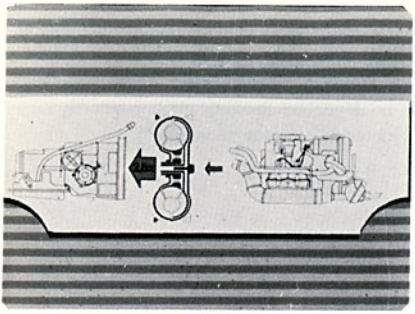
The stator is like this curved piece, it redirects the otherwise wasted fluid back into the cup so that the remaining force of the fluid is added to the force that was transmitted when the fluid first hit the cup.



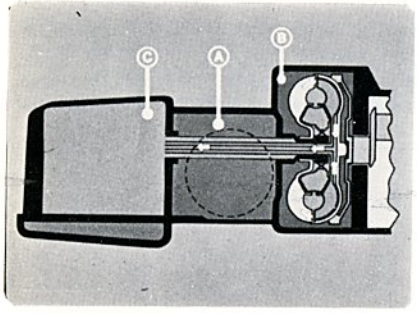
As the turbine turns faster and faster, it eventually approaches the speed of the impeller and then torque multiplication falls off.



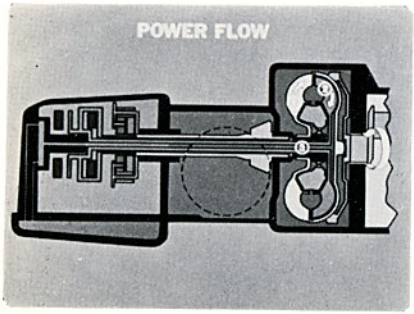
Torque multiplication is only possible when there is a difference in speed between the impeller and turbine. The greater the difference in speed, the greater the torque multiplication.



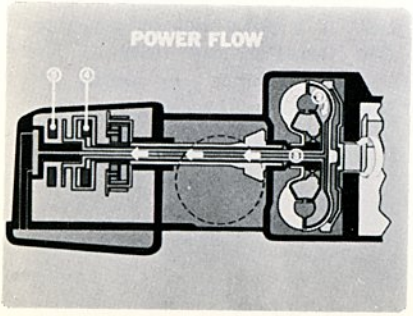
Therefore an engine driving a torque converter, can increase its torque to the transmission by as much as 2½ times.



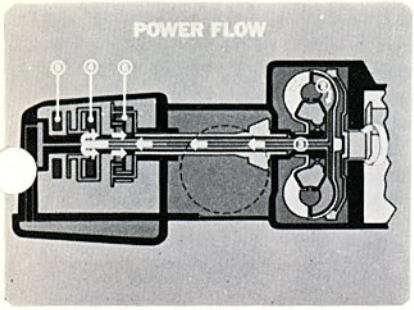
Let's look at the complete unit . . . a hollow turbine shaft (A) connects the torque converter (B) to the transmission assembly (C). ATF flows between the torque converter and the transmission through the hollow turbine shaft.



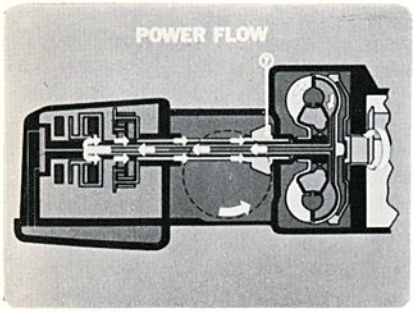
Now we examine the actual power flow through the transmission. . . . The engine's crankshaft drives the impeller, number 1, which drives the turbine, number 2, as described earlier. The turbine is attached by splines to the transmission input or turbine shaft, number 3.



Power is transmitted by the turbine shaft, number 3, to the forward clutch, number 4, which is engaged in all forward driving ranges. The direct and reverse clutch number 5 is engaged only in direct drive (third gear) or reverse.

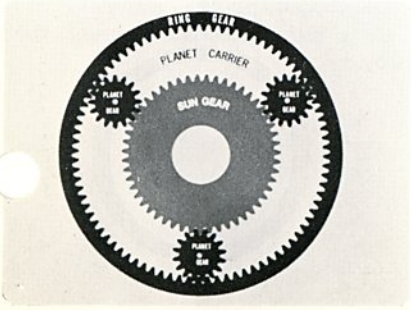


From the clutches the power passes into the planetary gear set (number 6) which produces the three forward and one reverse gear ratios.

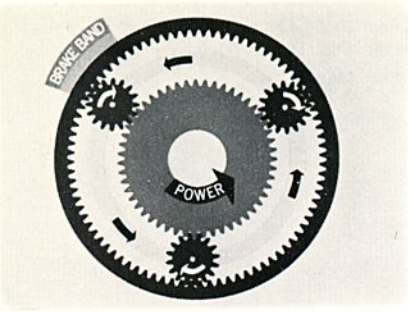


The planetary gear set is coupled directly to the pinion shaft, number 7, which drives the differential and the road wheels.

The planetary gearset is the heart of any automatic transmission. It is an assembly of constant mesh gears, that can change ratio depending on which gears are held and which gears are driven. The double planetary in the Volkswagen transmission is very compact considering that it can develop 3 forward and one reverse gear ratio.

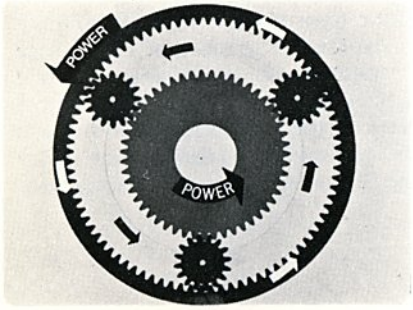


A simple planetary consists of a sun gear (Red) around which planet gears (Blue) rotate. The planet gears run on a planet carrier (Yellow) and are in constant mesh with the ring gear (Brown).

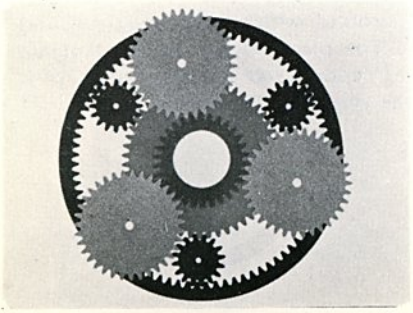


If the ring gear is held and power is applied to the sun gear, the planets would be forced to rotate and "walk around" the ring gear. The planet carrier would also revolve but at a slower speed than the sun gear and the result would be increased torque similar to low range on an automatic transmission.

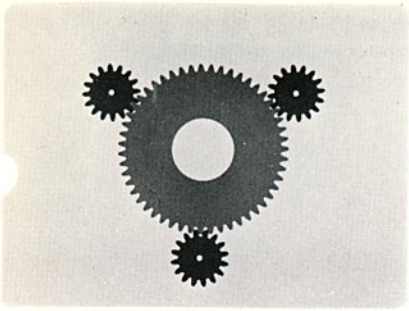
If, however, the Sun Gear is held and the ring gear is driven, the planets would "walk around" the sun gear, causing the planet carrier to turn within the ring gear. Again, resulting in an increase in torque, but not as great as before. This would be similar to an intermediate range on an automatic transmission.



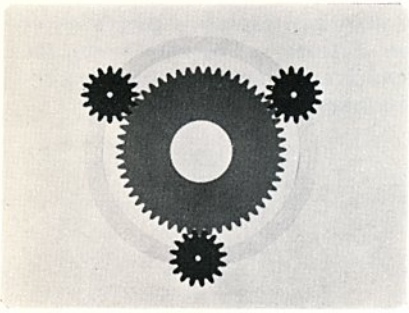
If any two members of the planetary are driven at the same time they will lock and there will be no increase in torque. The entire planetary unit would revolve and direct drive would result as in high gear range.



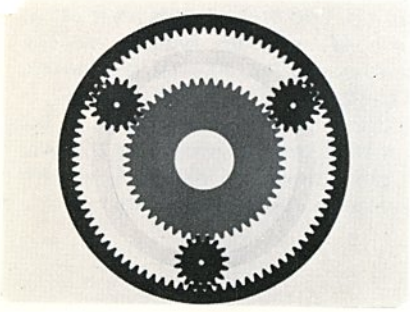
The Volkswagen double planetary has more parts but functions in much the same way.



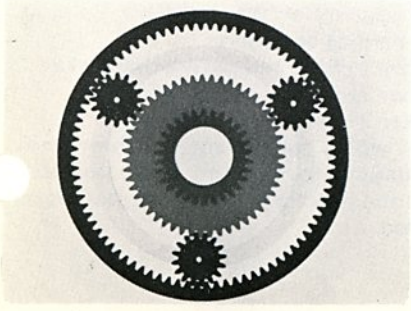
A large sun gear meshes with small planet gears



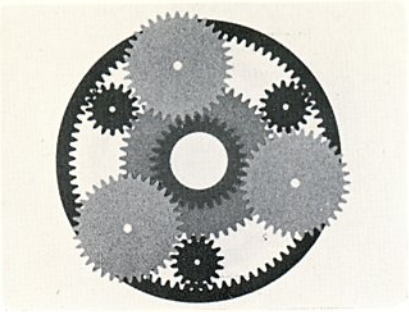
that are connected by a planet carrier which transmits all power to the differential.



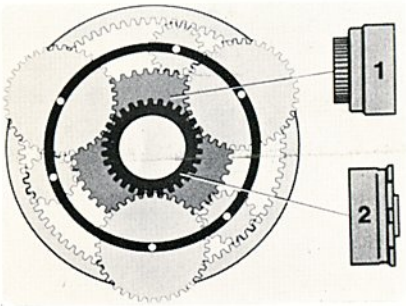
The small planet gears are also in mesh with the ring gear.



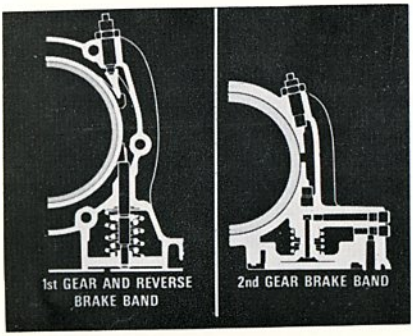
In addition, a small sun gear . . .



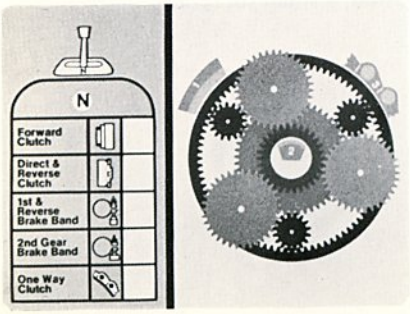
meshes with large planet gears that are also supported by the planet carrier.



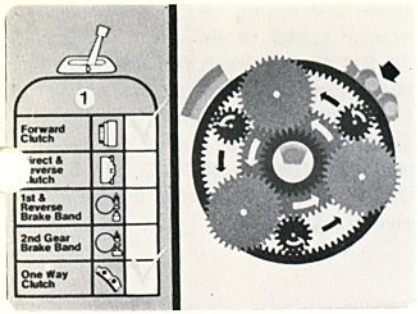
The Volkswagen planetary gear is driven by two clutches . . . number 1—the forward clutch and number 2—the direct and reverse clutch.



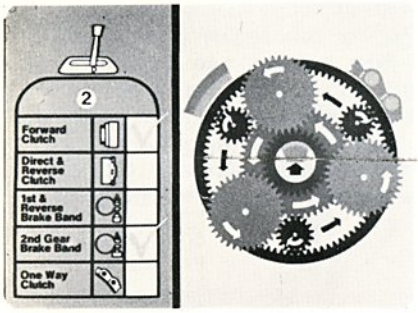
In addition, two brake bands, that act as hydraulically operated holding devices, are used for shifting. The 1st and reverse brake band, which holds the ring gear, is applied whenever the shift lever is in the 1st or reverse gear position. The 2nd gear brake band, similar in design, is applied whenever second gear is engaged.



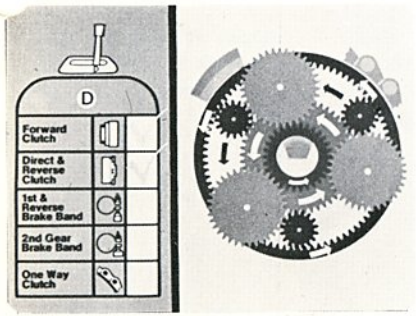
This diagram of the planetary with its three holding devices . . .
Number 1—First and reverse brake band
Number 2—Second gear brake band
Number 3—One way clutch
shows which components are functional in relation to selector lever position. When the selector is in Neutral, nothing is engaged.



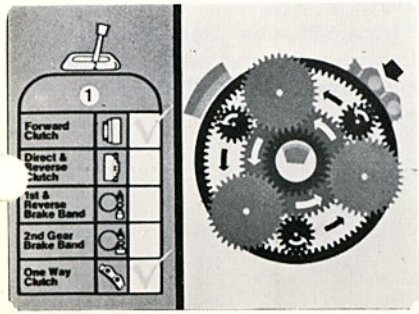
When drive position is selected, the forward clutch engages as it does in all forward speeds, and begins to drive the large sun gear. The ring gear tries to rotate in the opposite direction but is held in place by the one way clutch. First gear is the result.



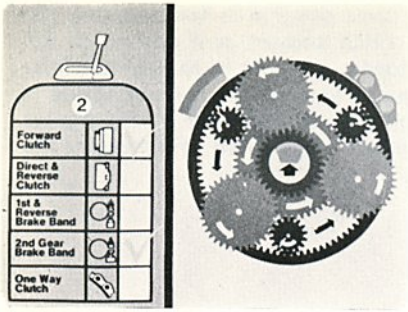
As road speed increases the second gear brake band is automatically applied, locking the small sun gear. The large sun gear is still driven by the forward clutch and Second gear is the result.



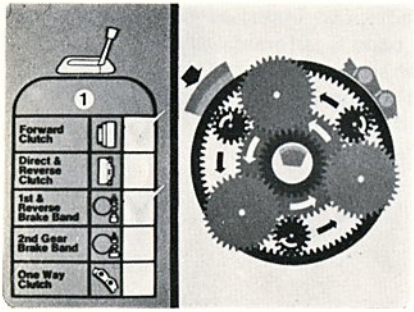
As road speed continues to increase the second gear brake band is released and the direct and reverse clutch begins to drive the small sun gear. Since the forward clutch is still engaged and driving the large sun gear this locks the planetary and the entire assembly begins to rotate at a 1 to 1 ratio . . . direct drive, or Third gear is the result.



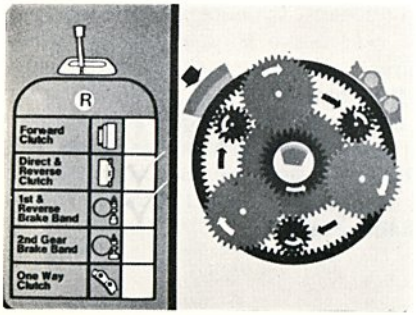
When lever position number 2 is selected, again the forward clutch is applied, and the one way clutch holds the ring gear from rotating. First gear is now engaged.



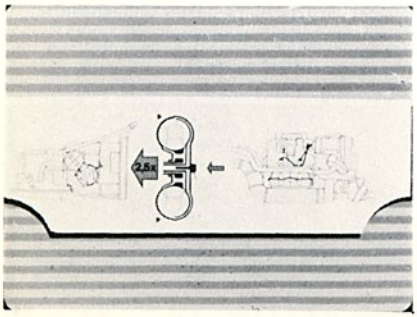
As before, increasing road speed causes the second speed brake band to apply itself to the clutch drum thereby holding the small sun gear. Since the forward clutch is still engaged and driving the large sun gear, second gear is the result. However, in order to shift to third, the selector lever must be moved by hand, to the Drive position.



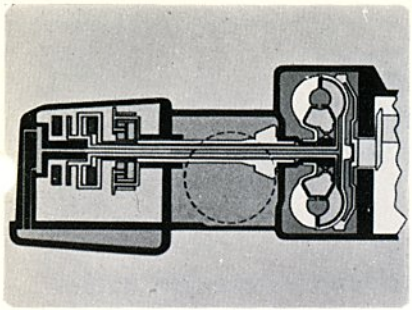
The main object of selector lever position 1 is to use full engine braking power. When lever position one is selected the forward clutch is applied as before but the first & reverse brake band is also applied. This locks the ring gear, keeping it from turning in any direction, and allows the car to decelerate against engine compression.



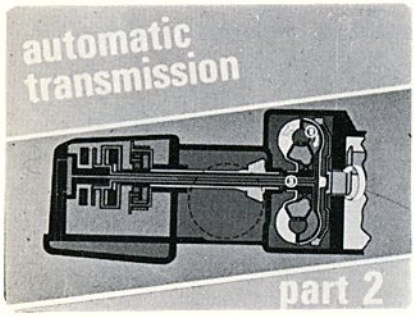
When Reverse is selected, the direct & reverse clutch is engaged driving the small sun gear. The first and reverse brake band is also applied locking the ring gear and the result is Reverse.



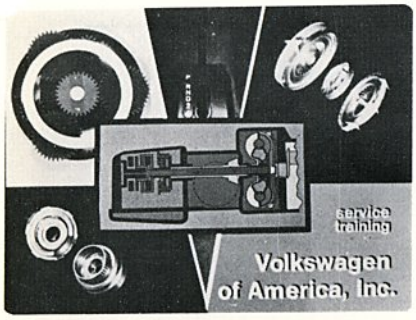
We have now seen how the torque converter transmits power from the engine to the transmission, and when conditions demand, how it can multiply torque up to 2½ times.



We have also seen how this torque reaches the VW planetary gearset and how 1st, 2nd, 3rd and Reverse are developed through the use of combinations of clutches and brake bands.



Details of how the transmission causes these things to happen automatically will be discussed in "Automatic Transmission —Part II".



Developed by Volkswagen of America Service Training

QUESTIONS
AUTOMATIC TRANSMISSION
PART I

1. The kickdown switch on type four Volkswagen automatics is located _____

2. The torque converter on Volkswagen automatics serves two purposes
   1. _____
   2. _____

3. Which component of the torque converter is responsible for torque multiplication? _____

4. The Volkswagen planetary is driven by _____ and held from turning by _____ and _____

5. The _____ is engaged in first, second & third speeds.

NOTES

ANSWERS
AUTOMATIC TRANSMISSION
PART I

1. The kickdown switch on type four Volkswagen automatics is located UNDER THE ACCELERATOR PEDAL.

2. The torque converter on Volkswagen automatics serves two purposes:
   1. HYDRAULIC CLUTCH
   2. INCREASES OR MULTIPLIES TORQUE

3. Which component of the torque converter is responsible for torque multiplication?
   THE STATOR

4. The Volkswagen planetary is driven by CLUTCHES and held from turning by BRAKE BANDS and A ONE WAY CLUTCH.

5. The FORWARD CLUTCH is engaged in first, second & third speeds.