A Laser System for Counting Cloth Filaments

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ABSTRACT

A simple, high speed and high accuracy counter system for cloth filament has been constructed. The principle is based on the laser light attenuation through the cloth. The system is composed of semiconductor laser, objective lens, focusing lens PIN photodiode and processing system including amplifier, ΔV detector, counter, comparator, preset and marker. The counting accuracy is above 99% and the maximum counting speed is beyond 5 kHz, which will be enough for practical use.

1 INTRODUCTION

In the textile industry, the output is usually measured by the length of the produced cloth. This method, however, has an important influence upon the quantity. The measurement of the length naturally has some errors because of a situation of the measurement, i.e. just after a completion of weaving or dyeing and weaving. These errors are large when the measurement is done under varying cloth tension, but the problem will be solved by counting a number of the weave in a given length, that is, the length may be normalized by the woof number. The purpose of this paper is to develop a method and make an experimental basis of a counter system for the cloth woof.

2 METHOD AND SYSTEM

The principle of the method is based on the light attenuation through the cloth woof. In one example, the woof density (woof number/inch) is normally 100–150 and then the diameter d of the woof is about 100 μm,

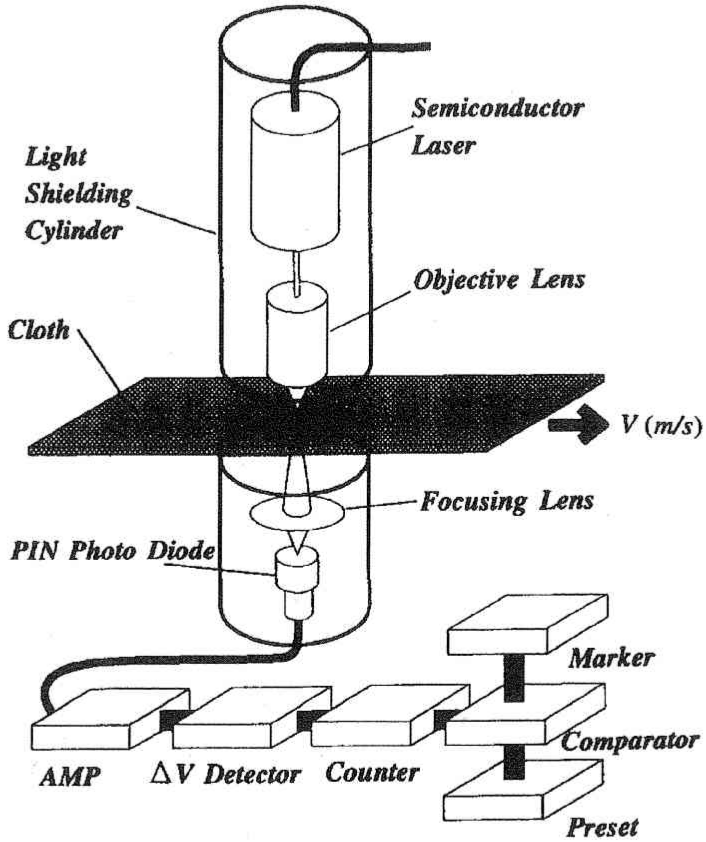

Fig. 1. Principle of the method and whole system.

since a gap between each woof is the same order as the woof diameter. Therefore, the spot diameter d' of the laser light at a focusing point on the cloth has to be at least less than half of the woof diameter, i.e. $d' \leq 50\ \mu m$, to obtain a clear change of the transmitted light intensity when the cloth is scanned.

Figure 1 shows the method and the experimental basis of a counter system. The light from a semiconductor laser is focused on the cloth by objective lens. For an example, if we use an objective lens of focusing length $f = 15$ mm, magnification $10\times$ and working distance $w = 6$ mm, the spot diameter at the focusing point on the cloth is about $d' = 30\ \mu m$. The laser light through the cloth is focused on the PIN photodiode by a focusing lens. All the optical components are arranged in a light shielding cylinder as shown in Fig. 1 to avoid the noise light.

The light signal received on the PIN photodiode (see Fig. 2(a)) is amplified and then is wave-reformed like a bar code (see Fig. 2(b)) by a ΔV detector to clearly count the woof. The number of counted woofs is compared with a preset number and is marked on the cloth. A representative production speed of the cloth is about 0.5 m/s. The maximum frequency of the light signal is, therefore, about 3 kHz, which can easily be detected.

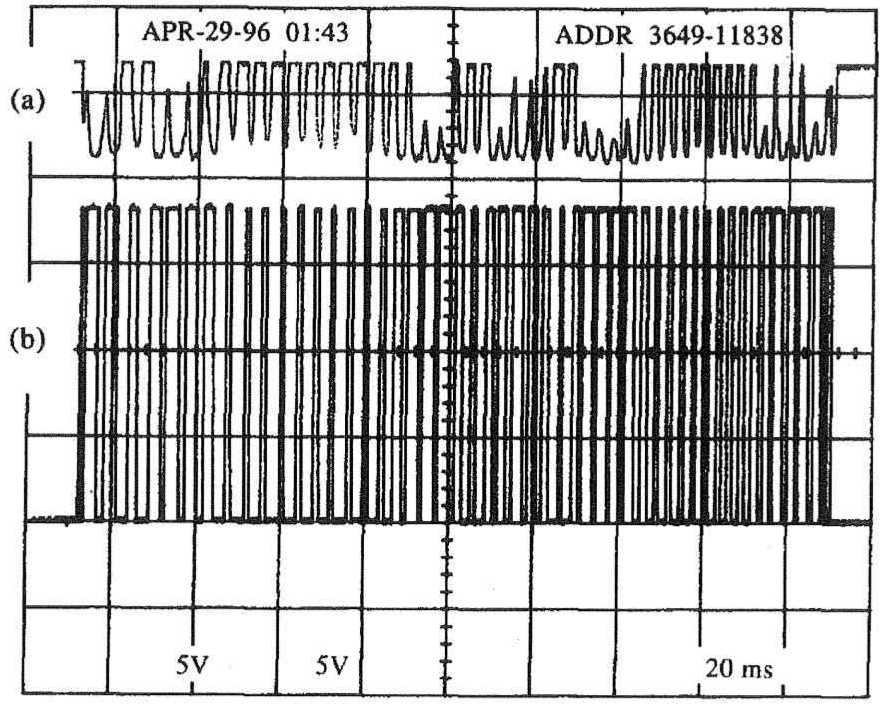

Fig. 2. An example of the received light intensity on the PIN photodiode (a); and bar code like output through the ΔV detector (b).

3 EXPERIMENTAL RESULT

Figure 2 shows an example of the experimental result which was obtained by storage sampling oscilloscope and then recorded. Figure 2(a) shows the received light intensity on the PIN photodiode and Fig. 2(b) the bar code-like signal through the ΔV detector. The total number of the woof is 50, which is just the same number as counted by a microscope.

In Fig. 2(a) a large change of the light intensity, due mainly to the scanning position of laser light on the cloth, is the laser light which is scanned just on both the woof and warp. The maximum intensity is limited to a reasonable value by a chopper circuit in this case, but the light intensity through the ΔV detector can be changed between high (1) and low (0) level just as the bar code reader, as shown in Fig. 2(b).

Figure 3 shows an microscopic view of the cloth used in this experiment. The number of the woofs in an inch is about 100 and the gap between woof is almost same as the woof diameter as shown in this photograph.

4 CONCLUSION

The simple counter system for a cloth filament has been constructed by the use of semiconductor laser, objective lens, focusing lens, PIN photodiode and processing system composed of amplifier, ΔV detector,

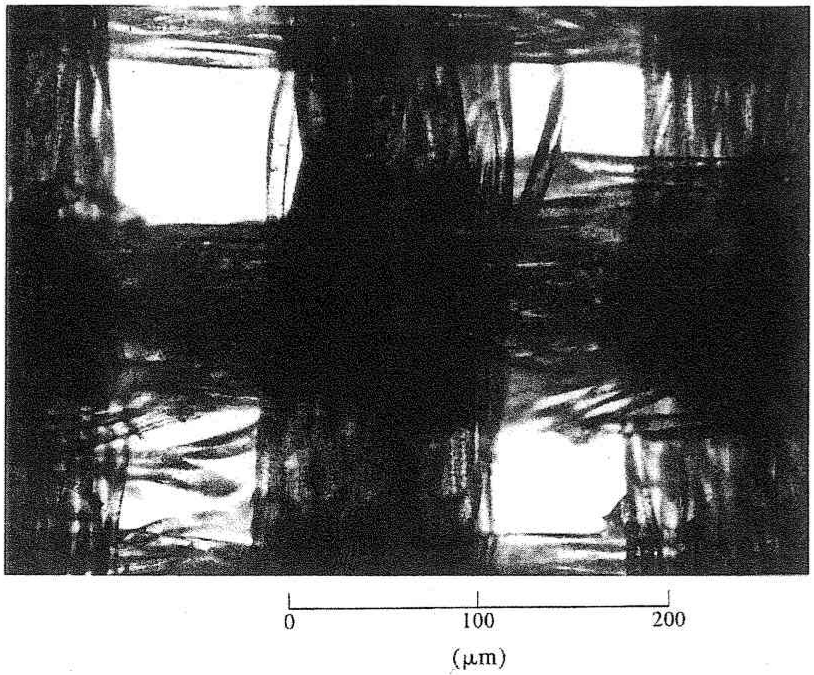

Fig. 3. Microscopic view of the cloth (20 ×).

counter, comparator, preset and marker. The accuracy is above 99% and the counting speed is at least 5 kHz. The performance may be satisfactory for practical use.

ACKNOWLEDGEMENT

Technical support throughout the present study was provided by Mr T. Inaki of Fukui University, Fukui, Japan.