

# MECHANICAL DESIGN PART 2

## INTRODUCTION TO MECHANICAL & INDUSTRIAL ENGINEERING

### MEC 130

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Mechanical Engineering Department

Abu Dhabi University



# INTRODUCTION

## Proposed Topics

Collect Information  
Concept Generation  
Recommend a Design

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- Important Machine Elements & Their Functions
- Transmission Systems & Their Operating Principle

Detailed Design &  
Analysis

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- Unit Systems & Conversions
- Force Analysis – Stresses – Tensile Test - Engineering Materials
- Dynamics
- Factor of Safety

Communication

Graphics & Engineering Drawing

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Manufacturing

Manufacturing Processes

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# IMPORTANT MACHINE ELEMENTS

## Important Machine Elements

**Machine (or Mechanical) Element** is a component of a mechanical system, e.g. machine.

**Mechanical System** is a composition of different mechanical elements.

**Machine elements consist of three basic types:**

### 1. Structural Components:

- Frame Members
- Bearings
- Axles
- Splines & Shafts
- Fasteners
- Seals



# IMPORTANT MACHINE ELEMENTS

## Important Machine Elements

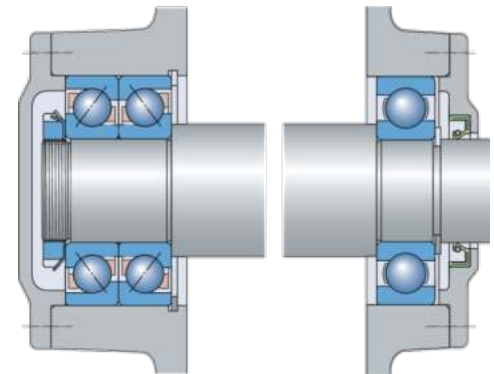
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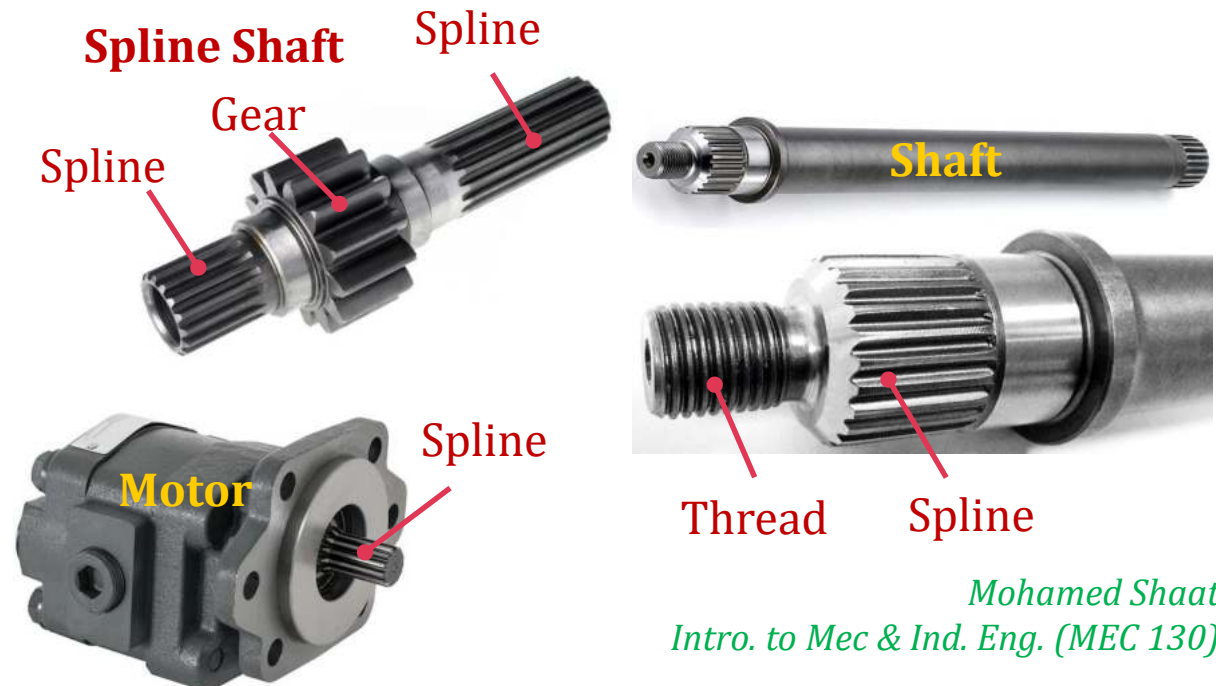
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### Nuts



### Bolts

# IMPORTANT MACHINE ELEMENTS

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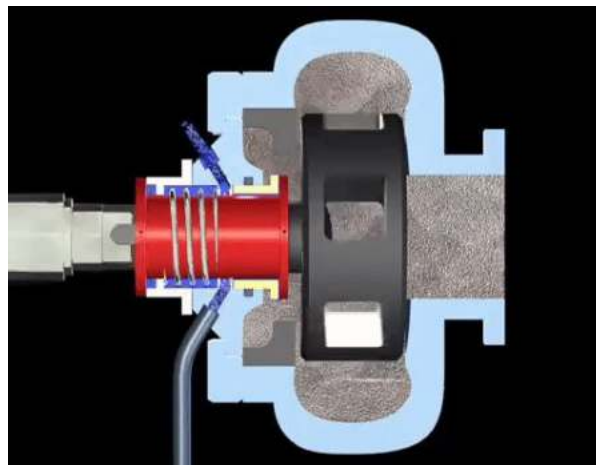
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**Machine (or Mechanical) Element** is a component of a mechanical system, e.g. machine.

**Mechanical System** is a composition of different mechanical elements, e.g. machine.

**Machine elements consist of three basic types:**

**2. Mechanisms:** A mechanism is a mechanical device that is used for controlling motion or converting motion from one type to another.

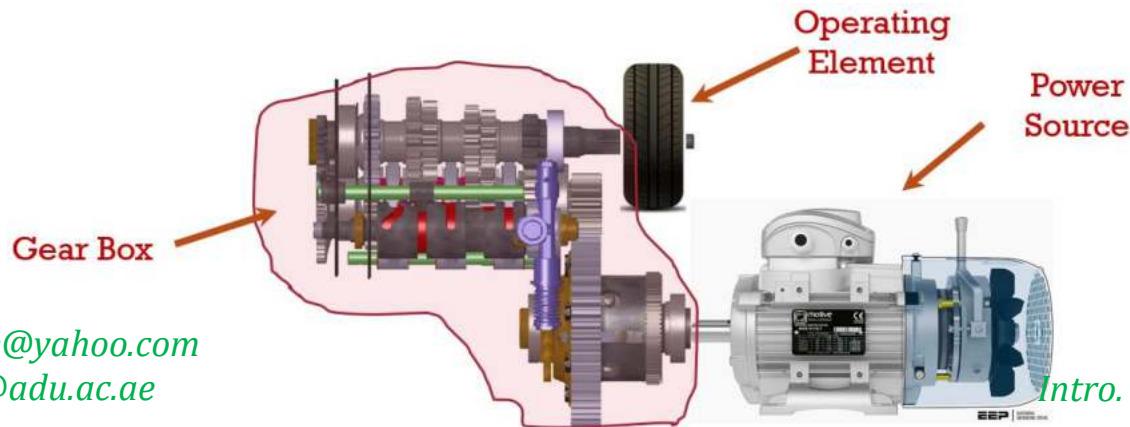
- Gear Trains
- Belt & Chain Drives
- Linkages
- Cam and Follower Systems
- Brakes
- Couplings & Clutches

# IMPORTANT MACHINE ELEMENTS

## Important Machine Elements

### Gear Trains:

- An automobile requires high torque when climbing hills and when starting, even though they are performed at low speeds.
- On other hand, when running at high speeds on level roads, high torque is not required because of momentum.
- Therefore, a device is required to change the vehicle's torque and speed according to road condition and driver's need.
- This device is known as **Transmission Box** (or commonly **Gear Box**).



# IMPORTANT MACHINE ELEMENTS

## Important Machine Elements

### Gear Trains:

A **Gear** is a mechanical element that is usually used to convert a **rotary motion** into another **rotary motion** with the same or different speed.

- Gears can transmit **power** and **speed** between two *parallel, perpendicular, or mutual* rotating shafts.
- ***Types of gears include:***

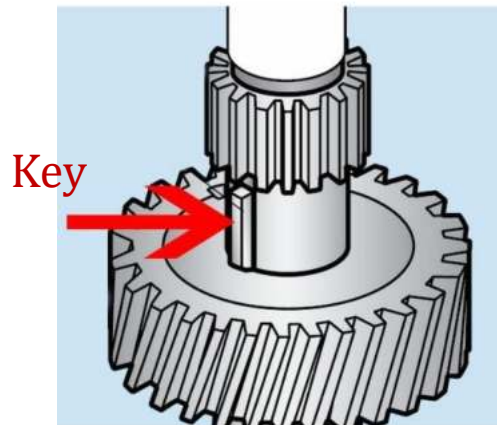
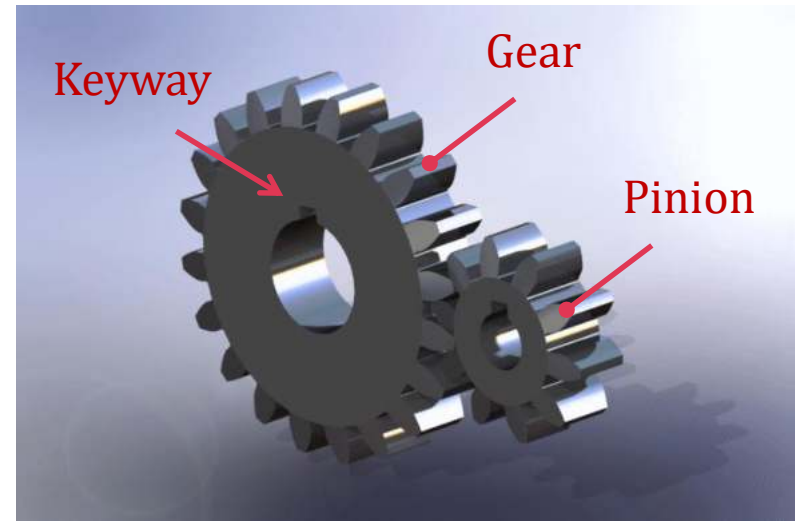
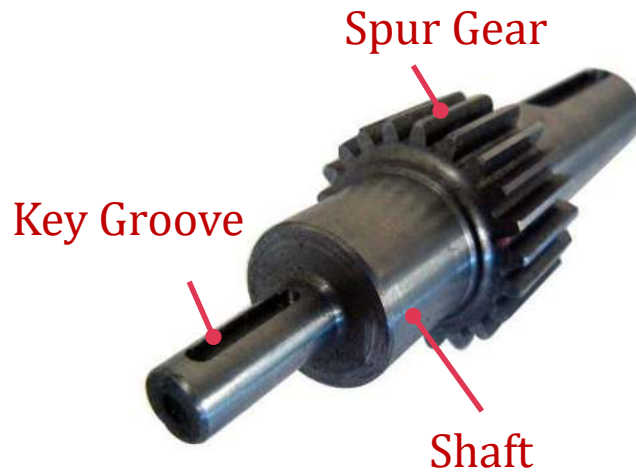
*Spur Gear – Helical Gear – Bevel Gear – Worm-Worm Gear*

# IMPORTANT MACHINE ELEMENTS

## Important Machine Elements

### Gear Trains:

- **Spur Gear:** Used to transmit power between two parallel shafts.



# IMPORTANT MACHINE ELEMENTS

## Important Machine Elements

### Gear Trains:

- **Helical Gear:** Used to transmit power between two parallel shafts. Also, it can be used to transmit power between two non-intersecting shafts.

### Non-Intersecting Shafts



### Parallel Shafts

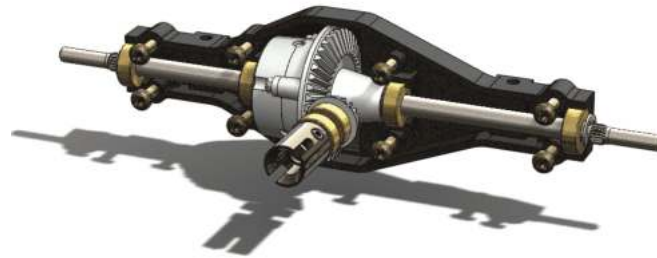
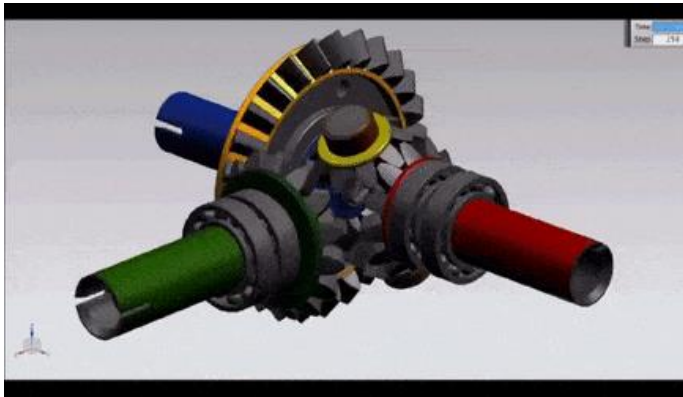
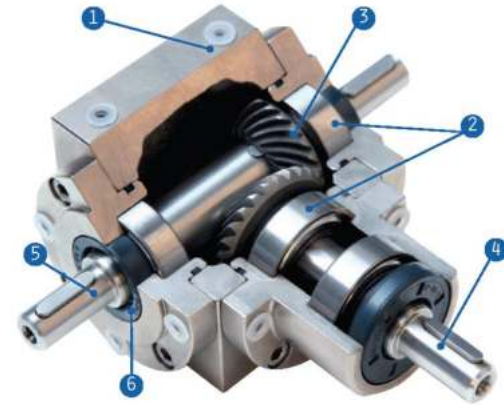
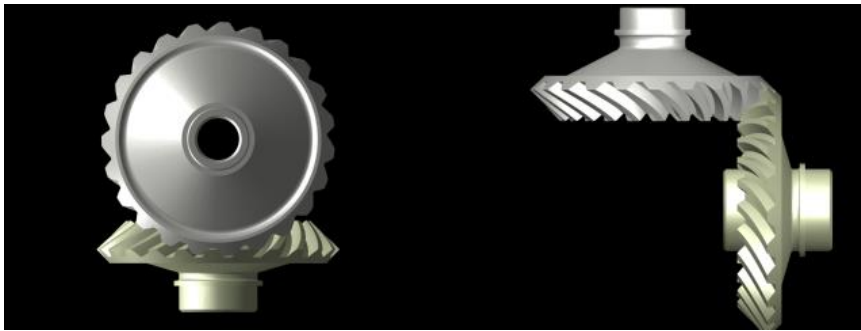


# IMPORTANT MACHINE ELEMENTS

## Important Machine Elements

### Gear Trains:

- **Bevel Gear:** Used to transmit power between two perpendicular shafts.

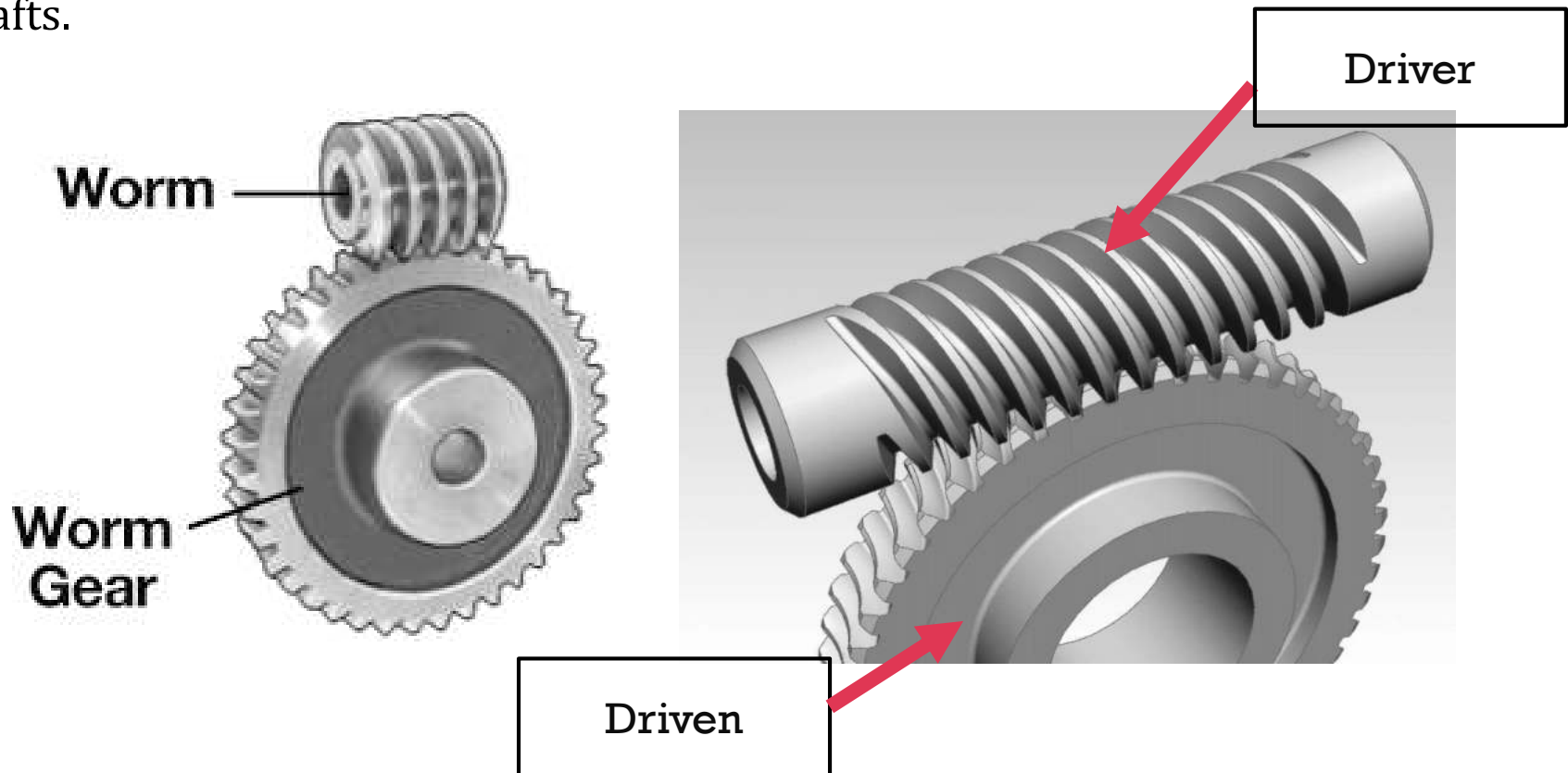


# IMPORTANT MACHINE ELEMENTS

## Important Machine Elements

### Gear Trains:

- **Worm-Worm Gear:** Used to transmit power between two non-intersecting shafts.

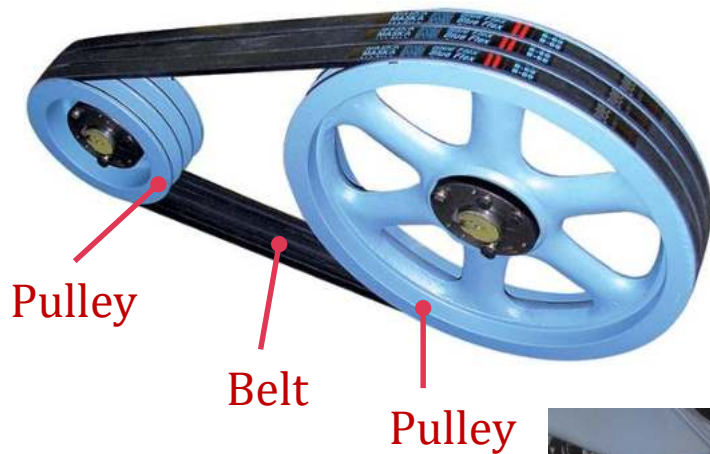


# IMPORTANT MACHINE ELEMENTS

## Important Machine Elements

### Belt Drive:

A **Belt**: Is used to transmit power and speed between two rotating pulleys.

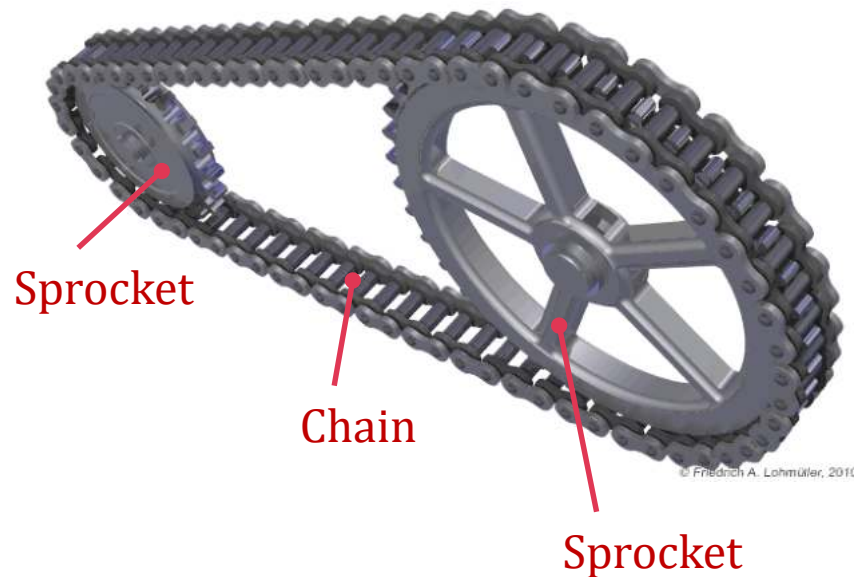


# IMPORTANT MACHINE ELEMENTS

## Important Machine Elements

### Chain Drive:

**A Chain:** Is used to transmit power and speed between two rotating sprockets.



# IMPORTANT MACHINE ELEMENTS

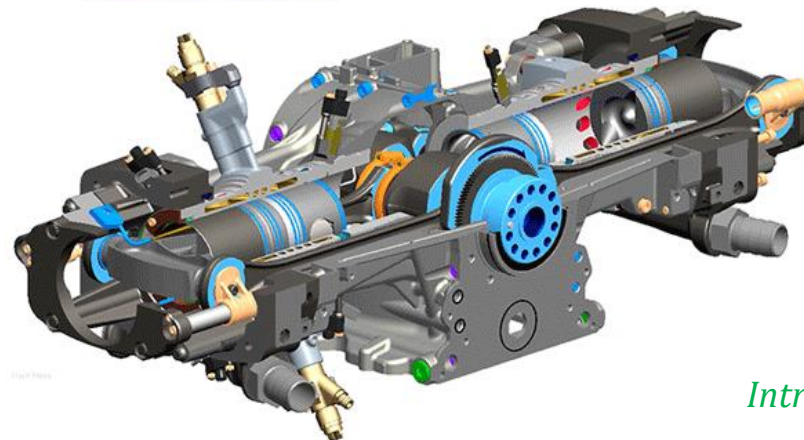
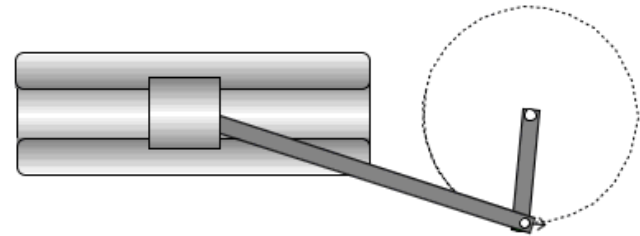
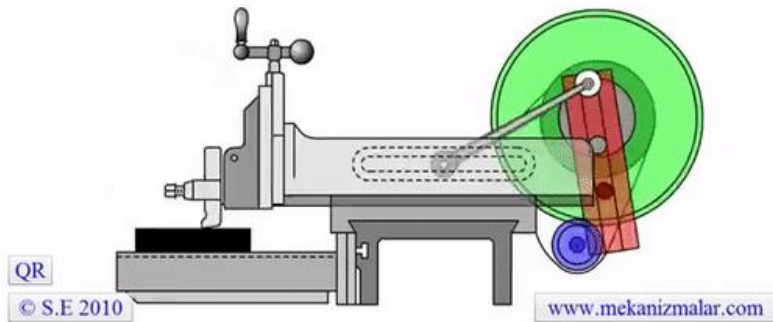
## Important Machine Elements

### Linkages:

**A Mechanical Linkage** is an assembly of bodies connected to manage forces and movement.

[www.mechanisms.co](http://www.mechanisms.co)

20  
Rotation Speed



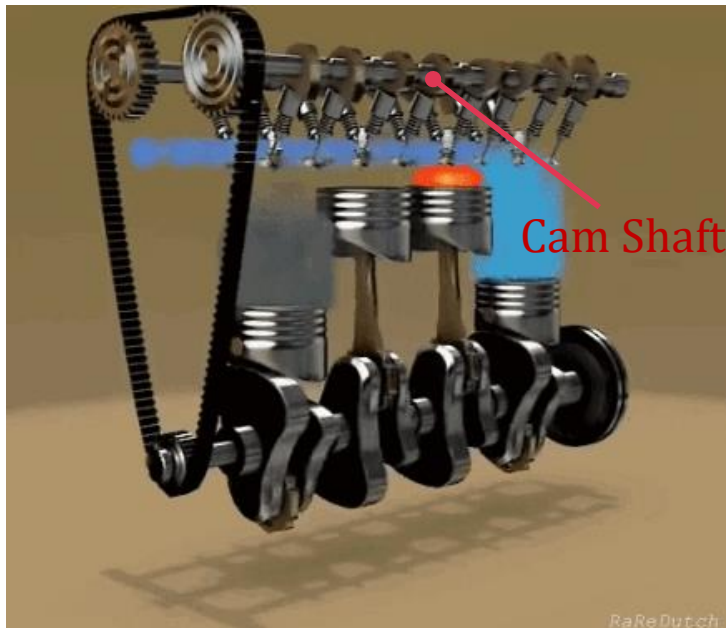
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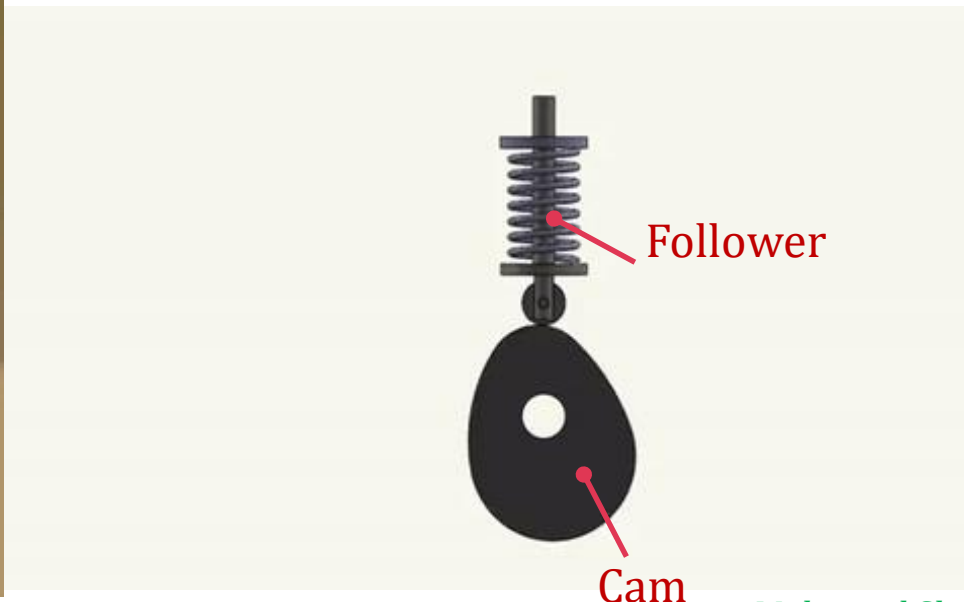
### Cam & Follower Mechanism:

A cam and follower mechanism is a profiled shape mounted on a shaft that causes a lever or follower to move.

Cams are used to convert rotary to linear (reciprocating) motion.



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# IMPORTANT MACHINE ELEMENTS

## Important Machine Elements

**Brakes:** Are mechanical elements that produce a torque opposite to the operating torque to slow down the motion or completely stop a rotating element.

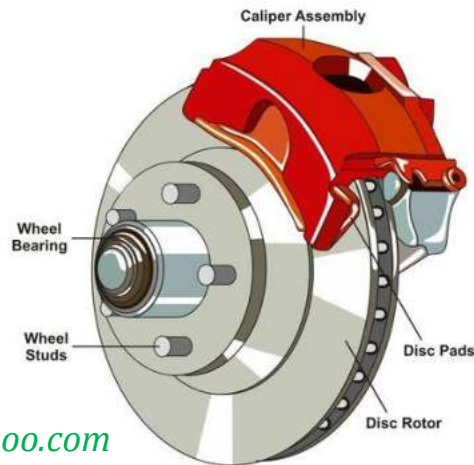
### Disk Brake



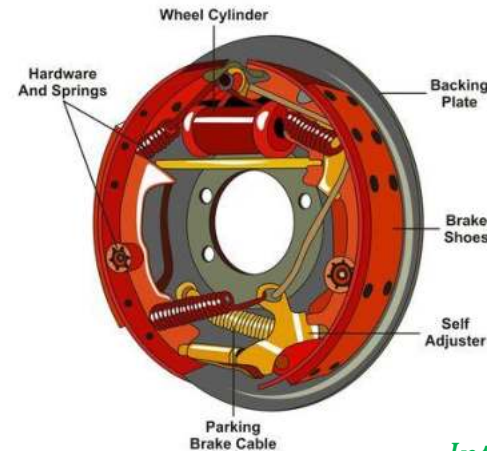
### Drum Brake



### Automotive Braking



Disk Brake



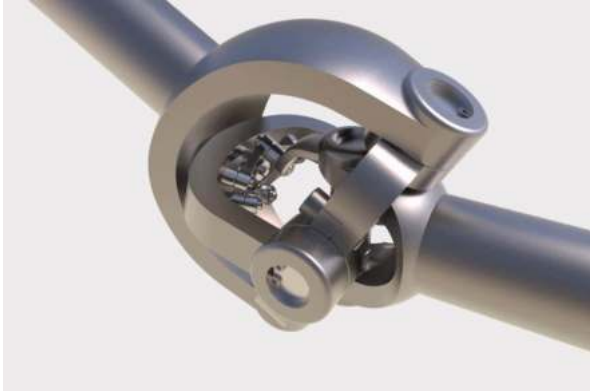
Drum Brake

# IMPORTANT MACHINE ELEMENTS

## Important Machine Elements

### Couplings:

A coupling is a device used to connect two shafts together at their ends for the purpose of transmitting power.



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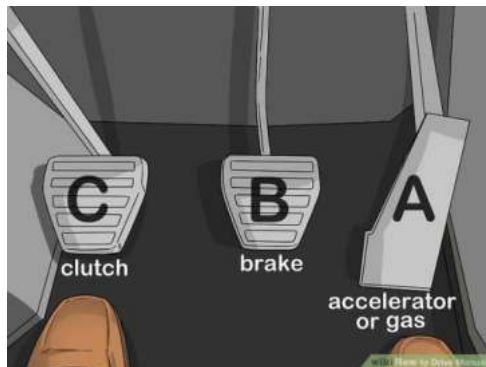
## Important Machine Elements

### Clutches:

A clutch is a mechanical device used to connect or disconnect two rotating shafts at their ends as needed.



Clutch in Manual Vehicles



Clutch in Automatic Vehicles



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### 3. Control Components

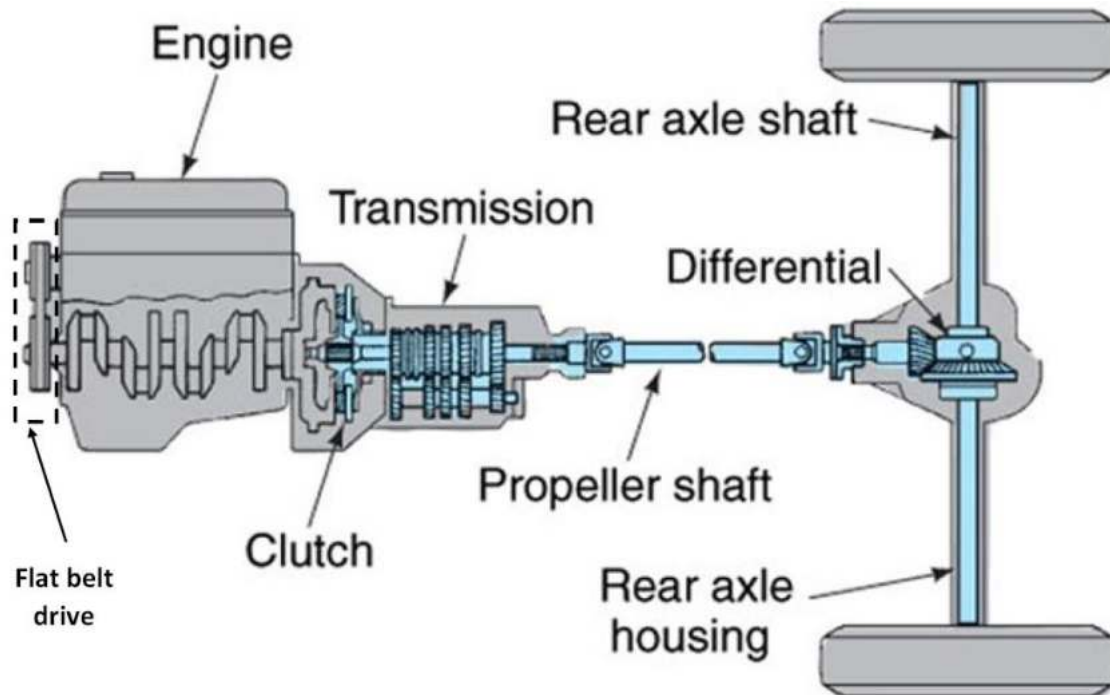
Buttons, Switches, Indicators, Sensors, Actuators and Computer Controllers.

# Transmission Systems & Their Operating Principle

## Transmission System of Manual Vehicles

**The Transmission:** is a mechanical device used for transmitting the power and speed from the vehicle's engine to its wheels. Using the transmission, the vehicle can move with a specific speed and torque.

**The Transmission of Manual Vehicles:** depends on a clutch to disconnect the energy delivery from the engine to the transmission to allow for the speed shifting (or gear mesh change).



### Rear-Wheel Drive Vehicle

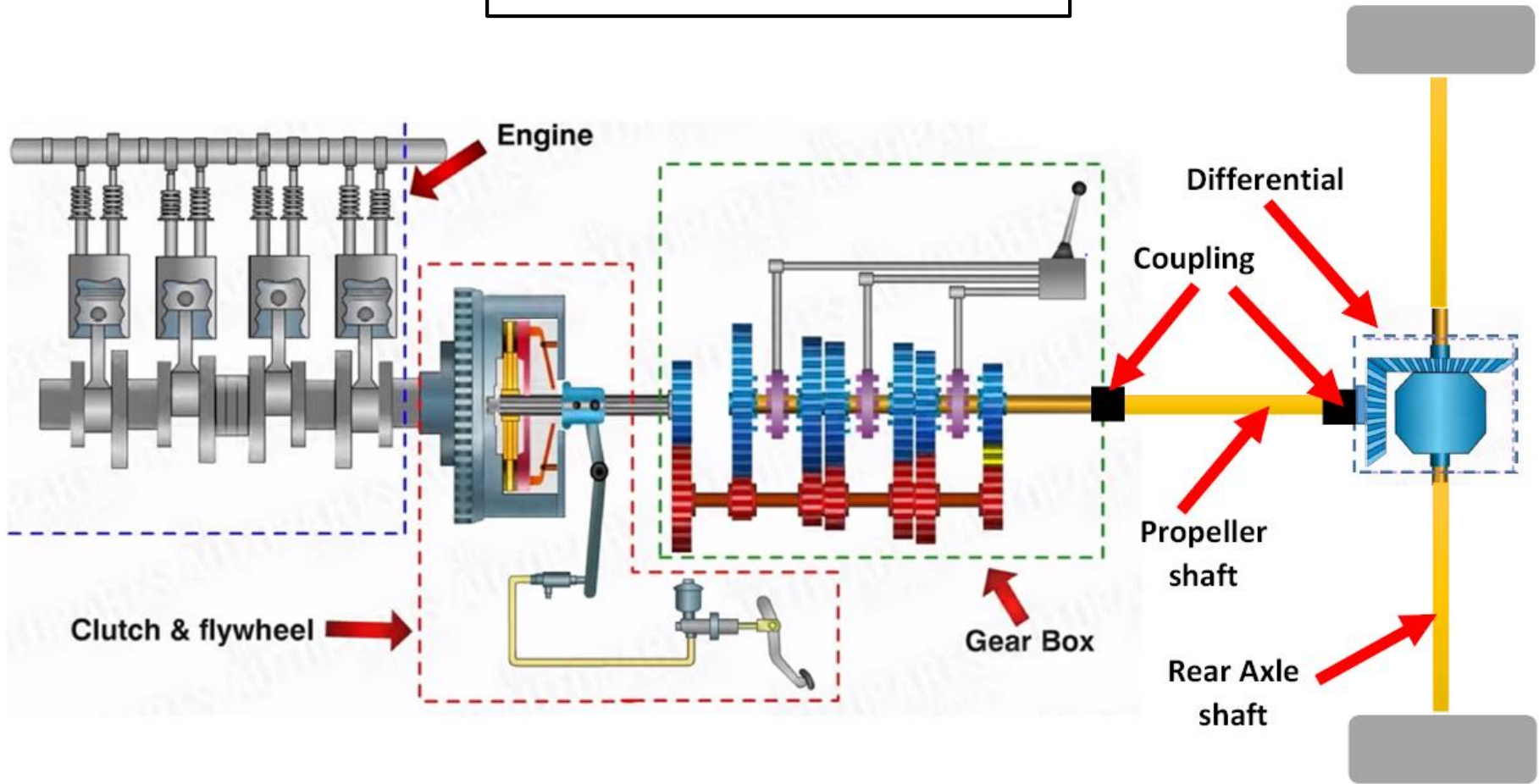


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# Transmission Systems & Their Operating Principle

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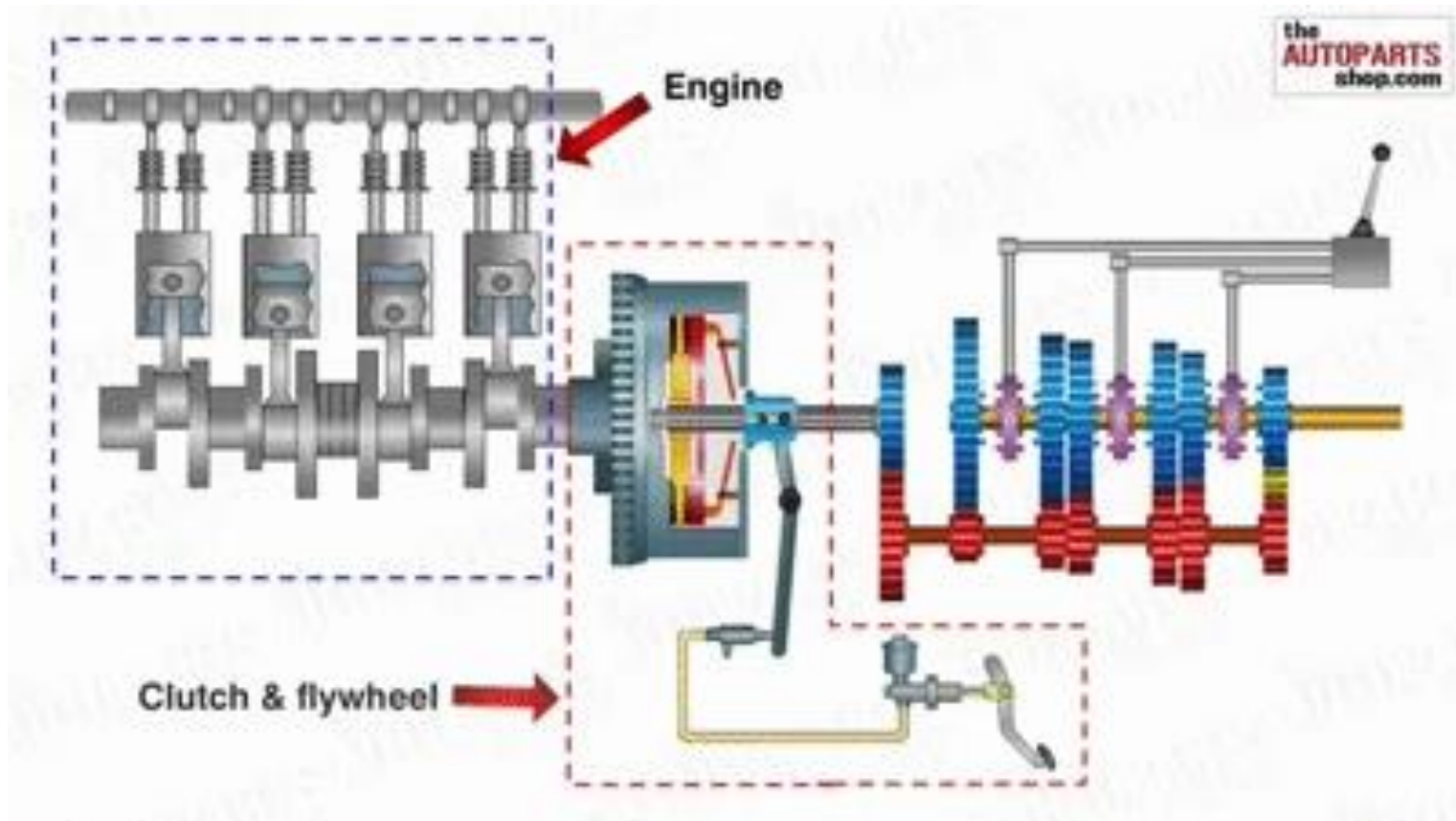
Rear-Wheel Drive Vehicle



# Transmission Systems & Their Operating Principle

## Transmission System of Manual Vehicles

Rear-Wheel Drive Vehicle



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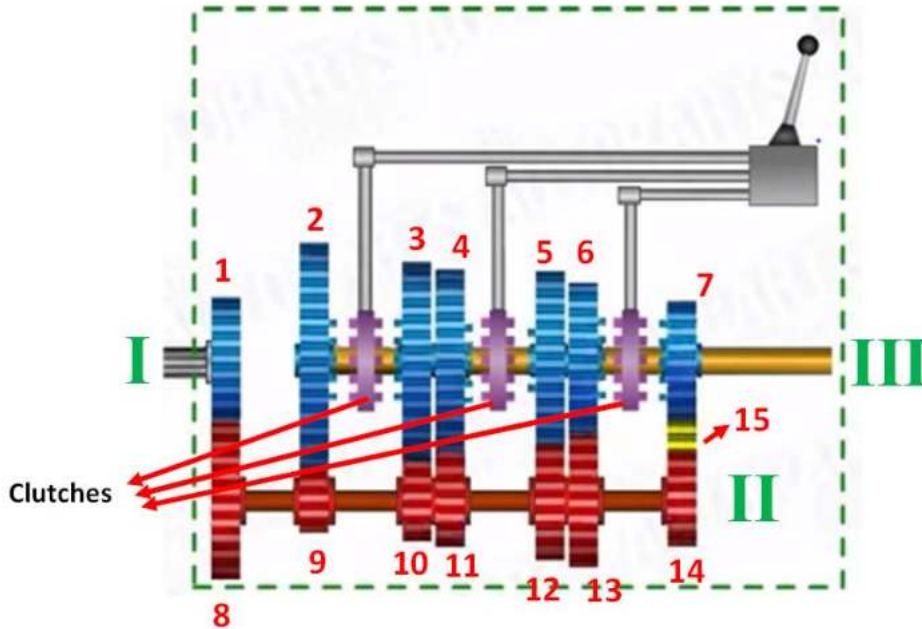
## Transmission System of Manual Vehicles



# Transmission Systems & Their Operating Principle

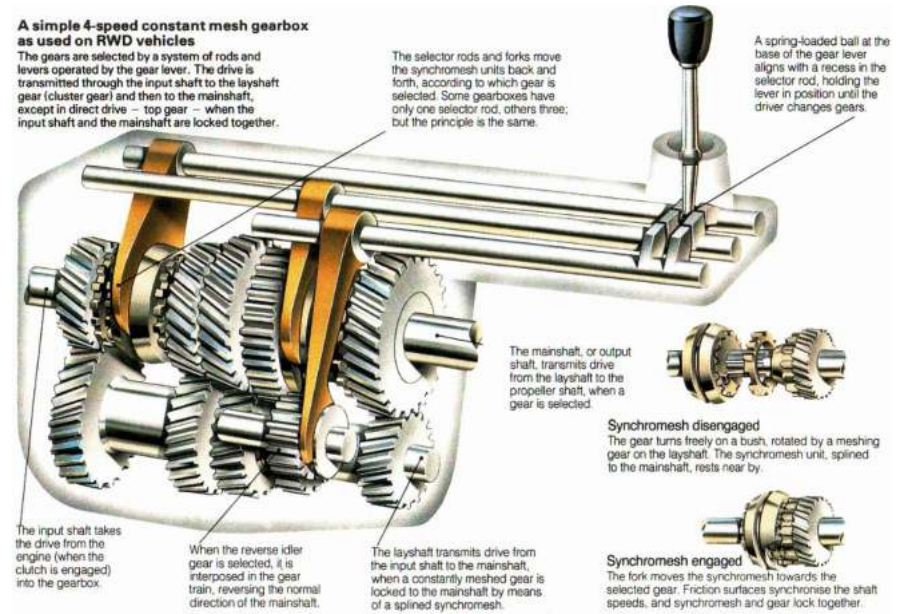
## Transmission System of Manual Vehicles

Transmission



A simple 4-speed constant mesh gearbox as used on RWD vehicles

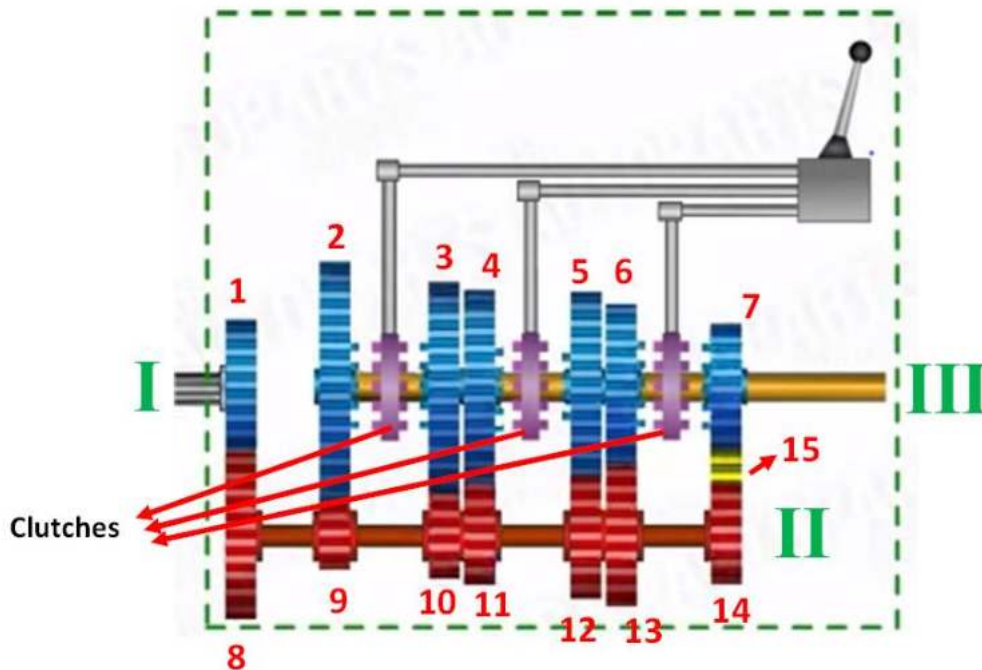
The gears are selected by a system of rods and levers operated by the gear lever. The drive is transmitted through the input shaft to the layshaft gear (cluster gear) and then to the mainshaft, except in direct drive – top gear – when the input shaft and the mainshaft are locked together.



# Transmission Systems & Their Operating Principle

## Transmission System of Manual Vehicles

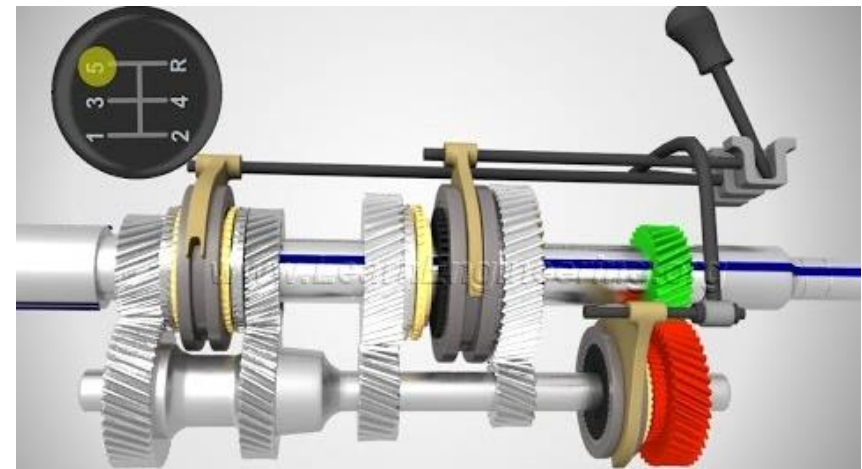
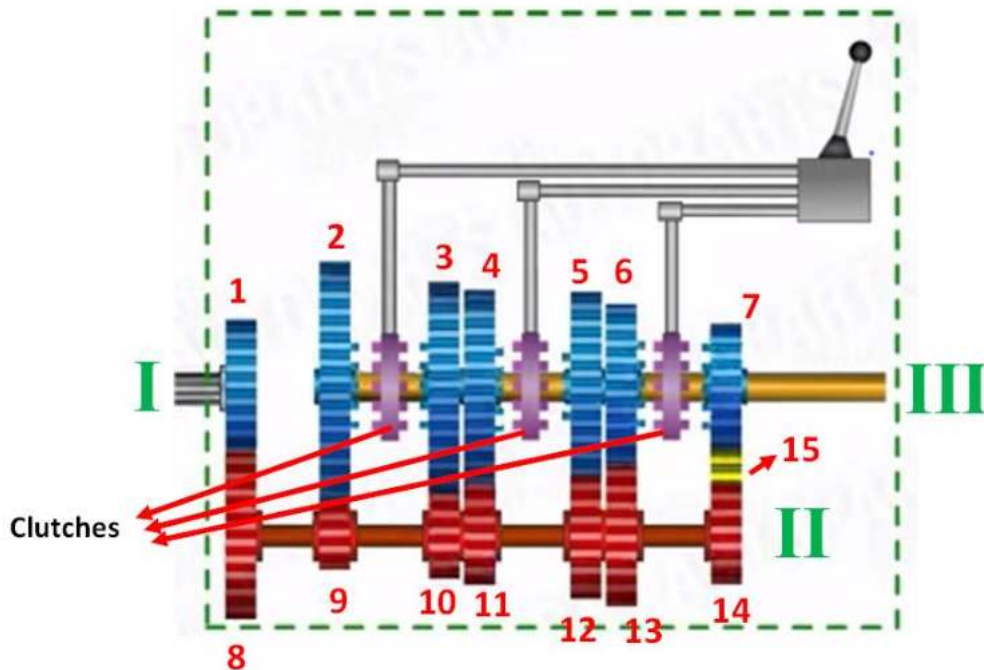
Transmission



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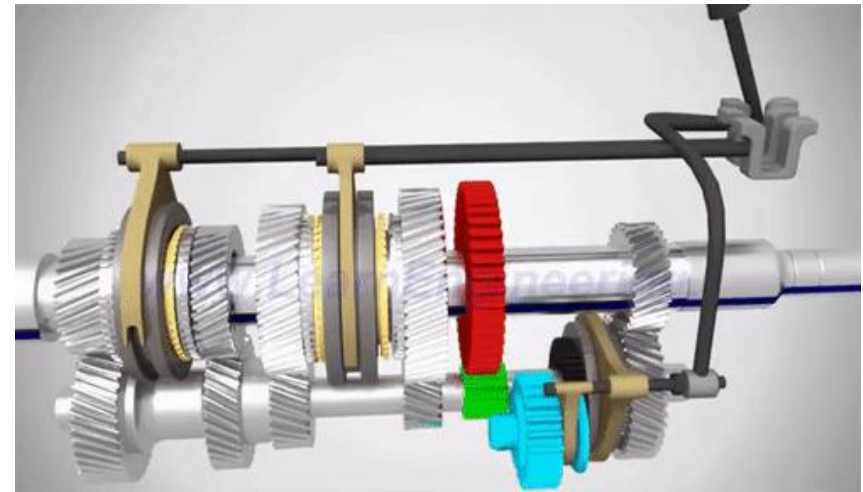
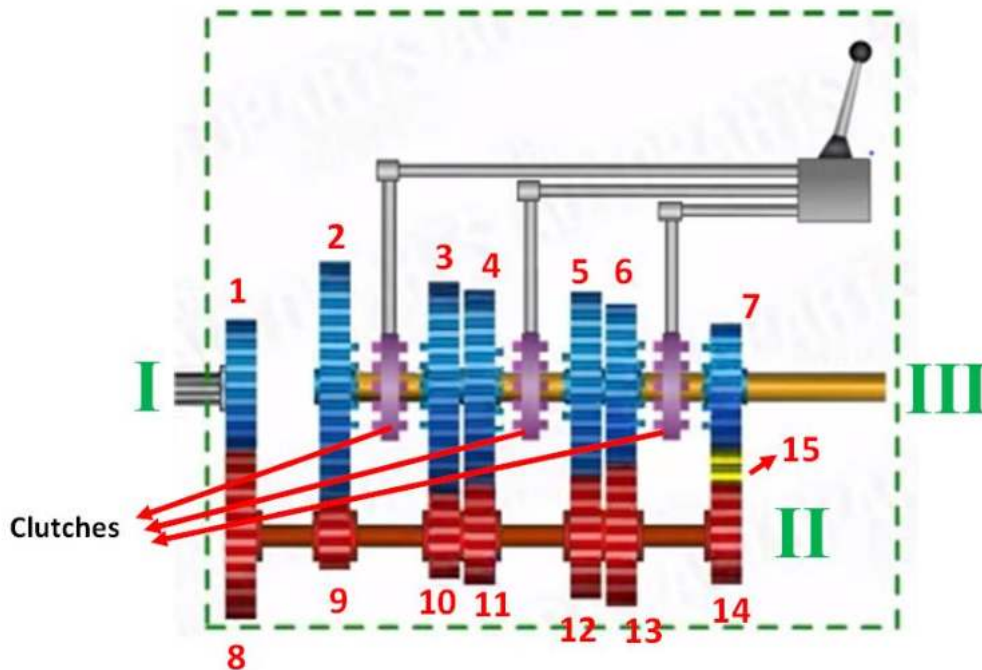
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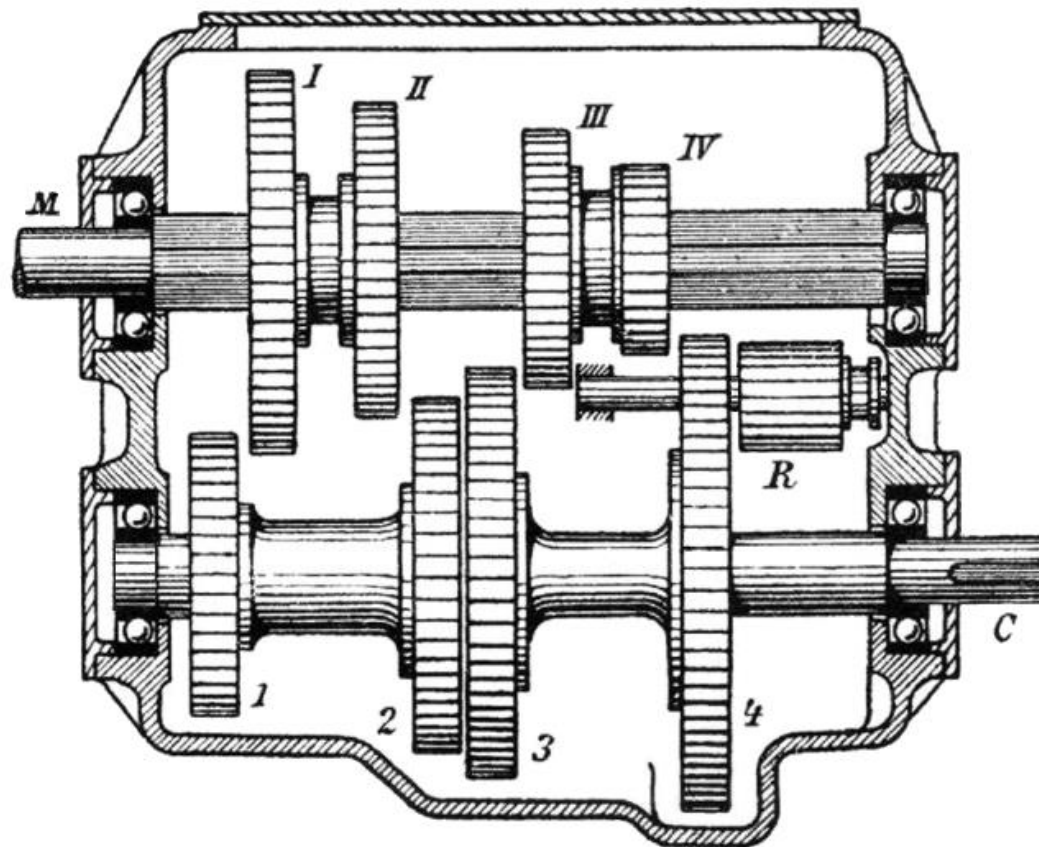
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