

# Innovative Multi-servo System Wrap-around Caser - Reduction of Life Cycle Cost -



Mitsubishi Heavy Industries  
Food & Packaging Machinery Co., Ltd,

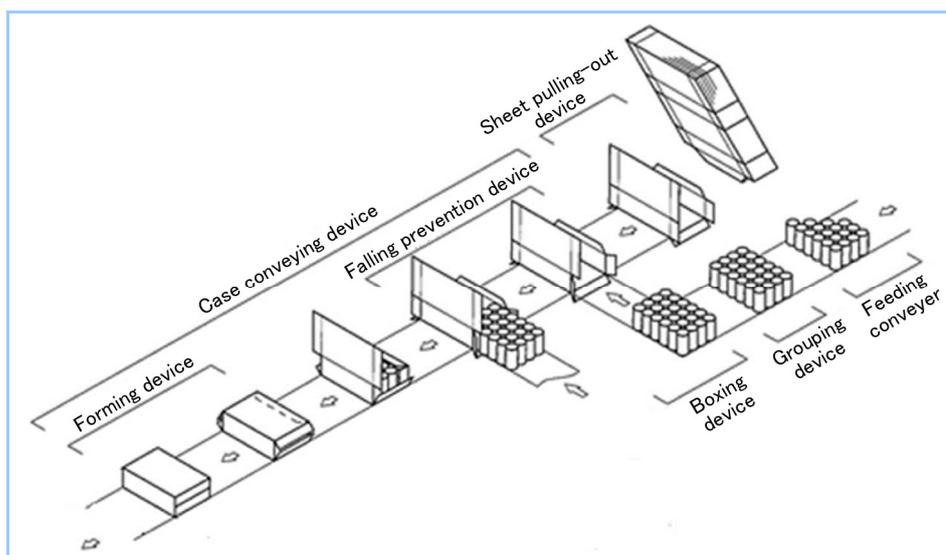
Mitsubishi Heavy Industries Food & Packaging Machinery Co., Ltd. (hereinafter referred to as MHISK) has contributed to domestic and overseas physical distribution/sales methods through the delivery of more than 4,000 packaging machines to various fields mainly including the food and beverage industry. In recent years, delivery to countries abroad has been increasing mainly in Asia, and therefore MHISK is required to respond flexibly to external changes such as a shift to machines that conform to local conditions (specificity) and the requests of the destination areas.

In addition, domestic market demand has increasingly focused on not only the quality and performance of the machine itself, but also its compatibility with constantly-changing external circumstances such as reviews of packaging materials for resource saving and cost cutting, the improvement of container shapes in consideration of consumer preferences, and the concretization of control criteria for ensuring packaging quality.

## 1. Integration of mechanical components and servo technology

### 1.1 Diversification of demanded specifications

MHISK's packaging machine is a so-called caser that automatically performs external packaging (cardboard boxing) of the products to produce packaged boxes that are used for selling units or transporting units. Many casers are used for food and beverage products including drinks (PET bottles and cans) and instant noodles (**Figure 1**).



**Figure 1** Process flow of caser

The machines that play a central role among MHISK's casers are beverage casers. Even when a PET bottle, one of the typical packaged products of the beverage caser, is considered, there are a wide variety of container specifications including shape, size, and hardness. The trend towards the diversification of containers is going to continue to increase on a global basis.

The operation of a packaging machine has become complicated as seen in the increased number

of parameters such as alignment and speed that have to be set as a result of an increased number of container types. In addition, mechanical components used in a packaging machine inevitably have uncertainties such as age deterioration including the elongation and backlash of chains. As a result, some customers face difficulty in terms of maintaining the optimum machine conditions.

For easy maintenance of constant packaging quality, MHISK has developed a multi-servo system that enables a packaging machine to have functions to make a database of set values and to understand the real-time conditions of each machine part.

## 1.2 Multi-servo system

Existing beverage packaging machines use a single motor as the drive source, and their actuator structure contains various mechanical components linked in a complicated manner.

The developed multi-servo system eliminates drive transmission mechanisms only, and still uses local mechanical components that are an accumulation of past technologies. Multiple servomotors are located locally at places where drive is needed and controlled fully synchronously. As a result, the integration of the advantages of mechanical components and servo technologies is established (**Figure 2** and **Figure 3**).



**Figure 2 Drive components of conventional packaging machine**

Mechanically linked system is employed.



**Figure 3 Drive components of new packaging machine**

Multi-servo driving system is employed.

The establishment of a multi-servo system is expected to bring the following effects.

(1) Shift from analog management to digital management

Digitalization due to use of the servo allows for numeric conversion of set values and the creation of databases. In addition, visualized management, such as monitoring and comparing with past results, of data for securing and maintaining the machine functions and quality, including the position, speed and torque data, is made possible.

(2) Reduction of life cycle cost

Electric power consumption can be reduced due to employment of high-efficient motor and reduction of drive transmission loss. The elimination of drive chains, etc., allows for the reduction of cost for periodic maintenance.

(3) Improvement of machine operation environment

The reduction of mechanical links significantly improves the low-noise characteristics and maintainability of the machine. The enhancement of the man-machine interface including visualization improves operability. In addition, the ability to monitor operational data contributes to preventative maintenance.

## 2. New technology responding to changing times

### 2.1 Change of external circumstances

In the beverage container field, in addition to appearance characteristics such as size and form, the weight reduction (thinning) of the materials that constitute the container has also been advancing. Such changes in containers have the potential to turn the functions that conventionally depended on the container itself (the shape based on the shape retaining strength and certain rules) on their heads. In this way, the roles of packaged products and the machine have been changing over time.

Therefore it is necessary for packaging machine technologies to advance in response to the

expansion of their assigned role. MHISK has developed its own technology, the fingerless grouping mechanism, based on a new idea.

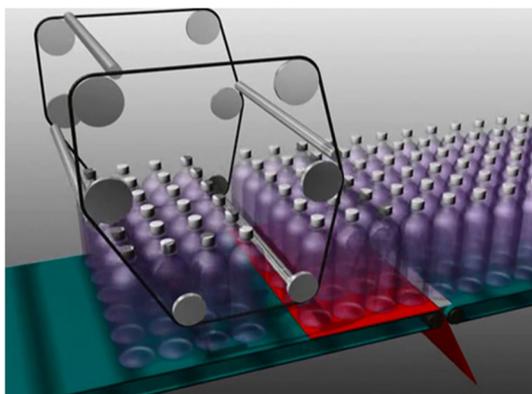
## 2.2 Fingerless grouping mechanism

To package beverage containers, a grouping process that divides containers into the packaging unit (specified number) is required. Existing machines perform grouping by inserting a bar-shaped finger stopper into a gap of the container row on the conveyer from below to block the containers that follow. Because this method is based on a container strength higher than a certain level that can withstand the force generated by blocking the conveyed containers, it is not suitable for containers that have a lower strength due to weight reduction.

The fingerless grouping mechanism eliminates the finger stopper, which may cause the deformation of the containers, and employs a grouping method that uses a speed difference between conveyers.

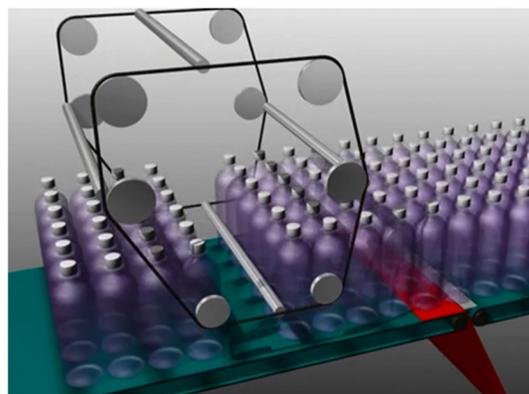
The operation principles of the fingerless grouping mechanism are as follows.

- (1) Containers flowing on the conveyer are placed on a movable sheet material, referred to as a mobile sheet, and they move at the same speed as the conveyer (**Figure 4**).
- (2) When the containers are transferred to the subsequent conveyer, a sheet of the length corresponding to the packaging unit (specified number) of containers is pulled out. The containers that were on the removed part of the sheet are conveyed by the subsequent conveyer (**Figure 5**).
- (3) Because the subsequent conveyer is faster than the first conveyer, containers on the subsequent conveyer are separated from the containers remaining on the sheet.



**Figure 4 Operation principle of fingerless grouping mechanism [1]**

Containers are placed on the mobile sheet and then conveyed.



**Figure 5 Operation principle of fingerless grouping mechanism [2]**

The mobile sheet is pulled out and the containers are transferred to the subsequent conveyer.

The establishment of the fingerless grouping mechanism has enabled the elimination of a mechanism that applies unreasonable force to containers and allows the machine to handle weight-reduced containers that were not compatible with existing packaging machines. In addition, the fingerless grouping mechanism has increased the leeway the machine has to deal with the evolution of containers that is expected to continue to advance in the future.

The fingerless grouping mechanism can not only handle weight-reduced containers, but also results in the following advantages.

- (1) Easier container size changeover

The time required for container size changeover can be shortened because the finger stopper that needs to be changed according to the container diameter to be packaged is eliminated. Although the evolution of containers has a tendency to make the container size changeover complex, the elimination of the finger stopper contributes to reduced labor.

- (2) Improvement of maintainability

The elimination of the finger stopper mechanism installed under the conveyer can make space for maintenance in the machine and improve easiness of cleaning.

MHISK's unique fingerless grouping mechanism technology is unprecedented in the industry and can generate synergistic effects when combined with the multi-servo system. MHISK's casers equipped with this combination have acquired a favorable reputation from many customers.