The Analysis and Modification of Spur Gear Design

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Abstract— This application are explain the design the spur gear and dimension specification. Its have a involving morden design, specific character, specific materials, with consideration of analysis of force, and its mechanical properties. These approach for morden spur gear design developing the tooth profils with modified the shape and improving the dimension. The main purpose of morden sper gear design it increases the power transmitting capacity and also improves the efficiency of power transmission.
Key words: Uneven illumination, Contrast enhancement

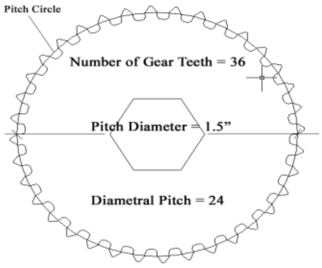

Fig. a: pitch diameter

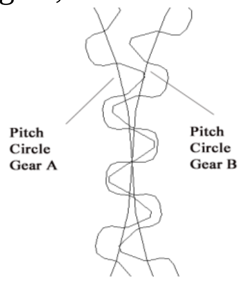

Fig. b: pitch circle

I. INTRODUCTION

This gear can be meshed together correctly only if they are fitted to parallel safts. The main reason for the popularity of spur gear is their simplicity in design and manufacturing. The two parameter i.e. Tip radius and in tooth widths which play a key role gear design are studied. [1]

A gear is a rotating machine part having cut teeth. which is meshing the gear teeth to transmit the torque. A geared device can be change the speed, direction of power sources and magnitude.[2] The tooth meshing on another gear of non roteting parts is called rack. When it a rotation it provide transmission in analogous to the wheels in pulley. It is the cylindrical shaped its teeth are parallel in axis. Its wide range of application most commonly used. [3]

A. Design of Spur Gear:

In order to design, build and discuss gear drive systems it is necessary to understand the terminology and concepts associated with gear systems.

B. Diametral Pitch (DP):

The gear tooth size is described by Diametral Pitch larger gear have fewer teeth per inch of diametral pitch, diametral pitch is inversely gear teeth size.

C. Pitch Diameter:

The pitch diameter is indicated the diameter of the pitch circle. If the diameter of the gear pitches is known pitch diameter.
We can mathematically expression;
$PD=N/P$
PD=pitch diameter
N= number of teeth on the gear
P=Diametral pitch (gear size)

D. Pitch Circle:

The pitch circle is the geometry.it is a imaginary circle through contact the circle of two pitch of the gear. The center of pitch circle meshing by center to center distance.

II. SOME IMPORTANT DEFINITION PARAMETER:

A. Pitch Diameter (D):

The diameter of the pitch circle from which the gear is designed. An imaginary circle, which will contact the pitch circle of another gear when in mesh.

$$D=N/P$$

B. Diametral Pitch (P):

A ratio of the number of teeth per inch of pitch diameter

$$P=N/D$$

C. Addendum (A):

The radial distance from the pitch circle to the top of the gear tooth

$$A=1/P$$

D. Dedendum (B):

The radial distance from the pitch circle to the bottom of the tooth

$$B=1.157/p$$

E. Outer diameter (OD):

The overall diameter of the gear:

$$OD= (N+2)/P$$

F. Root diameter (RD):

The diameter at the bottom of the tooth

$$RD= (N-2)/P$$

G. Base circle (BC):

The circle used to from the involute section of the gear tooth.

$$BC=D*CosPA$$

H. Circle Pitch (CP):

The measured distance along the circumference of the pitch diameter from the point of one tooth to the corresponding point on an adjacent tooth

$$CP=3.1416/P$$

I. Circular Thickness (T):

Thickness of a tooth measure along the circumference of the pitch circle

$$T=1.57/P$$

J. Clearance (C):

Refer to the radial distance between the top and bottom of gears in mesh some mechanism,. In other word the gap between two distances is known as clearance.

K. Whole depth (WD):

The distance from the top of the tooth to the bottom of the tooth the whole death is calculated by

$$WD = 2.157/P$$

L. Pressure angle (PA):

It refers to the angle through which forces are transmitted between meshing gears.

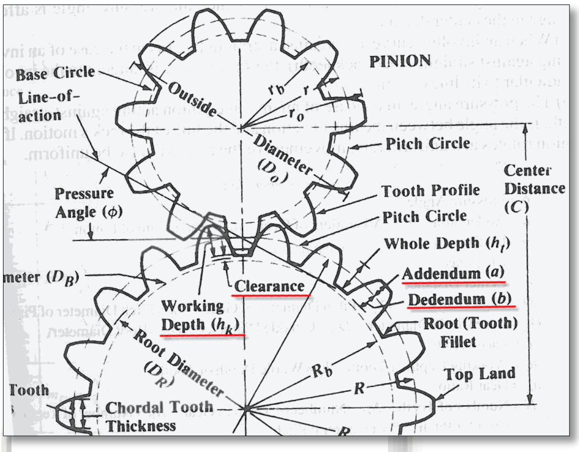

Fig. c: Gear rotation= driven gear teeth/drive gear teeth

Center distance:

The distance from the center shaft of one spur gear to the center shaft of the other spur gear.it is called center distance.

M. Gear Ratio:

The ratio of a given pair of spur gears is calculated by dividing the number of teeth on the driven gear, by the number of teeth on the drive gear [4].

N. Gear strength:

It has good strength, durability, wear resistance, and chemical resistance, so can be used to each gear. gear wreck will happen because of its tooth fatigue and tooth surface wear, so strength design from both side is necessary.

O. Tooth surface strength:

Damage phenomenon like pitching and wear will occur on tooth surface, and hertz formula (2) is generally employed.

$W = \square_{\alpha 2} - bd_1$

$(\sin 2\alpha/2.8)(2Z_2/ Z_1 + Z_2)(1/ E_2 + 1/ E_2)$

W: pitch circumferential tangent load
B: face width
d1: gear pitch circle diameter
A: meshing pressure
Z1: gear teeth number
Z2: pinion teeth number
E1: gear longitudinal elastic modulus
E2: pinion longitudinal modulus
□α: Allowable compressive stress [8]

Many gear solution could be left out of consideration if a traditional approach based on a predetermined set of rack dimension is applied. For example, spur gears with a high operating pressure angle or with a high contact ratio could not be produced with standard rack dimensions.

The design intent of asymmetric teeth is to improve performance of main contacting profiles by degrading opposite profiles. These opposite profiles are unloaded or lightly loaded, and usually work for a relatively short period. The improved performance could mean increasing load capacity or reducing weight, noise, vibration, etc.

Direct gear design for asymmetric tooth profiles opens additional reservers for improvement of gear drives with unidirectional load cycles that are typical for many mechanical transmissions[4].[5]

Direct gear design is an alternative approach to traditional gear design .it allows analysis of a wide range of parameter for all possible gear combinations in order to find the most suitable solution for a particular application. This optimum gear solution cans exeed the limits of traditional rack generating methods of gear design. [5]

If a gear does not produce a satisfactory desgin based on bending requirements, a design alteration may be needed. This is not always straightforward, since such alterations may help in one area and hurt in another, and may affect associated machine elements such as bearings. However, some factors that improve bending performance are the following:

- Reduction in the load, such as by increasing contact ratio, or altering other aspects of the system.
- Increase the center distance.
- Apply gears with a finer pitch.
- Use a higher pressure angle.
- Usea helical gear instead of a spur gear.
- Use a carburized material.
- Increase the surface hardness by material selection, or by performing a surface hardening operation.[6]
- Improve the gear accuracy through manufacturing process selection.
- Use a wider effective face width.
- Increase the lubricant film thickness.[6]

The Tooth stress for spur gear:

Lewis considered gear tooth as a cantilever beam with static normal force F applied at the tip.

Assumptions made in the derivation are:

- The full load is applied to the tip of a single tooth in static condition.
- The radial component is negligible.
- The load is distributed uniformly across the full face width.
- Forces due to tooth sliding friction are negligible.
- Stress concentration in the tooth fillet is negligible.

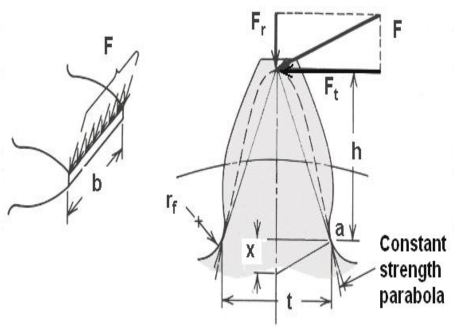

Fig. d: Gear toothascantilever beam [7]

Shows clearly that the gear tooth is stronger throughout than the inscribed constant strength parabola, except for the section at a where parabola and tooth profile are tangential to each other.

At point an ending stress is

□ = Mc/l =6F_t h/bt^2

By similar triangles,

Substituting of Eqn

□ = 6F_t/4bx

Y = 2x/3p

Where y is defined as the Lewis from factor and substituting eqn we get

□ = F_t/bpy

Eqn. is the basic Lewis equation in terms of circular pitch.

In SI units gears are more often made to standard modules. Hence by substituting

P = πm in Eqn we get

□ = F_t/ bπym

Let y = πy, which is known as modified Lewis from factor, then

□ = F_t/ bym

Eqn. is the standard Lewis equation for tooth bending stress based on module.

Both Y and y are functions of tooth shape (but not size) and therefore vary with the number of teeth in the gear. These values can be olained. [8]

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[6] CRC Fundamental of machine elements 3rd schmid Hamrock and Jacobson 2014 CRC pre,Desigan procedure method to Increase the pitting Resistance

[7] Figure shown in gear tooth scntilever beam (prof.k.gopinath and prof.M.M.Mayuram)

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