International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 09 | Sep 2020 www.irjet.net p-ISSN: 2395-0072

Design and Development of Compact Multi Grain Dehusking Machine using Human Power

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Abstract - *The present paper describes the design and development of a human powered machine system consisting of a chain drive which drives the pulse cleaner machine by pedalling a Bicycle mechanism that can dehusk more than one grain (Multi-grain). The pulse cleaner assembly is required to dehusk the grains of different dimensions and hence is provided with the gap adjustment mechanism between the rotating and fixed Discs. The rotating disc is to run at moderate speed & torque so that the bran can easily be removed to give clean pulse. The setup is* a low cost and efficient grain processing machine for household consumption without any loss of nutritional values with appreciable quality for sustainable agricultural post production using human energy and the initial test is *yielding around approx 4 to 5 kg of pulse per hour of peddling. The size and cost of setup may be affordable for every home.*

KeyWords: Threshing, Grains, Processing machines, Pedal Powered, Kinetic Energy, Moving Plate, Stroke motion, Crank Mechanism

1. INTRODUCTION

In the developing world in particular, the cost of fossil fuels has necessitated the need of unique unconventional energy source by means of developing human powered mechanisms. Today, human power is not appropriately recognized for its potential as an alternative solution to our growing energy needs. However, energy production on a smaller scale is often not addressed. In some respects, human-power can be seen as the cleanest renewable energy source available, with great potential for helping people stay healthy and could create a credible new perspective towards exercise as an alternative energy source. Milling is a crucial step in post harvesting or postproduction of grains. The basic objective of milling system is to remove the husk and the bran layers from the paddy or grain and produce an edible, kernel that is sufficiently milled and free of impurities. Hence has to be done with utmost care to prevent breakage of the kernel and improve the recovery.

1.1 Objectives

Objective of this project is reviewing and product development of Compact Multi Grain Dehusking Machine Using Human Power that can dehusk more than one grain for household consumption without any loss of nutritional values at affordable cost and create a credible new perspective towards exercise.

1.2 Methodology

In this project the main goal is the development of Compact Multi Grain Dehusking Machine by reviewing the commonly used available machines. The objective identified to accomplish the goal was:

- Review of Literature
- Formulation of the problem
- Design Calculations
- Fabrication
- Result and Discussion
- Economic Analysis

2 REVIEW OF LITERATURE

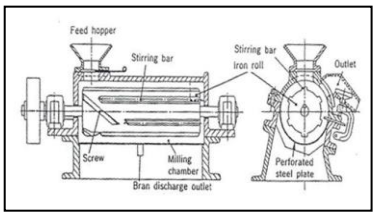
From the earliest times to the present times, different setups were used for the Dehusking of rice, wheat, pulses from hand pounding to single stage mills to latest high capacity mills. The advantages and limitations of all mechanisms and their analysis are studied in detail & information about the process carried out during dehusking and how the grain are cleaned. The articles reviewed are from the point of view of their aims and objectives, methodology adopted, important findings and conclusions.

In order to know the feasibility of Design and Fabrication of Pedal Operated Pulse Cleaner (Dehusking), the literature review is carried out in following areas:

2.1 Rice Dehusking Process.

2.2 Wheat Dehusking Process

2.3 Pulses Dehusking Process



(a) Mortor and Pestle (b) Rice Milling Machine

(c) Traditional Wheat Dehusking (d) Mechanized Thresher

(e) Traditional Pulse Dehusking (f) Modern Dal Mill

Fig -1

Based on the literature reviewed above, it may be inferred that separate dehusking machines are available for each grains. The studies had been gone through only improvement, development and settings of the machine. So the present study was to develop a three in one setup at household level.

3. PROBLEM FORMULATIONS

To design and develop a manually operated bicycle setup to produce Power:

The basic need is to design and develop a bicycle setup for manual power generation and supply the same for dehusking process and also comfortable for system arrangement and driving without any complexity in handling and transferring material with minimum workplace.

1. To develop an efficient mechanism for forward thrust of pulses with also providing rotational motion to plate :

There is a need for a mechanism which would efficiently supply proper quantity of pulses and at the same time provide rotation to the moving plate i.e Disk.

2. To Fabricate an economic Mechanism for Reliable Function:

The conventional methods for dehusking are costly and require high Initial and Maintenance capital. The setup for the same requires good design and research background. The chain drive mechanism is simple and easy to design and fabricate and at the same time bears less cost compared to the belt drive i.e conventional methods.

3. To develop a Futuristic, Eco-Friendly and physic maintenance Method:

Manually pedal operated, less cost and eco-friendly, which is no doubt a future need. There are negligible harmful impacts on the environment which makes it no doubt an Eco-Friendly method. Due to its capability of operating successfully in all conditions which makes it perennial system.

4. Mills available in the market such as baby hullers requires electricity to run motors of 2 to 3 HP and the cost of machine is not affordable.

5. An average man can produce approximately 75W (0.10 hp), if He/She works continuously per hour. Hence utilizing this work to operate house hold machines.

6. Human power may be stored in the flywheel & used for running the mill.

7. Minimizing the amount of crushed grain.

4. CONSTRUCTION OF COMPONENTS

4.1 SPROCKET AND CHAIN DRIVE MECHANISM

Chain drive is a method of transmitting mechanical energy from one area to another. It is regularly used to deliver strength to the wheels of a vehicle, specially bicycles and motorcycles. It is also used in vast variety of machines besides vehicles .Most often, the electricity is conveyed through a curler chain called the power chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes within the links of This pulls the chain and became the tools placing mechanical pressure into the system.

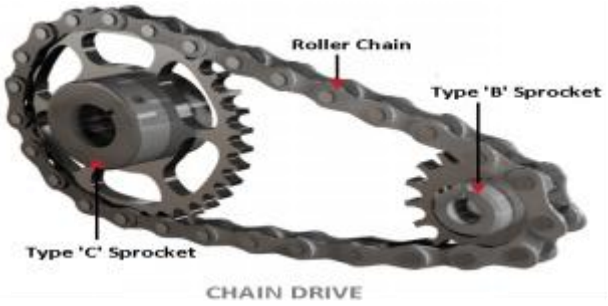


Fig -2: Sprocket and chain drive mechanism

Sr.No	Particulars	Range
1.	Outer diameter	100mm
2.	teeth	44mm
3.	Width	6mm
4.	Pitch	12.13 mm

Table -1: Specification of larger Sprocket

4.2 HOPPER

A hopper is a large, container used in industrial processes to clasp matter that has been collected from expelled in air. All hoppers are designed according to their volume Capacity.

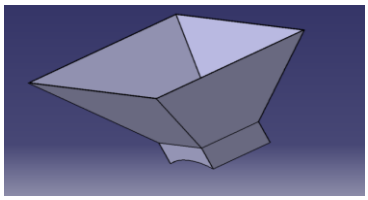


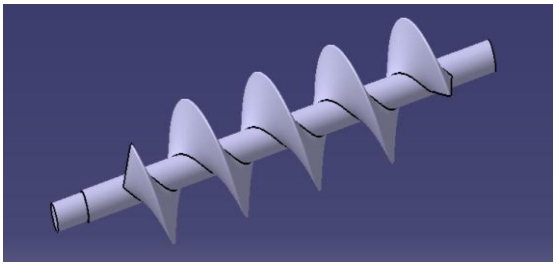
Fig -3: Hopper

Table -2: Specification of Hopper

Sr.No	Particulars	Range
1.	Length	195 mm
2.	Width	195 mm
3.	Height/Depth	153.16 mm
4.	Volume Capacity	3 Kg

4.3 SCREW CONVEYOR

A screw conveyor or auger conveyor is a mechanism that uses a Rotating helical screw blade, typically inside a tube, to transport materials. They are used in many material handling industries. Screw conveyors in contemporary-day enterprise are regularly used horizontally or at a moderate incline as an green manner to transport semi-stable



materials.

Fig -4: Screw Conveyor

Sr.No.	Particulars	Range
1.	Outer Diameter	38 mm
2.	Inner Diameter	25 mm
3.	Pitch	15 mm
4.	Tooth thickness	4.5 mm
5.	Threaded portion distance	147 mm
6.	No. of turns	8

Table -3: Specification of Screw conveyor

4.4 STATIONARY AND MOVING DISC

Stationary disc is installed on the fixed body of processing unit while moving disc is supported and fixed by screw conveyor. These disc faces are coated with natural rubber which result in developing shear action i.e shear force between raw material covering i.e paddy and disc.

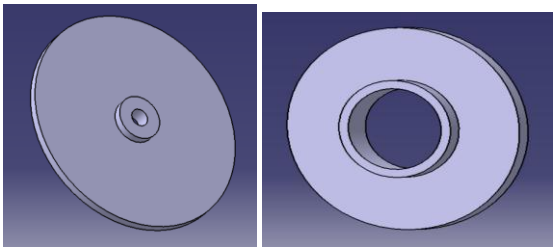


Fig -5-a: Moving disc **Fig -5-b**: Stationary disc

Table -4: Specification of Discs

Sr.No	Particulars	Range
1.	Stationary Disc Diameter	250 mm
2.	Rotating Disc Diameter	250 mm
3.	Disc thickness	10 mm

4.5 Bearing

Ball bearing is rolling element which used ball to maintain the desired distance between two respective races. These Ball Bearing are used in many industrial and automatic applications. The 6003 17 mm. Ball Bearing Inner Dimension 17mm X Outer Dimension 35mm X Width 10mm is an open style ball bearing designed for high rotational speeds and high dynamic loads.

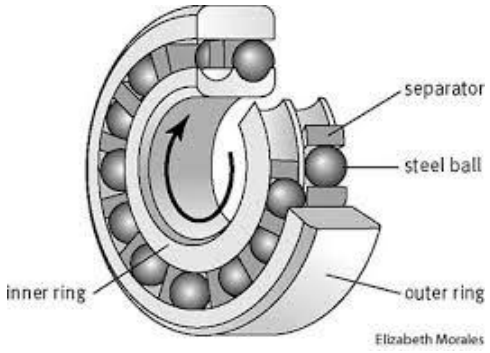
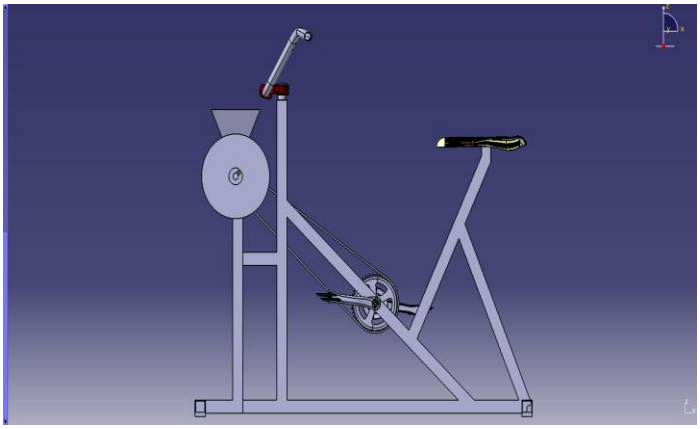


Fig -6: Ball Bearings

5. WORKING PRINCIPLE

The principle of operation of mini mill is that when power supply by bicycle through chain as well as gear drive to the conventional grain dehusking mechanism, then the huller shaft revolves in a particular direction says clockwise or anticlockwise direction. The shearing force between huller shaft and fixed plate is responsible for grain milling.

There being provided a cover plate on the top of the said housing having a grain feeding chute of the rest edges of the aid flutes inside the housing. The person sitting on the seat then iterates the pedal thereby causing the flywheel to rotate and also the huller shaft rotate. The closed plate is slowly withdrawn to allow grain to fall through the spiral portion of the huller shaft. The grain is thrust forwarded into the distributor section which distributed the paddy into spiral shaft or the huller shaft. As the huller shaft rotates the paddy falls through adjustable gap formed between the two plates in which one plate is fixed and another plate is movable. Grain is subjected to pressure and shearing action between the huller shaft and fixed plate and the husk is removed.



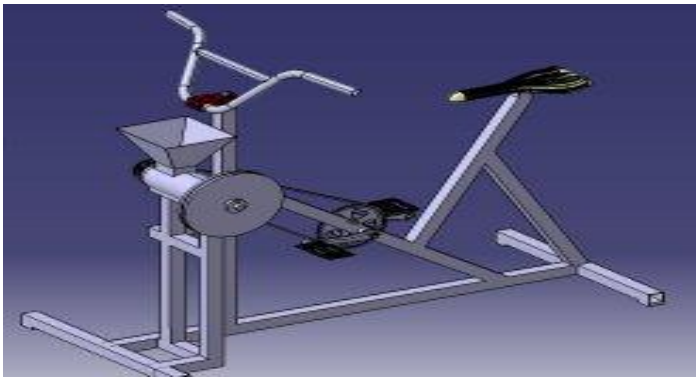
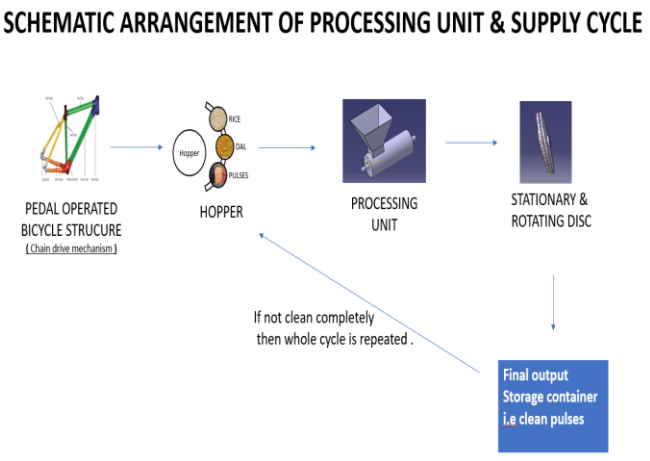


Fig -7: Final Design

6. CONCLUSIONS

The main objective behind development of pedal operated pulse cleaning machine is to dehusk the multi grains at low cost without using electricity at household level, at affordable size and cost without any loss of nutritional values as no polishing would be done. This machine is going to be very helpful for farmers in villages to cater their daily demand of grain dehusking. Moreover, in Urban areas could create a credible new perspective towards exercise helping people stay healthy .Multi-grain dehusking machine will not depend on a single seasonal crop and will be useful in all seasons for dehusking multiple grains.



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