

AUTOMATED PRODUCTION LINES



CH 17 AUTOMATED ASSEMBLY SYSTEMS

Sections:

1. Fundamentals of Automated Assembly Systems
2. Quantitative Analysis of Assembly Systems



AUTOMATED ASSEMBLY - DEFINED

The use of mechanized and automated devices to perform the various assembly tasks in an assembly line or cell

Fixed automation usually

- Most automated assembly systems are designed to perform a fixed sequence of assembly steps on a specific product that is produced in very large quantities



AUTOMATED ASSEMBLY - APPLICATION CHARACTERISTICS

Where is automated assembly appropriate:

- High product demand
- Stable product design
- The assembly consists of no more than a limited number of components
- The product is designed for automated assembly



TYPICAL PRODUCTS

Alarm clocks

Ball bearings

Ball point pens

Cigarette lighters

Door mechanisms

Gear boxes

Light bulbs

Locks

Mechanical pencils

PCB assemblies

Small electric motors

Wrist watches



ASSEMBLY PROCESSES IN AUTOMATED ASSEMBLY

Adhesive bonding

Snap fitting

Insertion of components

Soldering

Placement of components

Spot welding

Riveting

Stapling

Screw fastening

Stitching



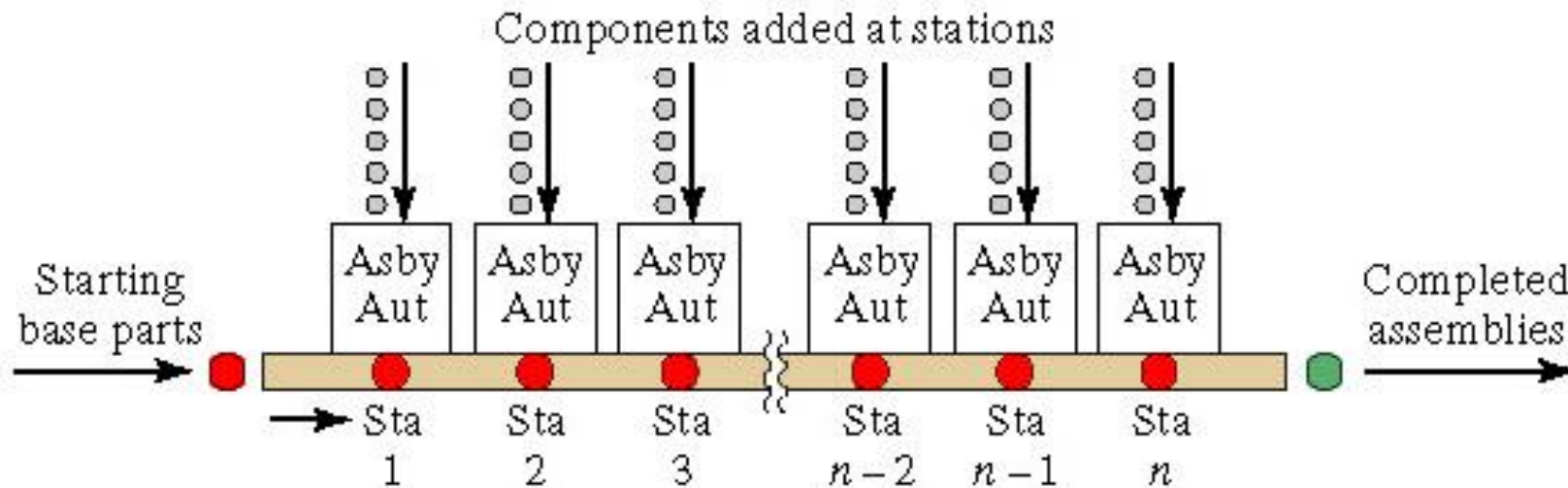
SYSTEM CONFIGURATIONS

1. In-line assembly machine
2. Dial indexing machine
3. Carousel assembly system
4. Single-station assembly cell

IN-LINE ASSEMBLY MACHINE

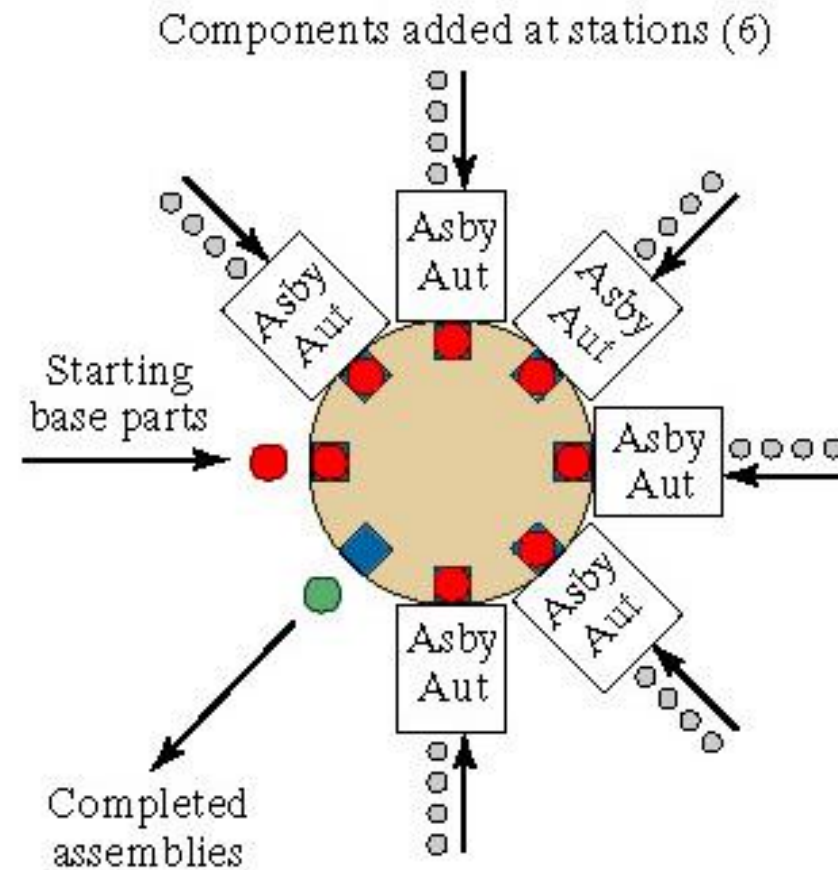
A series of automatic workstations located along and in-line transfer system

Either synchronous or asynchronous work transfer used

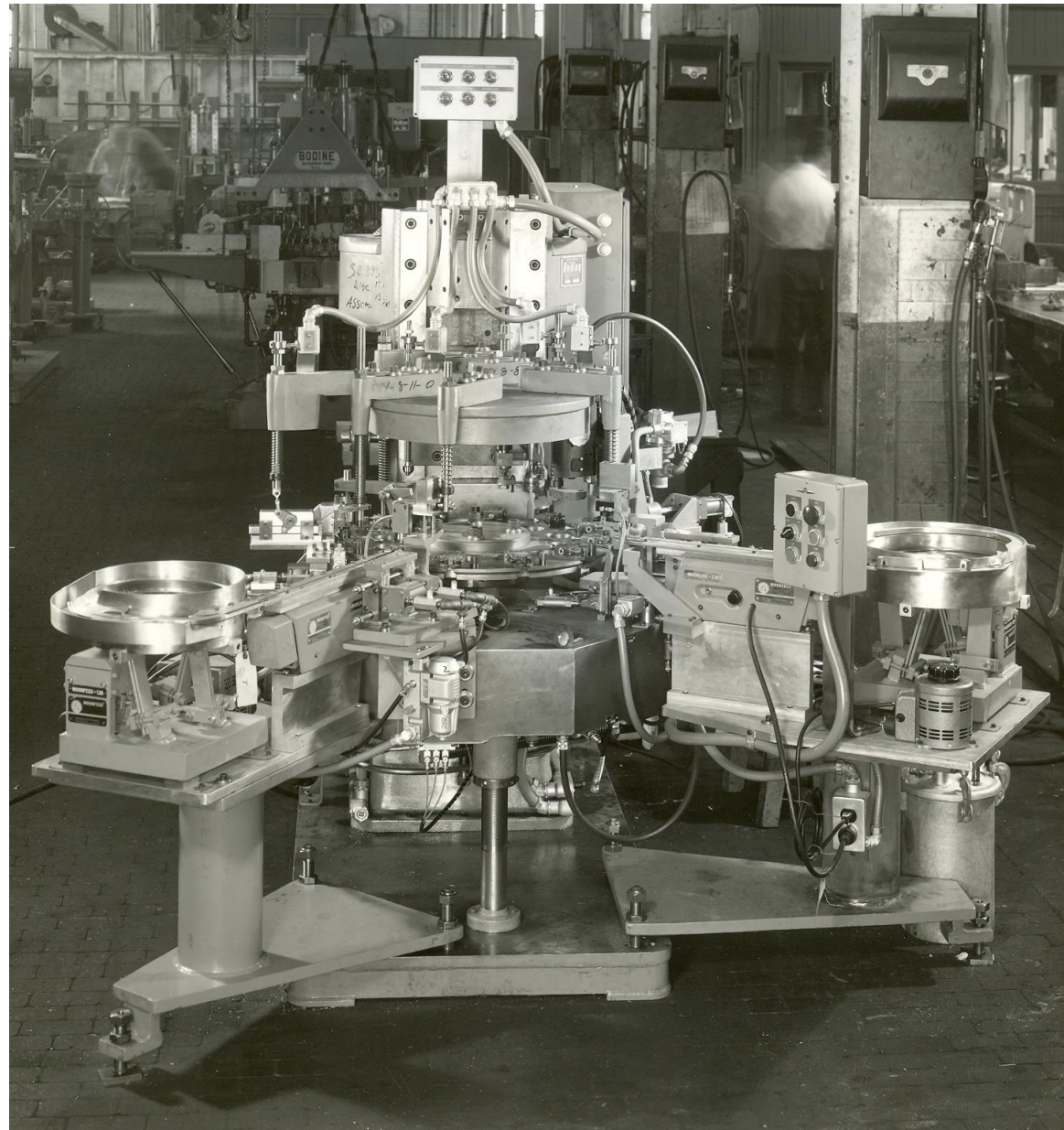


DIAL INDEXING MACHINE

Base parts are loaded onto fixtures or nests attached to a circular dial table, and components are added at workstations located around the periphery of the dial as it indexes from station to station

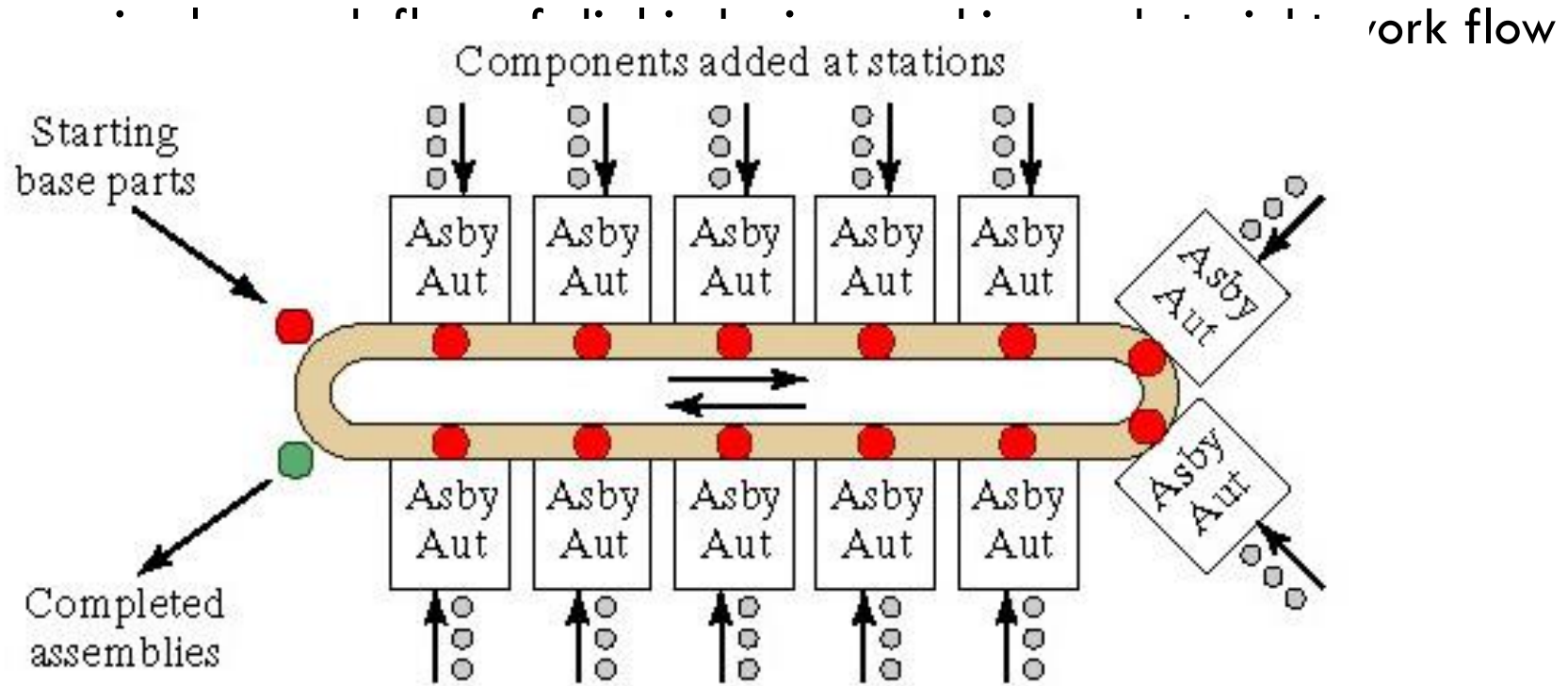


Dial indexing
assembly machine
(Bodine Corp.)



CAROUSEL ASSEMBLY SYSTEM

A hybrid betw
of in-line syst

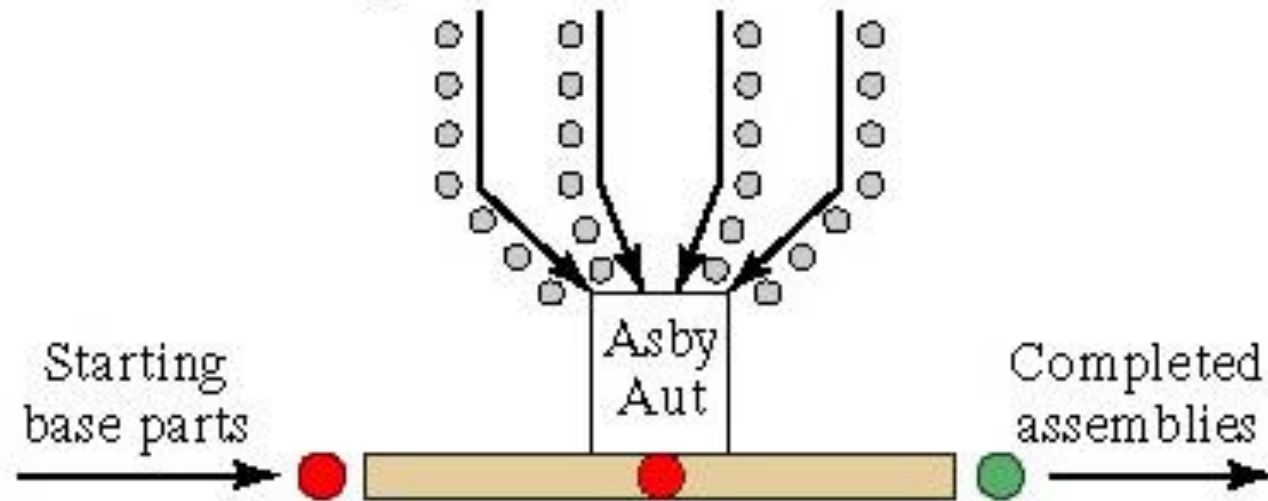


SINGLE-STATION ASSEMBLY CELL

Assembly operations are performed on a base part at a single location

A robot is sometimes used as the assembly machine

Components added at one stations





MULTI-STATION VS. SINGLE-STATION

Multi-station assembly machine or line

- Faster cycle rate
- High production quantities
- More operations possible
- More components per assembly

Single-station assembly cell

- Suited to robotic assembly
- Intended for lower production quantities

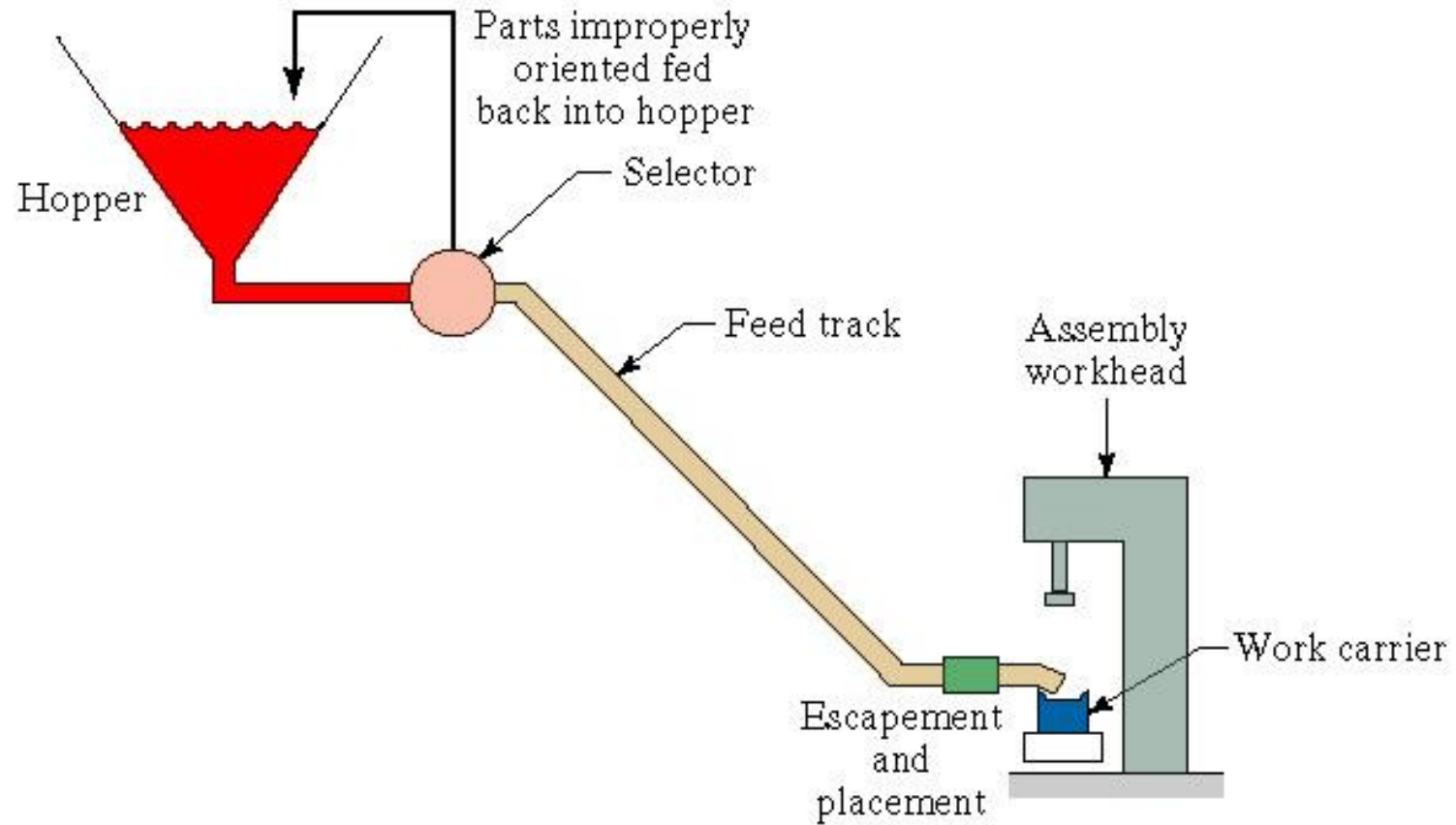


PARTS DELIVERY AT WORKSTATIONS

Typical parts delivery system at a workstation consists of the following hardware components:

1. Hopper - container for parts
2. Parts feeder - removes parts from hopper
3. Selector and/or orientor - to assure part is in proper orientation for assembly at workhead
4. Feed track - moves parts to assembly workhead
5. Escapement and placement device - removes parts from feed track and places them at station

PARTS DELIVERY SYSTEM AT STATION





VIBRATORY BOWL FEEDER

Most versatile of hopper feeders for small parts

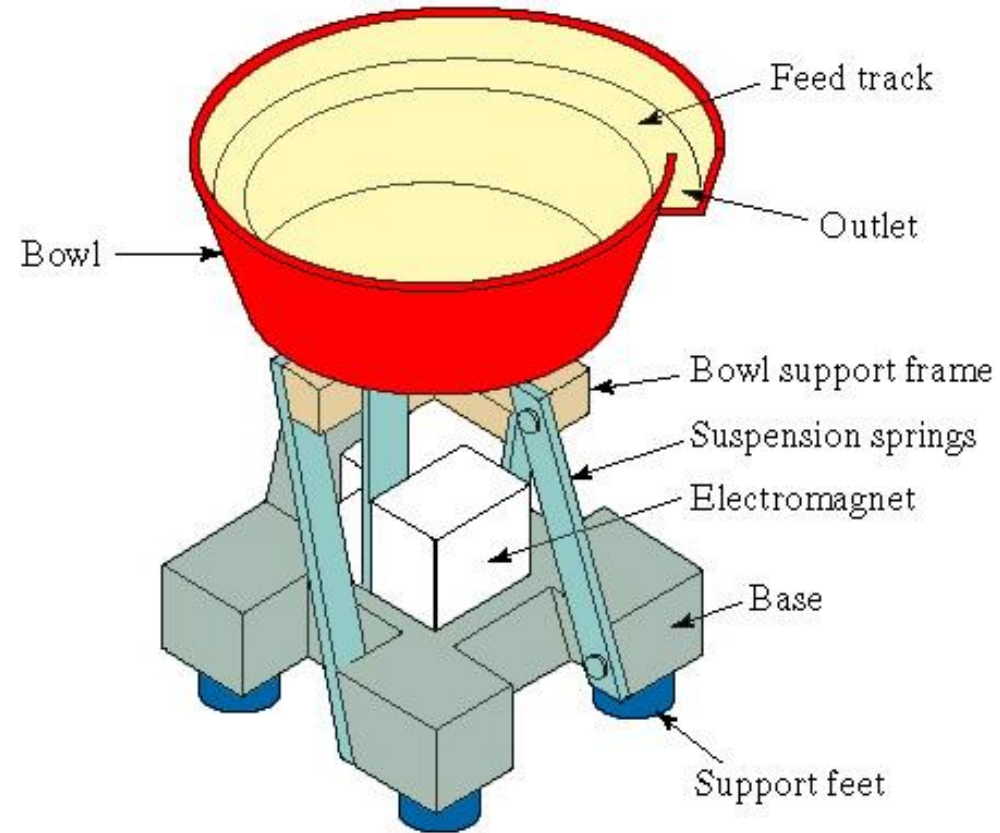
Consists of bowl and helical track

- Parts are poured into bowl
- Helical track moves part from bottom of bowl to outlet

Vibration applied by electromagnetic base

- Oscillation of bowl is constrained so that parts climb upward along helical track

VIBRATORY BOWL FEEDER



VIBRATORY BOWL FEEDER

Photo courtesy
Syntron Inc.





SELECTOR AND/OR ORIENTOR

Purpose - to establish the proper orientation of the components for the assembly workhead

Selector

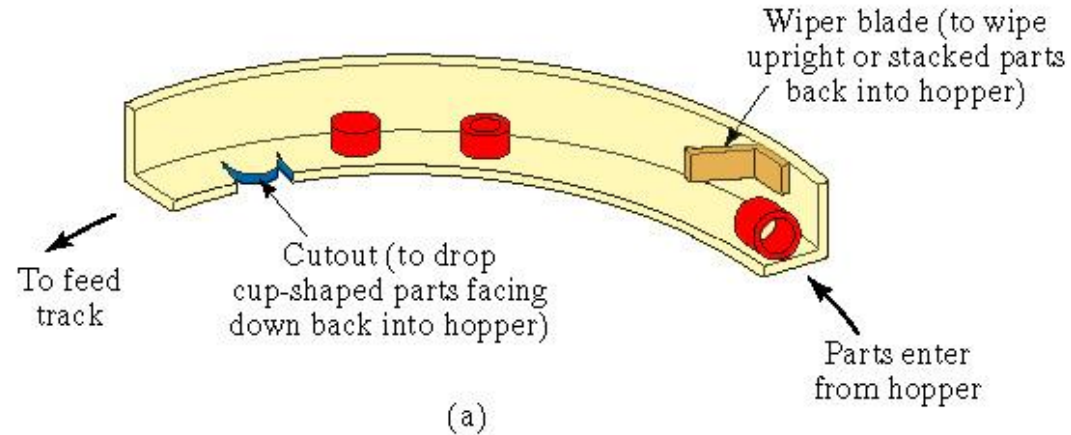
- Acts as a filter
- Only parts in proper orientation are allowed to pass through to feed track

Orientor

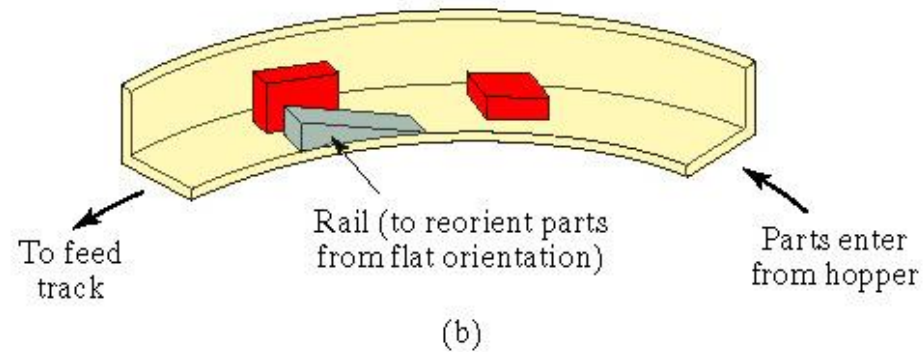
- Allows properly oriented parts to pass
- Reorients parts that are not properly oriented

PARTS SELECTION AND ORIENTATION

(a) Selector



(b) Orientor





FEED TRACK

Moves parts from hopper to assembly workhead

Categories:

1. Gravity - hopper and feeder are located at higher elevation than workhead
2. Powered - uses air or vibration to move parts toward workhead



ESCAPEMENT AND PLACEMENT DEVICES

Escapement device

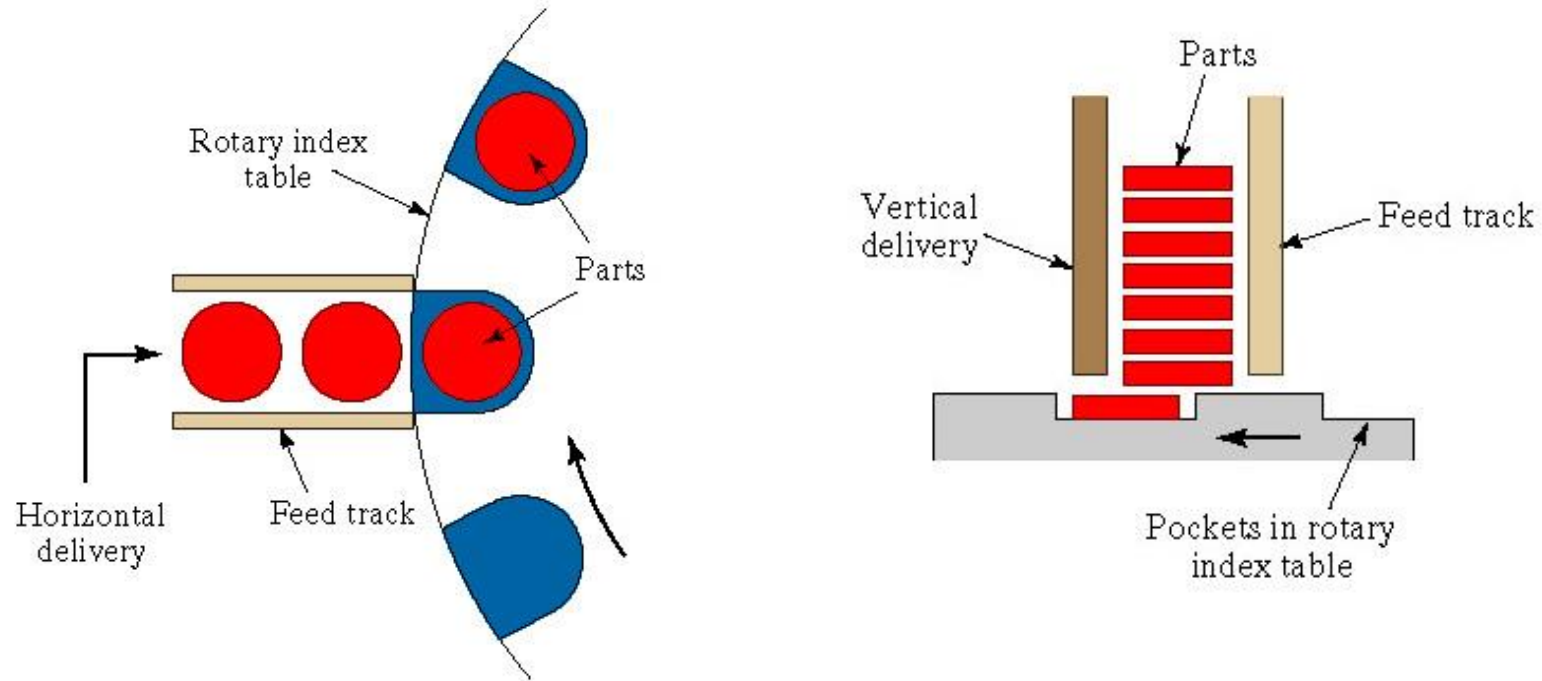
- Device that removes parts from feed track at time intervals that are consistent with the cycle time of the assembly workhead

Placement device

- Device that physically places the parts in the correct location at the assembly workstation

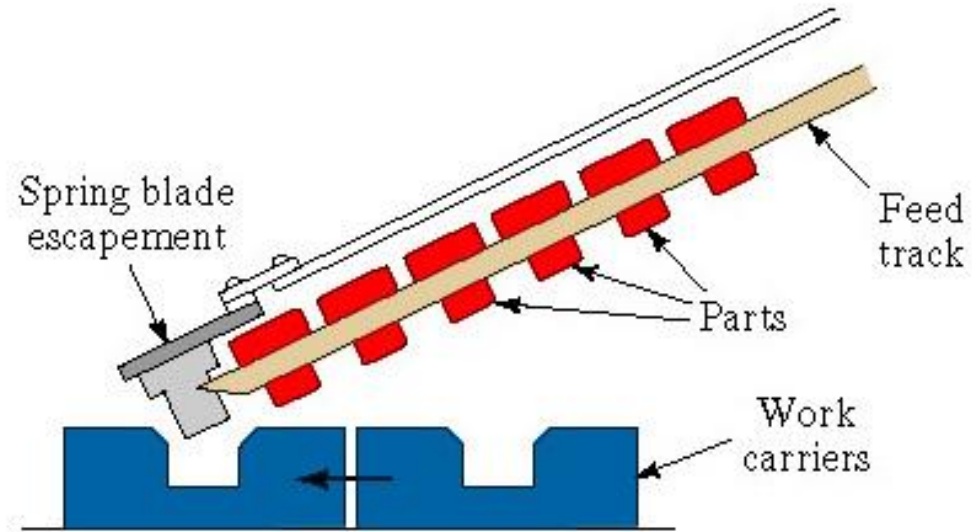
Escapement and placement devices are sometimes the same device, sometimes different devices

ESCAPEMENT AND PLACEMENT DEVICES



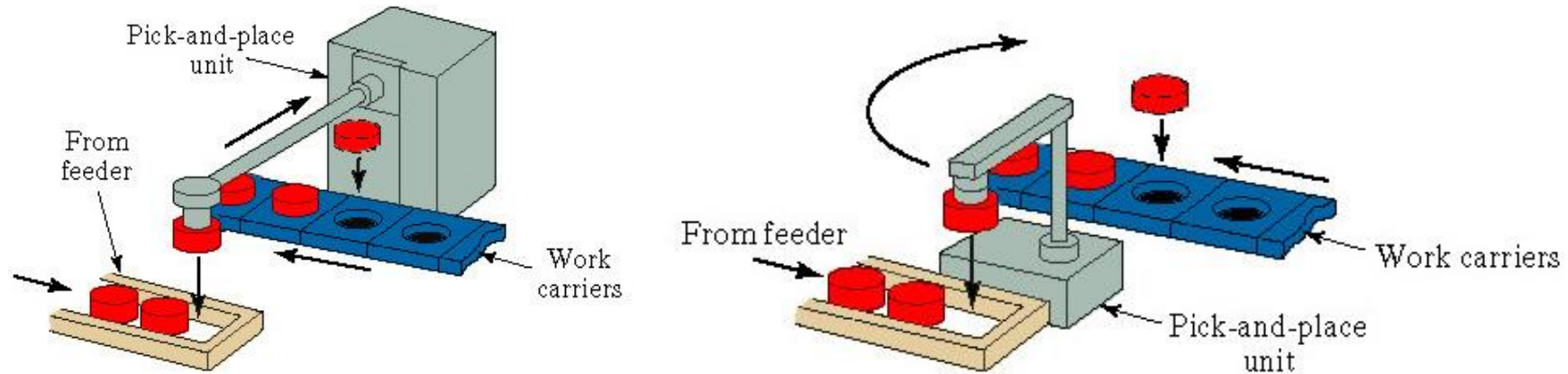
(a) Horizontal and (b) vertical devices for placement of parts onto dial-indexing table

ESCAPEMENT AND PLACEMENT DEVICES



Escapement of rivet-shaped parts actuated by work carriers

ESCAPEMENT AND PLACEMENT DEVICES



Two types of pick-and-place mechanisms for transferring base parts from feeders to work carriers



QUANTITATIVE ANALYSIS OF ASSEMBLY SYSTEMS

1. Parts delivery system at workstations
2. Multi-station assembly machines
3. Single-station assembly cells
4. Partial automation