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Design and Development of Vibratory Bowl Feeder

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Abstract - *The success of Automated Assembly in Mass Production hinges on the effective performance of automated high speed part positioned. One such part presenter is the conventional Vibratory Bowl Feeder (VBF). This project attempts to make progress in the development of a VBF.As earlier we use cross-pad assembly drive but it was not convenient as the error was more. So to overcome this problem we use small spring plate in the assembly drive. The project gives the information about the design, development and manufacture of range of automated orientation tools which, in combination, make up a typical orientation system for the VBF. Four prototype tools were developed: the wiper blade, the needle, the Spocket, the edge riser tool. These tools were focused for the purpose of the project on the feeding of a specific target component. The target component for which we are designing and orienting VBF are Square Metal Washer (Black component) and Square Plastic Washer (Orange component).*

***Key Words*: Wiper Blade, Edge Riser Tool, Needle, Narrow Track, Spocket**

I. INTRODUCTION

The principal object of this project is to provide a conveyor path which is of considerable extent and wherein the inlet and outlet may be located at the same or different levels or different relative positions. The conveyor track between the inlet and outlet functions as a storage reservoir for the purpose of maintaining a supply of components that may be fed independently in turn to one machine regardless of the rate of delivery of the component from another machine.

This project relates to the provision of a storage feeder bowl which provides a pair of inner and outer annular walls for supporting a descending and an ascending conveyor track for the purpose of depositing the articles in the bottom of the bowl and then picking them up and delivering them to the upper edge of the other annular wall of the bowl thereby providing a storage not only along the helical conveyor path but in the bottom of the bowl.

Vibratory Bowl Feeder(VBFs) employed to present parts to manufacturing machines in correct orientations are used mainly in high volume production. The VBF is essentially a fixed sequence feeding device, allowing a very limited range of parts to be accommodated for any given set-up and can therefore be considered unsuitable for batch manufacturing process.

II. OBJECTIVE

- To design and fully develop the automated orientation tool .This could be used as a prototype for future automated orientation tools.
- To identify, study and design a wide range of future tools that would in future provide a platform for a VBF system with large scale application in industry.
- To research various orientation tools developed for conventional fixed-sequence
- This information would assist in the design process helping to contribute to the development of Prototyping Automated Orientation Tools such as wiper blade, narrow track, edge riser, needle, spocket.
- To design and fully develop the automated orientation tool (The needle).

III. METHODOLGY

Vibratory bowl feeder has many assembly operations. The bowl sizes vary from 100mm to 500mm. The alternating vibrations produce a motion that will in practice because the product to proceed up the spiral ramp on the inside curved surface of the bowl. The upward spiral path has custom fiducials either attached to it or machined into it, so as to only allow parts in the predetermined orientation to make it to the top.

Parts that are not Parts that are not correct are dumped back into the bowl. So any particular part may make several short-circuited trips before reaching the top properly aligned. The product's motion up the spiral seems to defy gravity. This is not actually true, since the vibrational energy is causing the part to go up the spiral each cycle more than it goes down. The force balances at rest, upward and downward. Parts do get shaken tremendously before they reach the top.The key to the net upwards motion is a combination of the frictional coefficients, bowl incline and the angle of bowl vibratory motion, vibrational frequency and amplitude. Following fig show how the inertial force at the peak of the upward cycle need to be higher than the frictional force to move, and yet in the inertial forces need to be smaller than the frictional forces to not slip backwards.

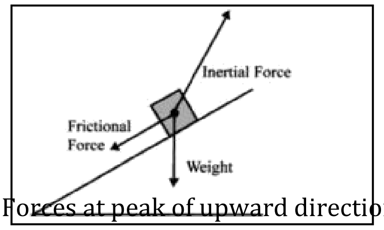

Fig-1: Forces at peak of upward directions

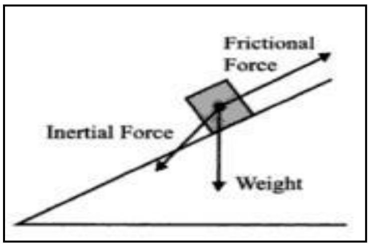

Fig-2: Forces at peak of downward directions

a. OPERATION

The electromagnetic parts feeder is a two-mass system. Mass one consists of the heavy base and rubber isolator feet, as well as the electromagnet. Mass two consists of the bowl mounting plate (often called the cross arm), the armature, and the bowl. The two masses are connected through four sets of leaf springs.

When the magnet receives power, vibration occurs because a pulsating magnetic field is established between the armature and the magnet. The springs permit the armature to move toward and away from the magnet, which imparts the vibration into bowl that ultimately moves the parts. The leaf springs are mounted at an angle, causing the parts to left off the bowl surface as they convey forward.

Generally, 60-hz power, part feeder normally vibrates at a frequency of either 3,600 or 7,200 vibration cycles per minute. To get a closer estimate of feeder speed, use the following:

$Fx = F \times A \times K$

Where;

FX = feeder speed

F = frequency (cycle or vibration per minute)

A = amplitude (length per cycle, for example, inch per cycle)

K = constant (factor is 1.3)

For example:

F = 3,600

A = 0.06*25.4mm/cycle

K = 1.3

Then:

(3600/60)cycle/sec*0.06*25.4mm/cycle*1.3

The estimated feeder speed or part travel =119mm/sec. Due to the effects of gravity, friction, and other factor, the maximum rate of part travel actually achievable is reduced. The 7,200 vibrations/min parts feeder is generally used when handling parts that are difficult to orient and sensitive to vibration. In this feeder, the parts are not moved as far per cycle, but are moved twice as many times as the 3,600 vibrations/min unit.

Fig-3: Wiper Blade and Needle Tools

Fig-4: Spocket and Edge Riser Tools

b. PERFORMANCE

Performance=
([(No of good component pass-under the wiper blade)-(No of Blockage*n)]*100)/(No of Components used in the Experiment)

Notation Expression:

Performance=$\frac{(N-R)-B*n}{N}$

Where,

N: is the number of Input components

R: number of Rejected Components

B: is the number of the Blockages

n: is the penalty factor

Table-1: Performance Table

Good	Reject	Block -ages	Performance with n=10	Performance with n=20
700	300	10	$\frac{700-100}{1000}$ $=60\%$	$\frac{700-200}{1000}$ $=50\%$
700	300	5	$\frac{700-50}{1000}$ $=65\%$	$\frac{700-100}{1000}$ $=60\%$

From above table it is clear that, the difference of the above observations is 10% and 5%, the results became clear and it was decided that more reliable and consistent performance number would have to be obtained. As the quantity of 200 components was too low and this should be increased to 1000 components for more consistent results.

IV. CONCLUSION

The main objective of this project is to contribute to the development of Vibratory Bowl Feeder. This has been achieved by the development and manufacture of orientation tool such as edge riser, wiper blade, needle, spocket. This orientation were implemented for the component Square Metal Washer (Black Component) and Square Plastic Washer (Orange Component).

Fig-5: Completed Vibratory Bowl Feeder

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