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Research on technological development strategy of new energy automobile industry in China-- Based on the perspective of patent analysis

Junling Yin[1*], Wei Song[2]

1. School of Public Affairs, University of Science and Technology of China 96 Jinzhai Road,Hefei 230026, the People's Republic of China
2. School of Public Affairs, University of Science and Technology of China 96 Jinzhai Road,Hefei 230026, the People's Republic of China

* E-mail of the corresponding author: yinjl@mail.ustc.edu.cn

Abstract

The traditional automobile industry is turning to new energy automobile industry due to environmental pollution, energy security and high oil prices. As a new and technology-intensive industry, the core technology of new energy automobiles is of vital importance to enterprises. Whether enterprises will keep competitiveness depends on grasping market hot technology direction and adjusting their strategy in time. This paper discusses the research status of new energy automobiles in China with the help of patent analysis. More specifically, we pay more attention to new energy automobiles patents and their distribution areas through SooPAT database, so as to obtain overview of China's new energy automobile industry technology. On this basis, the study summarizes the present situation and future development trend of new energy automobile industry from the technical level and puts forward some corresponding strategies.

Keywords: New energy automobiles, Patent analysis, Strategy and advice, China.

1. Introduction

In the 21st century, the global energy becomes shortage and worsening environmental problem is serious with the rising of car ownership. Therefore, the development of new energy automobiles to reducing car emissions has become the focus of the global automobile industry, which makes new energy automobiles quickly become the new R&D and production targets of automobile industry in the world. China identified the new energy automobile industry as a strategic emerging industry and a key development industry in the future in October 2010. It launched a detailed development plan for the new energy automobile industry in 2012.

The new energy automobile industry is a technology-intensive industry, so the company competition is essentially the competition of technical strength. New energy automobile companies have high R&D investment and technology content. Using patent to protect their technological achievements is the most commonly-used method. Therefore, it is the most feasible way to analyze the technical strength of the new energy automobile enterprises, their R&D layout, technical route, as well as the technical opportunities and technical defects through patent research. According to patent retrieval, this paper analyzes new energy automobile patents and their key parts in China. Then, we make a comparison between China and other countries from patent numbers, patent application trends, technical layout, etc. Thus the technology status of new energy automobile industry in China is analyzed in a more detailed evaluation.

2. Literature review

At present, the research on new energy automobiles mainly focuses on the field of technical R&D as well as industrialization theory and practice exploration. Because new energy automobile industry started relatively late in China, research fields were not extensive. Except for research in the field of technology, research on the industrialization of new energy automobiles focuses on the summary of international experience, analysis of R&D strategy and industrial policy.

According to the social-technical theory, Xue and Shao (2013) adopted a multi-level perspective to analyze the dynamic interplay and feedback mechanism among elements in the current internal combustion automobiles. On the analysis, social—technical scenario method is used to map out the basic transition scenarios to AFVs in China. Huang and Wu (2007) summarized the characteristics and R&D status of hybrid electric automobiles and their prospects. In summarizing the international experience, the Science and Technology Special Office of Electric Automobile in Ministry of Science and Technology of the P.R.C released the report of global research

and development of hydrogen and related policy investigation which summarized the current situation and policy system of hydrogen energy development in countries around the world. According to two dimensions of industrial innovation chain and policy instruments, Lu et al. (2014) developed a theoretical framework, which was applied to analyze polices of new-energy automobile industry in five typical developed countries (USA, Japan, Germany, France and UK) and "BRICS countries" through content analysis method. Afterwards, they provided implications for policy-making systems.

New energy automobile industry became one of strategic emerging technology industries in China in 2010. Since then it has attracted great importance to the patent status of new energy automobile industry from researchers. It is also considered as an important condition for enterprises to realize "curve overtaking". Lan et al. (2013) used the Thomson Innovation patent retrieval analysis platform to collect and collate patents of global new energy automobile industry by using a professional patent retrieval and analysis method. The six technology fields of new energy automobile industry, including time trends, national distributions, technical branch distributions, applicant distributions, were analyzed in the view of the global and the domestic respectively. Li (2016) analyzed the current patent status of auto enterprises in new energy automobile industry and put forward the competitive strategy for them to successfully achieve the route from technology patents to patent standardization. Xie et al. (2015) used patent map to analysis patent characteristic about three types of new energy automobiles, including hybrid automobiles, pure electric automobiles and fuel cell automobiles. Based on the analysis, the paper made a foresight on new energy automobile technology evolution path by using TRIZ technical evolution theory. And they found new energy automobile industrial key technologies and their expected achievement time. Zhang et al. (2011) found that China's new energy automobile industry had some problems, such as unclear strategic direction, lack of core technology and imperfect consumption environment. Therefore, they suggested that governments should increase support and companies should speed up R&D process.

In the field of theoretical research, new energy automobile technology and industrialization is still in the primary stage. Moreover, it is involved in research and extension projects which are usually dominated by the government and are participated by enterprises and research institutions. So the current research of new energy automobiles is mainly embodied in industry analysis, technical analysis, project results and evaluation report by the government, enterprises and research institutions. Afterwards, the results generally were published in international conference about new energy automobiles.

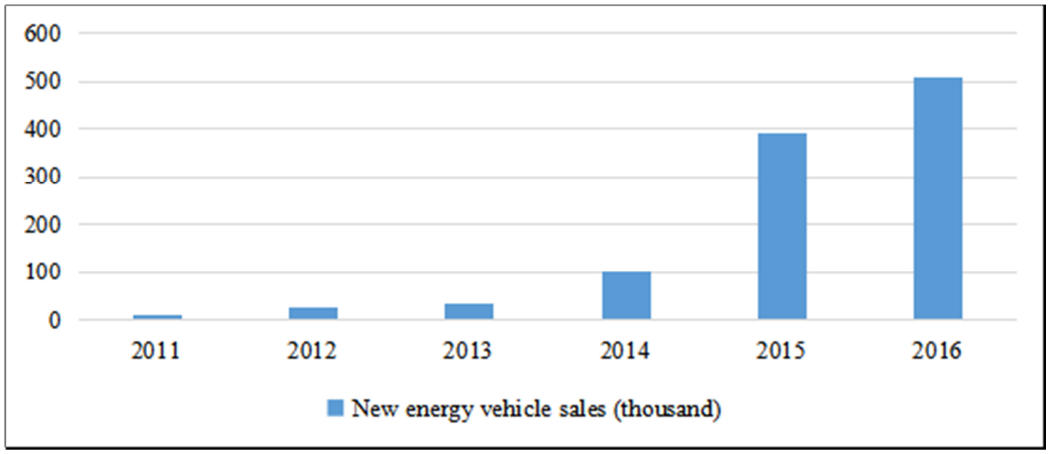

Figure 1. New energy automobiles in China from 2011 to 2016

3.Status of new energy automobile industry and patents in China.

3.1 New energy automobile industry in China

There are many types about new energy automobiles, including hybrid electric automobiles, pure electric automobiles, fuel cell cars, hydrogen engine automobiles, gas-powered cars, alcohol and alcohol, and so on. The Chinese government has formulated the development route for the new energy automobile industry which gives priority to pure electric automobiles and complementary to plug-in hybrid electric automobiles. It means that hybrid automobiles are short - term transition products, pure electric automobiles and fuel cell automobiles are the ultimate development goals. At the same time, China focus on developing three types of new energy automobiles (hybrid electric automobiles, pure electric automobiles and fuel-cell automobiles) and their key

component technologies.

Figure 1 shows that productions and sales of new energy automobiles in China are increasing year by year under the impetus of government policies, which makes China become the biggest new energy automobile market in the world. What's more, the social acceptance of new energy automobiles has gradually been improved. In 2016, 507,000 new energy automobiles were sold in China, an increase of 51.7% over the same period last year. Among them, 40.9 million were pure electric automobiles, an increase of 65.1% over the previous year, while 98,000 were plug-in hybrid cars.

3.2 analysis on patent status of new energy automobiles in China

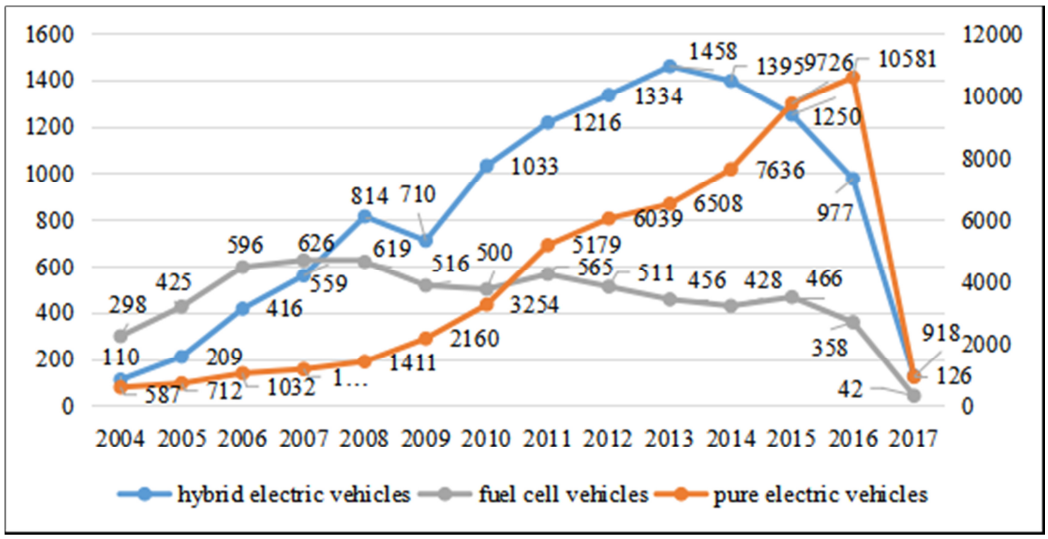

Figure 2. Patent applications of new energy automobiles in China

In terms of patent layout, the patent growth trend of new energy automobile in China is basically consistent with the international trend. The annual patent applications of pure electric automobiles have been rising and growing rapidly, which makes pure electric automobiles become the main research direction in past, present and future. It is also the focus of other countries' patent layout in China. China's patent applications for hybrid electric automobiles gradually declined after reaching a peak in 2013.According to the relationship between patent application and technology life cycle, hybrid power technology has gradually matured. Most of China's automobile manufacturers rely mainly on hybrid power technology import while R&D expending of these manufacturers is less. China's patent applications for fuel cell automobiles began to decline after 2007, which showed that R&D investment in this field was reduced due to technical research and development blocked.

Although development time of new energy automobile industry in China is short, but China has become an important layout area and market for new energy automobiles following the United States, Japan and the European Union, due to a substantial increase in sales. Companies in Japan and America have a huge advantage in patent applications for hybrid automobiles and fuel-cell automobiles, especially Japan. Japan has the largest number of leading companies and strongest technology in hybrid automobiles, particularly in the field of fuel cell automobile technology. And Japan's advantage is more and more obvious. Only three car companies in China, including Geely, BYD and Chang'an, are in the top 10. Chinese enterprises occupy the majority of pure electric automobiles while the advantages of pure electric automobile patents in other countries are not obvious. However, the quality of new energy automobile patents of car companies in China should be improved. In addition, although China has a lot of research and development institutions of new energy automobile, its concentration ratio is low and technology is weak.

Table 1. The top ten patent applicants of new energy automobiles in China

patent applicant of HEV	percent	patent applicant of HEV	percent	patent applicant of HEV	percent
Toyota	7.17%	State Grid Corporation of China	1.31%	Toyota	26.09%
GM	2.62%	BYD	0.81%	GM global technology operations	14.42%
Hyundai	2.85%	Chery	0.81%	Nissan	6.36%
Geely	2.49%	BAIC BJEV	0.72%	Hyundai	6.04%
Ford	2.11%	Honda	0.70%	GM	2.74%
Chery	1.93%	Geely	0.67%	Shanghai fuel cell automotive power system co. LTD	1.75%
BYD	1.75%	Toyota	0.66%	KIA	1.71%
Changan Auto	1.62%	Beiqi Foton	0.53%	Honda	1.45%
Nissan	1.58%	Hyundai	0.50%	Tsinghua University	1.38%
Saic Motor	1.37%	Changan Auto	0.43%	Wan Gang	1.32%

4. Patent analysis on key parts of new energy automobiles in China

The new energy automobiles are developed on the basis of traditional automobiles by adding components such as power battery, driving motor, electronic control system and special automatic transmission. The battery, driving motor and electric control system are the most important components of the new energy automobiles industry chain, they respectively play a role in power source, driving force and brain of new energy automobiles. This section analyzes the current technology development in China new energy automobiles industry by retrieving the world patents in the field of battery, driving motor and electronic control system.

4.1 Patent analysis on power battery

Power battery is one of the three core technologies of new energy automobiles. It plays an crucial role in new energy automobiles industry chain. Company that mastered the core technology of power battery has great advanced advantage in new energy automobiles industry. Currently, the bottleneck of power battery is its high cost and its in developing technology. According to the statistics, battery cost accounts for almost 40% of the overall cost of electric vehicle. Meanwhile, because of the weight and limited budget of the battery, the current mainstream models just have a very short cruise range, which seriously restricts the promotion of electric vehicles. In addition, the long charging time of the battery also greatly restricts the commercialization and marketization of electric vehicles. Therefore, as the core segment of the development of new energy automobiles, Chinese research and development institutions should be pay high attention to the technology of power battery. This section analyzes the patent of dynamic battery through hotspots technology of power battery, application countries, main patent applicants and their technology fields.

(1) Analysis on hotspots technology of power battery

According table two, in the field of battery power technology, electric propulsion with power supplied within the vehicle (b60l11/00) is the most closely watched by new energy automobiles companies. Secondly, as the main components of the battery, the battery electrode technology has also received wide attention. Circuit arrangements for charging or depolarising batteries or for supplying loads from batteries (H02J7/00) and secondary cells are well considered as well; manufacture thereof (H01M10/00) are the hotspots research technology of this subdivision field. And the areas such as arrangement or mounting of plural diverse prime-movers for mutual or common propulsion (B60K6/00), conjoint control of vehicle sub-units of different type or different function (B60W10/00) are also focused by relevent researches, development institutions and enterprises.

Table 2. The hotspots technology of power battery of new energy automobiles

ran king	main group symbol of IPC	technical content	ran king	main group symbol of IPC	technical content
1	B60L11/00	Electric propulsion with power supplied within the automobile	6	B60W20/00	Control systems specially adapted for hybrid automobiles
2	H02J7/00	Circuit arrangements for charging or depolarising batteries or for supplying loads from batteries	7	B60R16/00	Electric or fluid circuits specially adapted for automobiles and not otherwise provided for; …
3	B60K6/00	Arrangement or mounting of plural diverse prime-movers for mutual or common propulsion	8	H01M2/00	Constructional details, or processes of manufacture, of the non-active parts
4	B60W10/00	Conjoint control of automobile sub-units of different type or different function	9	B60K1/00	Arrangement or mounting of electrical propulsion units
5	H01M10/00	Secondary cells; Manufacture thereof	10	G01R31/00	Arrangements for testing electric properties; Arrangements for locating electric faults;…

(2) Analysis on major application countries of power battery

Figure 3 ranks the top eight countries and regions which have the largest number of patent applications in the field of power battery technology for new energy automobiles. China, Germany, Japan, US and Australia rank among the top five. The high rank of China proves great effort from Chinese government to new energy automobiles. This phenomenon not only reflects the rapid development of China's new energy automobiles enterprises, but also demonstrates that the new energy automobiles market of China has gained recognition internationally.

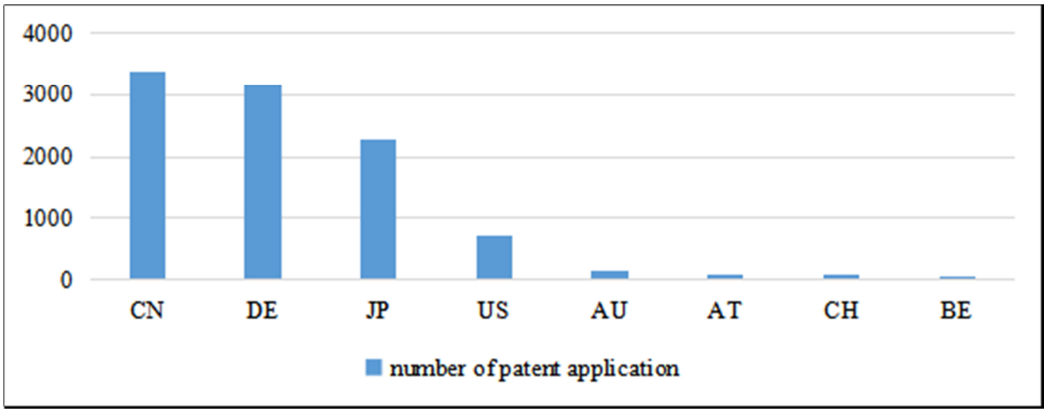

Figure 3: The top eight countries and regions which has the largest number of patent applications in the field of power battery technology for new energy automobiles

(3) Analysis on main patent applicants and their technology in the field of power battery

The main patent applicants in the field of power battery are Toyota, Honda, Bosch and Daimler, etc. Japan has the largest number of shortlisted companies, with nearly half of them, such as Toyota, Honda, Nissan. Japan takes comparatively great advantage in each technical field. It can be seen that Japanese companies value power batteries very much, and had a lot of resources investment. The next is German companu, which represented by

Bosch, Daimler and Volkswagen, which also have some advantages in H02J7/00 and H01M10/00. In addition, South Korean enterprises such as Hyundai group succeed in the dynamic battery field. The only one Chinese company entered the list is BYD, with the main technology sectors B60K6 and B60K1, but its number of patents is still less when comparing to the representative companies in Japan and Germany. Combining figure 3 and figure 4, we can find that most of power battery patents applications of new energy automobiles in China are applied by foreign enterprises, that means the market of Chinese new energy automobiles has gained international recognition. However, the current situation will hinder the development of China's new energy automobiles industry technology in the same time.

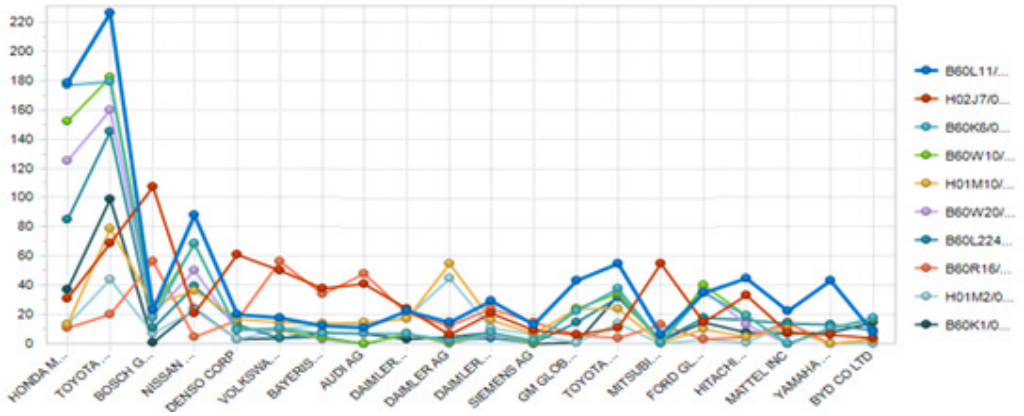

Figure 4. The top 20 patent applicants and their technical fields in power battery technology for new energy automobiles

4.2 Patent analysis on driving motor

The vehicle driving motor is the core component of new energy vehicle, and especially the pure electric vehicle. The driving motor of electric car mainly includes DC motor, AC induction motor, permanent magnet synchronous motor, and switched reluctance motor. This section retrieves the relevant patents in the world and analyzes the patent of driving motor through hotspots technology of driving motor, application countries, main patent applicants and their technology fields.

(1) Analysis on hotspots technology of driving motor

According table 3, in the field of driving motor technology, arrangement or mounting of plural diverse prime-movers for mutual or common propulsion (B60K6/00) is the most closely watched by new energy automobiles companies. The following technology areas are conjoint control of vehicle sub-units of different type or different function (B60W10/00) and Electric propulsion with power supplied within the vehicle (B60L11/00), which also widely concerned and invested by automobile enterprise. And the areas such as control systems specially adapted for hybrid vehicles (B60W20/00), methods, circuits or devices for controlling the propulsion of electrically-propelled vehicles (B60L15/00) and purposes of road vehicle drive control systems not related to the control of a particular sub-unit (B60W30/00) are also focused by relative research and development institutions and enterprises.

Table 3. The hotspots technology of driving motor of new energy automobiles

ranking	main group symbol of IPC	technical content	ranking	main group symbol of IPC	technical content
1	B60K6/00	Arrangement or mounting of plural diverse prime-movers for mutual or common propulsion	6	B60W30/00	Purposes of road automobile drive control systems not related to the control of a particular sub-unit
2	B60W10/00	Conjoint control of automobile sub-units of different type or different function	7	F02N11/00	Starting of engines by means of electric motors
3	B60L11/00	Electric propulsion with power supplied within the automobile	8	B60K1/00	Arrangement or mounting of electrical propulsion units
4	B60W20/00	Control systems specially adapted for hybrid automobiles	9	H02K7/00	Arrangements for handling mechanical energy structurally associated with dynamo-electric machines
5	B60L15/00	Methods, circuits or devices for controlling the propulsion of electrically-propelled automobiles	10	F16H3/00	Toothed gearings for conveying rotary motion with variable gear ratio or for reversing rotary motion

(2) Analysis on major application countries of driving motor

Figure 5 ranks the top eight countries and regions which has the largest number of patent applications in the field of driving motor technology for new energy automobiles in the order of China, the U.S., Germany, and Japan. China ranks the top one, which means the Chinese new energy automobiles market has been noticed and paid attention by countries over the world. However, similar to the patent application for power battery, most of driving motor patent applications of NEV in China are applied by foreign enterprises. In addition, a larger number of patent applications in the field of motor technology are applied to WO and EP. This phenomenon indicates that the demand for patent cross-regional protection in the field of motor technology is much more stronger than power battery. The reason may be that the technology of driving motor is relatively similar, and it led to the demand for broader protection.

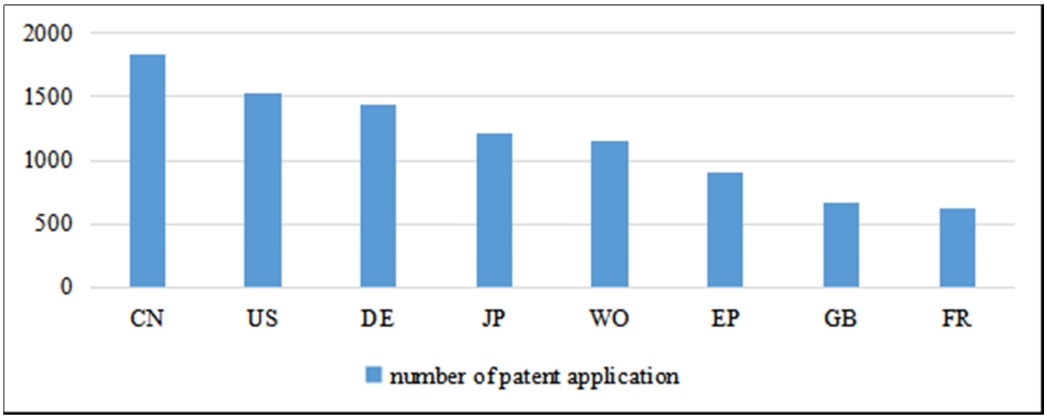

Figure 5. The top 8 countries and regions which has the largest number of patent applications in the field of driving motor technology for new energy automobiles

(3) Analysis on main patent applicants and their technology fields of driving motor

The top twenty patent applicants in the field of driving motor are Bosch, Toyota, Valeo and Friedrichshafen, etc. Germany has eight companies in the shortlisted companies, such as Bosch, and Friedrichshafen. This phenomenon is caused by the abundant strengths and technical accumulations of German automobile industry. The following is Japanese companies, which represented by Toyota and Aisin. In addition, French companies such as valeo, Peugeot and Renault also have some advantage in driving motor technology. It is noteworthy that Japanese companies such as Toyota, Honda also shows superior strength in the power battery field, which can be seen that Japan is committed to the ambition and strength of the whole industry chain of NEV. On the corporate side, Bosch and Toyota have a great advantage in all areas, Friedrichshafen and Peugeot, also have some advantages in B60W10/00 and B60W20/00. But Chinese companies are clearly vulnerable in this area, this is not commensurate with the status of Chinese new energy automobiles market, and Chinese companies need to strengthen research and development in this area.

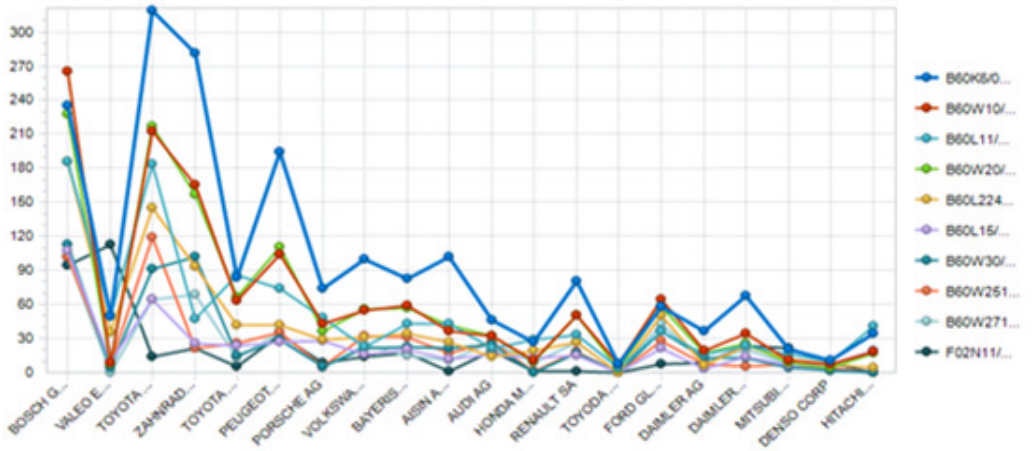

Figure 6. The top 20 patent applicants and their technical fields in driving motor technology for new energy automobiles

4.3 Patent analysis on electronic control system

Another core component of new energy automobiles is the electronic control system. The electronic control system is regarded as the brain of new energy automobiles, which includes energy management system, regenerative braking control system, motor drive control system, electric power steering control system and powertrain control system. It directly affects the power performance, power consumption and battery life of new energy automobiles. This section retrieves the relative patents in the world and analyzes the patent of electronic control system through hotspots technology of electronic control system, application countries, main patent applicants and their technology fields.

(1) Analysis on hotspots technology of electronic control system

According table 4, in the field of electronic control system technology, arrangements or methods for the control of AC motors characterized by the kind of supply voltage (H02P27/00) is the most closely watched by new energy automobiles companies. The following technology areas are Electric propulsion with power supplied within the vehicle (B60L11/00) and arrangements for controlling synchronous motors or other dynamo-electric motors using electronic commutation dependent on the rotor position (H02P6/00), which also paid great attention and invested by automobile corporations. And the areas such as arrangements or methods for the control of electric machines by vector control (H02P21/00); conversion of ac power input into dc power output; Conversion of dc power input into ac power output (H02M7/00) and electric devices on electrically-propelled vehicles for safety purposes; Monitoring operating variables (B60L3/00) are also the hotspots of electronic control system area.

Table 4. The hotspots technology of electronic control system of new energy automobiles

ranking	main group symbol of IPC	technical content	ranking	main group symbol of IPC	technical content
1	H02P27/00	Arrangements or methods for the control of AC motors characterised by the kind of supply voltage	6	B60L3/00	Electric devices on electrically-propelled automobiles for safety purposes; Monitoring operating variables
2	B60L11/00	Electric propulsion with power supplied within the automobile	7	E02F9/00	Component parts of dredgers or soil-shifting machines, not restricted to one of the kinds covered by groups E02F 3/00-E02F 7/00
3	H02P6/00	Arrangements for controlling synchronous motors or other dynamo-electric motors using electronic commutation dependent on the rotor position; …	8	H02P29/00	Arrangements for regulating or controlling electric motors, appropriate for both AC and DC motors
4	H02P21/00	Arrangements or methods for the control of electric machines by vector control	9	B60L15/00	Methods, circuits or devices for controlling the propulsion of electrically-propelled automobiles
5	H02M7/00	Conversion of ac power input into dc power output; Conversion of dc power input into ac power output	10	D06F33/00	Controlling a series of operations in electric motor

(2) Analysis on major application countries of electronic control system

Figure 7 ranks the top eight countries and regions which have the largest number of patent applications in the field of electronic control system for new energy automobiles, in the order of Japan, China, US, UK, and Germany. China is ranked number two just behind Japan. In the field of electronic control technology, Japan and US have the most advanced technology. UK, Germany and South Korea also have strong research capabilities in this area. Similar to the patent application for driving motor, part number of patent applications in the field are applied to WO and EP, it demonstrate that the patent of electronic control system also have the demand for cross-regional protection.

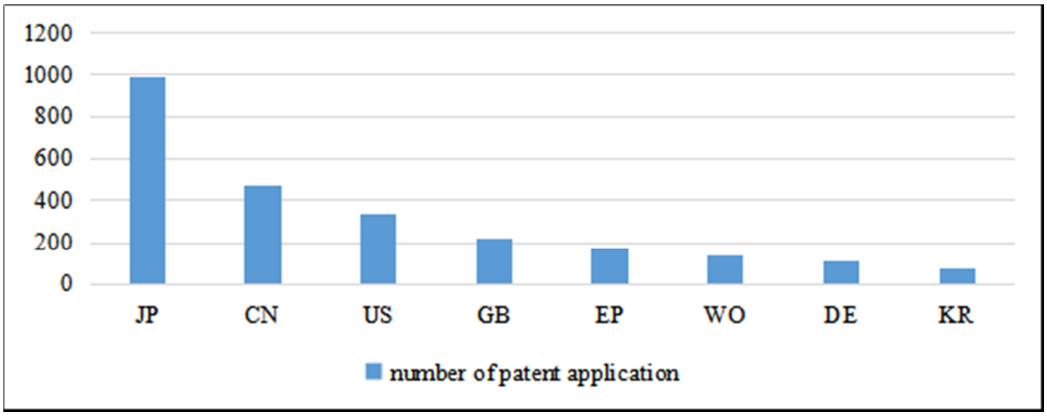

Figure 7. The top 8 countries and regions which has the largest number of patent applications in the field of electronic control system technology for new energy automobiles

(3) Analysis on main patent applicants and their technology fields of electronic control system

The main patent applicants in the field of driving motor are Mitsubishi, Hitachi, Toyota, Matsushita and Denso, etc. Japanese companies took the top five, Bosch and GM are the only two companies in the top

ten which not belong to Japan. It can be seen that Japan has absolute superiority in the field of electronic control system technology. This is the same the area of power battery and motor technology.It's obvious that Japanese enterprises have a strong strength and leading advantage in the whole industrial chain of new energy automobiles. Chinese companies are vulnerable in this area and cannot keep up with international competitor except BYD.

In the technical field of the global new energy vehicle automobile control system technology, according figure 8, D06F33/00, H02P6/00 are key areas of research. On the corporate side, Mitsubishi has great advantages in D06F33/00, H02P6/00 and H02P27/00; the preponderant fields of Matsushita is H02P27/00 and H02M7/00; the advantageous area of Hitachi is E02F9/00; Bosch and Toyota have some advantages in B60L3/00 and H02P29/00.

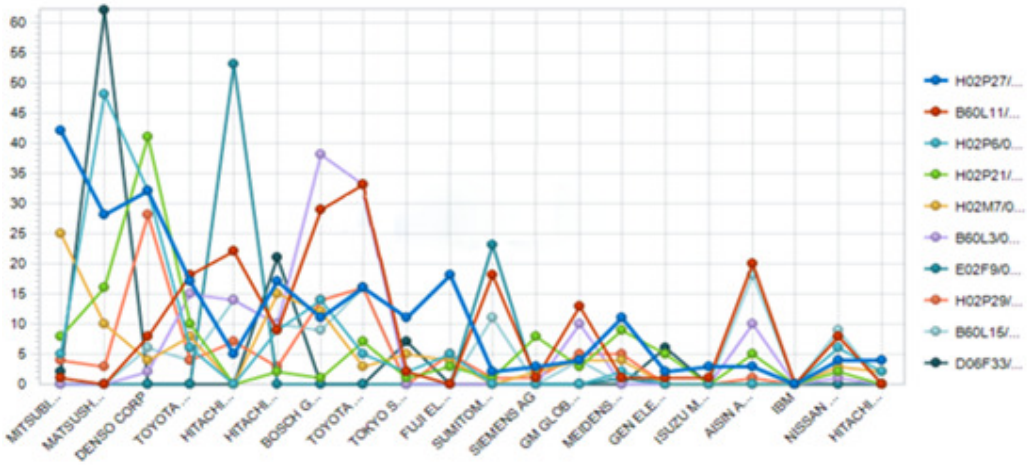

Figure 8. The first 20 patent applicants and their technical fields in electronic control system technology for new energy automobiles

5.Suggestions

This paper makes an empirical analysis on the development of China's new energy automobile industry on the perspective of patent analysis, by means of patent map and so on, which enriches the development of new energy automobile industry and patent research.This paper concludes and shows the current tendency of China's new energy automobile industry and the patents` situation .Especially ,this paper analyzed such areas in detail as the key technical fields, power battery, motor, electronic control system hot technology, application countries and major applicants and their technical areas.Research indicates the following six aspects.Firstly,the development of China`s new energy automobiles technology is severely imbalance .The technology of pure electric automobile is much advanced than hybrid automobile technology, especially than the fuel cell automobile technology.Secondly,on one leading enterprise in the field of China`s new energy automobiles technology.All enterprises are at the similar level .Relatively speaking, among those Chinese enterprises, some private car companies are in a leading position such as BYD, Chery and Geely cars.Thirdly,With China's new energy automobile sales increased significantly,China has become an important place where many countries would like to expand their market share in after the United States, Japan and the EU. Japan owns the most patent technology and its technical strength is the strongest in the field of hybrid cars and fuel cell automobiles.Fourthly,in the battery hotspot technology, the current popular technology are the electric propulsion with power supplied within the automobile (B60L11/00), circuit arrangements for charging or depolarising batteries or for supplying loads from batteries (H02J7/00) and secondary battery and its manufacturing (H01M10/00). Japan has the most enterprises and its technology is the most advanced followed by Germany and South Korea all over the world .In China, BYD car enterprises` R&D strength is the strongest , but the weakest while compared with the international rival. Fifthly,in the motor hotspot technology,the current popular technology are the arrangement or mounting of plural diverse prime-movers for mutual or common propulsion(B60K6/00), conjoint control of automobile sub-units of different type or different function (B60W10/00), and the electric propulsion with power supplied within the automobile (B60L11 / 00)and other aspects of the motor.Germany possesses the strongest strength in this field followed by Japan and French all over the world.The Chinese enterprises have little experience in the field of motor technology,and this is one of the reasons that the development of Chinese motor

technology is slowly.Sixthly,In the electronic control system hotspot technology, the current popular technology are arrangements or methods for the control of AC motors characterized by the kind of supply voltage (H02P27/00), electric propulsion with power supplied within the automobile(B60L11/00) and arrangements for controlling synchronous motors or other dynamo-electric motors using electronic commutation dependent on the rotor position; Electronic commutators therefor (H02P6/00) .Japan is in an absolute dominant position, followed by Germany and the United States. From above ,we found that Japan has a strong strength and leading position in the new energy automobile industry chain,especially in power battery and motor technology.This paper puts forward the following suggestions based on the above conclusions.

Firstly, make a reasonable development plan of new energy automobile industry technology.We should make a reasonable plan of all aspects to better the industrial situation and form the industrial agglomeration effect.For example,the feasible and reasonable plan of technical route,the talent training and introduction,the excellent standards,the perfect infrastructure,the fiscal policy and the construction of the whole industry chain.In a short word,we should make the best use of the current resources to make sure that Chinese new energy automobiles could develop harmoniously and orderly.In addition,in order to meet the new energy automobile users charging needs, we should actively improve the supporting measures.such as increasing the charging stations, charging piles, battery replacement stations and other infrastructure facilities, encouraging people to construct charging piles ,and improving the welfare treatment of the parking lot construction.

Secondly,establish China's new energy automobile industry alliance and patent alliance.Take China's weak R&D capability of new energy companies into account that we should establish a cross-industry and cross-section new energy automobile industry alliance including traditional automobile and parts enterprises, electricity, electronic information technology, semiconductor, equipment manufacturing and even financial enterprises.Establish sharing platform of related technology, information and industrial cooperation with electric car as the center.Strengthen the cooperation and interaction among the complete industrial chain,from the key technology research and development to the application of manufacturers .In addition,we should get the dispersed technology innovation and patent results together by establishing the New Energy Car Patent Alliance consisted of mainly local enterprises.In this way,we can make the patent entity that can be comparable with overseas enterprises on technology and patent.And we can enhance our research and development ability through the cross permission among the patent within the alliance.We can enlarge the influence of enterprises then collect and accumulate resources of reform and innovation by patent allowance.Besides that,we can improve the efficiency of research and development and the quality of patent by the means of sharing R&D developments which collected from other countries with union members and providing other services such as patent analysis and technology development strategy.

Thirdly,choose and decide R&D focus based on rigorous scientific patent analysis.Only in this way,can we locate accurate market positioning and design effective R&D plan.To ensure the correctness, effectiveness and sustainability of decision making,we should focus on both Existing R&D strength and the needs of future competition ,by which we can reduce subjective or discretionary decision making.Besides,we should exert the right to apply a patent in time and raise the awareness of patent distribution between Chinese and foreign enterprises in order to increase the number of patent in the international market and prevent the patent infringement.

Fourthly,strengthen international cooperation and exchanges.Different countries have different advantages on the patent of key parts in the new energy automobiles.Japan, Germany and South Korea are in the lead position in power battery.Germany, Japan and France have the strongest R&D ability in the car motor.Japan, Germany and the United States take obvious technical advantages of electronic control system.Considering this,we still have a long way to run.In one hand,China 's new energy automobiles and parts enterprises should decide the future R&D direction.In the other hand,they'd better cooperate with foreign advanced car manufacturers closer.

Reference

Lan,F.C ,Huang,W.J.etc. (2013), "Research Review on New Energy Automobile Industry Patent", Science and Technology Management Research, 21, 104-119.

Li, W.W.(2012), "New Strategy for the Patent Standardization of New Energy Automotive Industry", Chinese university science and technology, 6, 62-72.

Xie, Z.M. Zhang,Y. etc. (2015), “Research on Patent Trend of New Energy Automobiles Industry”, China Soft Science, 9, 127-141.

Zhang,X.Y. Zhao,H.B Zhou,X.K. (2011), “The Development and Problems of China's New-Energy Auto Industry:Based on the Perspective of Sustainable Development of Auto Industry”, Theory and Modernization, 2, 60-66.

Wang,Z.L. Sun,S.J. (2011), “A Case Study on Intellectual Property of New Energy Automobiles Industry in China”,Economic Review, 6,84-87.

Lu,C and You,J.X. (2014), “International Comparison of Industrial Policies for New Energy Automobiles”, Science Research Management, 12, 26-35.

Zeng,Y.M and Shi,Z.L. (2011), “Comparative analysis of new energy automobile industry policies in China and foreign countries”, Enterprise Economy, 2, 107-109.

Xue,Y.X and Shao,L.N etc. (2013), “Research on Transition to Alternative Fuel Automobiles:Social — Technical Regime Analysis in China”, China Soft Science, 3, 78-88.

Luo,S.W. (2008), “Research on the Development Strategy of China's New Energy Automobiles Industry”, Thesis, *Fudan university*, Shanghai.