

# Product Knowledge Document

## TRANSAXLE SYSTEM

QUALITY



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# INTRODUCTION

Transaxle to transfer power from the engine to the drive wheels via the driven axles, and it also allows the driver to change the gear ratios.

A transaxle is a major automotive mechanical component that combines the functionality of the transmission, axle, and differential into one integrated assembly.

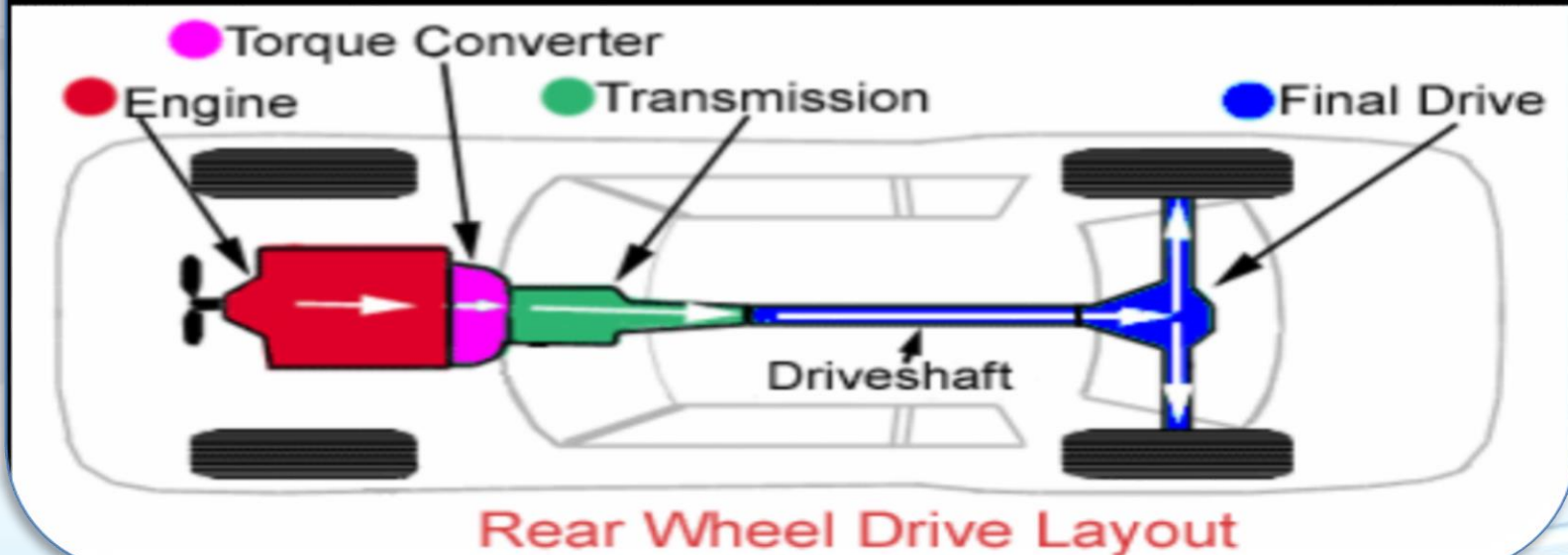
## TYPES OF TRANSMISSION SYSTEM

There are three types of transmission system which are used in the vehicle.

As below mentioned are –

1. Front-engine, rear-wheel drive transaxles
2. Rear-engine, rear-wheel drive transaxles
3. Four-wheel drive

### Automotive Transmission



# REQUIREMENTS OF TRANSMISSION SYSTEM

- To provide for disconnecting the engine from the driving wheels.
- When the engine is running , to enable the connection to the driving wheels to be made smoothly and without shock.
- To enable the leverage b/w the engine and driving wheels varied.
- Speed reduction b/w engine and the drive wheels in the ratio of about 5:1.
- To enable power transmission at varied angles and varied lengths.
- To drive the driving wheel at different speeds when required.
- To enable diversion of power flow at right angle.

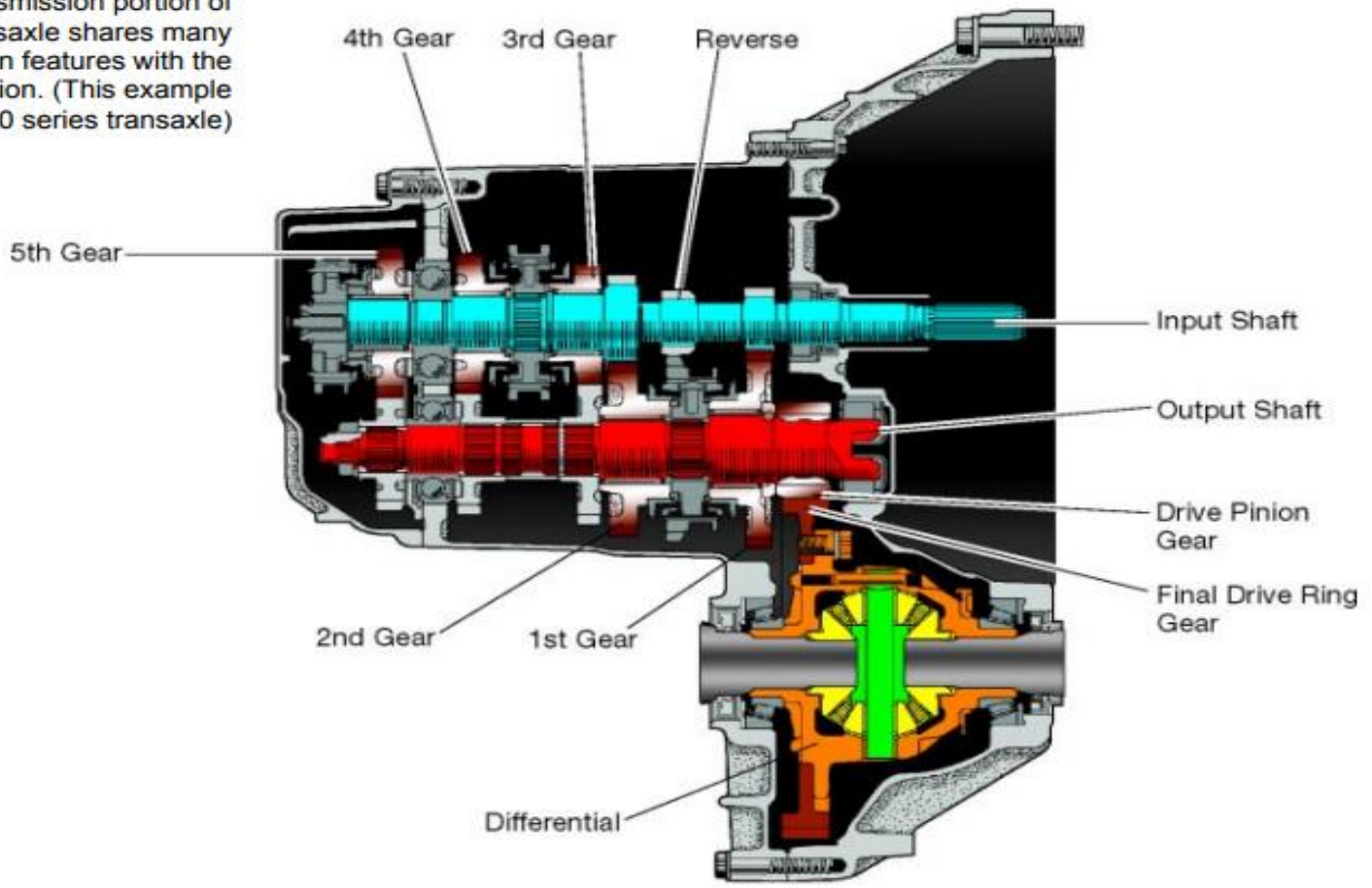
# HISTORY OF THE TRANSAXLE

- Transaxles have only entered into widespread use in relatively recent history, they've been around just as long as the automobile itself. The first transaxles were used in rear-wheel drive vehicles that had front-mounted engines. One of the earliest examples was the De Dion Bouton in 1898, although Stutz also introduced a rear-wheel drive, front-engine transaxle in 1914, and Bugatti had one by 1929. Of course, the rear-engine, rear-wheel-drive Volkswagen Beetle also used a transaxle starting in 1938.
- Most early examples of transaxles were in European cars, and the trend didn't reach the United States until the 1960s. In 1960, the Chevrolet Corvair was introduced with a rear-engine, rear-wheel-drive transaxle, and the front-engine, rear-wheel-drive Pontiac Tempest utilized one in 1961.
- Starting in the 1980s, a handful of automakers turned to transaxles for four-wheel-drive vehicles. Audi's Quattro system, which first appeared in the 1981 Audi Quattro turbo coupe, uses a transaxle. Ford and Mitsubishi also introduced four-wheel-drive vehicles with transaxles in the 1980s, and Nissan's 2007 GT-R also introduced a front-engine four-wheel-drive transaxle system.

# TRANSAXLE CONSTRUCTION

Transaxles are constructed with two parallel shafts, a differential, four to six forward gears and a reverse gear.

The transmission portion of the transaxle shares many common features with the transmission. (This example is the C50 series transaxle)





➤ **Input Shaft-**

The input shaft connects to and is driven by the clutch disc. The drive gears are located on the input shaft, one for each forward speed and reverse. The input shaft is supported by bearings at the front and rear of the transaxle case.

➤ **Output Shaft-**

The output shaft includes a driven gear for each forward speed. The output shaft also includes the drive pinion, which drives the final drive ring gear on the differential. The output shaft is supported by bearings at the front and rear of the transaxle case.

➤ **Differential –**

Also also known as a final drive used to transfer power from output shaft to drive wheels. final drive ring gear, side gears, pinion shaft and pinion gears. The ring gear is attached to the differential case. The pinion gears mount to the pinion shaft attached to the differential case. The side gears mesh with the pinion gears and transfer the rotation of the differential case to the side gears, which turn the drive axles. the pinion gears start to turn, allowing the wheels to move at different speeds. If one wheel is slipping, some of the power is transferred to the other wheel.

➤ **Gears-**

Gears transfer engine power from the input shaft, through the output shaft, to the differential. There are five forward gears and one reverse gear.

➤ **Forward Gears-**

All forward motion gears are helical gears and are in constant mesh. In each pair of gears, one gear is secured to the shaft and one gear floats on the shaft next to the synchronizer assembly.

➤ **Reverse Gears-**

Reverse requires an additional gear in the gear train. A reverse idler gear is used to change the direction of the output shaft for reverse. The reverse gear is a straight cut spur gear and does not have a synchronizer.

➤ **Bearings-**

Bearings are used to support the shafts, gears and the differential in the transaxle: gears use needle bearings; shafts use roller, ball, and tapered roller bearings.

➤ **Synchronizer Assemblies-**

Synchronizer assemblies are used to make all forward shifts and to assist reverse gear engagement. The role of the synchronizer is to allow smooth gear engagement. It acts as a clutch, bringing the gears and shaft to the same speed before engagement occurs. Synchronizer components help to make the speeds equal while synchronizing the shift. Gears on the input shaft are in mesh (contact) with gears on the output shaft at all times. Consequently, when the input shaft turns, the gears on the output shaft rotate. When shifting gears, the synchronizer ring supplies the friction force, which causes the speed of the gear that is being engaged to match the speed of the hub sleeve. This allows the gear shift to occur without the gear and hub sleeve splines clashing or grinding.

## Key-less Type Synchronizer Components

Some Toyota transaxles use a key-less type synchronizer to improve shift feel and reduce size and weight.

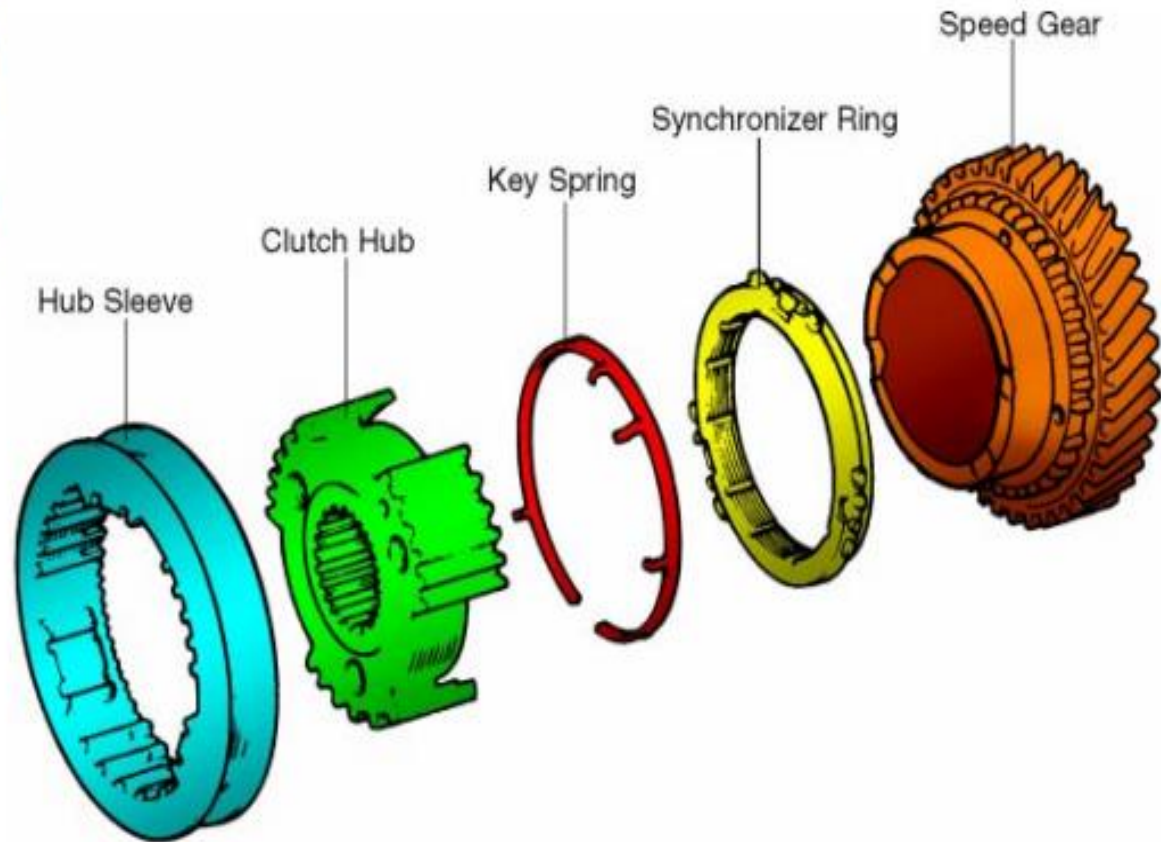


Fig. 4-13  
T302/413

## MECHANISM/POWERFLOW

Power passes from the drive gear on the input shaft to the driven gear on the output shaft and through the synchronizer assemblies to the output shaft. For first gear, the smallest gear on the input shaft drives the largest gear on the output shaft, and for top gear, the largest gear on the input shaft drives the smallest gear on the output shaft. Powerflow for reverse gear is similar to powerflow in a transmission.

The reverse idler gear is shifted to mesh with the reverse gear on the input shaft and the sleeve of the 1<sup>st</sup>/2 synchronizer assembly on the output shaft. The spur gear teeth for reverse are on the outer diameter of the synchronizer hub sleeve.

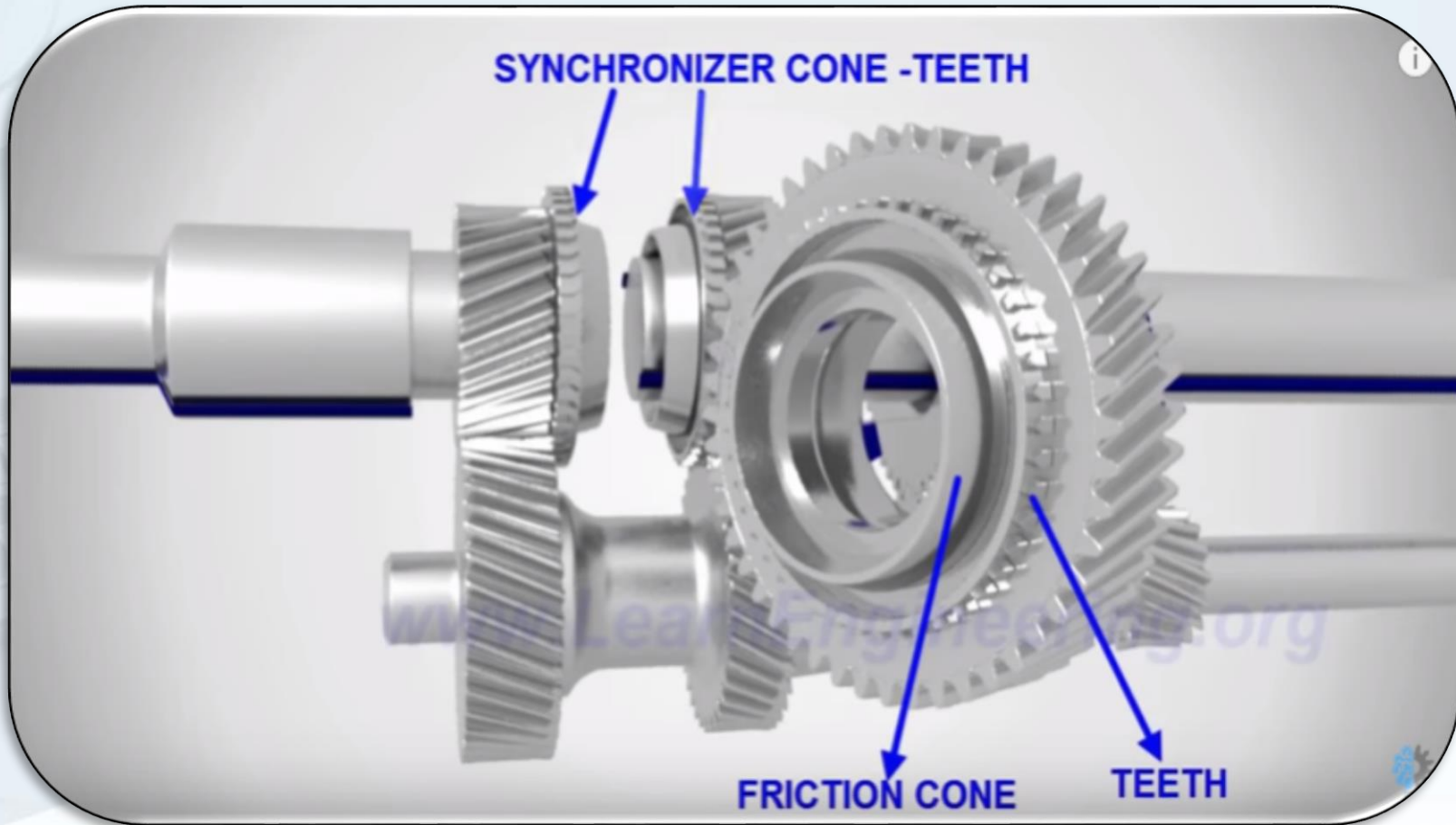
Output shaft have Synchronized cone teeth arrangement , a hub is fixed on the shaft and sleeve is free to move over a hub, when the sleeve get connected to teeth of synchronizer cone the gear and shaft will turn together or the desired locking action will be achieved

## MECHANISM/POWERFLOW

But during the gear box operation the gear and shaft rotating at different speed ,so such a locking action is not a easy task , a synchronizer ring help to match speed of gear with shaft, a synchronize ring is capable of rotating with hub free to slide axially , before moving the sleeve the clutch paddle is pressed this way power flow to gear is discounted , when we move the sleeve it will press the synchronizer ring against the cone , due to high frictional force between synchronizer ring and cone speed of gear will become same as the shaft at this time the sleeve can be slide further and it will get lock with gear, thus gear gets lock with shaft in efficient and smooth way. The same mechanism is used shift other gears .

The reverse gear uses three gear arrangement out of those one is idler gear and other two are input and output, when idler gear is push it will engage with other two gear and rotate the shaft in reverse direction, reverse gear does not usages synchronizer ring mechanism.

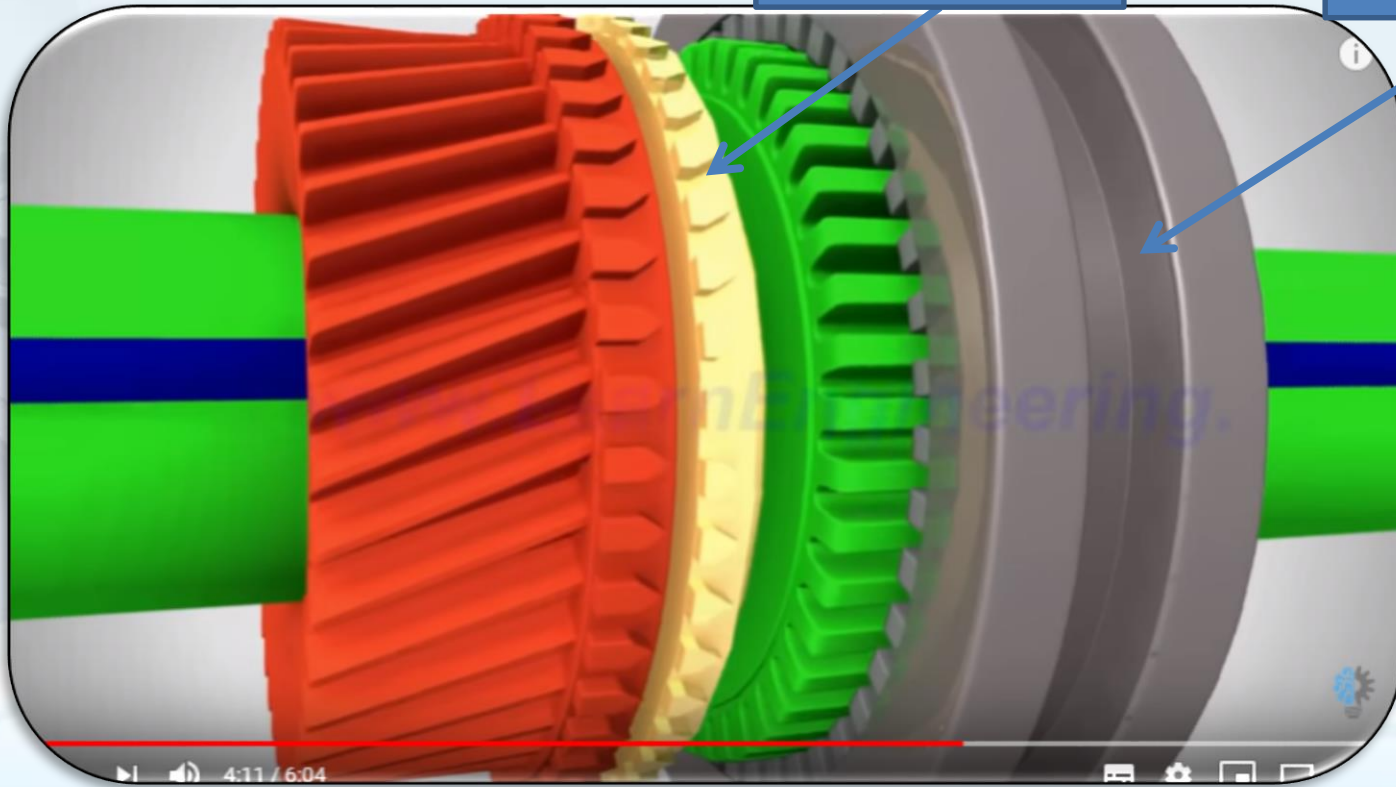
Output shaft have Synchronized cone teeth arrangement as shown in fig.



A hub is fixed on the shaft and sleeve is free to move over a hub, when the sleeve get connected to teeth of synchronizer cone the gear and shaft will turn together or the desired locking action will be achieved

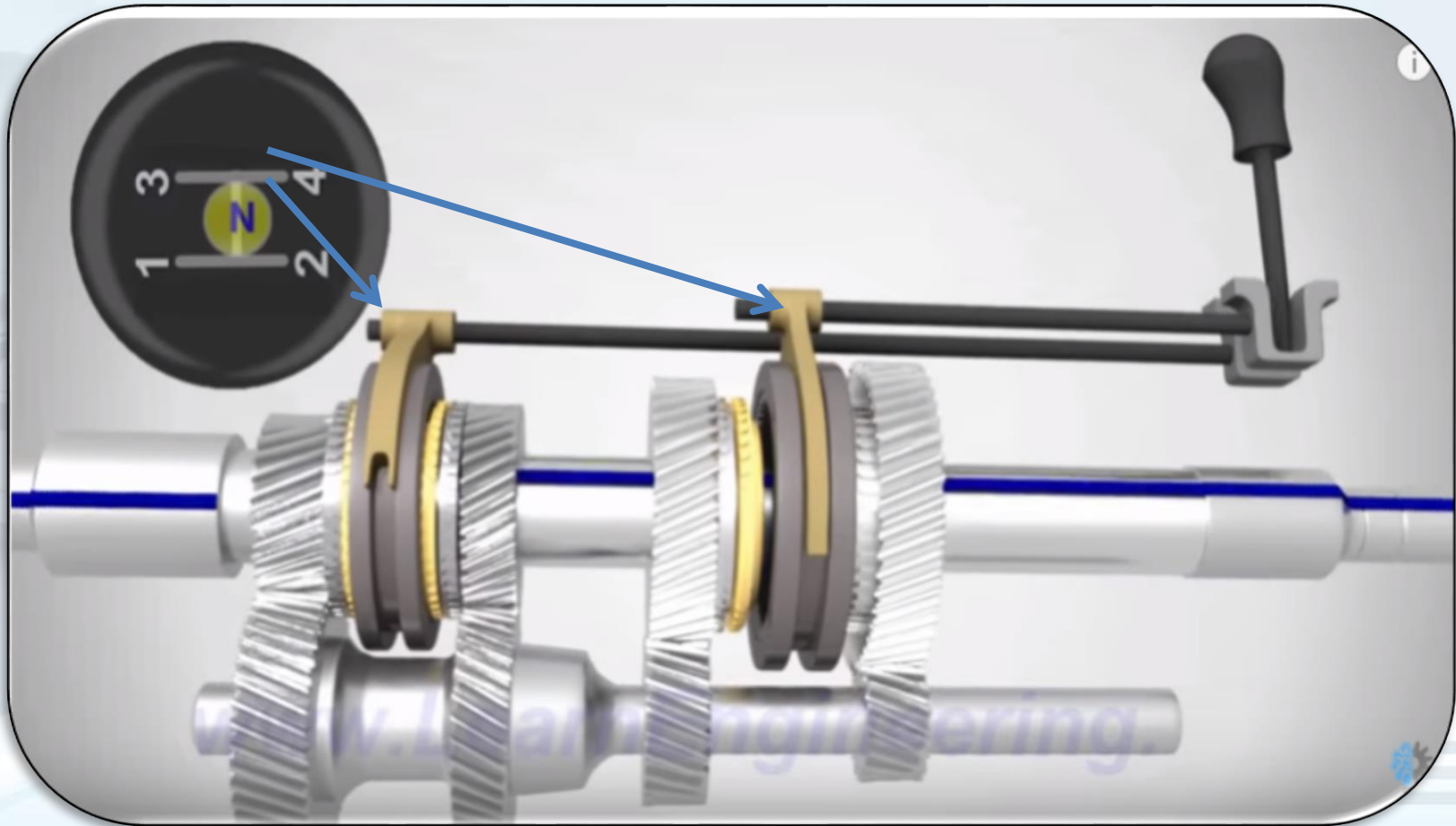
synchronize ring  
free to slide  
axially

Sleeve free to  
move on hub



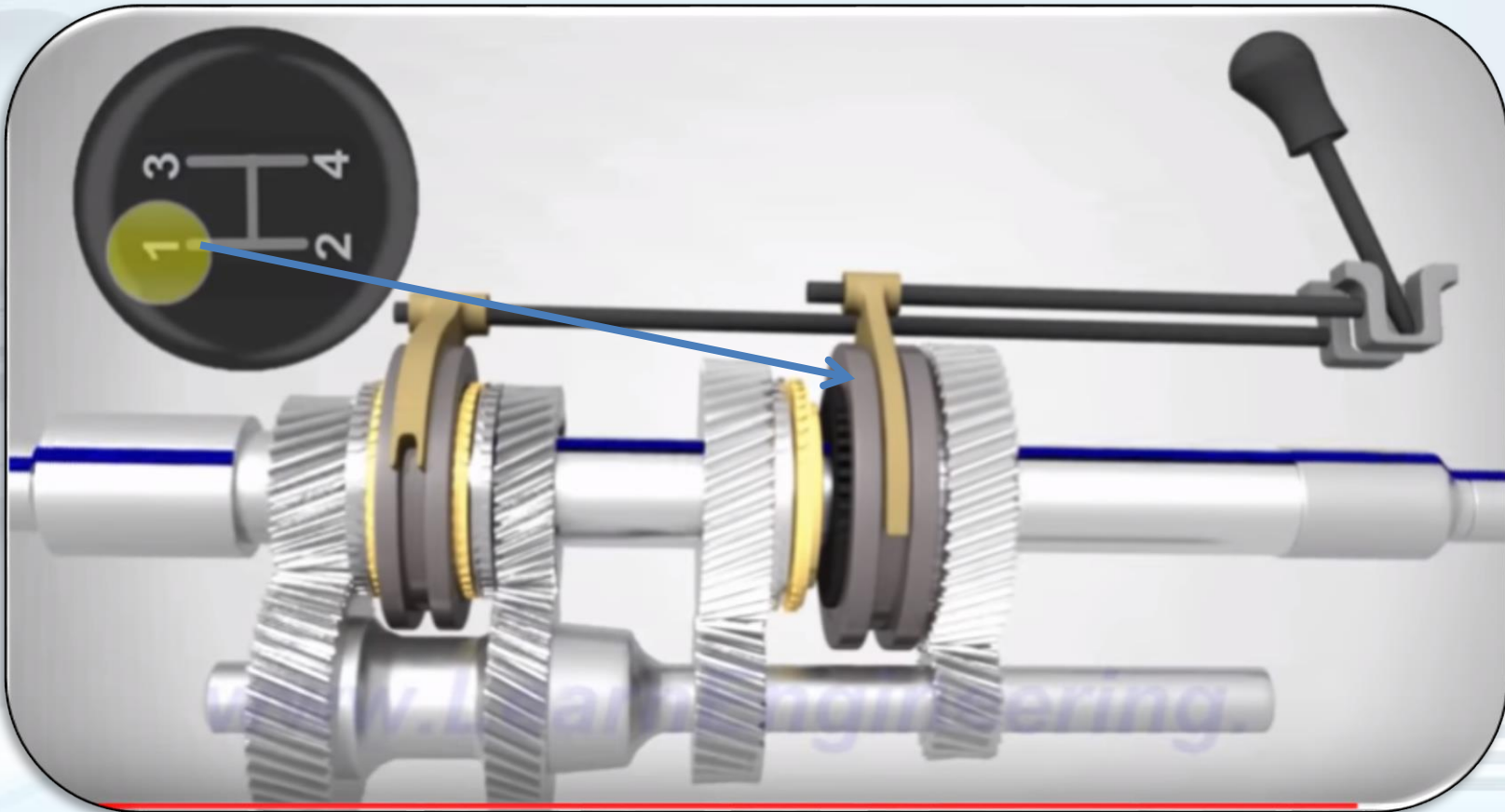
## MECHANISM/POWERFLOW

At Neutral position sleeves are at middle position and synchronizer ring are not in contact with gear as shown in fig.

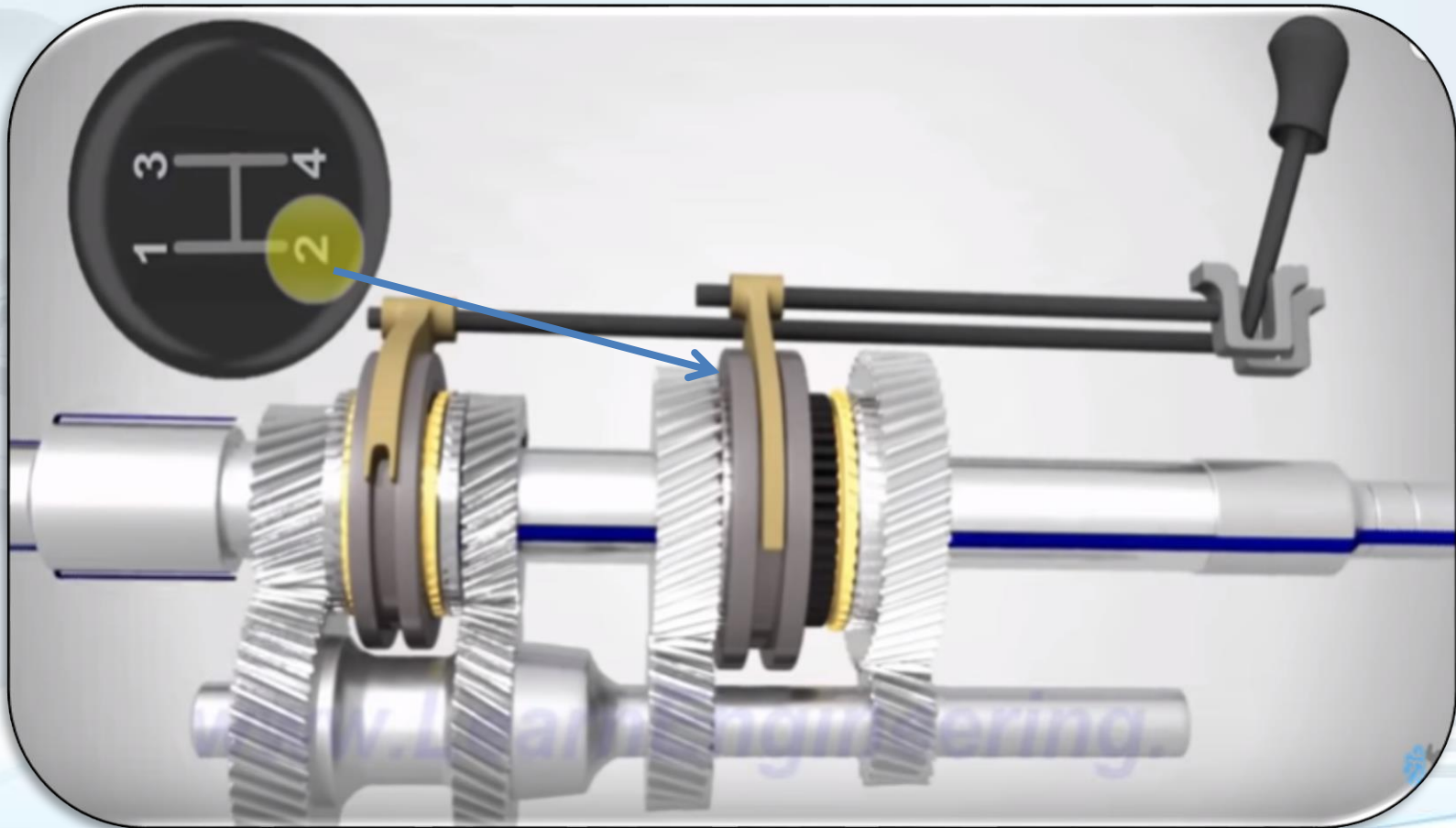




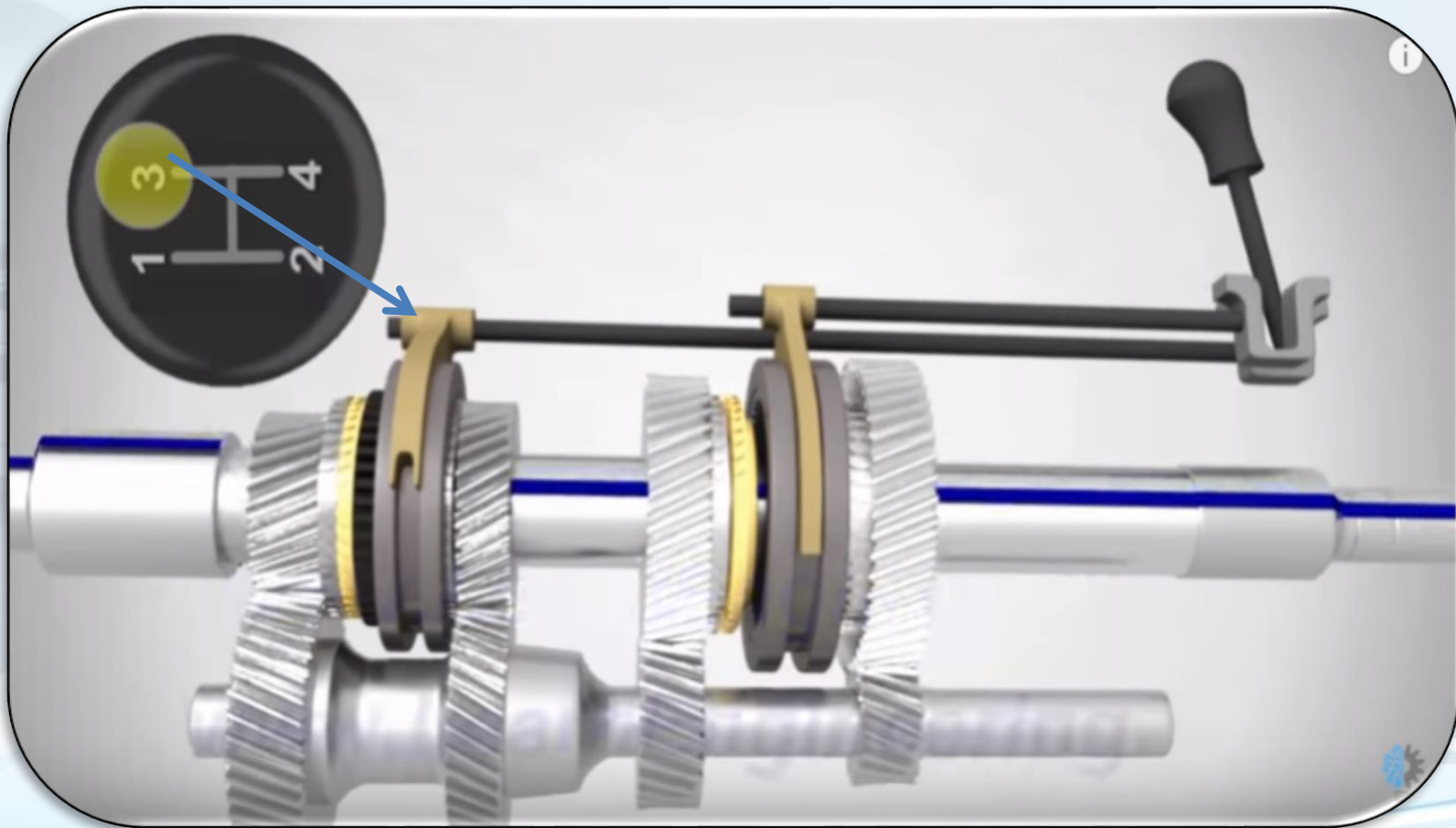
A selector will select the 1/2<sup>rd</sup> shifter and fork assembly that will move sleeve to left to engage synchronizer ring and cone, speed of first gear will become same as the shaft at this time the sleeve can be slide further and it will get lock with first gear as shown in fig. thus gear gets lock with shaft in efficient and smooth way



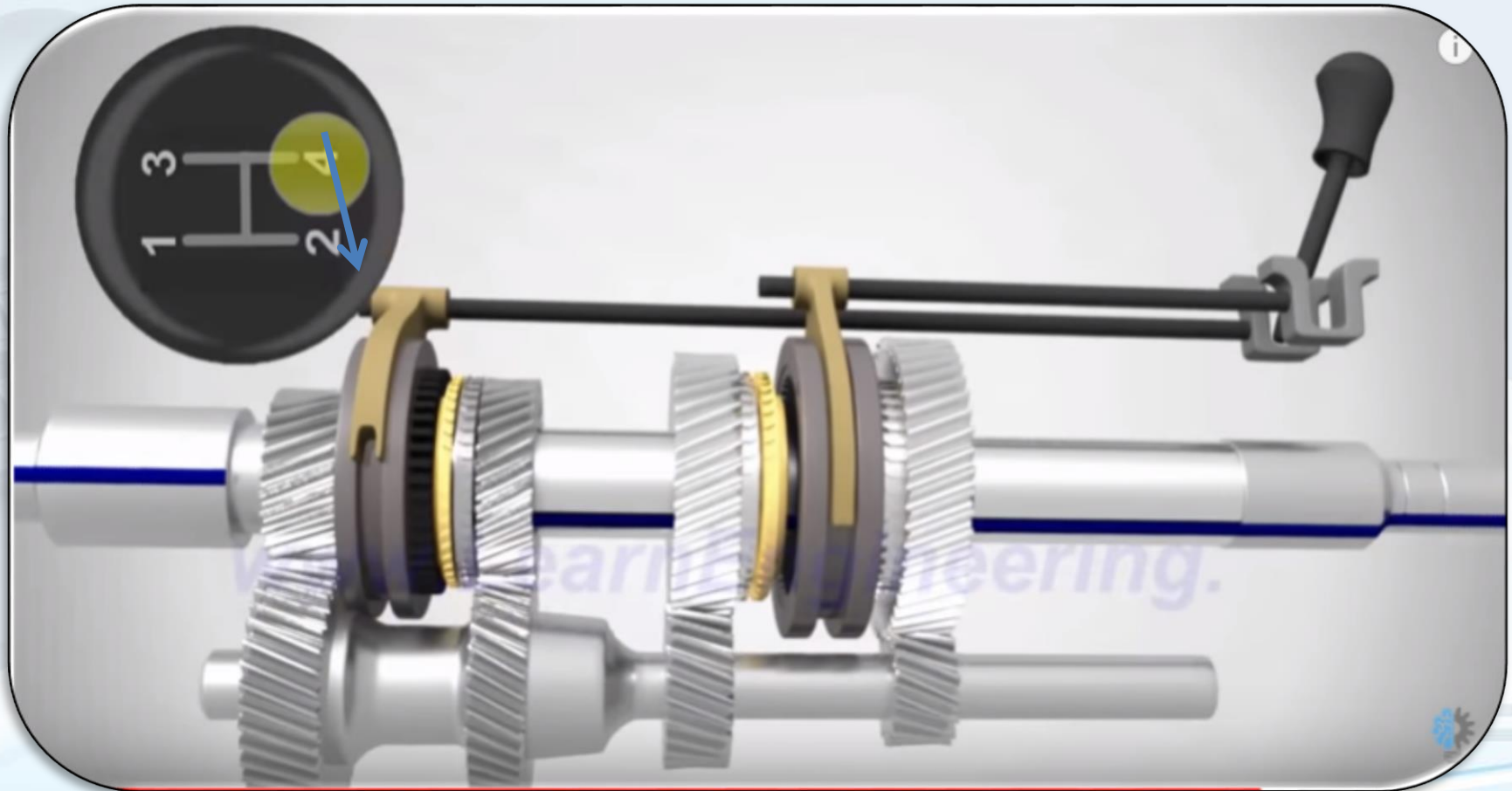
A second gear will be engaged as sleeve will be moved to right by 1/2<sup>nd</sup> shifter fork assembly to engage synchronizer ring with gear. Due to high frictional force between synchronizer ring and cone, speed of second gear will become same as the shaft at this time the sleeve can be slide further and it will get lock with second gear as shown in fig. thus gear gets lock with shaft in efficient and smooth way



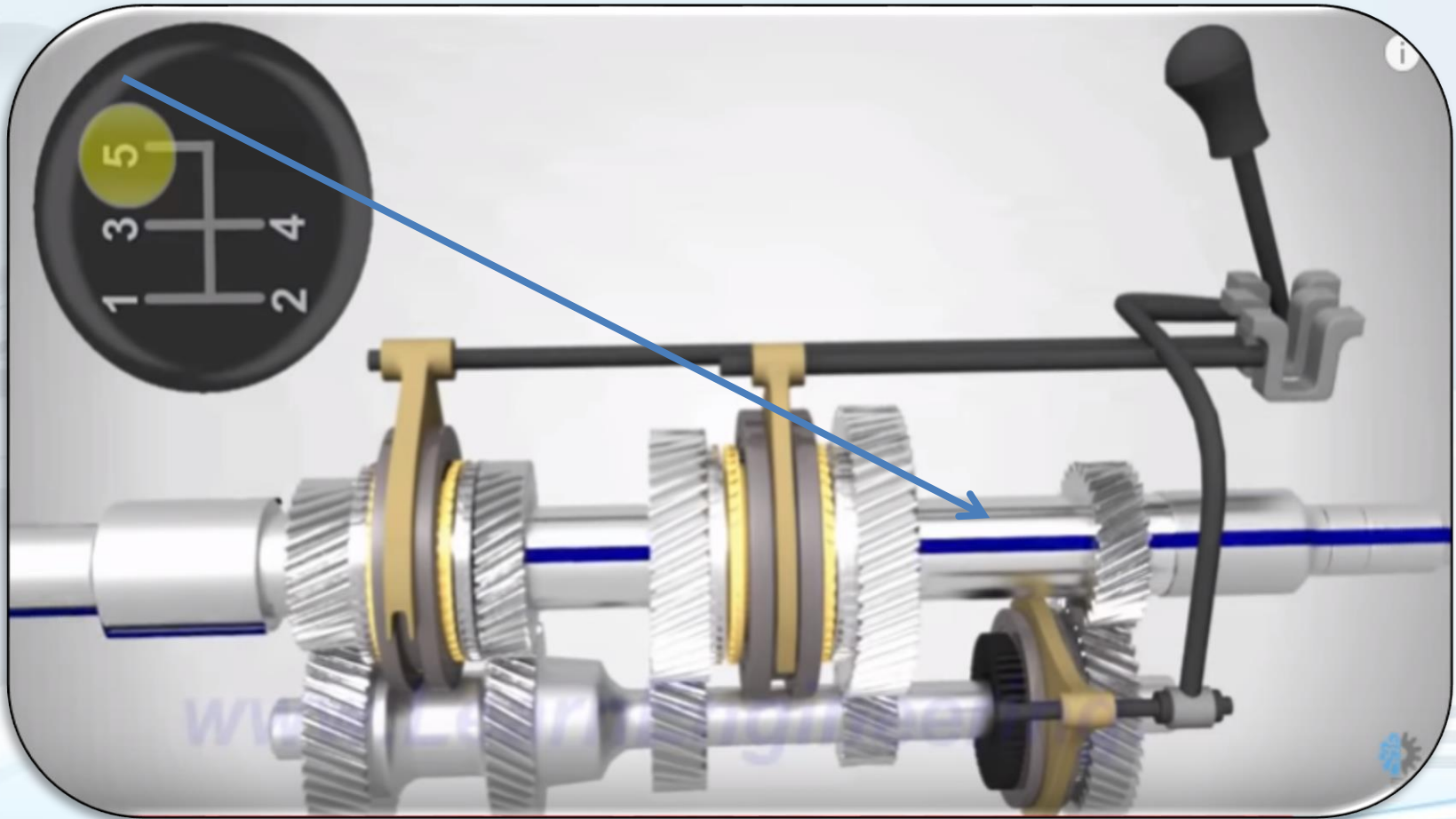
A selector will select the 3/4<sup>rd</sup> shifter and fork assembly that will move sleeve to left to engage synchronizer ring with third gear Due to high frictional force between synchronizer ring and cone, speed of third gear will become same as the shaft at this time the sleeve can be slide further and it will get lock with third gear as shown in fig. thus gear gets lock with shaft in efficient and smooth way



A selector will select the 3/4<sup>rd</sup> shifter and fork assembly that will move sleeve to right to engage synchronizer ring with forth gear Due to high frictional force between synchronizer ring and cone, speed of forth gear will become same as the shaft at this time the sleeve can be slide further and it will get lock with forth gear as shown in fig. thus gear gets lock with shaft in efficient and smooth way



A selector will select the 5/R shifter and fork assembly that will move sleeve to left to engage synchronizer ring with fifth gear Due to high frictional force between synchronizer ring and cone, speed of fifth gear will become same as the shaft at this time the sleeve can be slide further and it will get lock with forth gear as shown in fig. thus gear gets lock with shaft in efficient and smooth way



The reverse gear uses three gear arrangement out of those one is idler gear and other two are input and output, when idler gear is pushed by 5/R shifter fork assembly it will engage with other two gear and rotate the shaft in reverse direction, reverse gear does not usages synchronizer ring mechanism.

