The Patent Map of a Measuring Cup

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(Received 11 September 2017; final version received 30 January 2019)

Abstract

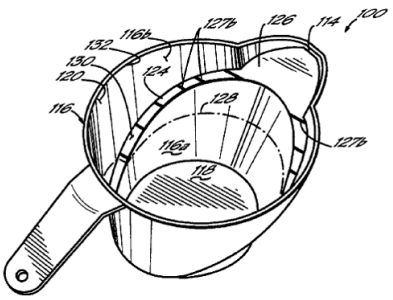
People use measuring cups to measure the required portion of liquid when making bread. Traditional measuring cups have indicia marked on the side such that they are difficult to read when the user is unable to bend his or her body or hold the cup firmly in the hand. However, the OXO measuring cup overcomes this problem by having at least one ramp formed radially inward on the inside surface of the measuring cup. The indicia on the upward surface of the ramp allow the user to look downward into the measuring cup, thereby eliminating the need to look horizontally at the cup at eye level. The design is shown in patent US6263732. This article carries out a further analysis of this invention by tracing its forward and backward citations to build a simple patent map of technology development of the measuring cup. Three patents, namely US4073192, US4566509, and US5588747, are chosen from 16 backward citations, while another three patents, namely US7306120, US8517219, and US9354098, are chosen from 25 forward citations. The analysis of these three backward citation patents shows that although various functions such as adjustable volume, thermometer, and so on can be added to the measuring cup, no measuring cup has ever discussed the issue of easy visibility as the OXO measuring cup does. In addition, three forward citations show that various methods have been invented to meet the need for easy visibility by using different structures such as a ramp or ladders. It is clear from the analysis that inventive principles 17, another dimension, and 32, optical change, are applied in those inventions. A trend of surface segmentation (Mann, 2002) can be found from US6263732 to US9354098, where the ramp in US6263732 is a flat surface, whereas US9354098 uses a more advanced design in which the ramp is a 3D protrusion, allowing the reverse side of the measuring cup to be used to measure the quantity of fluid too.

Keywords: Backward citation, Forward citation, Inventive principles, Trend of surface segmentation.

1. Introduction

The patent map was first proposed by the Japan Patent Office in 1997 to assist in using patent information in industry (Japan Patent Office, 2000). There are many kinds of patent maps, including tree maps, time series maps, portfolio maps, matrix analysis, three-dimensional bar graphs, matrix charts, bubble graphs, bar graphs, and pie graphs. The purposes of patent maps are to understand the overall state of a technology field, identify technological changes, seek business opportunities, know the properties of applicants, and deal with the globalization of business. As TRIZ researchers, we are more interested in finding out technological changes. From there we can obtain insights into the trend of the evolution (Mann, 2002) of a particular product or industry.

Measuring cups are used in many applications ranging from food preparation to laboratory experiments. A common drawback is that it is necessary for the user to lift the cup firmly to read the indicia. This problem was solved by the OXO measuring cup (OXO, 2017), which contains one ramp formed radially inward on the inside surface of the measuring cup. The indicia on the upward surface of the ramp allow the user to look downward into the measuring cup, thereby eliminating the need to look horizontally at the cup at eye level. The design is shown in patent US6263732 (Hoeting and Hoeting, 2001).



(a) Measuring cup in US6263732

(b) OXO measuring cup

Fig. 1 Measuring cup with a ramp on its inside surface

To study the trend of evolution of measuring cups, the citations of US6263732 in the European patent database (Espacenet Patent Search, 2017) are used to extract the related patents. The purpose of this paper is to demonstrate the procedure of creating the patent map in terms of technological changes. The trend of evolution of the measuring cup will be identified as well.

The rest of the paper is organized as follows: Section 2 provides a literature review of patent maps of technological changes. Section 3 describes the construction of the patent map and trend of evolution of the measuring cup. Section 4 concludes the paper.

2. Literature review

Global competition in the development of technology has caused continuous technological changes. In order to survive in this severe changing environment by accommodating these changes, companies need to be aware of patent maps which are produced by analyzing patent information. There are several kinds of patent maps related to technological changes (Japan Patent Office, 2000).

1. Changes in the relation between the number of applications and the number of applicants

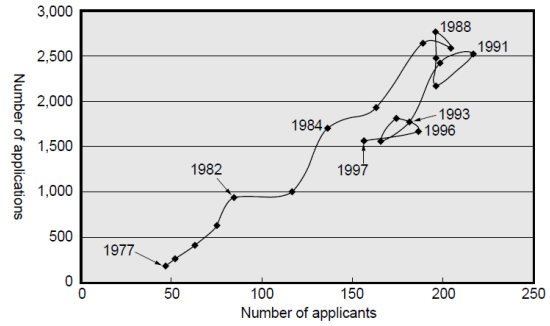


Fig. 2 Line chart of number of applications versus number of applicants

Fig. 2 shows the relationship between the number of applicants and the number of patent applications for optical disks for each of the years from 1977 to 1997. There are four periods in Fig. 2. The period from 1977 to 1988 is a time of growth. Then the period from 1988 to 1991 is the first period of stabilization. Next the period from 1991 to 1994 is a period of decline. Lastly, the period from 1994 to 1997 is the second stabilization period.

2. Map portraying the degree of maturity of a technology field

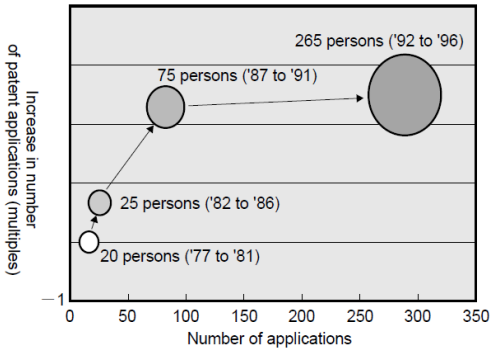


Fig. 3 Bubble chart of incremental change in the number of applications

Fig. 3 shows the ratio of the increase in the number of patent applications during a later period relative to an earlier period plotted on the vertical axis and the total number of patent applications within a certain period plotted on the horizontal axis, with respect to the recycling of plant and animal waste into fertilizer. This indicates that starting after 1987 the number of companies and so on newly entering the industry is increasing each year and that the technology field is in the developmental stage.

3. Changes of technical contents

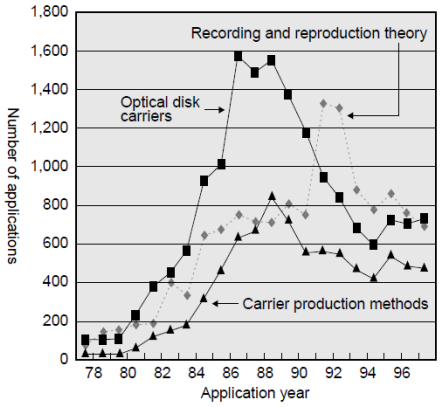


Fig. 4 Line charts of three major technological changes

Fig. 4 indicates the changes in the number of patent applications for the three major technologies that compose optical disks, namely "recording and reproduction theory", "optical disk carriers", and "carrier production methods". It can be seen from this figure that, after appearing to have reached a technically mature stage around 1988, development activity again accelerated in the area of the "recording and reproduction theory" around 1991, and as a result the technology entered a development stage for next-generation products.

4. Trends of problems in technological development

Map relating to dioxin decomposition of fluid bed incinerators

Purpose	Dioxin decomposition only				Cost reduction				Improved maintenance				Accommodation to fluctuations of refuse type and volume				Heat recovery and others			
Technical item \ Application year	84-86	87-89	90-92	93-95	84-86	87-89	90-92	93-95	84-86	87-89	90-92	93-95	84-86	87-89	90-92	93-95	84-86	87-89	90-92	93-95
Fluid bed combustion characteristics		●●●●●●	●●●●●●	●●●●●●				●			●			●		●●●●				●
Secondary combustion temperature control		●●	●●	●	●		●								●	●				●
Secondary combustion mixing control		●●●●●	●●●●●	●●●			●				●					●				
Secondary combustion retention time		●●	●●	●																

● represents one patent.

Fig. 5 Matrix of purpose and function

Fig. 5 shows a trend in which patent applications were concentrated during the period from 1990 to 1995 in response to the announcement of guidelines by the Ministry of Health and Welfare. Although patent applications consist primarily of those in fields related to fluid bed combustion characteristics and secondary combustion mixing and temperature control, which have a direct effect on dioxin decomposition, from the 1980s to the present day, it can be seen that patent applications relating to accommodation to fluctuations of refuse type and volume have been filed continuously.

5. Changes in influential industrial fields in technological development

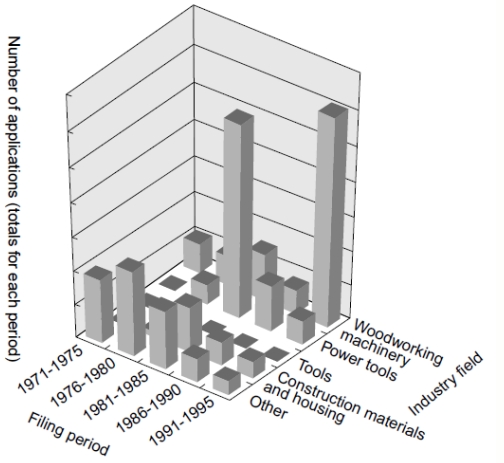


Fig. 6 Bar chart of varous industry fields

Fig. 6 shows the changes in the respective numbers of patent applications by dividing those manufacturers ranked from first to tenth in the number of patent applications throughout the entire period into industry fields consisting of woodworking machinery, power tools, tools, construction materials, housing, and others with respect to rotary blade tenoning machines. In this study, a clear change in the leading industry field from power tools to woodworking machinery can be seen.

6. Map of technology development

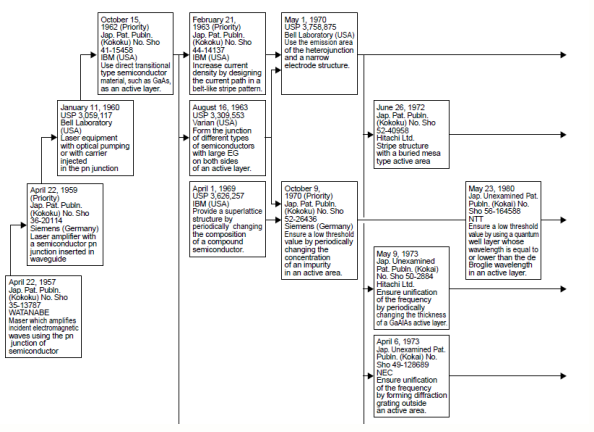


Fig. 7 Map of technology development for semiconductor lasers

Fig. 7 shows in part basic patents of semiconductor lasers in chronological order. It can be seen that the world's first semiconductor laser was invented by a Japanese researcher in 1957. Later, new devices were invented, led primarily by the US, and various inventions were added to enable laser excitation at low temperatures and eventually at room temperature. At the practical application stage, it can be seen that Japan has overcome technological problems including prevention of deterioration, unification of vertical mode, and reduction of the threshold value for excitation.

Only one paper addressing both patent maps and TRIZ could be found, although others may exist. The only one we found was done by Li, Atherton, & Harrison (2014), who compared the patent map and TRIZ in terms of purpose, logic, and outcome. However, only TRIZ technical contradictions were used to analyze the court case of infringement based on the conflicting parameters from different patents.

The reasons of literature review are summarized as follows. There are two parts of literature review. The first is for the patent maps of technological changes. The second is the only paper we found in the literature. It regards the TRIZ and patent map. The content of the literature review shows that there are several methods to analyze the technological change. And we choose one them for convenience, map of technology development. As for the TRIZ and patent paper, it presents a novel method of patent mapping for visualizing conflicts between patent claims that incorporates the Theory of Inventive Problem Solving (TRIZ). The method uses TRIZ engineering parameters as the criteria for evaluating dissimilarities between patent claims, producing a visualization based on Multi-Dimensional Scaling (MDS) that can be compared with legal judgments. And this paper has nothing to do with technology change. The connection between literature review and the purpose of the study is that although there are some papers on the patent technology change and TRIZ individually, there is no case study on both patent technology change and TRIZ. Thus it ushers the opportunity for us to do the study in this area.

3. Construction of patent map

The forward and backward citations of the European Espacenet patent database were used to establish the patent map of technology development. US patent US6263732 was used as a seed to retrieve its backward citations, and there were 16 patents, as shown in Figs. 8 and 9. Note that cited documents were used to indicate the backward citations in Fig. 9. The meaning of a backward citation is the reference patents that appeared before patent US6263732. The reference point is its filed date, May 18, 1999. Three patents, namely US4073192 (Townsend, 1978), US4566509 (Szajnz, 1986), and US5588747 (Blevins, 1996), were chosen from 16 backward citations. Similarly, forward citations were applied to US patent US6263732, and 25 patents were available. The result is shown in Fig. 10. The meaning of forward citation is the reference patents that appeared after patent US6263732. Another three patents, namely US7306120 (Hughes, 2007), US8517219 (Prince, 2013), and US9354098 (Breit and Kushner, 2016), were chosen from the 25 forward citations. The characteristics of these seven patents are analyzed and shown in Table 1. From Table 1, a map of technology development is shown in Fig. 11.

Three related patents were selected from both backward and forward methods based on their uniqueness. This means that other un-selected patents are quite similar to the selected one in terms of functions. In our case, the functions of backward citation are: to adjust the volume (US4073192), extend the measuring function to a cap of a bottle (US4566509), or combine a temperature-measuring function with a cup.

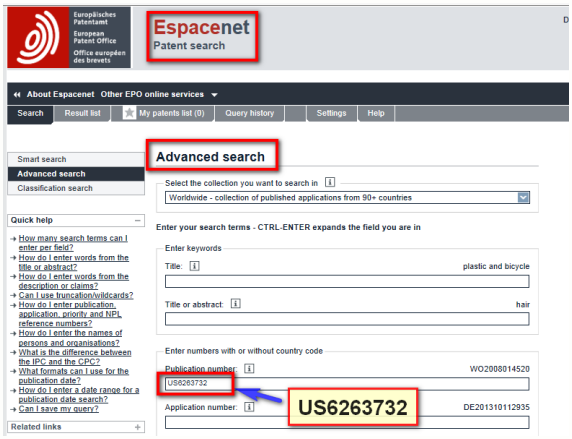


Fig. 8 Espacenet patent search

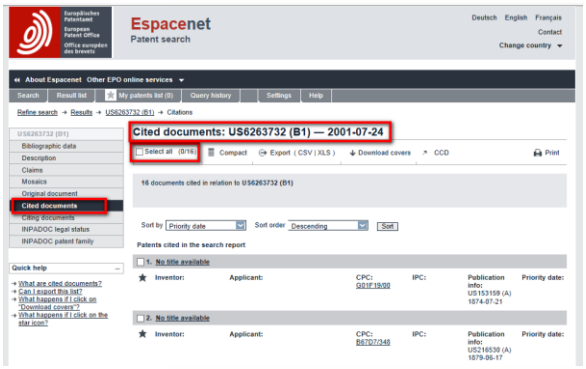


Fig. 9 Sixteen patents in backward citations

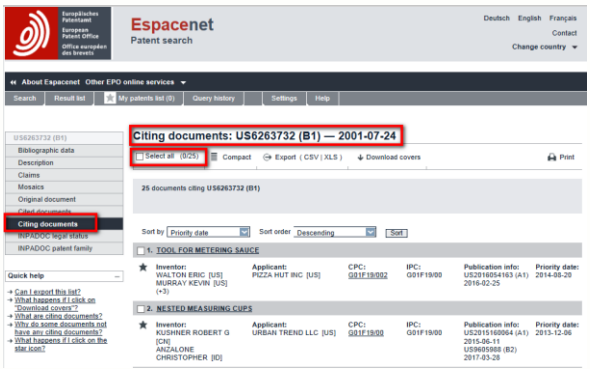
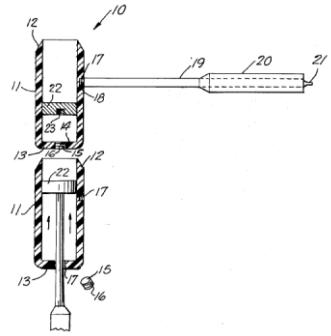
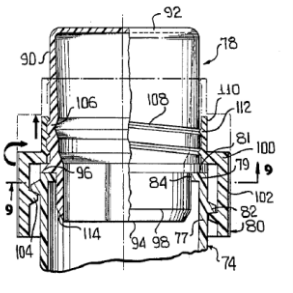
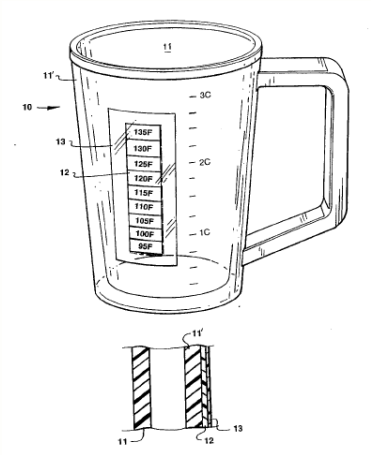
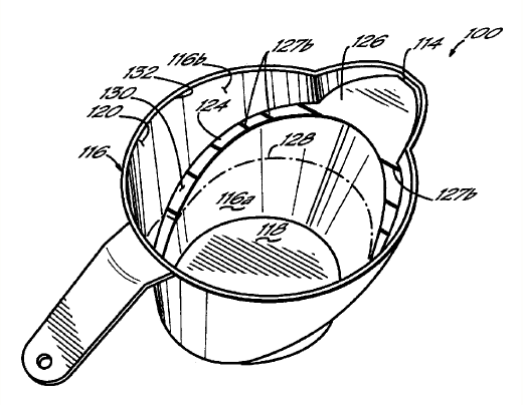
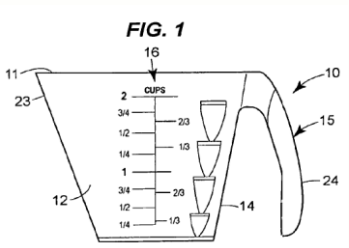
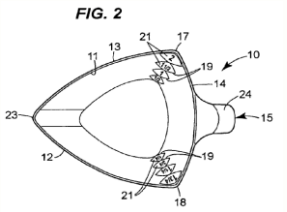
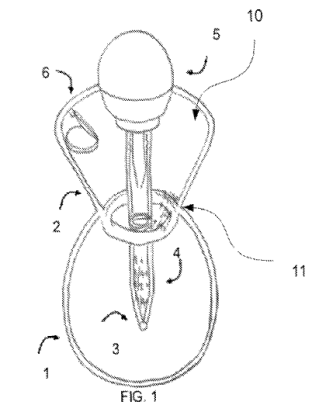
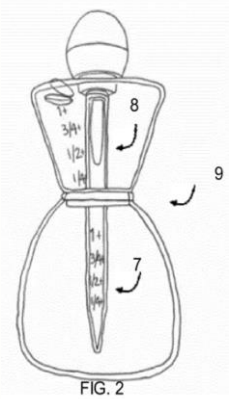


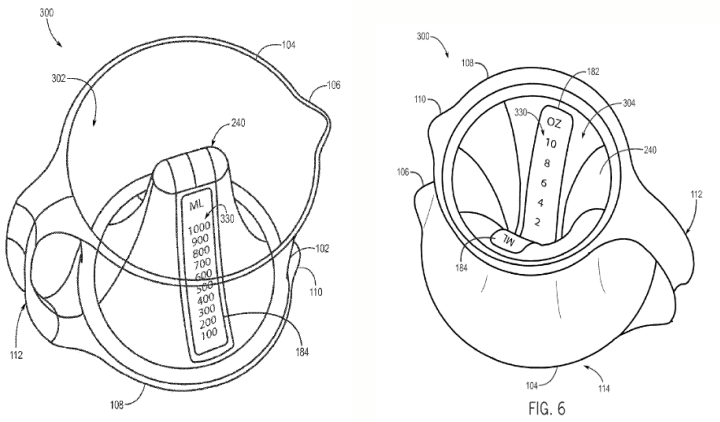
Fig. 10 Twenty-five patents in backward citations

Table 1 Selected backward and forward citations of US6263732

No.	Patent number	Filed date	Technical description and drawings
1	US4073192	1976-06-16	An adjustable-volume measuring cup in which the body of the cup is formed of clear plastic having a threaded opening in the axial center of the bottom thereof, closed with a removable screw. 
2	US4566509	1984-07-09	In accordance with this invention, a closure unit is provided which includes a measuring cup wherein the body of the measuring cup is provided with a flange which is seated on and sealed with the neck finish of a container. The closure unit also includes a ring member which engages the flange and clamps it against the container neck finish when a skirt of the ring member is interlocked with the neck finish. In this arrangement, the measuring cup telescopes within the container and any residue within the measuring cup after usage runs only into the interior of the container. 

3	US5588747	1995-01-05	A measuring cup with a thermometer mounted on an exterior surface thereof for measuring the temperature of a liquid prior to placing it in the cup. The cup can be used in many operations involving a liquid having a critical temperature requirement. One such operation is bread-making, in which water, once it has been warmed to a desired temperature, is added to yeast or, alternatively, to a flour mixture containing yeast. To use the cup in bread making, the cup is placed under a stream of warm water, and when the thermometer indicates that the water has reached the desired temperature, a measured amount of the water is added to the cup. 
4	US6263732	1999-05-18	A measuring cup has one ramp formed radially inward on the inside surface of the measuring cup sidewall. The ramp rises from near the bottom edge of the sidewall to near the top edge of the sidewall. The indicia on the upwardly directed surface of the ramp allow the user to look downward into the measuring cup to visually detect the volume level of the content of the measuring cup, thereby eliminating the need to look horizontally at the cup at eye level. 

5	US7306120	2004-07-15	An improved measuring device is disclosed which comprises a bottom wall connected to at least three sidewalls, which, in turn, are connected together to form an open top and at least three corners. One of the corners forms a spout and at least one of the other corners is connected to a plurality of vertically spaced steps inside the cup. Each step has a horizontal upper surface and the horizontal surfaces of each step are marked with volumetric indicia. In this way, as the user fills the container with material, either liquid or solid, the user is confident that the correct volume has been achieved when the volumetric indicia located on the horizontal surface of the selected step begin to be covered with material.  
6	US8517219	2010-06-28	A measuring tubing with its lower opening is inside the lower portion of the lower base member.Then draw a measured amount of liquid into the tube area via a suctioning means. Next, verify that the proper amount of liquid is drawn on a printed indicia on the sides of said measuring tubing into the upper cup area. Turn the bottle upside down, letting the liquid flow out of a upper lateral opening of said measuring tubing. Plac the bottle back into an upright position, and pouring the liquid out into the desired area.  

7	US9354098	2013-12-06	A measuring cup may have volumetric indicia printed along the upper and lower surfaces of a reference member placed near a central portion of a space encircled by a sidewall of the measuring cup. The volumetric indicia may be viewable from above the measuring cup when the cup is placed on a horizontal countertop or work surface. When inverted, the volumetric indicia printed along the lower surface of the reference member may likewise be viewable from above. In essence, the measuring cup contains two receptacles for measuring volumes of substances. One receptacle is accessible from the "top" of the measuring cup, while another receptacle is accessible from the "bottom" of the measuring cup. The reference member eliminates the need to raise the measuring cup to eye level to check the volume of substance.  FIG. 6

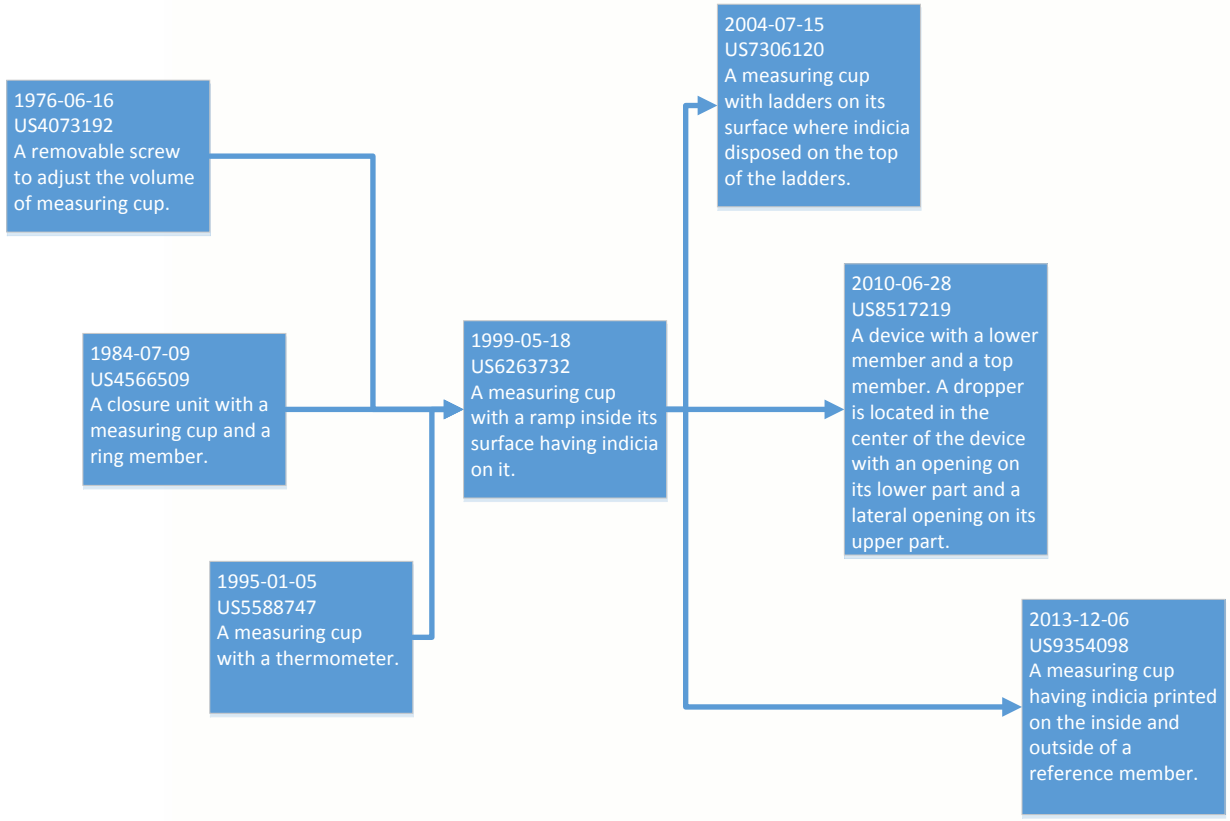


Fig. 11 Map of technology development for measuring cup

Fig. 11 shows that before the invention of patent US6263732, patents focused on ways to adjust the volume (US4073192), extend the measuring function to a cap of a bottle (US4566509), or combine a temperature-measuring function with a cup (US5588747). Then the function of easily readable indicia on the cup was incorporated into patent US6263732. Afterwards, various means were proposed to achieve the easy reading function such as using ladders (steps) on the inside surface of the cup (US7306120) and inserting a mound-like reference member in the middle of the cup (US9354098). In addition, the transparent material used in US6263732 was also applied in US8517219 to invent a device that could measure the liquid precisely without an additional part such as a spoon, as shown in its reference patent, US4192360 (Rodriquez, 1980). The trend of evolution of the measuring cup shows that once a long-sought solution to a problem is provided by an invention (US6263732), other inventors will try to use different means to solve the same problem. In our case, patents US7306120 and US9354098 solved the same problem as US6263732 did. These three patents take advantage of the inside surface of the measuring cup. They apply inventive principle 17, another dimension. A trend of surface segmentation (Mann, 2002) can be found from US6263732 to US9354098, where the ramp in US6263732 is a flat surface, whereas US9354098 uses a more advanced design in which the ramp is a 3D protrusion, allowing the reverse side of the measuring cup to be used to measure the quantity of fluid too.

To resolve the problem by forming a technical contradiction (Cameron, 2010), if we put the ordinary measuring cup on the table and stoop down to see the indicia at eye level, then we can see the scale precisely; however, we will get tired. So in this scenario, the parameter that is improved is the ability to see the scale precisely, which can be considered as parameter 28, measurement accuracy, while the parameter that is worsened is becoming tired, which can be considered as parameter 19, use of energy by a moving object. The contradiction matrix in Fig. 12 shows that the triggering inventive principles (IPs) are IP 3, local quality, IP 6, universality, and IP 32, optical changes. Retrospectively, the OXO measuring cup uses inventive principle 3, local quality (the ramp inside the surface), and inventive principle 32, optical changes

(transparent material such as Pyrex). Note that IP 17, another dimension, is not among the suggested IPs. Note also that IP 6, universality, was not used in the previous patents, so perhaps this inventive principle could be used to find a new solution.

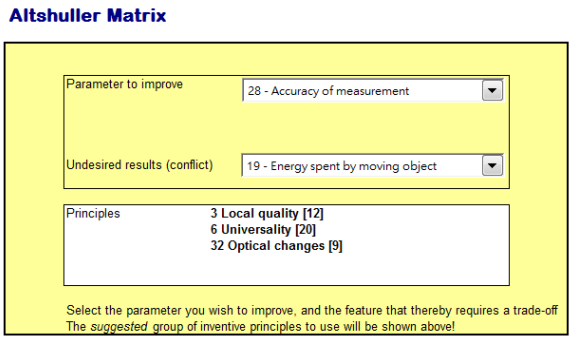


Fig. 12 Contradiction matrix for measuring cup

4. Conclusion

A patent map is very useful for keeping track of technological developments and we have applied it to the measuring cup. The task started with the OXO measuring cup described in the patent US6263732. Three patents were extracted using the backward citations of US6263732 and three were extracted using the forward citations. They are US4073192, US4566509, US5588747, US7306120, US8517219, and US9354098, respectively. A map of technology development based on these seven patents is established. Analysis of the map shows that before the invention of patent US6263732, the patents focused on ways to adjust the volume (US4073192), extend the measuring function to a cap of a bottle (US4566509), or combine a temperature-measuring function with a cup (US5588747). Then the function of easily readable indicia on the cup was incorporated into patent US6263732. Afterwards, various means were proposed to achieve the easy reading function such as using ladders (steps) on the inside surface of the cup (US7306120) and inserting a mound-like reference member in the middle of the cup (US9354098). In addition, the transparent material used in US6263732 was also applied in US8517219 to invent a device that could measure the liquid precisely without an additional part such as a spoon, as shown in its reference patent, US4192360. In our case, patents US7306120 and US9354098 solved the same problem as US6263732 did. These three patents take advantage of the inside of the surface of the measuring cup. They apply the application of inventive principle 17, another dimension. A trend of surface segmentation (Mann, 2002) can be found from US6263732 to US9354098, where the ramp in US6263732 is a flat surface while the ramp in US9354098 is advanced to 3D protrusion so that the reverse side of the measuring cup can also be used to measure the quantity of fluid too.

To resolve the problem by forming a technical contradiction, if we put an ordinary measuring cup on a table and stoop down to see the indicia at eye level, then we can see the scale precisely but we will get tired. So in this scenario, the parameter that is improved is parameter 28, measurement accuracy, while the parameter that is worsened is parameter 19, use of energy by a moving object. The contradiction matrix shows that the triggering inventive principles (IPs) are IP 3, local quality, IP 6, universality, and IP 32, optical changes. Retrospectively, the OXO measuring cup uses inventive principle 3, local quality (the ramp inside the surface), and inventive principle 32, optical changes (transparent material such as Pyrex). Note that IP 17, another dimension, is not among the suggested IPs. Note also that IP 6, universality, was not used in the previous patents, so perhaps this inventive principle could be used to find a new solution.

The conclusion will not be too much different from the ones derived. Because the main conclusion is that before the invention of US6263732, the patents focus on various functions of cup instead of easy reading. After the invention of US6263732, the patents focus on using the inside surface of the cup to provide the easy reading. It focuses on structure and nothing else. Perhaps other direction can shed some light on solving the same problem. For example, using the flexible wristband may serve another way to solve the same problem. This solution will be presented in one of the authors' thesis.

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