Design and Fabrication of 0.5mm KLIICK Pencil Assembly Machine

Ashish Chaudhari, Hemant Isai, Sumit Jha, Abhijeet Shetake, Mitesh Thakkar

Abstract: This work aims at design and development of Special Purpose Mechanism for assembly of 0.5mm klick lead pencil for KOKUYO CAMLIN LTD. The important assembly stations consists of feeding the lead on the assembled pencil with barrel and chuck with the help of special fixture and pneumatic circuit followed by mounting cylindrical eraser over the pencil barrel and at last pencil cap for feeding the lead forward during working. All the three operations are simultaneously carried out over the turn table which rotates in forward step and dwell period with use of special Geneva Mechanism. The design of jigs, fixtures and pneumatic circuits will be done on Solid Works and simulated using ANSYS if necessary. The designed component will be then manufactured and fabricated at KOKUYO CAMLIN CAMPUS at Vasai Road and will be tested for the product. The results expected will be less assembly time and faster work production which saves human errors, electricity and time of production.

Keywords: SPM, Chuck, Jig & Fixtures, Geneva Mechanism.

I. INTRODUCTION

Now days to withstand competition of corporate world, marketing cost of product should be minimum as compared to competitor, with providing excellent quality of product. To maintain the balance between quality Excellency and dual profitable cost, the manufacturer needs to be updating the technology. The automation is necessary for this purpose. Every mega factories also small entrepreneur is therefore titled towards the installation “special purpose machine” for fulfilment of their manufacturing requirement.

The project is about design and manufacturing of jig and fixtures. The design and manufacturing operations are performed station wise. The roadmap to reach the destination of our project will be as follows:

This work aims at design and development of Special Purpose Machine (SPM) for assembly of “0.5mm Klick Pencil Assembly Machine” parts. The parts to be assembled are:

- Lead
- Eraser
- Eraser Cap

II. MOTIVATION

In this world of competition time and speed are important parameter in each field. In production line speed and time are inversely proportional parameters, which mean production speed must be high enough to consume less time, with best the quality of product. Engineers are constantly working on the fulfillment of this purpose. The project is related to idea. It is slightly on the other way of above parameters along with them. “0.5mm Klick Pencil Assembly Machine” aims at reduction in labour cost with increment in profit. As a future engineer we are going to try our best at professional levels. “0.5mm Klick Pencil ” is actually automation based project, which aims at reducing the labour cost which in turn increases profit of company. In current time, the assembly of mechanical pencil takes place manually.

III. DEFINITION PROBLEM

Fig. 0.5mm Klick Pencil Parts

The 0.5mm Klick Pencil consists of 10 parts as mentioned in above fig. Currently, the assembling of parts i.e., Lead, Eraser, Eraser Cap is carried out manually as shown in above fig., involves 16 manpower which results in:

- Slow production rate
- High production cost
- Lead breakage

To overcome the above problems, we decided to automate the process i.e., to develop the special purpose machine for the assembly of parts which are Lead, Eraser, Eraser Cap.

IV. METHODOLOGY

Working:

Revised Version Manuscript Received on March 27, 2017.
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A. Components:
Following components are utilized in the machine:
- Pneumatic cylinder
- Jigs and Fixtures
- Pneumatic Fingers
- Slider
- Proximity Sensors and Controller
- Bearings

V. THEORETICAL EVALUATION

B. Pencil Feeding Hopper Calculation:

- Volume of Pencil:
  Diameter of Pencil = D = 12.1 mm
  Length of Pencil = L = 137 mm
  Taking 5mm clearance,
  L = 137 + 5 = 142 mm
  Considering Pencil a Cylinder,
  Volume of 1 Pencil = \( \frac{\pi}{4} D^2 L \) .... (eqn. no.1)
  \[ \frac{\pi}{4} 12.1^2 \times 142 \]
  = 16.28 cm\(^3\)

C. Pencil Hopper:
Hoppers are used for the temporary storage of materials. It is a container type thing in which raw material is fed at the initial stage. They are designed so that stored material can be dumped or fed to a process easily. Most hoppers are made of steel. In our case, Hopper is the first station in which pencil barrels are fed.

D. Calculation for Pencil Hopper Capacity:

E. Volume of Hopper:
Volume of Part-1(Rectangle), \( V_1 = l_1 \times h_1 \times b \) .....
Volume of Part-2(Right Angle Triangle),
\[ V_2 = 2 \times \frac{1}{2} \times l_2 \times h_2 \times b \] ....
Volume of Part-3(Rectangle), \( V_3 = l_3 \times h_2 \times b \)
\( \) ....... (eqn. no.4)
Volume of Part-4 (Right Angle Triangle),
\[ V_4 = \frac{1}{2} \times l_3 \times h_3 \times b \]  \hspace{1cm} (eqn. no. 5)
Total Volume of hopper = \( V_4 + V_2 + V_3 + V_4 \)  \hspace{1cm} (eqn. no. 6)

F. Lead Hopper:
Leads are fed into the Lead Hopper so that they can be drawn into the pencil barrel. Two drums are used in the lead hopper which have a single slot on each of them so that lead can be fed properly in the drum. As the drum rotates, lead can be fed into the pencil barrel.

G. Lead Feeding Hopper Calculation:

\[ \text{Volume of hopper:} \]
\[ \text{Volume of part 1} = \frac{1}{2} \times l_1 \times h_1 \times w \]  \hspace{1cm} (eqn. no. 7)
\[ \text{Volume of part 2} = \frac{1}{2} \times l_2 \times h_2 \times w \]  \hspace{1cm} (eqn. no. 8)
\[ \text{Volume of part 3} = l_3 \times b_2 \times w \]  \hspace{1cm} (eqn. no. 9)

\[ \text{Volume of Lead:} \]
\[ \text{Volume of lead} = \frac{\pi}{4} \times d^2 \times l \]  \hspace{1cm} (eqn. no. 10)

\[ \text{Critical Buckling load is given by,} \]
\[ P_{cr} = \frac{\pi^2 \times E \times A}{(Cr)^2} \]  \hspace{1cm} (eqn. no. 12)

VI. RESULTS
1. Reduction in manpower.
2. Reduction in space requirement.
3. Precise operation.
4. Reduction in overall cost of assembly process.
5. Reduction in time.
6. Fabrication cost of machine will overcome within one month.
7. Reduction in rejection rate.

VII. CONCLUSION
In this thesis, the assembly line is modified from manual to automation to fulfill this purpose, an assembly machine is developed at very low cost, with a payback period of less than one month. Before process automation, the required manpower for the product (Mechanical Pencil) assembly was 16 persons. Now, after the development of machine, we have successfully reduced 15 manpowers. Now only one operator will be required to handle the machine. The productivity is improved by 40%, it is a very great achievement in field of process automation.
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