VIBRATION FEEDING OF SMALL PARTS

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Abstract

- Vibratory feeding of small parts with length 0.5 mm to 5 mm? Can it be done?

- Small parts are usually manipulated by gripping (micro assembly)!

- Vibratory feeding is suited for parts with minimum length 6 mm and width 3.6 mm.

- What are the main problems with vibratory feeding of smaller parts?

- How can they be solved?
Vibratory feeders

• Vibratory feeders are the most versatile type of machine for feeding and orienting parts
• Main parts: - vibrating unit
  - track
  - bowl
• Are weary expensive
• The tooling is made for each part separately

Problems with small parts

The main problems are the:
Adhesive forces; because of them the parts stick to the bowl, to the other parts and track
Adhesive forces

This forces are present every where but they don’t have a big influence until we are working with small parts. For vibratory feeding of small parts three main forces accrue:

Surface tension force

Van Der Walls forces

Electrostatic attraction
Adhesive forces and dynamics of part vibration

Because of adhesive forces a large acceleration is required $a > g + x$ where $x$ is the acceleration related to adhesive forces.

From second Newton law we calculate the requirement for a part come loose in the presence of adhesive forces:

$$\frac{1}{A \omega^2} \left( g + \frac{F_{adh}}{m} \right) < 1$$

Where $A$ is amplitude and $w$ is frequency of the tooling plate. $G$ is the gravitational force and $m$ is the mass of the part. Adhesive force $F_{adh}$ can be calculated from:

$$F_{adh} = \left( \frac{1 - K}{K} \right) F_{grav}, \quad K = \frac{g}{A \omega^2} \quad \text{and} \quad F_{grav} = mg$$
Piezoelectrically driven vibratory parts feeder

Typical piezoelectric vibration generator having piezoelectric elements attached to opposite sides of a resilient plate for generating slight vibratory motion. Vibratory parts feeder incorporating such piezoelectric vibration generator for feeding small parts in a predetermined supplying direction.
Components

Piezoelectrically driven vibratory parts feeders include:

- a base
- a vibratory conveyor table
- parts feeder bowl
- four piezoelectric vibration generators
Piezoelectric vibration generator

- a pair of resilient plate joined together at their one ends
- two piezoelectric elements attached to a front and a rear surface of resilient plate
Advantageous

- Large vibratory impulses can be imported to the vibratory conveyor table.
- The current vibratory parts feeder is relatively large in height.
- The amplitude extends linearly between the base and the vibratory conveyor table.
- Easily adjustable of the amplitude and direction of vibrations impulse.
One of them is FPF 2000!

FPF 2000 is a flexible feeder for small parts.

It consists of programmable mechanical gauges, a vision sensor, a flexible manipulator such as a programmable robot to actively orient parts.

It can feed and orient bulk packed small components directly into assembly lines.

It can be reconfigured automatically to feed different parts through software control.
HOW THE FPF 2000 WORKS

- FPF 2000
- Part silhouettes as seen by machine vision system
PART CHANGEOVER

- Is accomplished by simply loading a software parameter file for the next part type

- The user places the part in front of the camera and choose a pick point and follows a machine vision

- Operator sets the height and width mechanical gauging devices stepper motors to bring the parts into rough alignment on the conveyer

- The system subtracts the part outline from the background image

- It then generates a series of additional templates, electronically rotating the parts image in small increments over 360° of rotation
CHARACTERISTIC OF PFP 2000

- The system identifies and locates parts between 0.05 mm and 12 mm approximately 350 msec
- This feeder can be modified to handle larger or heavier parts
- Parts need to have at least one non-rolling stable configuration
- Parts size limitations is between 0.5 mm to 5 mm
- PFP 2000 cost 55,000$ (less the robot)