Improvement of Needle Bar in Textile Machine by Hitting Process

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Abstract. The research conducted was to study the hitting process of a needle bar used within textile machinery and how to improve its efficiency and performance. A needle bar consists of a brass bar attached with a number of small pins. The primary focus was learning technique while straightening the needle bar. In order to join pins and brass bar together, the soldering is applied. The result from the heat transfer during soldering process can cause the brass pins to bend, which is undesirable for finished product. A soldering expertise uses hitting movement technique to modify and straighten the brass bar. Even though soldering process is the only step in making the brass bar; however, its method is considered very complicated and requires refinement and specialization from the maker.

Keywords: Needle bar · Hitting process · Linking machine

1 Introduction

The linking machine is using for joining knitted fabric pieces together to form a garment. Linking is a method of seaming/attaching pieces of a garment together after the pieces have been knitted on a flat-bed knitting machine. The linking process requires a skilled operator, and is used mainly for high-end knitted apparel. In the linking process, a slacker course of loops of yarn is created on the linking machine, which connects two pieces of fabric together.

For over thirty years of experience in soldering, a man who first started his own business became an expert in making a needle bar in textile industry. This specific part is the important component of a linking machine. The needle bar is very useful and faster for the seaming process of garments. The fabric has been set on the pins of needle bar that will guide a needle of a sewing machine. This specific part was produced by man-made technique, which strongly influenced by personal skill and experience. The most important process in producing a needle bar is to know how to place each pins onto the groove perfectly. Soldering pin to pin is necessarily in this process. The heat transfer during soldering process has an extensive effect to the pins row and the brass

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bar to bend in zigzag pattern. The straightening process or hitting process is required after soldering process in order to make a straight needle bar. For this reason, a skilled needle bar maker uses his own sensations and experience to re-shape the brass bar.

2 Experimental

The linking machine is using for joining knitted fabric pieces together to form a garment. Linking is a method of seaming/attaching pieces of a garment together after

2.1 Fabrication Process of Needle Bar

The straight brass bar (4.5 × 92.0 × 0.2 cm) is prepared as the basement of needle bar. Small slots that using as the channel for placing the needle pins are marked on the brass bar by using the groove cutter machine. The groove cutter machine and the slotted brass bar are shown in Figs. 1 and 2, respectively.

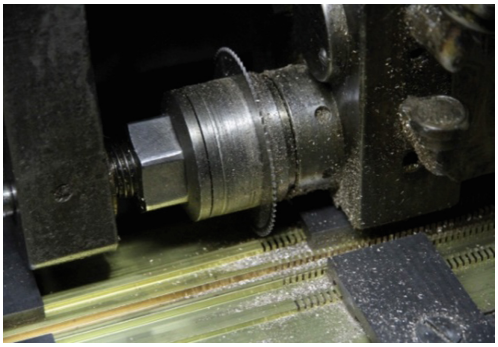

Fig. 1. The groove cutter machine

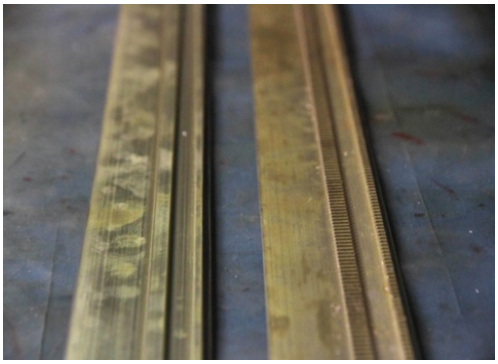

Fig. 2. The slotted brass bar

In this research, the needle bar number seventh is studied. The "number seventh" means the amount of pins placed onto grooves within an inch (seven pins per inch). In the middle of a brass bar, seven pins are placed onto the groove one by one and the metal plate is used to hold the pins with the brass bar as presented in Fig. 3.

Fig. 3. Pin setting step

The pins are joined together with the slotted brass bar by the soldering process. Soldering is a process in which two or more metal items are joined together by melting and flowing a filler metal (solder) into the joint, the solder having a lower melting point than the adjoining metal [1].

The soldering process of needle pins and brass bar is shown in Fig. 4. In order to remove impurities that can obstacle the joint, the flux is applied prior the soldering process (Fig. 4a). The solder is applied on the heated soldering head (Fig. 4b) and consequently tapped on soldering area (Fig. 4c) to let the solder melting and covering the soldering area (Fig. 4d). Then the soldering process continues to the next part of the brass bar from the middle portion (Fig. 4e). After that the needle bar maker continues to place more pins at the end of each side of the brass bar (Fig. 4f) and repeat soldering (working from the side towards in the middle of the brass bar) until the pins are all placed and covered all length of the brass bar (Fig. 4g).

The post soldering processes consist of the scrap removal and the straightening of the needle bar. The needle bar maker uses the file to scrape an excess dust and smoothen the brass bar's surface after soldering process as shown in Fig. 5.

2.2 The Straightening of the Needle Bar

In general, the needle bar, which is attached with a number of pins, is supposed to straight in order to be able to insert into the linking machine. However the heat transfer during soldering process causes an extensive effect to the needle bar to bend in an arch shape as illustrated in Fig. 6 [2, 3]. Furthermore, the arch shape of the needle bar has caused the alignment of the pins to shift. The needle bar is not productive if the pins are not aligning in straight line.

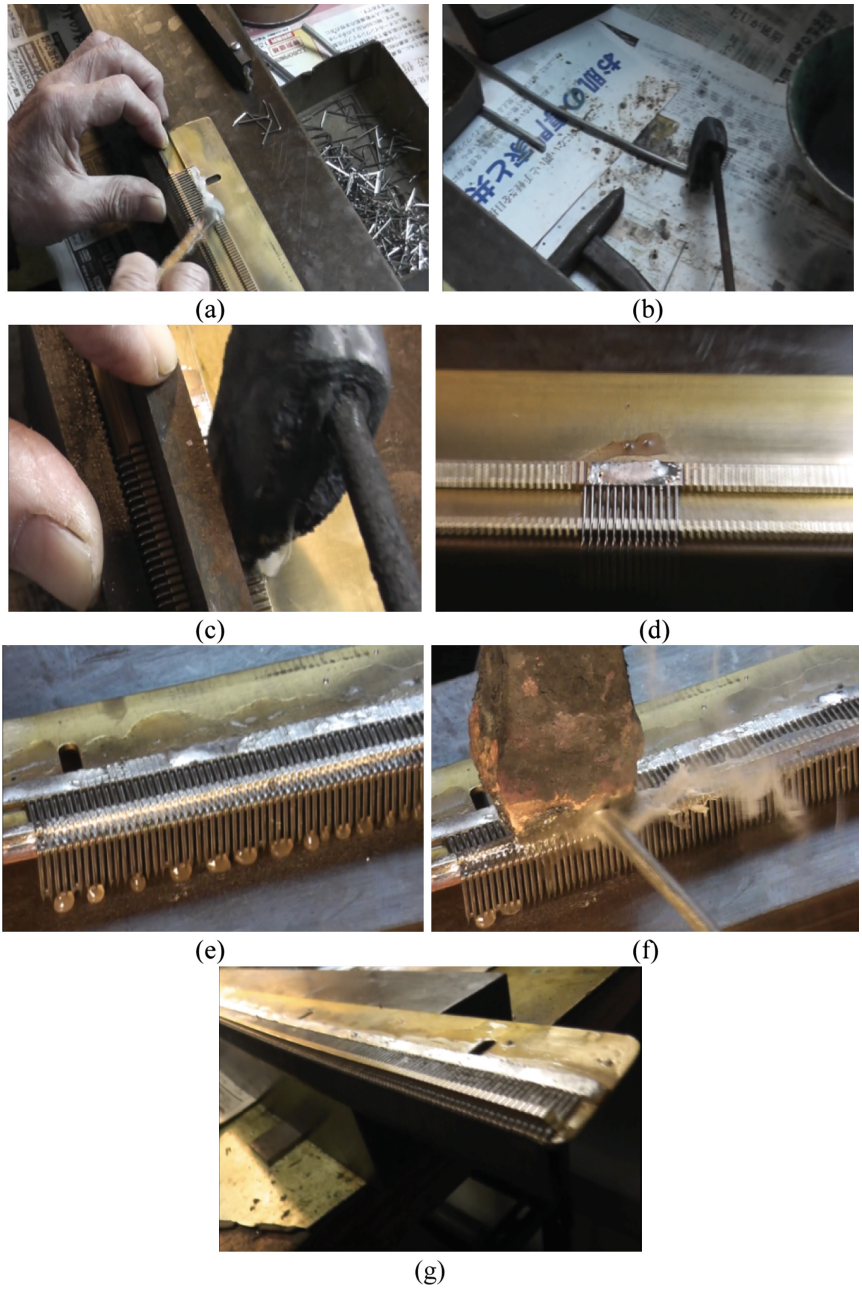

Fig. 4. Soldering process of the brass bar: (a) Apply flux, (b) Preparation of the solder and the heated soldering head, (c) Tap the soldering head on the soldering area, (d) Complete soldered area, (e) Extended soldering area, (f) Continue to solder on other area of brass bar and (g) The finished soldered brass bar.

(a) Scrape on the soldered surface (b) After scrape

Fig. 5. The scrap removal process: (a) Scrape on the soldered surface, (b) After scrape

Fig. 6. The arch shape bending of the needle bar after soldering process

In order to modify the needle bar, the needle bar maker uses hitting technique. The needle bar was hit for several cycles with different hitting positions and frequency as shown in Fig. 7. The hitting positions start from the center of the needle bar from the first hitting cycle and gradually expand until covering the overall length of the needle bar.

3 Results and Discussion

3.1 Effect of Hitting Process on Gap Length Between Pins

In order to evaluate the effect of hitting process on the straightening of needle bar, the gap lengths between both pin's base and pin's tip are measured. The gap distance between base of needle pin and between tip of needle pin are plotted in Figs. 8 and 9, respectively. It can be seen that the gap distance between both base and tip of the needle pin gradually decrease with the increasing of hitting cycle especially at the hit positions. The effect of hitting process on the decreasing of the gap distance is more pronounce for the pin's tip than the pin's base. The average gap distance between the pin's tip decrease from 2.749 mm before hitting to 2.693 mm after the sixth hitting cycle. This indicates the hitting process straightened the needle bar.

The needle bar was placed on the flat table in order to measure the curvature of the needle bar. The curvature is determined by the gap length between the surfaces of the table to the surface of needle bar (h) as illustrated in Fig. 10. The higher gap length refers to the higher curvature of the needle bar.

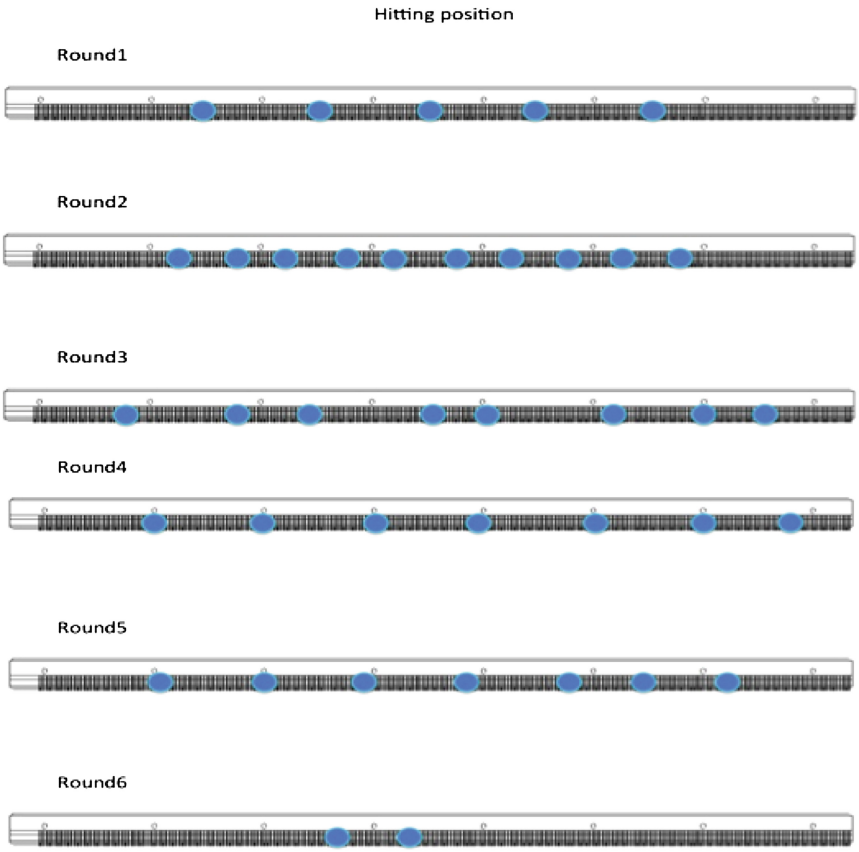

Fig. 7. The hitting process of the needle bar

The comparison of the gap distance under the needle bar between prior and after hitting process is shown in Fig. 11. The curvature of the needle bar after soldering process show highest value (~0.6 mm) at the center of needle bar due to the effect from the heat transfer during soldering process. By the application of hitting process, the curvature decreases by 30 percentage and shows highest value at 0.4 mm.

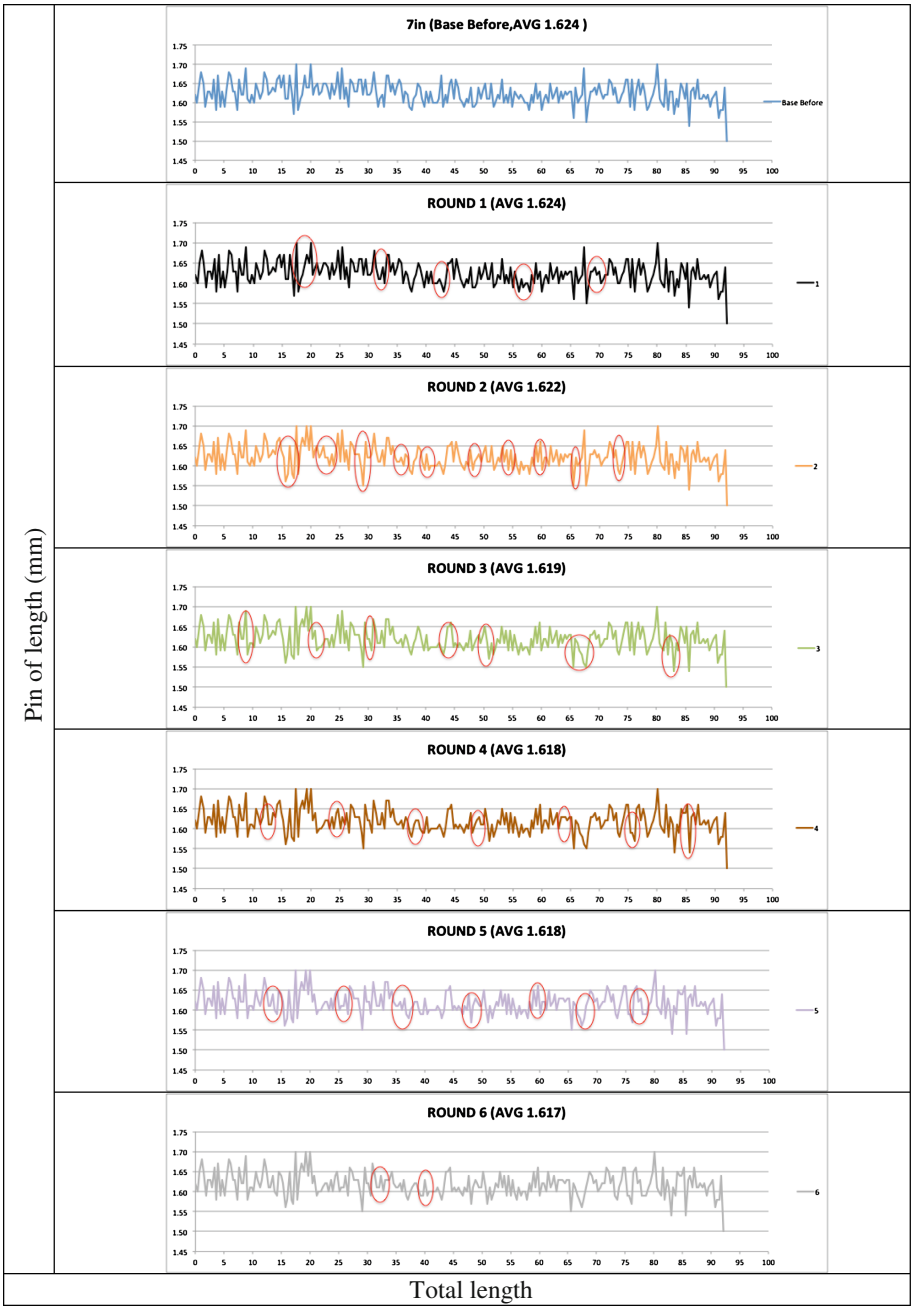

Fig. 8. The gap distance between the base of needle pin at different hitting cycle (The red eliptical shows the position of hitting in each cycle) (Color figure online).

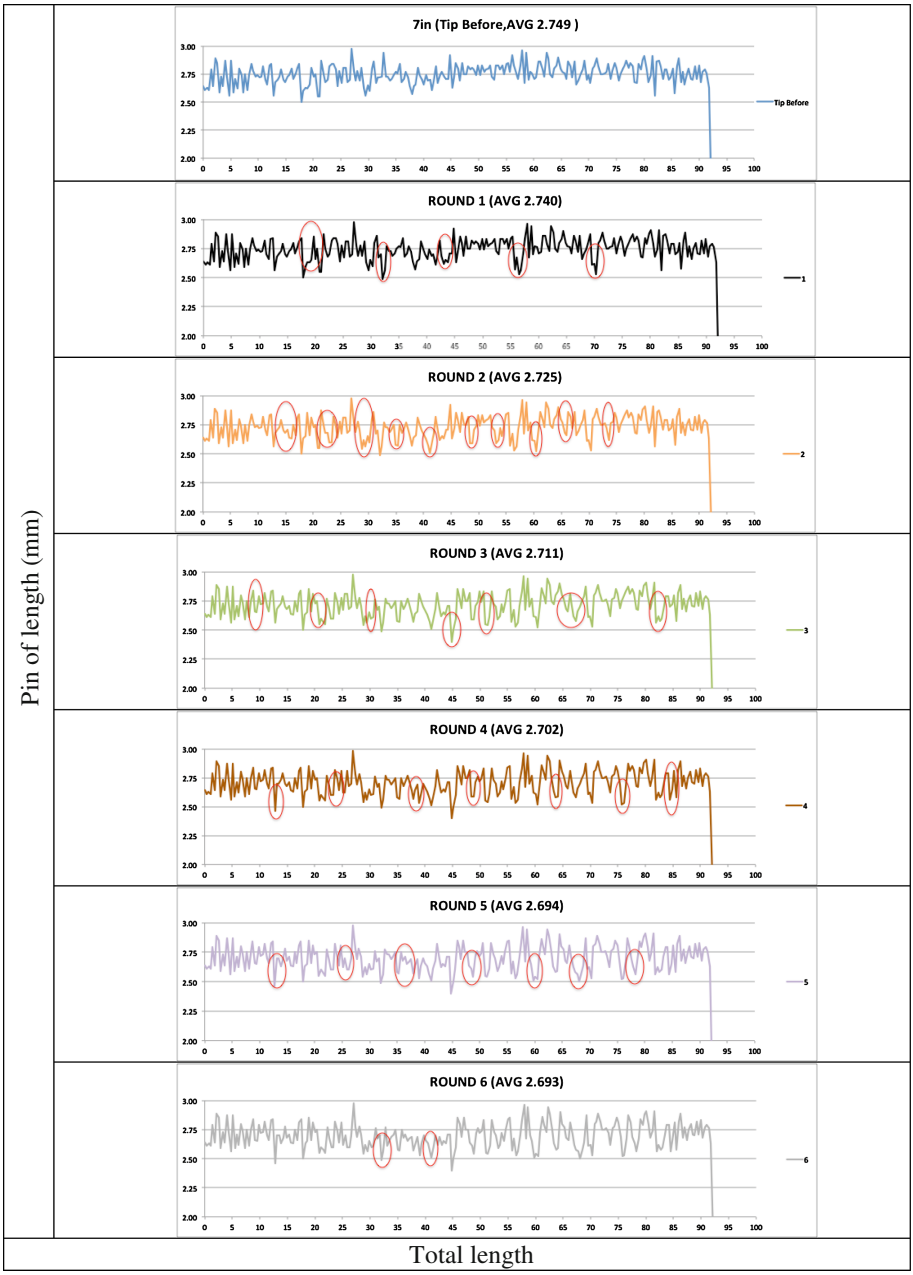

Fig. 9. The gap distance between the tip of needle pin at different hitting cycle (The red eliptical shows the position of hitting in each cycle) (Color figure online).

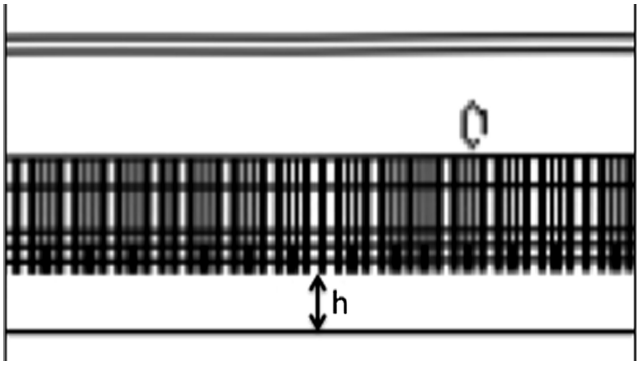

Fig. 10. The measurement of curvature of needle bar

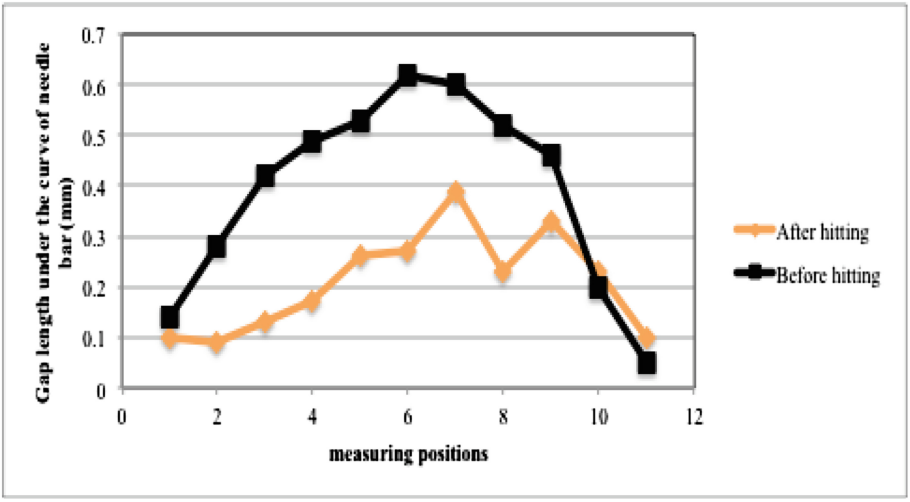

Fig. 11. The gap length under the curve of needle bar before and after hitting process

4 Conclusion

The preparation of the needle bar, which is an important part of the linking machine, was studied. The soldering process was used to joint the needle pins with the brass bar. Heat transfer while soldering has an extensive effect onto the brass bar to bend in an arch shape. Moreover, it has caused the alignment of the pins to shift. The needle bar is not productive if the pins are not aligning in straight line. Thus, the needle bar maker applies hitting technique to modify the shape. The hitting position was significantly based on the experience of the bar maker which was started from the middle area of the needle bar. The hitting process gradually straightened the needle bar as the hitting cycle increased. In addition, the gap between the pins' tip decreased and resulted in more straight alignment.

References

1. Humpston, G., Jacobson, D.M. (eds.): Principles of Soldering. ASM international, Materials Park (2004)
2. Huling, J.S., Clark, R.E.: Comparative distortion in three-unit fixed prostheses joined by laser welding, conventional soldering, or casting in one piece. J. Dent. Res. **56**(2), 128–134 (1977)
3. Tomlinson, W.J., Collier, I.: The mechanical properties and microstructures of copper and brass joints soldered with eutectic tin-bismuth solder. J. Mater. Sci. **22**(5), 1835–1839 (1987)