July 04, 2019

SUBSTRATE WITH NON-NEGLIGIBLE THICKNESS LENGTH TRACKING ON HYBRID PRINTERS

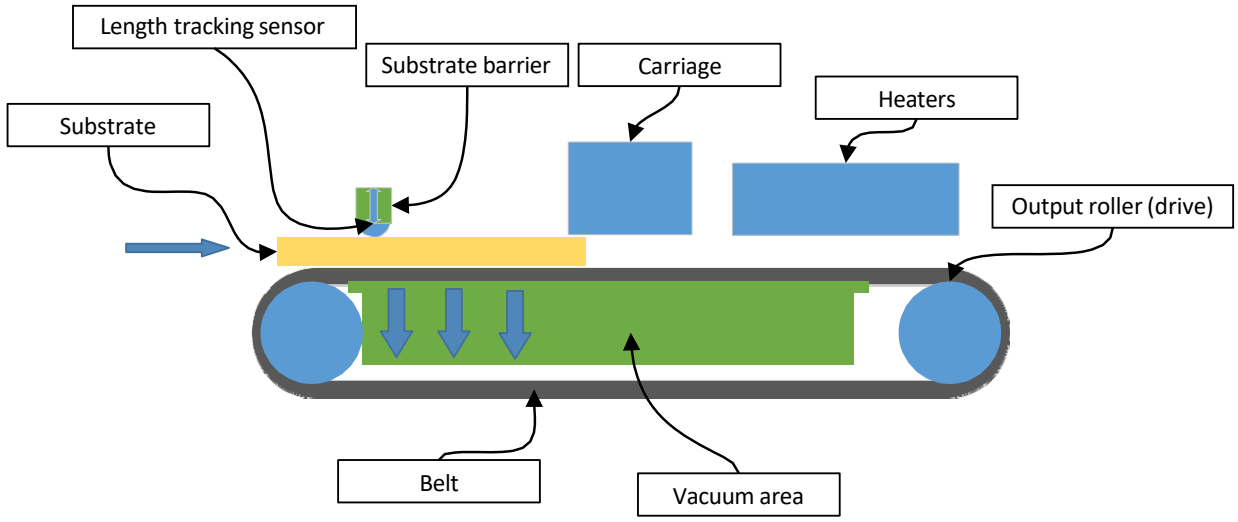
HP INC

Substrate with non-negligible thickness length tracking on hybrid printers

Abstract

In the new generation of hybrid Large Format Printers for sign & display market, based on latex inks, there is a breakthrough in image quality compared to previous products. Hybrid printers allow to print both on rigid and flexible substrates, improving versatility and substrate breadth to the end user.

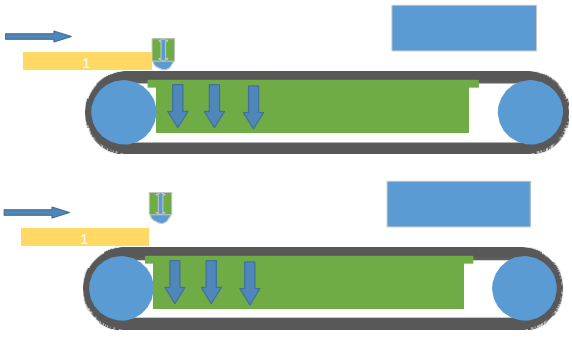
Hybrid printers use a substrate advance belt and vacuum to handle the media from the entrance to the exit of the printer. See below a schema of the cross-section of a hybrid printer:

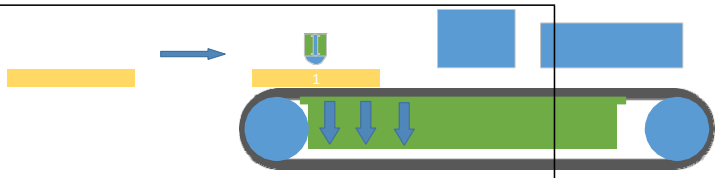
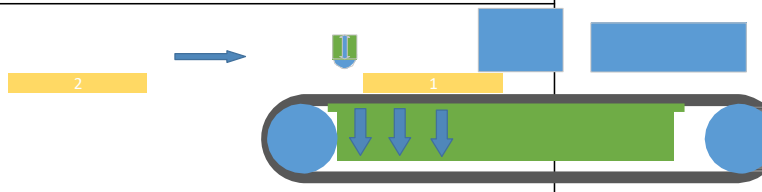
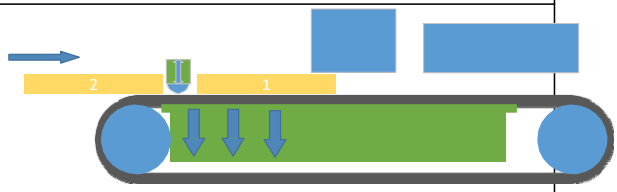
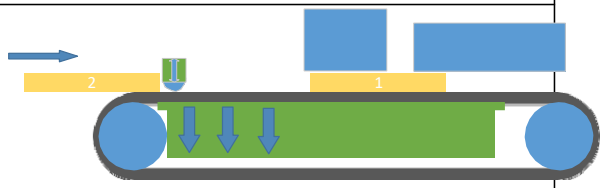
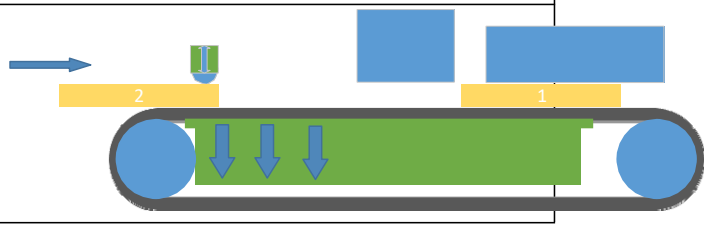


In the entrance of the belt usually there is a substrate barrier that can moves up and down. This barrier is used, among other uses, to avoid substrate with non-negligible thickness placed over the input area of the belt to enter to the printing zone before the printer is not ready for print it.

Let's see what happens when two substrates are printed in sequence to understand the barrier usage:

1 • Substrate 1 is loaded • Substrate 1 is not ready for print • Barrier is down, blocking substrate 1
2 • Substrate 1 is loaded • Substrate 1 is ready for print • Barrier goes up



3 • Substrate 1 enters to print zone	
4 • Substrate 1 back edge surpasses barrier	
5 • Substrate 1 keeps advancing • Barrier goes down • Printer announce to operator to load substrate 2 • Operator loads substrate 2 • Substrate 2 is not ready for print • Barrier blocks substrate 2	
6 • Substrate 1 keeps advancing • Barrier blocks substrate 2	
7 • Substrate 2 is ready for print • Barrier goes up	

In the step 4 the length of the substrate is needed to know when the barrier can be moved down. Knowing the exact length is critical to do this operation just in time, and not before or after. If the barrier is moved down before the substrate surpasses the barrier, the barrier will crash with the substrate; if it´s moved down much after, it´s a loss in throughput.

This invention focuses on automatizing the substrate length tracking without any operator intervention during the process.

Problems solved by the invention

The length of the substrate is an important feature that the printer needs to know. As we have seen in the previous section, it can impact in the throughput when printing multiples substrates with non-negligible thickness in sequence.

Some problems related with not having a proper substrate length are listed below:

- Loss in throughput when printing a batch of substrates
- Damage of the substrate
- Printing outside the substrate
- User must provide substrate length
- Using same media length for all substrates in the batch

Prior solutions and their disadvantages

The first and more obvious way to obtain the substrate length is to ask to the operator to do it manually and input the value to the printer. The main disadvantages of this solution are:

- Errors in measurement due to:
    - measure accuracy depends on operator ability
    - variability in length between substrates in same batch, very common in some substrate types due to manufacturing and processing
- Time consuming
- Printer interface more complex

Currently some printers include an optical sensor to detect the substrate presence. This, indeed, can be used to measure and track the length of the substrate. The main disadvantages of this solution are:

- Not works on some substrates due to its properties, basically transparency and color.

Description of the construction and operation of the invention

The current invention proposes to automatically measure the length of substrates with non-negligible thickness. This is achieved adding to the bottom of the substrate barrier a sensor (discussed below). The main advantage of putting the sensor in this place are:

- It's in the entrance of the input path
- The height of the substrate barrier can be adjusted at any value between the belt and a maximum height, so the distance between sensor and substrate can be adjusted as per sensor needs

The sensor used can be of different kinds.

- Tracking wheel (a wheel with and encoder disc and encoder sensor). This sensor needs to touch the substrate surface and can measure the advanced distance by the substrate with high accuracy. This usually is a very cheap option.
- Capacitive sensor. This sensor can detect the presence of substrate without contact.
- Etc

Multiple sensors could be placed on the substrate barrier to measure different substrates loaded in parallel.

As an example, the detailed process of printing a substrate while measuring its length using a tracking wheel is:

1. The substrate is loaded, and the barrier is down, blocking the advance
2. Once the substrate is ready for print, the barrier goes up
3. When the substrate advances the length of the barrier, the barrier goes down. For simplification we consider that the printer already knows the thickness of the substrate.
4. When the substrate advances, the barrier wheel spins, measuring the actual advance of the substrate.
5. When the substrate surpasses the barrier, the wheel stops spinning.
6. The total advance of the barrier wheel is equal to the substrate length.

Results and advantages of the invention over prior art

Main advantages of the invention are:

Robustness, simplicity: the operator does not need to measure manually the length of the substrate, eliminating errors and reducing operating time.

Printer reliability: Less risk of damaging the substrate and the printer:

- The length of each substrate can be measured while it is being printed and the measure is available before the end of printing, so
    - printing out of the substrate can be avoided.
    - the substrate barrier will not crash with the substrate.
- If a tracking wheel is used, it´s possible to detect a discrepancy between the substrate and belt advance. This information can be used to
    - detect a substrate crash
    - compensate advance

Productivity and cost efficiency: Maximizing printing time and reducing substrate load time. Reduce the time between loads and gaps between jobs by measuring each substrate length while it is being printed.

Disclosed by Brian Carvajal, Francisco Javier Rodriguez Escanuela and Marc Muntaga Passarell, HP Inc.