New Series of Can Vending Machines

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1. Introduction

As of December 2002 in Japan, about 2.17 million can vending machines are installed in indoor and outdoor locations. The operators use these can vending machines to sell soft drinks, coffees and teas in PET (polyethylene terephthalate) bottles, cans and bottles in cooled and warmed conditions. Beverage suppliers introduce new products one after another into the market every year and increase the diversity of their containers. Route men and staff employees of beverage suppliers restock and exchange the products being vended and collect and replenish cash reserves. Can vending machines have been traditionally discarded after 6 to 7 years, but today they are used for 7 to 8 years or longer, the longer useful life being supported by overhauling and other types of maintenance.

2. Challenges for Can Vending Machines

2.1 Vending of new products

Such new containers as lightweight containers and containers for small quantity products are put out on the market one after another, and can vending machines must be capable of accommodating them to the extent possible.

2.2 Ease of use by consumers

Can vending machines are widely used by children and adults. In order to be easy to use for all consumers, it is required that the display be easy to understand, money can easily be inserted, products are easy to take out, and that the machine be sanitary.

2.3 Reduction of operation costs of can vending machines

The operators search for cost reduction opportunities in all processes – from purchase, to operation, until disposal of the vending machines. During operation, much cost is required in restocking products, changing of the racks due to product changes, removing jammed products and servicing the doors and cooling units. Accordingly, the construction has been completely redesign to develop a new series of can vending machines that are easy to use for users and easy to operate for operators. Figure 1 shows the appearance of the new series of can vending machine. An overview of this new series is presented as follows.

Fig.1 Appearance of new series can vending machines

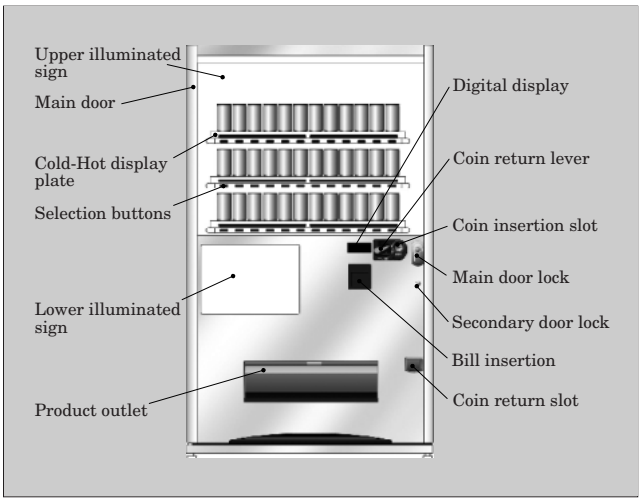
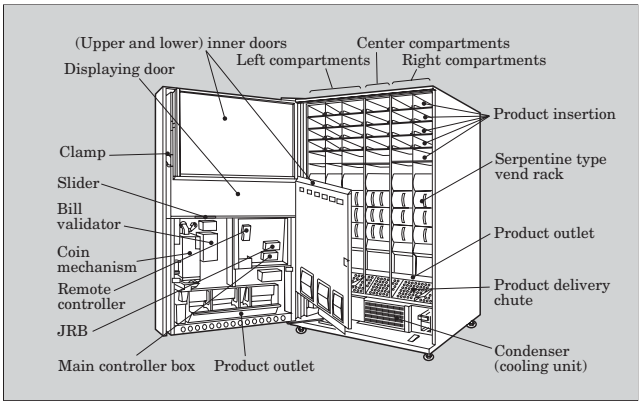


Fig.2 Internal component descriptions



3. Construction and Features of the New Series of Can Vending Machines

The can vending machine construction is grouped into the four blocks of: (1) a door block for displaying products, this block faces consumers, accepts inserted

cash, delivers products and returns change; (2) a rack block for accepting and delivering products; (3) a cabinet block for cooling and warming products; and (4) an electric control block unit for controlling the vending and temperature of products. Figure 2 illustrates the names of internal components with the door opened.

3.1 Rack

Serpentine type vending racks, which have been conventionally installed in vending machines, are said to be easy to use as they enable products to be rolled along the rack from the top. But these serpentine racks always had to be changed whenever the external shape of the product (outer diameter and height) changed. In the newly developed series of can vending machines, no setting change is required at the product outlet and, furthermore, the installed rack does not require any setting for narrow cans at product insertion. The side view of the new rack is shown in Fig. 3 and its features are explained below.

3.1.1 Product outlet

In conventional racks, if products smaller than ϕ53 mm are conveyed along a path intended for products wider than ϕ69 mm, the products will slip or become jammed. To avoid such troubles, the product path in a vending mechanism (delivery unit) at the rack outlet had to be narrowed so as to fit slim products. Outlet width adjustors (regulating plates) must be operated or attachments (separate components) must be mounted for adjusting the path dimensions. The product paths of a rack are arranged from front to back in rows inside the vending machine. As the number of product paths is increased from 4 to 5, 6 and 7, the location of adjustors or attachments become maximally about 800 mm away from the front side, which makes setting difficult to implement and requires special skills and much cost. To resolve these problems, racks requiring no outlet setting when vending wide products and/or slim products were developed. Figures 4 and 5 show the vending operation of conventional racks and Fig. 6 shows that of new

Fig.3 Side view of new rack

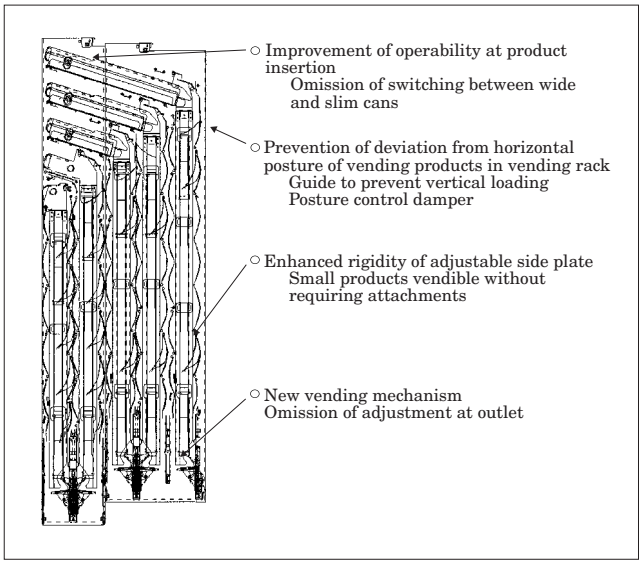


Fig.4 Vending behavior of conventional rack (wide products with ϕ66 mm)

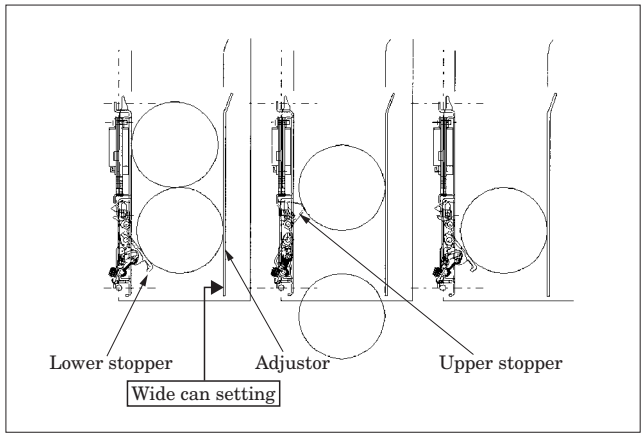


Fig.5 Vending behavior of conventional rack (slim products with ϕ53 mm)

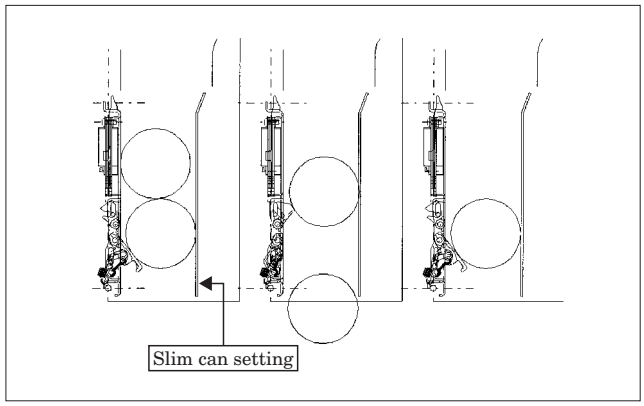
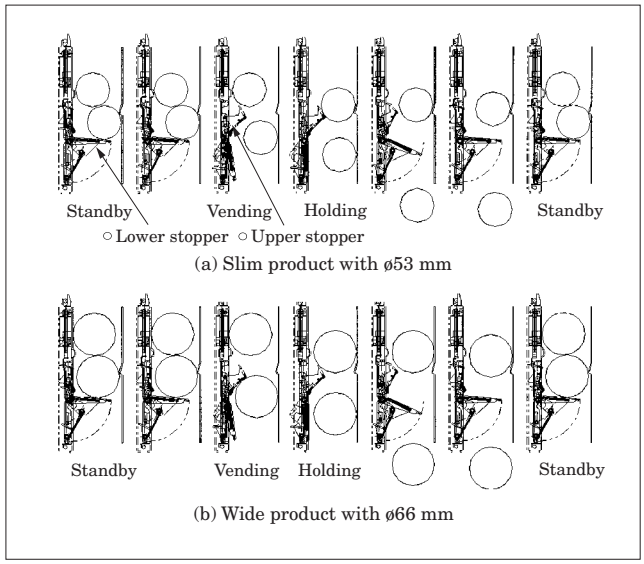


Fig.6 Vending operation of new rack (having no setting change for wide/slim cans)



racks.

(1) Vending operation of a conventional rack

Figure 4 shows the operation of a conventional rack in the case of vending wide cans. In the standby state, all products are supported by a lower stopper that project about 22 mm into the path that is about 70 mm deep. During vending, the solenoid is switched on, the product path is opened by unlocking the lower stopper, a product in the lowest stage is delivered, and the upper stopper is inserted about 14 mm into the product path to hold the products in the second and higher rows. By turning off the solenoid, the lower stopper projects into the product path, the upper stopper opens the product path, and the second and subsequent products move on top of the lower stopper and the rack returns to its standby state. As an upper stopper supports a maximum weight of approximately 8 kg and projects in the direction of the line connecting the rotation axis of the lower stopper with the center of the wide product, that projection is limited to about 14 mm. If slim products (ϕ53 mm) are put into the vending machine in this condition, they will slip through the upper stopper. Therefore when vending slim products, paths are set for slim products (about ϕ56 mm) by shifting the adjusters in the paths or by installing additional attachments as shown in Fig. 5.

(2) Vending operation of a new rack

Figure 6 shows the vending operation of a new rack. The operating cycle of standby – vending – holding – standby is similar to that of the conventional rack. In the new rack, the projection of the lower stopper was set to be about 54 mm and nearly horizontal, and the projection of the upper stopper was about 25 mm so that slim products could be held, while leaving the path for wide cans unchanged owing to an ingenious link mechanism.

This enabled the vending of slim products along a path configured for wide cans and eliminated the necessity for making setting changes at the rack outlet, thereby simplifying the tasks involved in a product change.

3.1.2 Product insertion

For conventional racks, if wide products are inserted when the racks are set for slim products, the wide products will jam in the narrow path entrance at the outlet and make vending impossible. Also problems would sometimes occur along the main paths of the rack, making vending impossible if slim and short products (ϕ53 mm, 200 mL cans, etc.) were vended in a column intended for vending wide products (ϕ66 mm, 350 mL cans etc.), as they would turn vertically and become jammed in the product path. Special expert skill was required to solve these problems and resulted in large added cost. For these reasons, when vending slim products, it was necessary to make the main path entrance narrow for the purpose of stacking products horizontally in the rack. These problems were solved through use of a mechanism requiring no outlet setting and the use of a posture control mechanism at the main path entrance. The posture control mechanism uses a damper to correct the posture of products installed at the entrance of the main path so that they will be aligned horizontally even if they are inserted aslant. The larger the damper moment, the larger the posture control function, but wide and light products jam if the moment is too large. If the damper moment is made too small, products do not jam but the posture control does not function. Therefore the proper damper moment was determined using working models, reliability was verified with video analysis of vending experiments, and a "rack that does not require slim and wide setting at insertion" was installed in a can vending machines for the first time in the market. The construction of the damper installed at the main path entrance is shown in Fig. 7. Figure 8 shows an example of the working models. The left figure shows the 3-D data of the product inserted into the rack, the main path of the rack, and the damper projecting into main path. The graph at right shows data of the change in falling speed and change in product posture after the product begins to fall. The shape and

Fig.7 Product insertion for new rack

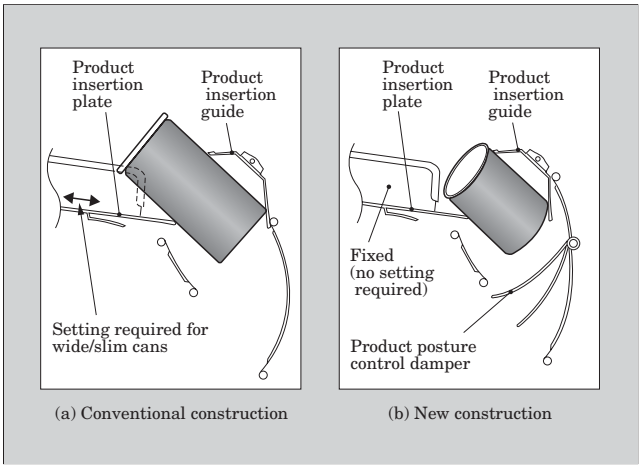
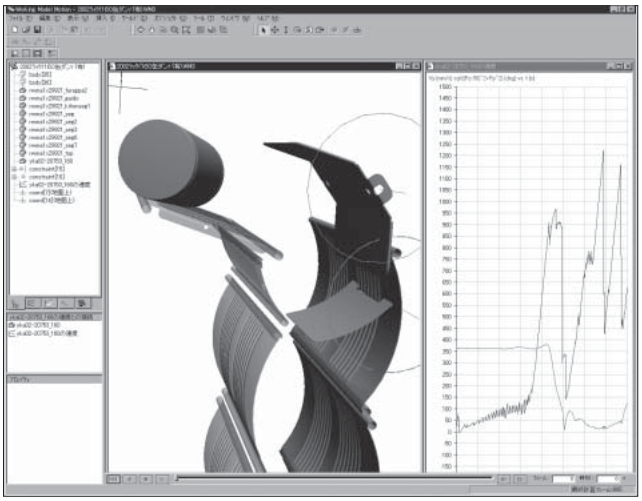


Fig.8 Working model



moment of the damper were determined by simulating the fall of wide and light products intentionally inserted aslant with various damper moments.

3.2 Door

3.2.1 Easy to understand signs

The vending machines were made still easier to use by customers by doubling the size of display characters in the "In service" display indicating that the machine is in service and the "Accepted amount" display indicating the amount of money inserted by the purchaser. Braille lettering was added at the coin insertion slot and coin return lever, and "Consumer use" indications common to all vending machines were added at the product outlet and money insertion slot. Figure 9 shows the money indicator and Braille lettering at the coin insertion slot and Fig. 10 shows the indications for users.

Fig.9 Money amount display and Braille lettering

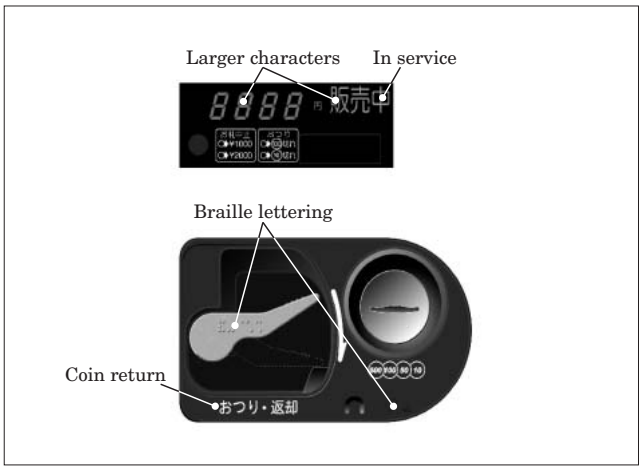


Fig.10 Indications for consumers

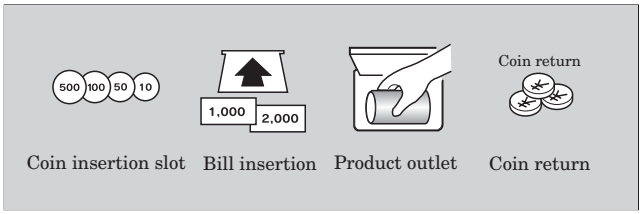
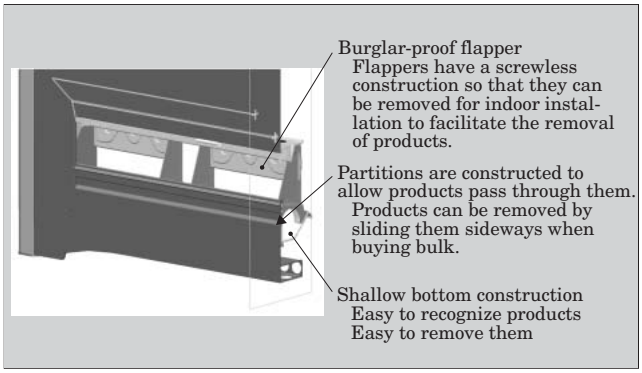


Fig.11 3-D CAD drawing for product outlet



3.2.2 Outlet for easy removal of products

The product outlet from which consumers retrieve products must allow for the easy removal of products even when several items are purchased, and the outlet must be sanitary. The product outlet was developed to have a bottom about 70 mm higher than conventional ones, and was composed of partitions having a passage way, through which the products may be shifted sideways. Raising the standstill height of the products enabled them to become easier to see and to take out. The problem of forming of carbonate drinks was remedied largely by reducing the height that the product falls from the rack outlet. Figure 11 shows a 3-D CAD drawing of the product outlet.

3.2.3 Construction for easy disassembly

The door is disassembled frequently to replace parts damaged by vandalism and the like. Moreover, during an overhaul, the door is disassembled and repainted, and its parts are replaced. Consequently, it is required that the replacement of door parts be performed more easily and with reduced work costs.

Fig.12 Construction of operation mechanism

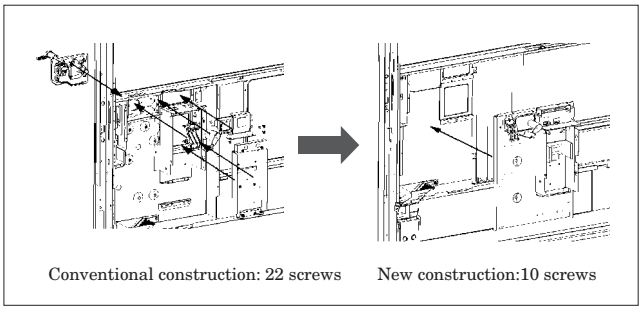


Fig.13 Construction of illuminated sign

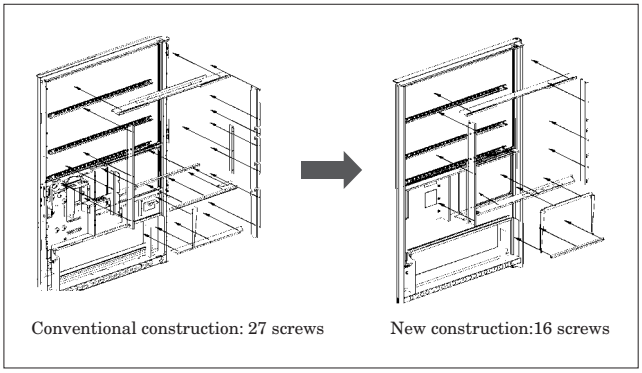
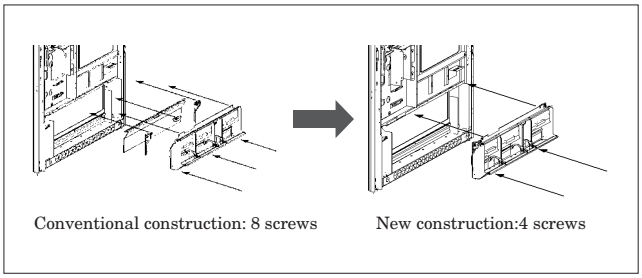


Fig.14 Construction of product outlet

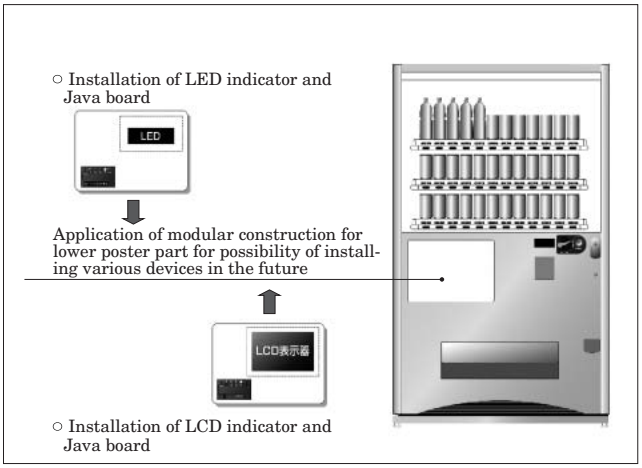


By modularizing the construction of operating components, electric sign components and product outlet components, by enabling replacement to be performed in block module units, and by reducing the number of screws for securing these components as shown in Figs. 12 to 14, the disassembly of a complete door was realized in 7 to 8 minutes.

3.2.4 Optional support of Java* applications

The controller of a can vending machine may be equipped with support for Java, a programming language well suited for Internet use. Display support was made available as an option. Figure 15 shows the options available for the door.

Fig.15 Options for the door



4. Conclusion

Product automatic vending machines were specified as energy-saving designated products in 2001, and subsequently, a large-scale of savings of energy is required. Pursuant to the Ozone Layer Protection Law, HCFC-141b and HCFC-22 will be totally abolished by 2004 and 2020, respectively, and a non-Freon alternative will be required in the cooling unit and as an insulator of can vending machines. Fuji Electric has already been studying these tasks and is continuing to improve its products. In the future, Fuji will establish even higher goals and continue to make efforts in research and development, taking into consideration the global environment, and will develop can vending machines that enable consumers to easily purchase products and are easy to operate by operators.

* : Java is a registered trademark of Sun Microsystems, Inc.