COIL GUN WEAVING

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Abstract: *Weaving is a textile manufacturing process in which weft yarns are inserted by machines through a gap in the warp yarns called a shed to form a woven fabric through interlacing. The filling insertion systems that are currently being used in the market have reached their maximum potential in terms of speed and production rate. There are also limitations that the current methods face such as a finite maximum width of woven fabric that can be produced which is caused by a limitation in machine width. Current weaving machines also produce too much noise pollution which may cause damage to the operator's ears. These set maximums and limitations have led us to seek an alternative method to insert weft yarns into fabrics.*

In this study, electromagnetic force is being used as an alternative method for inserting weft yarn. In order to accomplish this, an electromagnetic launcher called a coil gun is used to launch a ferromagnetic projectile which would carry the weft yarn through the shed of the warp yarns in order to achieve the interlacing necessary to form a woven fabric. It is expected that this new method of weft insertion would reduce the energy costs that are associated with other weaving machines. The proposed design would be able to insert yarns at a higher rate than any of the current systems available in the market. The new system would eliminate the limits imposed on current machines due to a maximum effective machine width being reached. The proposed design would also eliminate the noise pollution associated with current machines due to the fact that the electromagnetic launching system makes very little noise when it is fired.

1. Introduction

In the past several years, the textile industry had seen much development, especially in weaving machines there are many modifications came for inserting weft yarn for weaving like projectile, rapier, air-jet, and water-jet. They are also having limitation either less speed or less width of weaving fabric Current weaving machines also have high energy requirements to perform their tasks especially air-jet weaving, which is the most commonly used method in the industry.. The current weaving machines are hazardous to their operators though not to the degree that shuttle machines once were. The hazards in current weaving machinery stem from the amount of noise pollution that they are capable of producing. This noise pollution causes pre-mature hearing loss in the operators that are exposed to it constantly.

This combination of economic factors and limitations has led us to propose a new type of filling insertion system. This new type of filling insertion system is based on the traditional projectile weaving machines, except that the projectile is launched by electromagnetic force. This new machine would offer several notable advantages over conventional weaving machines. One of the advantages that this machine offers would be an increase in insertion speed. This would greatly increase the production rate of woven materials. This machine would also eliminate the limits imposed on fabric width by machine width due to the fact that this launching system can be used to effectively insert filling yarns at any practical width. Another advantage of this new machine is that it would have less energy requirements than the current most common weaving machine, air-jet. This would make producing woven products cheaper. Another beneficial characteristic of this machine is that the launching of the projectile by electromagnetic force is extremely quiet to the point of producing almost no noise at all. This minimizes the hearing risk that the machine operators are placed under while working, which is premature hearing loss. This combination of characteristics would make this machine highly desirable in the manufacturing world.

2. Rail gun

A rail gun is an electrically powered Electromagnetic projectile launcher, based on similar principles to the homo polar motor. A rail gun comprises a pair of parallel conducting rails, along which a sliding armature is accelerated by the electromagnetic effects of a current that flows down one rail, into the armature and then back along the other rail.

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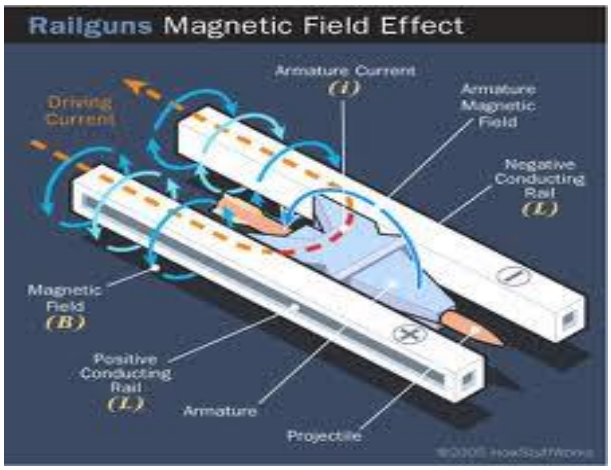

Figure 1: schematic representation of working of rail gun

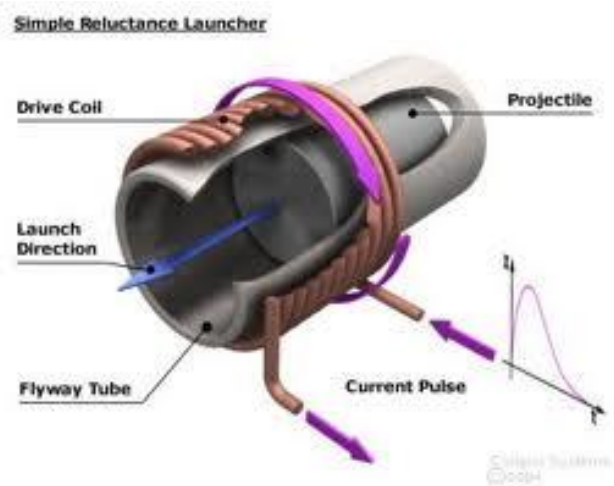

Figure 2: Electromagnetic Launcher Outline

Rail gun requires more amount of electricity and hence the projectile moves with high velocity (equal speed of bullet sparked from bullet).
To reduce the high velocity and to improve the voltage (to 230 V).we discovered a new idea called electromagnetic launcher.

2.1 Lorentz force

When a ferromagnetic material (copper or aluminum) is powered by emf (electromagnetic field) it gets accelerated (either pushed or pulled) called LORENTZ FORCE.

3. Electromagnetic launcher

Electromagnetic launcher is a simpler design than a rail gun. In this type of launcher, a ferromagnetic projectile is accelerated down a tube that is the barrel of the gun. In order to achieve acceleration, the tube is encased in multiple coils of a magnetic material that creates a solenoid similar to what is used in a rail gun. The coils are used to create a magnetic attraction between the projectile and the coil which propels the projectile at a rapidly increasing speed. This launching mechanism makes a perfect example of a solenoid that does not have any limits

placed upon it. This type of electromagnetic launcher is incredibly powerful despite having a simple design that features no moving parts. This design also allows for repeated usage due to the fact that there are no parts that can wear out making the launcher incredibly durable. Projectiles fired from this launcher produce no extra effects such as fire, flash, or sound which makes this type of launcher incredibly quiet.

3.1 Construction and working of electromagnetic launcher

An electromagnetic launcher is a type of mechanism in which the setup consists of an insulating tube it is winded with required amount of copper coil which is the working part of the electromagnetic launcher. A ferromagnetic substance such as iron is placed inside the tube. The two ends of the copper coil are connected to the positive & negative terminals of a DC supply through capacitors and resistors they are used to control the charge flow through the coil. A switch is also used for charging and discharging of the capacitor. When the switch is turned ON the charge is passed through the copper coil. The charge flow in the coil produces a magnetic field around the coil, which in turns produces a magnetic field inside the tube. The magnetic field produced inside the tube attracts the ferromagnetic substance which is placed inside the tube and when the switch is turned OFF the charge flow is stopped due to that the capacitor gets discharge and so in the insulating tube therefore the magnetic field inside the tube tends to push the ferromagnetic substance out of the tube.

3.2 Relation between voltage and emf

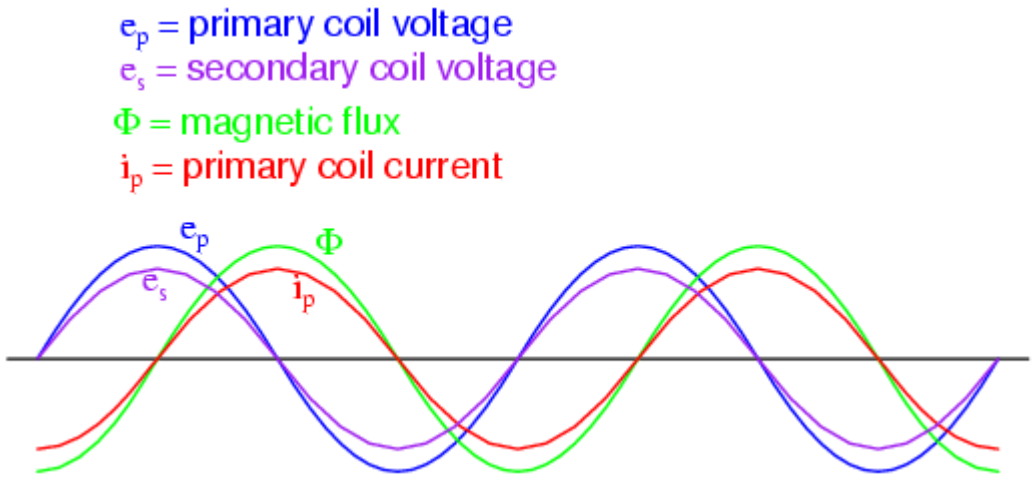

Figure 3: Relation between voltage and emf

This graph shows when voltage is raised emf also get raised,both are directly propotional to each other.we can increase the voltage according to the number of coil windings and the emf required.

3.3 Reason for implementing electromagnetic launcher

In the present power loom that is shuttle loom machines create lots of noise, the noise is mainly created by the picking action in the machine and also the average fabric width produced by the weaving machine is limited. These problems can be eliminated by using the electromagnetic launcher instead of the picking arms. This will also increase the life span of the weaving machine. The Power Consumption is also less compared to modern weaving machines. This is why we are using the electromagnetic launcher as a substitute for picking mechanism in the weaving machine for inserting the weft yarns into the warp yarns.

Figure 4: picking arm to be replaced by electromagnetic launcher

3.4 Replacement of picking arms with electromagnetic launcher

Now we are just going to replace the picking arms in the weaving machine with the above constructed electromagnetic launcher on both the sides of the machine. The two electromagnetic launchers are kept at 180degree to each other in order to maintain the to and fro motion of the shuttle between the two electromagnetic launchers i.e. on the shuttle broad. We made the shuttle board friction less to achieve high speed in the movement of shuttle. Since the power supply for the electromagnetic launcher is a DC source we are providing an "ELIMINATOR" for converting the AC supply into DC supply and we are supplying it to the electromagnetic launcher. The amount of power supply to the electromagnetic launcher is based on the weight of the shuttle and the speed we required; therefore we are reducing the weight of the shuttle by using weightless materials
Then the shuttle is coated with ferromagnetic substance so that the shuttle can be projected using the electromagnetic launcher, since the normal shuttle is made of wood it cannot be attracted by the magnetic field hence it should be coated.

Figure 5: Wooden Shuttle to be coated with ferromagnetic substances

3.5 Working of our project

When everything is in place, the power is switched ON and the charge flows through the coil, which produces a magnetic field inside the tube which attracts the shuttle which is kept inside the tube. The shuttle is coated for this purpose only i.e. if it is not coated with theferromagnetic substance itwould have not been attracted by the magnetic field. After this happens the power is switched ON due to this the magnetic field inside the tube tends to push the shuttle out of the tube with high velocity. The shuttle which is pushed out of the tube from one side of the tube moves on the shuttle board through the gap between the warp yarns carrying the weft yarns and completing the weaving action. When the shuttle reaches the other end I passes inside the other electromagnetic launcher setup simultaneously the same process that happened in the opposite direction happens here also and thus the weaving action takes place into our project without producing any noise. There is another problem that may be faced by this design; the problem is that the alternatively switching switches ON & OFF. This problem can be eliminated by using "MICROCONTROLLER" which can do this operation by coding with suitable programs.

Figure 6: Micro Controller

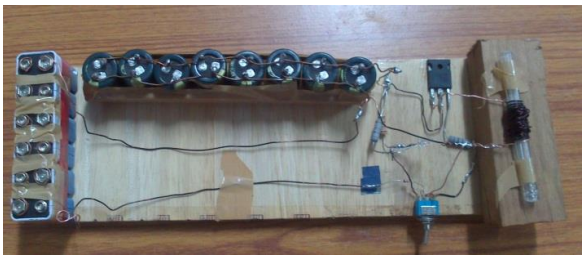

Figure 7: Electromagnetic Launcher

3.6 Advantages

- Reduction in noise to a maximum extent.
- Increase in average fabric width.
- Higher efficiency.

Thus by using the proposed design in the weaving machine there are the above benefits can be attained. Since there is only some changes were made in the weaving machine, the operator can easily understand and operate this weaving machine. Even though there are many advanced machines were developed as a substitute for shuttle weaving machines, this weaving machine which we have designed can be affordable for normal weavers also. Thus this can increase the average benefits given by a normal weaving machine to an extent with somewhat minimum cost.

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