

5 Research and Study on the History of Industrial Developments from the Viewpoint of Patent System

Survey and review were made from the historical viewpoint of system, industry and life sides on how the patent system has previously contributed to the economical and industrial growth and the improvement of technical competence in Japan having achieved the industrial growth uniquely different from American and European countries.

From the viewpoint of utility model system, it can be considered that an individual utility model may be technically less innovative, however, as a small invention, largely contributes to the promotion of activities for gradually improving the productivity by accumulating small technical modifications in the production field in Japan.

Rikagaku-kenkyujo, RIKEN (the Institute of Physical and Chemical Research) which was established as a comprehensive research organization has brought up many ventures by positively using its unique inventions and patents, and some of the ventures are playing active roles as a core of industries in Japan now.

As a background of making it possible to widely penetrate the patent system contributing to such the industrial growth of Japan into the nation, the outstanding results obtained from the invention promoting activity eagerly developed by private enterprises together with various national organizations can be pointed out.

On the other hand, as an example of advanced countries other than Japan, a review was made on the role of the patent system in the Industrial Revolution in England. Through which, it was made clear that the patent system had played a critical role in the developments of spinning machines and steam engines that had largely contributed to the progress of the mechanization, while causing the severe patent battles to be developed.

I Roles of Patent System Met the Needs of the Times

1 History of Industrial Growth from the Viewpoint of Utility Models

(1) Establishment of Utility Model Law and Its Background

The industrial property protection system in Japan was started in 1870 when the Provisional Regulations for Monopoly were promulgated. However, the regulations was not enforced and abolished in 1872 due to the fact that a considerable difference was observed and recognized between the conditions on patentability and the level of the inventions that Japanese at that time were conducting.

As the Paris Convention for the Protection of Industrial Property was established in 1884 and the demand for establishing system for protecting inventions was gradually increased in Japan, Patent Monopoly Act, after the patent law in France, was promulgated and enforced in 1885. This law was revised in 1887 by introducing the features of the U.S. patent law. It was abolished, and the Patent Act was newly promulgated in 1888 (the Design Act was also promulgated) and enforced in 1889, in which the word "monopoly" was removed according to suggestions, for example, of Korekiyo

Takahashi. As a result, a patent office was established in the Agriculture and Commerce Ministry. In 1899, the Patent Law, Design Law and Trademark Law were promulgated and enforced, so that the Patent Act and so forth promulgated in 1888 were abolished.

After Japan joined the Paris Convention for the Protection of Industrial Property in 1899, any foreigner has been given an opportunity to acquire a patent in Japan. They are able to obtain the same protection as given to Japanese, so far as they also follow the conditions and procedures that Japanese must follow. However, the level of "handicraft-scale inventions" by Japanese were low as inventive objects and on the other hand, foreigners had applied and obtained patents which had attained an absolutely high level in order to establish the basis of economic activity in Japan. Actually, the ration of registrations to applications by foreigners was relatively high and that of Japanese was relatively low. From this fact, a doubt was arisen how much the patent system established in Japan could contribute to the encouragement of inventions so as to promote the industry in Japan.

Also, such an opinion was increasingly arisen that high-level inventions should be seen out of inventions applied by Japanese and refused from the viewpoint of the level of technology in Japan

at that time. As a result, the then government strongly felt the necessity to protect these small inventions made by Japanese and started the investigations and reviews on the introduction of utility model system existing in England and Germany at that time. Through which, as a part of protecting policy of domestically made devices (namely, "novel devices conveniently applicable in human life"), a utility model law was established in 1905.

(2) Roles that the Utility Model System Achieved

(i) Meaning of the utility model in particular industrial sectors

Around when the utility model system was established in 1905, a greater part of registered utility models were related to daily necessities and the like. However, since the time of the establishment, a great number of utility models related to vehicles and so on were applied. It would not be recognized as "a result of reflecting the era" by linking the fact that utility models related to vehicles and measuring equipments came in the best ten in number in 1937 with the industrial developing stage. This fact rather suggests the relation to characteristics of the industrial sectors.

After the World War II, the number of utility model applications in the sections of general electric parts, audio equipment, automobiles and so on are outstandingly large and also, utility models related to heavy industries are largely applied. Referring to the utility models in the section of automobiles, the number of applications is relatively small up to about 1966 and afterwards considerably increased.

The survey of the long-term trend in each technological field from 1947 to 1977 revealed that the respective numbers of applications for utility models were always larger than those of patents in the sections of "agriculture, fisheries, food and drink", "machine elements, mechanism and transmission" in the machinery section, "audio equipment", "strong electrical appliance", "daily necessities", "furniture", "textiles" and "miscellaneous goods". Also, if limited to the period up to about 1960, the section of "photograph and motion picture" could be pointed out as above. If limited to the period up to about 1970, the section of "test and measurement" and so on could be added to the

group following the above trend(*1). When surveying the change of the number of applications from 1977 to 1985, in the main technological fields, "automobile" section and its subsection "engine and pump" had the number of applications for utility models larger than that of patents(*2).

On the other hand, referring to the share of top 100 companies by industry in the numbers of patent and utility model applications, in the case of patents, the share of companies classified into the electric and machine industries fields were outstandingly high (30.7% in 1971, 42.7% in 1982). In the case of utility models, about one-third of them were shared by the companies in the electric and machine industry fields(*3). Accordingly, it can be said that companies classified into the electric and machine industry fields have a larger number of applications than other industry fields in both patents and utility models. It can be said that companies classified into the precision machine, metal and chemical industry fields have obtained a larger number of patents than utility models. On the other hand, companies classified into the machine and car industry fields have obtained a larger number of utility models than patents.

From the above descriptions, it is no doubt that the utility models were domestically positioned as a considerably effective indicator of technical development in some of technical and industry fields up to a certain time during the high growth period, or in a certain time period after the high growth period, after the World War II in Japan.

As repeatedly described above, after the utility model system was established in 1905, it has been largely utilized in the section of "vehicle and automobile". During twenty years after the World War II, although utilization of utility model system in this section was relatively low compared with the section of "daily necessities and others", the utilization of utility model system was substantially higher than that of patent system. The reason of this can be supposed that unique technological aspects of transportation-machine and automobile industries are largely related to these movements, which include the development of design and machine accompanying frequent

(*1) The Japanese Patent Office; "Centennial History of Industrial Property System", last volume (1985), 6th period, Chap. 2, 7th period, Chap. 3

(*2) Kikai Shinko Kyokai Keizai Kenkyujo (the Economical Institute of Machinery Promotion Association); "Reports on Fundamental Survey related to the future Development of Science and Technology" (1988)

(*3) The Japanese Patent Office; "Annual Report by Patent Office" Vol. 35, 13p.

model changes and continuous technological improvements(*4).

(ii) Improvement activities and utility model system

In the case of Hitachi Ltd. that is a representative company always highly ranked in the number of patents, the number of utility models was considerably larger than that of patents between 1960 and 1972. The patents and utility models were reversed in the number for the first time in 1975. The Hitachi's patent application policy has progressed with "encouragement of inventions and devices" as the main theme between 1955 and 1965, the "acquisition of effective patents" between 1965 and 1975. The policy "promotion of inventions and proposals" was established in May 1972 and the "effective patent doubling campaign" had been developed in the entire company scale since June in 1972, respectively. The main purpose of the campaign was to improve the technical level and to strengthen the development power in order to cope with the technical and development competition with other companies. Hitachi has strengthened the proposal activity of employees according to these policies and the number of proposals was increased from ten thousand in 1971 to twenty-three thousand in 1973, so that the quantitative target was achieved and this proposal activity was put an end in the middle of the fiscal year 1974(*5).

Noticing the relation with the in-house proposal activity of Japanese enterprises, such a logical hypothesis has been proposed that the large total number of proposals is intimately connected to the large number of patent and utility model applications, largely contributing to the vitalization of technological activity of the Japanese industry. In this logical hypothesis, explanations are made such that severity of unique business competitions in Japan and high level educations giving to individual employees are the backgrounds of positive activities of improvements and devices by individual employees. Particularly, it is discussed that

characteristics of positive activities of technical development such as specialized in products developments and concentrated in the improvement and devices in details, although it is one of important factors, results in such the enormous number of patent and utility model applications that would not be seen in other countries(*6). Some considerations upon this hypothesis made clear that what is relatively connected to the number of in-house proposals is not the number of patents but the number of utility models(*7). In this connection, it is said that patents will largely depend on researchers and research cost and utility models will be intimately related to the movement of new product developments. It is also said that inventions will be made in the R&D sections and devices will be proposed from the design sections and plants and in the proposal system(*8). From the viewpoint of the creation of patents and utility models, however, an important point is how much technical improvements, not limited to the know-how of specific companies and yet those not related to the invention of process, can be found out in daily proposals related to process control (improvement) in the production scene. However, in production scene in Japanese enterprises, the "formation of habit" for workers in production section to voluntarily and continuously make efforts in improvement may be a main object rather than the entitlement of the result of improvement activities.

(iii) Does the utility model system have proper functions for small and medium enterprises?

It should be noticed that the basic functions of the utility model system had been utilized by a part of machine industry fields such as the vehicle manufacturing and so forth since the initial stage of the establishment, although it was utilized mainly for devices in the conventional household or light industries in the Meiji Era. It is supposed that the conventional household industries consisted mainly of small, medium and private enterprises. In this sense, it may be said that the utility model system has been intimately

(*4) The Japanese Patent Office; "The Establishment of the State on the Basis of Industries and Patent", published by Japan Institute of Invention and Innovation. (1985), pp. 124 to 125, indicating that the development of principles concerning automobiles has already passed through the peak and the many of technological innovations are the improvement, pp.125, illustrating that the number of utility models is greatly larger than the number of patents in Company A in Japan.

(*5) Hitachi Ltd.; "The History of Hitachi Ltd. (3)" (1971), pp. 152 to 153, "The History of Hitachi Ltd.(4)" (1985), pp.152 to 153

(*6) The Japanese Patent Office; "The Establishment of the State on the Basis of Industries and Patent", published by Japan Institute of Invention and Innovation (1985), pp.60 to 62

(*7) Institute of Industries Found. & the by Japan Institute of Invention and Innovation; "Roles of the Utility Model System in the Development of New Technologies" (1981), pp.121 to 125, Yoshihiko Akashi; "The Suggestion System and the Utility Model": "A Fresh Look at the Technological Innovation of Incremental Improvement in Japan", Osaka City University Economic Review, Vol. 30, No. 1, 2, January (1995), pp. 49 to 51

(*8) Institute of Industries Found. & by Japan Institute of Invention and Innovation; "Roles of the Utility Model System in the Development of New Technologies" (1981)

connected with small and medium enterprises from the initial stage of its establishment (1905) to the Taisho Era. It may be supposed that from the viewpoint that the utility model system promoted the incentives of technological development and the exploitation of new technologies by small and medium enterprises, there was a side view that it had a unique system function different from the patent system since a certain time after the World War II. Particularly, when the utility model law was revised in 1959, it mainly aimed encouragement of small and medium enterprises. It was emphasized that there largely existed small and medium enterprises that were too weak in capital to invest in R&D activities resulting in the situation that many small inventions were made rather than big inventions^(*9), so that a system for protecting small inventions should be introduced in Japan in order to encourage them and prevent them from excessive competition.

However, so far as looking at the availability of the utility model system, limited to small and medium enterprises, it cannot be said to be a remarkably "proper system" for them compared with the patent system. It can be said that the situation of acquiring rights and the availability of the system are largely different depending on the type of industries rather than company sizes. As one of interpretations, the following assumption may be made. In the revisions of 1959, the utility model system was positioned as a system for small and medium enterprises and the difference between the patent and utility model in terms of the right became a difference in degree. The emphasis of the point that both systems were not so different in their legal functions became a pump priming for spreading (or converting) the users of the system from small and medium enterprises to large-scale ones. As seen in the discussions and interpretations concerning the roles of patent and utility model systems at the time of the revisions of 1959, while the difference between the both systems is only a difference in degree, it cannot be said that the effective term and dispute competence of utility models in the aspect of the right are comparatively short and weak. This is reflected in the fact that the acquisition of utility model right was effective to some extent in relation to the "defensive patent".

(iv) Incremental improvement type technological innovation and utility models

The technological innovation can be classified for the sake of convenience into a quantum-leap type and incremental improvement type.

For example, among the innovations in production process, there are the quantum-leap type which accompanies a qualitative change in physical and chemical coupling system in the production process and the incremental improvement type based on the daily innovations and improvements. In the case of the quantum-leap type, relatively large-scale innovations of production process and products themselves will be brought because the plant and equipment investment will be required to embody the R&D investment and new technologies. On the other hand, the incremental improvement type technological innovation serves to reduce the production cost independently of the equipment scale and their operating state in many cases, and does not necessarily require a new plant and equipment investment. For example, an improvement concerning raw materials and synthesizing and reacting processes of them or a daily improvement concerning parts, mechanisms and parts assembly can be pointed out in this type of innovation. Furthermore, the process innovation and production control for reducing the cost price through small-group activities such as the QC circle activity in Japan can be pointed out as a typical example of the learning-by-doing type incremental improvement. These improvements are largely depending on the steady efforts for technical improvement and the in-house promotion activity concerning the quality control and process control, which is characterized in that technical conditions desirable even from the economical viewpoint in the long term can be achieved through these daily small improvements.

It has been told that the incremental improvement type activity cannot be called "revolutionary innovation" accompanying novelty in the meaning that was advocated by Schumpeter. For example, the micro-electronics are an integrated technology of electrical control, mechanization and automatization and in a technological field which continuously changes, however, daily improvement activities are being developed widely while aiming at the effective application and commercialization of fundamental technologies. It is well recognized at present that the incremental improvement type technology development played a vital role in leading the stride improvement in the product development and quality enhancement aspects. To be a little brief, in addition to the patent system in response to the revolutionary and uncontinuous type technological innovation, there exists in Japan the utility model system in

(*9) Industrial Property Law Research Group; "The Patent System that Should Know", 4th revision, The Printing Division of the Finance Ministry (1990), pp.138, partially corrected.

response to the incremental and progressive type technological innovation from the viewpoint of how to realize production of products with high quality and utility value, even if the scientific principles and laws are already known. Both systems have been functionally complementary to each other.

2 Change of the Patent System in Japan after World War II and Its Economical Implication^(*10)

(1) Introduction

The patent system is recognized as a rule to deal with results created from the R&D activities. Here, the economical implication of the patent system will be discussed by referring to the historical circumstances that Japan followed after the war. Particularly, the desirable way of patent system will be reviewed from two sides, the effect on the R&D incentives and the propagation of technologies.

(2) Effects of the Patent System on the R&D Incentives and the Propagation of Technologies

(i) Appropriability

From the view point of enterprises, the larger the merit of technologies obtained by the R&D activity is, the stronger the R&D incentives towards such technologies should be. However, the profit rate (social profit rate) that the R&D activity brings to all society does not coincide theoretically with the profit rate (private profit rate) that enterprises can receive individually. It depends on the character as a public property that the technological information has. The difference between the private and social profits in the technological information will be brought by the trade-off of prior efficiency and post efficiency resulting from the character as a public property of them. As a result, the both efficiencies never coincide with each other. Here, the ratio of the private profit rate accompanied with the R&D activity to the social profit rate is called appropriability.

The factors for determining the degree of appropriability will be classified into those that effect on the social profit rate and those that effect on the private profit rate.

Generally, in case that the external economical effects largely act on benefits brought by technological information, the social profit rate will be increased. For example, the more the technological information are common and generic, the more the social profit rate brought by the use and propagation of them will

be increased in which the social profit rate means a post social benefit brought by the propagation of technologies. As a result, so far as the private profit rate is not increased so as to meet the social profit rate, the appropriability will be reduced. In such case, the R&D incentives will become too small from the social standpoint of view.

On the other hand, as a factor influencing the private profit rate, an imitation cost can be pointed out. Generally, the larger the imitation cost is, the larger the pioneer's benefit accompanying technical innovation should be, thus the private profit rate being increased. As a result, the degree of the appropriability may be increased. As the imitation cost, there will be cost for searching technologies to be imitated, cost for market research for determining the product value to be imitated, additional R&D investment and plant and equipment investment required to absorb the technologies to be imitated, costs for obtaining the patent license, cost for re-arrangement of the company structure required to carry out the imitated ones and so on. In addition, as another factors for increasing the imitation cost for followers, the learning effects in the production process due to the prior introduction of products, the market dominating power brought by the related-sales and service network the brand power may be pointed out.

(ii) Drastic technological innovation and incremental technological innovation

It is not so self-explanatory what type of the R&D activities can be stimulated as the appropriability increases. This is, as emphasized above, due to the fact that the R&D activity has two characteristic sides, namely, the accumulative character and formation of receptive capacity.

Here, the technological innovation for creating unique technology information having low dependence on the prior art is called drastic innovation. Also, the application and improvement type technological innovation such as the cost reduction type technological innovation largely reflecting accumulative character of technologies and an invention of method of new application is called incremental innovation. In general, when the appropriability is high, the pioneer's benefit will be extremely larger than follower's one. As a result, the R&D competition will be of the rank-order tournament type. In such case, R&D investment may be made excessively from the social standpoint.

However, when noticed to the accumulative

(*10)Yosuke Okada; "Patent System for Law and Economics", "Financial Review", the Institute of Finance and Financial Affairs, Ministry of Finance (1998)

characteristic side of technological innovation, the effect on the R&D incentives is not so self-explanatory. In case that the technologies themselves are not yet so mature and the inter-relations of technologies are fluid, if the appropriability becomes higher, the R&D competition will become a remarkable rank-order tournament type, so that an excess R&D competition may be developed as shown above. However, in case that technologies themselves are fully mature, the standardized technologies are established and the inter-relation between them are stabilized so that the stabilized technological system can be established, the technological innovation of the incremental type will become the main stream. In case that the appropriability is increased in such a phase, the utilization of prior researches will become difficult, so that the incentives toward the incremental technological innovation are possibly impeded. Developing stages of technological system will be largely different by country, industry, product and technical field so that the effect of the total enhancement of appropriability on the R&D incentives in the whole society can be variously different.

(iii) Technological system and R&D incentives

As typically seen that in the rapid development of information communication technology, a method of applying the technological information in combination has become complex recently. This fact suggests that the mobilization of the technological system has been made severe again. As such typical industrial fields, telecommunications, broadcasting, computer and consumer electronics can be pointed out. These industrial fields are being just confronted to the huge wave of technological innovations such as the digitization, distributed processing and open-systematization and the existing highly mature technological systems have become rapidly stale, so that severe R&D competitions have been developed aiming at the construction of new technological systems. A typical example for this is the competition aiming at the adoption of an industrial standard. Severe alliance and confederation between enterprises in the multi-media field also can be pointed out as an example for this.

In such cases, the existences of the R&D incentives and propagation of technologies will be made more complex. This is due to the fact that not only the technological information has the accumulative aspect but also the relationship complementary to each other can be complexly formed. If the complex relation of technological information is further deepened, it cannot be simply said that the more the appropriability is enhanced, the more the R&D incentives will be

improved. Rather than this, such a viewpoint that the coexistence and co-prosperity is sought for an enlarged pie by enhancing the social profit rate may be required for enterprises. Or, other factors may be made important equally to or more than the appropriability. For example, the capability of instantly finding the technical chance of technological seeds and the growth of potential demands brought by products embodying the technologies will be more important as a decisive factor of the private profit rate of the R&D investment.

II Roles of the Patent System in the Growth of Industries and Enterprises **—Rikagaku-kenkyujo: Riken (the Institute of Physical and Chemical Research)—**

1 Start of the Institute of Physical and Chemical Research (Riken)

Due to the outbreak of World War I, the import of necessities for life and industry, medicines and industrial raw materials from Europe was restricted, through which Japanese came to know the weakness of industrial structures in this country. Accordingly, the necessity of having a comprehensive research organization was enhanced and the Institute of Physical and Chemical Research was established on March 20, 1917.

2 Riken Industrial Group Combine (generation of a venture group changing the industrial structure)

Riken thus started had been suffered from a lack of the research fund at the initial stage of its start. Firstly, because of the economical depression after World War I, only 3.1 million yen (equivalently about 3.1 billion yen at present) contributions were collected but not sufficient as compared with the target of about 5 million yen (equivalently about 5 billion yen at present). Besides, the construction cost of the institute was largely increased due to the inflation, resulting in the serious financial difficulty. As a result, it was directly confronted with the alternative judgement between the reduction of business scale and the secure of further funds.

In order to overcome these problems, while the chief-researchers system was introduced, the positive management was introduced through that the immediate operating fund was secured by approaching the government, the research structure was expanded to promote the

acquisition of patents, and industrializing the research results. Consequently, the patent exploitation and marketing of the results such as "Vitamin A" got the right track, thus the income and outgo balance became obtainable in 1924.

The survey carried out by the Riken's Intellectual Property Division on the operating income and outgo balance of 1924 revealed the operating income of 886 thousand yen consisted of 280 thousand yen from "Vitamin A", 47 thousand yen from machines and the like, 13 thousand yen from enzyme and 15 thousand yen from the others, 250 thousand yen from the subsidize by the government and 281 thousand yen from the money amount carried forward and the sale of stocks and bonds. Referring to the outgoes, 493 thousand yen for the research cost, 360 thousand yen for marketing cost and 33 thousand yen for administration cost. Through these efforts, 141 domestic and 32 foreign patents were counted in 1927.

Also, the industrialization of research results by itself was positioned as one of the targets and in the production plant named as Kagaku-shugi Kogyo (Scientism Industry), production, employees and management were thoroughly-specialized, small-scale enterprises or plants were established as one-business by one-company, seeking division of works and subcontracts. Particularly, the economic progress of agricultural regions was positively promoted by actively using the agricultural industry as the main partners of Riken. Be driven to extremes, researchers exerted their best efforts in creating the research funds by themselves, leading to a success story. The specialization policy will be connected to the Riken ventures at present. Besides, in order to use effectively the labor of the agricultural regions, such a system was introduced that the research results were made of a single process so that anyone could take part in manufacturing products. This basic concept is resulted in Riken combine and the number of enterprises exploiting the results obtained by Riken's researchers were increased to 64 at a certain period of time.

The first venture of Riken was "Toyo Gas Laboratory" with capital of 50 thousand yen established in 1922. There, acid clay produced in Niigata Prefecture was processed to be an absorbent, which was manufactured and marketed as air drier "Adsole" having utilized like current air conditioners.

As Riken had a slogan "when the target is achieved, it will be dissolved to newly start a stock company", it started Rikagaku Kogyo as the core of the Riken Combine in 1927. This company industrialized invented products and

marketed trial products through the industrialization of inventions patented by Riken, the commissions of product development and sale by investing the companies exploiting Riken's patents and the assignments of Riken's patents and the mediation of licensing. As products, Vitamin A, Vitamin B, Neoton insecticide, Columdom sand cloth, positive image photosensitive paper, synthetic liquor and piston-ring etc can be pointed out.

As companies born from the Riken industrial group, there are Riken Dengu Seizo, Asahi Optical Co., Ltd. as a camera manufacturer, Ricoh Co., Ltd. as a copying machine manufacturer, Okamoto Industries Inc. (the former Okamoto Riken Co., Ltd.), Riken Electric Wire Co., Ltd., Kyowa Hakko Kogyo Co., Ltd., Riken Corporation (Riken Piston Ring Industrial Co., Ltd.), Riken Vitamin Co., Ltd., Riken Vinyl Industry Co., Ltd. and Riken Keiki Co., Ltd.

The Institute of Physical and Chemical Research established as a juridical foundation in 1917 was changed to the Scientific Research Institute Ltd. in 1948 through the dissolution of the big financial combines after World War II. The medicine production section become independent to establish the Kaken Kagaku Co., Ltd. around 1950. Since then, in 1958, it was changed to the Rikagaku Kenkyujo (Institute of Physical and Chemical Research) as a special corporation in the present form under the law and has continued the research activities to date. Under such a circumstance, it is not exaggeration to say that it has been globally well known as a representative institute in Japan because the predecessors' will has been well followed.

3 Present State

"A patent has ten times the value of a paper." Taking over the position of the former President Minoru Oda in October 1993, physicist Dr. Akito Arima (he took up the post of Minister of Education and Science and Technology Agency later) emphasized the importance of researches returning the results to the society as well as advanced researches and researches of unknown. Reconsidering that this research institute has not played so much such roles that the leading institutes in the world have done, the research system that might be previously apt to exert its efforts in making papers were reformed so as to be strengthened to play the roles to be attained in the society. The strengthening measure was to put patents to practical uses including strengthening the environment, structure and various systems such as the equipment of intellectual property section, the construction of

Riken Science Town and the exhibition of patent fair. Specifically, patenting the research results was strengthened and putting the research results to practical uses was promoted.

(1) Practical Use of Patents

One of the strengthening measures for patenting research results was to turn researchers' minds previously being toward making research papers by 180-degree, in which the number of acquired patents is considered as an important factor in evaluating the activities of all researchers. For this purpose, as strengthening of promotion activity, patent application procedure and its utilization are explained to researchers in their laboratories and the patent seminars are organized in order to have directly researchers to well understand about the meaning of researches and patents. Concrete measures by which the consciousness of inventors will be enhanced and researchers can positively apply patents have been also provided. Additionally to the measure that a patent right is jointly owned by the inventor, the compensation for patent application was newly funded and the amount of compensation for patent registration was increased in 1997. This measure makes it easy for researchers to have patent right as well as for the benefit to be returned to them as much as possible so as to change the thinking way of researchers being previously toward making papers.

Since 1998, patent liaison staffs have been posted to prepare own patenting policies and their rules.

At the same time, the industrialization and practical use of research results have been promoted. An example of this is the cooperation strengthening measure with the companies implementing the inventions so as to provide the patent information that researchers acquired. Specifically, there are the publication of the magazine "Riken Patent Information" and the exhibition of patent fair.

(i) Riken Patent Information magazine

This magazine is published four times a year and features that inventions are described in the form of direct speaking by inventors. Information of granted patents are shown in the Riken's homepage so that anyone can know the patent rights that the Riken's researchers created.

(ii) Patent fair

The patent fair provides an opportunity that researchers and companies can be looked at each other and is being noticed with keen interest as a unique one performed by itself. Particularly, in Riken's patent fair, researchers explain their inventions by themselves to appeal their

technological features differently from other patent fairs. In front of the posters or exhibits explaining the researches, the inventors will explain their inventions easily to understand, so that anyone can directly listen to and know the intention of researchers. This fair is largely popular in that available information is extremely valuable for the company that needs them. As a result, companies aiming at being high technologies and planning the development of new business positively participate in it to seek the technology transfer. In addition, such a system is combined that if a joint research is asked to obtain a license as a result of looking at each other, the company is financially supported by Riken.

This patent fair is carried out one of the research strategies through which practical use of the research results created by Riken's researchers is promoted, which is based on the practical use promoting measure of Riken. Furthermore, this patent fair appeals the postures of researchers contributing to the economy and society as well as to show the achievement indicating that the governmental funds is efficiently used, industrial structure is changed or the results become a seed for creating new wealth. Besides, it is to show a concrete scenario, as the results, for establishing the country on the basis of science and technology that Japan is targeting.

(iii) Riken venture

Similar to the patent fair, this institute has positively developed the venture system. This system was started at the time when Dr. Arima was president as the strategy to connect the research results more effectively with the practical use of them and created 60 and a few more companies at the initial stage of the start. The system is also a measure aiming at the creation of new ventures consisting centrally of researchers reflecting in the present corporate structure. Having thoroughly analyzed such the actual situation that the consistent strategy fostering research results and measure putting them to practical use have largely stimulated the economy and served to act as a motive power of prosperity in the United States, the Science and Technology Agency in Japan also supported the venture system as a certain measure putting research results obtained in Japan to practical use.

Specifically, it supports the creation of ventures by researchers or engineers so as to become the motive power for fostering them. For a Riken venture to be supported, its researchers themselves should take a part in its establishment in order to put patents based on their research results to practical use. Such

venture is supported that Riken has recognized as meaningful from the viewpoint of the development of economical society and the promotion of science and technology.

Under this support, eight ventures, Raitex, Wyckoff Co., Ltd., Photon-tuning Co., Ltd., the NEXSYS Corporation, Advanced Dynamics Simulation Institute, Zaiya, Danaform and Brain Vision are developing their own businesses at present.

(iv) Technical scientist system

Besides, in order to put the research results to the practical use, Riken has developed an efficient procedure of technology transfer helped by private sectors. The system named Technical Scientist System has been established since 1999, which is a system that engineers and researchers having advanced technological know-how are invited to promote the practical use of research results. This system will support them for five years maximum and candidates are now under selection.

(2) The Present State of Practical Use, Patents and Products of the Institute of Physical and Chemical Research as a Special Corporation

The doubling plan of the number of patent applications and the patent licensing income has been now under development in Riken since 1996. Riken established as a private comprehensive institute in Japan in 1917 has not only succeeded in attaining research results but also positively progressed the industrialization of them, thus establishing the Riken industrial group. It has possessed a power as to be a basis of enterprises including Kaken Pharmaceutical Co., Ltd., Sankyo Co., Ltd., Riken Piston Ring Industrial Co., Ltd., Kyowa Hakko Kogyo Co., Ltd. and Asahi Optical Co., Ltd., currently in active. This means that it has a bright history of having been continuously creating ventures and the Institute of Physical and Chemical Research as a special corporation having newly established in 1957 through the dissolution of big financial cliques (Zaibatsu) after World War II has maintained traditionally thus accumulated power. The agricultural antibiotic "Polyoxyne" (the trademark of Kaken Pharmaceutical Co., Ltd.) in 1966 was put to practical use by Kaken Pharmaceutical Co., Ltd. The invention "Production of a single crystal of composite ferrite" in 1967 was applied for electronic parts such as magnetic head and industrialized by Fuji Denki Kagaku (FDK) Corp. The invention "An axial-flow molecular pump for forming super vacuum" in 1971 was put to practical use by Osaka Vacuum Machine. The invention "A baby-cyclotron for producing a short life RI" in 1973 was industrialized by The Japan Steel Works, Ltd. The number of such cases is too many to

count.

Noticeable ones of them are the invention "Mirror-surface polishing using electrolytic in-process dressing (ELID)," the sports-drink VAAM (the trademark of Meiji Milk Products Co., Ltd.) born from the research on wasp, detergents or cyclodextrin born from researches on alkali microorganism, study on bio-plastics, hybrid type small-diameter artificial blood vessel and a production technology of echelette grating by laser micro-processing technology".

III Inventions Based on the National Life and Idea Products Group

1 Introduction

The Japanese people have national character being energetic curiosity and largely interested in inventions and devices. This tradition was converged to the craftsman culture in the Edo Era to create craft arts through the high-level mind to manufacturing goods. Actually, considering the representative cases such as making guns, Japanese-type watches and Karakuri (mechanism) goods among the major technologies representing the Edo Era, unknown high-level technologies brought over from foreign countries were added with the original devices and technologies generated in Japan to achieve such the stage as making the mass-production possible in a short period of time.

After introducing the patent monopoly system in the Meiji Era, such traditions have been continued to exist among the Japanese people and various types of inventions have been made not only from the heavy-industrial and scientific and technological fields, but also from the conventional handicraft industry field. Many companies in the local industry field have generated unique technologies and there are many cases that they have been grown up to the global manufactures.

What supports the grass-roots invention activities is the existence of the patent system. As a background capable of widely spreading it into the nation, there is the positive invention promoting activity of the government and private enterprises as a body. Awakening and spreading deep interests in invention into not only engineers but also general citizens had produced many hit products with a long life being familiar to the daily life. Such a success story can be largely exemplified that a housewife acquired a patent or utility model for an idea conceived in her daily life and entered successfully into the business world.

Now, from viewpoints of the history of the

invention promotion activities in Japan and the contents of their undertakings, it will be analyzed how the inventive culture of Japanese people has been enhanced and which roles the patent system has played in the process of generating idea products in the daily life.

2 The History of Invention Promoting Activities and the Inventive Culture Based on the National Life

The importance of promotion and protection of inventions were started to earnestly describe since the latter half of 1900s. In this period, Japan had gradually succeeded in establishing the heavy-industry field after the Russo-Japanese War and under such a circumstance, the protection and fostering of the Japan's conventional handicraft industries had been positioned as an important field for fostering industries. Besides, the inventions by Japanese and widely put in practical use, such as the invention of an automatic loom by Sakichi Toyota who established the basis of Toyota Automatic Loom Works Ltd. and Toyota Motor Corporation, become frequently seen. When the importance of inventions was started to be discussed was around that time.

In 1904, the Industrial Property Protecting Association was established aiming at the original promotion and protection of inventions in Japan. This association had widely developed various invention promotion undertakings including the prize competition, patent fair and exhibition, largely contributing to fostering the Japanese inventive mind.

This association was the organization as the predecessor of Japan Institute of Invention and Innovation supporting the promotion and protection of inventions in Japan at present. This association constructed the basis of various invention promotion undertakings having continued up to now in order to support the inventive activities by conventional industries as well as individual inventors.

3 Grass-roots Invention Activities Being Continued to the Present Time

(1) Boys and Girls Invention Club

In 1974, Japan Institute of Invention and Innovation established boys and girls invention clubs as a part of the undertakings toward the development of young people's creativity intended for children going to support and drive the future of Japan. This is an attempt, through which, in many regions, enough space is provided for children to work freely and easily and tools necessary for production are fully equipped and

the earnest people in the education of children give advice them to enhance their concern with invention.

At present, 138 clubs were established throughout Japan and as many as 6,600 children are endeavouring on the creative activities. These activities includes the creation activity by region on holidays, the publication of "Invention News for Boys and Girls" and the annual national exhibition presenting the activity results.

(2) Women's Invention Activities

In Japan exist invention promotion groups by and for women with women's inventors and supporting people having a deep interest in women's inventions and devices as leaders.

The National Association of Women Inventors was established in 1961 as a women's voluntary group and re-organized as a corporation in 1970. The aims of its establishment is to gather women interesting in inventions and devices from all over the country, promote and guide them inventions and devices as well as promote practical uses of inventions and devices, thus contribute the promotion of science and technology and the development of industries.

This association mainly organizes (i) "the exhibition of inventions for life" showing collections of women's daily idea works, (ii) spot sales of idea goods and (iii) the lectures on women's inventions, etc.

The Association of Women's Inventors was established in 1953 as a voluntary group and re-organized as a corporation in 1970. This association mainly organizes (i) the exhibitions named "NARUHODO (good idea) fair", showing collections of women's small idea works, (ii) spot sales of merchandised works and (iii) consultation of idea and guidance of its merchandising.

As idea goods close to the life created through women's invention activities, there are "Chaco Paper" (a registered trademark of Chacopaper Corp.) which is convenient to copy a design on a cloth before sewing and cutting, vessel with transparent straw which was devised as a vessel capable of drinking while laying down, "Kitchen-pocket" which was devised for arranging vinyl bags gotten in shopping.

As described above, ideas that only housewives can create have been changed into the business so that individual women's inventors have successively achieved works contributing to the growth of society and technology. In these situations, the patent system and utility model system have played a strong role in protecting their ideas.

(3) Undertakings of Exhibitions

Undertakings of exhibitions have played an important role in promotion of the peoples' interests in invention, introduction of good inventions and evaluation of inventions. The largest exhibition is "National Inventions and Devices Contest" sponsored by Japan Institute of Invention and Innovation and started in 1960 under the joint sponsorship of NHK (Nippon Hoso Kyokai - Japan Broadcasting Corporation). The numbers of applied works and visitors were steadily increased every event. It can be said that this undertaking is the most effective one among the undertakings that the association previously organized for promotion of the practical use of unexploited excellent inventions.

Among the prize-awarded works in the past, a considerable number of works have been marketed and become popular merchandises seen in various places at present. For example, "A carrier for a delivery food" that won the Promotion Award in the sixth event is designed to be equipped on the carrier of a motorcycle for delivering a food such as a wheat or buckwheat noodle dish so as to hold them always horizontally and absorb any shock caused by the road conditions and slope. "An umbrella coat" that won the Commissioner Japanese Patent Office Award" in the 36th event is a device by which a wet umbrella can be easily covered by a vinyl bag by inserting it into the device with a single hand then pulling it forward. This device has grown-up to a popular good that can be seen at entrances of many department stores, restaurants or the like.

On the other hand, the National Exhibition of Inventions and Devices of Students and Children has been organized to bring up children's invention thought. In the exhibitions, works are invited on a particular subject section every year in addition to a free subject section.

Besides, various types of invention exhibitions have been locally organized in every prefectures making use of local characteristics such as for original ideas and inventive works close to the region or made by students and children so as to contribute to the promotion of invention volition in the region.

(4) National Commendation of Inventions

A typical event for promoting inventions is the national commendation of inventions and its major prizes are the Imperial Award, Special Award and Invention Award, etc. Furthermore, in order to make them more significance, prize money are also awarded from Japan Institute of Invention and Innovation as such supplementary prizes as the Issei Hatakeyama Award, Invention Promoting Award, Sakichi Toyota Award, Karoku Mine Award and Shigetaro Toyama

Award.

4 Overseas Exchanges through Inventions

Recently, the growth of invention culture and invention promotion activity in Japan are watched with a keen interest from the foreign countries and many missions to inspect or research from many countries frequently visit Japan.

Particularly, "the overseas exchange project for fostering and developing the creativity of youth" provides opportunities for young people to foster sense of values and global senses by contacting directly to the cultures, histories, science and technologies and life-styles of foreign countries, and at the same time to deepening the mutual understanding and international friendship through the exchange with students of the same generation beyond a language barrier.

The overseas exchange project for fostering and developing the creativity of youth has sent missions to the United States, then West Germany, Singapore, Korea, China, Taiwan, Philippine and Malaysia since 1987 in order to promote the growth of the original conception and fertile creativity of young Japanese people through such experiences.

Besides, It has been endeavored to extend understanding of intellectual property rights and promote invention activities in the overseas cooperation, for example, by sending Japanese lecturers to overseas seminars sponsored by WIPO (World Intellectual Property Organization).

IV Effects of the Patent Systems of Advanced Countries on the Industry Development - from the Viewpoint of "the Modern Patent System and the Industrial Revolution in England"

1 Birth of Modern Patent Systems

In 1624, the Statute of Monopolies was established as a statute law in England, which is positioned as the beginning of modern patent system in general. However, this statute could not be suddenly established in England. Various attempts had been made for several hundred years in European history.

2 Birth of Modern Patent Systems in England

In 1624, namely, in the period of James I, a statute of monopolies was established by the

Parliament for prohibiting exclusive licenses which are different from present patents and like business licenses and over-issued by the monarch supreme power. While the main sentence of the statute was to restrain the abuse of supreme power by the king, an application exception articles stipulated the exclusive licenses, judgement of novelty and setting up of rights organization so as to have become a model of modern patent system.

3 The Industrial Revolution in England and Patent Disputes

The Industrial Revolution in England was progressed by the inventions of working machines such as a spinning machine and an automatic weaving machine and got into a further developing process by introducing a steam engine as its motive power.

Although James Watt (1736 to 1819) is regarded as the inventor of "steam engine" in general, prior art of his technology existed in fact. Namely, they were a steam engine invented by Savory and the "atmospheric pressure engine" invented by Newcomen. Both were, however, extremely inferior in thermal efficiency.

Therefore, Watt improved the atmospheric pressure engine by Newcomen and applied a patent for "a method of reducing the fuel consumption by reducing the steam consumption of the steam engine".

The steam engine invented by Watt could most brilliantly shine in the Industrial Revolution because the rotation motion became usable as a power. This can be demonstrated by the fact that the steam engine has been penetrated into a wide range of fields such as the iron manufacturing industry and metal processing industry since then.

However, as similar engines and imitations emerged, Watt lodged a petition for extension of the term (14 years) of the patent acquired in 1769 to Parliament in 1775 before the expiration of the right. He considered that a longer term was more advantageous for him to win the battle. For the grounds of his petition, he appealed - his steam engine could work twice as much as the other normal steam engines work at the same cost, so that the use of his engine made it possible to obtain a great benefit. However, enormous expense was already spent to invent his steam engine and considerable expense would be estimated in the future. Therefore, he wished exceptional extension of the patent term in order to cover the expense. Consequently, an extension of 25 years from 1775 was granted. The contribution of steam engines to the industrial

society had Parliament to decide for a special treatment. His strategy was that competitors' power should be yielded by the power of patent.

Since then, he resolutely challenged patent battles against competitors whenever any competitor appeared, for example, the action brought by a mine owner for seeking the revocation of his patent for steam engine and the patent infringement action against a steam engine having higher efficiency than that of his steam engine.

The Industrial Revolution period in England was really the age of patent battles. Who protected own rights and interests by fighting and winning the patent battles was Watt himself.

4 Noticeable Points and Problematic Points of the Industrial Revolution in England

The Industrial Revolution period was really an age of patent battles. Explanation will be made below on what problems could be pointed out in the Statute of Monopolies regarded as a modern patent system in this period and what revisions were introduced into related laws in the 19th century.

(1) Problematic Points of the Patent Systems in the Industrial Revolution Period

During the Industrial Revolution period in England, the Statute of Monopolies, regarded as a modern patent system, had been never revised. As a result, the provisions established in 1624 had been valid as it was. Reviewing it from viewpoint of today's patent system, however, there are several problems as follows;

(i) The cost of patent application was too high

Arkwright was a famous inventor of a spinning machine in the Industrial Revolution period. However, this spinning machine had still several problems and what improved from it was a mule-spinning machine invented by Crompton. However, he did not apply a patent for it. One of the reasons why he refrained from applying a patent can be supposed that when the mule-spinning machine was invented, the patent for Arkwright's spinning machine had not yet been expired and another reason is supposed that the cost of patent application was too high.

It is natural that reduction in cost related patent such as patent application, its maintenance and so on were chief concerns for inventors.

(ii) The procedure was too complicated

An application might be able to do only when the preparation of necessary documents was made patiently by approaching to many clerks at the window, because there did not exist a unified organization like a Patent Office as today. It was

difficult for a normal inventor to apply a patent readily.

The fact that the cost related to patent application was too high and the procedure was too complicated might restrain patent applications so that it was extremely difficult to popularize the patent system. There existed many inventors in those days, however, it is supposed that the number of those having applied a patent might be supposed to be considerably small consequently.

(iii) Substantial examination of patent application were not made when applied and a dispute was to be brought to the court for settlement

Referring to the Statute of Monopolies, there is no provision for examining the substance of a patent application when applied. As a result, it might be automatically patented if necessary documents for the procedure were completed. If any dispute occurred, it had to be settled by justice.

It can not be instantly judged whether or not this system was right. The issue is whether the patentability of the invention is judged in advance when applied, or settled by bringing the case into the court after the dispute occurred. At present, the principle of examination of the former is predominant.

(iv) The Statute of Monopolies did not make it an inventor's duty to lodge the specification of an invention.

The Statute of Monopolies had a style as a modern patent system for the first time in the world when established in 1624. However, it was not such the one to be anticipated to meet the development of science and technology since then.

As the substance of a patent application was not examined and it was not necessary to submit the specification when applied, it is doubtful on what basis the judgement might be made on the dispute pending in court. Accordingly, it is supposed that the examination could not be actually made if there was nothing to specify the substance of an invention. It is a matter of course that the specification best conveying the substance of an invention becomes necessary.

Indeed, in the cases of the patent suit *King v. Arkwright* in 1785 and the patent suit *Liardet v. Johnson* in 1778, the judge in charge clearly required to disclose objectively the substances of the patents by means of the specifications of the inventions. While there was no provision of the Statute of Monopolies, lodging the specification of invention when applied had been already common according to the case law in the Industrial Revolution period.

However, in most of the cases only brief

specifications of invention were actually lodged at that time.

In the cases of the first patent for a steam engine by Watt and the second patent for a spinning machine by Arkwright, the specifications of the both cases were simple, comprehensive and abstract and limited to the principle descriptions without the mechanical structures and operating methods to be disclosed. It was regarded that even after expiration of the patents, no one could make the same by referring to the patent specifications only. This means that specifications were extremely rough so as not to be referred to. As a result, Watt had been frequently involved into disputes. For example, in the case of the dispute concerning a superior steam engine invented by Bull, the point that the technology by Watt was too vague to be understood became an issue and the proceedings was so prolonged that the patent had expired before the conclusion of a trial.

(2) Revisions of Patent Law

While the Statute of Monopolies had some defects, it was not revised in the Industrial Revolution period in England from the standpoint of framework of the patent law, thus the old system had continued as it was. However, such opinions that the defects should be corrected were advocated and it was partially revised in 1835. This was the first revision after more than 200 years, however, the contents was not changed substantially. The further and substantial revisions were made for the first time in 1852 and 1883. The major revisions of the patent law of the United Kingdom are as follows;

- (i) The patenting procedure was made simple by establishing the Patent Office as the unitary window;
- (ii) The patent fee was considerably reduced twice;
- (iii) The filing date of a patent application was made the reference date for granting a patent (the first to file principle);
- (iv) Lodging a patent specification was made mandatory (this was expressly stipulated in the statute law while it had been practically made according to the case law). Accordingly, the claims of the patent were made clear; and
- (v) After filing a patent application, the contents are disclosed to the public and if no opposition is file, the patent is granted (the disclosure principle).

In other words, the largest point of the revision of the patent law of the United Kingdom was to introduce the disclosure principle.

Through the revisions of the patent law, the patent application became easier and simpler and the patent became familiar to the people.

However, even if the patent was acquired, the industrialization became possible only if sufficient funds were made available. While the industrialization of patents was progressing, such a trend that the patent itself became gradually apart from the individual people was observed in the contrast.

The Industrial Revolution period was a period of time when an individual inventor could be still active by using a patent as a powerful weapon.

5 A Consideration upon the Patent System and Industrial Policies of Developing Countries on the Basis of Their Own Technologies

The TRIPs agreement ruling the protection of intellectual properties become effective also in the developing countries and these countries are hurrying up the preparation and arrangement of laws to observe this agreement. Under such a circumstance, the developing countries will manage to succeed in preparing and arranging the laws in the near future even while remaining many problems. Actually, even if the preparation and arrangement of the laws are made possible superficially, the enforcement of them seems not so easy.

As an industrial policy of the developing countries, the preparation and arrangement of laws are reasonable and urgent issues. However, it can not be denied that there will be still a long way to go toward solutions of the questions how their own technologies are developed and connected to patents.

Therefore, it is considered that the Industrial Revolution in England achieved earliest in the world can provide some hints to the developing countries for developing their own technologies.

Although it is a matter of course to take considerations on the R&D activity of high technologies becoming a boom recently, it is an important problem that engineers having gone to the United States from developing countries will not return to their native countries by their own wills. In Thailand, for example, the government had recommended and economically supported their home coming up to the economical crisis of 1997, however, has not yet provided a special policy after the crisis.

After all, it may be supported to seek the own technological developments in its honest manner. The author believes that the survey and review from the viewpoint of patent system centering around the Industrial Revolution in England, which looks old but is actually new, should be referred to when developing countries take considerations on their patent system and

industrial policy.

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