Design of an Automatic Jute Bag Making Machine

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Abstract

This paper deals with the design of an automatic machine for producing parallel type jute bags of industrial standards. This design is unique in the sense that similar machine is not existing in national or even international market.

This paper describes a semi-automatic jute bag making machine which is under development at CMERI, Durgapur. This machine can do all operations like cutting, hemming, mid-folding and herackle stitching in synchronized manner by appropriate mechanization and automation The machine is designed for making 50 kg mouth hemmed parallel sides stitched Jute bags.

Key words: Automatic, Jute bag, Machine.

1. Introduction

In the present scenario the jute industry is facing a stiff competition against the rising demand for plastic bags for storage and transportation purpose because the present jute bag making process is completely manual and involves large manpower for performing all manual operations and material handling. This leads to high production cost with low productivity and poor quality bags with high rejection rates. Nevertheless Jute bags are preferred to plastic bags for packaging of agricultural products because plastic bags are not eco-friendly. Hence the development of a new machine has become imperative to overcome the difficulties faced by the industry.

Therefore an automatic machine is envisaged to produce quality bags in single continuous line with much less floor space and improved productivity. This machine can replace the work of 12 manual labours to one/two man per machine with the productivity rate of 120 bags per hour that is 3 times more than the manual process.

Jute bags are being preferred to plastic bags for packaging of agricultural products like, sugar, vegetable and fruits because of growing awareness about the harmful affects of plastic bags. The present demand of jute bags cannot be met with the existing method followed in jute industries for bag making because the bags are manufactured by stand-alone cutting and sewing machine with the help of number of operators and helpers.

2. Present State-Of-The-Art

An industrial survey reveals that a balanced setup for making jute bags consists of (i) one shear cutting machine, (ii) twelve numbers of single needle double thread chain stitching machines and (iii) six machines for single needle double thread overlock stitching. All operations in sequence such as material movement, edge folding i.e. mouth hemmed, feeding to stitching machines, mid-folding and herackle stitching are carried out manually. The main drawbacks of the present systems of jute bag manufacturing are; (i) Rate of production depends on the efficiency and willingness of the operators (ii) Requirement of skilled and unskilled manpower.

3. Description Of The Machine Under Development

3.1 Mechanical Systems

The proposed machine (fig. 1) comprises of three successively arranged work stations namely cutting station, hemming station and herackle station at which various operations are performed in the manu-

facture of the bags from a bale of fabric roll or a form of folded bookshelf. An indeterminate length of stock is wound in the form of roll on the mandrel. The fabric is unwound continuously from the fabric roll at required feed rate by the pull of two rubberized rollers of feed roller assembly. Then the fabric is made to pass through the guide roller assembly, tensioner assembly and dancing roller assembly as shown in the diagram. The pull feeder assembly consists of flat belts running over a pair of rollers to pull the fabric intermittently depending on the sequence of operations. The fabric flows underneath the top shearing blade in shearing assembly. The top blade moves in vertical direction by means of a pneumatic actuator. The free end of the fabric is gripped by the pneumatically actuated grippers. The gripper assembly slides on a pair of rails with the help of a motor driven timing belt, for back and forth motions. The infrared sensor positioned on the gripper senses the fabric end and thereby grips the fabric and pulls it until the required length is reached as indicated by the position sensor. During gripper movement the fabric is passed between the set of top and bottom belts of the conveyor assembly. This will ensure the perfect tension in the fabric material and help in smooth flow of the fabric. The fabric is sheared off by the top blade shearing on the edge of the bottom blade. The cut length fabric is pulled further until the gripper position reaches another infra red sensor such that the cut fabric is aligned with the hemming station. The other end of the fabric is held under pneumatically actuated top belt assembly. This ensures that the cut fabric is aligned and remains in tension. After sensing of material availability by means of infrared sensors positioned on the second pairs of grippers of another gripper assembly, the cut length fabric is held and pulled in the transverse direction to the hemming station. Simultaneously, the grippers of first gripper assembly and the pneumatically actuated top belt assembly release the fabric. As the fabric moves into hemming station, the edges pass through the spiral shaped-tapered dual edge folder. The set of top and bottom conveyor belts at the center portion of the fabric ensures better tension and smooth flow of the fabric.

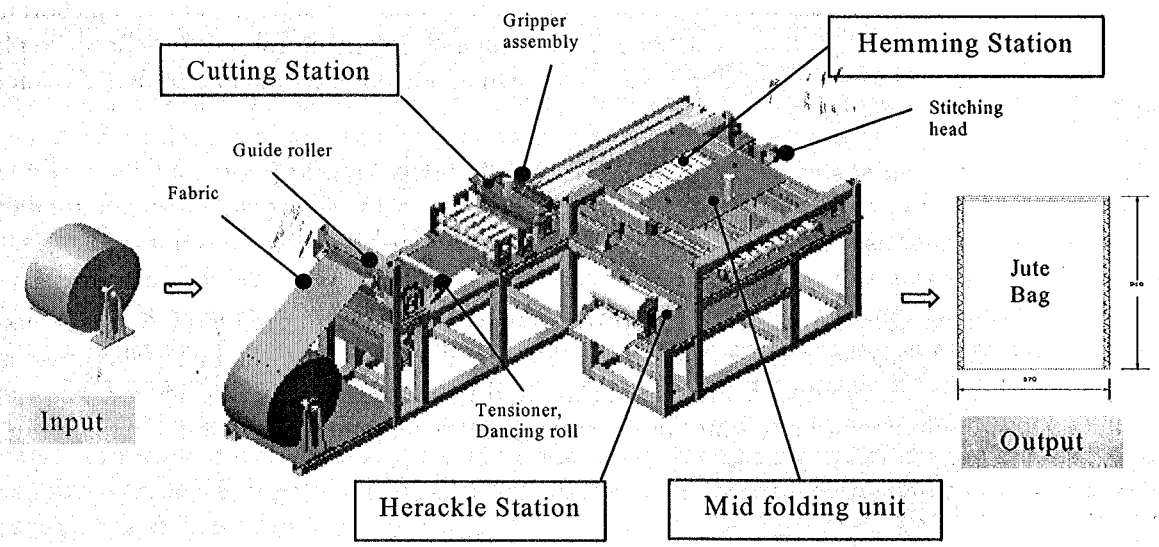


Fig. 1 3D View of Automatic Jute Bag Making Machine

As the fabric comes out of edge folder device, the fabric edges get folded and enter the stitching heads. After stitching, the thread cutter sensor will sense the position of the fabric and actuates the thread cutter. The extended thread from the fabric is cut and the hemmed fabric moves into the mid folding unit. The gripper now releases and vertical plunger cum mid-folder, actuated by pneumatic cylinder, move downwards which consists of spring loaded pressure rollers to hold the material under tension. As the plunger descends through the mid portion of the fabric, the fabric is mid folded and further movement of the plunger causes the folded end to be pushed in between vertical conveyors of mid folding unit. The folded fabric is carried downwards in the longitudinal direction. Thereafter, the fabric is passed through a set of top and bottom conveyor belts. Soon the folded fabric passes through the stitching machines for simultaneous parallel side stitching unit wherein the two parallel sides of the bag are over lock stitched [2].

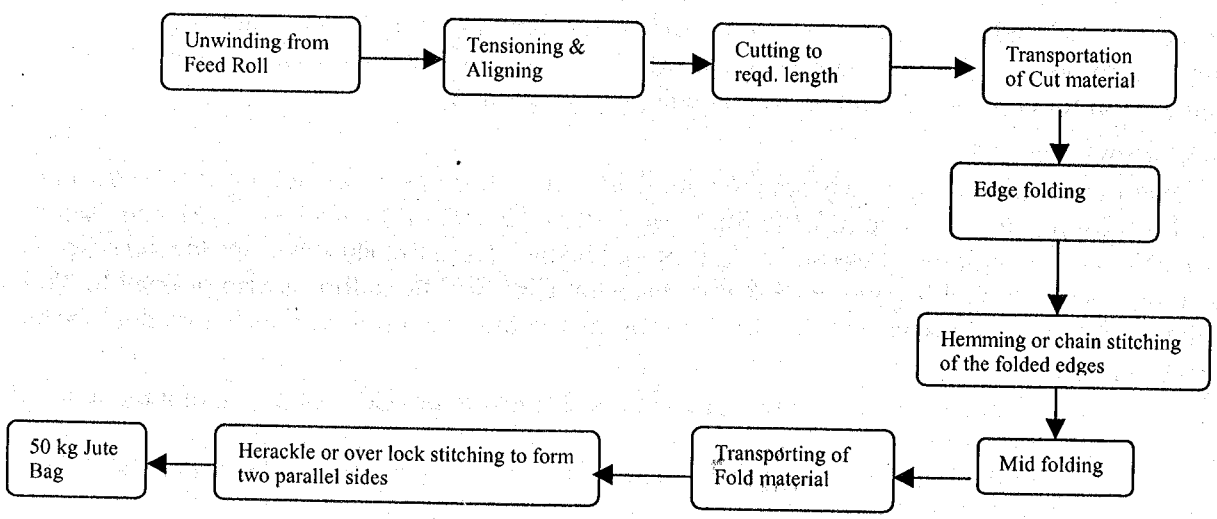
3.2 Drives and Control Systems

The motor drives, sensors and actuators are synchronized and automated by programmable logic controller. All drives are frequency controlled. The sensor signals through PLC are fed to drives to start/ stop the motors.

The combination of Seven AC motors with frequency controllers and 13 pneumatic actuators automate all the operations. The total of 53 sensors at various positions provide a perfect feed back signals to PLC and the entire operations are performed through closed loop control system.

All three stations are synchronized and operations are sequentialsed through programmable logic controller (PLC) program to form a complete bag.

The following flow chart illustrates the flow of operations that are to be synchronized and Annexure - I shows sequence of operations to be automated for producing the bag of required size and specification



3.3 Specification of the machine

- Input of the machine : Fabric Roll/ book shelf
- Output from the machine: mouth edge folded hemmed and parallel side stitched bag
- Size of the bag : 940mm x 570mm
- Estimated Production rate per man - hour : 120 bags
- Total power consumption : 6.0 KW
- Overall size: 6000x3000x1750 mm

4. Expected Output

Based on the industrial survey, a total of 12 manpower involved for manufacture of single line production facility of similar jute bags. The total bags produced are 48 bags per hour per man.

In proposed system, independent operations are synchronized to perform sequential operations through PLC and total cycle time is programmed to produce one bag in 30 seconds. The total cycle time per bag per man is 30 seconds. The total bags produced is 120 bags per hour per man.

5 Advantages

In countries like India, petrochemical products especially plastic carry bags have come as a menace to municipalities. Indiscriminate use of carry-bags made of plastic has wrecked havoc on the environmental front. Soil pollution, visual pollution, choking of drains, blocking natural water streams has all added to

the plunder. This has compelled civic authorities to ban this indiscriminate use of plastics and look for congenial resources like jute. Jute bags and paper bags are thus gaining popularity for a good cause. The alternative may not come as cheap as its plastic counter part, but the price paid will still be cheap for the cost of saving to the environment.

Jute bags are mainly used to pack cement, sugar and other bulky articles, which are packed in weight range from 50 to 100 kgs. These are tailored as per customer's specifications in terms of size and to meet the ever-increasing demand of jute bags in the farm sector, agro-based industries and cement industries. They are specifically used for the purpose of storing agro-based products, known as Hydrocarbon free bags that have been treated with vegetable oils to destroy the harmful effect of hydrocarbons.

6. Conclusion

The new proposed automatic machine will definetly remove the drawbacks present in the manual operation and provide complete solutions for appropriate mechanization and synchronization. The new machine will provide uniform quality of mouth edge folded, hemmed stitched (mouth edge) and herckle stitched (parallel) side bags in one single integrated machine at more than 3 times higher productivity compared to present system. Importantly the present machine will reduce manpower requirement to a single person for complete operation with less floor space area.

7. Acknowledgement

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8. References:

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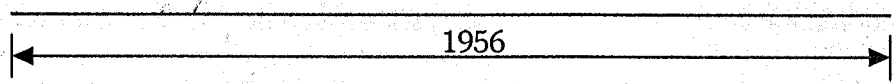
2. Krutz Gary W," Machine Design for Mobile & Industrial Application", Warrendale.SAE, 1994.

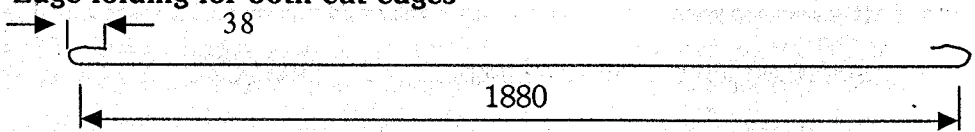
ANNEXURE - 1

Sequence of Operation for Automatic jute Bag Making Machine

1. Cut to size

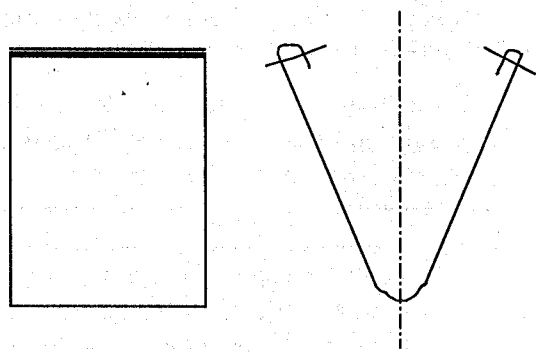


2. Edge folding for both cut edges

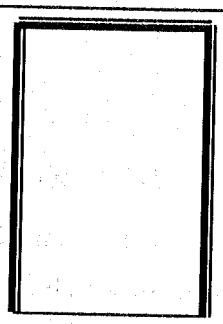


3. Hemmed stitching

4. Mid folding



5. Herackle stitching



6. Branding/ Labeling