IRJSE International Research Journal of Science & Engineering
Int. Res. J. of Science & Engineering, 2018; Special Issue A2 : 272-275
ISSN: 2322-0015
SJIF Impact Factor 4.11
UGC Approved Journal No. 63628
RESEARCH ARTICLE **OPEN ACCESS**

Design and Development of Rack and Pinion for 180° Flipping Machine

Vavhal Prashant, Shivam Swami, Harshal Mahajan, Jueli Lad, Suraj Nanaware

Department of Mechanical Engineering, P. K. Techanical Campus, Chakan, Pune, MS, India
Email: prashantvavhal44@gmail.com

Manuscript Details
Available online on http://www.irjse.in
ISSN: 2322-0015

Editor: Dr. Arvind Chavhan

Cite this article as:
Vavhal Prashant, Swami Shivam, Mahajan Harshal, Jueli Lad, Nanaware Suraj. Design and Development of Rack and Pinion for 180° Flipping Machine, *Int. Res. Journal of Science & Engineering*, January 2018; Special Issue A2: 272-275.

ABSTRACT

This is 180 ° Flipping Mechanism. In this mechanism the component is rotated at an angle of 180 ° from its main position. In this mechanism the component is rotated with the help of rack and pinion mechanism. The Gears while transmitting the power develop stresses at the mating positions. A pair of teeth inaction is generally subjected to stresses like bending stresses inducing bending fatigue, Wear stresses inducing wear fatigue and Shear stresses inducing shear fatigue. It is required to explore some alternate materials to improve the performance of the spur gears and to sustain stresses. Composite materials provide adequate strength with weight reduction and they are emerging as a better alternative for replacing metallic gears. This work includes design and weight optimization of output pinion.

Keywords: 180° Flipping Machine, Rack and Pinion, etc.

INTRODUCTION

Gears are mechanical components used for transmitting motion and torque from one shaft to another. Ever since invention of rotating machines, gears existed. During early centuries gears made of either wood or stone teeth set in wood. Later during metal ages Iron, Bronze or tin were used instead of stone. A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack"; rotational motion applied to the

Pinion causes the rack to move relative to the pinion, Thereby translating the rotational motion of the pinion into linear motion.The spur gear is simplest type of gear manufactured and is generally used for transmission of rotary motion between parallel shafts. The spur gear is the first choice option for gears except when high speeds, loads, and ratios direct towards other options. Other gear types may also be preferred to provide more silent low-vibration operation.

Figure 1.1 Rack and Pinion mechanisms

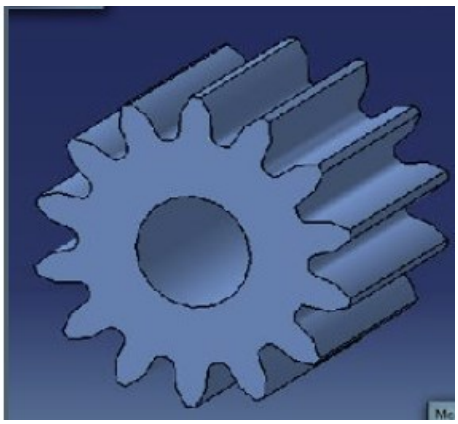

Figure 1.2: Rack and Pinion

A single spur gear is generally selected to have a ratio range of between 1:1 and 1:6 with a pitch line velocity up to 25 m/s. The spur gear has an operating efficiency of 98-99%. The pinion is made from a harder material than the wheel. A gear pair should be selected to have the highest number of teeth consistent with a suitable safety margin in strength and wear. The minimum number of teeth on a gear with a normal pressure angle of 20 degrees is 18. This 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. They are simple in construction, easy to manufacture and cost less. They have highest efficiency and excellent precision rating. They are used in high speed and high load application in all types of trains and a wide range of velocity ratios. Hence, they find wide applications right from clocks, household gadgets, motor cycles, automobiles, and railways to aircrafts. During this phase, they encounter high stress at the point of contact. A pair of teeth in action is generally subjected to two types of cyclic stresses:

i) Bending stresses inducing bending fatigue
ii) Wear stress causing wear fatigue.

Both these types of stresses may not attain their maximum values at the same point of contact. However, combined action of both of them is the reason of failure of gear tooth leading to fracture at the root of a tooth under bending fatigue and surface failure, due to contact fatigue. When loads are applied to the bodies, their surfaces deform elastically near the point of contact. The highest stresses exist at regions where the lines are bunched closest together. The highest stress occurs at two locations:

a. At contact point where the force' F' acts
b. At the fillet region near the base of the tooth

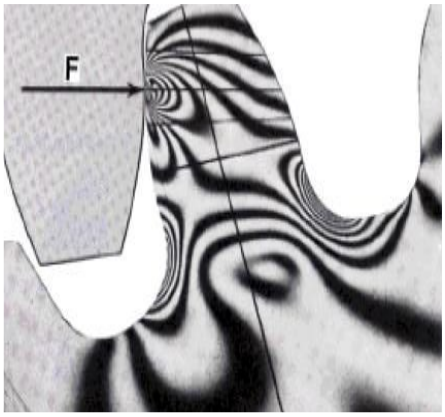

Figure 1.3: The highest stresses

PROBLEM STATEMENT

In this thesis spur pinion are widely used for 180^{o} Flipping mechanism. The failure is observed in pinion are due to various reasons like condition of loading, improper lubrication, corrosion etc. in the pinion failure generally start at root fillet radius and the cracks may have observed at fillets. This teeth failure may lead to failure in entire transmission system. this

problem can be minimizing by a selection of different material to a spur pinion. In the higher weight of part also lead problem in rotation of component in 180° to such the weight reduction can be achieved by changing the material of spur pinion.

OBJECTIVE

In spite of the number of investigations devoted to gear research and analysis there still remains to be developed, a general numerical approach capable of predicting the effects of variations in gear geometry, bending stresses and Von-Mises stresses. The objectives of this project are to use a numerical approach to develop theoretical models of the behavior of gears in mesh, to help to predict the effect of gear tooth stresses and transmission error. The main focus of the current research as developed here is to analyses the failure of spur pinion.

i) Model of baseline of spur pinion by solid edge ST7 software.
ii) Analyses the baseline spur pinion design by Ansys and evaluate deflection and stress for different material as steel and aluminum, composite material.
iii) Development of Spur Pinion with all Material.
iv) Compare Experimentally Material Testing and Loading Stress for all material

SCOPE

This work focuses on the use of less weight material like aluminum, composite material for spur pinion. It shows that the stresses are lower in the aluminum, composite material than in steel alloy. So it increases the life of gears used for180° Flipping Mechanism. Thus this work suggests replacing the metallic gears with less weight aluminum and composite gears which has better properties than metallic gears.

CONTRRUCTION AND WORKING

CONSTRUCTION

In this mechanism actuator and rack are assembles with the help of fasteners. That actuator moves rack linearly. There is rack and pinion assembly. There is also base plate and two support plate that is called holding device. Linear pneumatic actuator is used of size 45*45*344, Bore: 32mm, Stroke: 200mm; Port size: PT1/8 Action Type: Double Acting; Rod Type: Single Rod Net Weight: 820g

WORKING

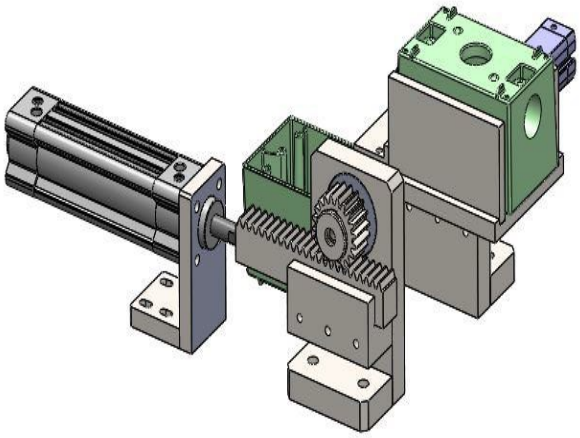

Figure 5.1 180° working model

This 180° Flipping mechanism is used to rotate the component in the 180° with less time and less human effort. In manufacturing work performed on top face of component or work piece, but sometimes it needs to work on its bottom side also for that we use 180° flipping mechanism. In this mechanism the power is supplied to run the linear pneumatic actuator. That is actuator moves forward and return stroke while power is transmitted.

The movement of actuator in forward direction that pushes the rack also in forward direction. Since there is rack and pinion assembly its rotates the pinion at the same time of rack moment. That pinion is attached to the shaft and when pinion rotates shaft also rotate. The holding device i.e. base plate and two support plate is welded to the shaft. The component is held in that holding device i.e. in between two support plate. When the pinion rotates the component is also rotating, which is held in that holding device. That component is rotated in 180° with this rack and pinion mechanism. This Flipping mechanism is like pick and place operation.

CONCLUSION

Various research works has been carried out in the past regarding to change of material of pinion. By changing the material of pinion increases the strength of rack and pinion. In various research by providing

the slots on the pinion weight can be reduced but strength will be reduced. This is simplest way to increase strength and reduce weight.

Conflicts of interest: The authors stated that no conflicts of interest.

REFERENCES

1. ABDUL MD, JUNAIDI RAHEEM, YAHIYA MD, AHMED MD NASER, AHMED MOHAMMED AQEEL, "DESIGN AND ANALYSIS OF HIGH SPEED HELICAL GEAR USING ANSYS" IJREAT INTERNATIONAL JOURNAL OF RESEARCH IN ENGINEERING & ADVANCED TECHNOLOGY,2016,VOLUME 4, ISSUE 1, ISSN: 2320 – 8791
2. RAJAPRABAKARAN V, AND ASHOKRAJ R "SPUR GEAR TOOTH STRESS ANALYSIS AND STRESS REDUCTION" E-ISSN: 2278-1684, P-ISSN: 2320-334X PP 38-48.
3. JABBOUR TONI, ASMAR GHAZI "TOOTH STRESS CALCULATION OF METAL SPUR AND HELICAL GEARS" JOURNAL OF MECHANISM AND MACHINE THEORY 92 ,2015, 375-390.
4. AMBADE VISHWJEET V, VANALKAR AV, GAJBHIYE PR "INVOLUTE GEAR TOOTH CONTACT AND BENDING STRESS ANALYSIS" INTERNATIONAL JOURNAL OF COMPUTATIONAL ENGINEERING RESEARCH, 2013,VOL. 03,30-36.
5. BADITHE MAHESH, SRIKANTH SRIMANTHULA, BODAPALLI JITHENDRA "STRESS AND REDUCTION ANALYSIS OF SPUR GEAR TOOTH" INTERNATIONAL JOURNAL ON EMERGING TECHNOLOGY AND ADVANCED ENGINEERING, 2014,VOL.4
6. SHINDE SP,NIKAM AA, MULLAH TS "STATIC ANALYSIS OF SPUR GEAR USING FINITE ELEMENT ANALYSIS." ISSN: 2278-1684, 26-31.
7. DOLAS DANANJAY ET AL. "STATIC ANALYSIS BENDING STRESS ON GEAR TOOTH PROFILE BY VARIATION OF GEAR PARAMETER WITH THE HELP OF FEA "IJERT,2014, VOL 3, 132-136