Whitepaper

Cap Feeding

12-31-19

The first step in capping is orienting the cap open side down. Cap feeders, sometimes called cap orienters or cap sorters are used to do this. They are typically mounted to the capping machine but can be standalone in some cases.

There are 6 common types of orienteers:

- Vibratory bowl feeder
- Centrifugal bowl feeder
- Elevating conveyor feeder
- Step feeder
- Vertical wheel
- Robotic feeder

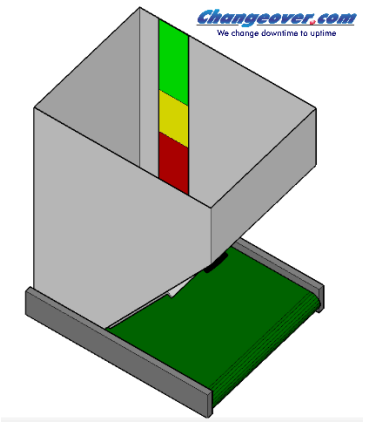
In addition to the feeder itself, there is often a bulk supply hopper. Most feeders work best with a relatively small quantity of caps in the feeder itself. The bulk hopper is typically sized to hold 10-15 minutes or more of caps to minimize loading frequency. Many cappers mount the feeder above the capper. If an operator has to climb a ladder or steps to replenish the cap supply, there are safety and ergonomic risks. All cap loading should be done at floor level. This will require some type of cap elevator.

A common design is a hopper with a cleated conveyor. Caps are loaded and the caps conveyed up to the feeder. These are available in a variety of styles and sizes using belt or chain conveyor, and angles from abut 45 degrees to vertical.

Another option is pneumatic transport. Caps are dumped into the hopper and blown to the feeder by high velocity air. This may not be suitable for all caps, especially those with more delicate features.

In all cases, a sensor and controls are required in the feeder to closely maintain the level of caps for optimum operation. Do not rely on the operator. They already have enough to do

TIP: Mark the inside of the hopper with red-yellow-green level strip. Red means that the hopper is low and more caps should be added immediately. Yellow means that caps should be added but it is not urgent. Green means that no caps should be added. The colors can be calibrated to reflect the number of caps in the hopper. This can be used to prevent excess caps in the hopper at the end of a production run.



A clear Lexan window in the side of the hopper can also be helpful.

Vibratory bowl feeder

Vibratory bowl feeders consist of an aluminum or stainless steel bowl mounted on leaf springs on a heavy steel base. Magnetic solenoid coils vibrate the bowl in a combined circular and vertical motion. The bowl does not actually rotate but moves back and forth a few hundredths of an inch. The angle of the springs causes the bowl to rise and fall as it reciprocates.

This directed vibration causes the caps to move up an internal track within the bowl. As they move up the track, guides single file the caps and send excess caps back into the bottom of the bowl.

In the feeder shown, by the time the caps get to the top track, they are all single file and open side up or down. Most caps will have a natural tendency to orient open side up because of weight balance. These caps will pass over the 3 stainless fingers at 11 o'clock. Caps that are open side down will not and will fall back into the bowl for another circuit. As the caps exit the bowl, they enter a twister chute or a "C" track (Not shown) to convert them to open side down for placing on the bottle.

This cap is simple to feed. Other, more complex geometries may require multiple sorting and orientation steps within the bowl.

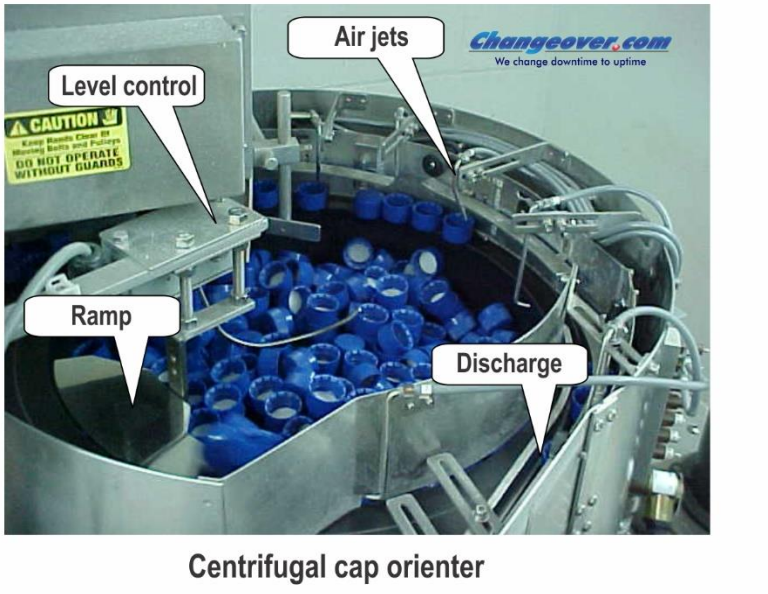
A couple of disadvantages of the vibratory feeder are that they are heavy, noisy and, especially with more complex caps, are dedicated to a single cap size.

On the plus side, the lack of moving parts and low particulate generation, makes them suitable for use in Class 100/ISO 5 cleanrooms. Though typically driven by solenoids, they can also be motor or pneumatically driven. Pneumatic drives make them intrinsically safe in flammable or explosive environments. (Always check safety with an expert)

Vibratory feeders is the ability to orient and feed very complex caps.

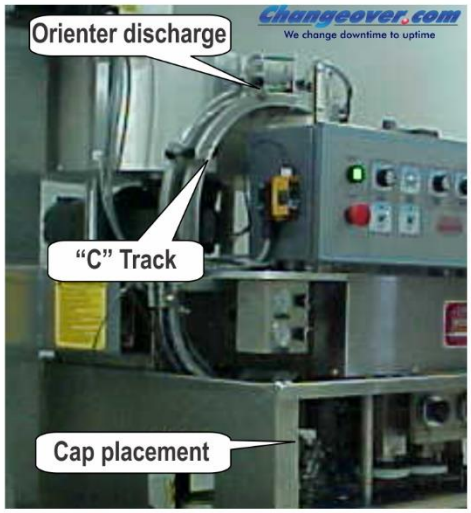
Centrifugal bowl feeders

Centrifugal feeders use a rotating bowl to feed and orient the caps. A small quantity of caps is fed into the bottom of the bowl. As the bowl rotates, a ramp carries the caps up to a ledge that is part of the bowl. Here excess caps are guided back to the bowl bottom. By the 2 o'clock position in the photo, they are all single filed, mostly open side up. Air jets blow open side down caps back into the bowl where they try again.



Centrifugal cap orienter

The caps exit the feeder to a "C" track, shown below. This track presents the cap open side down to the escapement for placeing on the bottle.



"C" Track

Centrifugal feeders are fast (600+ caps per minute) and capable of handling most standard caps.

Elevating hopper/orienter

These feeders, also called waterfall feeders combine the bulk hopper, elevating conveyor and orientation into a single system capable of high (600+ cpm) speeds.

Caps are fed or dumped into the bulk hopper at floor level. A lugged conveyor pulls caps from the hopper and raises them nearly vertically. The thickness of the lug and the angle of the conveyor allows caps that are open side out to be carried up to the discharge. Caps that are open side toward the conveyor will fall off the lug and back into the hopper. Conveyor width will be determined by the required capping speed. A wider chain will allow more caps to be carried on each lug.

After allowing for the falling off, a Lexan cover confines the properly oriented caps into the lug pockets.

At the top of the conveyor a continuous air jet blows across the conveyor. This blows the caps out of an opening on the opposite side of the conveyor where they are funneled into a chute to the capper.

A variation on this style feeder uses a perforated belt with vacuum. This allows the conveyor to be completely vertical and allows different size caps to be run with no changeover. As caps are picked out of the hopper, if the open side is out, the vacuum will hold the top of the cap to the conveyor belt. If the open side is toward the belt, the vacuum will not hold it and the cap will fall back into the hopper.

Step Feeder

Step feeders use 1 or more vertical steps to elevate caps from the hopper to a conveyor. This example shows a single step. As it is lowered into the mass of caps, they fall forward onto the ledge or “step”. The thickness of the step determines how many caps will be picked up on each stroke and influences their orientation. At the top of the stroke, the caps fall onto a conveyor.

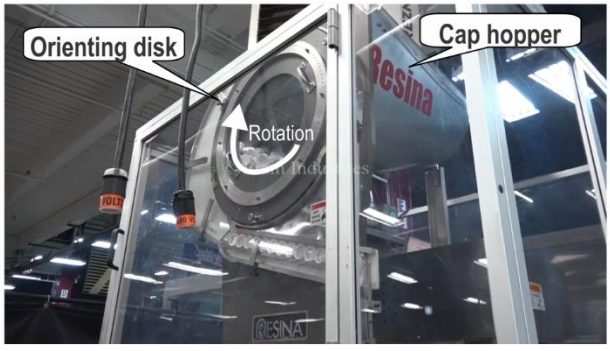
Step feeder
Courtesy Performance Feeders Inc

Guides on the conveyor guide the caps into a single file, 1 cap deep. Caps laying on their side are guided back into the hopper. As they pass under a sensor, any caps not open side up, are blown off, onto recirculating conveyor in this demonstration system, normally directly into the hopper. Properly oriented, open side up, caps are discharged to a “C” track for feeding to the cap placer.

Step feeder
Courtesy Performance Feeders Inc

Vertical disk

Vertical disk feeders consist of a rotating disk, mounted vertically, with an attached hopper as seen here



Vertical disk cap feeder
(Courtesy Frain Industries)

The hopper has a flange that forms a gap between it and the rotating disk. As the disk rotates, it agitates the caps and some fall into the gap. The disk has pins on it that allow properly oriented caps, open side out in this case, to fall into the gap between them. In some designs the pin catches the cap pulling it along. The disk moves the cap up until

int falls into the discharge track or chute at about the 9 o’clock position. Caps move down the chute by gravity to the escapement (not shown) where they are placed on the containers.

In the illustration, the disk has a clear Lexan centerpiece. This can be removed for emptying the feeder and is clear to display the quantity of caps in the hopper.

In some designs the rotating disk, and sometimes the internal flange, are change parts which must be replaced when changing cap sizes. Other designs may provide some adjustment for changing sizes.

Horizontal disk feeders are reliable and can run at high, >600 cpm, speeds. They can feed a wide variety of relatively standard caps but may not be suitable for feeding some specialized caps,

Robotic

A special case is highly polished, sometimes metalized, caps used on high end cosmetic and similar products. If these were ever in bulk, they would scuff and scratch. These caps are shipped in thermoform trays with individual pockets. They may be placed on the container manually then tightened with a non-scuffing chuck.

Operators can’t do this very fast, probably not more than 30cpm, so any kind of speeds will require multiple people.

The price of SCARA robots has dropped dramatically in recent years. Epson offers an All-In-One SCARA robot for under $8,000.These are ideally suited to picking and placing the caps from tray to container, automating the process. The robot gripper can be a rotating chuck allowing the to not only place the cap but tighten it as well.

In all cases it is generally a good idea to have a sensor on the cap chute to detect misoriented caps before they cause a jam at the escapement. Some machines use photoeyes or other electronic sensors. This petal design is mechanical and simple. The sensor shown is for alarm but is not strictly necessary. In the event of an upside down cap the petal will jam. A cap presence sensor near the escapement will sense an absence of caps and stop the capper.

The cap feeders discussed in this paper are the ones typically seen but are not the only ones used. Some builders have their own special designs, some caps or machines will require their own designs. In most cases, it is best to rely on the capping machine builder to recommend the feeder best suited to the application.