Patent-map Analysis of Gauge-changeable Systems

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Abstract

Gauge-changeable systems can be used for the fast and safe transportation in the railways with different gauges instead of transshipment or bogie-changing. The system will be necessary to connect the trans-Korean railway with the trans-Siberian railway effectively. In this paper, searches of patent information about variable-gauge system are conducted and the patent maps are analyzed to seize the overall image and trend of the technology field. It can be found that the number of patents applied to Japan is the greatest and the number of applications by Spain and Germany increased remarkably from the mid-1980s. The technology field is still in the development stage in its life cycle, but seems to go to the mature period in near future. The possibility of successful entry of a new company can be relatively high and the most important technological issue seems to be the mechanism of gauge lock and changing. The results can be a reference for determining the development direction of the gauge-changeable system suitable in the north-east Asian railway networks.

Introduction

The gauge of the railroad which is mainly used worldwide is the standard gauge (1435 mm), that is also the case of Korea but the countries which used to be in the former Soviet Union are using the broad gauge (1520 mm) [1]. Meantime, Spain has the gauge of 1668 mm and Japan has the narrow one of 1067 mm in the conventional railways. For the transportation across the border of two countries having different gauges one can use the transshipment or bogie-changing, but will have the problem of transportation lag due to their relatively slow processing or large cost for additional infrastructures in the case of the large transportation volume. In order to solve the problem gauge-changeable systems can be used, which can give the fast and safe transportation. The systems are usually based on the principle of wheels able to move along the axle or, in the case of independent wheels, on the stub axle. The wheel is locked into the position corresponding to the required track gauge to prevent any undesired movement [2,3]. At the border of two railways with different gauges, the vehicle passes over the gauge changeover installation which is compatible with the particular gauge-changeable system design. To date, various gauge-changeable systems have been designed and have different reliability, maintenance and cost efficiency according to their mechanisms [4].

In this paper, the patent information about the gauge-changeable systems was investigated inclusively and classified for obtaining the patent maps, which can show the technical development trend, area of emphasis and the propensity of the corresponding technical market.

Patent maps of gauge-changeable systems

A Patent map is the visual representation of related patent information of a target technology field [5]. The number of patents for analyzing the field of gauge-changeable system was 358 and Fig. 1 shows the number of applications which were applied to each country. The map can be used to analyze patent application filing trends and it shows the possibility of success for advancing the gauge-changing technology into the according market, as well as how much the technology field of gauge-changeable system is activated in each country. It can be found that lots of patents were applied in Japan, USA, Germany, France, the former Soviet Union, Spain and Poland, and one can hardly move into the markets. All countries in the Fig 1 have the railways with different gauges in its own territory or neighboring country.
It is possible to analogize the degree of the technological development by analyzing the number of patent applications for country of priority as shown in Fig 2. The countries related to lots of applications for its priority were Spain, Germany, Switzerland and Japan. The change of the numbers of the applications can be seen in Fig 3. For the countries shown except Switzerland and France, the numbers are increasing remarkably from the mid-1980s, when the economic cooperation and expanded trade between nations are very common as the Cold War ended. Gauge-changeable systems are needed in the international transportation between the two railway systems with different gauges. Another reason for the change of numbers can be found in the fact that for some countries high speed railway was constructed in the standard gauge in 1970s regardless of their conventional railway with narrow or wide gauge. It is the case of Japan and Spain. In Korea, gauge-changeable system has been studied lately since the trans-Korean railway has been planed and constructed, which can be connected to the trans-Siberian railway. In Fig 3 one can see that the number of patent applications from Switzerland is relatively high in 1960s. This is related to the International Invitation to Tender issued by RENFE for defining a variable gauge axle with high performance in 1966. RENFE awarded first prize to the system submitted by Maison Vevey of Switzerland. At that time the system was tested and improved, which might result in lots of patent applications [4].
The patent maps portraying the degree of maturity of the technology field are shown as Fig 4 and 5. In Fig 4 the number of patent applications can be found in vertical axis and the numbers in the circles are the number of applicants in the corresponding periods. From the mid-1980s the numbers of applications and applicants increased rapidly. Fig 5 shows the ratio of the increase in the number of patent applications plotted on the vertical axis and the total number of patent applications within a certain period plotted on the horizontal axis. Such portfolio map portrays the life cycle of a certain technology that consists of growth, development, mature, decline periods in general. From Fig 5, it can be said that the increases in the number of patent
Fig 6: Percentages of numbers of patent applications by applicants.

applications starting in 1987 and grew continuously, and the number of applicants also increased rapidly. This indicates that the number of applicants (or companies) newly entering the industry is increasing, and the technology field is still in the development stage but will go to the mature period in near future [5].

Fig 6 shows the percentages of numbers of patent applications by applicants, which make it possible to know the main companies and the monopolistic structure in this technical field. It is helpful for estimating whether or not the field can be easily entered by a new company. The main companies are Talgo, RTRI, Fuji Heavy Ind, Vevey. However the applications from the higher rank companies do not still make up the majority so that the possibility of successful entry of a new company can be relatively high. One can see the percentages of numbers of applications by technology categories in Fig 7. The 77% of applications is about the mechanism of gauge lock and changing, which can be considered the most important technological issue. The numbers of patent applications in technology categories by applicants are shown in Fig 8. Most applicants have many applications about the mechanism of gauge lock and changing, and RTRI and Fuji Heavy Ind also studied the problems about durability and dynamic safety. DB of Germany has the patent application about the break system.

Fig 7: Percentages of numbers of patent applications by technology categories.
Fig 8: Numbers of patent applications in technical categories by applicants.

Fig 9 shows the basic patents of gauge-changeable system in chronological order, which provides an image of the technology field and a hint for forecasting the direction of technological development. The early patent application was the gauge-changeable bogie from Talgo of Spain and later, the locking catch was improved. Other applications were about the gauge-changeable bogie for motor cars or the bogie with roller supports on the bogie frame or gauge-changing installation.

Conclusions

In this paper, the patent maps produced by gathering patent information about gauge-changeable system were analyzed to seize the overall image and trend of the technology field.
The characteristics of the technology market related to the main countries and companies were studied and the life cycle and categories of the technology were also considered. It can be found that the number of patents applied to Japan is the greatest and the number of applications by Spain and Germany increased remarkably from the mid-1980s. The technology field is still in the development stage in its life cycle, but seems to go to the mature period in near future. The possibility of successful entry of a new company can be relatively high and the most important technological issue seems to be the mechanism of gauge lock and changing. The results can be a reference for determining the development direction of the gauge-changeable system suitable in the north-east Asian railway networks.

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References