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Design of Automatic Magnetizing Workstation In The I-Booster Assembly Line

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Abstract: - The proposed work describes the design and development of an automated magnetizing workstation in the i-Booster assembly line. The i-Booster assembly line has four workstations, loading, magnetizing, insertion and clipping. Magnetizing the steel plates in the magnetizing unit before inserting it into the i-Booster is the main objective. The steel plates are magnetized and inserted into the core in opposite polarity alternatively. The magnetizing workstation is designed and 3-D model has been developed using 3-D based software called Autodesk Inventor.

Keywords: - *Magnetizing workstation, i-Booster, Autodesk Inventor, Assembly line.*

I. INTRODUCTION

A workstation is considered any point on the assembly line in which a task is performed on the part. Once the part enters the station, the task is then performed on the part, and the part is fed to the next operation. One of the main issues concerning the development of an assembly line is how to arrange the tasks to be performed, this arrangement may be somewhat subjective but has to be dictated by implied rules set forth by the assembly line sequence in order to assemble an efficient i-Booster. Hence, an optimal automated magnetizing workstation has to be developed in the assembly line.

The i-Booster is an electromechanical brake booster that provides situation-dependent support when the driver initiates braking. The i-Booster makes hybrid and electric vehicles even more efficient, while enhancing safety through shorter braking distances.

II. OBJECTIVE

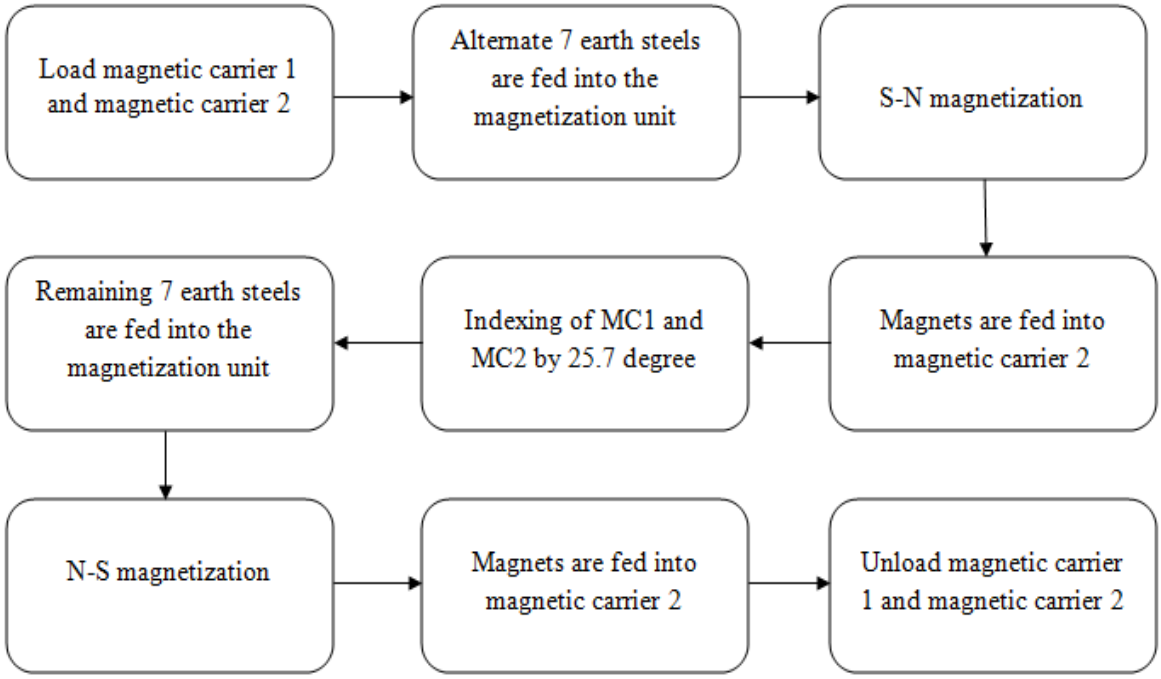
The main objective of the project is to design a workstation in which the earth steels are magnetized in opposite polarity i.e., seven earth steels in S-N polarity and other seven with N-S polarity and inserted into the magnetic carrier 2 using finger set. Finger set is a set of seven fingers used to carry the steel plates from magnetic carrier 1 to carrier 2 via magnetizing unit. The i-Booster that is assembled has a core to which fourteen earth steels have to be magnetized in the opposite polarity and inserted with the clips. Presently in the assembly line, the first workstation is operated manually by inserting fourteen earth steels into the magnetic carrier 1 which is then carried to the next workstation i.e., the magnetizing workstation where these earth steels has to be magnetized and inserted into magnetic carrier 2 and is sent to the third workstation for insertion of magnets into the core and it is sent to the fourth workstation for clipping.

III. PNEUMATIC CYLINDERS

Pneumatic cylinders are mechanical devices which produce force, often in combination with movement, and are powered by compressed gas. To perform their function, pneumatic cylinders impart a force by converting the potential energy of compressed gas into kinetic energy. This is achieved by the compressed gas being able to expand, without external energy input, which itself occurs due to the pressure gradient established by the compressed gas being at a greater pressure than the atmospheric pressure.

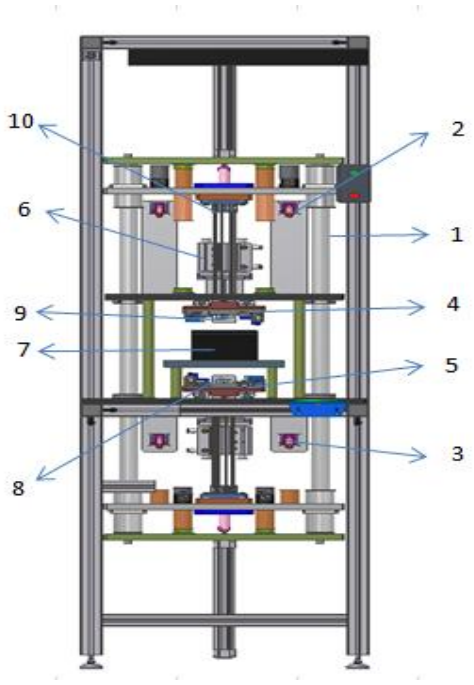
In the magnetizing workstation, the pneumatic cylinders have been selected for actuation in linear motions. The reasons for selecting pneumatic cylinders are reliability, simplicity of design and control, easy storage of gas, safety, high speed, easy availability.

IV. METHODOLOGY AND WORKING



The magnetic carrier 1 with fourteen earth steels and magnetic carrier which is empty is loaded into the fixture 1 and fixture 2. Then the alternate earth steels are fed into the magnetizing unit by finger sets which are driven by pneumatic cylinders. These seven earth steels are magnetized in S-N polarity and fed into the magnetic carrier 2. Then, the magnetic carrier 1 and 2 are indexed by 25.7º (360º/14) using pneumatic cylinder. The remaining sevenº steels are then fed into the magnetization unit and the steels are magnetized in N-S polarity. These are then fed into the magnetic carrier 2 and all the fingers are retracted. Then, both the carriers are indexed back and unloaded

V. DESIGN AND MODELING OF THE MAGNETIZING WORKSTATION



1- Structure
2- Stopper assembly 1
3 -Stopper assembly 2
4 -Upper load unit
5 -Lower load unit
6 -Load unit stopper assembly
7 -Magnetizing unit
8 -Magnetic carrier 1
9-Magnetic carrier 2
10- Finger set

Fig.1: Model of the magnetizing workstation

The subassemblies which are assembled together to form the workstation has unique features, components and work methodologies, which are

- Structure of the workstation is used to hold the different subassemblies of the workstation at their respective positions. It also has two Compressed air cylinders [SeriesPRA, double acting type, 32mm diameter and 320mm stroke length] which is used in the vertical movement of the finger sets.
- Stopper assembly 1 is a subassembly which consists of a Compressed air cylinder [SeriesKHZ, single acting type, 12mm diameter, 100mm stroke length] and a stopper which is used to stop the upper finger set carrying plate during the magnetization of the steel plates.
- Stopper assembly 2 consist the same components which are in stopper assembly 1 and the working procedure is also the same, but this assembly is used to stop the lower finger set carrying plate.
- Upper load unit is a movable unit along horizontal guide rails. The load unit is projected outside using a Mini cylinder [SeriesOCT, double acting type, 12mm diameter, 160mm stroke length] for insertion and removal magnetic carriers. Once the first cycle of insertion is completed the Magnetic carrier 2 is indexed by 25.7 degrees by the Compact air cylinder [Series CCI, double acting type, 16mm diameter, 100mm stroke length] which is mounted to the indexing plate. After the second cycle is completed the carrier 2 is indexed back.
- Lower load unit is similar to that of upper load unit with similar parts and working procedure but carriers the magnetic carrier 1. That is the insertion of loaded magnetic carrier 1 and removal of empty carrier.
- Load unit stopper assembly is used to stop the load unit when it is retracted from the home position i.e., the extended position to the working position. It consists of a Guide cylinder [Serier GPC, double acting type, 32mm diameter, 50mm stroke length]. This assembly is 2 in number i.e., one for upper load unit and one for lower load unit.
- netizing unit is a device which is used in the magnetizing workstation to magnetize the earth steels in both the polarities. It has seven slots in it through which the earth steels are magnetized by holding them in it for 5 seconds, this completes one type of magnetization i.e., S-N polarity. Then the coil is reversed inside the unit and the other set of steel plates are inserted to complete the N-S magnetization.
- Magnetic carrier 1 is simple in construction, it has fourteen through slots of earth steels shape and size. These slots are filled with steels manually and the carrier is inserted to the lower load unit and the empty carrier is removed after the cycle is complete.
- Magnetic carrier 2 has the same structure of that of magnetic carrier 1 but has a magnetic cylindrical body in it which is used to hold the magnetic steel plates in it. At first the empty magnetic carrier 2 is inserted into the upper load unit and after the cycle is complete the filled magnetic carrier with 14 magnet steels is removed from the load unit.
- Finger sets are 2 in number which are positioned vertically each having seven fingers. These finger sets are placed on the horizontal plate which moves vertically by the help of cylinders by carrying the steel plates from magnetic carrier 1 to magnetic carrier 2 via magnetization unit.

VI. AUTODESK INVENTOR

It is a 3D mechanical engineering, design, visualization, and simulation software. Autodesk Inventor is a parametric and feature-based solid modeling tool. It allows converting the basic 2D sketch into a solid model using very simple modeling options.

VII. SEQUENCE OF OPERATION

1. The subassemblies and the load units will be at home position and the start switch is pressed manually.
2. The two magnetic carriers are loaded into the load units respectively. The magnetic carriers are located and locked in their proper position before beginning the cycle..
3. Advance the lower and upper finger sets till it touches the steel plates in the magnetic carrier 1.Then lower finger set is advanced and the upper finger set is retracted to carry the steel plates into the magnetization unit.

   4. Both the stopper assemblies are extended in order to hold the finger sets in that position during magnetization.
5. S-N magnetization is done.
6. Both the stoppers are retracted.
7. The lower finger set and upper finger set is extended and retracted completely so that all the 7 magnets are placed into the magnetic carrier 2.
8. Then finger sets are retracted completely.
9. Indexing of magnetic carriers is done by 25.7º.
10. Steps 3 to 8 is repeated in same order with N-S magnetization.

11. Then the Magnetic carriers are indexed back to their home position.
12. The magnetic carriers are unlocked and unloaded.

VIII. CONCLUSION

The workstation design is made in order to achieve the optimum magnetization of steel plates and inserting them into the magnetic carrier 2. This is achieved by developing 3-D models using Autodesk Inventor. The working and sequence of operation is described in detail under methodology.

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