

Design of Spur Gear for Anti-Gravity Power Generation System

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Abstract— This paper presents the Review on Analysis and modification of spur gear design and explain the design the spur gear and dimension specification. To design the spur gear for power generation by using anti-gravity system. Gearing is one of the most critical components in mechanical power transmission system, and in most industrial rotating machinery. It's have an involving modern design, specific character, specific materials, with consideration of analysis of force and its mechanical properties. These approach for modern spur design developing the tooth profiles with modified the shape and improving dimension. Spur gear is cylindrical shaped gear in which the teeth are parallel to the axis. It is easy to manufacture and it is mostly used in transmitting power from one shaft to another shaft up to certain distance & also used to vary the speed & Torque. The main purpose of modern spur gear design it increases the power transmitting capacity and also improves the efficiency of power transmission.

Key words: Spur Gear Design, Gear, Dimension

I. INTRODUCTION

Spur gears are the most common type of gears. They are used to transmit rotary motion between parallel shaft i.e. they are usually cylindrical in shape, and the teeth are straight and parallel to the axis of rotation. Sometimes spur gears are used at once to create very large reductions. Spur gears are used in many devices but not in cars as they produce large noises. Gears is rotation cylindrical wheel having tooth cut on it and which meshes with another toothed part to transmit the power or torque. Spur gear is the simplest type of gear having at tooth cut parallel the axis of shaft on which the gear is mounted. Spur gears are used to transmit the power between parallel shafts. Spur gear gives 98-99% efficiency.



Fig. 1: Spur Gear

This gear can be meshed together correctly only if they are fitted to parallel shaft. The main reason for the popularity of spur gear is their simplicity in design and manufacturing. The two parameters i.e. tip radius and in tooth widths which play a key role gear design are studied. 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 changed the speed, direction of power sources and magnitude. Spur gear is a cylindrical shaped gear in which the teeth are parallel to the axis. It has the largest applications and also it is the easiest to manufacture. Spur gears are the most common type used. Tooth contact is primarily rolling, with sliding occurring during engagement and disengagement. Some noise is normal but it may become objectionable at high speeds. Now days there are so many mechanisms those involve with load and requirement to understand the stress in component is increased. The mechanism and the always come together and they have a strong relation between each other.

II. BASIC TERMS OF SPUR GEAR

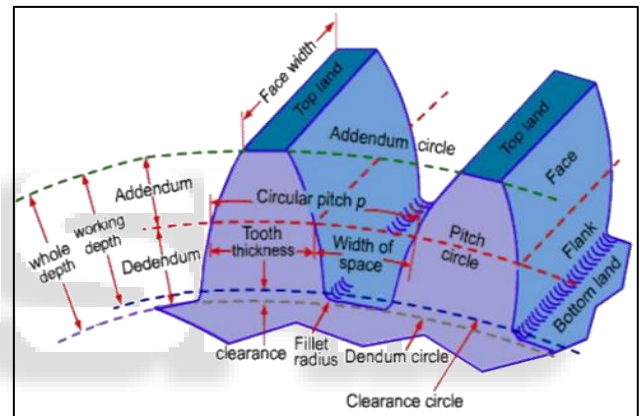


Fig. 2: Involute Spur Gear

MODULE: module of gear is defined as ratio of diameter to number of teeth.

$$m = \frac{d}{N}$$

FACE WIDTH: the width along the contact surface between the the gear is called the face width.

TOOTH THICKNESS: the thickness of the tooth along the pitch circle is called the tooth thickness.

DIAMETRAL PITCH (DP): The gear tooth size is described by diametral Pitch larger gear have fewer teeth per inch of daimetral pitch, daimetral pitch is inversely gear teeth size.

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.

$$PD = \frac{N}{P}$$

PD=pitch diameter

N= number of teeth on the gears

P=diametral pitch (gear size)

III. DESIGN OF SPUR GEAR

Selection of material=C30

Assume teeth=65

Power=36watt

Beam strength

$$\sigma_b = \frac{S_{ut}}{3} = \frac{620}{3} = 206.66 \text{ N/mm}$$

$$Y_p = 0.484 - \frac{2.87}{Z}$$

$$Y_p = 0.484 - \frac{2.87}{65}$$

$$Y_p = 0.4398$$

$$F_b = \sigma_b b m$$

$$Y_p = 206.66 \times 4m \times m \times 0.4398$$

$$= 363.5563 m^2 \text{ N/mm}^2$$

Effective load

$$V = \frac{\pi d n}{60 \times 1000}$$

$$= \frac{\pi \times m \times z \times n}{60 \times 1000}$$

$$= 0.0476 \text{ m/sec}$$

$$F_t = \frac{P}{V}$$

$$F_t = \frac{36}{0.0476}$$

$$F_t = \frac{756.3025}{m}$$

$$K_v = \frac{3}{3+v}$$

$$K_v = \frac{3}{3+0.0476}$$

$$F_{eff} = \frac{K_v}{K_a K_m F_t}$$

$$F_{eff} = \frac{1.25 \times 1.3 \times 756.3025}{m} \times \frac{3+0.04766m}{3}$$

Estimation of module

In order to avoid bending failure

$$F_b = N_f \times F_{eff}$$

Initially taking factor of safety

$$N_f = 1.5$$

$$= \frac{1.5 \times 409.6639(3+0.0476)}{3}$$

$$= 363.5563 m^2 = 1843.4873 + 29.25 m$$

$$m = 2.55$$

$$m \approx 3$$

The standard value of module under first choice is 3 mm.

Dimension of gear:

$$m = 3$$

$$Z = 65$$

$$b = 25 \text{ mm}$$

$$d = m Z = 3 \times 65 = 190 \text{ mm}$$

$$h_a = 1m = 3 \text{ mm}$$

$$h_f = 1.25m = 3.75 \text{ mm}$$

$$a = 190 \text{ mm}$$

Precise estimation of dynamic load by Buckingham's equation

For grade 7

$$e = 11.0 + 0.9(m + 0.25\sqrt{d})$$

$$e = 11.0 + 0.9(3 + 0.25\sqrt{195}) \mu m$$

$$e_p = e_g = 16.84 \mu m$$

$$e = e_p + e_g$$

$$= 33.68 \mu m$$

$$= 33.68 \times 10^{-3} \text{ mm}$$

The equations Buckingham's equations for dynamic load

$$F_d = \frac{21 V_c + F_{tmax}}{21 V \sqrt{b c} + F_{tmax}}$$

$$\text{Now } C = 0.111 e \left[\frac{E_p E_g}{E_p + E_g} \right]$$

$$C = 0.111 \times 33.689 \times 10^{-3} \times \frac{210000 \times 210000}{42000}$$

$$C = 406.29 \text{ N/mm}$$

$$V = 0.0476 \text{ m/sec}$$

$$F_t = \frac{756.3025}{m}$$

$$= 252.1008 \text{ N}$$

$$F_{tmax} = K_a \times F_m \times K_t$$

$$= 1.25 \times 1.3 \times 252.1008$$

$$= 409.6639 \text{ N}$$

$$F_d = \frac{21 \times 0.0476 + (12 \times 406.29 + 409.6639)}{21 \sqrt{12} \times 406.29 + 409.6639}$$

$$F_d = 71.6843 \text{ N}$$

Available factor of safety

$$F_{eff} = K_a \times F_m \times K_t + F_d$$

$$= 1.25 \times 1.3 \times 252.1008 + 71.6843$$

$$F_{eff} = 481.3481 \text{ N}$$

From equation

$$F_b = 363.5563 m^2$$

$$F_b = 3272$$

Hence the available factor of safety is

Hence the available factor of safety is

$$N_f = \frac{F_b}{F_{eff}} = \frac{3272.0}{481.3481}$$

$$N_f = 6.79 > 1.5$$

As the available factor of safety is higher than the required factor of safety then the gear pair is safe against bending failure.

Surface hardness

$$Q = \frac{2Zg}{Z_g + Z_p}$$

$$= \frac{2 \times 65}{65 + 65}$$

$$K = 0.16 \left[\frac{B.H.N.}{100} \right]^2$$

$$FW = db. b. Q. k$$

$$FW = 195 \times 12 \times 1 \times 0.16 \left[\frac{B.H.N.}{100} \right]^2$$

In order avoid pitting failure

$$F_w = N_f \times F_{eff}$$

$$= 195 \times 12 \times 1 \times 0.16 \left[\frac{B.H.N.}{100} \right]^2$$

$$= 1.5 \times 481.3481$$

$$B.H.N. = 138$$

$$B.H.N. \approx 140$$

IV. CONCLUSION

This paper performed a comparative analysis of spur gears, through the combination of both experience and the traditional theory of gear modification. A short overview of the major modification was given. As a result based on this finding that the spur gear is better choice for the anti-gravity power generation system. As spur gear gives 98-99% efficiency.

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