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A Review on Linear Vibratory Part Feeding System

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ABSTRACT

Industrial employers has to face challenges in the process of material handling unless a robotic system is not used for production, the resultant of the produced goods in the industry turns to be in undesired pose for the process of material handling. In those cases, part feeder is a solution to align the produced goods to the desired one for the specific process which ever it is, like stacking, packing etc. The purpose of this review is to segregate different methods that help to provide the industry in the orienting Products to the desired one to help in sub assembling using vibrating part feeder systems.

Keywords- Trap, Part Feeder, Orientation, Drop test

1. INTRODUCTION

Mass production industries are the main areas where the part feeders takes the role. Manual handling of the parts, turns to be a hectic work, which consumes time and energy of workers. So far the fast and reliable handling of materials is done by automation. In assembly automation part feeders take the main role to segregate parts for material handling. The parts to be handled may be symmetrical or non-symmetrical. So feeders are constructed accordingly to fulfil the purpose.

Two types of feeders are passive feeder and active feeder. Parts wrongly oriented are rejected and feeder will not pass the part through it and then it is passive orientation. The rejected part will go back to the initial position of the orientating process and continues to be rejected until the part randomly becomes correctly oriented before allowing the part to pass through the feeder. Active orientation places parts from the wrong to the correct orientation before allowing the parts to pass through the feeder. So active orientation consumes less production time and is more efficient than passive orientation. Hard automation, for a specific part, can help in achieving high economics of scale when producing of the parts in large volume. [1].

The part feeders consist of many parts like hoppers, singularizing unit, traps and conveyors. These systems altogether function to help in increase productivity and to decrease the lead-time of production. After the production, the products will be available as clusters or group, which has to be passed to the next level for sub assembling or material handling. So the first step in the process will be singularizing unit along with a hopper. Then the single units are been passed through traps. The main function of the trap is to align the component in its desired orientation for the proper material handling, preferably active feeders. The component can be arranged in many different orientations.

The favorable orientation has to be determined using experimental method and theoretical method. The most used experimental methods are family method and individual method. The theoretical methods are of four types, which are energy barrier method, stability method, centroid solid angle method and critical solid angle method. After analyzing all these methods, it comes to a conclusion of the most favorable method. Then the trap has to be designed to obtain the most favorable orientation. The favorable orientation can be obtained with the help of Markov analysis [2]. Machine vision systems are also employed in aligning and orienting parts in assembly automation. But this machine vision system makes more complicated in both structure and cost wise. The use of part feeders is the simple, cost effective method in assembly automation.

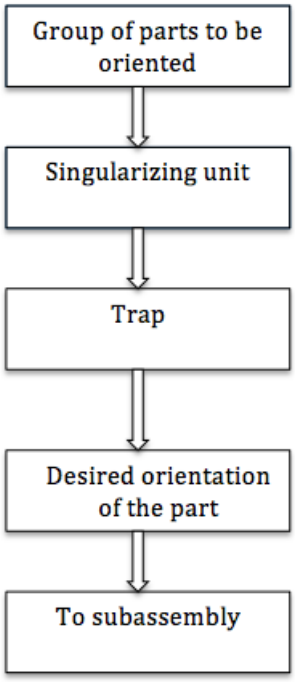

Fig 1 Subsystem of Feeding System

2. SINGULARIZING UNIT

The products that received by singularizing unit are in clusters. The final outlet sector for finished products is a area in an industry where volume production occurs. Those produced reach the end of production for organizing in packing or assembling. So the parts have to be individualized or the process. Singularizing unit helps to singularize or individualize by separating from clusters [6].

This type is used for singularizing cylindrical parts of various lengths and diameter. Deflator blades are non-vibrating blades which helps for separating. In this case, before orienting the part, singularization has to be performed. The working parameter of the singularizing unit are the blade angle and the belt speed [1]. Other kind is, vibrational nodes helps the motion of particles at a frequency level set. Part orientation also changes to the speed of frequency and where it is provided [8].

However, the singularizing operation is performed and then change of orientation operation to follow. This is not the mandatory method. This can also be reversed. The change of orientation can be performed first and the singularizing operation can be done later.

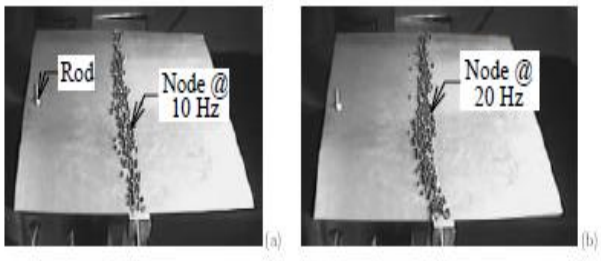

Fig 2 Part motion at different Frequencies

3. ORIENTING UNIT

The unit helps to change the pose of the part to desire one different kinds of units are illustrated in figure 3.

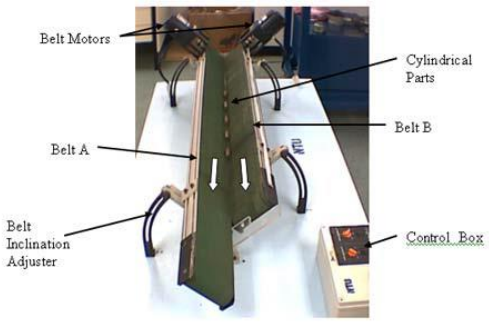

Fig 3 The Orientating Unit

The kind of orienting unit showing in figure 3 is used for orienting cylindrical parts of various dimensions. It is a V shaped conveyor belt. Two flat belts are joined at horizontal angle to help in orienting. It has a different belt roughness and move at different speeds [1].

The above mentioned orienting unit suits only for a particular product of varying sizes. The other available methods of orientations are discussed as follows.

Another kind of orienting unit is the fence orientation. Determination of various fence orientations is an incapability of this kind of orienting unit. It helps to align parts while in motion through the conveyor [4].

Blade horizontally mounted is a sort of unit. Feeder wall is attached with a metal plate which is parallel to track. This is a sensor less system. These orientation and rejection take place while obtaining the desired pose [3].

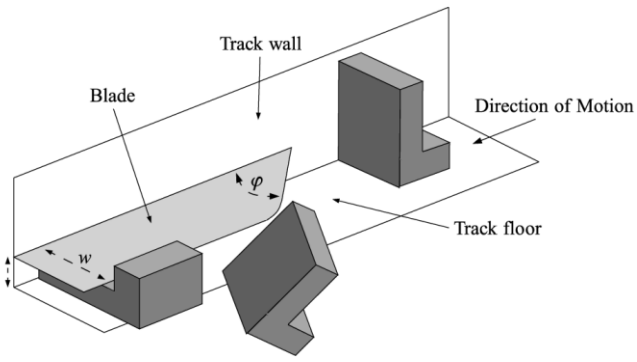

Fig 4 Horizontally mounted blade in track

Geometrical structure change of projections for orienting unit can be used to orient other objects like rectangular blocks traps. Another kind of parameter includes the wiper blade, edge raiser, narrowed track and the wall projection. By using the three supports such as of wiper blade, narrowed track and edge riser it is possible to change the orientation of the rectangular block. It is a passive kind of orienting unit. Orienting fitters are applied one after the other [2, 14]. For orienting a cap, the use of wiper blade, wall projection and narrowed track is employed. To reject the undesired pose and to recalculate, the wall projection and narrowed track is applied together, so this is also passive type. Another passive type feeder uses only narrowed track consisting of a balcony and a gap. Part which helps in rejecting the undesired pose is gap and part helps for feeding desired part is balcony [5, 10]. Infrared reflective sensors are used at the scanning station to determine the orientation and to send the date to computer [7].

Software is used in modular orienting devices to design vibratory bowl feed along with the integrate part design using CAD to count the part for its geometrical features [13]. Other method used in vibratory bowl feeder to orient part is Air Jet. The major issue with these feeder is part jamming as a result the output of the feeder shuts down. Close to track surface, air jet is placed on the track wall to prevent the part jamming [16]. This helps to overcome such issues in the way mentioned below.

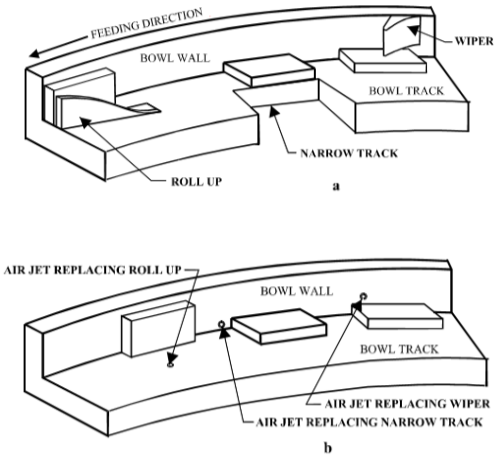

Fig 5 Air Jet Equivalence

This example shows the difference between conventional vibratory part feeder system and air jet part feeder system where the air jet is used as an active tool which aligns the products in the path of the feeder.

4. CONVEYING VELOCITY

Vibratory conveyor helps in part motion with the help of increase in vibration amplitude. When amplitudes are small, the parts are at stationary due to parallel inertia of force is small. The parallel and normal components of force are [15, 17]

$m_p a_0 \omega^2 \cos\psi$ and $m_p a_0 \omega^2 \sin\psi$ respectively. … (1)

Where

$F = \mu_s$

$N = \mu_s [m_p g\cos\theta - m_p a_0 \omega^2 \sin\psi]$ and

μ_s is the coefficient of static function between part and the track [9, 12].

5. ANALYSIS

Different methods that represent for the analysis of orientation for the purpose of material handling, i.e, the chosen one are the theoretical method and the drop test method. The correlation of the results if the above two helps to obtain the favourable orientation of the part.

5.1. Theoretical Method

Basically 4 methods are available to analyse using theoretical method. The methods are,

- Stability method
- Controlled solid angle method
- Critical solid angle method and
- The energy barrier method [18].

Each methods are analysed separately. The study is undergone on the part to check whether the theoretical results correlate with the results obtained through drop test.

5.2. Experimental Method

Family method and individual drop test methods are the two experimental methods used to analyse the orientation of parts. The drop test helps to find the frequent resting pose of part when the sample part is dropped from a height, then the resting orientation is recorded [11]. So that the pose that occurs maximum is the most occurring resting pose [18].

6. OBSERVATIONS

Undergoing a review on part feeders, it is understood that there are different sorts if feeders in the industry, of which the vibratory bowl feeders (VBF) are the most preferred ones. VBF are passive kind of part feeders where they rejects the un-oriented parts back to bowl for recirculation.

When a pick and place manipulators is used for assembly, this system alone will not be effective as the part to be oriented depends on the probability of the part to be oriented.

In such a case, active feeders are employed where no rejection of part takes place and deserved pose of the part exits the feeder. With the active feeders in assembly automation the complicated equipment usage used for image processing and link systems on the manipulator can be eliminated. This production time reduction can be enhanced by high production capability of the industry.

7. CONCLUSION

The area where the employees have to devote their time and capability is in mutual handling. So this turns out to be the great concern of industries. Here the part feeders has a role of assisting in material handling. There are different sorts of part feeders where each one has its own capability and performance measures. The part feeder suitable for one assembly process may not assist other assembly procedure. The purpose of the paper is a deep insight on the kinds of feeders that can assist material handling for assembly automation to help increase the production in large scale.

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