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The Invention of the Multiple Denting Machine to Accelerate Denting in the Ghanaian Cottage Weaving Industry

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Abstract:
In the Ghanaian traditional weaving industry and in the second cycle institutions, a single reed hook is inserted into the dents in succession while a yarn is threaded. This process is associated with some problems and difficulties such as the time wasted in denting and passing the hook through each dent and the possibility of missing some of the dents. The Multiple Denting machine was therefore designed to serve as an improvement on the single reed hook. It offers a faster and efficient way of denting. This machine was designed solely for the broad and table looms and is limited to a reed size of 14 inches. It has thirteen (13) equally-sized metallic reed hooks displaced in slots in a box. The box which contains the hooks is screwed to a metallic plate. The machine has a wooden base with "casters" under it to control its movement. There are also two square pipes located in two hollow pipes and these serve as supports on which the box and the plate carrying the hooks are mounted. In addition, there is also a metal rod connecting the two square pipes together and this ensures the quick withdrawal of the hooks from the reed. A provision has also been made for adjusting the height of the machine to suit the type of loom it is being used for. After experimenting with the machine by using it to dent a 4 inch plain woven fabric, the following encouraging results were recorded: the denting was carried out within 30 minutes as compared to a single reed hook which does the same work within some hours. Also, the finished product was devoid of warp floats and gaps.

Keywords: *REED, DENTING, HOOK, SECOND CYCLE INSTITUTIONS, WEAVING INDUSTRY, MULTIPLE, WARP FLOAT*

1. Introduction

Weaving is a very important activity in fabric production. It dates far back as the prehistoric era. The process involves the interlacing of warp and weft yarns to form a planular surface known as fabric. According to Wynne (1997), weaving can be done on a simple handloom or a highly complex and totally automated power loom. Weaving on the handloom is very tedious and this tends to deter many people from engaging in handloom weaving. Prior to weaving on the broad loom, table loom or any another handloom, there are a number of preparatory processes that one has to pass through, notable among them is denting.

Denting is the process of passing individual warp ends through the dents of a reed. This is normally done using a reed hook made of metal, wood, or plastic. During denting, the hook is passed through the dents of the reed one at a time (Adu- Akwaboa, 1994). This makes it very slow and time-consuming. Coupled with this, there is also the tendency of missing some of the dents and this will result in the formation of floats on the final product. Apart from the floats, the misplaced warp yarns can cause undesirable holes or gaps in the fabric because there will be no interlacing between the warp and weft yarns. This will eventually affect public appeal as no client would want to buy a fabric full of holes and other defects.

And as a way of providing some solution for this teething problem, the Multiple Denting Machine was designed by the researcher which is the first ever manually operated denting machine to be designed for denting on handlooms, apart from the single reed hooks which operate at a slow pace.

2. Literature Review

Weaving is a technological and scientific process carried out to produce a fabric on a device known as loom. Before a fabric is woven on the loom, there are some processes the weaver undertakes and one of such processes is denting. Denting is done by passing individual warp yarns through the dents of a reed using a single hook.

Adu-Akwaboa (1994) in his book "Art for schools and colleges", described a reed hook as an instrument used for passing warp yarns through the dents of a reed. He added that denting using the single hooks is very slow and tedious. However, he could not give any suggestions as to how the problem could be remedied.

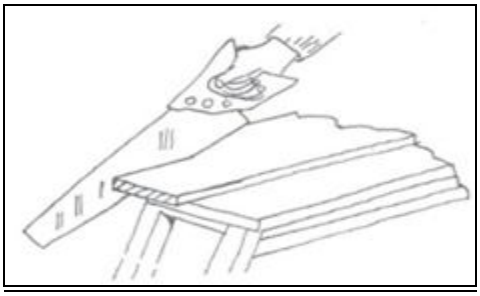
Wynne (1997) pointed out in his book titled "Textiles" that the reed hook exists and adds that the hook is inserted in the dents of the reed according to a denting plan. He explained further that the denting plan together with the heddling order determine the type of design that will appear on the woven fabric.
Lord P.R. (1973) in his book, "Industrial Weaving" classified denting under drawing-in and stated that, "there are two systems available; namely drawing-in machine and a reed denting machine. He further went on to explain the mode of operation of the latter by stating that, it employs a pattern chain to control a selecting finger which selects the warp threads separately and delivers them through the required dents.
According to Adobe, apart from the fully automatic machines, there are also machines operating semi-automatically. The correct warp yarn is presented by a machine and is threaded through the dents manually by operatives.
After reading through all these books, it was however clear that, none of them spoke about a possible way of designing a manually operated multiple denting machines for denting on the broad and table looms hence the decision to embark on this project of designing and constructing a Multiple Denting Machine.

3. Materials and Methods
The Descriptive and Experimental research methods were employed to describe the various stages of the research including the manufacturing processes and mode of operation as well as testing for the efficiency and performance of the machine.
The tools and materials used for the construction of the Multiple Denting Machine were varied. They included hacksaw, bench vise, hand plane, hammer, mallet, rip saw, hand vice, grinding machine, oil paint, electrode, odum wood, square pipe, porti filler, brush, chisel, files, screw drivers, scriber, bolts and nuts, iron rod, stainless, sand paper, centre punch, shears, goggles, chalk, pencil, try square, welding shields, drilling machine, tape measure, and pair of gloves. The construction of the machine was done as follows:

3. 1. Construction
Methods of Preparation

3.1.1. Base

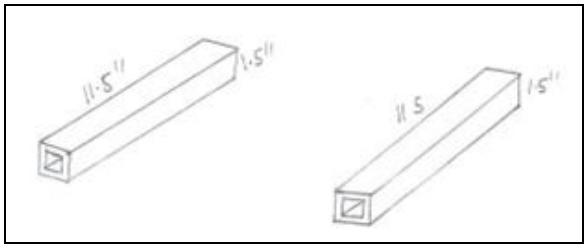
- The Odum wood was measured to the required length and breadth (32" x17") and cut with a rip saw by holding it in a bench vice as shown below:



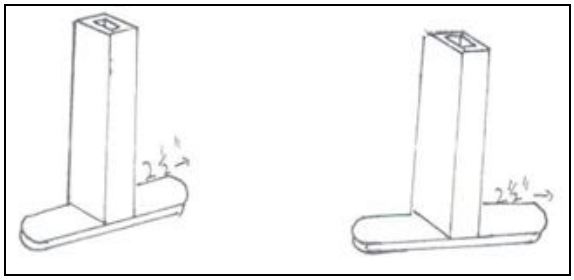
- The wooden base was then planed by the help of a smooth-plane.

3.1.2. Hollow Pipes

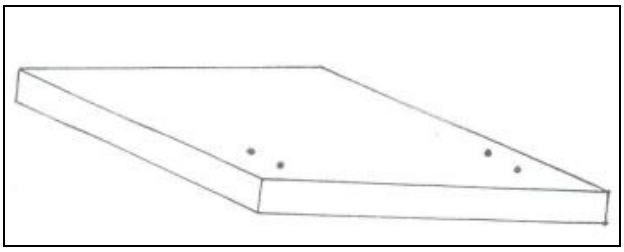
- The hollow pipes were then cut to the required sizes



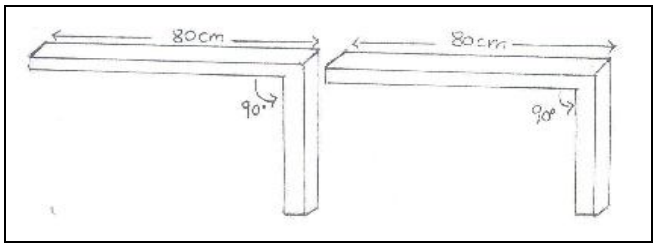
- The next stage was the cutting of four flanges from stainless steel and these were welded to the hollow pipes as indicated below:



- After welding, the joints were "grinded" with a grinding machine to polish and trim them.
- Followed by this, four holes were drilled with a drilling machine on the wooden base and the same on the flanges using the same drill size as shown below:

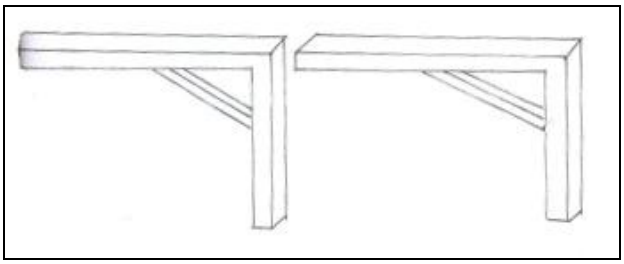


- The next stage was the cutting of two angle pipes of the same width and length

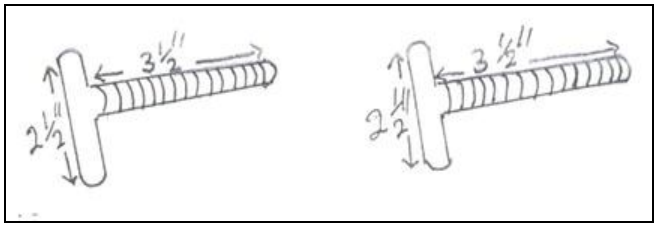


3.1.3. Support Bracket

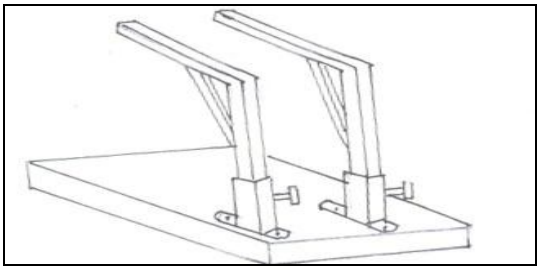
- Two square pipes were again cut and welded to the angle pipes so as to maintain an angle of 90º.



- Four holes were drilled in both the square pipes and hollow pipes to help in adjusting the height of the machine. Two bolts and nuts with knobs were then used to lock the legs to the hollow pipes.

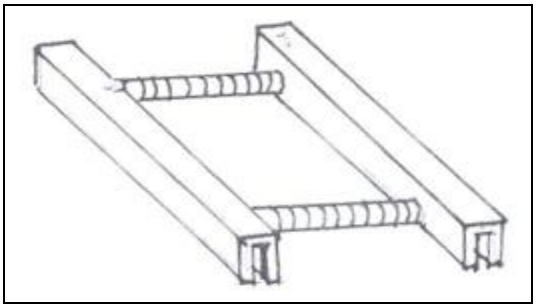


- Afterwards, the hollow pipes were bolted to the base with bolts and nuts by the help of a spanner.

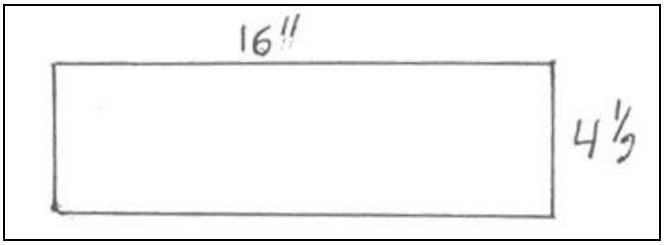


3.1.4. Metal Sleeve

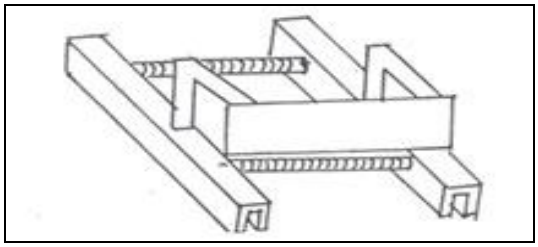
- Two hollow pipes were measured to the required sizes and cut to serve as sleeves which are worn on the square pipes. An iron rod was then welded to connect the two sleeves.



- Two knobs were then made and attached to the two ends of the sleeves so as to help in controlling their movement.
- Followed by this, a metal plate which holds the box containing the hooks was cut. The appropriate measurement was taken by the help of chalk, tape measure, scribe and try-square and cut to the required size with a HackSaw.

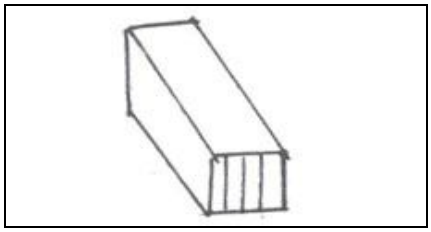


Next, two metal strips were cut according to the measurement of the plate and then fixed to the two sleeves. The metal plate was then welded to the metal strips as in the diagram below:

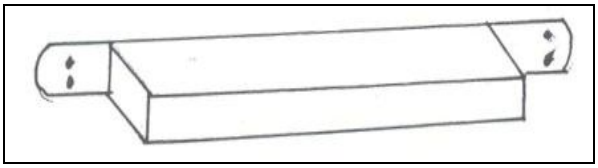


3.1.5. Hooks and box

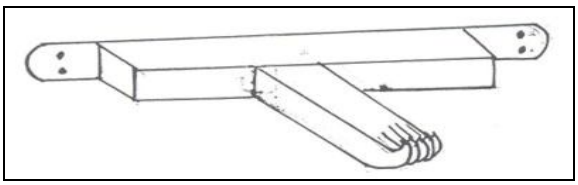
- A solid metal was measured to the size 4"x1½" and cut according to the dents in a 14" reed. And these cuttings were later shaped to the design of the hooks.



- A box was then made and attached with flanges as indicated below:



- The hooks that were cut from the solid metal were then welded to the box.



- Finally, casters (ties) were fixed to the base with screws.

3.2. Finishing

All the joints of the machine were filled with porti filler and polished by the help of sand paper and file.
After polishing, the machine was painted with the grey colour of oil paint using a brush except those areas which require friction.

Picture of Multiple Denting Machine

4. Mode of Operation

The machine operates basically as the single reed hook.

- Prior to denting, the centre of the reed is located and the warp sheet divided into two equal halves.
- This is followed by adjusting the machine to suit either the table loom or broad loom and then moving it to the reed in the sley.
- The hooks which have been cut according to the 14" reed size are pushed into each of the dents by the help of the metal rod connecting the two sleeves (starting from the centre towards the right and left)
- This is followed by threading each of the hooks with a warp yarn.
- The metal rod is then drawn backwards and as a result, the hooks are withdrawn from the dents.
- The machine is then moved sideways to the next set of dents until a time that the denting reaches the selvedges where two yarns are threaded with a hook
- After denting, the machine is moved away from the loom.

5. Results and Discussion

After the Multiple Denting Machine had been fixed, it was used for an experimental denting. First of all, a warp was laid and heddled ready for the denting process to take place. The machine by the help of "casters" was moved to a broadloom containing a 14 inch reed size and the warp sheet was divided into two equal halves. In addition, the centre of the reed was determined and then denting was done from the centre towards the right and then from the centre towards the left. This was followed by the drawing forward of the rod connecting the two square pipes and this interestingly resulted in each of the hooks entering the dents perfectly. Followed by this, each hook was threaded with a yarn. After threading, the rod was drawn backwards and as a result, the hooks together with the warp yarns moved backwards. Thus the yarns were passed perfectly through the dents. However, there was a little problem associated with the movement of the machine from one row to the other. But this was solved by carefully gauging the hooks at the dents in the second row before drawing the rod forward.

A 4 inch by 6 inch woven fabric was produced by the use of the machine and this gave very encouraging results. The denting was finished within 30 minutes as compared to a single reed hook which will do the same work within some hours. Also, the finished product was devoid of warp floats. This is a clear indication that the project is successful.

6. Recommendations

It is recommended that for proper maintenance of the machine, its parts such as the hooks, hollow pipes, square pipes, the sleeve carrying the box which contains the hooks and also the bolts and nuts should be oiled from time to time to prevent friction. This, if not done, will result in wearing off of some vital parts of the machine as well as difficulties in moving parts and rusting of the parts.

To ensure the long life-span of the machine, it will be appropriate that it is dismantled and all the parts cleaned with water and duster to remove dirt. Dirt, if allowed to settle on the machine, will prevent the free movement of the parts.

It is also suggested that there should be collaboration between textile designers and engineers to help improve upon the machine. When this is done, it will go a long way to alleviate or remove some of the problems encountered by handloom weavers in Ghana.

7. Conclusion

Denting is very important in the handloom weaving industry and for that matter the traditional weaving industry. This is obvious because research shows that the Ghanaian Cottage weaving industry contributes substantially towards the growth of the Ghanaian economy. Their activities span across the country from the Volta region, through the Asante region to the Northern region.

Although these contributions may seem not to be enough, they have made remarkable impact on the economy of the country. This sector uses crude tools and equipment which impede the fastness with which production is carried out. For instance, the use of the single reed hook has remained the same till the advent of the Multiple Denting Machine.

In spite of the contributions made by the traditional weavers, it has been observed that not much has been done in terms of technological advancement. Most of the equipment used are primitive and less efficient. In such a state, the producers are only able to turn out a very low output since they have to go through laborious processes during fabric manufacture.

From the above descriptions, it is evident that the traditional weavers are faced with problems which need not to be underestimated. The problems and difficulties associated with the single reed hook have compounded the deplorable state the traditional weaving equipment find themselves and the earlier something is done about it, the better for all of us. This as a matter of fact, calls for an intensive study of the hand loom weaving industry. It is therefore without doubt that the invention of the Multiple Denting Machine is one of the attempts geared towards solving problems concerning handloom weaving.

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