

JAPANESE PATENTS INVESTIGATION REPORT ON WEB HANDLING TECHNOLOGY

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ABSTRACT

In order to initiate programs in web handling, it is necessary to understand the technical vector that has developed in the field. In this paper we have investigated 1784 Japanese patents on web handling technology that were issued from 1971 to 1988. 227 patents have been classified into several categories and as a result, we have found that Japanese patents concentrate on hardware (e.g., splice, tension control and edge position control) and phenomena. Phenomena include improvement of winding quality and recently, several patents to increase yield percentage and to improve storage quality.

OBJECTIVE

The objective of this work is to understand the Web Handling technical vector by studying the Japanese Patent Literature. This will help to initiate technical programs.

INVESTIGATION METHOD

The patent search included the B65H patent classification (Thin plate, sheet, web, etc.) and investigation period was from July, 1971 to September, 1988 for 17 years. Within this classification the search was forced on specific webs in combination with specific web handling problems. The total patents meeting our search criteria totaled 1784. This total was narrowed down to 227, based on the patent abstract. The full text and diagrams were ordered for the patents in the final group.

PATENT APPLICATION LIST IN CHRONOLOGICAL ORDER

At first we classified the 227 patents into substrate analysis and hard technology. See Figure 1.

GENERAL REMARKS

There are many interesting patents of the 1784 patents studied during the 17 year period. It is difficult to standardize patents in this field because they apply to different kinds of substrates. We believe this investigation will be useful to decide the vector of future study.

There are some patents which are applied by user and supplier, supplier and supplier in cooperation. This tells us cooperative efforts between companies sometimes resulted in patents. For example, there are patents on winding by TORAY INDUSTRIES, INC and KOBAYASHI ENGINEERING WORKS, LTD, a patent on butt splicing by FUJI PHOTO FILM CO., LTD and RELIANCE ELECTRIC LTD, a patent on butt splicing by KONICA CORPORATION and MINAMI-SENJU MFG CO., LTD., a patent on a rider roller by NIRECO CORPORATION and MINAMI-SENJU MFG CO., LTD.. In the other industries, joint application from JAPAN TABACO INC. and SANJO MACHINE WORKS, LTD., ASAHI SHIMBUN and DAINIPPON INK AND CHEMICALS INC., KAWASAKI STEEL CORPORATION and MITSUBISHI HEAVY INDUSTRIES, LTD etc.. Companies which apply many patents include KATAOKA MACHINE CO., LTD, MITSUBISHI HEAVY INDUSTRIES, LTD, KOBAYASHI ENGINEERING WORKS, LTD on the supplier side and TORAY INDUSTRIES, INC., TEIJIN LIMITED, FUJI PHOTO FILM CO., LTD, KONICA CORPORATION, DIAFOIL CO., LTD on the user side.

Web Handling

We have categorized patents on Wrinkle, Web Shift, Scratch/Slip, EPC and Tension/Drive Control to Roll Structure, Unit Design and Application.

In roller structure field, patents on elastic roller which has a metal surface (S51-65940), substrate support system which uses air (S51-28152; S57-184050; S61-188351), combination air bearing with vacuum roller (S59-74850) are interesting

In unit design, patents to drive nip roller in the same velocity with line speed when nip is off (S61-217455), V shape expander brush (S60-122183). In application, patents to remove stress, strain by air, to make short vertical thread in the line (S62-215455) are interesting.

Splice

Extraordinary developments have been made to connect old and new substrates continuously and instantaneously. Many patents exist which describe complicated mechanisms in this area. The patents are divided into Butt Splice, Cut & Tack, Bump & Cut, Traverse Cut and Characteristic Method by each splice method.

Butt Splice

There are many patents from photographic material companies. The reason why they adopt butt splice at the unwinder is that they need to remove uneven differences of substrate to eliminate coating defects. In the case of overlap splice, a coating defect happens to thicken the splice part of the substrate at the coating head.

In butt splicing, new substrate is necessary to run at the same speed with line speed before splice. Previously, the substrate of the new core was wasted for the approach run but a patent which uses a guide sheet instead of substrate approach run

decreases waste - FUJI PHOTO FILM CO.,LTD (S63-31963) in 1988 and modifications for high speed (S54-91676, S63-60848)

Cut & Tack

The mechanical issues for Cut & Tack are how to shorten time which needs to cut the substrate and in the case of the winder, how to attach substrate to the core. For this purpose, patents exist to add small nip size nip roller at the top of ordinary size nip roller (S59-198240), to provide elastic guide at cutter to hold substrate (S63-101250), to short roller span which is a position of cutting (S59-130850).

Bump & Cut

Bump & Cut is a splice method to cut substrate by knife after nipping substrate to new core or new unwinding roll by nip roller. There are several methods applied, for example, push substrate to knife by 2 span rollers (S61124470), add electrical charge to core for easy involving of substrate (S62-285858). It is said that Bump & Cut is more suitable for high speed splice than Cut & Tack. The reason, in case of Cut & Tack, is that knife cutting speed must increase as substrate speed increases, but there is some limitation of the knife speed, and in case of elastic material, accurate cutting is difficult because of the occurrence of elongation when the knife pushes on the substrate.

In the case of Bump & Cut, it is necessary to increase tape thickness and differences in level have a bad influence on products. For the correction, we've already mentioned, there is a patent which uses thin adhesive tape to lighten the burden imposed on adhesive tape by pushing substrate into the knife using 2 rollers.

Traverse Cut

Traverse Cut is a method in which the knife moves in the cross web direction to cut the substrate. It is used for high speed cutting and/or thick substrate cutting. The advantage of the method is that it removes the disturbance of cutting edge of substrate. On the other hand, there are some problems that it makes waste of length of cutting shape because cutting shape becomes oblique against the machine direction and cutting shape triangle has a bad influence on wound substrate. There are many patents on using a knife at high speed For example, for a knife moving quickly in middle (S61-168495), cut substrate from both edges by 2 knives (S59-227646; S62-136458), etc. Other patents include selecting cutting shape to prevent miss of winding and holdover (S58-220037), cutting substrate at close range to core. (Score cut method which cuts substrate according to pushing knife to core injures the core (S59-36068), etc).

The application of several patents are limited since they are not universal, but specific to a particular, unique equipment. There are patents from machine suppliers using 4 shafts at 90 degrees intervals to short transfer distance during turret (S62-65870), set knife and suction box like wheel by guide rollers and cut substrate (S60-48858), etc. and the possibility that these methods are used actually is very high. There was no patent on substrate handling during turret in the past, but in 1984 and 1986 patents that hold wound roll by assistance roller directly to decrease waste of products during turret are applied. (S59-36058, S61-203054). It seems to be a cost reduction benefit on the user side. There are several patents on splice tape, for example, spray method of adhesive paste to core (S62-240246, S62-240247, S63-

160961), keeping a high force for tangential line but low force for normal direction (S63-101251), making multi holes in cross web direction of substrate and putting both faces tape on holes to prevent substrate shift of new unwinding roll (S62-180848), etc.

Winding

The winding process is the final part of the web handling process to make products and is very important in maintaining the quality of products. We categorized the field in terms of Wrinkle/Web Shift, Material, Core and Storage. Many devices are proposed to decrease wrinkle and web shift in behavior of winding process. For example, patents on shape of nip roller [groove shape (S61-75762)], stiffness of rubber roller (S62-116445) control involving rate of air (S59-36057), elastic porous roller (S50-156566, etc), shape of core [crown (S59-128170), flat (S60-12477), stiffness up (2000 kg/mm²) (S60-188258)], keeping distance between surface of winding roll and near roller (S49-89055), (S54-93555), (S61-254456), utilization of static electricity (S51-71351), (S51-46354), adding cyclical tension variation to substrate forcibly (S53-52864), (S54-121367), etc. are applied.

There are patents which control quality of winding involving the relationship between air and substrate. for example, there is a patent that describes adding heated air to substrate (S62-201760), (S62-205953). This idea suggests a strong influence on product quality. It is very interesting to consider the use of a technology which influences material properties as well as a mechanical technology. There is a also a patent to prevent wrinkles by mixing inorganic matter in polyester (S63-97558). It also seems to be necessary to consider materials for preventing wrinkles.

The stiffness of the core is a very important element in the control of wound in pressure. There is a patent to cover the surface of stiff material with elastic material (S63-41382). The possibility to apply this will be high for some special products in the near future.

There are many patents on the storage of wound rolls. For example, there are patents which put a protective sheet at 2 circuits from outside of wound roll to prevent severe temperature and moisture conditions from affecting the roll (S62-136456), control wound roll]l hardness by surface roughness of substrate (S62-222953), control wound roll by moisture and time (S62-279926), turning roll during storage (S63-31962), etc.

Summary

1. There are many patents on hardware as compared with phenomenon analysis.
2. Recently patents on OA (office automation;FAX,COPY,etc) are increasing.
3. Companies which apply many patents include, of suppliers: KATAOCA MACHINE CO., LTD, MITSUBISHI HEAVY INDUSTRIES,LTD. and KOBAYASHI ENGINEERING WORKS, LTD. and of users:TORAY INDUSTRIES, INC., TEIJIN LIMITED, FUJI PHOTO FILM CO., LTD., KONICA CORPORATION and DIAFOIL CO ,LTD.
4. Items which have many applications are as follows.
 - 1 Splice

- 2. Wrinkle/Web shift on winding
- 3. Tension Drive Control
- 4. Edge Position Control

5. Recently some patents which discuss increasing percentage of yield and improvement of storage quality are applied.

- 1. Prevent wrinkles on turret
- 2. Decrease material on butt splice
- 3. Storage Method

6. Recently there is a new approach to improve materials to prevent wrinkles as opposed to only improvement of machine mechanics.

POSTSCRIPT

As we mentioned in our General Remarks, the content of patents depends on characteristics of the substrate and the content varies according to circumstances. However we believe this study shows the industry vector and should prove useful.

Table. 1 PATENT LIST ON WEB HANDLING FEB. 14, 1980

	WEB PHENOMENON ANALYSIS			HARDWARE TECHNOLOGY		
	WRINKLE	WEB SHIFT	SCRATCH SLIP	EDGE POSITION CONTROL	TENSION, DRIVE CONTROL	SPLICE SYSTEM
1972				□□		
1973				□□□		△
1974	△△					△
1975		△		□	△△ □□	△△
1976	△ □	△△△			○○ △	△△
1977						
1978	△		□	□	□	○ △△△

○ UNWINDING SECTION	△ WINDING SECTION	□ OTHER SECTION
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Table 2

PATENT LIST ON WEB HANDLING

FEB. 14, 1990

	WEB PHENOMENON ANALYSIS			HARDWARE TECHNOLOGY		
	WRINKLE	WEB SHIFT	SCRATCH SLIP	EDGE POSITION CONTROL	TENSION, DRIVE CONTROL	SPLICE SYSTEM
1979	△△△			□□	□	○ △
1980	△			○ □□□	○ □	○○
1981	△ □	□□	□	○ □	△ □	△
1982	△	□	□	□		
1983	△△			□	□	△△△△
1984	△ □□	△	□	□□□	△ □□	○○ △△△△△△△△ △
1985	△△△△△ □□		□		○ △ □□	○○ △

○ UNWINDING SECTION	△ WINDING SECTION	□ OTHER SECTION
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Table 3

PATENT LIST ON WEB HANDLING

FEB. 14, 1990

	WEB PHENOMENON ANALYSIS			HARDWARE TECHNOLOGY		
	WRINKLE	WEB SHIFT	SCRATCH SLIP	EDGE POSITION CONTROL	TENSION, DRIVE CONTROL	SPLICE SYSTEM
1986	△△△△△ □□			□□□□	○ △ □□	○○○○ △△△△
1987	△△△△△△△△ □□□□	□□	□ □□□□□□□□	○ □□	△ □□□	○○○○○ △△△△△△△△ △△△△△
1988	△△△△△ □□	△		□□□	○○○○ △△ □□	○○○○○○○ △△△△△△

○ UNWINDING SECTION	△ WINDING SECTION	□ OTHER SECTION
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Figure 1 Substrate Analysis

July, 1971 to Sept. 1988

Wrinkle	56	}	81
Web Shift	11		
Scratch/Slip	14		
Hard Technology			
Edge Position Control	30	}	146
Tension /Drive Control	37		
Splice	79		

Patents are sorted in chronological order as Table.1 to Table.3.
The contents are classified as follows:

