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Hybrid Springs for Power Generation

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Abstract: *The objective is to achieve a composition of alloy has to be precisely correlated at a state of best alloy combination to make good resilience spring ranging from 2mm- 3mm wire thickness which can be achieved by a proper selection of alloys with different aspects of mechanical properties in a real time power generation device for rapid movement of the rack and pinion power generator. The former is similar to [1] were in open spring type is used along the guide path, this part deals with modification of spring composition with selection of alloys apart from the existing scenario & and analyzing their various properties by using ANSYS. The various combinations of spring are selected for the following advantages Copper and zinc combinations give the ductility and hardness to the spring. Silver gives moderate improvement in strength and hardness. Copper atom replaces the core metals as it distorts the crystal lattice, so 5% of copper is added to withstand compressive and tensile stresses*
Key words: *Alloy, Resilience, Rack & Pinion,*

I. Introduction

The normal springs used in the automation and manufacturing sectors are used as stopping or retrieving mechanism of various operations according to the need of machining process. The various applications of springs in the industrial sectors are Constant Force Spring Application, Constant Torque Spring Applications and Power Spring Applications; hence this paper deals with the constant force of spring acting on the rack and pinion mechanism for generation of power with its enhancing stiffness for the spring action against the applied Manuel load.

The spring was designed in pro-e and analysed for various spring factors for various comparison of spring factors of constraining degree of freedom at various

Loading condition as per the real time experimental results. The various applications of the springs in industrial applications are used for mechanisms and material handling.

Hence this paper entitles on the constant spring force on the rack and pinion apparatus to generate power for the repeated reciprocating mechanism of the spring for the manually applied load or force in [1].

II. Design Process Of Spring

The open spring is designed for a length of 120 mm thickness of diameter of 2.5 mm, which has a compression index for about 60 mm. providing essential movement for the rack and pinion for power generation.

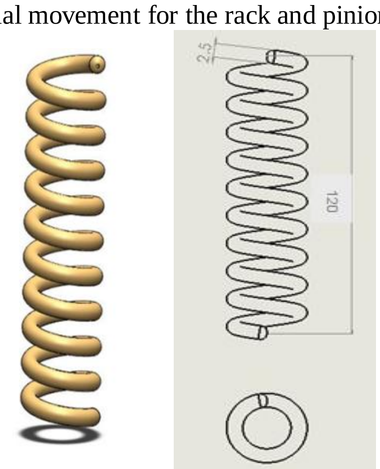

Figure 1. Showing the spring design

parameters considered while designing a Spring are

- No of turns
- Stiffness
- Compression index
- Resilience

The normal spring has an alloy combination of various components like Carbon (C) 0.47-0.55, Chromium (Cr) 0.90-1.20 %, Vanadium (V) 0.10-0.20%, Silicon (Si) <0.40%, Manganese (Mn) <1.15, o 0.60 %, Remaining are steel (Fe) is about 0.50 % .

But in this paper a new combination of spring with alloy combination of zinc (Zn) 0.13-1.30 %, Silver (Ag) 0.20-2 %, Copper (Cu) 0.5-5 % & remaining metal consists of steel of about 0.50 %.The usage of the following materials are detailed for the following reasons

Zinc - Zinc is blue white lustrous metal, diamagnetic. The metal is hard and brittle at most temperatures but becomes malleable between 100 and 150 °C. Brass is an alloy of copper and zinc. 3-4.5% Zn by weight

Silver – the former is stronger and has good endurance of sustaining at high temperatures Silver is also able to reflect light very well. It has melting point 961.93 Celsius hardness 3.25 on mohs scale. It has young's modulus of 83 Gpa. It is a poor whitener.

Copper - They are ductile, light weight. Jewelry, the alloys of copper are tend to be harder, stronger and tougher than pure copper

Mechaniser

The spring works as reciprocator with having high compression index for the former movement in any machinery for about stiffness of respective value. Due to the addition of alloys like zinc, copper that enhances the ductility & hardness for the spring at 5% of silver added to this enables it to withstand tensile and compressive stress for an applied varying load.

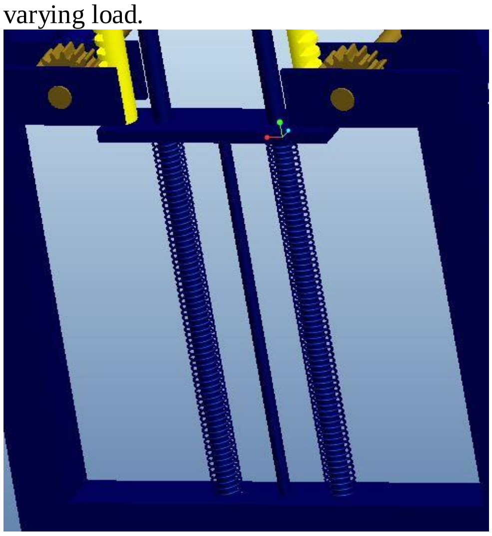

Figure 2. Showing the spring used in the apparatus

The figure 2 showing the spring the structural member used in the power generation mechanism with the usage alloy combination used in normal spring used in industrial application, Further these combination replaced by new range of alloy combination with structural anlysis.

Spring Stiffness Calculation

Given data:
Pitch=7mm
Gap =6mm
No. of turns=48
F=100N
Angle=α=10'57"
Mean diameter of spring wire=D=40mm
Diameter of spring wire=d=18mm
δ = 4mm
To find
$\zeta < \zeta_y$
Design is safe
Solution

1) $L = 2\pi Rn \sec \alpha$
$= 6143.714$mm
2) $\delta = WR^2L\{\cos^2\alpha/JN + \sin^2\alpha/EI\}$
$N = 105256.562 N/mm^2$

3) $K = w/d$
$=100/40$
$=0.25\ N/mm^2$

4) Shear stress
$F_s = 16*w*R/\pi d^3$
$= 174.6\ N/mm^2$
Or
$\tau = FD*16/\pi*D_W*2$
$= 174.6 N/mm^2$

5) Energy stored = $Kd^2/2$
$= 40.5J$

For mild steel $\tau_y = 300 N/mm^2$
$\tau < \tau_y$
Hence, the design is safe

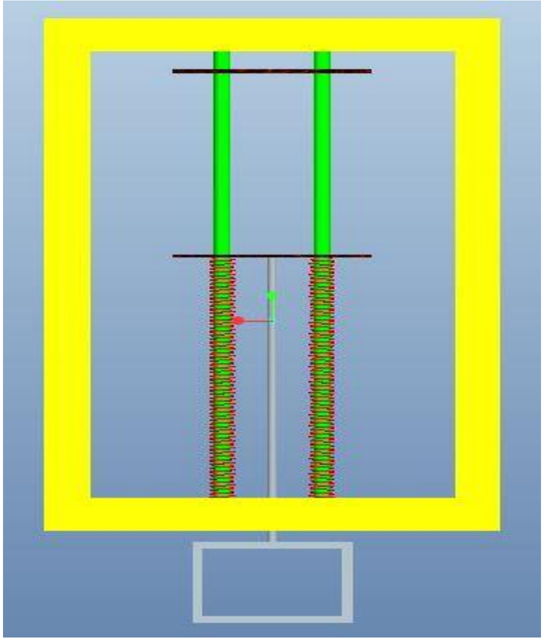

Figure 3. Showing the modal in Pro-e

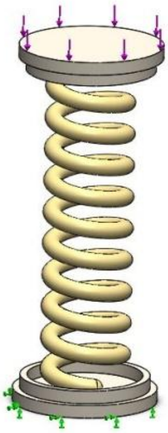

Figure 4. Showing the constraints for spring

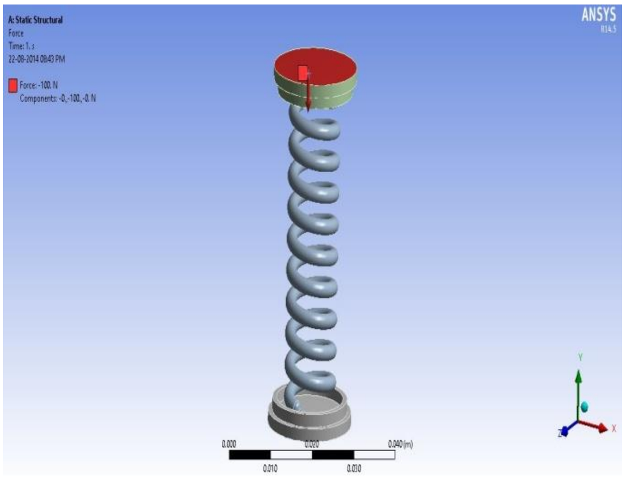

Figure 5. Showing the load application

Load are applied on the basis of the practical application varying from 100 – 500 KN for the former and various structural members are finely meshed

Figure 6. Showing the mesh view

Fine meshing is being used for with structural analysis.

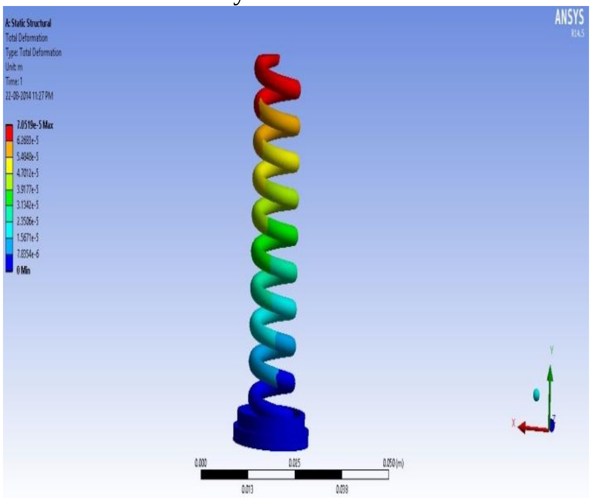

Figure 7. Showing the deformation on the spring

The distribution of stress is structurised over the each turn of the spring for efficient usage with maximum of 7.0519×10^5 to minimum of 0 Mpa .

The figure 8 shows the elastic strain results ranging from maximum of 6.4096×10^5 Mpa to minimum of 1.559 $\times 10^{10}$ Mpa

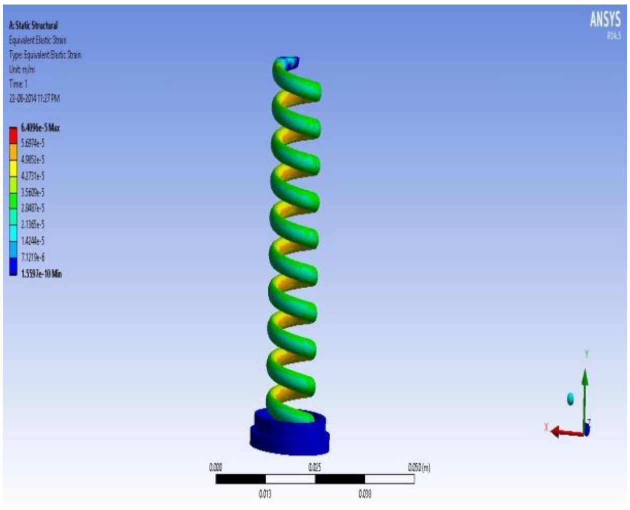

Figure 8. Showing the elastic strain of spring

III. Results And Discussions

The usage of new alloy combination enhances the following characteristics such as
The model was designed in fine weld mends. The structure was analyse to get the following results
Load is applied at 100-500 Kn
Fine mesh is used for constrains
From the stress distribution the values obtained are Max-7.0519 × 10^5 Mpa.
From the elastic strain the values obtained are max- 6.4096 × 10^5 Mpa, Min-1.559 × 10^{10} Mpa

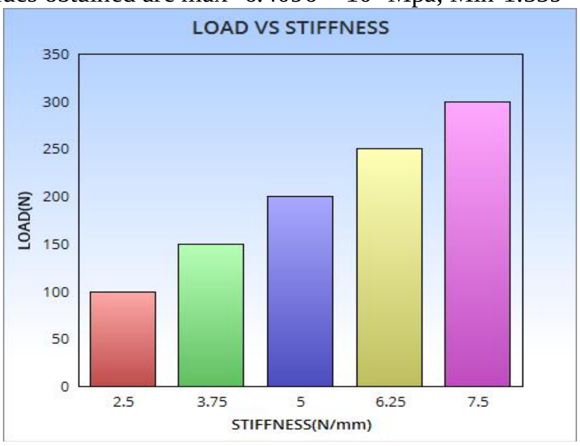

Figure 9. Showing the load vs stifness graph

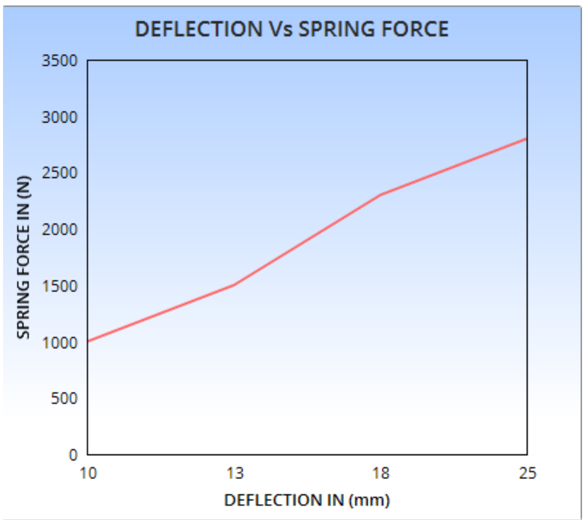

Figure 10. Showing the deflection vs spring force graph

IV. Conclusion

Usage of the zinc, copper, silver, chromium and remaining steel are used in replacement of normal spring is analysed in ANSYS for various results for determination of stresses, Elastic strain and various deformation. The usage of silver enhances improvement in strength and hardness, Copper enhances to withstand compressive and tensile stresses, zinc enhances give the ductility and hardness to the spring. This combination tends to with stand even at varying deformation loads about 500 Kn.

Reference

[1]. S.Krishna, S.Naveen Kumaar **"**Power Generation through Grab Handles" IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 3, March 2015.
[2]. L. Del Llano-Vizcaya, C. Rubio-Gonzalez & G. Mesmacque (2007), "Stress relief effect on fatigue and relaxation of compression springs", material and design, vol.28, pp.1130-1134.
[3]. C. Berger & B. Kaiser (2006), "Results of very high cycle fatigue tests on helical compression springs", international journal of fatigue, vol. 28, pp. 1658-1663.
[4]. Tausif M. Mulla, Sunil J. Kadam &Vaibhav S. Kengar (2012), "Finite element analysis of helical coil compression spring for three wheeler automotive front suspension", international journal of mechanical and production engineering, vol-1, issue-1
[5]. V.Maleev and James B. Hartman , Machine Design, CBS Publishers And Distributors.3rd Edition. 1983.
[6]. Fundamentals of Machine Elements, 3rd ed. Schmid, Hamrock and Jacobson.