Original Research Paper

Volume : 5 | Issue : 7 | July 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48

Skip Stitch Defect Monitoring in Lock Stitch Sewing

Textiles

KEYWORDS : Skip stitch, Sensors, Shuttle, Bobbin case

Dr. D. Samuel Wesley	Associate Professor, Department of Fashion Technology (Apparel Production) National Institute of Fashion Technology, Rajiv Gandhi Salai, Taramani, Chennai-600113, India
Swathi Ramalingam	Graphic Designer, 73, Palkalai Nagar, Palavakkam, Chennai 600041
Kiran Vijay	Senior Retail Planner, Iconic International, Landmark Group , Dubai
S. Gunaseelan Daniel	Upper Division Clerk, Employees State Insurance Corporations, Chennai

ABSTRACT

A skip stitch in lock stitch sewing is formed when the needle thread does not pass over the bobbin case due to machine part misalignment, machine vibration etc. A sensor is developed to detect that needle thread passage. If the thread doesn't pass over the bobbin case then it is detected and counted as a skip stitch. A LED (Light Emitting Diode) is placed in the drilled hole through the center of machine bottom shaft that holds and rotates the shuttle and bobbin case. A LDR (Light Dependent Resistor) is placed opposite to the shuttle. The pulse of the thread passage is thus read. The developed device has shown 100 % efficiency in detecting skip stitch in shop floor sewing conditions.

Introduction

The first step in producing a stitch on a sewing machine is the formation of the needle thread loop. This step is the same regardless of the type of stitch being produced, or the nature of the machine being used. Failure to generate a good loop will cause many different problems such as skipping, breaking thread, loose stitches, thread bunching up etc. Proper formation of this loop depends on the tendency of the thread to bulge away from the needle as it is drawn upward after reaching the bottom dead point (BDP) of its stroke - due to inertia and friction against the material through which it passes. Either no loop is formed at all, or the loop is formed too late will result in skipped or broken stitches. During the lock stitch formation the top (needle) thread as a loop has to go completely around the bobbin case, in a smooth motion every time to make a proper stitch.

Skip stitch

It is the inconsistent stitch length, possibly appearing as double the normal stitch length caused by the stitch forming device in the lock stitch sewing machine missing the thread loop during stitch formation. On chain stitch machines, this will allow the stitch to unravel causing instant seam failure.

Error proofing is a manufacturing technique of preventing errors by designing the manufacturing process, equipment, and tools so that an operation literally cannot be performed incorrectly (CAD&CAM, CNC sewing machine for on-line monitoring of seam quality) [1]. The root cause of the problem has to be identified and then eliminated, therefore in the formation of the skip stitch the root cause of the problem lies in formation of needle thread loop. So the device is designed to sense the formation of loop.

Existing mechanisms to detect skipped stitches

A skipped stitch detection system [3] for a sewing machine is provided with a strain gage mounted on the slack thread regulator. The strain gage is connected in a Wheatstone bridge configuration. An amplified output from the Wheatstone bridge and timing signals from the sewing machine are provided to a microprocessor which analyzes the thread tension profile to detect the occurrence of a skipped stitch. Another method [4] is an apparatus for detecting an improper stitch for a Class 400 chain stitch sewing machine. Generally that type of sewing machine includes an axially reciprocal needle adapted to incorporate one or more needle threads into a succession of Class 400 chain stitches and includes a reciprocal looper adapted for incorporating a looper thread into the chain stitches. To detect improper stitches, a monitor assembly determines the consumption per stitch of the looper thread during the formation of the chain stitches. A processor identifies times when the monitored looper thread consumption per stitch is below a predetermined threshold value. Since the consumption per stitch for looper thread is nominally a predetermined multiple of the stitch length, those identified times correspond to times when improper stitches have occurred. In one form of the invention, the looper thread monitor assembly includes an encoding wheel arranged so that the looper thread is disposed about and frictionally coupled to a portion of the periphery of the encoding wheel between the source of the looper thread and the looper. This encoding wheel provides a looper thread signal representative of the angular position of the encoding wheel where thread consumption corresponds to a change in angular position of the encoding wheel. The monitor assembly further detects the completion of individual stitches.

The sensor outputs one stitch-completed signal every rotation of the sewing machine shaft. The processor, responsive to the looper thread signal and the stitch signal, determines if a stitch is proper or improper by comparing looper thread consumption per stitch with a predetermined threshold value. Both the earlier skip stitch devices are detecting skip stitch in an indirect manner but the skip stitch detecting system detailed here detects the skip stitch in a direct manner, i.e. by directly checking the presence of the needle thread over the bobbin case. Thus it is more positive and the accuracy is much higher than the previous ones.

Sewing Floor Defects Analysis [5]

To ascertain the frequent occurrence of the skip stitch in the sewing production floor a defect analysis is done on 150 garments belonging to five styles in a garment industry

and the result of the same is shown in the Fig. 1. Out of 20 odd defects noticed, skip stitch tops the list with about 11%.

The result of sewing defect analysis confirms the need for a device to stop/reduce skip stitch formation, thus to achieve defect free production, because under high speed sewing conditions, the machine operator typically will be entirely unaware that a stitch has been skipped, and the skip is not readily evident in the fabric itself, except by a painstaking stitch-by-stitch inspection, which of course is highly impractical.

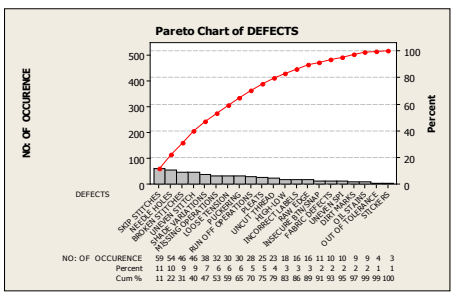


Fig. 1 Result of sewing defects analysis

stitch detection device [5]

In the developed skip stitch detection device (Fig. 2), loop formation is identified by using the through beam method using optical sensor. A proximity sensor is attached to the hand wheel of the sewing machine to read the rotation. System requirements and components of the skip stitch detecting system is given below.

- LDR (Light Dependent Resistor)
- Power led
- Batteries
- Micro switch
- RMC connector
- Proximity sensor
- Microprocessor Setup
- Buzzer
- LED (Light Emitting Diode)

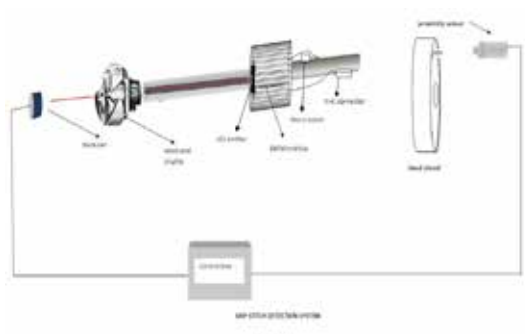


Fig. 2 Sensor arrangement

Sensors

The formation of loop can be found by various sensors:

1. Proximity sensors
2. Reflective photo sensor
3. Through-beam sensors

The proximity sensor cannot be used because it becomes insensitive when the material moves at a very high speed similar to this case, where the thread

moves at very high speed. Reflective photo sensors are capable of sensing the thread, but the drawback is the photo sensors which can produce sharp beam costs very high. The through beam sensors can sense the thread even at a high speed and it costs relatively less compared to the photo reflective sensors. Power LED acts as emitter and it is connected to the rechargeable battery of 3.6 volts. Battery is connected to the micro switch and the battery can be charged using a RMC connector. The LDR sensor is placed as the receiver. A photo resistor or light dependent resistor or cadmium sulfide (CdS) cell is a resistor whose resistance decreases with increasing incident light intensity. It can also be referenced as a photoconductor. LDR generates the pulse when the thread passes over the surface of bobbin case. A proximity sensor is connected to the hand wheel which gives a signal for every rotation of the hand wheel. The pulse generated from the LDR and the proximity sensor is sent to the Microcontroller. The microcontroller program process both signals such that, in between two pulses from the hand wheel it should receive one pulse from the LDR, if it is missing it will be considered that a skip stich formed and the buzzer will be activated.

Modifications in the machinery setup

To fit the sensor and the power source in the machine the following modifications are need to be done the single needle lock stitch sewing machine. This set up is fitted on Juki single needle lock stitch sewing machine model 5550N-7. The bobbin shaft of the machine is removed and cut into two parts one measures 8.4 cm and another measures 15.5 cm. A cylinder is made of 30mm in length and 30mm width which are cut into two halves. A projection is made on the both the sides, to fit the cylinder to the shaft. Annealing is done to the shuttle shaft of length 84mm and hole is drilled into it. Annealing is done because the shaft rod is made of super steel. The centre cylindrical structure in the hook and shuttle case is made hollow using the spark technique.

Working of the device

The power LED acts as an emitter is placed inside the cylinder and connected to the battery setup and battery is connected to the micro-switch and the input RHC connector. This setup is connected to the main shaft and placed in the machine. The LDR is positioned opposite to the hook and shuttle (Fig. 3 Left). The LDR is connected to circuit board which amplifies the signal generated to the pulse and send to the micro-controller in the main board. The metal object is attached to the hand wheel in such a manner it comes close to the proximity sensor when the needle is at its top dead point (TDP). So that for every rotation of hand wheel the proximity sensor sends a signal to microcontroller (Fig. 3 Right). Each stitch forms in between the two signals from the proximity sensor.

The micro controller is programmed as that in between two signals it receive from the proximity sensor, a pulse generated by LDR due to the crossing of needle thread over bobbin case must be received. If this happens then the stitch is formed, otherwise it is a skip stitch. In the circuit a buzzer is attached so that it goes off whenever the system senses a skip stitch so that the operator shall stop the machine immediately and take corrective action to avoid the recurrence of skip stitch.

Volume : 5 | Issue : 7 | July 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48



Fig. 3- (Left) Position of LDR-Opposite to LED beam, (Right) Position of proximity sensor

System validation

This skip stitch detection device fitted sewing machine is used for normal production process for 100 sewing hours in a garment industry. The device detected all the 39 skip stitches and a few needle thread breakages occurred during that period (the machine was not adjusted during these 100 hours). This validates that this skip stitch detection setup is 100% efficient in detecting and alarming the operator about the occurrence of skip stitch, thus improvement in sewing quality.

Conclusion

The skip stitch detection/monitoring device if fitted in a single needle lock stitch sewing machine will detect the skip stitch by direct means so it will be a useful tool in achieving defect free sewing.

References

1. System proof in garment industry, Serbian Journal of Management, 2 (1) (2007), pp 77-85
2. www.poka-yoke.org.uk
3. Automatic Detection of a Skipped Stitch, United States Patent 4170951
4. Method and Apparatus for Detecting Improper Stitches for a Chain stitch Sewing Machine, US Patent 4991528
5. Samuel Wesley D, Gunaseelan Daniel S., Kiran Vijay and Swathi R., Poke Yoke Device for Skip Stitch Detection in Lock Stitch Sewing (May 2011), Unpublished Graduation Project Report, Faculty of Fashion Technology, NIFT, Chennai