Design Alternate Bearings for Deep Groove Ball Bearings Used in Headstock of Landis Grinding Machine.

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Abstract— **Journal grinders are basically used for machining and giving a surface finish to crankshaft, gun barrels, and flanges .Pin grinding and journal grinding is carried out on the automated Landis Journal Grinder. The bearings present in these grinders are deep groove ball bearings .These balls bearings restrict the relative motion between the fixed element and the rotating element that is frame in headstock and spindle. So it reduces rotational friction and supports radial and axial load.**

Due to heavy loads and large grinding force, great amount of radial and axial force exerted on bearing. Because of this, wear and tear of deep groove ball bearing occurs, Thus reducing the life of bearing. So, there is a need to find an alternative solution to this problem. Therefore we studied and analyzed different types of bearings and came to the result that angular contact bearings can be used in the Landis Journal Grinder, because these have the capability to withstand heavy axial forces and radial loads, this is due to angular type of contact. More the angle of contact, greater the axial thrust or load, the bearing can withstand.

Keywords— **Landis Grinding Machine, Deep Groove Ball Bearings, Angular Contact Ball Bearings, Bearing Life (L_{10})**

I. INTRODUCTION

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction.

A. Angular contact ball bearing

An angular contact ball bearing uses axially asymmetric races. An axial load passes in a straight line through the bearing, whereas a radial load takes an oblique path that acts to separate the races axially. So the angle of contact on the inner race is the same as that on the outer race. Angular contact bearings better support combined loads (loading in both the radial and axial directions) and the contact angle of the bearing should be matched to the relative proportions of each. The larger the contact angle (typically in the range 10 to 45 degrees), the higher the axial load supported.

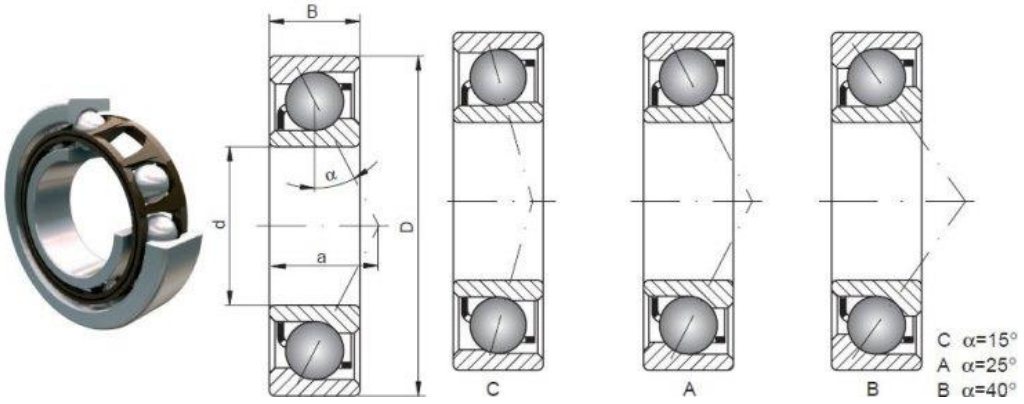

Fig. 1. Angular contact ball bearing

II. PULLEY DESIGN

A. ORIGINAL DESIGN

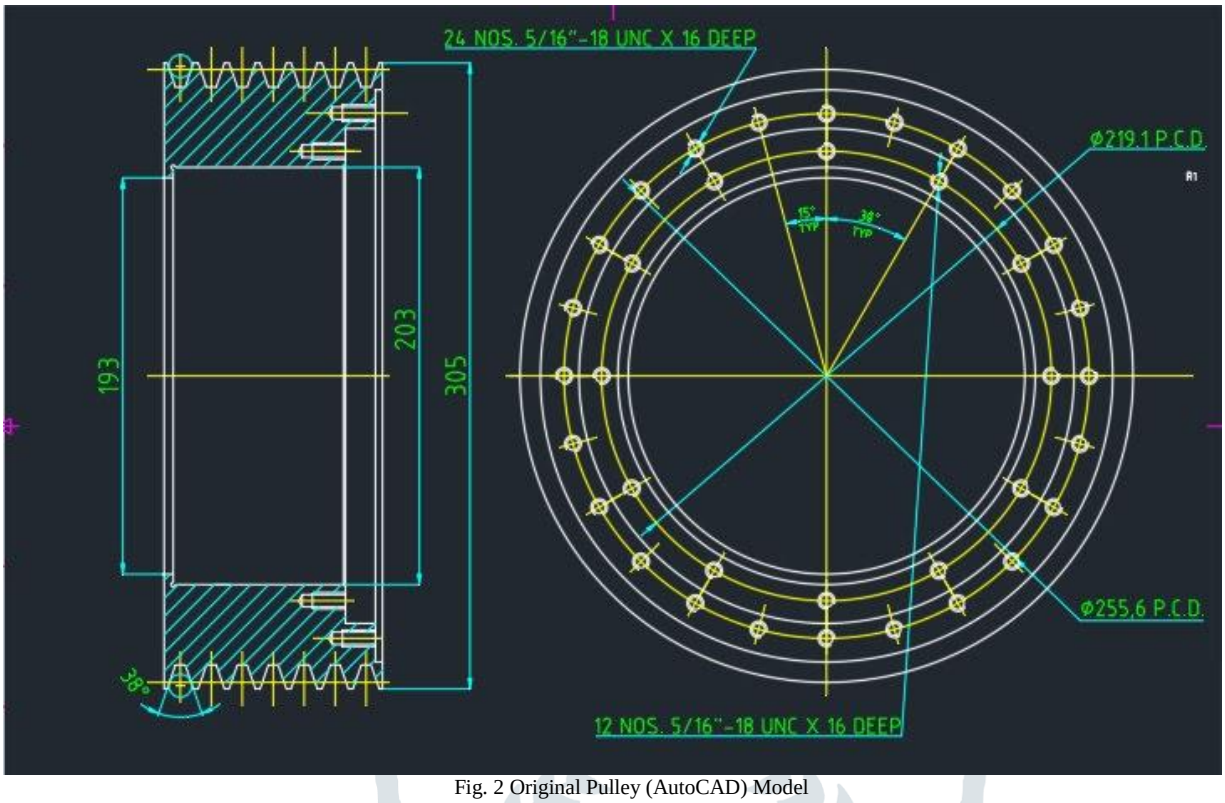

Fig. 2 Original Pulley (AutoCAD) Model

B. PROPOSED DESIGN

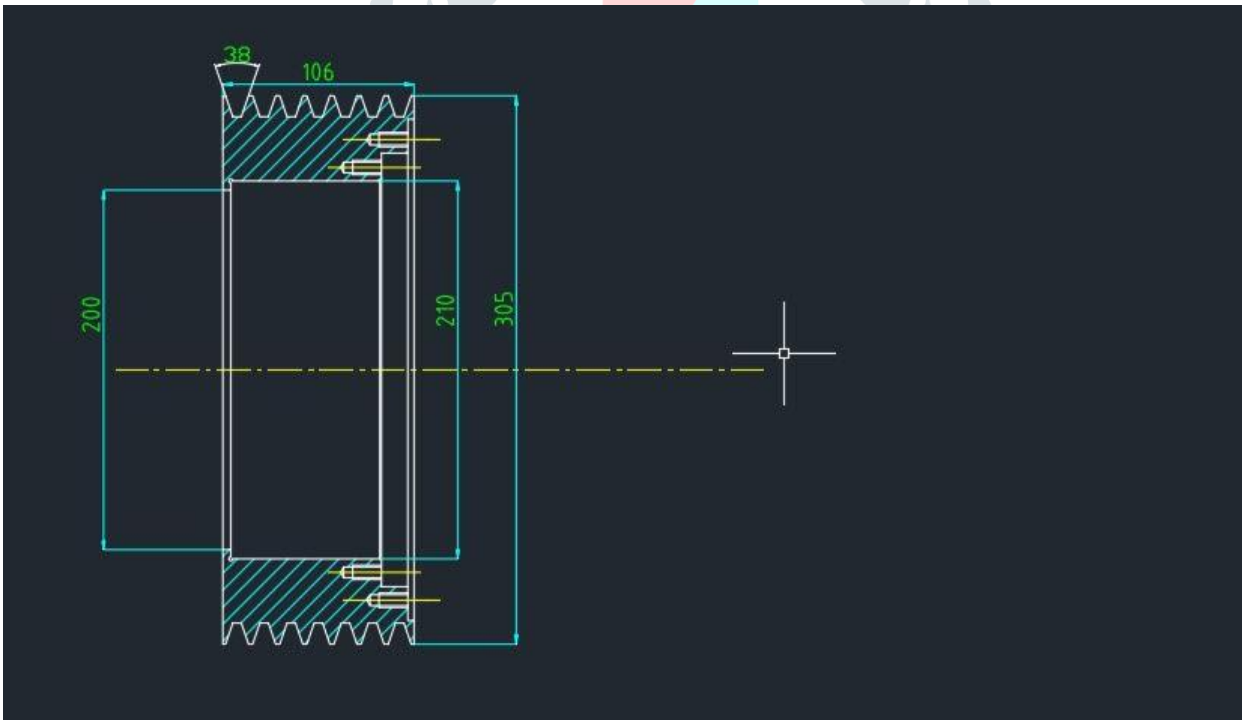

Fig. 3 Proposed Pulley (AutoCAD) Model

III. BEARING LIFE

The basic rating life of a bearing according to ISO 281:1990 is

$L_{10} = (C/P)^p$ …… where L10 = basic rating life (at 90 % reliability), millions of revolutions

C = basic dynamic load rating, kN

P = equivalent dynamic bearing load=$X*F_r+Y*F_a$

p = exponent of the life equation

= 3 for ball bearings

= 10/3 for roller bearings

C. Life of Deep Groove Ball Bearing V/s Angular Contact Ball Bearing

$(L_{10})_{agbb}/ (L_{10})_{dgbb} \approx (96.5/54.5)^3$

≈ 5.55 *(Refer table I, II, III)*

TABLE I [2], [3]
BEARING PARAMETERS

Type	Designation	Dimensions (mm)			Basic Load Rating	
		d	D	B	C (kN)	C_0 (kN)
DGBB	XLJ6	152.4	203.2	25.4	54.4	45.5
AGBB	7930A5	150	210	28	96.5	115

TABLE III [1]
X AND Y FACTORS FOR SINGLE ROW DEEP DROVE BALL BEARING

$\left(\frac{F_a}{C_0}\right)$	$\left(\frac{F_a}{F_r}\right) \le e$		$\left(\frac{F_a}{F_r}\right) > e$		e
	X	Y	X	Y	
0.025	1	0	0.56	2.0	0.22
0.040	1	0	0.56	1.8	0.24
0.070	1	0	0.56	1.6	0.27
0.130	1	0	0.56	1.4	0.31
0.250	1	0	0.56	1.2	0.37
0.500	1	0	0.56	1.0	0.44

TABLE IIIII [2]
X AND Y FACTORS FOR ANGULAR CONTACT BAL BEARING

Contact Angle	$i f_0 F_a^* / C_{or}$	e	Single, DT				DB or DF			
			$F_a/F_r \le e$		$F_a/F_r > e$		$F_a/F_r \le e$		$F_a/F_r > e$	
			X	Y	X	Y	X	Y	X	Y
15°	0.178	0.38	1	0	0.44	1.47	1	1.65	0.72	2.39
	0.357	0.40	1	0	0.44	1.40	1	1.57	0.72	2.28
	0.714	0.43	1	0	0.44	1.30	1	1.46	0.72	2.11
	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
	1.43	0.47	1	0	0.44	1.19	1	1.34	0.72	1.93
	2.14	0.50	1	0	0.44	1.12	1	1.26	0.72	1.82
	3.57	0.55	1	0	0.44	1.02	1	1.14	0.72	1.66
	5.35	0.56	1	0	0.44	1.00	1	1.12	0.72	1.63
25°	—	0.68	1	0	0.41	0.87	1	0.92	0.67	1.41
30°	—	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	—	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

*For i, use 2 for DB, DF and 1 for DT

IV. CONCLUSIONS

The bearing life of angular contact ball bearing is nearly five times that of the deep groove ball bearing. The new proposed design has higher load carrying capacity as well. Higher load carrying capacity and greater bearing life together considerably reduces the maintenance requirement. The machine downtime due to servicing and maintenance is reduced. Thus the productivity is improved.

ACKNOWLEDGMENT

It gives me immense pleasure to present a report on "**Design Alternate Bearings for Deep Groove Ball Bearings Used in Headstock of Landis Grinding Machine**". In preparing this report, number of hands helped us directly and indirectly. Therefore it is my duty to show gratitude towards them.We are very much obliged to Project guide Prof. P. H. Biradarfor helping and giving us proper guidance. It is our duty that we acknowledge a great sense of gratitude to Dr. M. M.Kulkarni and the head of Mechanical Engineering Department Prof. N. P. Sherje for making this opportunity available to us.

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