

Multi-Deck Open Refrigerating Display Case for Chilled Food

Eiji Yamada

1. Introduction

Because of serious competition between stores, open refrigerating display cases now strongly require not only a reduction in initial expenditure and running costs but also high display efficiency and stage effects so that the merchandise excites customer interest.

To meet these requirements with “friendly” as the central theme and with the goal of “easy to see, select, and remove merchandise”, Fuji Electric developed and marketed the “Fresh MAX series open refrigerating display cases”. This series is friendly to customers and fitters alike. An outline of the series is introduced below.

2. Outline of the Fresh MAX Series and Multi-Deck Open Refrigerating Display Cases

To meet the diversity of stores, merchandised items, display methods, and sales systems, the Fresh MAX series open refrigerating display cases consists of four types differing in their basic sectional views: multi-deck, semi-multi-deck, flat, and pair-freezer

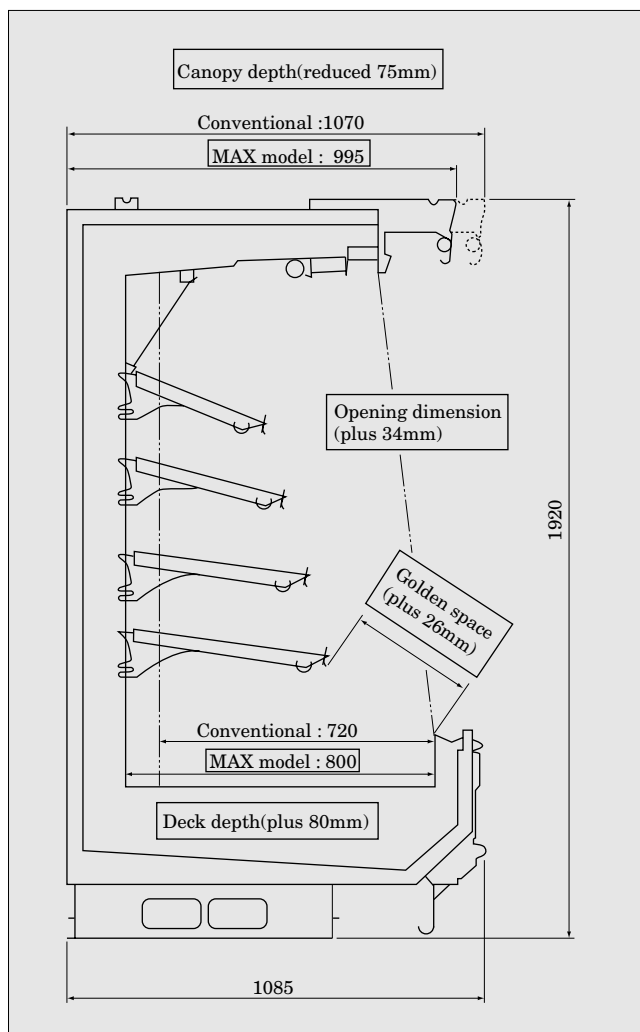
Fig. 1 External view of the Fresh MAX series multi-deck open refrigerating display case



types. Each type can be divided according to different working temperature ranges. A grand total of 423 types compose the series. Included among these is the multi-deck open refrigerating display case which has a separately installed refrigerator. A sectional view of this type is shown in Fig. 2.

In this type of case, a curtain of cooled air is formed in front of the open space by cold air blown

Fig. 2 Sectional view of the Fresh MAX series multi-deck open refrigerating display case



from the upper exhaust outlet and drawn back through the bottom suction inlet. This air curtain isolates the interior from the open air and keeps the air cold for the display of merchandise. This type is subdivided into 98 types, differing in cold storage temperatures of the displayed merchandise, case depth and length dimensions, and the number of air curtain layers.

Among these, the fuzzy series which first applied fuzzy control to open refrigerating cases has attracted attention. Individualized and diversified needs can be met by corner cabinets, special cabinets, and other options.

3. Advantages of the Multi-Deck Open Refrigerating Display Case

3.1 Customer friendly

(1) Structure facilitates display and selection of merchandise

Case dimensions are determined by human engineering so that merchandise can be efficiently exhibited and customers can select and remove merchandise naturally.

(a) Shelf configuration

For customers standing near the open refrigerating display case for selection and removal of merchandise, the standard shelf configuration is such that the shelf depth gradually increases from the top to bottom. Also taking eye height calculated from the average person's standing height as the reference point, shelf angles are determined so that customers standing in front of the display case can glance from top to bottom over the merchandise.

(b) Canopy dimensions

The canopy depth, formerly the same as the lower part, was shortened by 75mm to eliminate a feeling of oppression when approaching the open refrigerating display case. Also, rounding the canopy end psychologically and physically facilitates a closer approach than before to the open display case for the selection of merchandise.

(2) Improvement in display efficiency

Increased the dimensions of the case opening and the golden space (the distance between the lowest shelf and the suction opening) enlarge the angle of view and increases the appeal of the exhibited merchandise.

Two heights of price cards and POP (point of purchase) hangers can be affixed on the upper support for the inclined mirror, which produces the impression of the bulk and continuity of the merchandise. The lower support's construction enables easy change of the mirror inclination in two stages, which greatly improves the stage effect of the merchandise.

3.2 Store friendly

(1) Improvement in display efficiency

To reduce the frequency of merchandise restocking and prevent lost sales due to a sellout, the depth of the

deck was increased. As a result, the display capacity of the merchandise grew by about 10%.

(2) Standard equipment of new microcomputer controllers

The standard equipment of the new microcomputer controllers for all cases realizes high freshness management through efficient operation. The compact indicator with a liquid crystal digital display offers refined design and easy temperature checking.

(3) Reduction in running and initial costs

The improvement of sectional and lengthwise air velocity distributions at the air curtain outlet, improved effects of air curtain rectification by improving the honeycomb, and the increase of evaporator efficiency by improving the pattern all reduce the required refrigeration capacity of the cabinet.

With regard to open refrigerating display cases for vegetables and dairy products, the former two layers of air curtains are reduced to one layer, and the number of parts is greatly reduced, due to a reduction in required refrigeration capacity.

3.3 Fitter friendly

(1) Use of 200V power supply

The former 200V and 100V mixed power supply for the cabinet was changed to a single-phase, 3-wire, 200V power supply for all the fan motors, dew prevention heaters, and lighting circuits. This improvement reduces the number of electrical circuits for installation by half and greatly simplifies electrical work.

(2) Improvement of installation and maintenance

The application of the kit form (optional) to the standard equipment of the new microcomputer controller and the mounting of a solenoid valve and defrost timer cases enable work on the case control functions on the case side. This simplifies installation and greatly improves maintenance.

4. Microcomputer Control

Fuji Electric was the first to introduce microcomputer control to open refrigerating display case operation control. The external view and the input/output block diagram of the M microcomputer controller for this series are shown in Figs. 3 and 4, respectively.

Temperature control, defrost end control, alarm output, and draining (differential time lag) control, which were formerly carried out individually with the mechanical or electronic thermostat, are performed by the M microcomputer controller in the lump. In addition, greatly improved control precision and severe storage temperature control realize high freshness control of the merchandise.

In addition, the case has new functions enabled only with the microcomputer such as adjustment of control temperature by changes in the ambient environment, the self-diagnostic function for indicating

Fig. 3 External view of the M microcomputer controller

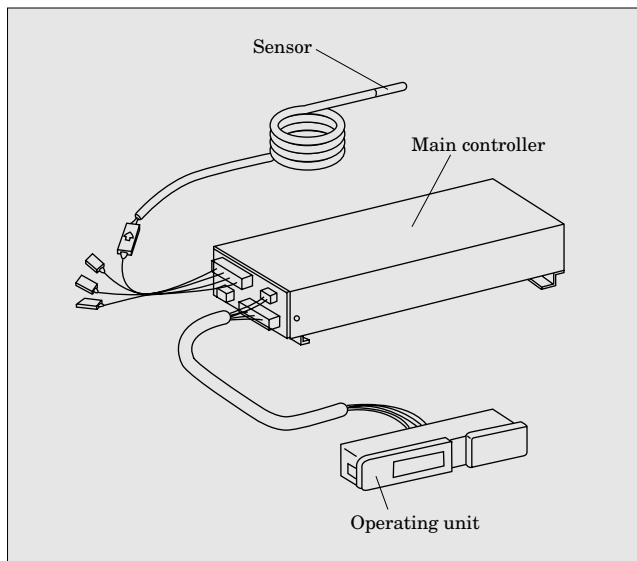
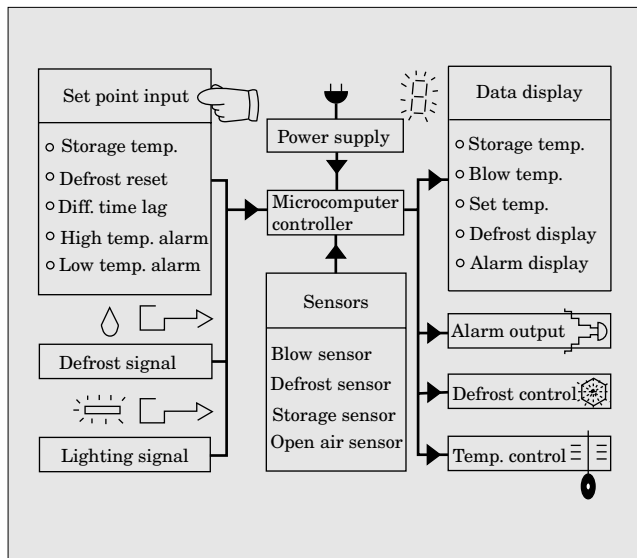


Fig. 4 I/O block diagram for the M microcomputer controller



sensor abnormality, and the temperature monitor function for various parts.

The major functions are described below.

(1) Display function

Storage temperature, set points, alarm contents, sensor temperature, and sensor abnormalities can be checked with the liquid crystal digital display on the operating unit.

(2) Setting function

With the push button of the operating unit, storage temperature, defrost reset temperature, alarm temperature, and draining time can easily be set.

(3) Storage temperature control function

This function adjusts control temperature for storage based on open air temperature sensor signals, temperature adjuster sensor signals, and set temperature. It maintains storage temperature at the proper level to ensure high freshness control of the merchan-

Fig. 5 Air velocity vectors

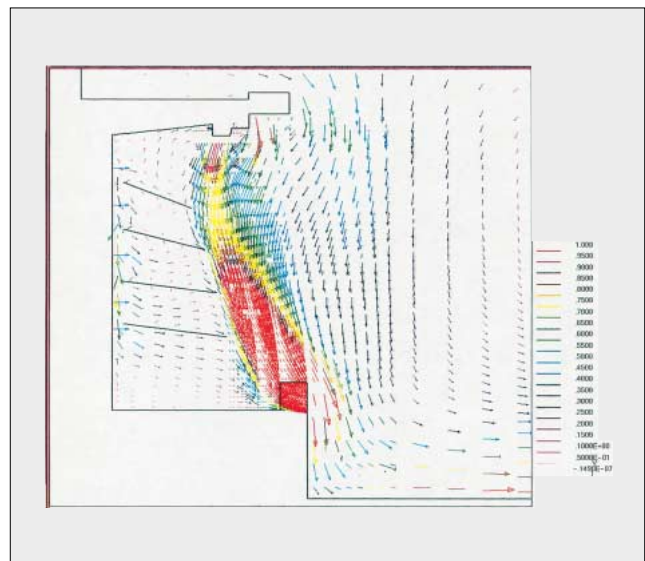
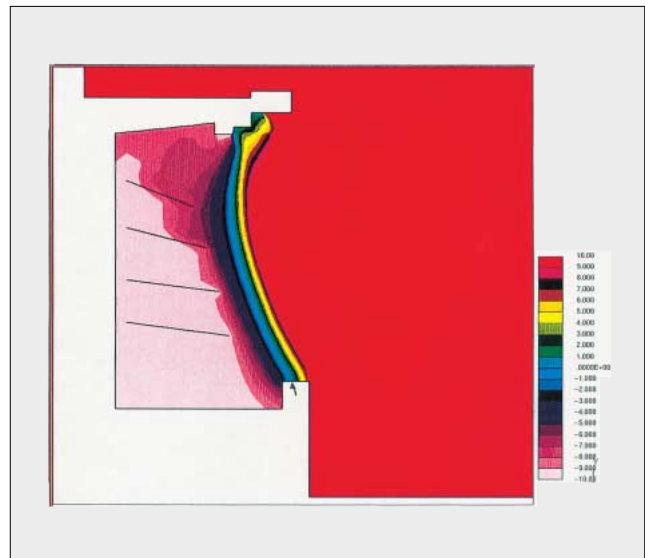


Fig. 6 Temperature distribution



dise as well as reduce energy loss due to excess cooling.

(4) Defrost control function

Based on defrost temperature sensor signals, this function controls defrost reset as well as draining time to securely discharge defrost water and attain reliable defrosting.

(5) Alarm output function

Judging the condition of case operation from temperature at the sensors and sensor input data, this function gives the alarm display when an abnormality occurs and also outputs the alarm to the outside.

5. Simulation Analysis

In developing this series, Fuji Electric maximized thermal fluid analysis, optimized air curtain performance, and made great improvements in the open refrigerating display case characteristics.

An example of an air velocity analysis is shown in Fig. 5, and an example of temperature analysis is shown in Fig. 6.

In this series, particularly the positional relationship between the air curtain exhaust and suction openings and the correlation between the honeycomb rectifier at the exhaust outlet, the blown air velocity, and the back flow from the rear of the case are optimized. Thus, temperature at the farthest parts, i.e. the lowest shelf and the case bottom near the suction opening, has now been improved. In the past, this has posed problems.

Due to these improvements, the storage temperature is more uniform than in the former types, and energy savings and high freshness control are attained.

6. Conclusion

Supermarkets tend toward individualization and diversification when seeking a new sales style. For example, showcases are also breaking tradition from the conventional uniform style. Fuji Electric will further the expansion of this series and the development of related products in a positive manner.





* All brand names and product names in this journal might be trademarks or registered trademarks of their respective companies.