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Design, Manufacturing and Analysis of Transmission Device Cutting Tools for Automobiles.

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ABSTRACT

Transmission devices of automobiles are Gears. It will transmit the power from one shaft to another for automobiles. It can be manufactured by form and machining process. This project deals with the gear manufacturing by machining process of gear hobbing. Hob is a gear cutting tool can be designed by gear attributes of module, pressure angle, helix angle etc and Stage wise operations are involved in manufacturing of a hob from raw material cutting to finish grinded gear hob with précised inspection. Hob teeth are shaped to match the tooth space and are interrupted with grooves to provide cutting surfaces. It rotates about an axis normal to that of the gear blank. It is the most accurate of the roughing process since no repositioning of tool or blank is required and each tooth is cut by multiple hob teeth averaging out any tool errors. Excellent surface finish is achieved by this method. Inspection can be performed by measuring instruments and P26 machine. This project mainly discussed about increasing mass production of gears with less time and wear by changing design and material of gear hob.

KEYWORDS: Design changes of gear hob, selection of cutting tools material.

I.INTRODUCTION

Gear hobbing is a generating process. The term generating refers to the fact that the gear tooth form cut is not the conjugate form of the cutting tool, the hob. During hobbing both the hob and the work piece rotate in a continuous rotational relationship. During this rotation, the hob is typically fed axially with all the teeth being gradually formed as the tool traverses the work face. For a spur gear being cut with a single start hob, the work piece will advance one tooth for each revolution of the cutter. When hobbing a twenty-tooth gear, hob will rotate twenty times, while the work piece will rotate once. The profile is formed by the equally spaced cutting edges around the hob, each taking successive cuts on the work piece. It is shown in figure 1.1

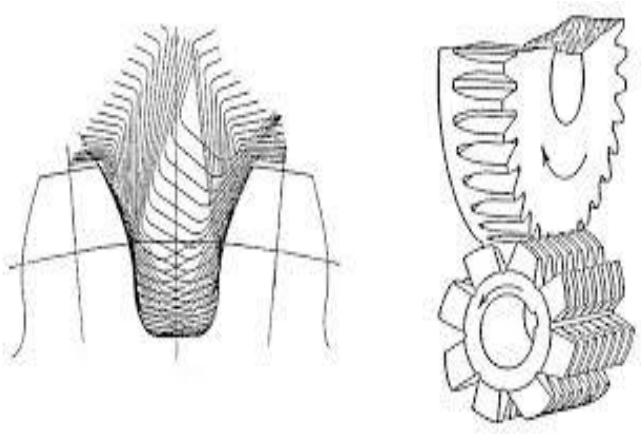

Figure 1.1 Gear hobbing

In this gear hobbing process, the gear blank is rolled with a rotating cutter called hob. Gear hobbing is done by using a multipoint cutting tool called gear hob. It looks like a worm gear having a number of straight flutes all around its periphery parallel to its axis. These flutes are so shaped by giving proper angles to them so that these work as cutting edges. In gear hobbing operation, the hob is rotated at a suitable rpm and simultaneously fed to the gear blank. The gear blank is also kept as revolving. Rpm of both, gear blank and gear hob are so synchronized that for each revolution of gear bob the gear blank rotates by a distance equal to one pitch distance of the gear to be cut. Motion of both gear blank and hob are maintained continuously and steady.

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Gear specifications

Consider a gear parameters are used to design the gear hob accordingly as shown in figure 1.2. The parameters are

MODULE:4.23333

PRESSURE ANGLE:20^0

NO.OF TEETH:47

HELIX ANGLE: 0^0

HAND OF HELIX: SPUR

O.D:205.35

B.C.D:186.9675

FACE WIDTH: 23.75

CLASS OF ACCURACY: 'AA'

PROFILE OF GEAR HOB: SEMITOPPING WITH PROTUBERANCE.

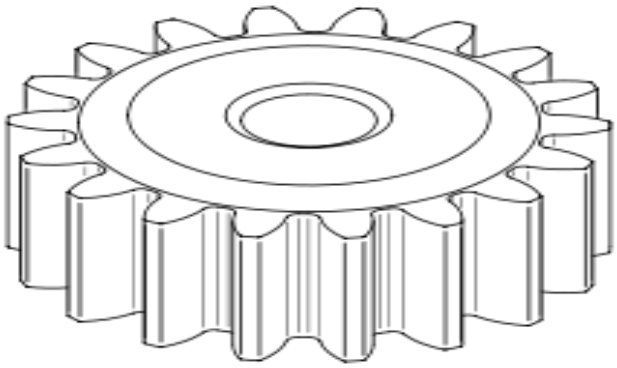

Figure 1.2. spur gear

BASIC GEAR HOB AND ITS PRODUCTION ANALYSIS:

Hob teeth are shaped to match the tooth space and are interrupted with grooves to provide cutting surfaces. It rotates about an axis normal to that of the gear blank, cutting into the rotating blank to generate the teeth.

Gear hobbing, the gear blank is rolled with a rotating cutter called hob. Gear hobbing is done by using a multipoint cutting tool called gear hob. It looks like a worm gear having a number of straight flutes all around its periphery parallel to its axis. These flutes are so shaped by giving proper angles to them so that these work as cutting edges. In gear hobbing operation, the hob is rotated at a suitable rpm and simultaneously fed to the gear blank. The gear blank is also kept as revolving. Rpm of both, gear blank and gear hob are so synchronized that for each revolution of gear bob the gear blank rotates by a distance equal to one pitch distance of the gear to be cut. Motion of both gear blank and hob are maintained continuously and steady. A gear hob is shown in Figure 1.3 and the process of gear hobbing is illustrated in Figure 1.4. The hob teeth behave like screw threads, having a definite helix angle. During operation the hob is tilted to helix angle so that its cutting edges remain square with the gear blank. Gear hobbing is used for making a wide variety of gears like spur gear, helical, hearing-bone, splines and gear sprockets, etc.

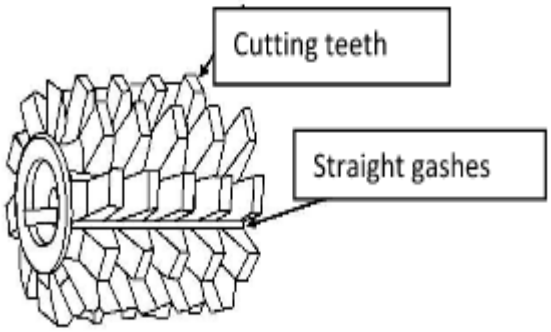

Figure 1.3 : Gear Hob

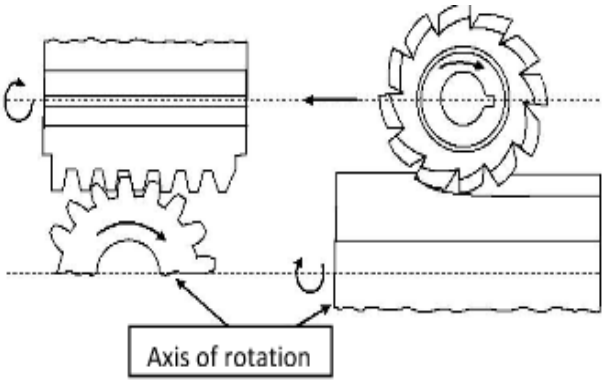

Figure 1.4 : Process of Gear Hobbing

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Design calculations for gear hob:

Gear parametrs are used to design the gear hob

Hob attributes:

OD:85

LENGTH:180

BORE:32

NORMAL MODULE: 4.33333

NORMAL PRESSURE ANGLE: 20^0

PITCH CIRCLE DIAMETER:77.658631

NORMAL PITCH: 13.10384214

LEAD:26.36021438

HELIX ANGLE OF THREAD: $6^0 10'$

NUMBER OF STARTS: TWO

HAND OF THREAD:RH

GASH LEAD:∞

NUMBER OF GASHES: 10

CAM VALUE RG: 5

TOTAL TOOTH HEIGHT: 15

MATERIAL:M35

RESULTS:

Gear hobbing, is the process of manufacturing gears. First we used M35 hob for production analysis.

The parameters of gear production:

Diameter of gear=205.35mm

Face width of gear=23.75mm

Speed=600rpm

Feed=1.8mm

Cycle time/gear=103seconds

Wear=0.3, it had blunt after 450pieces

By observing this hobbing process, points to be noted as

1. Wear amount of 0.3mm for 450 manufacturing of gears.
2. Cycle time/gear=103seconds

To reduce these two parameters can improve the mass production. Desired changes to be made for gear hob.

1. Wear, is related to material of gear hob, gear hob material to be changed to S290 compared to tough with M35.
2. Cycle time, the material removal rate of each cutting edge to minimized to increase the gashes of gear hob.

Table 1.5 modification parameters for gear hob:

	OD(Ø, mm)	LENGTH (mm)	BORE(Ø, mm)	NO.OF GASHES	NO.OF STARTS
M35	85	180	32	10	TWO
S290	85	180	32	14	TWO

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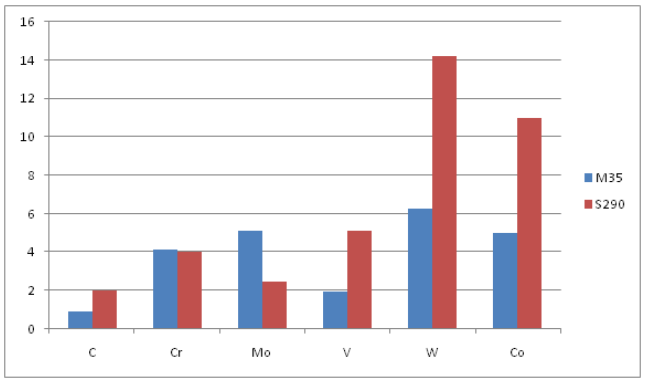
Table 1.6 Comparison of M35 & S290 Material compositions



- Again we manufactured the gear hob by modified data(material and no.of gahses)
- Actual gear hob to be considered as m35 hob and modified hob to be considered as s290 hob.
- **Design changes are to be made:**
- OD:85
- LENGTH:180
- BORE:32
- NORMAL MODULE: 4.33333
- NORMAL PRESSURE ANGLE: 20^0
- PITCH CIRCLE DIAMETER:77.658631
- NORMAL PITCH: 13.10384214
- LEAD:26.36021438
- HELIX ANGLE OF THREAD: $6^0 10'$
- NUMBER OF STARTS: TWO
- HAND OF THREAD:RH
- GASH LEAD:∞
- NUMBER OF GASHES: 14
- CAM VALUE RG: 4
- TOTAL TOOTH HEIGHT: 14
- MATERIAL: S290

With the same speed and feed of m35 hob to be used for S290 hob and the results are.

Outer diameter of gear hob=85mm

Length of gear hob=180mm

No.of gashes =14

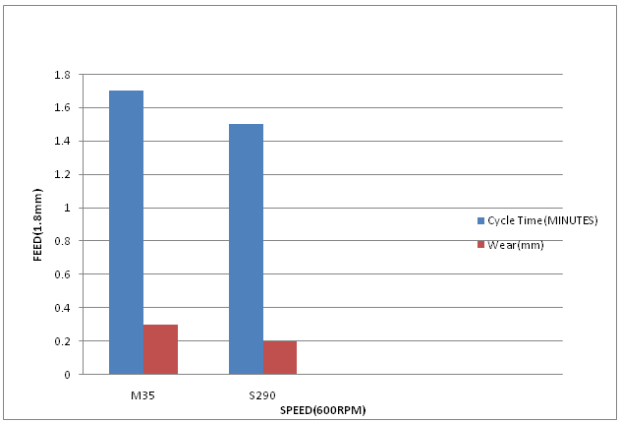
Material=S290

Speed=600rpm

Feed= 1.8mm

Cycle time/gear=80seconds

Wear=0.2, it had blunt after 800pieces



CONCLUSION:

M35 gear hob, 0.3mm will blunt by manufacturing of 450 gears. In order to reduce the wear amount we shifted to powder metallurgy of S290 material. It posses high toughness compared to M35 material.

Cycle time of gear, Material removal rate on each cutting edge can be increased by increasing the no. of gashes in gear hob.

S290 hob with same speed and feed,

1. Cycle time/gear=80seconds

2. Wear=0.2, it had blunt after 800pieces.

For mass production of gears S290hob to be used.

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ISSN No: 2348-4845
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