

WORKSHOP TECHNOLOGY - III



AMIT JANGRA

Lecturer

Mechanical Engineering Department

GDGP HISAR

Lesson Plan

Name of the faculty	:	AMIT JANGRA
Discipline	:	Mechanical Engineering
Semester	:	4th
Subject	:	Workshop Technology - III
Lesson Plan Duration	:	15weeks
Work Load	:	Lecture (3 Periods/Week)

For full syllabus please [visit here](#)

Attendance

Minimum 70%.

Grading policy

3 Sessional each carry 30 marks (Best of 2 will be considered)

3 Assignments must be submitted

Internal Assessment			External Assessment		
Th	Pr	Total	Th	Pr	Total
40	-	40	60	-	60

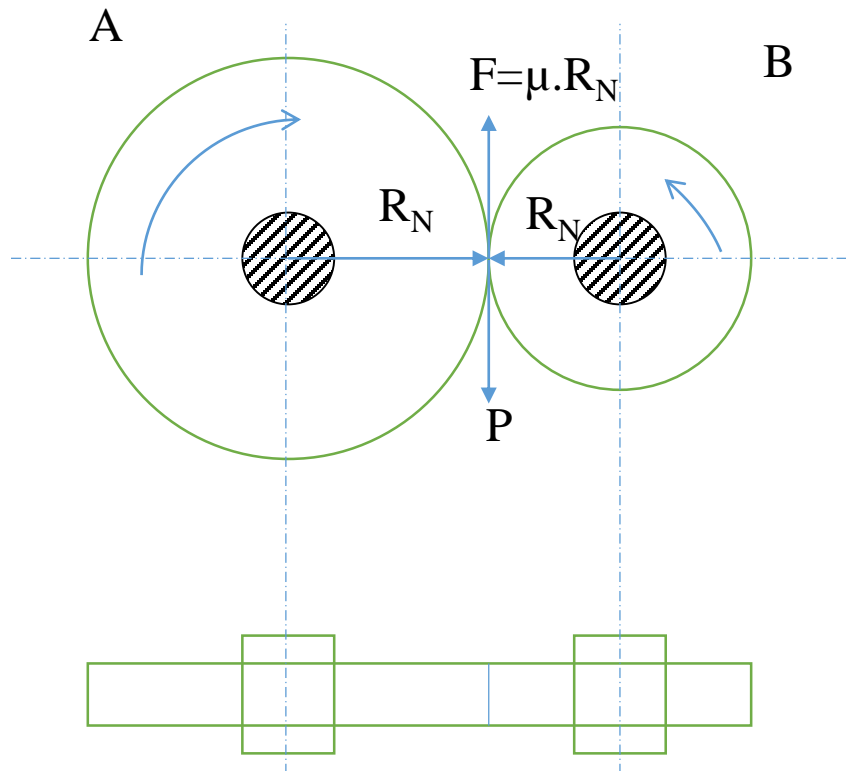


Chapter 1

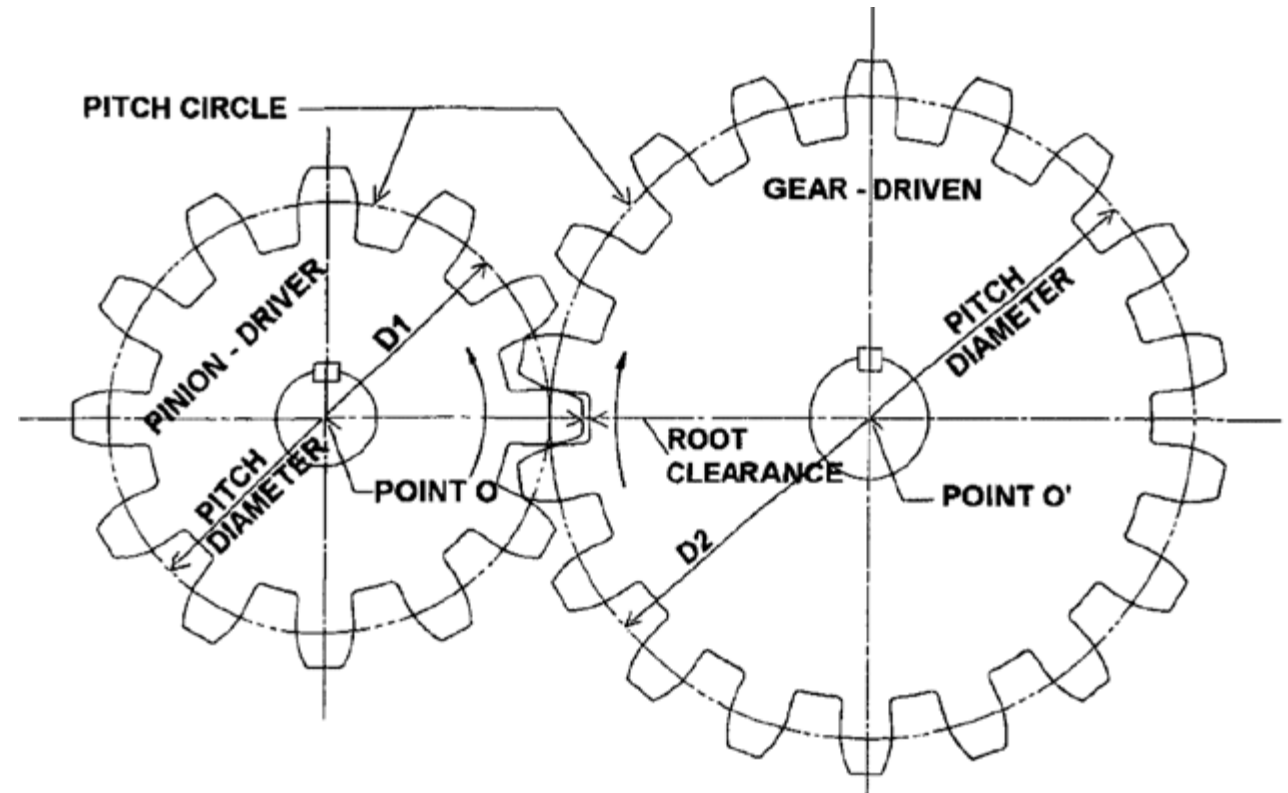
(Gear Manufacturing and Finishing Process)

Introduction

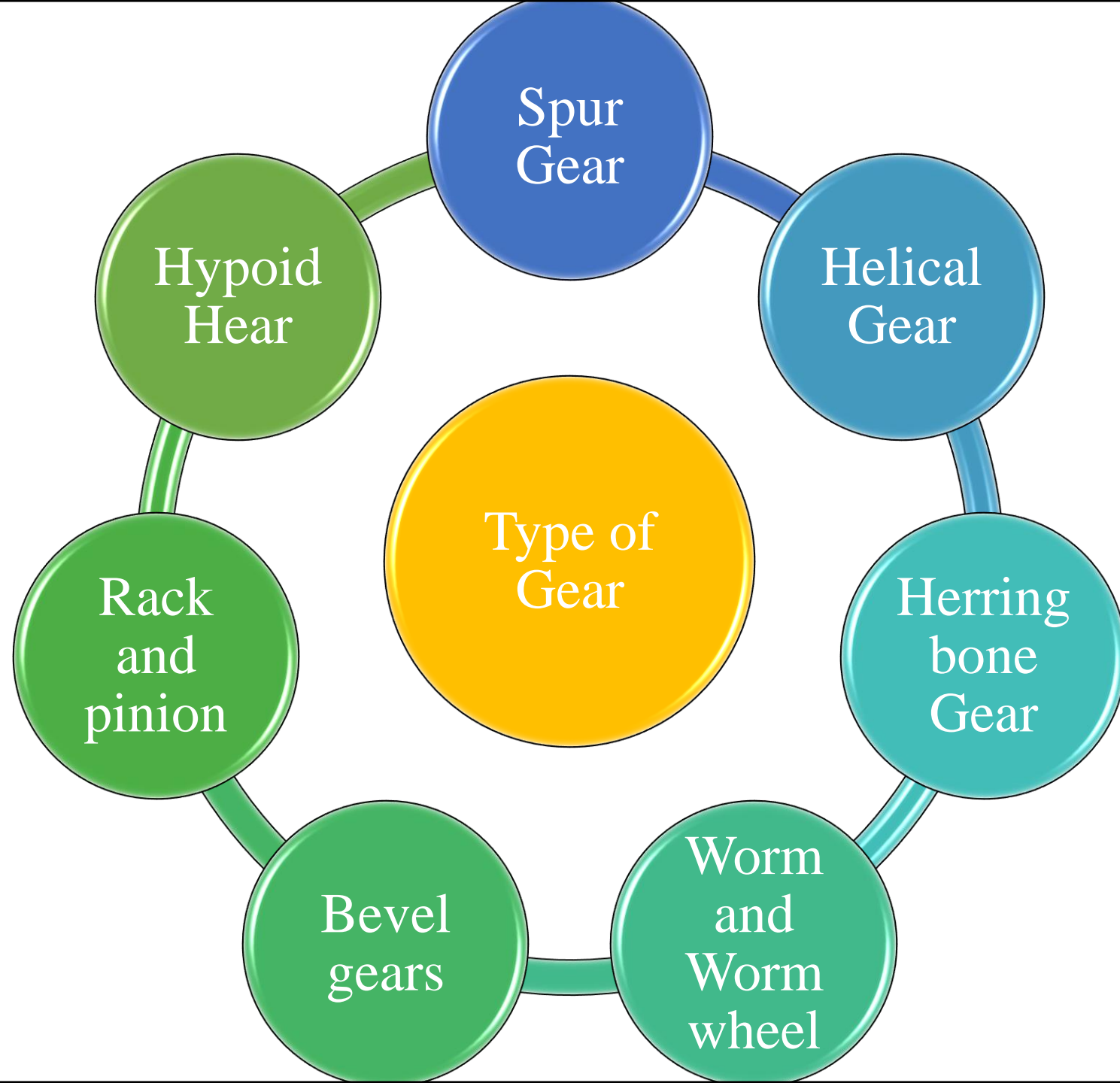
A gear is an important machine element for the transmission of power or rotary motion from the driving shaft to the driven shaft. It is a round blank with teeth on its circumference to have positive drive.



a) Friction wheels



b) Toothed wheels



Spur Gear



- Simple
- Teeth are parallel to the axis of gear
- Transmit power between parallel shafts
- Mounting using ball bearing
- 95-99% efficiency
- Washing machine, blender, dryer, railway engines, ball mills, sugar mills etc.

Helical Gear



- Teeth are inclined to the axis of gear (spiral gear or helical)
- Stronger and quieter
- Difficult to make so it is expensive
- Transmit power between parallel and non-parallel shafts
- Mounting using thrust bearing
- Gearbox for automobile, printing industry etc

Herring Bone Gear



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- Two single helical gear placed side by side.
- Difficult to make so it is more expensive
- No thrust produced so either to use smaller thrust bearing or eliminate it totally

Worm and Worm wheel



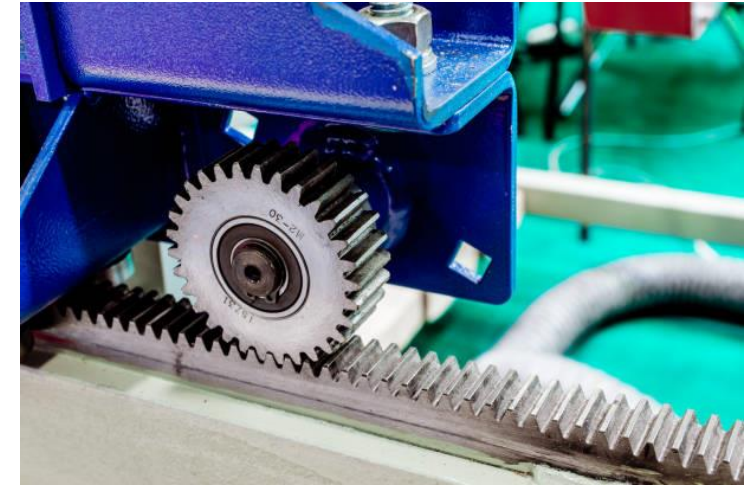
- Transmit power between two non-parallel and non-intersecting shafts at 90 degree.
- Worm drives the worm wheel and drive is not reversible.
- Used for high speed reduction. (20:1 or higher)

Bevel Gear



- Transmit power between two shafts at right angle or at an angle other than right angle but in the same plane.
- Cone crushers and sand mixtures, cooling towers, air preheaters, aircrafts etc.

Rack and Pinion



- Rack teeth are cut straight and mesh with ordinary spur gear.
- Convert the reciprocating motion into rotary motion or vice-versa.
- Steering system of cars.

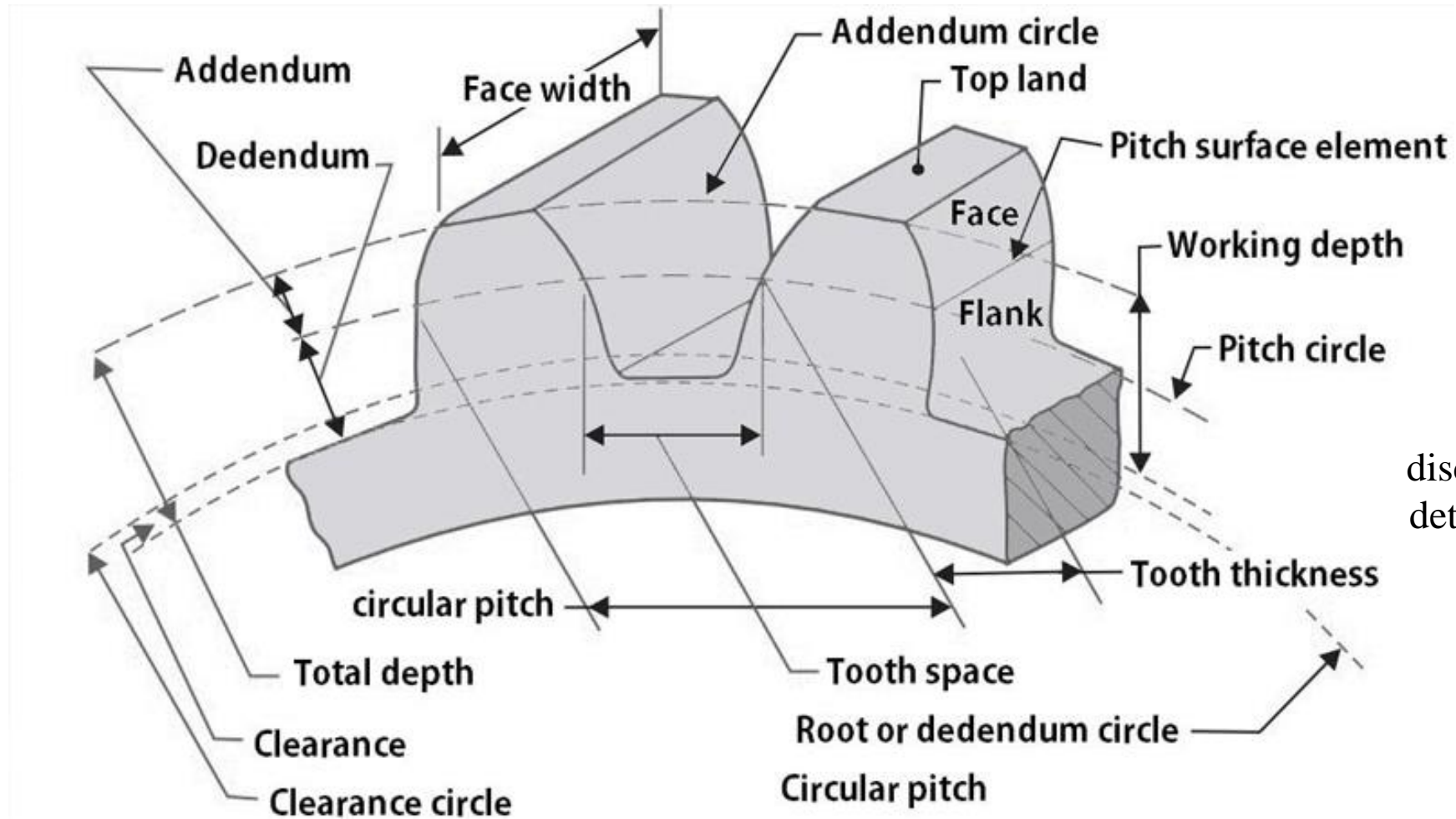
Hypoid Gear



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- Similar to bevel gears but the axis of two shafts do not intersect.
- Teeth are curved and stronger than common bevel gears
- Used in automobile rear axle drives.

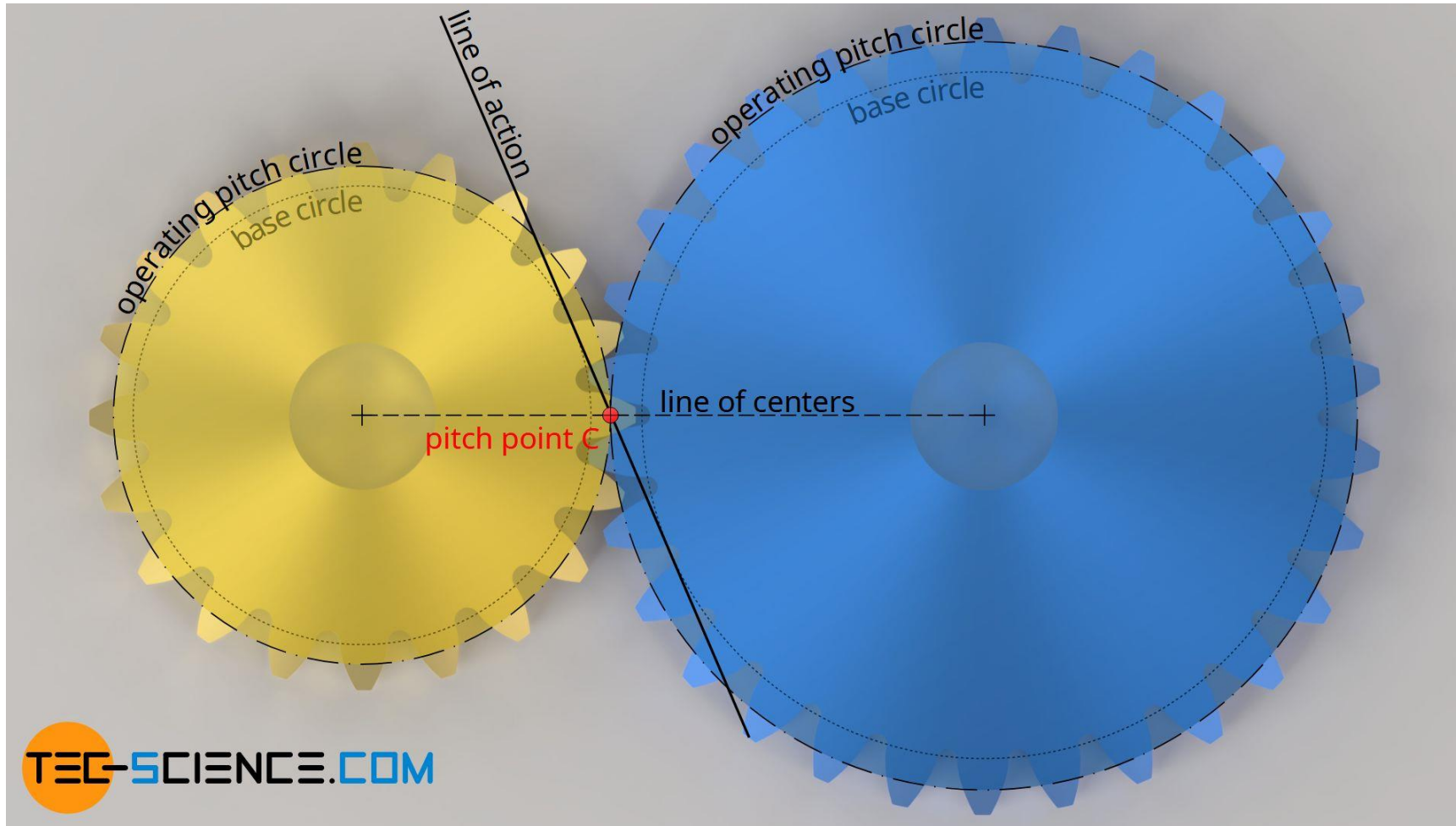
Gear Terminology



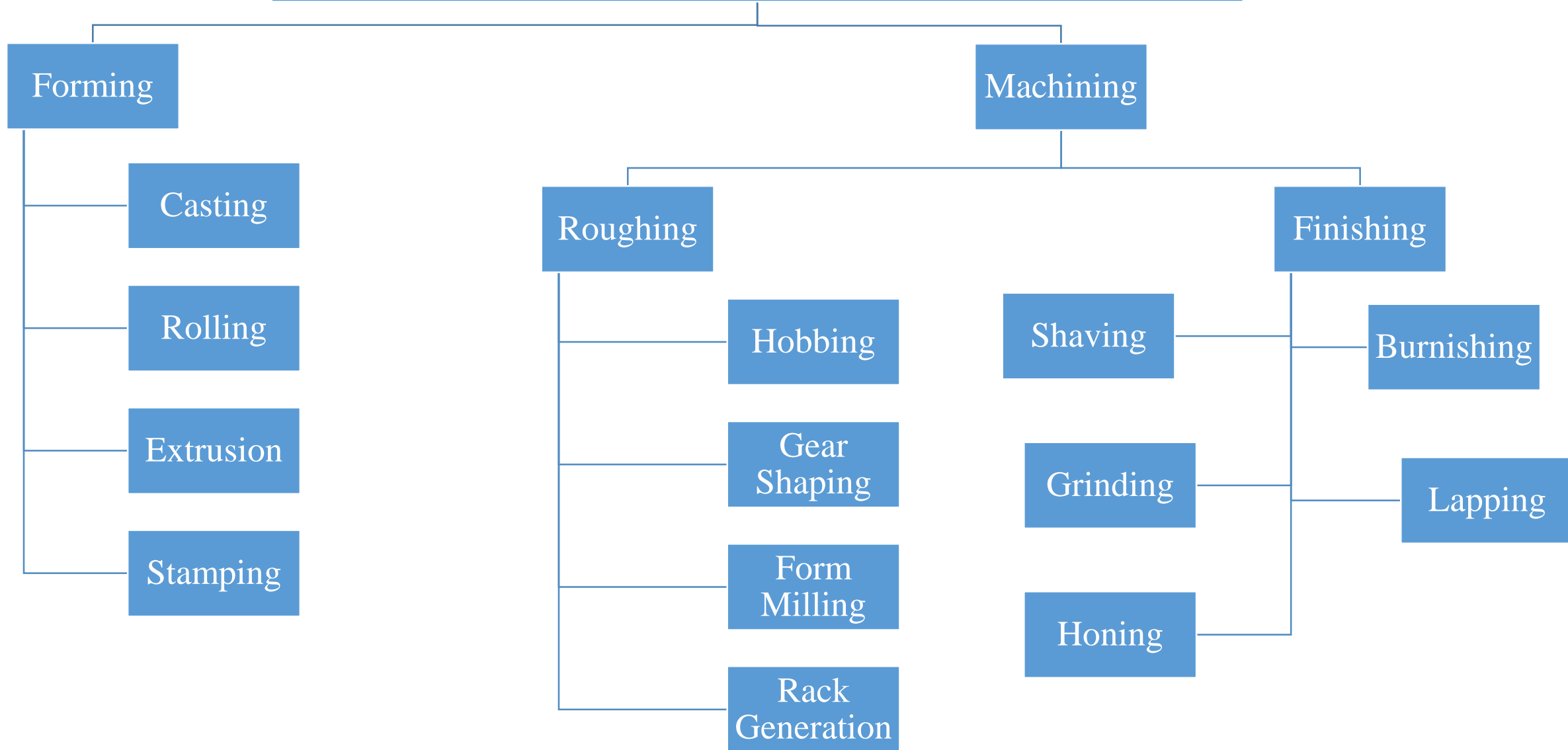
To be
discussed in
detail in the
class

Gear Terminology

Gear Terminology



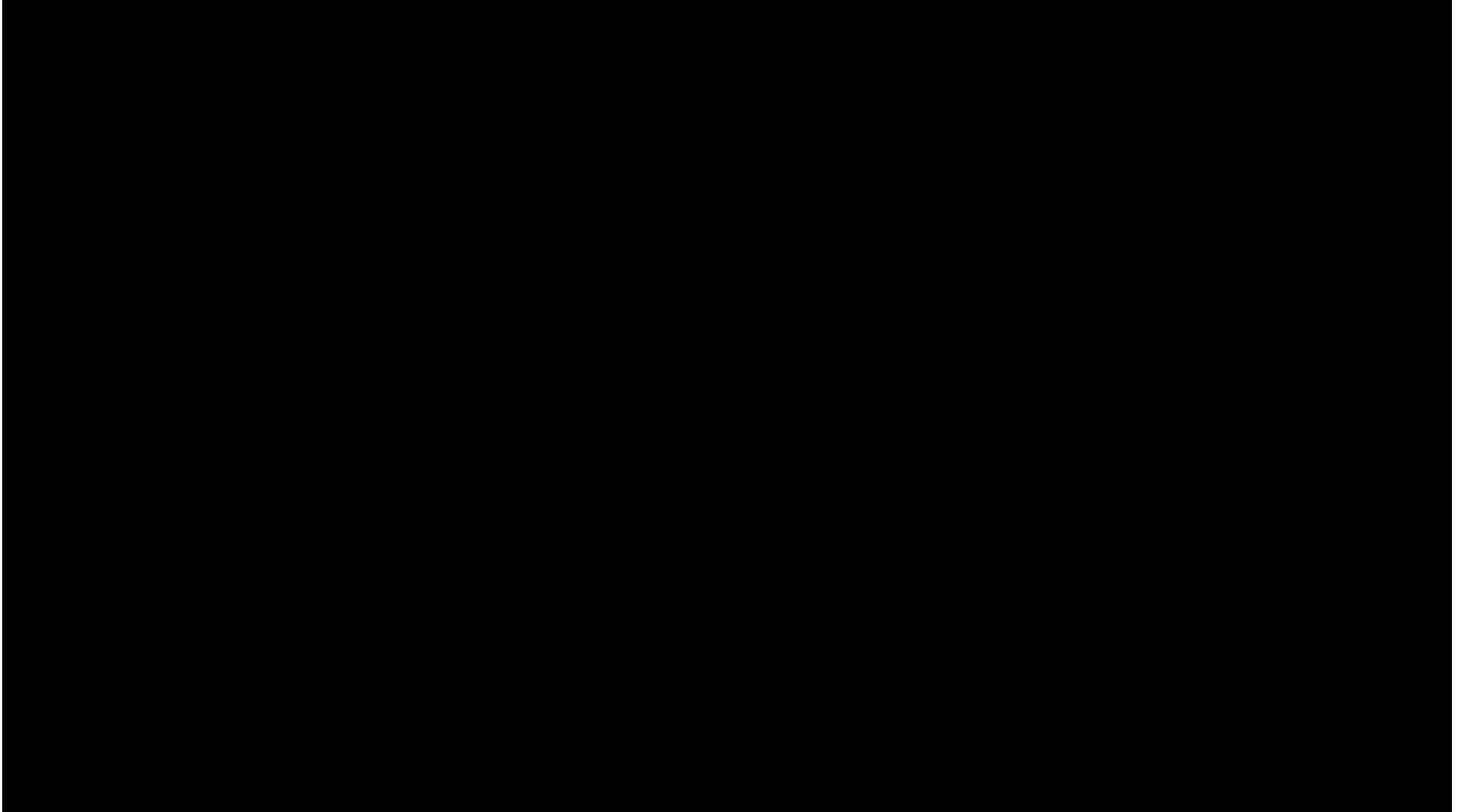
Method of gear manufacturing



Gear Casting

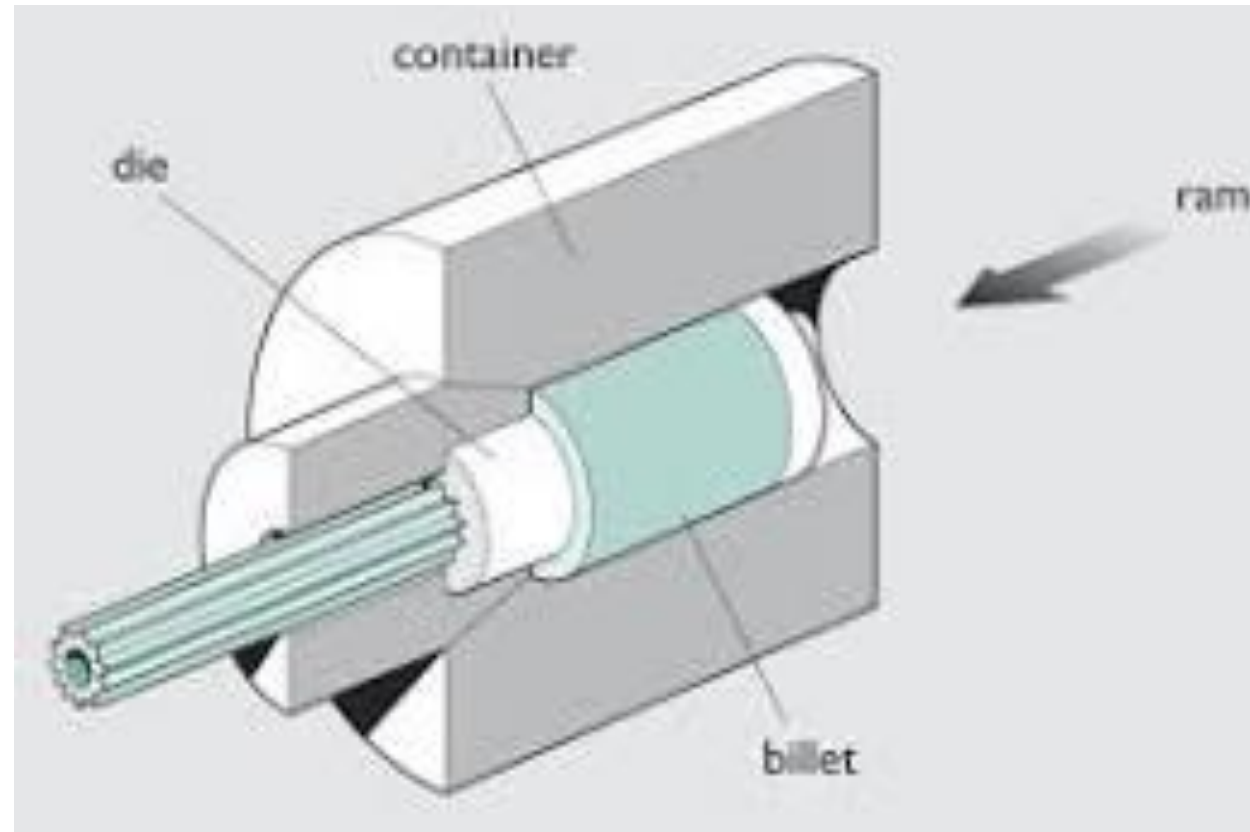


Gear Casting



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Gear Extrusion



Gear Forging

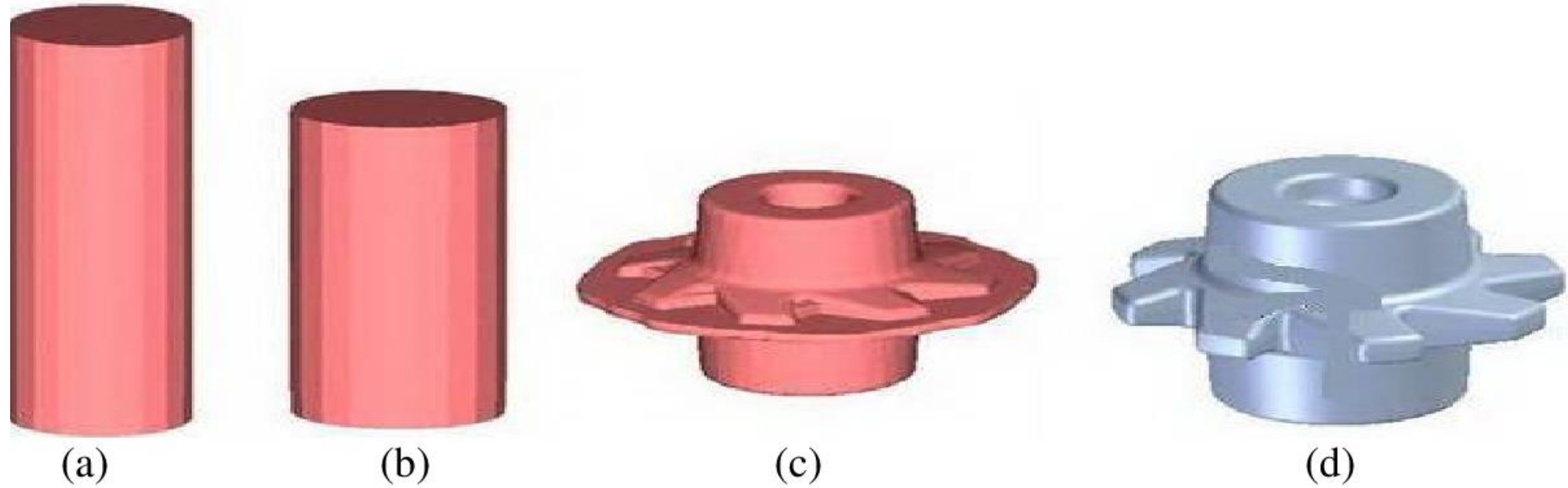
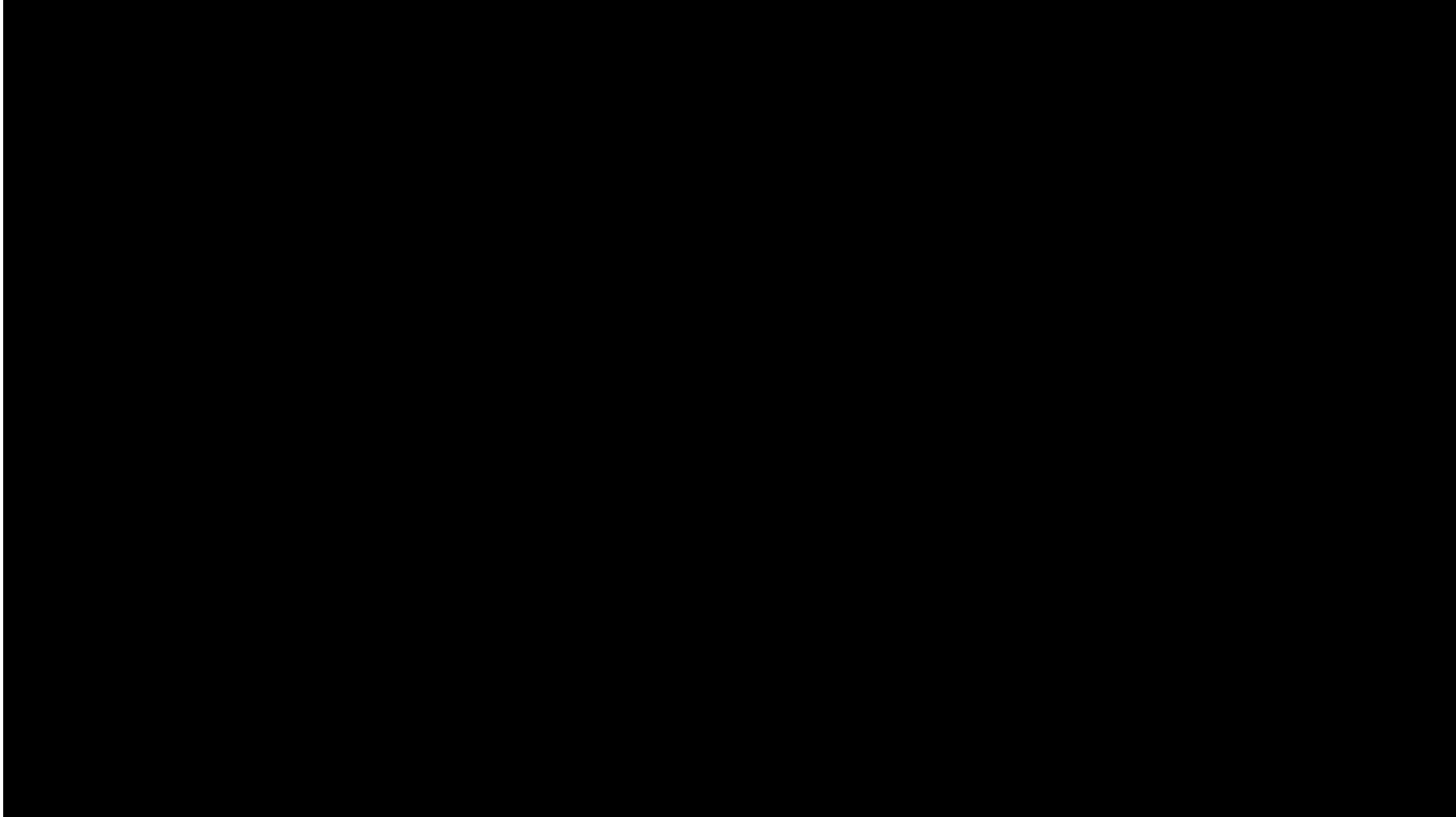


FIGURE 6. Simulation of part production, (a) raw material, (b) reduction of height, (c) final formation, (d) flashing.

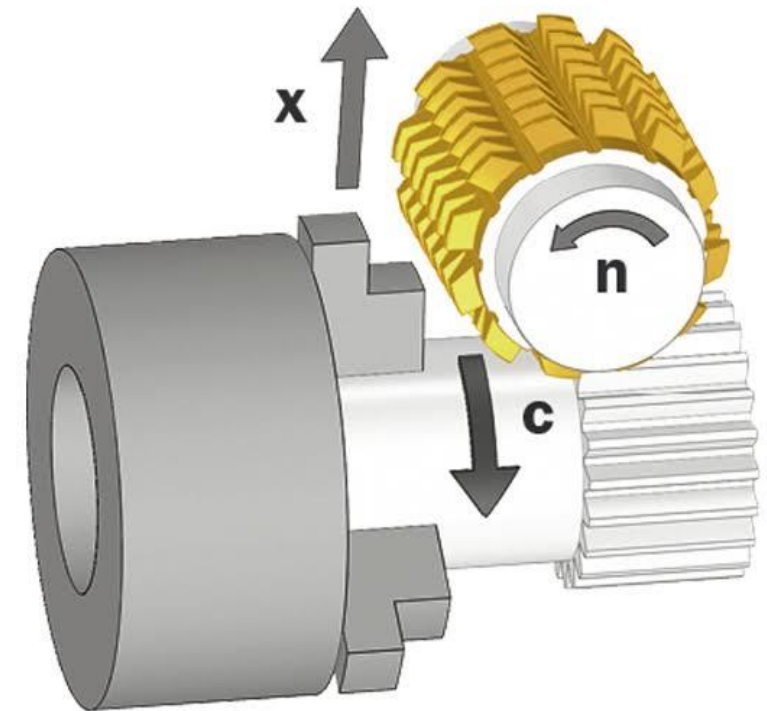
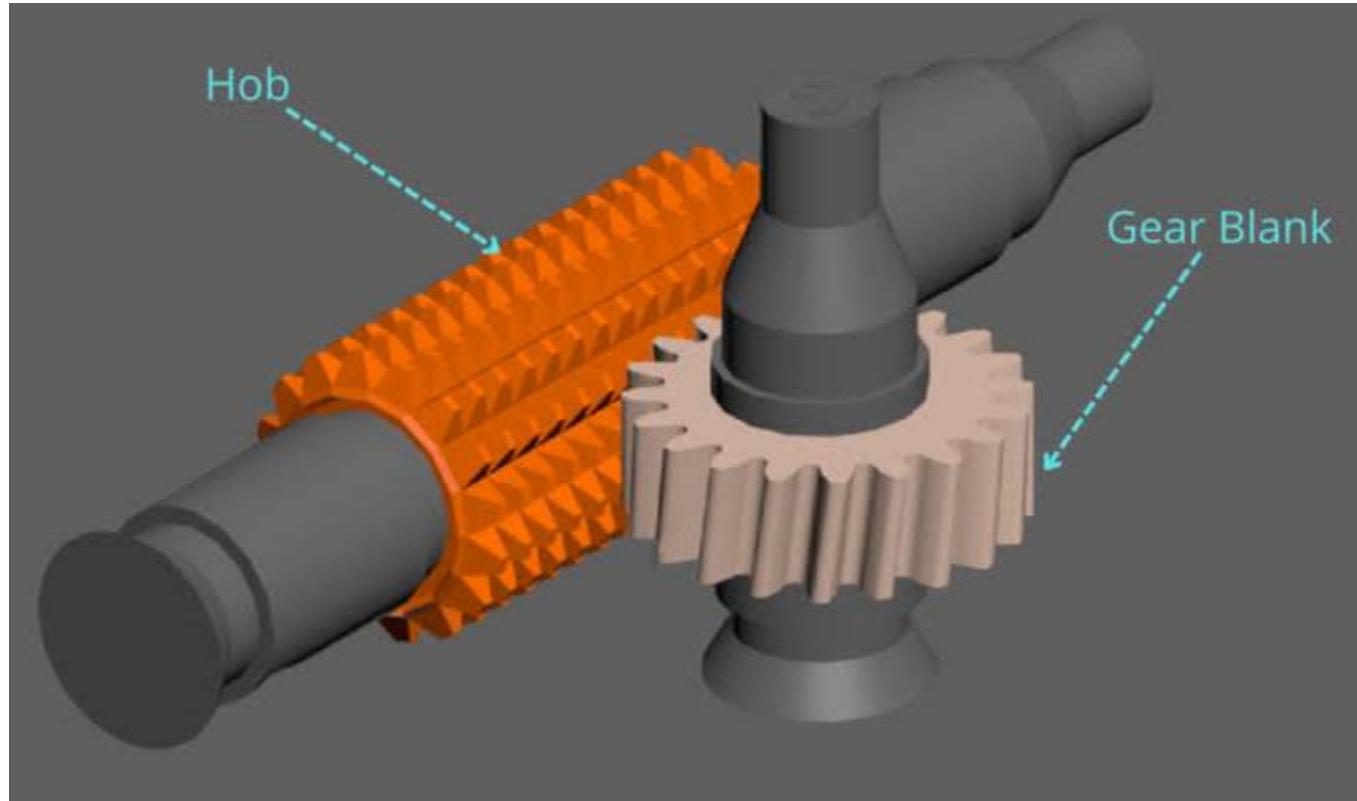
Gear Forging



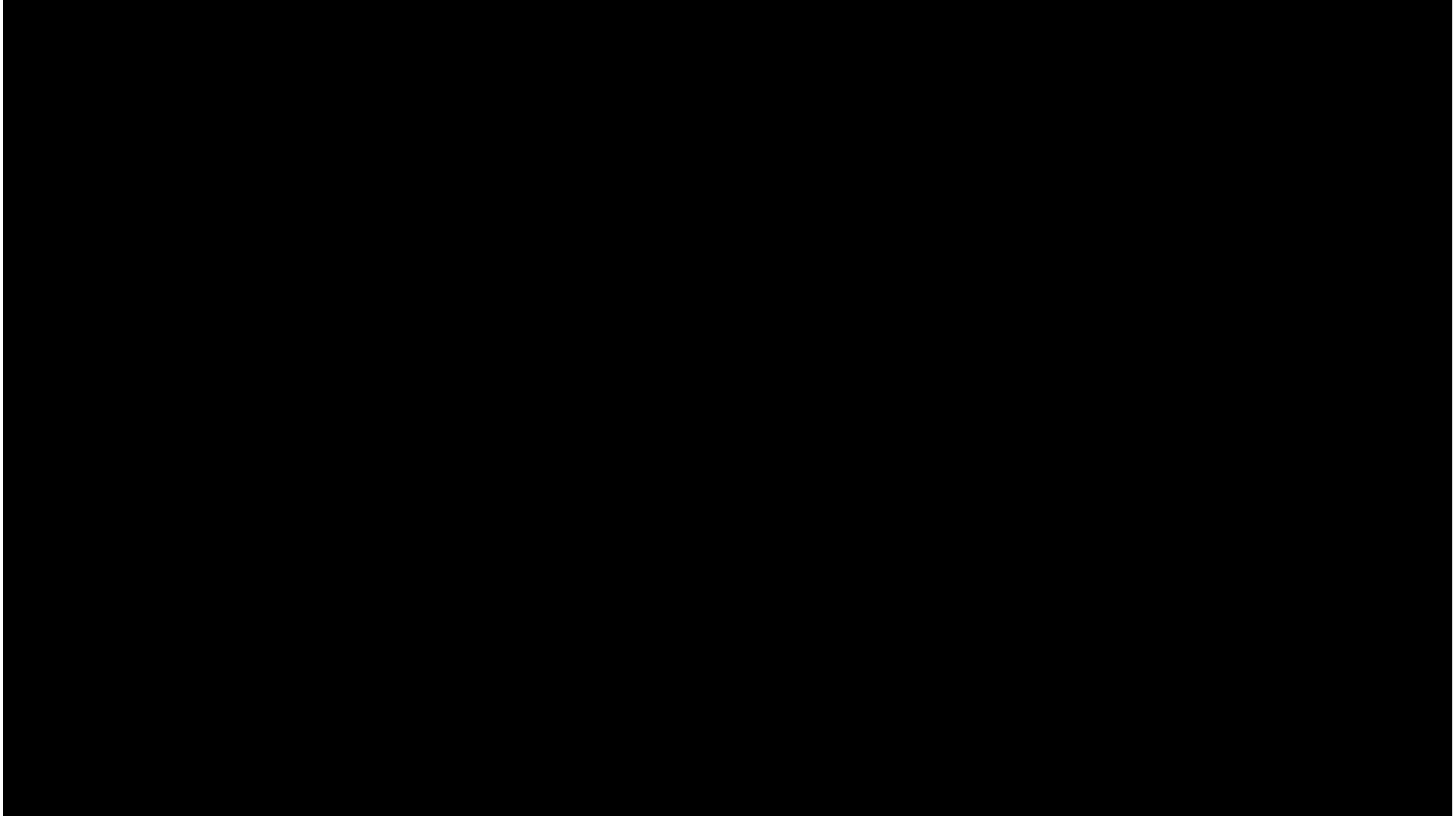
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Gear Hobbing

It is a process to generate gear by rotating a cutter called a hob. The revolving cutter cuts like a milling cutter.



Gear Hobbing



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Gear Hobbing

Advantage

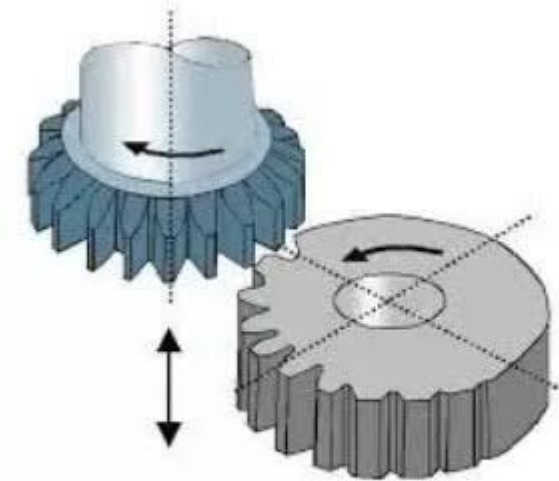
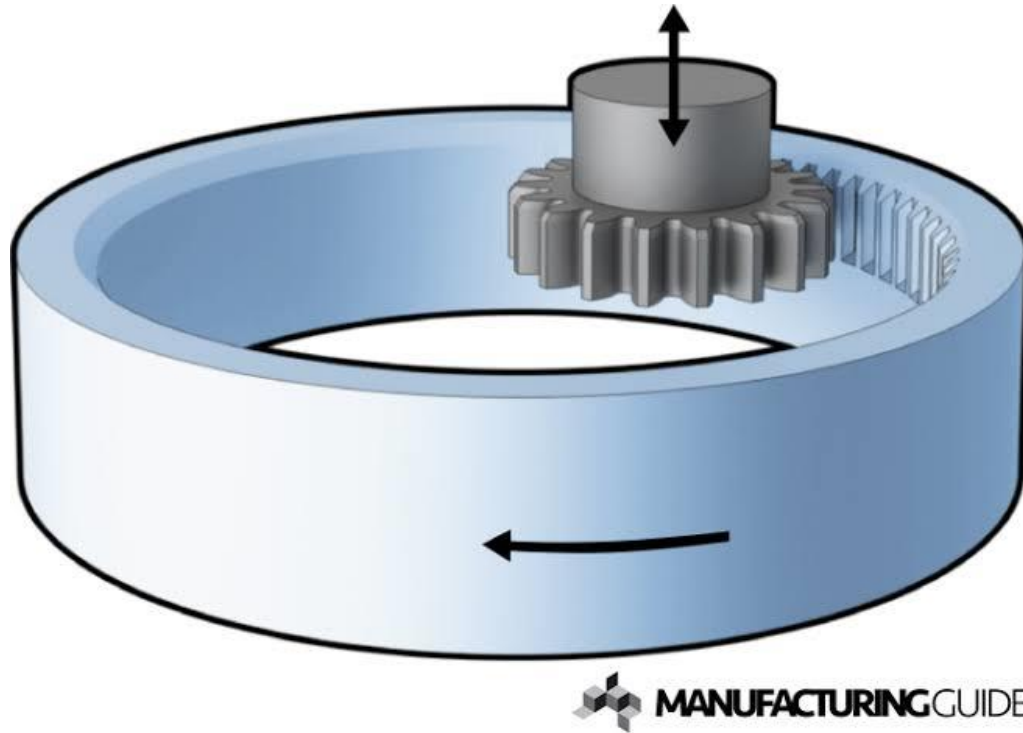
- i) It is faster, continuous and economical as compared to other gear generating process
- ii) It enables high rate of production and can generate different type of gear
- iii) Irrespective of number of teeth same hob is used.
- iv) It is an accurate process and adopted for medium and large batch production.

Disadvantage

- i) It is not suitable for cutting internal gears.
- ii) It is not suitable for cutting cluster gears.
- iii) It does not produce unsymmetrical shapes like interrupted gears.

Gear Shaping

This method is based on action which is achieved due to the movement of two meshing gear. One of them is pinion which is cutter while the other is a blank.

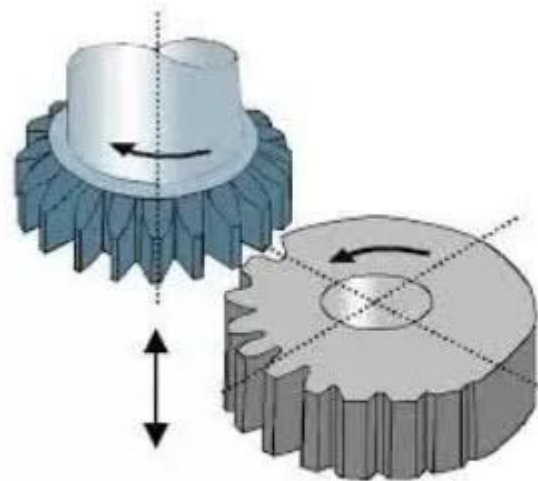


GEAR SHAPING PROCESS

Gear Shaping

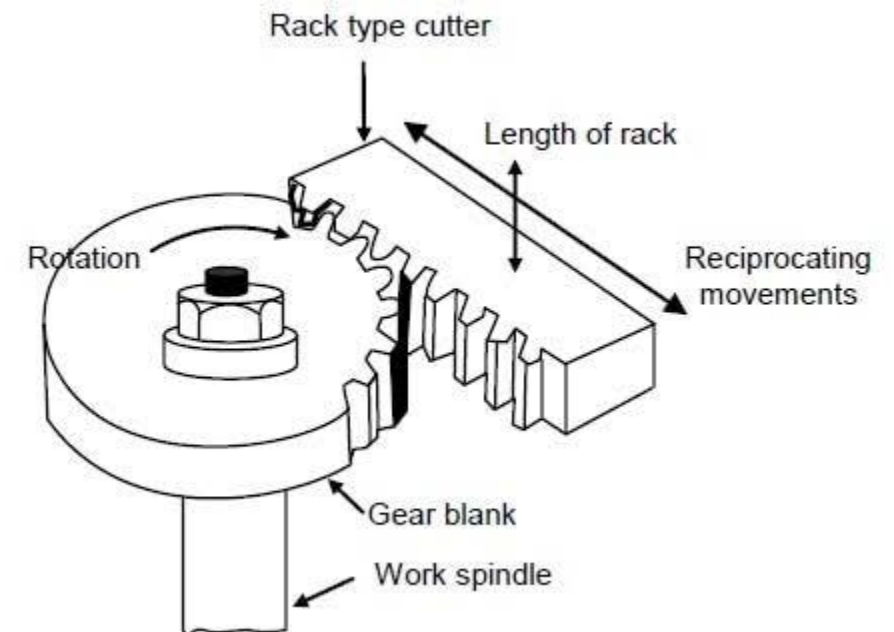
Type of Gear shaping Cutter

Rotary Gear Shaper cutter

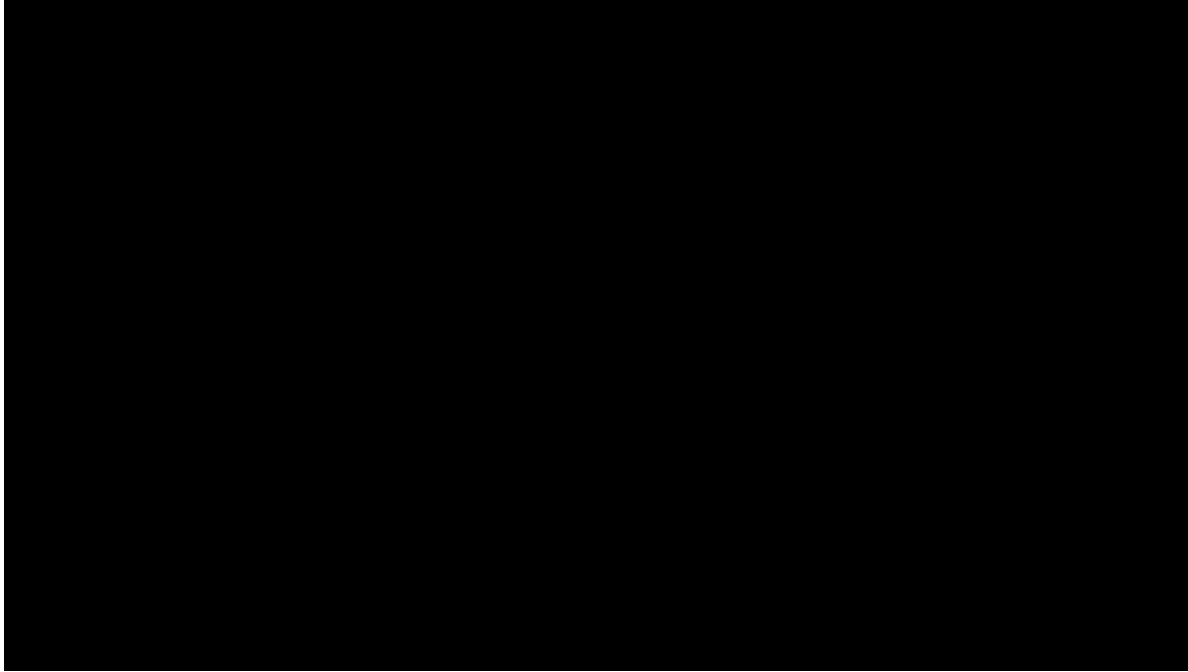


GEAR SHAPING PROCESS

Rack type Shaper cutter

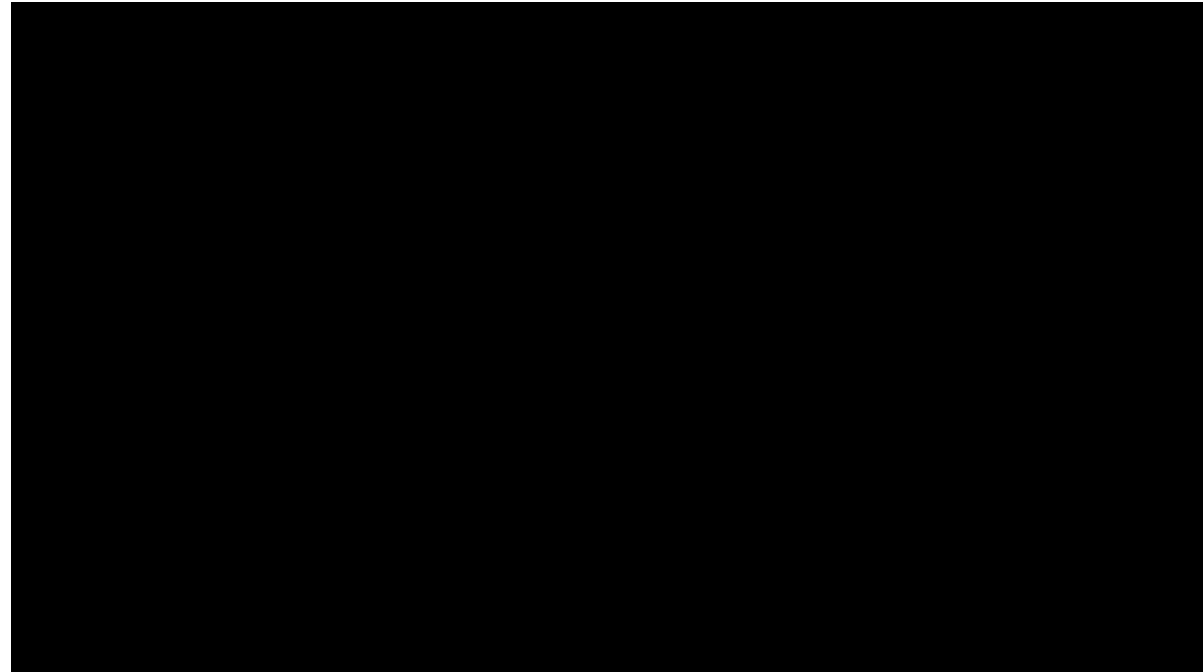


Gear Shaping

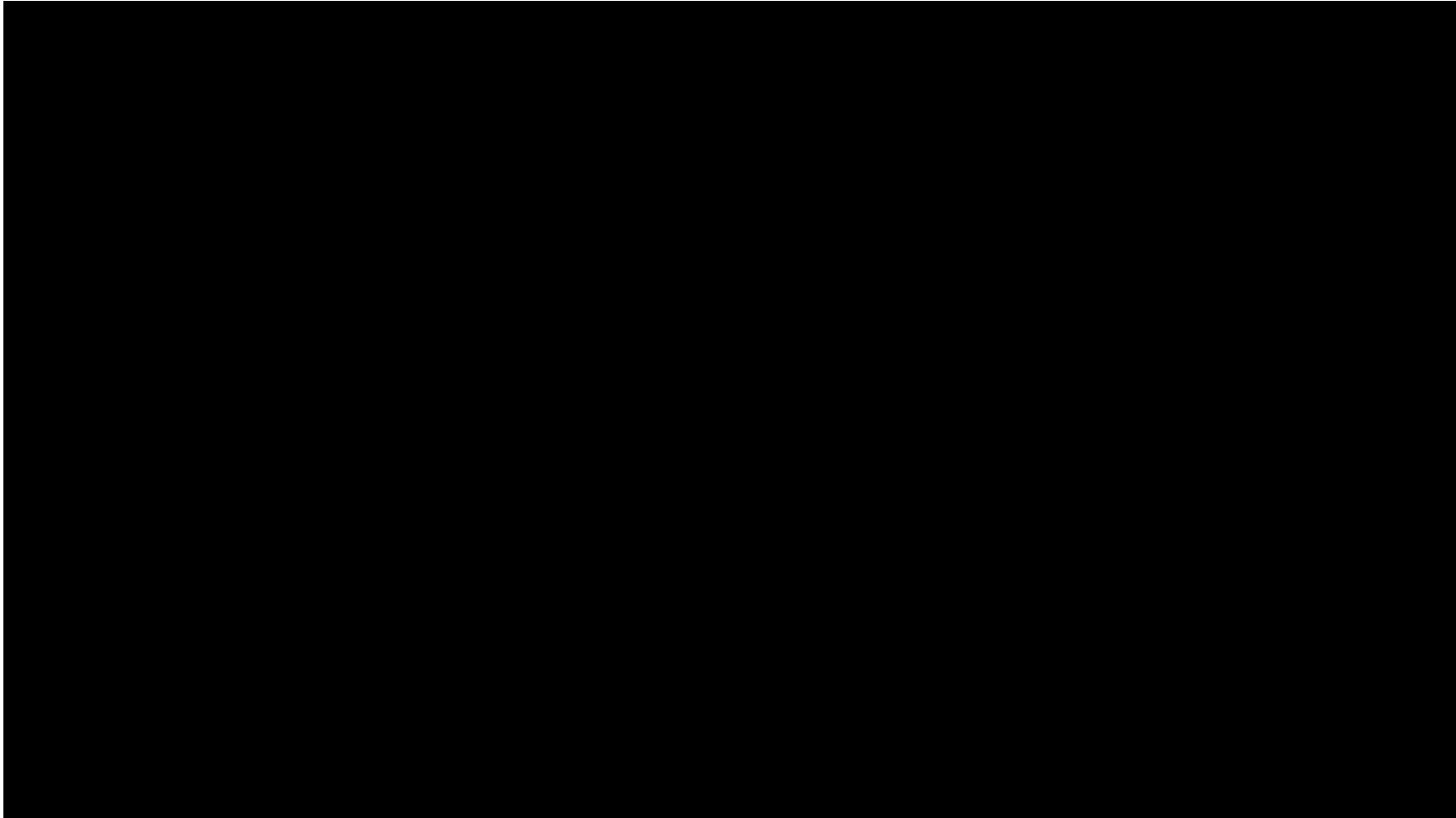


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Gear Shaping



[link](#)

Gear Shaping

Advantage

- i) Very High accuracy.
- ii) Used for medium and large sized gears
- iii) Used to cut both internal and external gears.
- iv) It can generate different type of gear except worm and worm wheels
- v) Irrespective of number of teeth same cutter is used as long as their module is same.

Disadvantage

- i) Worm and worm wheels cannot be cut by gear shaping process.
- ii) Single cutting takes place during the cutting stroke, thus the time spend in return stroke is a waste.

Hobbing versus Shaping

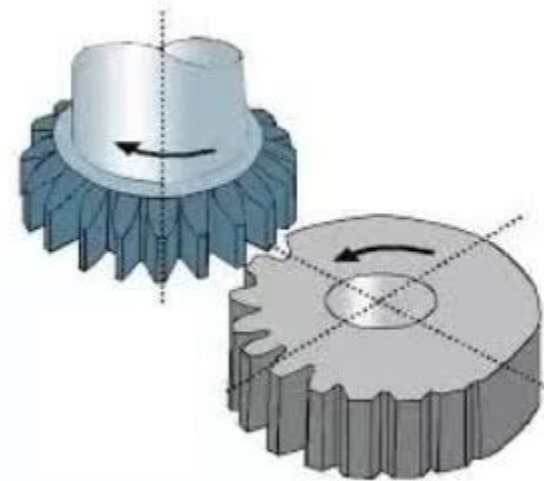
1. Due to continuous process of cutting and indexing and non-reciprocating motion of the hob, the hobbing process is faster as well as more accurate. The heat liberated during cutting is uniformly distributed on the cutter and the work; therefore the distortion of the gear tooth is never a problem with hobbing. Hobbing machines are much simpler and more rigid in construction because of few motions.
2. Shaping enjoys wide popularity for one simple reason that it can cut internal types of gear at a very fast rate. Because of shorter stroke of the cutter, it is possible to cut those gear which have flanges and shoulders in close proximity. A large number of identical and accurate teeth are difficult to manufacture on a shaper cutter,

Gear Finishing Methods

- i) Eliminating the after effects of heat treatment
- ii) Rectifying the tooth profile and the pitch
- iii) Maintaining the concentricity of the pitch circle and the central hole.

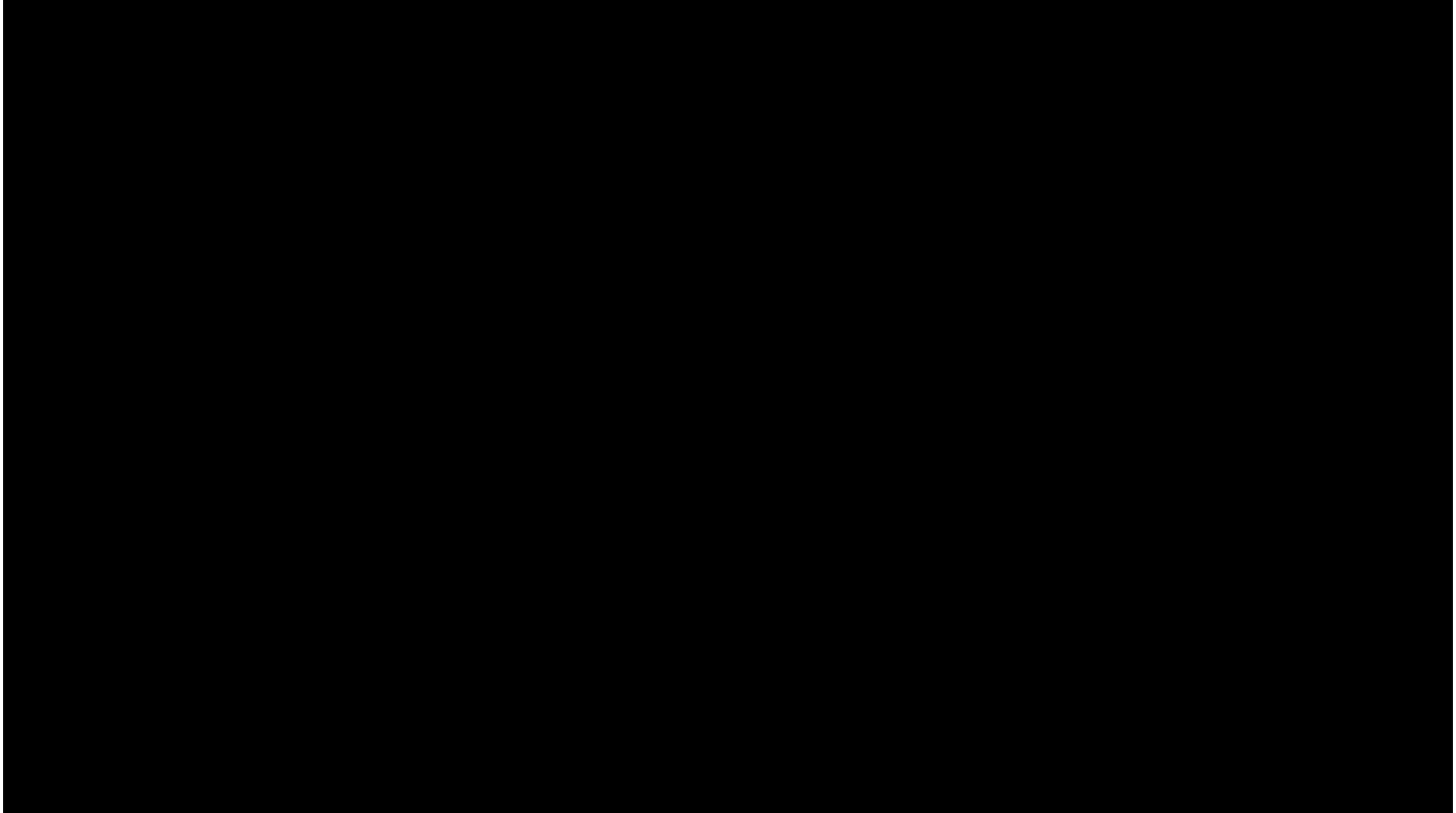
Gear burnishing

- i) Cold working process for unhardened gears
- ii) Standard and highly hardened gear is rolled around work gear.
- iii) Both rotate in perfect alignment
- iv) Not advisable for precision gears due to localized residual stresses.



Gear Finishing Methods

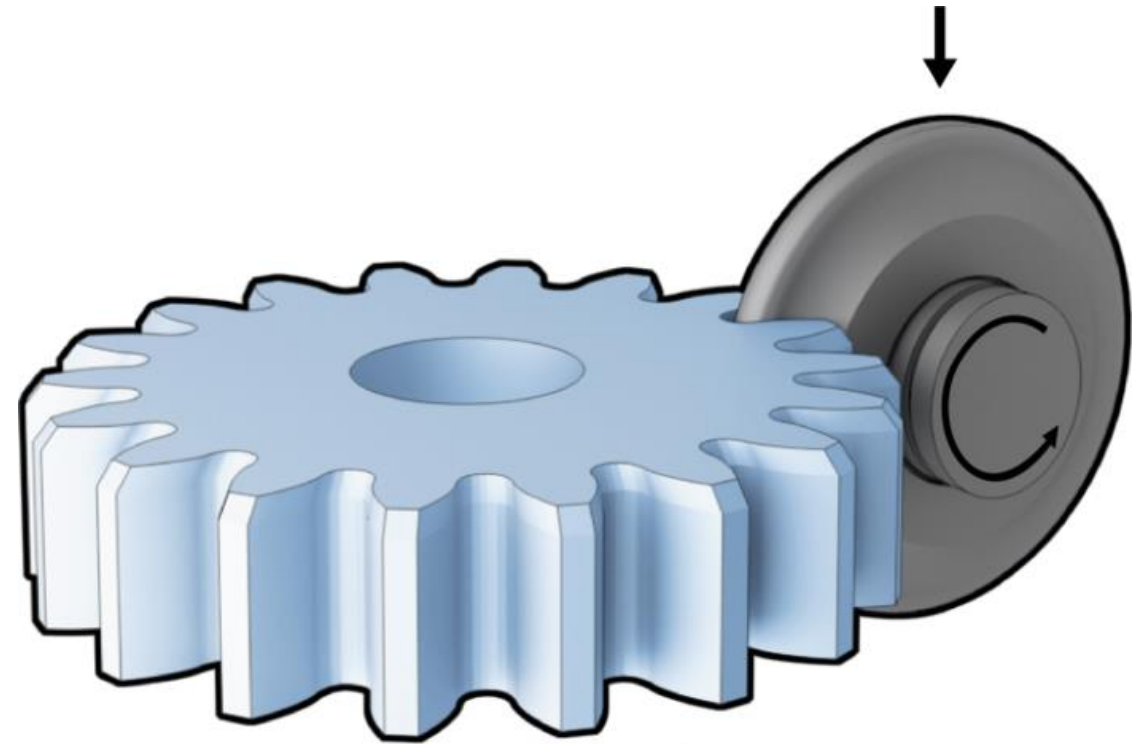
Gear burnishing



Gear Finishing Methods

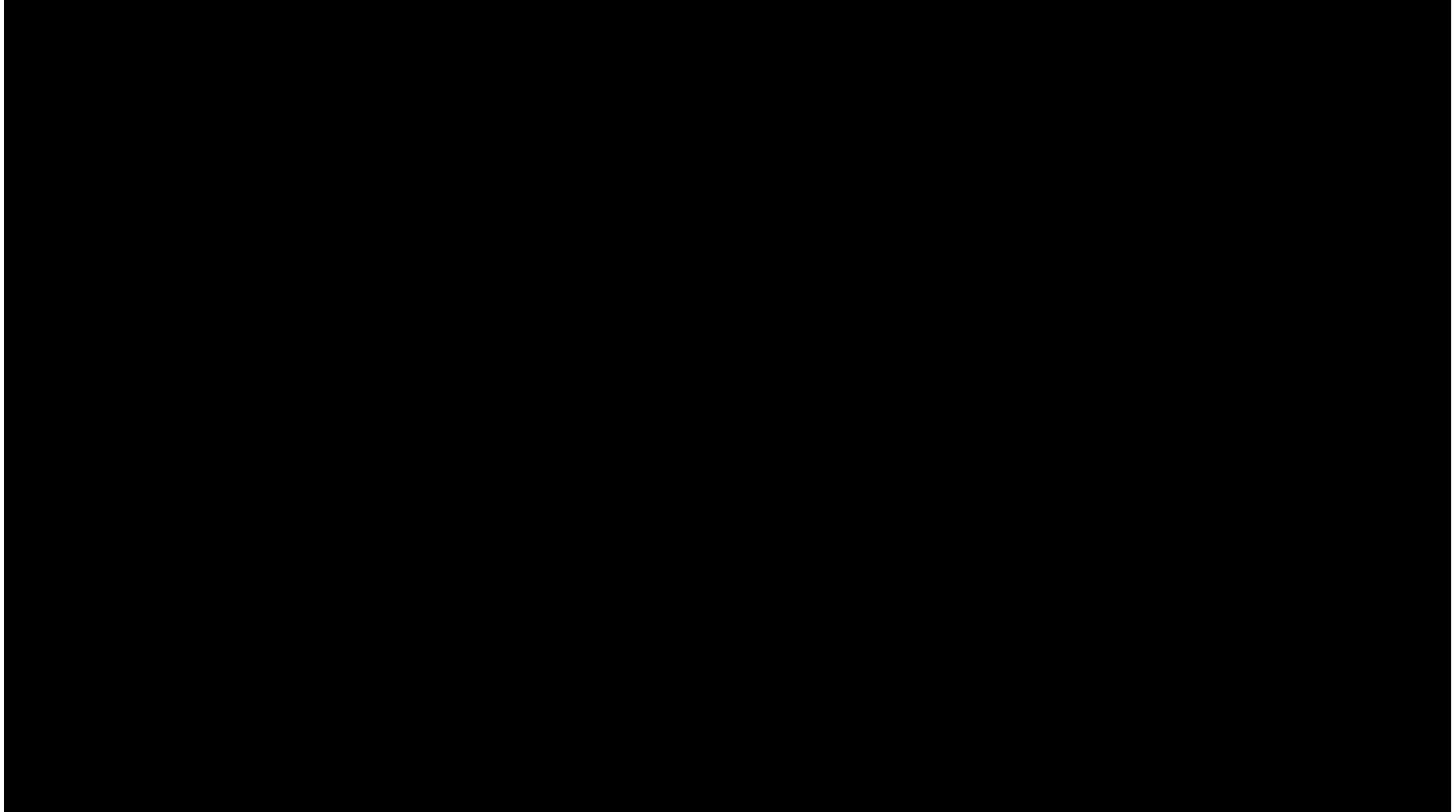
Gear grinding

- i) Used for hardened gears
- ii) Heat treatment may caused severe distortion and oxide film formed on teeth require removing of material.
- iii) Grinding method is used to finish the heat treated gears.
- iv) This is slower and expensive.
- v) Provide highest quality gears.



Gear Finishing Methods

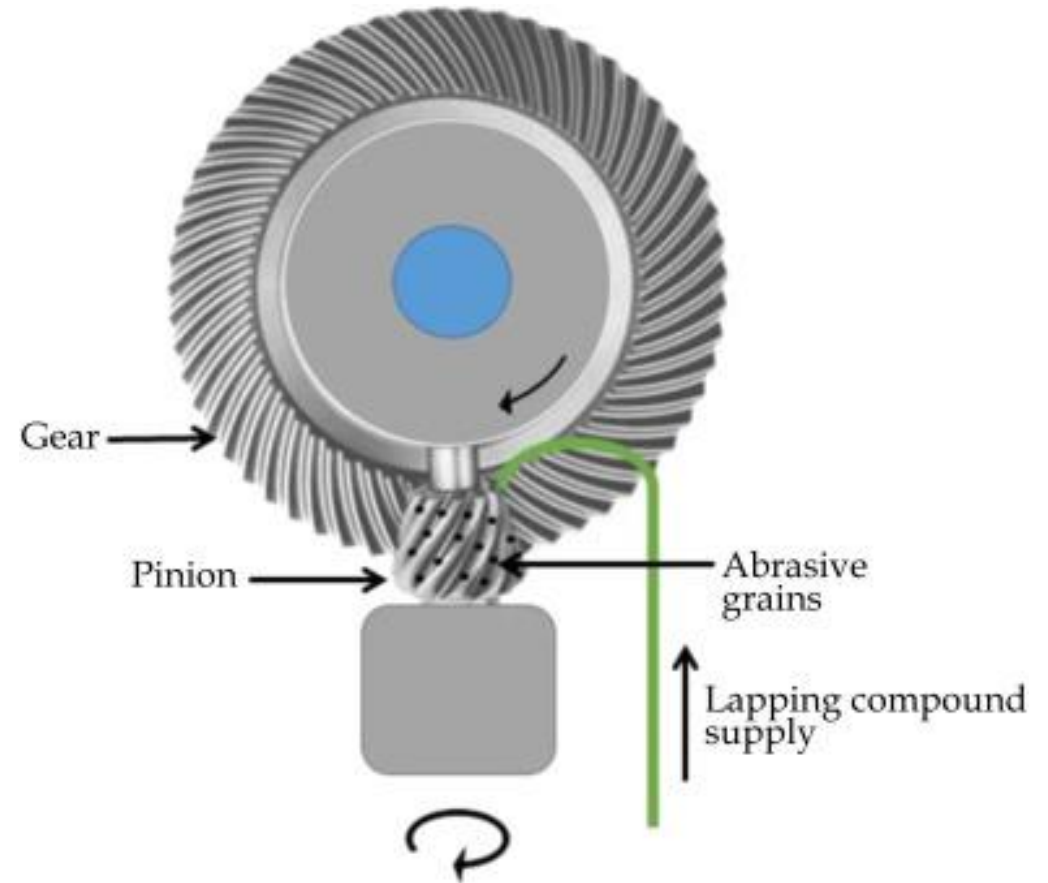
[Gear grinding](#)



Gear Finishing Methods

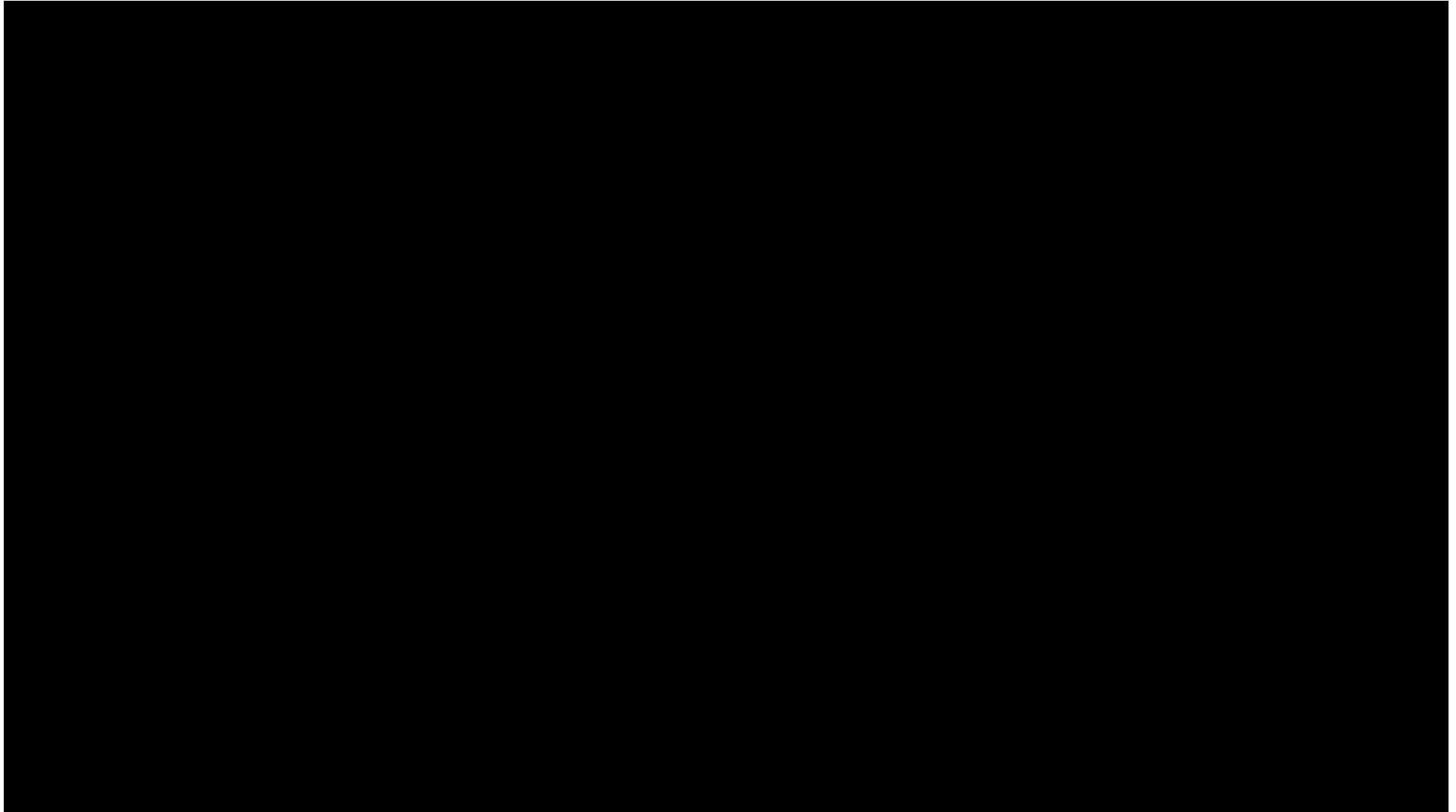
Gear Lapping

- i) Used to achieve very high degree of finish.
- ii) It is done after burnishing.
- iii) Performed with the help of **cast iron gears** which carry abrasives.
- iv) Cast iron gears are made to run in contact with the gear and a flow of very fine abrasive is maintained.
- v) Can correct small errors upto 0.05mm.



Gear Finishing Methods

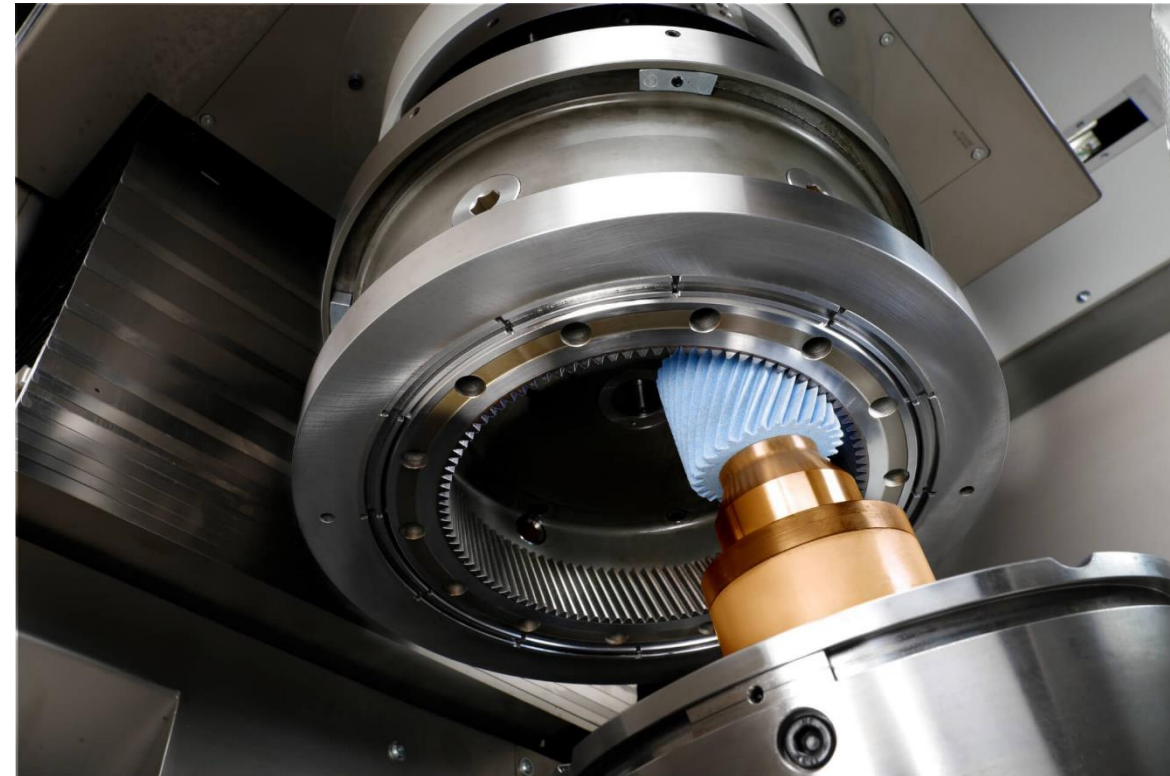
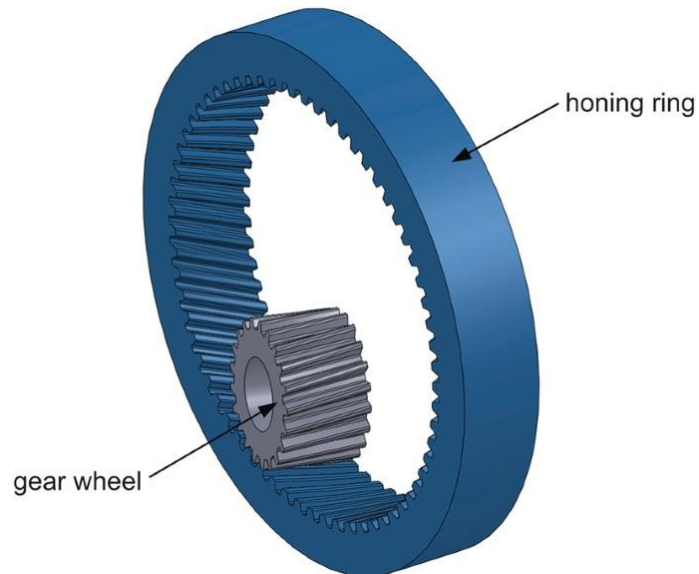
Gear Lapping



Gear Finishing Methods

Gear honing

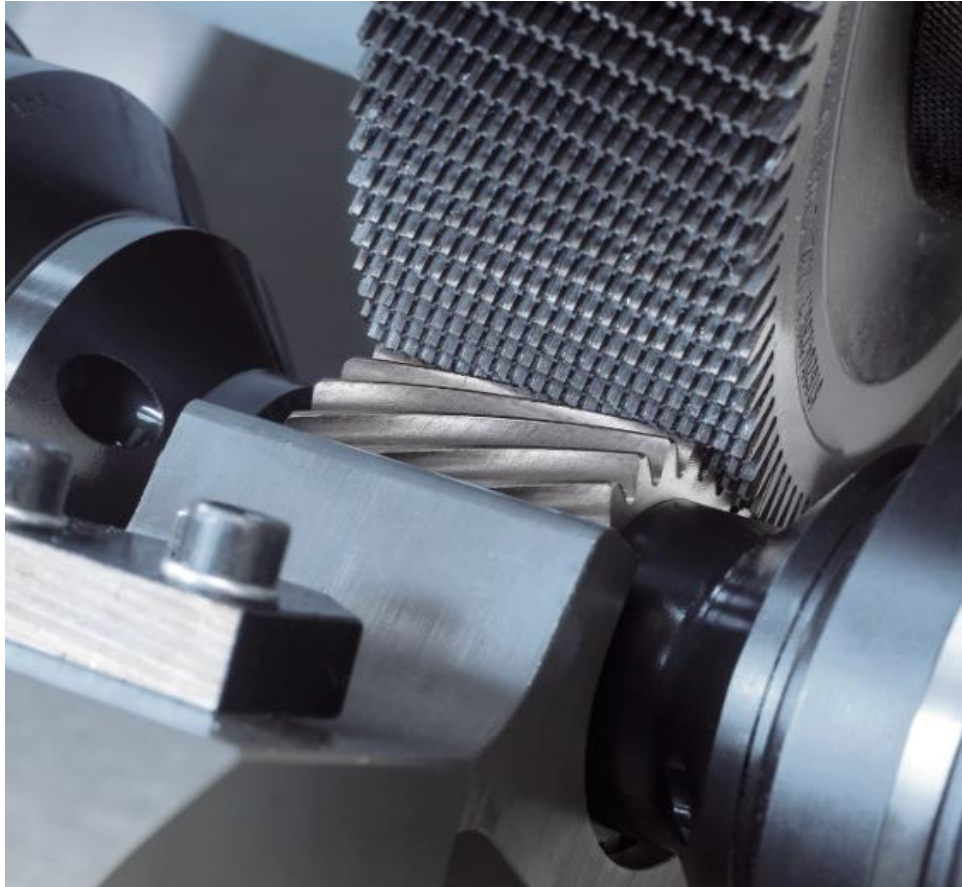
- i) Last operation performed on hardened gears
- ii) Also correct gear errors.
- iii) Remove minor nick and burrs and gives fine surface finish.
- iv) Helps in achieving low level of noise emission required in many application.
- v) Honing materials can be corundum, silicon carbide, cubic boron nitride, and diamond



Gear Finishing Methods

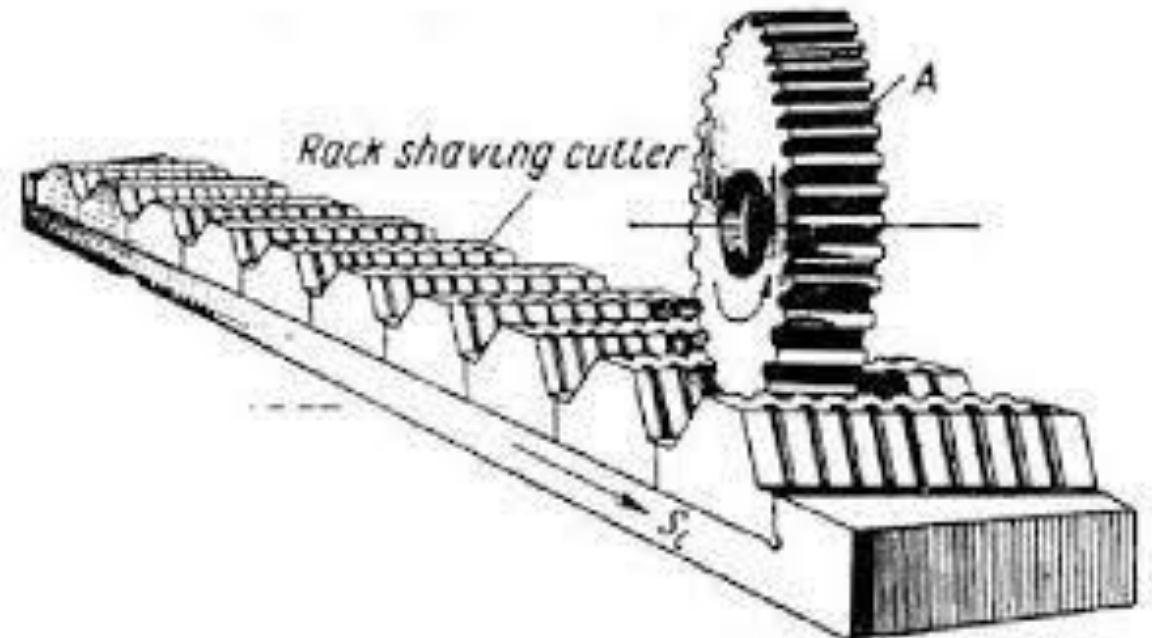
Rotary gear shaving method

- i) Extensively used method where a rotary shaving cutter meshes with a work gear.

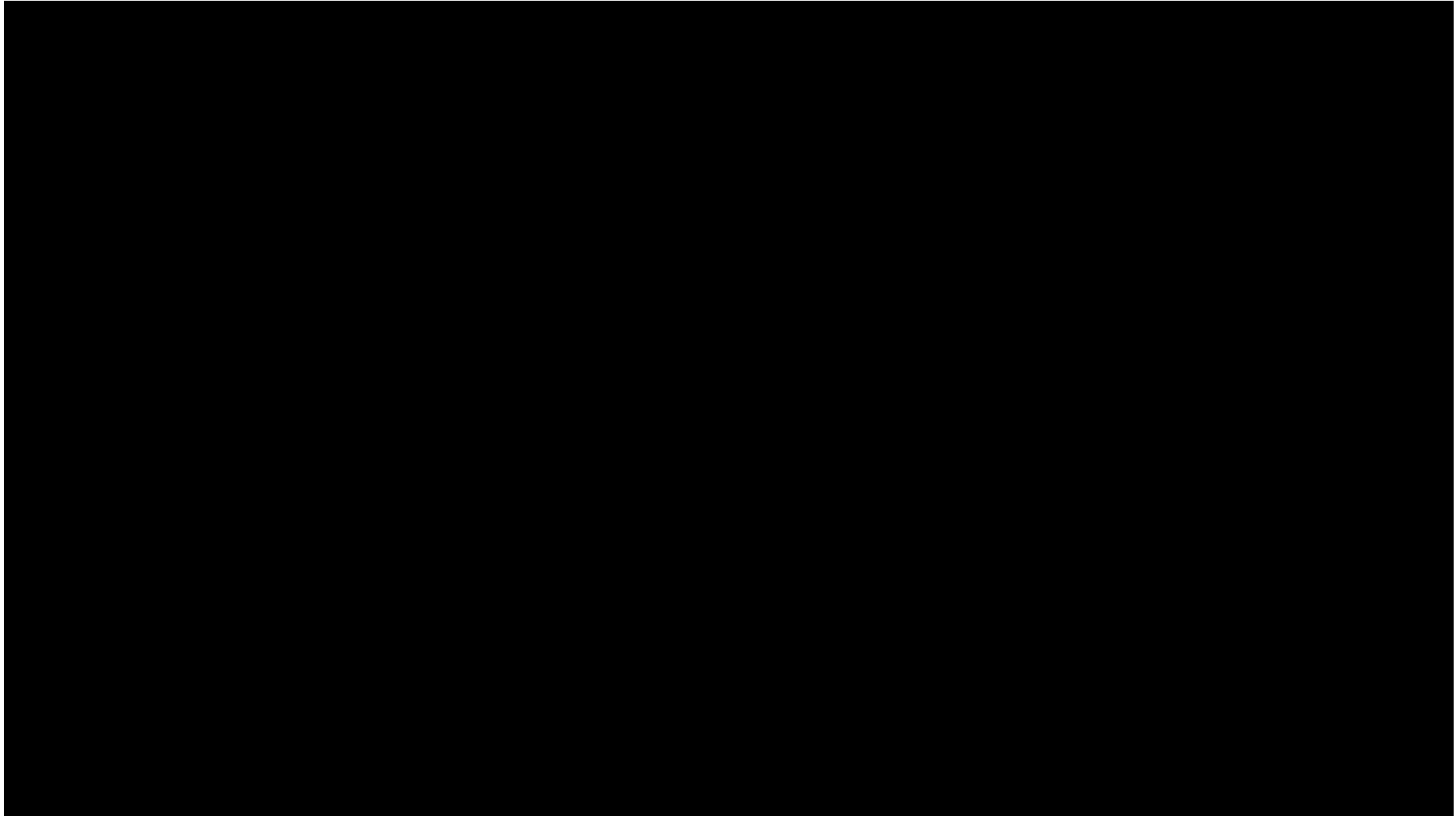


Rack gear shaving method

- i) Gear shaving is done by gear rolling on the rack type cutter.
- ii) Also reciprocates back and forth across the face of the cutter



Gear Finishing Methods



[link](#)

Comparison of rotary shaving with rack shaving methods

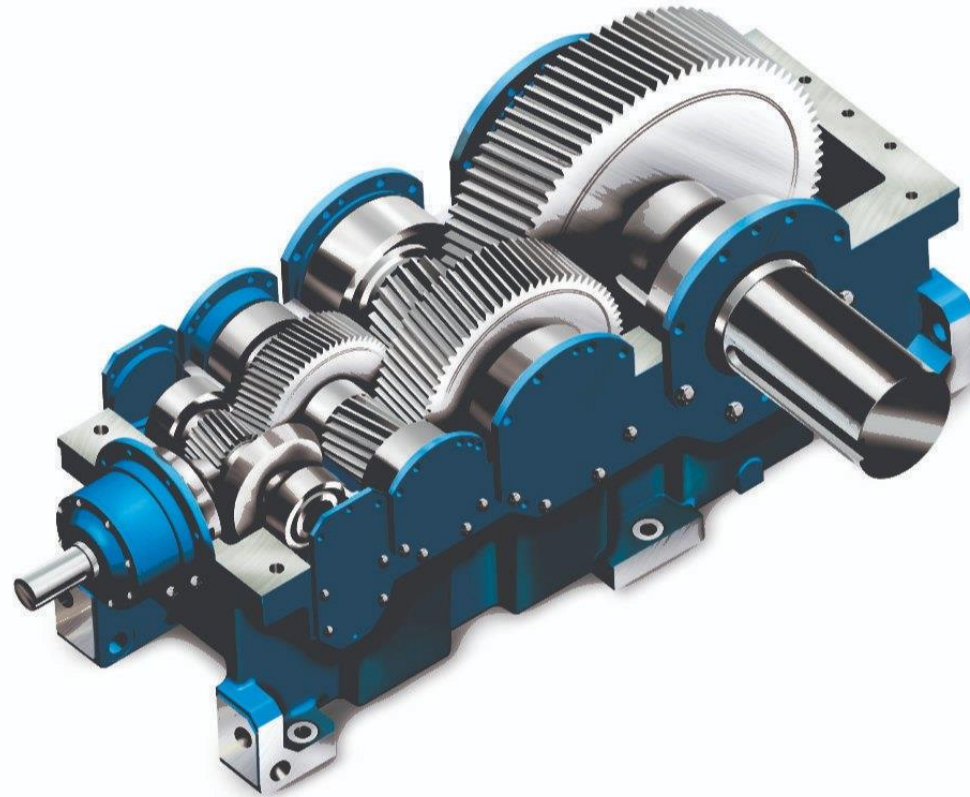
S. No.	Points	Rotary shaving method	Rack shaving methods
1.	Initial cost of cutter	It is less expensive.	It is more expensive.
2.	Design of machine	Machine design is simple and smaller in size.	Machine design is complex and larger in size.
3.	Chip disposal	Satisfactory	Unsatisfactory
4.	Scope	Shaves both external and internal spur and helical gears	Shaves only external type spur and helical gears
5.	Cost of grinding of tools	It has lower grindings cost of tool	It has higher grindings cost of tool
6.	Tool life	Low	high
7.	Tool replacement	Separate teeth of cutter cannot be replaced	Separate teeth of cutter can be replaced
8.	Machining allowance removal	0.10 to 0.20 mm	0.14 to 0.30 mm

Materials for Gears

Gears are made from metals and non-metals.

Metals

- Cast iron
- Cast steel
- Structure steel
- Gun metal and brass



Case Hardening: - Low carbon steel gear teeth are hardened by carburizing process

Flame Hardening: - High carbon steel gear teeth are hardened by heating with flames and quenched in water.

Materials for Gears

Non-Metals

- Synthetic plastics
- fibres
- laminated



Selection of material for a gear

- i) Peripheral speed required
- ii) Amount of power to be transmitted.
- iii) Size and weight of the drive.
- iv) Mode of drive i.e. continuous or intermittent
- v) Expected degree of accuracy.
- vi) Method of manufacture to be used
- vii) Resistance to wear and shock.
- viii) Permissible stresses
- ix) Type of drive i.e. open or enclosed.
- x) Service requirements i.e. a noiseless drive or light drive etc.

Please refer to your book for details

Sr. No.	Gear Type	Applications
1	Spur	Transmissions, Conveyor belts, Gear pumps, Bicycles, Washing machines
2	Helical	Automotive gearbox, Printing machine, factory automation
3	Herringbone	Heavy machinery such as coal cutter, aerospace engine
4	Worm and worm Wheel	Elevators and lifts, of road vehicles
5	Bevel Gear	Automotive differential
6	Rack and Pinion	Lifting mechanisms, shaper machine, Lathe
7	Hypoid Gear	Rear drive automobiles

Thank You