A Review on Gear Manufacturing Technology

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Abstract- *The most common use is in motor vehicles, where the transmission adapts the output of the internal combustion engine to the drive wheels. Such engines need to operate at a relatively high rotational speed, which is inappropriate for starting, stopping, and slower travel. The transmission reduces the higher engine speed to the slower wheel speed, increasing torque in the process. Transmissions are also used on pedal bicycles, fixed machines, and anywhere else where rotational speed and torque needs to be adapted. Due to the increasing demands concerning resource-efficient manufacturing processes, the aspect of material savings becomes more and more important. In comparison with cutting operations, the use of forming processes offers the chance to achieve significant saving effects. To understand heat treating, a basic knowledge of metallurgy is needed. Iron, when combined with small percentages of carbon, forms steel.*

Keywords- Hobbing, Chamfering, Shaping, Shaving, Hardening.

I. INTRODUCTION

A gear is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part in order to transmit torque. Two or more gears working in tandem are called a transmission and can produce a mechanical advantage through a gear ratio and thus may be considered a simple machine. Geared devices can change the speed, torque, and direction of a power source. The most common situation is for a gear to mesh with another gear, however a gear can also mesh a non-rotating toothed part, called a rack, thereby producing translation instead of rotation. When two gears of unequal number of teeth are combined a mechanical advantage is produced, with both the rotational speeds and the torques of the two gears differing in a simple relationship. In transmissions which offer multiple gear ratios, such as bicycles and cars, the term gear, as in first gear, refers to a gear ratio rather than an actual physical gear. The term is used to describe similar devices even when gear ratio is continuous rather than discrete, or when the device does not actually contain any gears, as in a continuously variable transmission. When two meshing gears transmitting rotational motion. Note that the smaller gear is rotating faster. Although the larger gear is rotating less quickly, & the torque of larger gear is proportionally greater.

Different types of gears are as follows:

1. Spur Gears
2. Helical Gears
3. Bevel Gears
4. Worm Gears
5. Spiral Gear

PROCESS:-

HOBBING:-

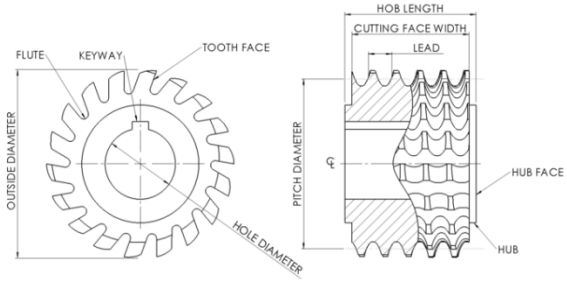
Hobbing is a machining process for making gears, splines, and sprockets on a *hobbing machine*, which is a special type of milling machine. The teeth or splines are progressively cut into the work piece by a series of cuts made by a cutting tool called a *hob*. Compared to other gear forming processes it is relatively inexpensive but still quite accurate, thus it is used for a broad range of parts and quantities. It is the most widely used gear cutting process for creating spur and helical gears and more gears are cut by hobbing than any other process since it is relatively quick and inexpensive

The *hob* is the cutter used to cut the teeth into the workpiece. It is cylindrical in shape with helical cutting teeth. These teeth have grooves that run the length of the hob, which aid in cutting and chip removal. There are also special hobs designed for special gears such as the spline and sprocket gears. The cross-sectional shape of the hob teeth are almost the same shape as teeth of a rack gear that would be used with the finished product. There are slight changes to the shape for generating purposes, such as extending the hob's tooth length to create a clearance in the gear's roots. Each hob tooth is relieved on the back side to reduce friction. Most hobs are single-thread hobs, but double-, and triple-thread hobs increase production rates. The downside is that they are not as

accurate as single-thread hobs. Depending on type of gear teeth to be cut, there are custom made hobs and general purpose hobs. Custom made hobs are different from other hobs as they are suited to make gears with modified tooth profile. The tooth profile is modified to add strength and reduce size and noise of gears.

This list outlines types of hobs:

- Roller chain sprocket hobs
- Worm wheel hobs
- Spline hobs
- Chamfer hobs
- Spur and helical gear hobs
- Straight side spline hobs
- Involute spline hobs
- Serration hobs
- Semi-topping gear hobs

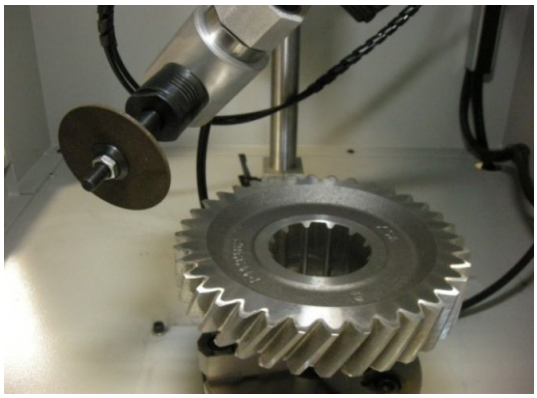


Hobbing is used to make following types of finished goods:

- Cycloid gears
- Helical gears
- Involute gears
- Ratchets
- Splines
- Sprockets
- Spur gears
- Worm gears

Hobbing is used to produce most throated worm wheels, but certain tooth profiles cannot be hobbled. If any portion of the hob profile is perpendicular to the axis then it will have no cutting clearance generated by the usual backing off process, and it will not cut well.

CHAMFERING:-

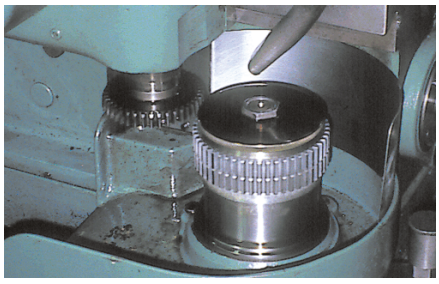


Chamfering is the process in which the tool fitted with a grinding tool is just rubbed against the surface of the work piece. There can be many types of chamfering tool depending on the suitable conditions.

Chamfering considerably reduces the risk of accidents by the burr which project out after the chamfering. This projection could cause were and tear on the operators or workers palm. Chamfering also reduces the sharp corners of the work piece and makes it a perfect for a smooth engagement of the gears.

SHAPING :-

A gear shaper is a machine tool for cutting the teeth of internal or external gears. The name shaper relates to the fact that the cutter engages the part on the forward stroke and pulls away from the part on the return stroke, just like the clapper box on a planer shaper.



The cutting tool is also gear shaped having the same pitch as the gear to be cut. However number of cutting teeth must be less than that of the gear to be cut for internal gears. For external gears the number of teeth on the cutter is limited only by the size of the shaping machine. For larger gears the blank is usually gashed to the rough shape to make shaping easier.

The principal motions involved in rotary gear shaper cutting are of the following :

1. **Cutting Motion:** The downward linear motion of the cutter spindle together with the cutter .
2. **Return Stroke:** The upward linear travel of the spindle and cutter to withdraw the latter to its starting position.
3. **Indexing Motion:** Slow speed continuous rotation of the cutter spindle and work spindle to provide circular feed, the two speeds being regulated through the change gears such that against each rotation of the cutter the gear blank revolves through n/N revolution, where "n" is the number of teeth of the cutter, and "N" is the number of teeth to be cut on the blank.
4. **Completion of Cutting Operation:** The indexing and reciprocating motions continue until the required number of teeth to the required depth is cut all along the periphery of the gear blank.

Shaving:-

Gear shaving is basically a finishing operation. This takes place after the operations of roughing with a hob or cutting with a shaper cutter is over. The Shaving process consists of the removal of tiny particles of metal from a gear teeth's working surface. Gear shaving produces fine hair like chips. The cutter comes in the form of helical gear. It has special serrations in the flank area of gear teeth. These serrations act as the cutting edges.

Advantages

Gear Shaving gives the gear the following advantages:

- Improves tooth surface finish.
- Eliminates, the problem of tooth end load concentrations.
- Effective reduction in the noise of gears with modification in the tooth profile.
- Increase the gear's load capacity Improved safety and service life.

Induction Hardening

Induction hardening is a form of heat treatment in which a metal part is heated by induction heating and then quenched.

The quenched metal undergoes a martensitic transformation, increasing the hardness and brittleness of the part. Induction hardening is used to selectively harden areas of a part or assembly without affecting the properties of the part as a whole.

II. PRINCIPLE

Induction heating is a non contact heating process which utilizes the principle of electromagnetic induction to produce heat inside the surface layer of a work-piece. By placing a conductive material into a strong alternating magnetic field, electrical current can be made to flow in the material thereby creating heat due to the I^2R losses in the material. In magnetic materials, further heat is generated below the Curie point due to hysteresis losses. The current generated flows predominantly in the surface layer, the depth of this layer being dictated by the frequency of the alternating field, the surface power density, the permeability of the material, the heat time and the diameter of the bar or material thickness. By quenching this heated layer in water, oil or a polymer based quench the surface layer is altered to form a martensitic structure which is harder than the base metal.

Procedure

- Select master gear or gear shaft (reference from setting parameter chart).
- Noise testing m/c to be set to specified centre distance ref. from setting parameter chart.
- Select and fix the dogs for master gear & gear to be tested (reference from setting parameter chart).
- Select mandrel for master gear and gear to be selected (reference from setting parameter chart).
- Adjust the tail stock of machine for master gear mandrel or gear shaft to be tested so as to accumulate the same.

Following steps are to be followed-

  - Loosen the champing screw
  - Move test of to suitable distance
  - Tighten the clamp screw
- Load master gear on mandrel and put it between centers of driven spindle, if master is gear shaft put it between centers of driven spindle.
- Start the machine & adjust the rpm.
- Start the machine for L.H. rotation and hear noise. In case of abnormal noise, check for high spots for

damages and remove the same with help of triangular oil stone and retest.

- Follow same procedure from above .
- Gear which are acceptable for noise to be identified with noise plane.

III. CONCLUSION

A variety of heat treatment techniques exist for case hardening gears. Heat treatment processes can be tailored to maximize the life and optimize the performance of a gear in its service application by tailoring the heat treatment to produce specific desired properties. Distortion is always a factor in heat treatment processes, but it can be controlled and minimized by selecting specific processing parameters, being knowledgeable about fixturing, using different types of case hardening processes, and taking extra steps to ensure the gears have minimal stresses present in them prior to heat treatment that could be relieved. No one heat treat process is superior to the other, but ultimately they all compliment each other. Having an understanding of the processes available will help you choose which process is appropriate for your gear.

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