

GEAR MANUFACTURING METHODS: A REVIEW

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Abstract: Gear is an important element of mechanical power transmission. It is manufactured by many processes such as casting, milling, hobbing & shaping. Among this manufacturing milling is preferred for job production & hobbing is preferred for mass production. The gear manufacturing operations mostly perform on milling machine & CNC milling machines. In modern manufacturing high dimensional accuracy & fine surface finish play an important role. The grinding process is commonly used as finishing operation. The all gear manufacturing has its own importance. The main purpose of this paper is to give the literature survey on various gear manufacturing methods.

Keywords: Gears, Milling, Hobbing, Grinding.

I. INTRODUCTION

We know that the slipping of a belt or rope is a common phenomenon, in the transmission of motion or power between two shafts. The effect of slipping is to reduce the velocity ratio of the system. In precision machines like watch a definite velocity ratio is important. When the distance between the driver and follower is very small a gear drive is used. Gears are widely used in various mechanisms and devices to transmit power and motion positively (without slip) between parallel, intersecting (axis) and non-intersecting non parallel shafts.



FIG.SPUR GEAR

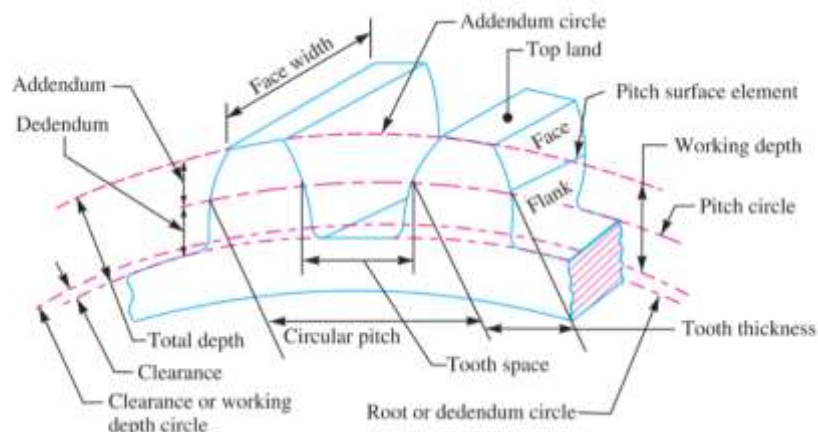


FIG.GEAR TERMINOLOGY

Terms used in Gears

- Pitch Circle: It is an imaginary circle which by pure rolling action, would give the same motion as the actual gear.
- Pitch Circle Diameter: It is the diameter of the pitch circle. The size of the gear is usually specified by the pitch circle diameter. It is also called as pitch diameter.

- Pitch Point: It is a common point of contact between two pitch circles.
- Pitch surface: It is the surface of the rolling discs which the meshing gears have replaced at the pitch circle.
- Pressure Angle or Angle of Obliquity: It is the angle between the common normal to two gear teeth at the point of contact & the common tangent at the pitch point. It is usually denoted by ϕ .
- Addendum: It is the radial distance of a tooth from the pitch circle to the top of the tooth.
- Dedendum: It is the radial distance of a tooth from the pitch circle to the bottom of the tooth.
- Addendum Circle: It is the circle drawn through the top of the teeth & is concentric with the pitch circle.
- Dedendum Circle: It is the circle drawn through the bottom of the teeth. It is also called root circle.
- Circular Pitch: It is the distance measured on the circumference of the pitch circle from a point of one tooth to the corresponding point on the next tooth. It is usually denoted by P_c .

II. GEAR CLASSIFICATION

Gears are used for following purpose according to type.

- Spur gear-sliding mesh gear box, machine tool gearbox.
- Helical gear- automobile gear box.
- Rack & pinion- lathe machine carriage, automobile steering gear box.
- Worm & worm wheel- wiper mechanism, material handling equipment’s gear box, steering gear box.
- Bevel gear- automobile differential gear box.
- Spiral gear-drives in textile machineries.

III. MATERIAL SELECTION

There are three factors that are most important when selecting a gear material. They are strength, durability, & cost, which include both the cost of the material & the cost of the manufacturing. Gears can be made of the following materials:

- Steel
- Brass
- Bronze
- Cast Iron
- Ductile Iron
- Aluminum
- Powdered Metals
- Plastics

Steel is the most common material overall. Steel is the most desirable because it offers a winning combination of high strength-to-weight-ratio, high resistance to wear the ability to enhance the physical properties through heat treatment & competitive pricing.

IV. BASIC MODES OF TOOTH FAILURE

Gear failures can occur in various modes. The gear failure is explained in flow diagram.

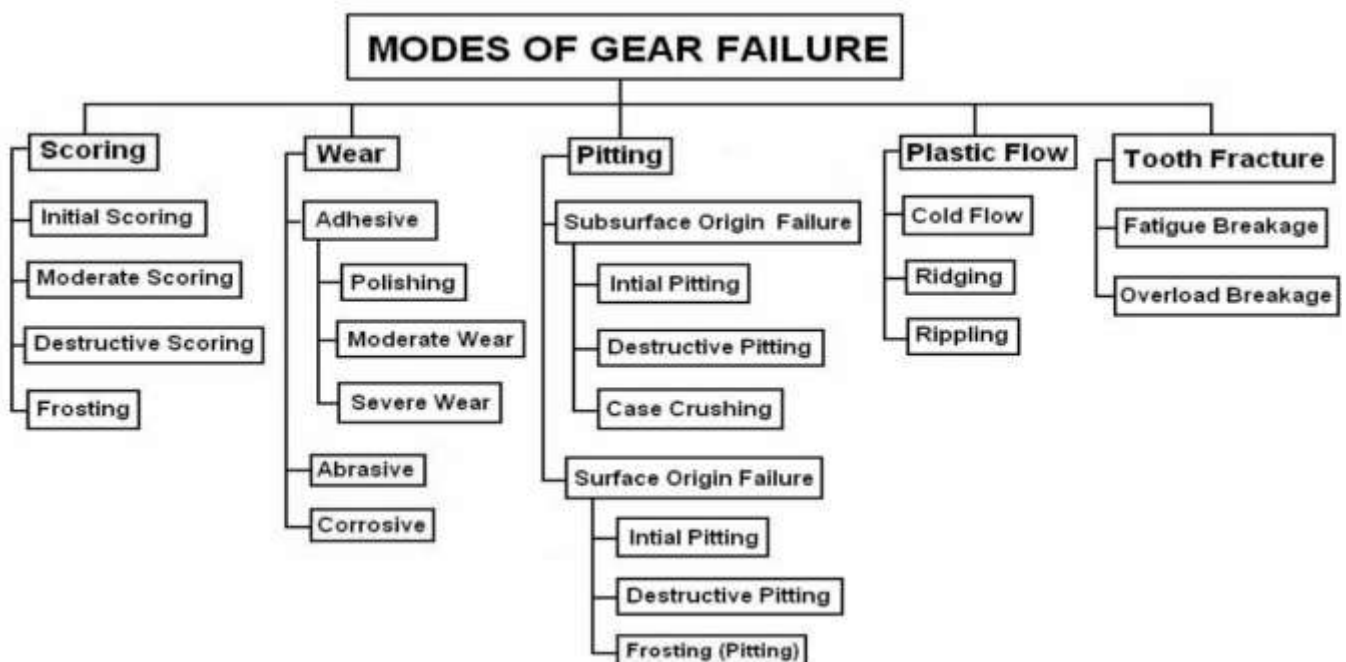


FIG.DIFFERENT MODES OF FAILURE

V. GEAR MANUFACTURING METHODS

Manufacturer of gears needs several processing operations in interval stages depending upon the material & type of the gears & quality desired. Those stages generally are:

- 1) Pre forming the blank with teeth or without teeth.
- 2) Annealing of blank, if required, as in case of forged or cast steels.
- 3) Preparation of the blank to the required dimensions by machining.
- 4) Full or surface hardening of the machined teeth if required.
- 5) Finishing teeth if required by shaving, grinding.

Various gear manufacturing methods are as follows:

1) Manufacturing of Gears by Rolling

The spline on the shaft is created by cold rolling of shaft between two circular dies. Such a small tooth thickness is difficult to achieve by other methods, therefore this type of method is suggested.

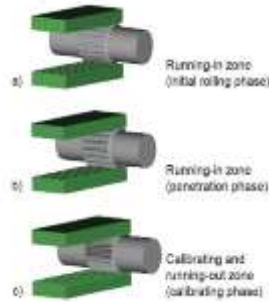


FIG.ROLLING PROCESS

2) Extrusion Process

Soft materials gears are done by extrusion process. It saves the heat treatment process. In extrusion a bar is extruded through a forming die and cavity shape. After coming out from cavity it achieves the shape of exact gear. After cutting this bar with required face width the gear form. Extrusion saves other operations hence it is suited for mass production.

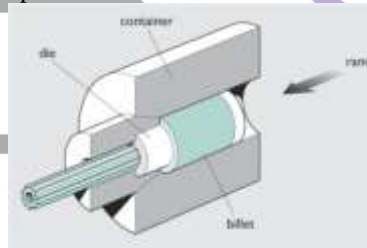


FIG.EXTRUSION PROCESS

3) Wire EDM

Instead of electrode thin copper or brass wire is used in wire cut EDM. In between work piece & wire potential difference is created. Due to this gap electric field gets created & gap breaks & current flows through & heat get generated. By using numerical control of table movement the shape of workpiece is controlled. In this way we get desired accurate & finished gear. For external & internal gears this method used.



FIG.WIRE CUT EDM

4) Form Milling

In this a cutter is mounted on arbor shaft making a right angle with work piece. For indexing movement of work piece indexing plate is provided. In single pass one tooth get finished, therefore it is time consuming process. It is also suitable for job production.

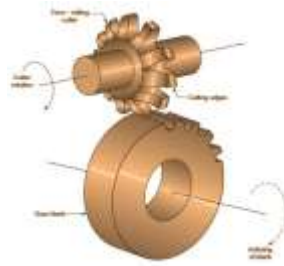


FIG.FORM MILLING PROCESS

5) **Hobbing**

In hobbing the hobbing tool is used. Hobbing tool also known as hob. Hob is rotated at suitable speed. Then it is feed into rotating gear blank. It is feeded up to required thickness. As compared to milling process it is fast hence it is suitable for mass production.

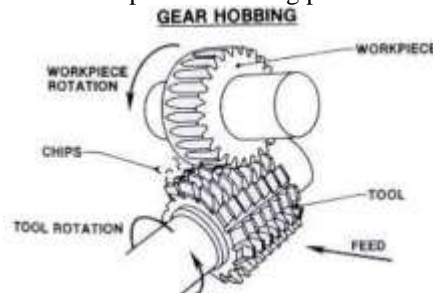


FIG.HOBGING PROCESS

6) **Shaping**

Cutter used in shaping is like a pinion. It is mounted vertically. It reciprocates up & down. During this movement of cutter workpiece is also rotated. This way the tooth profile gets generated on work piece. This method is useful for mass production & external as well as internal gears.

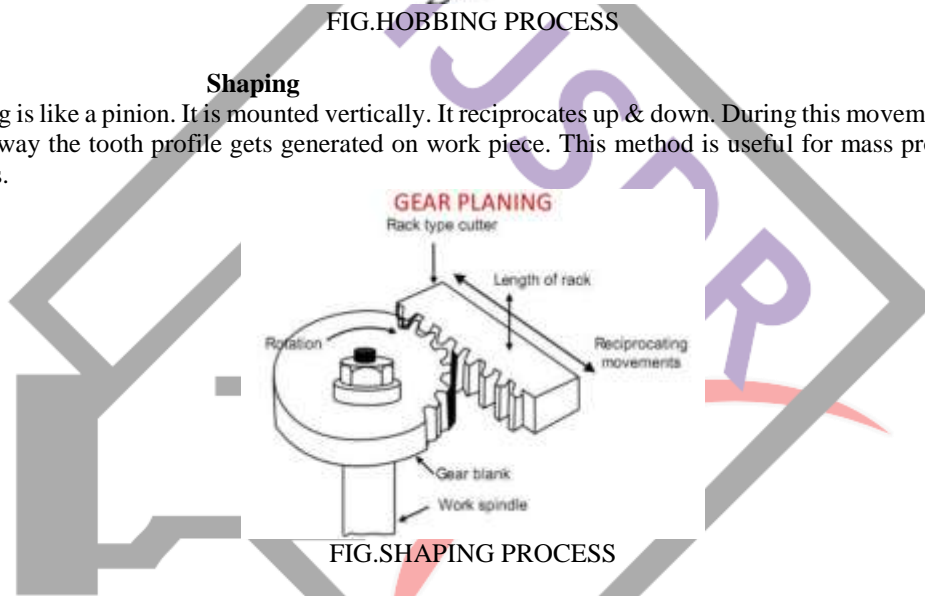


FIG.SHAPING PROCESS

VI.

CONCLUSION

Gear is an important element of mechanical power transmission. Through various research papers we had learnt the fundamentals of gear which consist of gear terminology, types of gears & use, various gear manufacturing methods, materials of gears, modes of tooth failure, etc. So through various research papers one can choose appropriate gear manufacturing method for particular application.

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