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Design and Fabrication of Automatic Multidimensional Spring Rolling Machine

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***Abstract:** In the spring industry both power and hand-operated machines are used.As the making of spring in a regular manner takes a lot of time and energy.to make several springs with less time and less energy, there is a need for an alternative spring making mechanism.*

Traditionally making of spring requires some operations on lathe machine like fixing and loosing checks, removing springs from the shafts. the solution to this problem is the design and fabrication of a multidimensional spring rolling machine. our project is simple by having a motor with pully to drive the shafts.

The gap between the spring coil can be regulated by a proper arrangement that can guide the wire automatically.

Design and fabrication of spring rolling machines include electric sewing motor, pulley, shaft, and belt.to overcome the limitations that are in the traditional lathe machine spring making process.

This project gives suitable ways to produce springs of wire diameter up to 6mm, inner diameter up to 20mm.the proposed springs are capable of bearing maximum loads of 100N for three different materials like copper aluminum, steel.

I. INTRODUCTION

As the springs are very important in absorbing the shocks and storage of the energy for quick return motion like the motion of brakes and clutches, measuring loads. their demand in day to day also increases. The major traditional spring making on a lathe machine is of a bigger process and more time consuming.productuion of spring on automatic multi-dimensional spring rolling machines reduces the production time and increases the number of springs.

In the present day, every material not only works with the manual but also automatically. Here we find simple and useful working equipment named as Automatic multi-dimensional spring rolling machine, it helps to make springs automatically. The motor helps to rotate the shaft and while rotating the shaft a wire can be inserted on top edge position of the shaft with the help of fixed support and it rotates with the shaft and spring can be formed. It provides flexibility when we observe any sudden shocks and due to external pressure on spring leads to some failure. So here we analyze the materials which can bear more loads, tests can be done and we provide basic information regarding that usage.

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At the end of the day-spring works under the strain energy. Springs are produced for many different applications like extension, compression, torsion, and constant force.depending on the usage spring may be operated in cyclic position, dynamic position or static position.

Problem Definition

As automation became a more efficient process with accuracy and less time consuming and easy to operate.fixing an auto operation for the spring wire on to the shaft on which the spring is made could help in decreasing the production time in making the small spring. this has brought the new simple spring rolling machine in a very compactable manner.

II. METHODOLOGY

In this Proposed System, we have used sewing motor, belt, pulley, and a bolted shaft. The single-stage supply is given to the acceptance engine, it will run. The engine pulley is coupled to the goad outfit pulley with the assistance of the belt. The goad outfit plan is to keep running as per the speed of the engine. Before switch on the acceptance engine, the spring wire is bolted to the secure nut in the spring moving shaft. The spring wire is supply by a spring wire tare. The tare is settled to the casing stand by two ends heading, with the goal that it will run openly as per the speed of the spring moving shaft.

The spring moving shaft is turned when the single-stage enlistment engine exchanged ON. The spring wire is coming in the moving shaft because of the turn of the spring moving shaft. The length of the moving spring is chosen by the administrator. The required length of the spring is rolled; the single-stage acceptance engine is turned OFF. The spring is cut by the shaper, the following above technique proceeds by and by for the following spring task.

III. EXPERIMENTATION & RESULT

There are five parts that this spring rolling machine is made up of

- SEWING MOTOR
- BELT
- PULLY
- BOLTED AND THREADED SHAFT
- TARE THAT MOOVE ALONG THE SHAFT

A. Motor Rpm Testing

This test is conducted to know the sewing motor rpm.

- To know the motor rpm firstly spring size and length of the spring and these are for 1 min to the time taken to complete 1 spring.
- $motor\ rpm =$
  $(size\ of\ spring \times$

$$60) \div \frac{length\ of\ the\ spring\ wire \times}{cycle\ time\ for\ 1\ spring}$$

- Spring size = 20mm
- Length of the spring = 180mm
- Cycle time = 40 sec
- $motor\ rpm = (20 \times 180 \times 60) \div 40 = 5400\ rpm$

Fig: I sewing motor

B. Testing Of Belt And Pulley:

In v-belts between belt and pulley slip can be produced. It is also known as relative motion between the belt an pulley. efficiency and power can be defined the slip conditions.

Coefficient of friction is different for different materials,

For Iron = 0.116

Cast iron = 0.102

Wood = 0.177

Rubber = 0.25

Fa= m g μ

m= mass of the pulley

g= acceleration due to gravity

μ= coefficient of friction

$$fa = 2 \times 9.8 \times 0.116 = 2.27\text{N}$$

The torque of the belt and pulley is

$$\tau = \frac{Fa \times r1}{1000 \times \eta}$$

Fa= accelerating force= 2.27N

r= radius of the pulley = 70mm

η = efficiency of the belt and pulley= 0.93 or 93%

$$\tau = \frac{2.27 \times 70}{1000 \times 0.93}$$

τ= 0.17

Power P = 2ΠN**τ**/60

$$P = \frac{2 \times 3.14 \times 5400 \times 0.17}{60}$$

P= 96.08 watts

η= Pi/P

Pi= 0.93× 96.08 = 89.35 *watts*.

Fig: II v- belt and pulley

Here motor showing different rpm depends on the size of the spring, length of the spring and cycle time for the spring. Based on these conditions the motor rpm can be varied. This can be shown in the Table-I

Table-I: various rpm of the motor

Specifications	Motor rpm
Size= 20mm	5400
Length= 180mm	
Cycle time= 40sec	
Size= 15mmLength= 120mm	3375
Cycle time= 32sec	

C. Total Production Rate Per Hour:

This machine can be produced the maximum number of springs per hour with some 60% efficiency.

Taken one example i.e.,

For 8cm spring wire:

Time is taken for rolling = 38 sec = 0.633 min

At 60% efficiency= 0.6× 0.633 = 0.3798 min

Production per hour = $\frac{60}{0.3798}$= 157

Total number of operators for each machine = $\frac{0.3798 \times 157}{60}$= 1

Total production per hour = number of operators×production per hour = 157

Table-II Hourly production of the springs

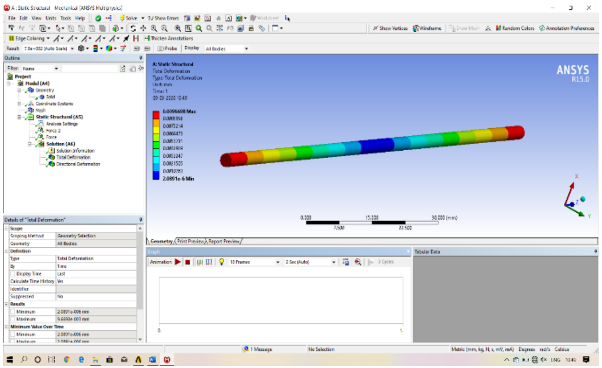
s.no	Operation sequence	Spring mean time(SMT)	Mt @60 % efficiency	Hourly production @60% efficiency	Number of operators	Total production per hour
1	8cm	0.633	0.3798	157	1	157
2	10cm	0.72	0.432	132	1	132
3	12cm	0.81	0.486	123	1	123
total		2.163	1.298			

D. Testing Of Spring Materials:

Here this test could be done between the three different materials they are copper, aluminum, steel. These materials propagate different deformation under one particular force acting on it. This test mainly used to identify the selection of better material under the action of one particular force.

Here force acting on each material = 100N

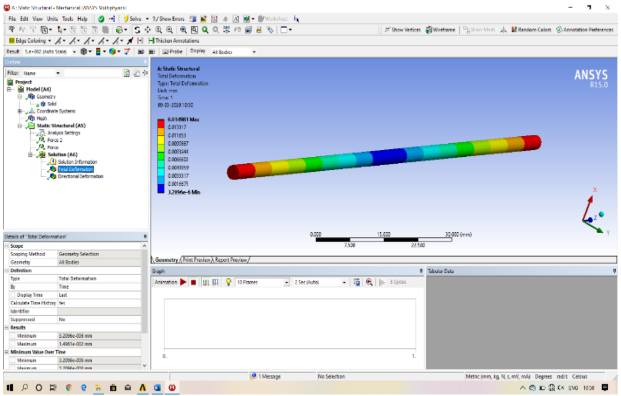
For copper material:



Maximum deformation = 9.6698mm

Minimum deformation = 2.0891mm

For aluminum material:

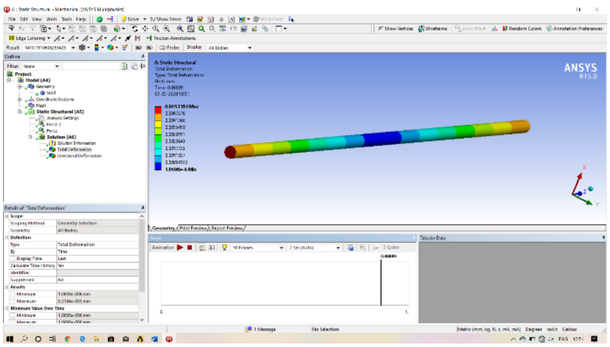


Maximum deformation = 1.4981mm

Minimum deformation = -3.2096mm

Negative becomes zero because it doesnot show any deformation.

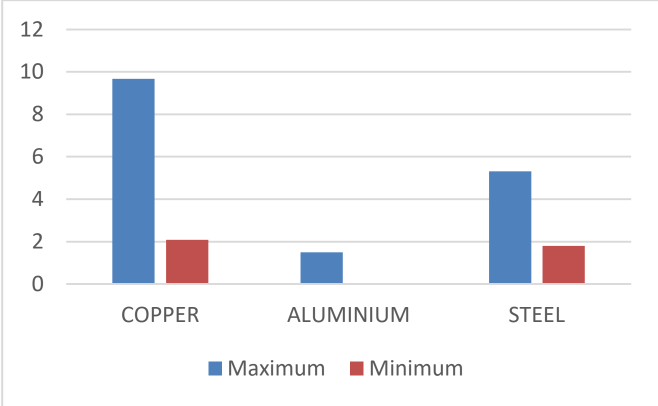
For steel material:



Maximum deformation = 5.3184mm

Minimum deformation = 1.0698mm

E. Graph Between Force And Deformations Of Materials:



Graph: I force and deformations of the springs

IV. SUMMARY

Spring is a mechanical device that undergoes deformation when the load is applied and returns to its original shape and size when the load is removed. When the spring is expanded the energy is stored in it and used to come back to its original shape and size when the load is removed. The deformation is directly proportional to the force applied. Spring rolling industry is a big and developing industry. There are many special machines used in this industry. The best selection of the machines depends upon the type of work taken by the particular industry. There are many examples of spring rolling work include copper,

iron, tin, aluminum, brass and stainless. This project the "AUTOMATIC SPRING ROLLING MACHINE" finds a huge application in all spring rolling industry. Rolling is of bending metal wire to a curved form. The shape of the round is made by spring roller shaft. The rolling operation can be done on a hand or power-operated rolling machine. In making round spring shapes a gradual curve to be kept in the metal rather than sharp bends. The gap between the sp rings can be regulated by proper arrangement. Spring is elastic bodies that can be twisted, pulled or stretched by some force. The spring machine is made by a very simple arrangement. This machine is operated by a manual method. This machine produces a closed coil helical spring of different diameters and different lengths. In our project is the spring rolling machine. Rolling is the process of bending metal wire to a curved form

V. CONCLUSION

The single-stage supply is given to the sewing motor, it will run The pulley is coupled to the goad outfit pulley with the assistance of the belt. The goad outfit plan is to keep running as per the speed of the engine. Before switch on the acceptance engine, the spring wire is bolted to the secure nut in the spring moving shaft. The spring wire is supply by a spring wire tare. The tare is settled to the casing stand by two ends heading, with the goal that it will run openly as per the speed of the spring moving shaft. The spring moving shaft is turned when the single-stage enlistment engine exchanged ON. The spring wire is coming in the moving shaft because of the turn of the spring moving shaft. The length of the moving spring is chosen by the administrator. The required length of the spring is rolled; the single-stage acceptance engine is turned OFF.

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