

Manufacturing of Spring Making Machine

Prof. Ravi Verma¹ Hafizur Rehman Khan² Imran Khan³ Saif Ali Nirban⁴ Rahul Rao⁵

¹Senior Professor

^{1,2,3,4,5}Theem College of Engineering Mumbai University

Abstract— To design and manufacture the efficient machine capable to accurately manufacture and design the helical spring. We all have come across in the modern age of technology spring has got primary importance right from application of retaining the motion to the storing of the energy for some positive work. The springs, which we are going to manufactured, will be in various diameters of different stiffness of closed coil type or of open coil type, either to take compressive or to take the tensile load. Similarly to store the potential energy or to retain the motion or to achieve the inertia of the object. Also it is capable to absorb the shock in case of automobile or in case of the machine tools or the luxury equipments. The machine will be operated in such a condition that the spring which it will design will have an constant parameters Accurate motion of the shaft with respect to the tool guidance or coil wire supplience is the essential functioning of the machine. We have designed a machine which may be hand operated/motor operated depending upon the requirement.

Key words: Spring Design, Spring Making Machines, Coiling Shaft

I. INTRODUCTION

The conventional spring making machine consists of manufacturing the spring using lathe machine or by hand hammering operation by hot forging method. But to manufacture the delicate softer springs there was requirement of such a machine with the massive ability to manufacture the spring using special mechanism which simply utilizes the potential energy stored by the raised weight of the rack shaft and energy stored by the spring. Also it is installed with the special attachment of self pitch adjustment that is the inclination of the strip linkage is so adjusted that the inclined strip with the pre-selected angle when comes down, it will push the trolley with that rate of adjusting the pitch. The machine work on principle of gear boxes in which speed is varying using different gearing arrangements. We make this machine manually/motor operated.

This machine is very much useful for the small scale industries being:

- Low cost with no/less requirement of power and
- Less maintenance with automatic pitch adjustment arrangement.

II. THEORY AND CONCEPTS

A. Definition

Spring: A spring is defined as an elastic body, whose function is to distort when loaded and to recover its original shape when the load is removed.

B. Application of Spring

The various important applications of springs are as follows:

- 1) To apply force, as in brakes and clutches and spring loaded valves.
- 2) To measure forces as in spring balances.
- 3) To store energy, as in watch spring and
- 4) To absorb shock and vibrations as in car springs and railway buffers.

C. Concept of Spring Design

The design of a new spring involves the following considerations:

- Space into which the spring must fit and operate.
- Values of working forces and deflections.
- Accuracy and reliability needed.
- Tolerances and permissible variations in specifications.
- Environmental conditions such as temperature, presence of a corrosive atmosphere.
- Cost and qualities needed.

The designers use these factors to select a material and specify suitable values for the wire size, the number of turns, the coil diameter and the free length, type of ends and the spring rate needed to satisfy working force deflection requirements. The primary design constraints are that the wire size should be commercially available and that the stress at the solid length be no longer greater than the torsional yield strength.

D. Problem Statement

Every dynamic spring is subject to these constraints where variation of forces and alignment takes place. Instability, even whilst the spring is guided, can lead to stiffness fluctuations, scuffing, and other undesirables. And also many companies manufacture valves and also in the cam operation automobile applications and they required the springs for installing in their products (hydraulic valves). Depending upon the valve size there is variations in sizes and shapes of springs, hence company are facing problem due to variation in parameters of spring. Approximately one-third of defective springs result from production problems. The other two-thirds are caused by deficiencies in the wire used to form the springs. In 1998, researchers reported the development of a wire coil ability test (called FRACMAT) that could screen out inadequate wire prior to manufacturing springs. Understanding the Industry problems and based on its usage criteria, we have designed and developed a spring making machine.



Fig. 1: Dynamic Spring

E. Objectives

According to the problem statement defined above, we chalked out the requirements, which are as follows:

- 1) To avoid use of different machines for the production of springs having different pitches, helix angle, coiled diameter.
- 2) To reduce manufacturing cost.
- 3) To reduce investment cost on machine.
- 4) To increase profit of company.
- 5) To save time.

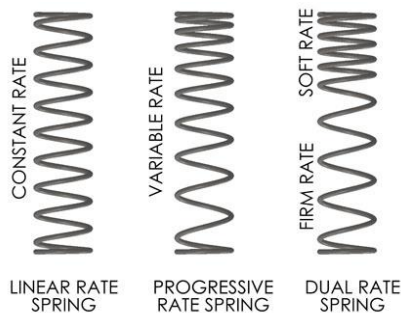


Fig. 2: Different Springs

F. Past Researches

The springs which are manufactured somewhere does not meet the standard parameters such as helix angle, coiled diameter, pitch etc. Thus when used in the practical application the springs life reduces due to unevenness in the design parameter stated above. Due to not uniformity in the design of the spring's pitch and helix angle the springs may not withstand the load for which the spring is design to take up the load.

G. Spring Materials

One of the important considerations in spring design is the choice of the spring material. Springs are usually made from alloys of steel. The most common spring steels are music wire, oil tempered wire, chrome silicon, chrome vanadium, and 302 and 17-7 stainless. Other materials can also be formed into springs, depending on the characteristics needed.

Some of the more common of these exotic metals include beryllium copper, phosphor bronze, inconel, monel, and titanium. Titanium is the strongest material, but it is very expensive. Next come chrome vanadium and chrome silicon, then music wire, and then oil tempered wire. The stainless and exotic materials are all weaker than the rest.

Some of the common spring materials are given below.

- Hard-drawn wire: This is cold drawn, cheapest spring steel. Normally used for low stress and static load. The material is not suitable at subzero temperatures or at temperatures above 1200C.
- Oil-tempered wire: It is a cold drawn, quenched, tempered, and general purpose spring steel. It is not suitable for fatigue or sudden loads, at subzero temperatures and at temperatures above 1800C.
- Chrome Vanadium: This alloy spring steel is used for high stress conditions and at high temperature up to 2200C. It is good for fatigue resistance and long endurance for shock and impact loads.
- Chrome Silicon: This material can be used for highly stressed springs. It offers excellent service for long life, shock loading and for temperature up to 2500C.

- Music wire: - This spring material is most widely used for small springs. It is the toughest and has highest tensile strength and can withstand repeated loading at high stresses. It cannot be used at subzero temperatures or at temperatures above 1200C.
- Stainless steel: Widely used alloy spring materials.
- Phosphor Bronze/Spring Brass: It has good corrosion resistance and electrical conductivity.

H. Conical Compression Springs

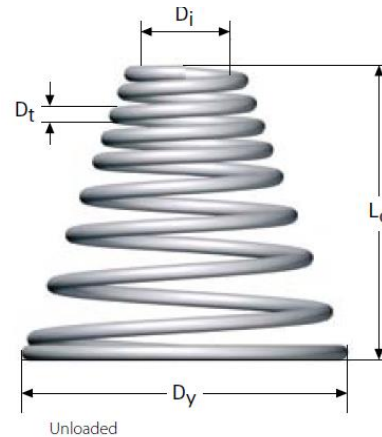


Fig. 4: Conical Compression Springs



Fig. 5: Springs

All dimensions are in mm

D_t = Wire diameter

D_i = Inner diameter, narrow end

D_y = Outer diameter, wide end

L_o = Unloaded length

n_t = Total number of coils

F_{st} = Spring force in Newton at full compression

L_{st} = Solid length

Conical compression springs replace cylindrical compression springs where axial space is limited. The conical spring is chosen to allow the coils to fold into each other when the spring is completely compressed.

III. MACHINE DETAILS

It is the special purpose machine mainly designed and fabricated for the grooving purpose. It is purely manually operated. With better mechanical advantage using gear drive. It is compact and can be conveyed to desired place easily.

A. Working of M/C

The machine works on principle of gear boxes in which speed is varying using different gearing arrangement. We made this machine manually operated. Te working is easily understood in below figure. In below figure the input revolution is given to upper shaft. The holding chuck is mounted on upper shaft. The rpm of upper shaft is same as in put revolution. A moving nut is mounted on lower shaft on which coil holding trolley is mounted .the output shaft is attached with lead screw & nut arrangement .the traveling

speed of trolley is depends upon gearing position of gear box.

The pitch of spring is adjusted by gearing i.e. speed of lead screw is constant & upper shaft speed is variable that means at high speed pitch is more vise versa. Also by changing spring shaft coil diameter of spring is changed.

B. Advantages of Machine

- No external source is required as machine is manual operated.
- Different pitch & coil diameter is obtained
- Force required to make spring is less.
- Machine is portable & compact.
- Less skill is required to make spring.

C. Disadvantages of Machine

- Only coil spring is manufactured.
- Rate of production is low.
- Wire diameter up to 5 mm spring is made.
- Length of spring is limited up to length of screw.
- Only four different pitch is made.

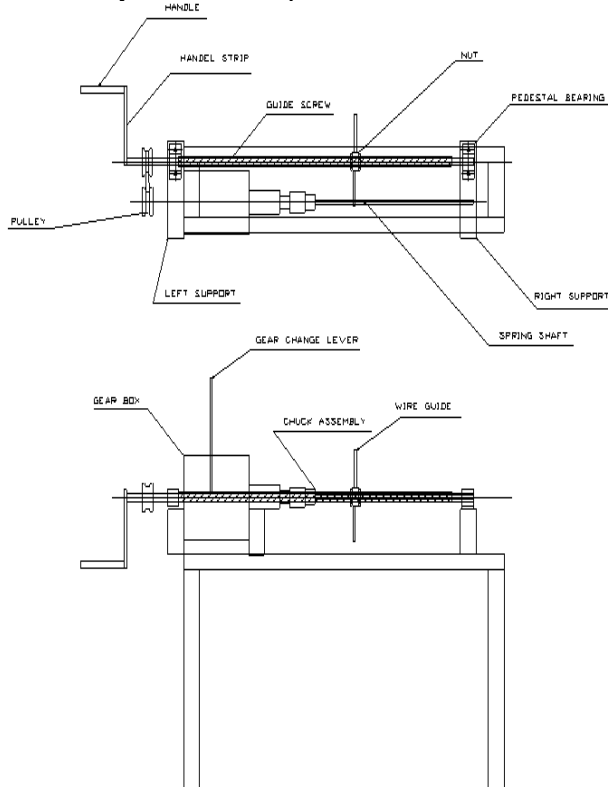


Fig. 6: Dimensions

D. Applications of Machine

- In small scale industries for producing small springs.
- For producing tapered and conical springs.
- For producing springs of constant as well as varying pitch.
- In toy making industries for producing small springs to be used in toys.
- In watch making industries for producing springs to be used in watches.

E. Machines Specifications

- SHAFT – variable diameter shafts are their depending upon the coiled diameter needed.
- GEAR BOX—it is a single stage gear box having spur gear to minimize the cost of the machines.
- BEARING—roller bearing is used as there is no high radial force acting on it.
- CHUCK—standard drill chuck of mild steel is used.
- LEAD SCREW—made of mild steel has a carbon content from 0.15% to 0.30%.
- HANDLE—if it is hand operated the handle is provided and made up of mild steel.
- MOTOR—for faster production motor is provided.

F. Design Specifications of the Machine

- Shaft - En 8.
- Gear Box -Spur Gear Box
- Gear - Mild Steel.
- Bearing - Skf6204.
- Chuck - Standard Drill Chuck Mild Steel
- Bolt - M12.
- Cover Sheet - Mild Steel
- Lead Screw - Mild Steel
- Lead Nut - Mild Steel
- Frame - Angle (40 X 40 X 5 Mm).
- Handel - Mild Steel

G. Modifications

Our project is simply a spring making machine, which is hand operated without consumption of power. Following different modification can be done to improve the output and efficiency.

- It can be made power driven, by installing reversible motor thus the productivity can be increased.
- The gear holding shafts can be extended and can be used as sheet-shearing machine.
- By utilizing the long teeth gears in between the two post (sliding housed) this machine can be utilized as sugarcane juice abstraction (extraction) plant.
- By replacing the wire holding chuck by drill chuck it can be used as the drilling and by installing tap set it can be used as tapping machine.

Hence by having above modifications above machine can be made a multipurpose output machine, which can be may power driver as well as manually operated.

IV. LITERATURE REVIEW

A few papers where discussed about the different types of mechanical springs used in the suspension system of automobiles. Also the different modes of spring failure and modifications were developed and validating the procedures for predicting the fatigue stress analysis.

M. T. Todinov (1999) author had given for helical compression spring with a large coil radius to wire radius ratio, the most highly stressed region was at the outer surface of the helix rather than inside.

The fatigue crack origin was located on the outer surface of the helix where the maximum amplitude of the principal tensile stress was calculated during cyclic loading; according to the author fatigue design should be based on

the range of the maximum principal tensile stress .from All the papers referred we came across that spring undergo failure due to unevenness in the spring parameters so as to avoid this unevenness in the parameter we came to the conclusion to manufacture machine which would produce spring having an constant parameters. By making simple arrangement of lead screw coupled with the coiling shaft.

V. CONCLUSION

The spring manufacturing machine is designed and manufactured by using gear changing and shaft coupling principle. It consist mainly three phase induction motor, gearbox, different diameters shafts ,gear changing lever, wire feeder from which spring would be formed. On the spring making machine we can make springs of different diameters constant pitches coiled as well as tapered spring can be formed. The manufactured springs have an constant parameters. This machine manufactures the constant parameters and of constant pitches and thus reduces the failure of the spring due to changes in the parameters.

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