DESIGN AND FABRICATION OF BAMBOO MAT MAKING MACHINE

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ABSTRACT

In social, economic and ecological terms bamboo is one of the non-timber forest products of the developing countries, especially in Asia. Therefore numerous technologies being developed for the processing of the bamboo and for the production of several bamboo products. As the modern trend is approaching more towards handcrafted art and natural artifacts specially products with bamboo mat as a raw agent, the demand for such hand-crafted arts has increased tremendously. To meet this increasing market demand there is always a need for advancement in the conventional production techniques to counter balance the ever-increasing market demand for such handcrafted arts. As the handicrafts are produced by the labour, also it is quite difficult to weave and time consuming process. So to overcome this difficulty and to minimize the stress on the worker, an attempt has been made to design Bamboo mat making machine, which is simple in design and even can be handled by unskilled labour. The machine consists of simple working mechanism so that it will be feasible to operate and to get the desired output.

Keyword: - *Bamboo, economic, ecological, handicraft, artifacts, mat making machine.*

1. INTRODUCTION

Bamboo or *Bambusa* belongs to grass family and has been associated with various names such as “poor man’s timber”, “Green Gold”, “Cradle to Coffin” because of its various documented applications. Bamboo is widely recognized as highly renewable, fast growing, economic raw material. Products from bamboo are grouped into industrial use, food products, construction and structural application, wood substitutes and composites, and cottage and handicraft industry. Bamboo is most abundant in India. India has the huge potential for bamboo with 14 million hectares of bamboo forest area. India is the second largest country in terms of bamboo resources. The yield per hectare of bamboo in India is very low compared to China, Taiwan and Japan which contribute about 80% to the world’s bamboo market.

Bamboo products (bamboo mats, bamboo boards, bamboo veneers, bamboo mat corrugated roofing sheets, etc) due to their physical and mechanical performance in terms of hardness, stability and strength are gaining attention with large opportunities in emerging market. As the modern trend is approaching more towards handcrafted art and natural artifacts specially products with bamboo mat as a raw agent, the demand for such hand-crafted arts and articles has increased tremendously but because of excessive cost and time consumption it is not so feasible. So to overcome these difficulties and to meet the demands of market an attempt has been made to design Bamboo mat making machine with simple mechanism, working & operation, which will help to decrease the cost of product and time consumption.

2. OBJECTIVES

The main objective of project is to develop the bamboo mat making machine which saves the time and cost. It can also help to analyze effectiveness of machine with the use of simple mechanism.

3. COMPONENTS

The main components of the bamboo mat making machine are mention as follows

a) **Frame:** The frame is the main supporting structure of the machine upon which all the components of the machine are mounted. The material used for the frame is mild steel (M.S). The frame structure is so designed that it has high strength that can bear the shocks, vibrations produced during the operation and also the load and weight of the components mounted on it. The frame is a welded structure of 35×35×5 mm angle of mild steel. The dimension of the frame is (940×680×870) mm.

b) **Drive:** Belt drive is used for the transmission of power. A single belt drive is used in this machine which is use for transmitting torque from Wiper motor to crankshaft. For this, we used 2 pulleys out of which one pulley is of 280 mm, and another is of 50 mm in diameter. The material of the pulley is cast iron (C.I.). Chain drive is also used for the transmission of power. Along with belt drive, we used chain drive for power transmission. Here, we used chain drive so that slip factor should not occur and proper power should be transmitted from point to another point. For chain drive, we used 2 sprocket and chain. The diameter of larger sprocket is 90 mm and that of smaller is 45 mm. The material of the lager sprocket is cast iron (C.I.) and for smaller sprocket plastic is used.

c) **Crankshaft assembly:** The crankshaft is an essential part of the engine responsible for converting reciprocating to rotational motions. Here we used the steel plate fabricated welded crankshaft which is used to convert the rotary motion of crank here pulley into the reciprocating motion of vertical links.

d) **Telescopic cylinder**: Telescopic cylinders are a special design of a hydraulic cylinder or pneumatic cylinder system which provides an exceptionally long output travel from a very compact retracted length.

e) **Wiper Motor:** An electric motor is a machine which converts the electrical energy into the mechanical energy. The electric wiper motor is a permanent magnet rotary electric motor. A worm gear machined on the armature shaft drives the output shaft and gear through the idler gear and shaft. It has very low speed but having the maximum torque transmission capability.

4. CONSTRUCTION & WORKING

It consists of the frame made up of M.S (35×35×5) which provides the foundation for machine. It also consist of the most important part of machine i.e. crankshaft which is made up of number of M.S. strips in alternet manner. It also consist of the bearing (6201) in between the alternet strips of crankshaft. The vertical links of crankshaft are further welded on the bearings so that it will reciprocate to form loop of bamboo strips. The whole assembly is operated with the help of Wiper Motor which has maximum torque transmission capability and having minimum rpm. Torque is transmitted motor to pulley with the help of belt drive. This torque is further transmitted to the oscillating link with the help of chain drive. Here we required to maintain the speed ratio of 1:2 for oscillating link.

The bamboo strips are attached to end of connecting rod of crank shaft with the help of nut bolt assembly and another end of strip is hold in strip holder which is located at rear bottom end of frame. The cross feeding of bamboo strip is done manually by adjusting time. The crank rotates with the help of Wiper motor so the ultimate torque is transmitted to the crankshaft. The rotation of crankshaft reciprocates the links of crankshaft which ultimate helps to forms the loops so to achieve cross feeding. This cross feeded bamboo strips are carried forward with the help of two linkages made up of aluminum which are hinged at top of frame. These linkages are operated with the help of Telescopic cylinder. Here the telescopic cylinder is used to maintain the expanded and contracted distance. Telescopic cylinder is operated by using chain drive having speed ratio 1:2.

5. COMPONENTS WITH SPECIFICATION:

PART NAME	DIMENSION (mm)	MATERIAL
Crankshaft Diameter	Ø 300	Steel
Frame	$940 \times 680 \times 870$	M.S
Roller Chain Length	140	C.I
Larger Sprocket Diameter	Ø 90	C.I
Smaller Sprocket Diameter	Ø 45	Plastic
Pulley Smaller (Dia)	Ø 50	C.I
Pulley Bigger (Dia)	Ø 280	C.I
Bearing (6201)	Ø 11	Steel
V Belt	W = 13, t = 8, $\propto = 40^{\circ}$	Composite
Telescopic Cylinder	Expanded length: 710 mm Contracted length: 100 mm	UPVC
Crank	303 mm	M.S
Oscillating Link	820 mm	Aluminum

6. DESIGN CALCULATION

Design Parameters:

Power of wiper motor (P_R) = 0.262 kW

Speed of Wiper Motor (N_1) = 50 rpm

Speed of Rotating Crankshaft (N_2) = 10 rpm

Diameter of smaller pulley (D_1) = 2 inch

Diameter of lager pulley (D_2) = 10 inch

No. of teeth's on lager sprocket (T_1) = 24

No. of teeth's on smaller sprocket (T_2) = 12

FOR REQUIRED CRANKSHAFT SPEED

As here we used V- Belt drive for the transmission of power from motor to Crankshaft, we know that for V-Belt drive there is no slip occurs.

∴ Diameter of smaller pulley × Speed of Motor = Diameter of lager pulley × Speed of Crankshaft

∴ $D_1N_1 = D_2N_2$

∴ $N_2 = \frac{D_1N_1}{D_2}$

∴ $N_2 = \frac{2\times50}{10}$

∴ $N_2 = 10$ rpm

∴ **Speed of Crankshaft (N_2) = 10 rpm**

FOR THE REQUIRED SPEED RATIO OF OSCILLATING LINK

As we know that,

$T_1 \times$ Speed of rotor = $T_2 \times$ Speed of oscillating link

∴ Speed of oscillating link = $\frac{T_1}{T_2} \times$ speed of rotor

$= \frac{24}{12} \times 10$

= 20 rpm

Hence form this we are able to established the speed ratio between rotating crankshaft and oscillating link is **1:2**

7. RESULT

After the complete fabrication of machine we conduct actual testing of machine. During testing we observe that we required less time, less complication as compared to traditional mat weaving process. It requires low skilled operator only to cross feed the strips in the loop but after continuous practicing on it, will get reflects the good result in the finalized product.

8. FUTURE SCOPE

- It will be operated with the automatic feeding mechanism.
- Possibility to optimize the size of machine according to requirement.
- By the alteration of material it will be light enough.
- It will also possibly operate manually.

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