"DESIGN OF PEDAL OPERATED RICE THRESHER"

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ABSTRACT

Threshing is an integral part of postharvest activities for cereal and legume crops. In many developing countries, threshing is carried out manually by farmers that lead to low quality of paddy rice and grain loss. When the rice production increases, consequently the manual threshing becomes arduous. In order to mechanize this process, a throw-in type thresher based on a prototype of a manually operated thresher.
The overall results are impressive and it will help improve drudgery and threshing challenges with small scale farmers.

Keyword -*wheelchair, Backaches, Hand and finger blisters, Exhaustion*

Introduction

Threshing is a key part of agriculture that involves removing the seeds or grain from plants (for example rice or wheat) from the plant stalk. In the case of small farms, threshing is done by beating or crushing the grain by hand or foot, and requires a large amount of hard physical labour. A simple thresher with a crank can be used to make this work much easier for the farmer.In most cases it takes two people to work these: one person to turn the crank and the other to feed the grain through the machine. These threshers can be built using simple materials and can improve the efficiency of grain threshing. They can also be built with pedals, or be attached to a bicycle, so that the person operating it can simply pedal to reduce the work even more and make threshing faster.Threshers can be made in a number of ways using simple tools, and can be used in the harvesting of maize/corn, rice, wheat, sorghum, pearl millet, and any other grain or seed that must be separated from a stalk. The attachment of a thresher to a pedal-system can be built with basic materials. Pedal-powered threshers have been suggested or made available to farming communities by governmental or non-governmental organizations.Rice is after wheat, the most widely cultivated cereal in the world and it is the most important food crop for almost half of the world's population . National rice consumption in India is estimated at about 300,000 tonnes against an annual domestic production of between 45,000 to 80,000 tonnes. This huge gap between consumption and production is met through importation of rice.In 2008, rice imports into India were valued at 7 billion . To reduce this dependency on importation, include decreased consumption which is not a viable option, increasing tariffs on imported rice, increasing the area under current cultivation, increasing productivity and proper post-harvest practices to minimize loss and improve quality.Majority of farmers in India grow rice in small scale, they therefore lack enough capacity to acquire appropriate equipment such as combine harvesters to be used for threshing. They therefore resort to manual means of threshing rice like: smashing ears of rice with hard objects to separate the paddies from the ears or straws, sometimes pedal operated threshing drums are employed in fairly big farms, or even driving trucks or tractors on the un-threshed rice. Manual threshing is tedious, time consuming and above all results in too much post- harvest losses which can be in the range of 1-15%.According to Earth trend, postharvest food loss translates not only to human hunger and financial losses to farmers but also results in tremendous environmental wastes. In India, rice production has remained low both in quantity and quality because of the inefficient production and processing techniques.This research was conducted to determine ways of reducing post-harvest losses and tediousness resulting from traditional methods of rice threshing. The study involved designing of a pedal powered thresher from scrap metals and affordable power transmission element and to make the whole system affordable to the small scale farmers.

IDEA AND NEED OF PROJECT

IDEA:-

In market only large scale rice threshers are available, so for small scale farmers we invented small rice thresher for threshing rice by greater efficiency.

NEED OF PROJECT:-

In day to day life, small scale farmers are not able to thresh rice by high cost machine (THRESHER), so for threshing rice by utilizing low cost small scale rice thresher is introduced.

For regular process of rice threshing more people required, but for this thresher only two peoples required for same quantity at the time of threshing.

In regular process we can thresh only 50-60kg rice per hour but by using rice thresher we can threshed 100-110kg per hour rice per day.

FEATURES

Economical and affordable to common man.

Materials used are easily available.

Easy to construct.

External power source is not required.

Rice threshing purpose for small scale farmer

MATERIALS AND METHODS

The ergonomic evaluation of paddy threshing operation was carried out with twelve female agricultural workers (subjects) of Bhopal district of Central India (Singh 2016). In this study, two methods of paddy threshing were used viz., traditional method (manual beating on wooden log) and improved method (pedal operated paddy thresher).

Both manual beating and pedal thresher was operated for 60 min duration. During threshing with pedal operated thresher, one person was engaged in supplying the paddy bundle to the operator and other person was engaged for manually moving the bundle over thresher and pedalling the thresher (Fig 1). At the beginning and at the end of each experiment, the subjects were given sufficient rest so that all the physiological parameters regained to their normal level.

After achieving the resting heart rate, the subjects were asked to perform the threshing operation by beating paddy crop on wooden log for 60 min duration and then rest of 15 min was given to regain the physiological parameter to its resting level. Same procedure was followed with pedal operated paddy thresher with sufficient rest period between the two methods of operation.

The data were recorded for both the threshing methods. The detail specification of the thresher used in the study is given in Table 2. The subjects selected were from the age group of 20-45 years as the highest strength level was obtained between this age group. All the subjects were right handed, physically fit and well-practiced with both the means of paddy threshing.

The physiological responses of female subjects were measured while threshing with traditional method as well as improved method. The subjects were familiarized with experiment procedure and were screened for postural abnormalities or any occupational problems.

Before conducting the experiments for measurement of physiological responses, each subject was checked for cardiovascular, neuromuscular and musculoskeletal disorders. The physical and physiological characteristics namely age, weight, stature and maximum heart rate of the selected subjects were also measured.

TREATMENTS

Traditional Rice Threshing

Threshing rice in Fogera is done traditionally. The traditional threshing methods are beating by stick and animal trampling. Beating involves pounding shelves of rice crop on hard surface or beating the ear of the crop with stick. Animal trampling is treading a layer of 15 to 20 cm thick harvested crop by a team of animals followed by manual refining, depending upon capacity, lot size and situation. Threshing by animal treading is practiced on large scale in the country but it is also time consuming and involves drudgery. Animal trampling (hereafter referred as traditional) on average takes two human labor and 5 oxen for 10 hrs to produce 1 tone output of fairly dried rice. However, it incurs huge loss due to spreading, fracture and mix up with soil impurities. Absence of sufficient livestock for trampling forces prolonging threshing period thereby increasing loss due to shattering, pests and rotting of grains. If threshing animals are not available, the farmers will thresh by stick beating little by little thereby exaggerating the loss.

Pedal Rice Thresher

The pedal thresher (Figure 1) consists of an open rotating drum with wire loops. The drum strips the grains from the panicles when fed by hand. The Pedal Rice thresher was simple to operate with leg muscle, doesn't consume fuel and it is used for threshing paddy rice easily. It can also be operated by women and can be used in hilly or terraced areas because of its portability.

WORKING

Threshing is the process of separating grains from their corns.
This pedal operated thresher is use to separate rice grains from their corns.
First rotate the cylinder rotor the cylinder rotor in the two directions of arrow by hands.
As the rotor rotates, apply effort on pedal and start pedaling.
The oscillating motion of pedal is transmitted to bigger gear through connecting rod.
The bigger gear which is properly meshed with smaller gear start rotating due to which smaller gear also rotates.
The speed ratio of gear train used is 1:4, hence smaller gear rotates 4 times faster than bigger gear.
The smaller gear is mounted on same shaft as that of cylinder rotor is build.
Due to pedaling rotor can achieve speed upto 500 rpm. For perfect threshing 350-400 rpm is the ideal speed.
Paddy threshing is done by holding the paddy stalks with grains against the teeth of revolving cylinder rotor.
The paddy stalks held into the cylinder strikes on cylinder rotor tooths. Cylinder rotor with tooths pulls the grains off the stalk as they are held onto the cylinder.
This pulling action seperates grains from there paddy stalk and threshing operation is done.

MAIN COSIDERATION DURING DESIGN

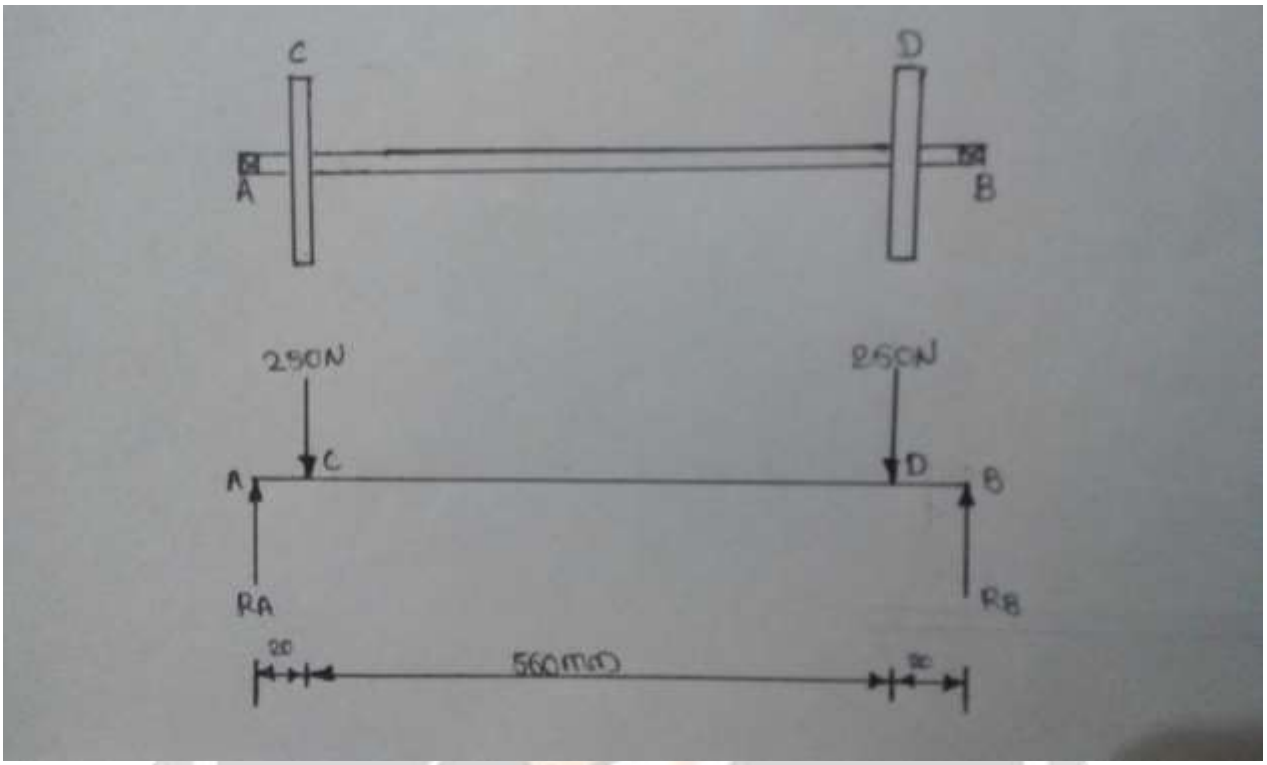
Total weight of rice thresher.
Load bearing capacity.
Transmission system.
Material selection.
Lubrication & maintenance
Load on threshing teeth
Load on foot pedal
Consideration of gear ratio
Selection of appropriate gear train, machining of shaft and machining of threshing teeth.
Before designing the CAD model, it was essential to consider various components necessary for the designing such as; threshing drum size and speed, power required for threshing and frame design.
Among the threshing methods, the threshing of grain through impact force at an average speed (350 to 500 rpm) provide minimum seed damage.
Therefore, threshing of rice paddies is based on the principle of impact force generated by beating action of the spikes.
The main design considerations for the entire machine include; dried rice paddy suitable for threshing by this machine should have moisture content of 20% to 23% to ease the removal of the paddy grain from the stalk, overall height of the machine to facilitate ease of operation by a rural farmer of average height, overall width and breadth of the machine for purposes of storage space in the rural farmers granaries, weight of the equipment for easy portability during operation on and off farm, the material to be used to be cheap and easily available to peasant farmers and the material should be strong for machine durability and should not rust resistant or if otherwise be painted.
The machine has the five main components that have to be designed and be fabricated accurately for its efficient working. These are: the threshing unit, power transmission system, screening unit and a collecting unit.
The threshing unit It is the most integral part where separation of the paddies from the straws take place. For maximum efficiency of the machine, this part requireproper and accurate design of the components. It is comprised of the following components: 2.3.1.1 Threshing drum It is the part that holds the threshing teeth and as well as the powering shaft in position. For efficient functioning of this component, the following design considerations were made; be made from lighter material to reduce the weight, its diameter be able to suck entire straw holding paddy grains, an average height of rice stock is 1.2 m and a diameter of 300 mm with a drum length of 400 mm were chosen.
This is the part that beat the paddies off the stalk, it consists of six angle line steel bars of length 400mm mounted along the circumference of the threshing drum. The material used for this component is designed to be lighter and stronger for durability.

DESIGN PROCEDURE

Design of rotor
Expected rpm=450-500
As per RPM we select the gear train
Compound G.T.
Epicyclic G.T.
Simple G.T.
From above gear train we select simple Gear Train
The rotor is made by using no of slats and threshing teeth
Slats- Length=520mm, w=45mm, t=2mm
Threshing teeth- no. of teeth=12 dia of wire=3mm Distance 40mm

Cylinder wheel- dia=320mm t=6mm

1) Design of Shaft:-



$\Sigma F_y=0$

$R_A+R_B-250-250= 0$
$R_A+R_B=250+250$
$R_A+R_B= 500N$

$\Sigma M_A= 0$
$250\times20+250\times580-R_B\times600= 0$
$250\times20+250\times580=$
$R_B\times600$ $R_B=2500N$

$R_A+R_B=500$
N
$R_B+2500=50$
0 $R_A=2500-$
500
$R_A=2000N$

B.M. at pt. $M_C= R_A\times20$
$=2000\times20$
$=40\times10^3$N.mm

B.M. at pt. $M_D = R_B \times 200$

$= 2500 \times 20$

$= 50 \times 10^3$ N.m

m So, $M = 50 \times 10^3$

Assume τ=42mpa,Due to combined twisting & bending moments we use max. shear stress theory,

The eq. of twisting moment is given by,

$T_e = \sqrt{M^2 + T^2}$

$T_e = \sqrt{(50 \times 10^3)^2 + (190.98 \times 10^3)^2}$

$T_e = 197.41 \times 10^3$

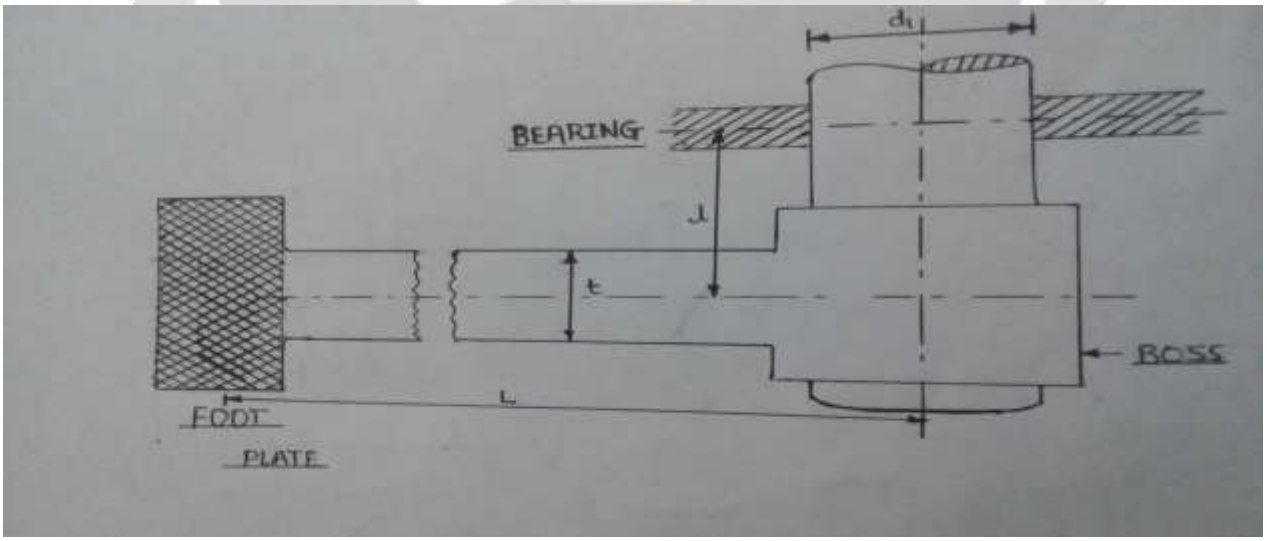
To find dia. Of shaft,

$T_e = \pi/16 \times \tau_{max} \times d^3$

$197.41 \times 10^3 = \frac{\pi}{16} \times 92 \times d^3$

$d = 20.19 \approx 22$mm

2) Design of lever:-



$M = P.\ l = 500 \times 100$

$= 5000$N.mm

$T = P.\ L = 500 \times 450$

$= 225000$N.mm

$$T_e = \sqrt{M^2 + T^2}$$

$$T_e = \sqrt{(50 \times 10^3)^2 + (225 \times 10^3)^2}$$

$$T_e = 225 \times 10^3 \text{ N.mm}$$

$$T_e = \frac{\pi}{16} \times \tau_{max} \times d^3 \qquad \tau = 70 \text{N/mm}^2$$

$$225 \times 10^3 = \frac{\pi}{16} \times 70 \times d^3$$

$$d_1 = 23.35\text{mm} \approx 24\text{mm}$$

ADVANTAGES AND DISADVANTAGES

ADVANTAGES :-

The thresher includes less physical labour and more efficiency. (Amount of grain thresher per amount of time).
Less seed breakage is also a benefits of using a thresher as compared to stomping of beating grains.
Variation in speed can be obtained as per requirement hence speedy performances.
Durable and strong structure.
Easy to use and maintained.
Installation cost is very low as compared to automatic rice thresher machines.
hresher required less maintenance hence, maintenance cost or running cost is low.
Durable and strong structure.
Suitable for small scale farmer.
Not required skilled operator.

DISADVANTAGES :-

Operation is lengthy and slow as compared to automatic rice thresher machines.
Hand and arm may be injured when feeding the stalk into the thresher.
Breakage of seals can occur if thresher is not use properly.
Paddy stalk must be very ripe and dry.
Sometime paddy obtained containes too many un-threshed grains and plant residues.CONCLUSION
The final conclusion of this “Pedal Operated Rice Thresher”, we can easily thresh rice manually.
Due to use of this Thresher labour effort decreased.
The cost of this Thresher is very less, due to which it can be useful for small scale farmer.
It is simple in construction and easy to use.

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