

Design and Development of Multipurpose Harvesting Machine

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Abstract— This study aimed to develop a multipurpose digger for harvesting potatoes well as separating and transporting them over soil surface with minimum losses, mechanical damage. Potato harvester is developed by adding a successful vibrating separating mechanism that should base on separating potatoes with minimum losses and damage. A potato digger was developed by adding a vibrating device to operate the digging blades and reduce the required drawbar pull and potato tuber bruising. The vibrating device includes beam holder, follower, cam and transmission system. The overall operating parameter (T) was also analyzed. The natural frequencies of the digging blade, potato tuber and disturbed soil were determined

Index Terms— Damage Tubers, Mechanical Harvesting, Potato, Sandy Soil

I. INTRODUCTION

Potato is considered as one of the most important vegetables crops, supplying human with carbohydrate. It is classified as the first alternative of the grain crops to solve the shortage of food in some countries. Potato is occupied in India the first position according to exportation vegetables crops, yearly producing about 2.5 million ton, it is exported from about 205 to 255 ton, it is raised to 435 ton in as a fresh and frozen potatoes to Arabian and European countries, according to Agricultural Researches Station. By traditional harvesting process, potato harvesting is time consuming process. It is highly time consuming and low efficient. At the time of harvesting, the harvesting process takes too much time This machine can finish mining, soil and potato separation in one time and can harvest the potato with the potato stems. It is a multifunctional machine. This is very efficient and also reduces damages of potatoes during harvesting. This study aimed to develop a multipurpose digger for harvesting potatoes as well as separating and transporting them over soil surface with minimum losses, mechanical damage. Potato harvester is developed that should base on separating potatoes with minimum losses and damage by adding a successful vibrating separating mechanism. Different types of soil and its properties as well as environmental conditions certainly affect production. . In future this project is use for any type of harvesting like peanut and sweet potatoes.

Identification of Problem

The potato harvesting is time consuming process and also requires higher man power. There is no any machine available

in agricultural sector for potato harvesting. For minimizing time as well as labour cost we are decided to manufacturing a mechanism for potato harvesting. This machine can finish mining, soil and potato separation in one time and can harvest the potato with the potato stems. It is a multifunctional machine This is very efficient and also reduces damages of potatoes during harvesting.

II. DESIGN OF MACHINE COMPONENT

A. Frame

The frame is made of square pipe of mild steel. The frame takes a rectangular shape include elements to fix (a spindle transports the vibrating movement to a cam at the end of it and vibrating system). The digger frame is carried by two tire wheels. The frame takes a rectangular shape with dimension of 760*610*50 mm

B. Separating unit

The separating unit is consists of a blade the distance between rods, this frame is connected to vibrating blade by nuts and bolts, also at the end of that frame longitudinal frame is provided.

Filtering net box (MS) = 760*520 mm

Diameter of rod (MS) = 5 mm

Spacing between two rods =40mm

Number of rods =21

C. Transmission system

The transmission system consists of a spindle transmit rotating motion from to a rotating shaft to the cam. The cam converts rotary motion into reciprocating motion to linkage shaft. This shaft is connected through the longitudinal frame to digger blade.

D. Design of shaft

The shaft is made up of MS material. The diameter of the transmission shaft was calculated according to design of shaft for transmit the power considering the bending moment, axial load, and the torque acting on shaft.

Standard Diameter of PTO shaft = 35mm

[from V. B. Bhandari, Design of Machine Element, Page no.31, Table no. 2.2]

50C4 ($S_{ut}=700 \text{ N/mm}^2$, $S_{yt}=460 \text{ N/mm}^2$)

Allowable shear stress according to ASME Code Without Key Way

$$\tau_s = 0.18 * S_{ut}$$

$$= 0.18 * 700$$

$$\tau_s = 140 \text{ N/mm}^2 \quad \dots\dots\dots (1)$$

$$\tau_s = 0.3 * S_{yt}$$

$$= 0.3 * 460$$

$$\tau_s = 138 \text{ N/mm}^2 \quad \dots\dots\dots (2)$$

Smaller of value from equation 1 and 2

$$\tau_s = 138 \text{ N/mm}^2$$

$$P = 5 \text{ Kw}$$

$$P = 5 \cdot 10^3$$

$$N = 540 \text{ r.p.m}$$

Torque (T) :

Now,

$$P = (2 \pi NT)/60$$

$$P = 5 \cdot 10^3 \text{ W}$$

$$N = 540 \text{ r.p.m}$$

$$5 \cdot 10^3 = (2 \pi \cdot 540 \cdot T) / 60$$

$$T = 88.4194 \cdot 10^3 \text{ N-mm}$$

E. Eccentric (Arm)

The main function of the arm is convert the rotating motion of the cam to reciprocating motion. Cam and follower are linked together by means of 2 bolts.

F. Wheels

Wheels are used to support and carry the load of whole body of project. The wheels are used of diameter 360 mm for reduce height of project from ground level & project can work properly for underground root crops.

G. Bearings

Bearings are machine elements that allow components to move with respect to each other. Bearings are used to support more skyscrapers to allow them to move during earthquakes as well as bearings enable the finest of watches to tick away happily. Compare the load capacity of a roller of length and diameter equal to the diameter of a ball.



Fig. Ball Bearing

Selected Bearing as per Standard Table [DDB, Page no.4.16] [From V.B. Bhandari. Design of Machine Element, Page No.567, Table no 15.5]

Dia of shaft = Bore Dia. (D) = 35 mm.

Bearing No. = 6207

Outside Dia. Of Bearing (D) = 72 mm

Width of Bearing (B) = 18.25 mm

Static Capacity of Bearing (Co) = 13.43KN

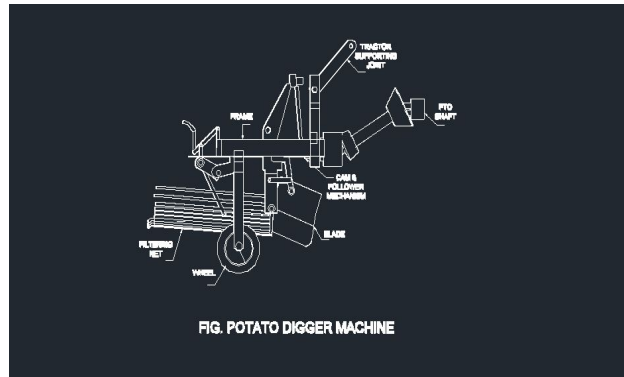
Dynamic Capacity of Bearing (C) = 19.62 KN

G. Blade

The blade attached at an angle of 15-20 degrees depending upon the depth needed with thickness of 8 mm. The material used for blade is MS.

III. CONSTRUCTION AND WORKING

This is simplest mechanism can used in project. The basic concept is that power transmission from one shaft to another shaft using two sprocket and chain but due to more noise as well as more cost and maintenance we can not use this mechanism in this project. The flat belt transmit very flow amount of power due to less friction of grip. It has more space which increase the cost of project and it give low velocity ratio while power transmit mission also the end of flat belt are joined so drive is not smooth. Universal joint it is known as U joints, allow positive transmission of rotating power at much larger angle than is permissible with a flexible coupling. Soil filtering is primarily done for filtering stones from soil which are not intended in farming. It can also be used for harvesting various vegetables & crops, mainly potatoes, turmeric, ginger, etc.



IV. POWER TAKE OFF (PTO)

PTO one of the several methods for taking power from power source to tractor such as running engine and transmitting it to an application such as an attached implement and separate machines. Most commonly it is system comprising a splined output shaft on tractor, designed so that PTO shaft a kind of drive shaft can easily connected and disconnected, and a corresponding input shaft on application end. The PTO allows implement to draw energy from engine. The PTO and its associated shafts are couple by universal joints. Agriculture PTOs are standardizing in dimensions and speed.



Fig. PTO Shaft

Safe use of potato harvesters

This information sheet is aimed at operators of potato harvesters. It describes typical hazards from the use of potato harvesters and gives guidance on how to minimize the risks to operators during harvesting work. It does not cover other

health or safety issues there might be when grading, handling or stacking potatoes.

There are particular features of various types of potato harvester, which you can take into account when considering the hazards, risks and precautions. For example manned harvesters, with workers stationed at a picking table, may form risks that are variable from unmanned machines. This information sheet covers the typical hazards likely to be found when using most types of manned and unmanned potato harvesters.

General guidance on safe working practice

- Everyone working on the harvester understands and obeys the safety instructions in the handbook, including the safe way to clean the harvester machine of stones, sand, potatoes etc.
- On harvesting machine, there can be a two way system for communicating between the workers on the picking and sorting platform and the tractor driver. These harvesting machines can be fitted with an audible warning alarm intended to draw the attention of those on the platform to the starting of the moving parts, e.g. before starting the engine and reversing or engaging drives.
- Machines with a picking and sorting platform require emergency stops accessible from the work position to stop the conveyor to the platform.
- We should take particular care when reversing; make sure we can see what is behind the harvester or get help if the view is obscured. People have been killed when they got off a manned harvester and approached a machine on foot or were run over by it.
- Stop the tractor before anyone gets on or off the harvester machine and does not allowed anyone to jump on or off the harvester when it is moving or stationary. Always use the access ladder to mount and dismount from the picking and storing the platform and do not climb over the machine.
- Picking and bagging platforms on manned harvesters require guard rails to prevent people falling off the harvester machine.
- Take advantage of relevant training/courses provided by manufacturers/dealers. They will help to ensure the safe and efficient use of your potato harvester.
- Workers on a harvester machine will also require training. Do not forget the training needs of any temporary and casual staff.

V. PROBABLE OUTCOME

- It is machine which separate potatoes from soil.
- The vibration reaches relative separation speed but cause less damage on potato.
- Mechanical harvesting of potato had a larger influence on lifted as well as unlifted and damaged potatoes which was not favoured for crop use.

- The average of without damage potatoes is more.
- It will save time as well as money and Required less man power.

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