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Design & Analysis of coil making machine (Servo Feed Version)

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ABSTRACT

This paper is all about making and analysis of Coil Making Machine for Circlips Manufacturing industry. As demand for Circlips is increasing day by day thus the supplier wants to make the process more error proof and speedy. This paper focuses on the material and calculations for the same which will help the manufacturers to increase their productivity.

Key words — Circlips, Coiling Machine, Servo Feed, and Special Purpose Machines.

I. INTRODUCTION

Circlips are often used to secure pinned connections. Circlips are basically of Two types: Internal Rings for holes (referred as J, JK, B-type). External Rings for shafts (referred as A, AK, AS, AL-type). The quality requirements here are very strict and too close tolerances has to be maintained. Indian as well as Foreign customers are day by day increasing their quality requirements so as to be in the race of increasing Customer Demands. To cope with the customer's demands and compete with other manufacturers the production process should be made more defect proof and regular monitoring should be done at all stages of production.

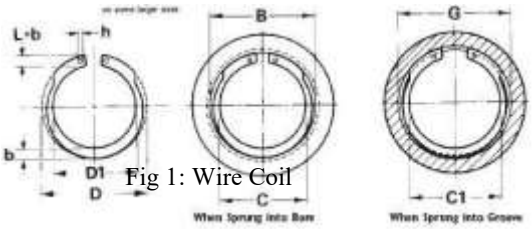

Fig 1: Wire Coil

Fig 2: Wire Coil

Circlips can be made by the following Two methods:-

i. Directly stamping from steel strips, but this method leads in wastage of costly Raw Material, up to 75% scrap is generated.

ii. The other process includes bending a required section wire into round coils and then ID/OD can be cut in the required shape, this method generates less than 10% scrap.

II. BASIC CONCEPT OF WIRE - COILING

➢ **Theory of Circlips making**

As said early manufacturing circlips from metal strips is an easy but costly business as more scrap is generated which leads to wastage of precious material. Thus to make circlips out of trapezoidal wire leads to increase in profit. But the machines for this method are a bit complicated and difficult to set and operate. This project aims to standardize the setting done for getting the desired output coils and involve very less parameters changes for component changeover.

III. OBJECTIVE

The main objective behind this concept is:

- To make a machine which can make coils with OD tolerance of +/-0.1mm and thickness tolerance of +/-0.06mm?
- The coils produced will directly be picked up by a Linear Transfer Mechanism for next operation i.e. stamping.
- To achieve more than 60 coils per minute with exact gap for External Rings.
- To produce perfectly flat and dishless coils, so that the components produced are also flat.
- To save material which is wasted in coils with less coils.

- Servo motor will be used for feeding of wire with a reduction gearbox. To standardize the settings of machine.
- To reduce setup time.
- To reduce setup rejection components.

Fig 3 : Coil showing gap Variation [1]

Fig 4 : Coil with Helix[1]

IV. PROBLEM IDENTIFICATION

In the present condition these coils are made on Wafios make (German manufacturer) machines and Flora make (Indian) manufacturer machines.
The output coils on these machines are with OD range of +/-0.3mm. Skilled manpower is required for setting the required diameter.
Gap setting is by trial and error method. All machines needs frequent maintenance.
It is been proposed to make all the 3D modeling and designing using Pro-E software while the analysis for heat generation and load calculations will be done using ANSYS software.

V. LITERATURE REVIEW

Many SPM (Special Purpose Machine) manufacturers are working constantly for the same purpose. These machines are very high end machines and very costly.
The selection of this project is done so as to make a cost effective machine in-house.
Importing such machines from outside is a costly and tedious job as the machines Line is very big in Size.

VI. WIRE FLOW PATH

Wire from a 500kg bundle is unwinded on a decoiler which is kept horizontally. It is then passed through a traightner for straightning so that any primary induced stress in wire is removed. It is then pinched by two pair of feeding rollers which feed wire upto the coiling station. These rollers are basically responsible for applying the 300Nm torque required for coiling the wire in a circular form. Wire is guided throughout its path in a wire guide made specially for each type of wire, this is done so that the wire does not repel back or divert from its path upto the coiling roller station. Wire then travels through set of three rollers maintained at pre determined distance to form a circle of desired size. Once the circle is complete an Hydraulically actuated ram cuts the remaining wire and then it is ejected by a pneumatic cylinder into a collection bin kept beside.

VII. RESEARCH METHODOLOGY

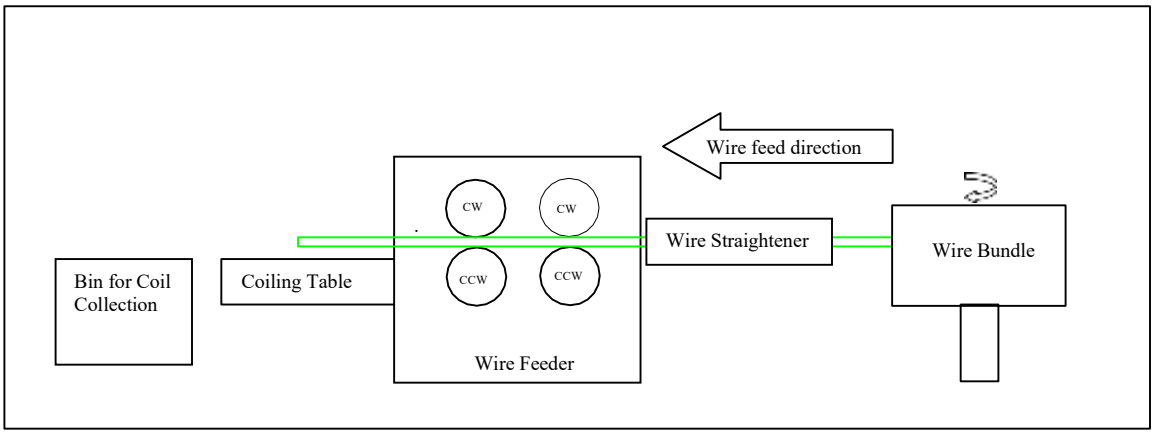

Fig 5 : Line Diagram of proposed Coil Making Machine

As shown in the above figure the machine will consist of the following major parts:

- Wire Decoiler
- Wire Straightner
- Wire Feeder (Driven by Servo Motor)
- Coiling Table
- Collection Bin

Wire after passing through wire guides is brought up-to the pinch rollers. These pinch rollers will be driven by a Servo motor Via Gear box.
Wire will be then pushed through a set of rollers which will bend it into the required diameter coil. Cutting of the extra wire can be done by a Die-Punch Set driven by a Hydraulic cylinder, after cutting the coil will be ejected and get collected into a bin or a mandrel kept aside. At this point cycle will start again.

VIII. CONCLUSION & FUTURE WORK

In this paper we have established a basic line for the manufacturing of the machine. All work and modeling has to done with the help of Pro E and ANSYS softwares, for better understanding and visuliasition.

Future Work:

- Design of Gears ,
- Power transmission from motor to gear box and GB to Feed rollers so that all four rollers rotate at same speed,
- Feed length adjustment module
- PLC programming
- Pre installed programs for particular size of coils will be done step by step.
- Conclusion:
- The coiling machine is seems to be OK and sturdy at initial designing stages.

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