

REVIEW ON SOLAR FOOD CUTTER WITH SHAFT MOUNTED SPEED REDUCER FOR AGRICULTURAL FIELD APPLICATION

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Abstract

Indian agriculture has a lot of dependency on farm labour for many kinds of operation. The main products of the farm are needed to be harvested. Now-a-days the cutting of fruits; flowers and vegetables are done by snips. Hence the main purpose now-a-days is to reduce the labour hours. Thus taking into account the fact that the development of a portable, light weight multi-purpose agricultural cutter using solar powered 12volts D.C motor is required. For this purpose the development of the cutter and then the shaft mounted speed reducer gear box is to be done. After development of cutter, the stress developed at the cutting edge and force acting on entire linkage will be measured. Then these stresses will be evaluated in ansys by applying proper boundary condition. Again different material will be tested and examined for manufacturing.

Keywords: Agricultural cutter, shaft mounted speed reducer, Solar panel.

1. Introduction

Agriculture is an important part of the Indian economy and culture, and it can play an important role in distributed generation of energy. This project concept identifies the opportunities for solar energy use in agriculture. Farmers have the tradition of being stewards of the land, and their investment in renewable energy supports their role of protecting the land, air, and water. Solar energy, like other renewable, offers an opportunity to stabilize energy costs, decrease pollution and greenhouse gases (GHGs), and delay the need for electric grid infrastructure improvements. Solar energy systems have low maintenance costs, and the fuel is free once the higher initial cost of the system is recovered through subsidies and energy savings (from reduced or avoided energy costs).

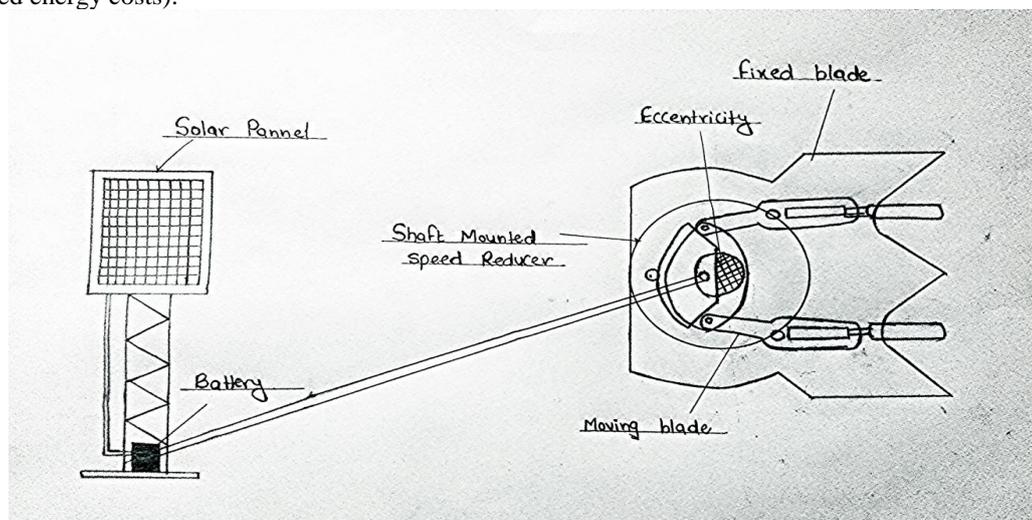


Figure 1: Solar Agricultural Cutter

1.1 Problem Statement

Indian agriculture has lot of dependency on farm labour for variety of operations to be performed in agriculture farm right from land preparation for cultivation to harvesting of the agriculture produce. Fruits, vegetables, flowers etc, that are grown in the farm need to be harvested. Meaning that they have to cut from the plant using suitable methods so that they can be packed and then transported to the market.

The cutting of vegetables like Brinjal (eggplant), lady finger, Capsicum, pumpkin, bottle gourds, bitter gourds, ridge gourds, cucumber, pumpkin, green peas, French beans, tomatoes, etc is normally done by use of plucking by fingers or using hand tools like snipes and shears as shown below.

Similar is the case with fruits like apple, plums, cherries, guava, pear, custard apple, jackfruit, water melon, litchis etc. Flowers grown in open field like roses, marigold, sunflower, tube rose, gladiolus, aster, etc which are marketed in bulk quantity are also cut by hand.

If observed keenly this activity of cutting the produce from the plant takes considerable amount of labour hours, it is tiresome and monotonous. Presently there are no mechanical means of carrying out this activity.

Thus taking into account the fact that all this activity is done in open field where abundant sunlight is available to tap solar energy the project concept proposes to design and develop a portable, light weight multi-purpose agriculture cutter and shear to carry the above mentioned activity using solar powered 12 Volt DC motor.

1.2 Energy used in Agriculture

As energy prices and volatility have increased in the past decade, incentives for energy efficiency and on-site renewable energy have emerged. Solar energy is emerging as a alternative energy source that ensures predictability, independence and even cost effectiveness for a number of agricultural applications. Potential is even higher for crop farming in India where in majority of agriculture work is done using farm labour using hand tools. Mechanization of farming activity will lead to reduced labour cost which has become extremely important in present age where shortage of farm labour due industrialization and inflation.

2. Literature Review

“Chiu-Fan Hsieh” in his paper titled “The effect on dynamics of using a new transmission design for eccentric speed reducers” has stated new transmission design for eccentric speed reducers that differs from that used with a traditional cycloid speed reducer. This paper proposes a new transmission design for eccentric speed reducers that differs from that used with a traditional cycloid speed reducer [1].

“R. Joshua, V. Vasu and P. Vincent” in his paper titled “Solar Sprayer - An Agriculture Implement” has stated that, Energy - demand is one the major thread for our country and finding solutions, to meet the “Energy - demand” is the great challenge [2].

“Ketchpel, ‘Jr. et al.” in his patent has stated that, A shear for grass and the like includes a tooth plate on which is pivotally mounted a plurality of shearing members, each including a narrow and resiliently deformable blade element [3].

“Hemant Ingale, N.N.Kasat” in his paper titled “Automated Solar Based Agriculture Pumping” he stated that, Solar power is absolutely perfect for use with irrigation systems for gardens, allotments, greenhouses, and polytonal. When the sun is shining you need more water and so the solar power is there for the pump. By adding a suitable deep-cycle leisure/marine battery, power can be made available 24 hours per day enabling watering in the evening - the best time to water plants in the summer so that the water has a chance to soak into the ground [4].

3. Design and Development

The development of concept is divided into three steps:

- Design Development, kinematic and strength analysis of multi-purpose agriculture cutter.
- Design Development kinematic and strength analysis of a shaft mounted speed reducer.
- Selection of proper solar panel to fulfil the requirement.

3.1 Design of Multi-purpose Agricultural Cutter

Design of multi-purpose agriculture cutter and shear suitable to cut all the above mentioned vegetables, fruits and flowers. It is obvious that there is a variety in stem diameter sizes and strength, thus a cutter with appropriate 'admit between shear blades' and appropriate strength is to be developed to achieve a cutting rate of minimum of 10 to 12 cuts per minute to achieve higher productivity and optimal use of labour by reducing labour fatigue and time. The concept of the shear will be developed on the basis of sketch shown below.

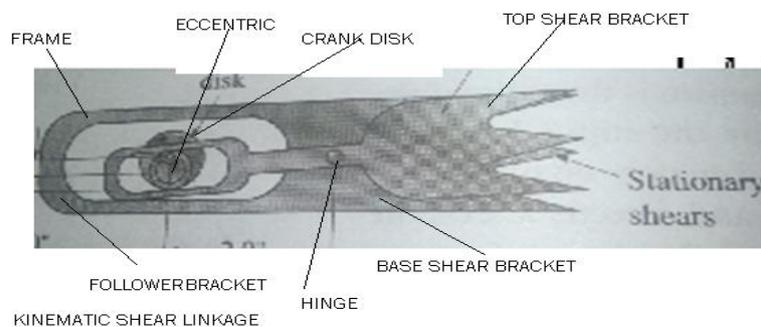


Figure 2: Agricultural Cutter

The kinematic linkage for the multi-purpose agricultural cutter and shear mechanism is as above. The motor drives the eccentric shaft to rotate which will make the movable arm bracket to oscillate. The movable arm bracket then imparts this oscillating motion to the moving blade arms which will oscillate about respective hinges to bring into effect the cutting or shearing action between the shear blades.

3.2 Design of Shaft mounted speed reducer

Design of a shaft mounted speed reducer to power the shear mechanism with suitable shearing torque so that the stem diameters upto 8 to 10mm of various agriculture produce. The arrangement of shaft mounted speed reducer is so selected that it gives maximum reduction ration (1:18) in minimum space and minimum weight owing to the fact that the agriculture cutter or shear is to be of minimum weight for efficient use the general arrangement of the gear box is to be as shown below.

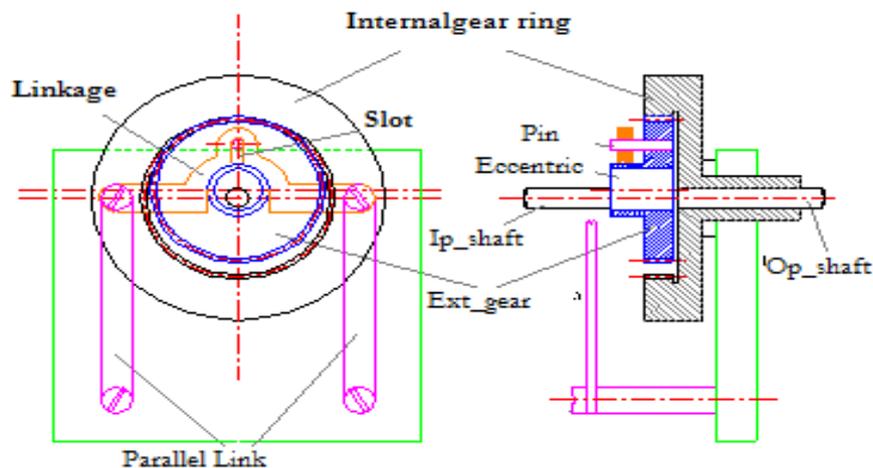


Figure 3: Speed Reducer

A standard internal gear and External gear are meshed without tooth interference. On the driving shaft is mounted an eccentric, the axis of the driving external gear follows the motion of eccentric, but is kept from rotating about its own axis by pin, which works in the slot. Parallel Linkage is actuated by the eccentric, which constantly maintains slot in a perpendicular position through the action of parallel links, pivoted on studs. Since the axis of external gear follows the motion of Eccentric and the gear does not rotate about its own axis, the motion imparted to the driven internal gear will be uniform.

➤ **Formula**

$$\text{Output speed} = \text{Input speed} \times \left(\frac{N-n}{N} \right)$$

Where;

N = No. of teeth on internal gear

n = No. of teeth on external gear

4. Motor Selection

Thus selecting a motor of the following specifications

12 V DC motor

Power = 1/15hp=50 watt

Speed= 0-2000 rpm (variable)

Motor is a 12 V DC motor, Power 50 watt, the speed of motor is varied by means of an electronic speed variator. Motor is a commutated motor i.e. the current to motor is supplied to motor by means of carbon brushes. The power input to motor is varied by changing the current supply to these brushes by the electronic speed variator; thereby the speed is also is changes. Motor is foot mounted and is bolted to the motor base plate welded to the base frame of the indexer table.

5. Results and Discussion

Testing of the agriculture cutter cum shear mechanism to determine

1. Maximum admit between blade capacities of cut.
2. Maximum number of cuts per minute for various item sizes.
3. Comparison of the newly developed agriculture cutter cum shear mechanism with conventional practices on grounds of productivity improvement, savings in labour cost and payback time of mechanism.

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