GRAPHICAL ANALYSIS OF PERFORMANCE OF MAGNETIC DISC FEEDER

1VIVEK GOYAL, 2RISHABH KANDHARI, 3 UTKARSH GARG, 4 PRADEEP KHANNA

1, 2, 3 Student, Netaji Subhas Institute of Technology, New Delhi, India
4 Associate Professor, Netaji Subhas Institute of Technology, New Delhi, India
Email: 1 vivekg.mp@nsit.net.in, 2 rishabhk1.mp@nsit.net.in, 3 utkarshgarg26@gmail.com, 4 khanna@gmail.com

Abstract - With the growing industrial conscience for high production rate and maintaining market competitiveness automation has become an indispensable tool. For the efficient running of complex industrial systems with minimal human involvement automation is essential. It not only saves labour cost and time but also strives for a better quality and precision of product and processes. The objective of our research is to design, fabricate and optimise a magnetic disc feeder for feeding industrial components like headed fasteners. After conducting numerous trial experiments it was found that the output response that is feed rate was dependent on certain parameters like part population of the fasteners, speed of the disc and the number of magnets on the disc. A series of experimentation was done wherein parameter of interest was changed and feed rate was recorded. The results were analysed graphically and the direct and interaction effects of the parameters were discussed.

Index Terms - automation, design of experiments, graphical analysis, feed rate, magnetic feeder, headed fasteners.

I. INTRODUCTION
An assembly line is an arrangement of workers, machines, and equipment in which the product being assembled passes consecutively from operation to operation until completed. [1]

In an assembly line, a feeder system is used to transport parts from a predetermined location (for e.g. A hopper, Rectangular storage etc.) to the desired workstation at a specific feed rate and orientation.

The phrase "islands of automation" has been used to describe the transition from conventional or mechanical manufacturing to the automated factory [2]. Hence, Automatic Feeders form an integral part of modern industrial endeavour for a higher productivity as it allows faster material movement as compared to a manual system.

It reduces the cost and brings consistency in quality of operation. In chemical or pharmaceutical industries, where material handling by the worker could be detrimental, automatic part feeders become a necessity. It is of utmost importance that the output feed rate of the feeder matches the consumption rate of the machine to which the parts are fed.

II. CLASSIFICATION OF FEEDERS
Part feeders can be classified as [3]:
1) Reciprocating block feeder
2) Rotary disc feeders
3) Stationary hook feeder
4) Paddle wheel feeder
5) Hook feeder
6) Reciprocating tube feeder
7) Reciprocating fork feeder
8) Rotary centreboard feeder

9) External gate feeder
10) Magnetic disc feeder
11) Centrifugal tube revolving hook feeder

Magnetic disc feeders are used to feed parts made up of ferromagnetic material. They are economical to build and operate and hence widely used in the small scale industry. They can be used to hold parts of varying shapes and sizes too, hence this feeder was selected.[4]

III. WORKING:
In the feeder used for experimentation, a 12 volt DC motor is used to rotate disc with round slots cut to accommodate the magnets. A semi-hemispherical hopper is used as the storage device. The curves in the hopper allow the concentration of the bolts at the centre. As the disc rotates, the magnets (ranging from 1-12) fixed in the slots start attracting the parts which are then discharged at a desire point that is the delivery chute.

The delivery chute in our case has a slot in the centre and is uniformly curved so that the headed fasteners are in an upright orientation while it moves to the desired workstation. The feed rate depends on part population, RPM of rotating disc and number of magnets.

IV. PARTS

- Circular disc-Circular disc of thickness 8mm and diameter 300mm with 12 circular slots for magnets was used to pick up bolts from hopper.
- Hopper-The hopper is that part of the feeder where parts to be fed are stored. The hopper has semi hemispherical shape; this facilitates continuous feeding of parts as the feeder picks up
parts from the bottom. Dimensions: diameter: 280mm, Width: 150mm, Depth: 130mm

- **Delivery Chute**: It is a long C-shaped channel with slot in the middle to facilitate the delivery of the part in the correct orientation. It transfers the bolts from the feeder edge to the workstation. It was made up of sheet metal (2mm thick) and inclined at an angle of 60 degrees with the horizontal plane. Dimension: Width of slot: 8mm. Length of Chute: 300mm

- **Motor**: A DC motor with rated maximum RPM of 50, Voltage rating of 12V was used to rotate circular disc.

- **Power Source**: A constant current DC power source was used to supply variable voltage to the motor to drive circular disc at different speeds.
  - Input: 220V AC
  - Output: 0-24V DC.

- **Magnets**: Twelve numbers of permanent magnets were used.

- **Working Part**: Parts used for experimentation are threaded bolts. Diameter of bolt: 6mm.

- **Length of bolt**: 20mm.

V. EXPERIMENTAL WORK

The project is primarily aimed for fabrication and analysis of a magnetic disc feeder whose feed rate was found to be dependent on three factors [5]:
1. Part population
2. Number of magnets
3. RPM of the disc

**Ranges of the parameter:**
1.) No.of magnets were varied from 3 to 9 in the steps of 3.
2.) Part population was varied from 50 to 200 in steps of 50.
3.) RPM of disc was varied from 14RPM 26RPM in steps of 6.

Analysis was done by keeping any one of the parameters, namely, part population, number of magnets and RPM of the disc constant while varying the other two.

Set-I

![Figure 1: Magnetic Disc Feeder](image1)

![Figure 2: Magnetic Disc Feeder](image2)

![Figure 3: a, b, c Feed Rate v/s Part Population](image3)

In SET-I, the number of magnets were kept constant, part population and RPM of disc was varied. The number of outcoming parts were counted per minute to obtain the feed rate. This was repeated for 3 readings and their average value was calculated. Thereafter the graph between part population and feed rate was plotted for different RPM of disc.
In set 2, the RPM of the disc was kept constant, part population and number of magnets was varied. Thereafter the graph between part population and the feed rate was plotted for varying number of magnets.

**VI. ANALYSIS**

The trends pointed by the graphs of both the sets are discussed below:

**Effect Due to Number of Magnets on Feed Rate**

As can be seen from graphs of set-2, Firstly, when the number of magnets on the disc increases, the ability of disc to pick up the threaded bolts augments, hence the feed rate increases for each value of part population. Secondly, the other trend which can be deduced from the graphs was that the two forces that is interaction amongst bolts and interaction between bolts and magnets have a significant impact on the feed rate. At low and medium number of magnets, the mutual interaction amongst bolts dominates interaction between bolts and magnets, hence as part population increases feed rate goes down [6]. But when the number of magnets become high i.e. nine (in our case), the mutual interaction amongst bolts was never able to overcome the interaction between bolts and magnets, therefore an increasing trend was observed.

**Effect of RPM of Disc on Feed Rate**

As can be seen from graphs of set-1, as the RPM of the motor increases, the feed rate increases. This trend can be attributed to the fact that as the RPM of the motor increases the rounds taken by the disc per minute augments, hence improving the chances for the disc to attract more number of bolts per minute.

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**CONCLUSION**

The work represents an attempt to fabricate and analyse the working of a magnetic disc feeder for industrial use by studying the dependence of feed rate on various factors like part population, number of magnets, and RPM of the disc.

**REFERENCES**