Patent Analysis of Intelligent Control Technology for Intelligent Refrigerator

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Abstract. The global patented technology in the intelligent control field of intelligent refrigerators has problems such as uneven development and low activity of overseas patent operations. Enterprises cannot accurately grasp the technological development trend in the field of intelligent refrigerator intelligent control. Based on PatSnap patent database, in-depth analysis of patent application changes in the field of refrigerator intelligent control, overseas patent distribution in the world, distribution of key patent technologies and patent operations, to find out the hot technology in the field of smart refrigerator intelligent control Identify patent risks and provide valuable patent information for Chinese intelligent refrigerator companies.

1. Introduction

With the rapid advancement of Internet of Things technology and sensing technology, refrigerator technology continues to innovate and develop towards intelligent and high-end[1]. The function of the intelligent refrigerator is extended on the existing functions of freezing and refrigerating of the existing refrigerator, intelligently controlling the refrigerator, intelligently managing the ingredients, automatically switching different modes, automatically adapting to different environments, and always maintaining the best storage state of the ingredients, while simultaneously maintaining the optimal storage state of the ingredients[2]. Intelligent refrigerator can realize human-computer interaction and monitor the quantity and quality of food in the refrigerator[3].

Patent is an important carrier of technology research and development activities, which can reflect the technical strength of the enterprise and the development direction of the field to a certain extent[4]. Studying the patented technology in the field of intelligent control for intelligent refrigerator, it can help intelligent refrigerator enterprises understand the cutting-edge technology of the industry, lead the research and development direction, identify the key points and breakthroughs of technology, and improve the efficiency of technical research[5]. At the same time, patent information analysis can clarify the patent layout and market strategy of major technology exporting countries, provide an effective reference for enterprises to enter the corresponding countries, and avoid patent infringement risks of similar technologies. Therefore, it analyzes the patent application change in the intelligent control field of smart refrigerators, the overseas patent layout of global countries, the distribution of key patent technologies and patent operations, etc., finds hot technology in the field of intelligent control for intelligent refrigerators, predict the development trend of the industry and provide valuable patent information for Chinese intelligent refrigerator companies.
2. **Patent application trend**

Intelligent control technology generally has two branches: preservation management and fault management. The hotspot technology of the branch management technology mainly focuses on intelligent temperature control, fine control dry and wet storage, frozen intelligent constant temperature, atomization humidification control and other technologies. The hotspot technology of the management technology branch mainly focuses on technologies such as intelligent fault detection and automatic repair. The patentsnap global patent database is used to search patent data in the field of intelligent control, and to sort out the keywords and IPC classification numbers of each branch direction, and comprehensive search strategies such as preliminary search, extended search and supplementary search to ensure comprehensive data retrieval. The data retrieval deadline is December 31, 2018. A total of 3,018 patents involving intelligent control of smart refrigerators worldwide, including 1583 domestic patent applications (The patent application has a lag period of up to 18 months to the public, so the change in the number of patent applications granted after 2018 cannot fully reflect the trend of technology development. The data is only for display).

The trend analysis of patent application is to analyze the law of patent data changes with time, reveal its development track, and reflect the technological development of each stage. Figure 1 (a) shows that the relevant patents in the field of intelligent control of refrigerators first appeared in the early 20th century, and have been in the germination period until 1988, with only a small number of patent applications for intelligent control related technologies. After ten years of technical accumulation, it entered the slow growth period in this field in 1988. After 2010, under the background of technological innovation and consumption upgrading, the patented technology in the field of intelligent control entered the rapid growth phase. Except for the slight fluctuation of the growth trend in 2013, the rapid growth trend after 2010 is basically indicated, indicating that the technology research and development in this field is in a stage of quite active and rapid development. In the field of intelligent control, the application trend of Chinese patents is almost consistent with the trend of global patent applications. After 2010, Chinese patent applications began to exert their strength, and the proportion of patents in the world increased year by year.

Intelligent control technology generally has two branches: preservation management and fault management. As of December 2018, the number of patents related to fresh-keeping management technology in the global intelligent control field was 2,738 (accounting for 90.72%), and the number of patents related to fault management was 279 (accounting for 9.28%). From the perspective of the whole application cycle, the patented technology in the direction of fresh-keeping management technology has developed significantly after 2010, which is in sync with the development trend of patented technology in the field of intelligent control, while the patents in the direction of fault management technology started late and the development trend is weak.

![Figure 1. Trends in global patent applications in the field of intelligent control](image-url)
3. Overseas patent layout

The proportion of overseas patents in the original applicant country directly indicates the country's willingness to overseas layout, which reflects the technical strength of each country to a certain extent. Figure 2 shows the willingness of overseas patents in major countries in the field of intelligent control for intelligent refrigerator. The number of overseas patents in the world totaled 286, accounting for 9.46% of the total number of patents. South Korea, Japan, China, and Germany have a large number of patents distributed globally. Germany has a strong willingness to overseas layout, and the number of overseas patents has reached 60% of domestic applications. South Korea, Japan, and the United States, as technological powers in the field of home appliances, have strong patent technology reserves and strong technical output and technological expansion. Although the number of overseas patents is not high in the original country, due to the large patent base, a certain number of patented technologies have been deployed in overseas countries. China's overseas patent distribution accounts for a small proportion of domestic applications. This is because China's technology development in the field of smart refrigerator intelligent control is still in the ascendant stage, and patent expansion has not been carried out on patent behavior. Switzerland, Turkey, Brazil and other countries have few patent technologies in the field of intelligent control of smart refrigerators, but their willingness to deploy overseas is very strong, and their technical output is almost the same as that of domestic applications.

4. Patent technology

Technically classifying patent data, classifying patented technologies in the field of intelligent control according to the IPC classification standard (currently the only internationally accepted classification method for patent documents). Analyze the distribution of patents in the segmentation area to understand the intensive points and blank spots of patent applications. Judging technical research concentration and technical research width.

In Figure 3, the main classification numbers of patent applications in the field of intelligent control for intelligent refrigerator are counted and sorted into large groups. The top ten are: F25D29 (equipment or installation of control or safety equipment), F25D11 (independently movable equipment associated with the chiller), F25D23 (general structural features), F25D17 (cooling fluid circulation device for circulating indoor venting gas), F25D25 (installation, support or removal of refrigerated items), F25D21 (defrosting, preventing frost formation, removing condensed water or defrost water), F25D19 (configuration and installation of refrigeration unit relative to equipment), G05D23 (temperature control), F25D27 (lighting device), F24F6 (humidification of air).

From the technical distribution represented by the classification number, the control technology and the cooling cycle technology are intensive areas of patent application in the field of intelligent refrigerator intelligent control technology, and the technical composition accounts for about 50%. Control technology and cooling cycle technology have a high degree of attention in the field of intelligent control, and the technology gathering and development momentum is good. However, the degree of attention to defrosting technology, refrigeration unit, and humidification technology is not significant, and the gap between the technical composition of the intelligent control field is obvious.
5. Global Patent Operations

The number of patent operations reflects to some extent the degree of industrialization, market activity and the level of attention of the competition subjects in this field. The low amount of patent transfer in the field of intelligent control indicates that the competitors are not paying much attention to the patented technology in the field of intelligent control. The research direction of the enterprise is inconsistent with the direction of the key technology branches. However, the amount of patent transfer in the field of intelligent control has shown a trend of rising volatility, and the degree of industrialization and market activity in the field of intelligent control is increasing year by year. At the same time, it also reflects that the smart refrigerator industry has gradually become a hot technology industry, and industrial technology innovation is on the rise.

Figure 4 shows the ranking of assignors and assignees in the smart control area of smart refrigerators. Figure 4 (a) shows the global patent transferor ranking distribution, the top three companies are Suzhou Lu Zhiyao, Ltd., Hisense (Beijing) Electric Co., Ltd., GENERAL ELECTRIC COMPANY. Among them, Suzhou Lu Zhiyao Co., Ltd. has the largest number of patents transferred, and its technical output advantage is obvious. Figure 4(b) shows the ranking of global patent assignees. The top three companies are Bo Xihua Electric (Jiangsu) Co., Ltd., Hisense (Shandong) Refrigerator Co., Ltd., SAMSUNG ELECTRONICS CO., LTD. Patent transfer in the field of intelligent control mainly occurs in China and South Korea, and patent operations in China and South Korea are more active.

6. Conclusions

The patented technology in the field of intelligent control for intelligent refrigerators in the world has shown rapid development. The number of patent applications has increased year by year, and the development and innovation of technology has been remarkable. However, while the rapid development of patent technology, certain problems have arisen.

The development of patent technology is uneven. The two branches of the fresh-keeping management and fault management technology in the field of intelligent control for intelligent refrigerators are not balanced, and the gap in patent technology development is obvious. Since 2010, the patented technology of the branch management technology has shown a rapid growth trend, while the patent technology of the fault management technology branch has developed slowly. The patent application in the field of intelligent control for intelligent refrigerator mainly focuses on control technology and cooling cycle technology, and the technical composition accounts for about 50%, while the degree of attention to defrosting technology, refrigeration unit and humidification technology is not significant. The gap between the technical composition of the intelligent control field is obvious.

The distribution of overseas patents is obvious. The overseas layout patents in the field of intelligent control for intelligent refrigerator account for only 9.46% of the total patents. China, Japan, and the United States are technological powers in the field of home appliances, the willingness to deploy overseas patents in the field of intelligent control is not strong, and the number of overseas
The number of overseas patents held by South Korea is small. South Korea is actively engaged in the overseas patent layout work, and the number of overseas patent applications accounts for more than half of the number of domestic patent applications, which is to protect the overseas market development of Korean refrigerator companies.

The patent operation is less active. The patent transfer in the field of intelligent control mainly occurs in China and South Korea. The patent operation behaviors of China and South Korea are relatively active, and the rest of the countries have fewer patent operations in the field of intelligent control. The transfer of patent transfer companies in China and South Korea is relatively concentrated, and domestic appliance companies have lower demand for patent technology transactions and weaker technology circulation.

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