Design and Application of a New Warp Stop Motion by using a Laser Beam.

By: ***Dr. Hashim Ali Salem,***
Ali Mohammed Ali Alkashif and
Mozamil Khider Osman.
Sudan University of Science & Technology.
Textile Engineering Department.

Droppers, LDR (light depending resistance),
ohm, breakage, relay, laser beam.

Abstract

This new method of warp stop motion using a laser beam is a genuine work designed, constructed and applied by the researchers of this research. It is based on the phenomenon shown by the light dependant resistance (LDR). The LDR acquires very low resistance when the light falls on it and very high resistance in the absence of the light.

An electronic circuit is used with two resistances one of them is the LDR. When there is no yarn breakage, the light falls on the LDR, so its resistance becomes very low and the current in the circuit passes through the LDR and back to the source. In the case of yarn breakage the dropper falls crossing the laser beam preventing it from reaching the LDR, so its resistance remains very high which makes the current to pass through the other resistance, to the transistor and then to the relay connected to the loom stopping mechanism.

10 droppers were dropped by hand, one at a time, as if caused by the yarn breakage and the result was that the loom stopped at the same moment of the dropper crossing the laser beam.

ملخص:

تم بواسطة الباحثين لهذا البحث تصميم وتركيب وتنفيذ طريقة اصيلة جديدة لايقاف حركة النول عند انقطاع أحد خيوط السدا باستعمال شعاع الليزر. وتعتمد هذه الطريقة على خاصية المقاومة التي تتغير قيمتها بسقوط ضوء عليها (LDR) فتكون عالية في حالة عدم سقوط ضوء ومنخفضة في حالة سقوط ضوء عليها .أستخدمت هذه الخاصية لتغيير مسار تياركهربي في دائرة كهربية تشمل مقاومتين احداهما الـــ(LDR). يمر التيار خلالها عائدا الى المصدر في حالة سقوط ضوء الليزرعليها ويكون ذلك في حالة عدم وجود خيط مقطوع ,اما في حالة انقطاع أحد الخيوط تسقط الحساسة المعلقة عليه فتعترض شعاع الليزر فلا يصل الى الـــ(LDR) مما يعني وجود مقاومة عالية تجعل التيار يغير مساره الى المقاومة المنخفضة ومنها الى ترانسستور ثم ريلاي موصلة بجهاز ايقاف النول, تم اسقاط 10 حساسات يدويا كل على حده كما يحدث ذلك بسبب انقطاع الخيط .وكانت النتيجة توقف النول في نفس اللحظة التي اعترضت فيها الحساسة شعاع الليزر.

1. Introduction

1.1. General:

Since early times man has tried hard to improve the style of life he is leading by using different methods and tools and making use of the most recent innovations. At present and with the great development in science and technology, a great advancement has taken place in all aspects of life, especially in industry. The textile industry, as one of the most ancient industries, practiced by man is a good example of this advancement, e.g. the time (hours) needed to produce 100 m of fabric was reduced from 20 to 0.3 hours during the last 125 years[1].

1.2. The loom:

Fabrics are produced by looms which consist of a number of mechanisms having different roles and motions, but work synchronously to give ultimately the required product . They also include other devices and control systems of which the warp stop motion system is of concern to us in this study.

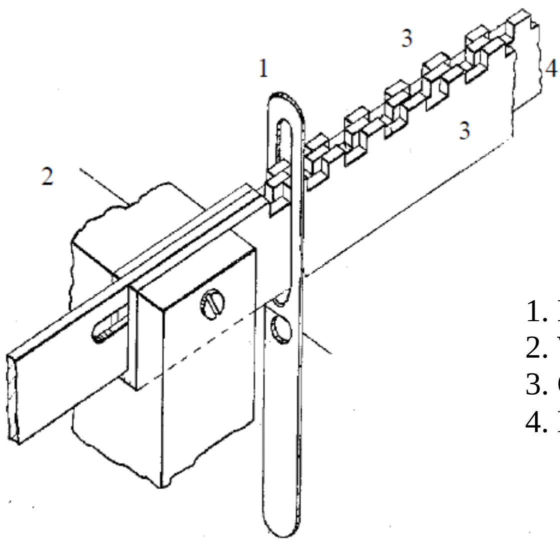
1.3. Warp stop motion systems (mechanisms):

These are the mechanisms that stop the loom when a warp yarn breaks (ruptures), which has to be remedied immediately by the loom attendant, otherwise The loom remains idle and a bad quality product may result.

The currently used warp stop motions are either mechanical or electrical devices. In this research a new warp stop motion is designed, constructed and applied by the researchers of this research by using a laser beam.

1.3.1.Mechanical warp stop motion[2] :

There are a number of different makes of this type of warp stop motion, of which the most widely used is as shown schematically in fig 1.1 below.



1. Dropper.
2. Warp thread.
3. Outer fixed toothed bars.
4. Middle reciprocating toothed bar

Fig 1.1 parts of the mechnical warp stop motion

When the dropper (1) freely falls between two teeth due to warp yarn (2) breakage, it stops the reciprocation of the middle bar (4) which is connected to the stopping mechanism of the loom. It is important that the middle bar is adjusted in such a way to prevent the dropper falling on the top of a tooth, a situation which has no effect in triggering the action of the loom stopping mechanism.

1.3.2. Electrical warp stop motion[3] :

The work of the electrical warp stop motion is based on the fact that when the yarn holding the dropper breaks, it falls freely on two bars separated by an insulator, one of them is electrically active, thus connecting them and closing the electrical circuit of the loom stopping mechanism. Two such mechanisms are used in practice, one with a frictional clutch and the other with an electromagnetic clutch.

2. Materials and methods:

2.1. The new method of warp stop motion using a laser beam:

Similar to the former methods of warp stop motion, this method also uses the dropper to cross a laser beam preventing it reaching the receiver LDR (Light Depending Resistance). When light falls on the LDR, its resistance falls to almost zero, but when no light reaches it, its resistance remains very high. This phenomenon is used in an electronic circuit to cause the required stopping effect.

2.1.1. Materials:

The loom *LOEPF SW10* present in *Dr*. *Khalil Osman's* hall for weaving, in the northern campus of *SUST* – Khartoum North was used in these experiments. Since the loom was working commercially and for technical reasons, it was operated with disabled electrical warp stop motion. A metallic bar accross the width of the loom, perpendicular to the warp yarns was fixed. 10 droppers were used hanging a bit over the metallic bar on a small piece of paper. These were dropped manually by pulling the piece of paper resembling a warp yarn breakage. A light source was used, consisting of a laser source known as pointer and a 4.5 dry battery. The pointer (light source) was chosen because of two reasons:

i. The light should be non-scattering and in the form of bundle of parallel rays of uniform diameter less than the width of the dropper and this is given by the pointer.
ii. The pointer is the most abundantly available in the market and perhaps the cheapest.

The electronic circuit, known as LDR circuit, which triggers the action of the loom stopping mechanism, has the following components:

a. Power source in the form of 9V dry battery.
b. Two resistances (a) 10 K ohm (b) 1 K ohm.
c. Transistor.
d. LDR (fixed to the right side of the loom).
e. Relay (connected also to the loom stopping mechanism).

The above components are connected as shown in fig (2.1) and picture (2.1)

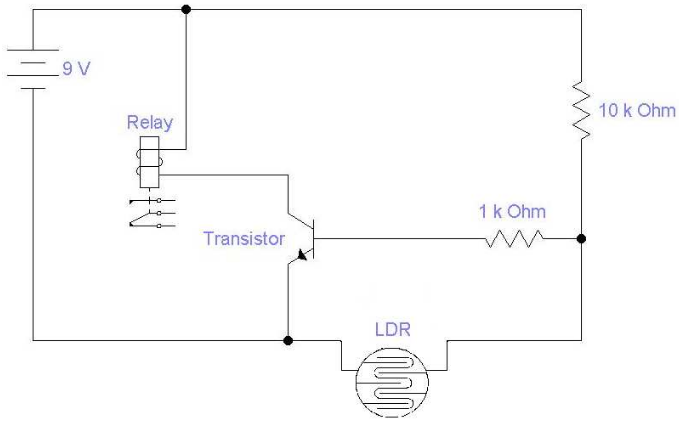
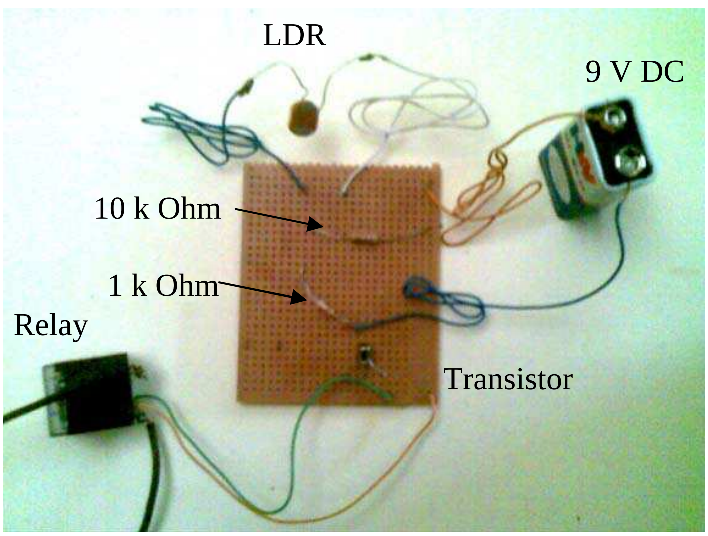


Fig 2.1: Connection of the electronic circuit components



Picture 2.1: the electronic circuit connection

The components used in the experiment were connected to the loom as follows:

1) The metallic bar was fixed accross the width of the loom perpendicular to the warp yarns with the 10 droppers hanging from it – a bit raised from the bar by a piece of paper, shown in the picture (2.2).

Picture (2.2): the middle bar accross the width of the loom

2) The light source was fixed to the left side of the loom as shown in picture (2.3) while the LDR was fixed to the right side of the loom as shown in picture (2.4).

Picture (2.3): fixation of the light source.

Picture (2.4): fixation of the LDR.

It is very important to make sure that the laser beam passes at a reasonable fixed distance below the lower tip of the droppers, so that it is not affected by their side movement. A general view of this arrangement is shown in fig (2.2).

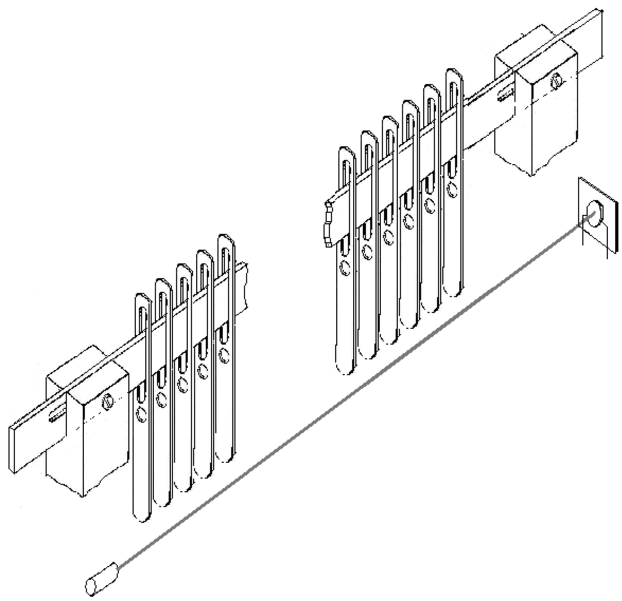


Fig (2.2): arrangement of fixing the source of the laser beam

However, due to the high level of vibrations of the loom causing unsteady fall of the light on the LDR, it was necessary to fix the light source rigidly to the ground using a separate metallic frame.

3) The relay was connected to the circuit of the loom stopping mechanism.

2.1.2. Methodology:

The theory behind this method of wrap stop motion using a laser beam is described below (see fig (2.1) the electronic circuit).

When the loom is normally working and no yarn breakage occurs the light reaches the LDR. Hence its resistance is lower than 1 K ohm the current passes through it and then back to the power source closing the circuit. But when the light does not reach the LDR, due to yarn breakage and fall of the dropper, the resistance of the LDR remains very high and greater than 1 K ohm.

As a result of this the current from the power source passes through the 1 K ohm resistance and then through the transistor to the relay.

The relay closes the circuit of the loom stopping mechanism, which is then actuated to stop the loom.

Since the loom used in this experiment was working on commercial basis, intentional yarn breakage was not allowed and this has to be substituted by some means closely resembling the actual situation. This was done by hanging 10 droppers over the metallic bar fixed accross the loom, by means of a small piece of paper. By pulling the piece of paper, the dropper fell to rest on the metallic bar, thus cutting the flow of the laser beam to the LDR, as shown in fig (2.3).

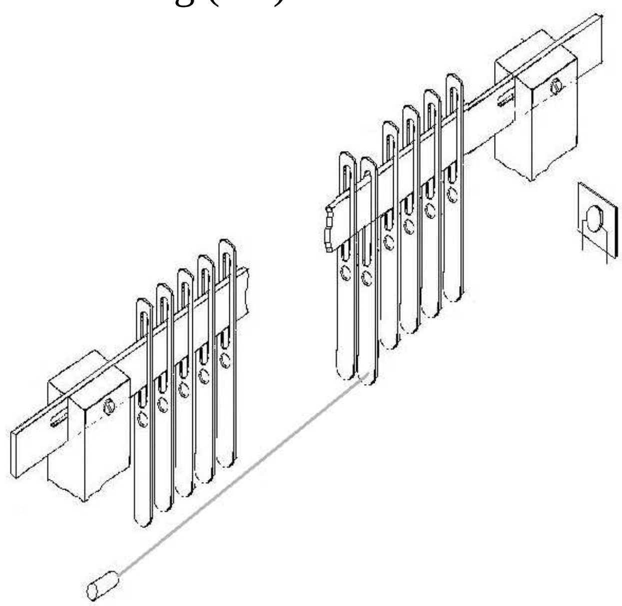


Fig (2.3): the falling of the dropper cutting the flow of the laser beam.

2. Results and discussion

The experiment was repeated using the 10 droppers one at a time and in all the 10 trials the loom stopped almost at the same instant the dropper crossed the laser beam.

The results obtained applying this new method of warp stop motion and under the conditions of the experiment using the materials mentioned earlier, seem very successful and encouraging. However certain observations have to be made:

1) Vibrations in the loom affect adversely the performance of the device, since it causes unsteady fall of laser beam on the receiver. These vibrations were inevitable in our case, because the loom used was not rigidly fixed to the ground. This was remedied by fixing the laser source rigidly to the ground separated from the loom by means of a metallic frame. The situation may be different with looms having low vibrations, so further investigation is required in this respect. However using a laser source separate from the loom may be a priviledge and a positive sign added to this method which may lead to further development in this field.

2) The power sources used in this experiment were dry batteries. These usually have short lives and their use in commercial production is not practicable, since they have to be frequently changed, which means increased downtime and so less production. Using AC to DC converters and lowering the voltage to the required levels represent a sound solution to this problem.

A general comparison of the wrap stop motion methods mentioned earlier is given below to show their shortcomings and at the same time to show how our new technique got rid of these disadvantages.

a. The mechanical warp stop motion is the oldest method used and it is becoming undesirable by the users for a number of reasons:

   i. It needs a relatively longer time from the moment of yarn breakage to the resumption of loom re-start. Sometimes the worker has to turn back the lower shaft of the loom a complete turn before fixing the broken yarn. In case of the dropper falling and resting on top of a tooth, the loom needs another turn to allow the dropper fall between the two teeth. As well the loom needs two turns before it stops.

ii. It is composed of various components which need regular cleaning, greasing and maintenance in addition to spare parts.

iii. The droppers are subject to high shear stress when they fall between the teeth and so a special material for their manufacture is needed. In addition they have to be changed frequently.

iv. Higher power of the loom motor is needed to cater for the additional movement of the mechanical components of the warp stop motion.

b. The electrical warp stop motion is generally preferred to the mechanical one since it gives almost immediate stop of the loom, when the dropper makes thorough contact between the two isolated bars.

The main drawback of this method is the hazard of fire outbreak which may be caused by the spark generated by the dropper fall on the active bar having (12 – 24) volts especially in the presence of the fly fibres in the production hall.

In addition there is the probability that the dropper, falling on the two bars, does not make a perfect contact between them and so the electric circuit will not be closed, i.e. the loom will not stop, although there is a yarn breakage.

The electrical warp stop motion devices having no mechanical components, are preferred at present, provided that spark generation is avoided and this may be realized by:

1. Lowering the voltage of the active bar.
2. Increasing the relative humidity in the production hall.
3. Using slow igniting yarn.

3. Conclusion

The new method designed, constructed and applied by the researchers of this research is very successful under the conditions stated earlier. But further work is needed in different areas to verify and confirm its success in commercial production. These areas include the following:

a. The use of AC to DC converters and lowering the voltage to suit the levels required by the LDR circuit and laser source.
b. Investigation of the maximum level of vibrations in looms, below which the laser source connected to the loom gives reliable results.
c. Testing the performance of the new method in a loom with full number of droppers instead of 10, in different rows, with a separate laser source and receiver to each row.
d. Testing the use of droppers made of materials not necessarily good conductor of electricity or having high shear stress, e.g. plastics.
e. Comparing the economics of all methods, bearing in mind the absence of fire hazards in the new method.
f. Provided that the investigations in the above areas show positive results in favour of the new method, it will be appropriate to consider its application in conjunction with central computerization of the whole process, programmed to locate exactly the loom with the yarn breakage. This will help saving time and reduce the labour force in the production hall.

References:

1. A. Ormerod, Modern preparation and weaving machinery, woodhead publishing L.T.D, Cambridge England (1995), p. 145.
2. USA Patent Office, Patent No. 1786686, 30 Dec 1930.
3. USA Patent Office, Patent No. 1832580, 17 Nov 1931.