DESIGN AND DEVELOPMENT OF PEDAL OPERATED MAIZE SHELLER

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ABSTRACT: Maize is most common cereal grain in the world. In India after the rice and wheat, maize is the third most important crop. In India many farmers grow maize but could not afford the cost of acquiring some of the imported threshing machines because of their cost. The maize is shelled traditionally by hands. This is done in such a way that maize is rubbed against another until the grains are removed from the cob. This method is time consuming with low productivity. Maize Sheller machine is constructed to shell maize and separate the cob from the grains. It was constructed from locally available materials and its cost is low and affordable. Design of various parts of maize sheller machine using different methodology. Design of the machine could be operated continuously for a comparatively long time with high shelling rate without causing damage to kernels. Four shelling units can be provided for shelling of maize cobs and operated with the chain and sprocket arrangement. The results revealed that the machine was easy to operate with an average kernel shelling rate .when operated by persons with no any kernel damage.

I. INTRODUCTION

Maize, the American Indian word for corn, means literally that which sustains life. It is, after wheat and rice, the most important cereal grain in the world, providing nutrients for humans and animals and serving as a basic raw material for the production of starch, oil and protein, alcoholic beverages, food sweeteners and, more recently, fuel. In Africa, maize has become a staple food crop that is known to the poorest family. There have been large variations in the production of maize in India since independence. The different methods of maize shelling can be categorized based on various mechanization technology used. These includes: hand-tool-technology, animal technology, and engine power technology. Hand technology involves the use of hand tools in shelling, while as animals technology were used in threshing on the field by marching on the maize. The easiest traditional system for shelling maize is to press the thumbs on the grains in order to detach them from the ears. Another simple and common shelling method is to rub two ears of maize against each other. These methods however require a lot of labour. It is calculated that a worker can hand-shell only a few kilograms an hour.

In India, Maize is emerging as the third most important crop after rice and wheat. In our country, most of the farmers shell corn by mainly three methods namely shelling cob grain by hand; hand operated corn Sheller and beating by stick method were carried for removing corn kernel from the cob. The Corn shelling was designed and built to improve the standards of living of people living in villages of developing countries. The power operated maize Sheller machine requires electrical energy for its working and its capital investment is also high compared to the conventional methods of shelling but in rural areas supply of electricity is not good at all times. So in order to suit the prevailing condition and reduce the capital investment and operating costs, pedal operated maize Sheller needs to be developed.

Maize shelling techniques

- Shelling by hand, with simple tools
- Mechanical shelling with simple machines operated manually
- Mechanical shelling with motorized equipment

II. WORKING PRINCIPLE

The person remained seated on the seat and started the pedaling activity with the help of pedals. Designed seat made up of plastic was provided on the machine itself for the user so that he/she could balance his/her body properly during the activity. The energy from the pedals was transmitted with the help of chain and sprockets made up of cast iron. Chain was used as the pedal chain, laid on the sprockets at the pedal end and at the main shaft in the horizontal direction. A flywheel was also fitted on this shaft which was used to store rotational energy. It resisted changes in rotational speed and provided continuous energy when the energy source was discontinuous. A set of another chain and sprocket was fixed on this shaft in the vertical direction connecting the shaft and bearing of the shelling unit. The maize was provided with help of hopper which used the force of gravity as the driving force to push the maize towards the shelling assembly. As the person started pedaling activity, the pedal side chain and sprocket drive the main shaft with the help of bearings and in turn the flywheel also started revolving and the rotational energy got stored in it so as to provide a continuous motion to the shaft. The rotating main shaft then in turn rotated another chain and sprocket and with the second chain and sprocket the bearing of the shelling unit started rotated and at the same time shelling unit also. From the reciprocating motion in the assembly maize separated out from the cobs. So, all the respective motions started simultaneously. The shelled maize were then collected at the outlet.

CHAIN AND SPROCKETS

A **c**hain is used to connect two sprockets. One sprocket is the driver sprocket and other sprocket is the driven sprocket. Motion and force can be transmitted via the chain from one sprocket to another, therefore from one shaft to another. Chains that are used to transmit motion and force from one sprocket to another are called power transmission chains. The chains were made up of rigid links which were hinged together in order to provide the necessary flexibility for warping around the driving and driven wheels. The wheels had projecting teeth and fit into the corresponding recesses, in the links of the chain. The wheels and the chain were thus constrained to move together without slipping and ensured perfect velocity ratio. The toothed wheels are known as sprockets. The chains were used to transmit motion and power from one shaft to another because the distance between the centers of the shafts was short. Chain drive gave high transmission efficiency as no slippage took place. Pitch of the chain is the distance between the hinge centre of a link and the corresponding hinge centre of the adjacent link. The diameter of the circle on which the hinge centers of the chain lie, when the chain is wrapped round a sprocket is known as pitch circle diameter of the chain sprocket.

Advantages of Chain and Sprockets

1. In chain and sprockets not any slip or creep, and so are more efficient than belt drives.
2. High transmission efficiency than friction drive.
3. They can operate under adverse thermal and atmospheric conditions.
4. It can operate under wet conditions.
5. It can use in both short and long distance power transmission.
6. It transmit more power than belt and rope drive.
7. The chain drive permits high velocity ratio in single step.
8. In low speed drive, chain drives are more practical than belt.
9. One chain can be used to transmit motion to more than one shaft.

Disadvantages

1. The chain and sprockets needs accurate and careful mounting.
2. The chain and sprocket careful maintenance, lubrication and slack adjustments.
3. Excessive stretching could cause variation in velocity.
4. Production cost is high.

III. DESIGN OF CHAIN AND SPROCKETS

Chains and sprockets were used for the transmission of power. One set of chain and sprockets was used at the pedal side and another was used to connect the main shaft to the cam shaft.

P = Pitch of the sprocket
d= Diameter of the pitch circle, and
T= Number of teeth on the sprocket

$$p = \mathrm{d}\sin(\frac{360}{2T})$$

P = 7.2 × Sin (180 0/18)
= 7.2 × Sin (100)
= 7.2 × 0.17
= 1.23 cm

The exact length of the chain (L) was determined as

$$L = \left\{\frac{P(T_1 + T_2)}{2} + 2\varkappa + \left[\frac{P}{2}csc\left(\frac{180^0}{T_1}\right) - \frac{P}{2}csc\left(\frac{180^0}{T_2}\right)\right] / \varkappa\right\}$$

T 1 = Number of teeth on the larger sprocket,
T2 = Number of teeth on the smaller sprocket

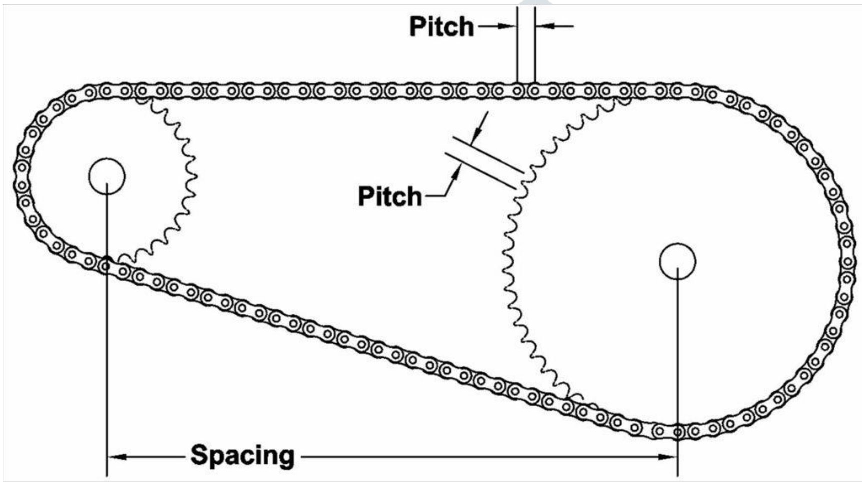
Where,
x= Centre distance between sprockets

Pedal side chain length:

L = 1.23(44+18)/2 + 2×63.6 + {1.23/2 cosec (180/44) 1.23/2cosec (180/18)/63.6}
= 165.93+0.615×{(-1.23)-(0.615×1.83)}/63.6
=165.90 cm

Length of chain connecting main and bearing shaft

L =1.23(18+9)/2+2×27.5+ {(1.23/2) cosec (1800/80)-1.23/2cosec (1800/9)}/27.5
= 71.6+ {(1.23×1.83)-(1.23×1.09)}
= 71.63 cm



Roller chain

IV. CONCLUSION-

The maize is shelled traditionally by hands. This is done in such a way that maize is rubbed against another until the grains are removed from the cob, this traditional method of shelling is highly tedious, inefficient and time consuming with low productivity. The power operated maize sheller machine requires electrical energy for its working and its capital investment is also high compared to the conventional methods of shelling but in rural areas supply of electricity is not good at all times. Hence there was a need for an innovative idea or product that is feasible, safe, cost effective and productive for the Indian farmer.

Keeping in view the prevailing conditions, a continuous and high capacity pedal operated maize shelling machine was designed, developed and tested by RSM methods. The effect of operational variables was studied on response variables. The main criteria for optimization were capacity of machine, mechanically damaged grain and shelling efficiency. The moisture content had no effect on the capacity of pedal operated maize shelling machine. Increase in speed of operation, capacity of the machine had shown a continuous and sharp increased. Capacity of the machine was maximum when the shelling disc r.p.m was maximum.

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