

# Diversity Change Design of Storage Support for Single Door Refrigerator Under 100L

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## ABSTRACT

This paper investigates and analyzes the attention of small-sized refrigerator market and the design of storing space through searching literature and other methods. Then, it researches and classifies users' characteristics and items stored by users in a small-sized refrigerator to conclude that the existing storage space of small-sized refrigerator has the problem of insufficient utilization rate. On the basis of this, this paper redesign the storage bracket of small-sized refrigerator to improve the utilization rate of storage space in small-sized refrigerator effectively.

**Keywords:** *Small refrigerator; Storage space; Diversity change*

## 1. INTRODUCTION

In recent years, China's economy has been developing rapidly and people are gathering in big cities more and more. But the high price of housing in big cities only makes people choose more small houses or rent small square meter apartments. Because of the small living space, this brings opportunities to the small refrigerator market, in addition, the number of domestic hotels has increased dramatically. The demand for small refrigerators for hotels is also increasing. In addition, the increase of office space, the pantry area of office space also needs small refrigerator for refrigerated storage. It can be seen that the market prospect of small refrigerator is great. But because of its small storage space, but also bring a lot of inconvenience to the user. In order to solve the traditional small refrigerator refrigeration space cannot effectively use the problem, the small refrigerator in the limited space to make full use of, and to meet the different needs of users, and at the same time according to the different needs of users, by the user's own free storage area of the division, the article mainly on the 100L below the single door small refrigerator storage space storage bracket redesigned.

## 2. SMALL REFRIGERATOR SHELF DESIGN FACTORS ANALYSIS

### 2.1. Small refrigerator market concern research score

According to "China market research data, 2017-2019 China refrigerator different volume products consumer attention ratio"<sup>[1],[2],[3]</sup> for 2017 the attention is 11.4%, in different volume products attention ranked 5th, 2018 attention is 13.7%, in In the first half of 2019, the attention rate was 18.57%, ranking 3rd in the attention rate of different volume products. 71.61%, and the retail volume share is 71.84%. The next most popular product is the 70L product with 23.87% of retail volume and 23.89% of retail sales. The third ranking is 40L mini refrigerator, with 3.58% of the retail volume and 3.43% of the retail value.

To sum up, in recent years, although the small refrigerator consumption concern is not as hot as the large-capacity refrigerator so much concern, but the overall keep a continuous rise in momentum, also shows that the small refrigerator market gradually into the consumer's line of sight. And the most popular small refrigerator volume is concentrated in the refrigerator below 100L.

## **2.2. Research on consumer groups of small refrigerators**

A total of 120 questionnaires were put into the streets of Qingdao, 120 questionnaires were collected and 120 questionnaires were valid. The results of the questionnaire research showed that 65 people in the age group of 18-30 years old participated in the questionnaire research, among which 47 people intended to buy or had already bought, accounting for 72.3%; 42 people in the age group of 31-40 years old, among which 30 people intended to buy or had already bought, accounting for 63.8%; 11 people in the age group of 41-50 years old, among which 2 people intended to buy or had already bought, accounting for 18.2%; 2 people in the age group above 51 years old, of which 0 people intend to buy or have already bought, accounting for 0%. It can be seen that the consumer group of small refrigerator is mainly concentrated in between 25-40 years old, and the overall group can be divided into fresh college graduates and white-collar groups.

In addition, the intention or has bought small refrigerator user group why in the concentration of the above groups, summarize the reason can be divided into two aspects of household demand and public demand. First, the household demand. Just graduated from college students choose small refrigerator reason is because the income level is not high, choose to share or rent a small square meter housing. Especially single group, with refrigerator storage food is not much, purchase small refrigerator affordable, do not need to share with others, have their own independent privacy refrigeration space, in addition this group just into society, moving to find housing frequency increases, also will let them choose to move more light small refrigerator.

White-collar groups choose small refrigerator reason is part of the single white-collar without the purchase of housing choose to rent an apartment or small square meters of housing to transition, small refrigerator can be to meet the daily needs, but also can save space. Another part of the white-collar group has purchased a house, this kind of group pursues higher quality of life, need to take the refrigerator out of the kitchen, need to be different from the ordinary storage food refrigerator, the refrigerator function for refinement, generally put medicine or cosmetics and other items need to be refrigerated. Small refrigerator volume is small, easy to move, can be placed in the bedroom, living room and other places, does not take up space there is very convenient.

Second, the public demand. In addition to the above for the needs of the home small refrigerator, some public space also need small refrigerator, such as hotels, with the city population mobility increases, the number of hotels and hotels also increased significantly, small refrigerator just suitable for this space. In addition, the

increase in the number of offices in the city, the office pantry will be placed in small refrigerators to place some need to refrigerate tea drinks, etc.

The above reasons, also well explain the above mentioned, in China small refrigerator market attention why in recent years gradually rise.

## **3. DESIGN PROBLEMS OF SMALL REFRIGERATOR STORAGE SPACE**

### **3.1. Insufficient storage space utilization**

Survey of 120 questionnaires, when asked about the shortcomings of small refrigerators and the use of inconvenience, 96% of people users feel that the purchase of after food refrigerator storage space is small, cannot be placed in a larger volume of items. Before mentioned the existing small refrigerator in order to solve this space problem, using is to adjust the position of the storage rack solution, but adjust the position of the storage rack at the same time, on the one hand can indeed solve the volume of larger items can be smoothly into the small refrigerator. But invariably part of the space will be wasted. The waste of space makes the space is not enough for the small refrigerator, it is difficult to put more items.

### **3.2. Can not meet the user's personalized needs**

The storage shelf is fixed form, the user can only place items in the fixed area space divided by its storage shelf. This will limit the size of the items put into the area, which will cause a lot of inconvenience. Nowadays, the material abundance, people put into the small refrigerator items, food and other kinds of increasingly diversified, the volume is also different. How to meet the needs of different users in life, is also a need to solve the problem of small refrigerators.

## **4. SMALL REFRIGERATOR SHELF INNOVATION DESIGN**

### **4.1. Design positioning**

In order to solve the traditional small refrigerator refrigeration space cannot effectively use the problem, the article mainly on the 100L below the single door small refrigerator storage space storage bracket redesigned. How to make full use of the limited space in the small refrigerator is an important aspect of this design you concept, for example, the original refrigerator bracket can be shortened after the wasted space can be reused. Secondly, "to make full use of the limited space in the small refrigerator and to meet the different needs of the users, it is necessary to divide the storage area freely by the users themselves according to their different needs" [4].

### 4.2. Structural design

First of all the internal space of the small refrigerator can be simplified into a square space. Such a square space can be divided according to the coordinates X-axis Y-axis Z-axis (Figure 1).

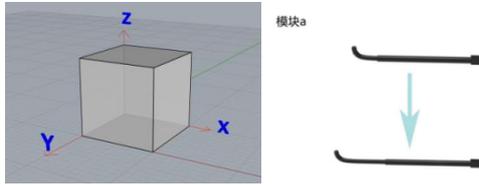


Figure 1 Schematic diagram of space coordinates

To solve the problem of low space utilization and storage space versatility, the original internal storage bracket needs to be redesigned, and the overall design is based on the modular design idea. The base module of the bracket is a nested rod that can be telescoped. The rod can be telescoped along the horizontal direction of its rod (X-axis) to adjust the length, and the end of the nested rod is cocked upward. The nested rod can be called module a, which ensures that a can be deformed along the X-axis direction.

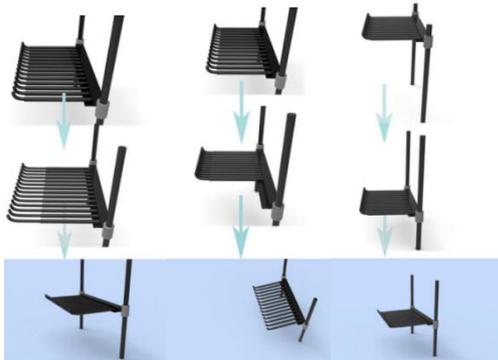


Figure 2 Schematic diagram of the deformation of module A

Multiple A are arranged with gaps and can be manually adjusted to deform freely in the horizontal direction (X-axis) to form a refrigerator shelf A. The end of the module is cocked to prevent items from sliding off the shelf. A refrigerator shelf A can be formed, and the end of the shelf can be turned up to prevent items from slipping off the shelf. A plurality of A's can be gathered and expanded along its own vertical horizontal direction (Y-axis) to gather and expand. The holder can also be moved up and down in the vertical direction (Z axis) (Figure 2).

This forms a storage rack that can be moved along the X-axis, Y-axis and Z-axis, which can be called module A. The same method can be used to obtain module B, and module A and module B are combined. You can get to a set of brackets, A and B storage shelf gap has a misalignment, through the gap, A and B in the Y-axis direction fully expanded state, but still can move freely

along the Z-axis direction, do not affect each other (Figure 3). a and B in the same horizontal position, the synthesis formed a horizontal bracket, due to the AB end upward. This allows the storage area of this horizontal storage rack to be divided into three positions of different sizes. The division of functional areas is realized.

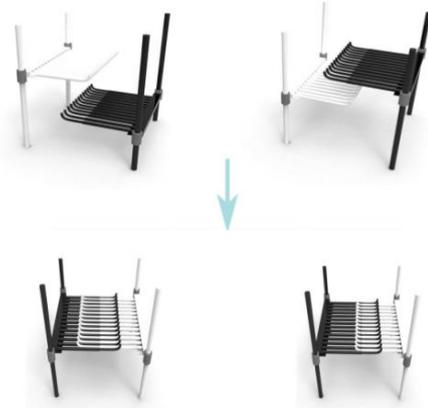


Figure 3 Schematic diagram of deformation of module AB combination

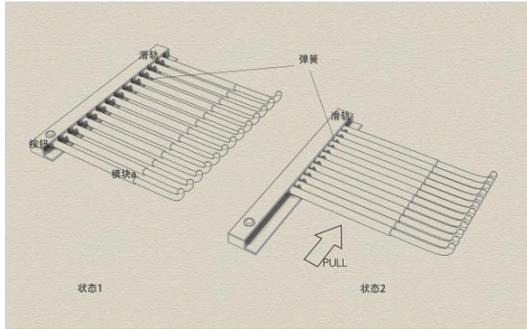
### 5. DESIGN RESULTS

Choice of material:

The material of the overall refrigerator bracket, the choice is aluminum alloy steel pipe and aluminum alloy plate, aluminum alloy low cost, and high hardness and not easy to rust, widely applicable. Ensure the overall stability and service life of the refrigerator bracket.

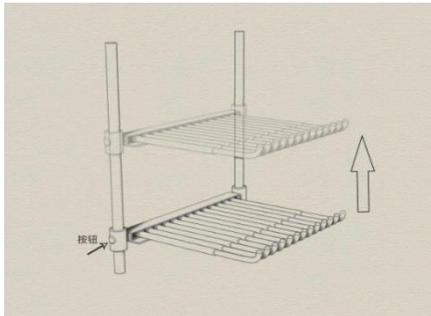
Fixed operation mode:

Module a moves and telescopes along the horizontal (X-axis) direction, requiring the nested aluminum tubes to be stretched by hand. The end of multiple modules a is a pulley, snap in the groove on the slide rail, so as to ensure the overall solidity of the bracket A in the unfolded state. When each a in the module A is unfolded along the horizontal (Y axis) direction of the same vertical itself, you need to press the button at the slide rail of the bracket, while manually pushing the outermost side of the a, moving in that direction. Each a has a fixed spring in the middle. This ensures that pushing the outermost a can push the other a together in one direction, and when pushing each spring to the limit, release the button at the slide rail, and the internal snap will catch the outermost a, which will realize the stent A closed state. When it is necessary to reach the unfolded state, similarly, press and hold the button, release the snap, and move the outermost a manually at the same time, each a, under the elasticity of the spring, will pull the connected a to one side, and when it is completely unfolded, release the button, the snap will catch the outermost a, and complete the fixing process, which is the unfolded state of the bracket A (Figure 4).



**Figure4** Module A operation mode and fixation mode 1

The two ends of Module A are fixed on the two circular tube slides by means of clips inside the slides. Press the button on the circular tube, the clips are released and the bracket A is moved manually in the vertical (Z-axis) direction, and after moving to a certain position, the button is released and the clips are stuck and fixed to complete the process of moving the bracket A in the vertical direction (Figure 5).



**Figure 5** Module A operation mode and fixing mode 2

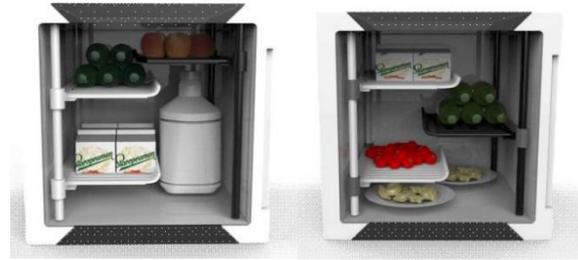
With the above design ideas, three identical modules A, module B and module C can be combined together to become the final solution. It is possible to divide a small refrigerator freezer area space freely (Figure 6).



**Figure6** Schematic diagram of the bracket in combination mode

The redesigned bracket, on the one hand, solves the problem of space utilization, when putting in large objects, can make good use of space, so that the small refrigerator can hold more items, to achieve maximum utilization of storage space. On the other hand, users can freely combine and move the storage shelves to meet the

personalized storage needs of different users. As shown in Figure 7.



**Figure 7** Schematic diagram of free combination

## 6. Conclusions

The design research of the article shows that the small refrigerator, because of its single function and small volume, its market is far less than the hot market of the refrigerator with large volume, but in the past three years in the Chinese refrigerator market, the small refrigerator has received more and more attention because of its unique small volume, convenient movement and low price, which can meet the needs of many young people in the market, but how to make the best use of the limited Refrigeration storage space has become an important design problem, the use of modular design small refrigerator storage shelves, to improve the refrigerator refrigeration storage space utilization. Through the design of this article, you can make the small refrigerator no longer look so small. Put in more storage, but also to meet the different storage needs of users.

## ACKNOWLEDGMENTS

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## REFERENCES

- [1] Chen Meng, "Discussion on the design of indoor space of ant family", Chinese packaging, 17(12), 2017.
- [2] Fu Qian, "Midea's small fridge design for online retailer, Hunan University, pp.12-15, 2013.
- [3] Lei Yang, "Analysis of the design problem of mini portable refrigerator", Information recording material, 18(7), 2017.
- [4] Weng Haowei, Zhang Chunhong, Innovative design of household vertical refrigerator freezer based on user experience, Design, 2019,32 (21): 20-22.