Study of a D2T2 Printing for High-Speed Print

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Abstract

We studied a D2T2 print featured high speed print. The head used was optimized and it is necessary to have optimized the head drive to speed it up. Optimizing head structure and optimizing head energy control was indispensable for high-speed print. In a high-speed print, the problem of Kogation on the surface of the head occurred. The counter measure was necessary. These problems were solved, and a high-speed print of 2ips-3ips was able to be achieved with the D2T2 print.

Introduction

Digital image input devices, represented by the digital still cameras have been rapidly spread. This makes us easy to obtain digital images. Recently, following the progress of the input devices the photographic printers, the output device for the digital images are also being spread rapidly.[1-3]

There are several method for these photographic printers such as Digital silver halide, Inkjet and Thermal. We are studying Thermal D2T2 printing method. So far, the defect in D2T2 method is the slow printing speed. We have studied upon speeding up D2T2 printing. In order to achieve high speed, we have studied speeding up the head running speed and also studied the tandem system. Head running speed has been improved to 2-3IPS from the conventional speed which was 0.5–1IPS. Furthermore, while studying architecture of tandem system, we have found out the possibility of the print speed up to 2sec/4x6inch on a technical level.

Study of Technical Issues in Speeding

1. Speeding Up Head Running Speed

Optimizing Head Structure

With the conventional head, the thermal head surface temperature rises as described in Fig. 1. For this problem, we have optimized the heating element length of the thermal head. To print a certain density, it is known that the longer the heating element is, the lower the necessary head temperature will be. On the other hand, making the heating element longer the outline of the printed pattern gets more unclear. By the optimization in consideration of these characteristics, we have found out the optimum heating element length. In case of 2-3IPS printing speed, the optimum heating element length is approximately 120-160 micron. In this case, the head surface temperature is approximately 450-550 degrees centigrade.

With the conventional head, high speed makes the thermal insulation layer accumulates the heat, and this makes an extra print on the margin. (smear) We solved this problem by optimizing the thickness of head thermal insulation layer and the heat physicality of the substrate. For example, the Fig. 2 shows the simulated result of correlation between thickness of the glaze and the heat accumulation. Hereby, we found out the optimum glaze thickness is approximately 100 micron.

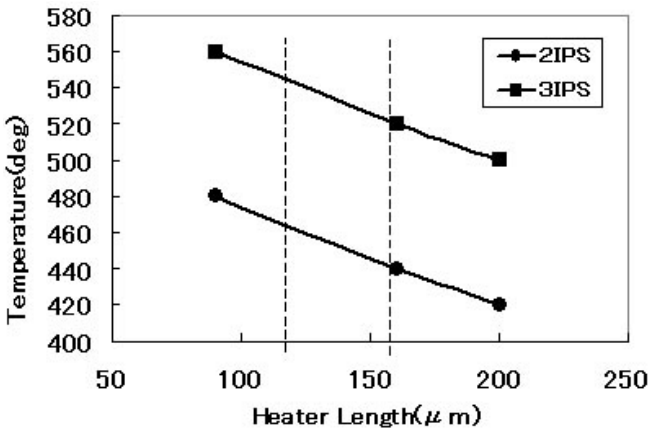

Figure 1. Relationship between heater length and head surface temperature

Optimizing Head Energy Control

It's been studied from past that the energy controlling method has a beneficial effect on high speed printing. We have studied the Multi-pulse method[4] which we saw a beneficial effect on high speed printing in the past, and confirmed the effects. The results Fig. 3 show the Multi-pulse method could print higher density with the head surface temperature remained low, compared with the conventional Single-pulse method.

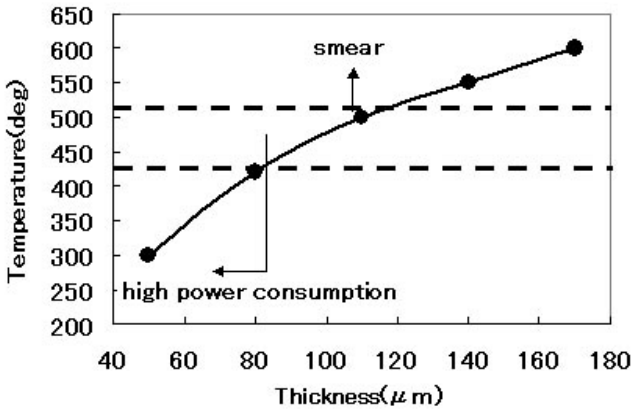

Figure 2. Relationship between glaze thickness and head surface temperature

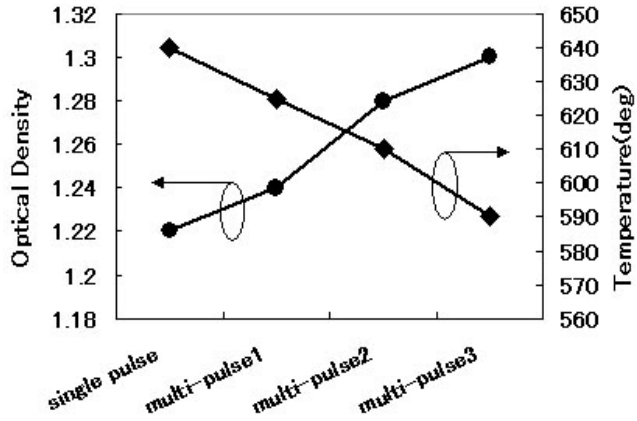

Figure 3. Comparison of optical density and head surface temperature between single-pulse method and multi-pulse method

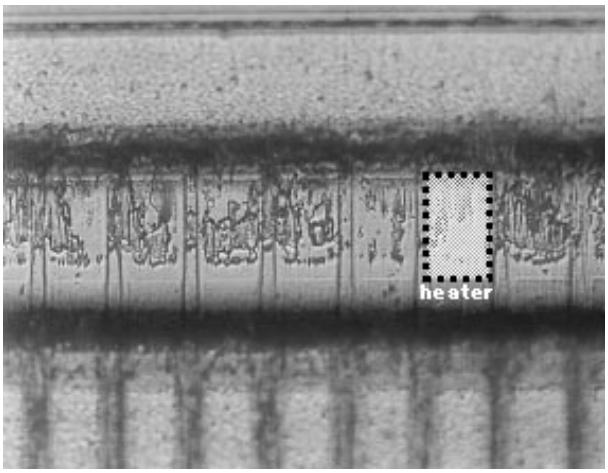

Figure 4. Head surface right after printing

Optimizing Head Surface Temperature and Measures Against Kogation

As mentioned above, the D2T2 high speed printing will make the head surface temperature rise. Even though adjusting the heater length, 3IPS print speed makes the head surfaces temperature up to 550 degrees centigrade or more. The fig4 shows the head surface condition while continued printing with the head surface temperature 550 degrees centigrade. As shown in the picture, the Kogation are generated on the head surface. For this problem, we studied a countermeasure with cleaning the head surface by micro-grinding. We adopted the pad coated with white alumina particle for the head cleaning. Also studied the ribbon which has silica particle back coat[5] and confirmed a beneficial effect.

2. Study of System Architecture

Tandem System

Tandem system has a beneficial effect on speeding up color printing. Tandem system is the system which every color are printed parallel with the heads assigned individual colors. (Fig. 5) This system is far more efficient than the 1 head system which has to change color or swings media backwards when printing every different color. However, it is imperative that the Tandem system will be larger because of the architecture. Meanwhile, it is also imperative that the Tandem system is required to be downsized to built in a prospective system such as Digital Photo lab, SOHO and KIOSK in the Photo Market.

Downsizing

To downsize the tandem system, it is especially required to downsize the head unit and to narrow the distance between the head units. The major issue to achieve the head unit downsizing is the head chip size and the heat radiation design. The major issue with narrowing the distance between the head units is jitter. Because of the narrow distance, when one head moving up and down, it will influence the other head which is printing. We have achieved the target with adopting the water cooling system for the heat radiation design and improving the form feed mechanism to solve the disordered printing problem.

To downsize the head chip, we adopted the wire bonding to mount the Driver IC. Also we have controlled the resin coating height and fixed the height to approximately 0.4mm. Therefore we succeed in setting sealing position near to the heating element as near as possible and could make the head unit width compact as to approximately 13 mm. With these factors, we achieved the high speed tandem system within the size of W310 mm x H320 mm x D300 mm, the same size with 1 head business use printers.

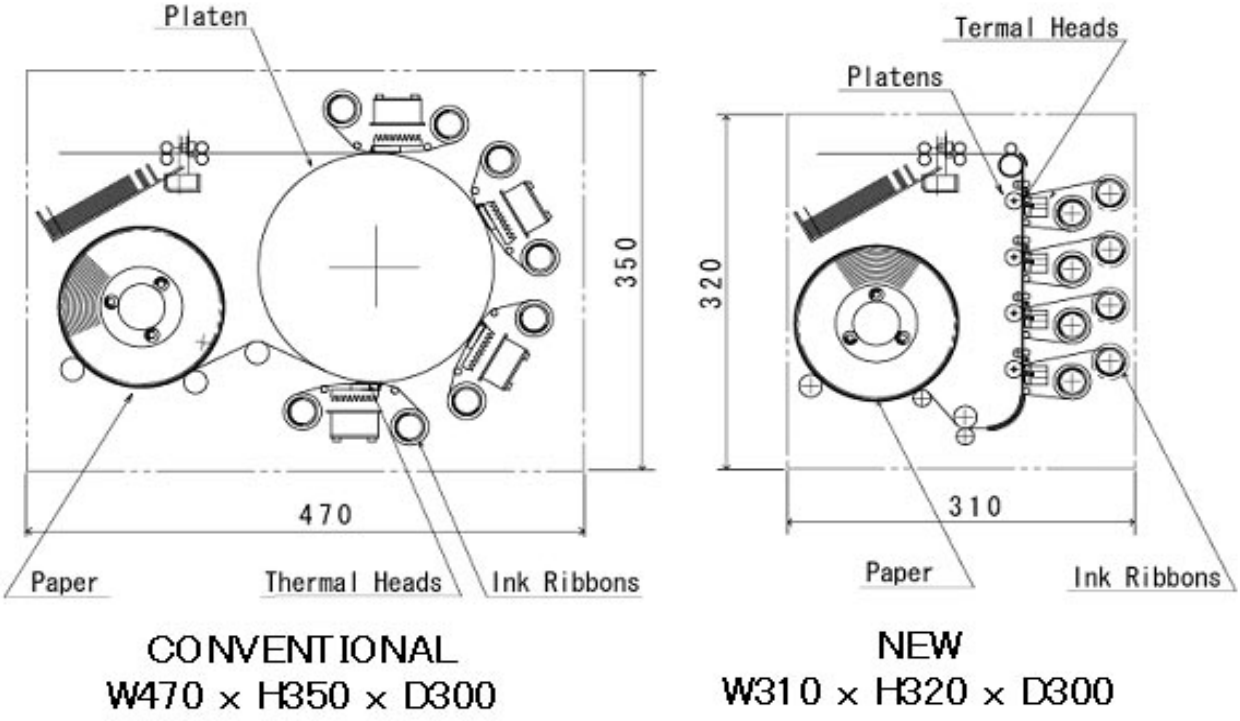

Figure 5. Comparison of tandem system architecture

Study of Print Speed Possibility

By the study above, the D2T2 printing time with the 4" x 5" media size had been decreased drastically as indicated in fig6. As the result of this study, we found out that the print speed for 4" x 6" size could be 20-30 seconds which was approximately 90 seconds. Additionally, with the 4 head tandem system, we found out that maximum 2 seconds is possible.

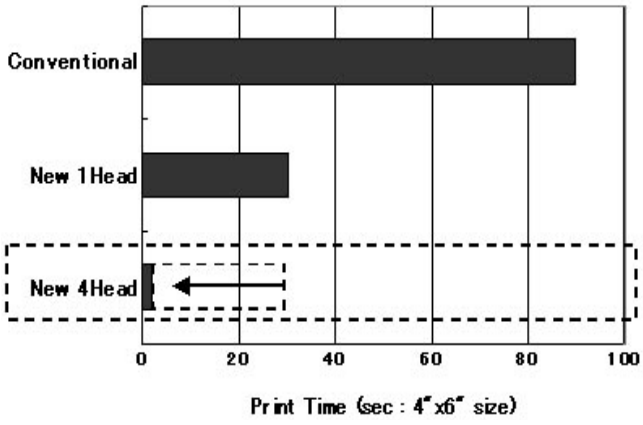

Figure 6. Comparison of printing speed

Conclusion

We have studied the D2T2 high speed printing by speeding up the head running speed. By optimizing the head structure and the head energy control, we have improved the print speed up to 2-3 IPS which was conventionally 0.5-1 IPS.

Also we have studied the tandem system. While studying the tandem system architecture, we have found out the possibility of the print speed up to 2sec/4x6inch on a technical level.

Afterword

With these studies, we found out that the high speed and high quality printing is feasible with D2T2 printing method. We strongly believe that the printer equipped with this technology will provide the photographic quality printing approaching that of silver halide imaging, and the high speed printing which will no longer have to care about the time.

References

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Biography

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