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Development of Bullock Cart Mounted Electricity Generation Unit

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A B S T R A C T

Draught animals are major source of motive power for majority of farmers. In India bullocks, buffaloes, camels, horses, mules and donkeys are common draught animals. These animals perform different field operations and are also used for rural transportation. In Indian agriculture, bullock farming operations are being carried out by small and marginal farmers and bullock power play an important role in many works. The availability of electric power in rural areas is a serious problem. The one way of utilizing bullock power could be for electricity generation to meet out the demand of the house hold purpose in villages. With this aim, the electricity generation unit was installed in the bullock cart and generated electricity was stored in battery. Alternator is used to produce current and that can be used for charging of battery.

Introduction

Draught animals power (DAP) play a dominant role in rural economy. Although an increasing mechanization is replacing the animal power in the villages, reducing the total DAP, yet India has to depend on animal energy for many years to come from agricultural operations and transport of farm products. The draught animal power has not been found adequate and, thus this is being supplemented by mechanical power, especially for tillage, irrigation and threshing (Singh, 1994). Ninety percentage of land holdings are distributed in marginal to semi-medium farm holdings. It covers about 50 per cent of total cultivable land. This asset has been cultivated using farm animals like bullocks, buffaloes and camels, where tractors and tillers are uneconomic, besides being too expensive for small farmers (Paras *et al.*, 2012). Fragmentation of land is also continuing. In such situation DAP is important.

Normally, bullocks are being used in agriculture for field operations as well as transport purpose. In Indian agriculture, bullock farming operations are being carried out by small and marginal farmers and bullock power play an important role in many works. Normally, the transport of goods from home to fields is being carried out by the use of bullock carts.

Rural electrification is one of the main requirements for a country like India with major population of approximately 70 per cent living in rural areas. Rural and the remote areas, people depend on the non-commercial fuels like firewood, agricultural wastes and animal wastes. Such type of areas has very low power. In a developing country like India the majority of the population lives in remote rural areas with no utility grid and this seems to be the main obstacle to overall development (Shau *et al.*, 2014).

The availability of electric power for lighting the lamps in rural areas is a serious problem and hence generation of electricity plays an important role by adopting renewable energy or any other source. Normally, alternators are being used to produce current and that can be used for charging of battery.

Hence, the development of an electricity generation unit in the bullock cart, which generate electricity and store it in battery that can be used in farmers house.

A pair of bullock (breed: Ongole) weighing 990 kg was used as power source of pulling the cart. As the bullock cart moves, the rotational speed of wheels is transferred to the gear box assembly to increase the speed ratio. The output speed of gear box unit is further connected to alternator through belt and pulley system for power transmission. The generated electricity by using alternator, stored in battery.

Double bullock cart

In this study, double bullock cart has been used for generation of electricity. A pair of bullock was used as power source for pulling the cart. The bullock cart mainly consists of two pneumatic wheels and a suitable platform for loading the cart. A suitable yoke was used for a pair of bullock which was made of wood. The platform is provided with wooden planks and the operator is capable to control the bullock by sitting on the platform. The specification of double bullock cart used for is presented in table 1. The drawing of double bullock cart is shown in figure 1. The different components of bullock cart are given below.

Pneumatic wheels

The bullock cart is provided with two pneumatic wheels for transportation purpose. Pneumatic wheels were fixed to axle of cart. The entire weight of cart was supported by two pneumatic wheels during transportation. The bullock cart is capable to move freely on murrum road or tar road as the wheels support the entire weight.

Beam

Beam of bullock cart is made of MS pipe and there is a provision to tie the bullock on the cart. A pair of bullock can be placed on either side of beam for pulling the cart.

Yoke

Yoke is energy harnessing part of the bullock cart. It is made up of wood which is used to fix over the neck of bullock for supporting purpose. The suitable yoke was used on the bullock cart and it was observed that no injury was found over the neck of bullock as the yoke is supported with supporting cloth, rubber materials.

Electricity generation unit

Electricity generation unit in bullock cart is mainly used to generate. This system comprises different functional components which are arranged systematically to produce electricity. The experimental setup of the study is shown in plate 1. Functional

components of electricity generation unit in bullock cart were mentioned below.

Power transmission system

The power transmission system basically consists of gear box unit, belt and pulley system, alternator and the path flow of power from pneumatic cart wheels to the alternator unit. Power transmission system of the electricity generation is shown in plate 2. As the bullock cart moves, the rotational speed of wheels is transferred to the gear box assembly to increase the speed ratio. The main purpose of gear box assembly is to increase the speed of alternator. The output speed of gear box unit is further connected to alternator through belt and pulley system for power transmission. The speed ratio of power transmission system is 1:12. As the bullock cart moves, the power was transformed to alternator.

The power transmission system is basically needed for the generation of electricity in the system. A pair of bullock pulls the cart at the walking speed and enhanced the speed in the gear box assembly and ultimately the power is transferred for generation of electricity. The power is transferred for generation of electricity.

Alternator

An alternator is an electromechanical device that converts mechanical energy to electrical energy in the form of alternating current. It is installed below the platform of bullock cart. It is used to convert mechanical energy obtained from bullocks into electrical energy through gear box assembly and belt and pulley system. The output shaft of belt and pulley system was connected to the input shaft of alternator. The alternator rotates as the bullock cart moves in forward direction. The speed of alternator basically depends upon the travelling speed of bullock and payload on the bullock cart. Speed of alternator was measured using a digital tachometer

Alternators operate on the fundamental principle of electromagnetic induction. They consist of an armature winding and a magnetic field. The armature windings are mounted on a stationary element called 'stator' and field windings on a rotating element called 'rotor'.

When the rotor is rotated the stator winding or conductors are cut by the magnetic flux of the rotor poles. Hence, an emf is induced in the stator conductors which further causes establishment of electric potential that is voltage. Because the rotor poles are alternately north and south, they induce an alternating emf in the stator conductors. The emf generated in the stator conductors is conveyed to distributor box.

Battery

The electricity generated in the system was stored in the lead acid battery. There was one battery of 12 volts 60 Ah was connected to store electricity.

The main function of the battery was to store generated electricity. Battery was connected in series to an ammeter as well as voltmeter and also to the control panel.

Voltmeter

The voltmeter indicates the available volts of battery. As the charging of battery is continuous, the voltmeter also indicates the volts during charging time. The voltmeter having the range of 0-20 V was fixed in the battery charging unit.

Ammeter

This unit measures the current in Amperes

and was connected to the battery charging unit. The ammeter which is having a range of 0-20 A was fixed for measuring purpose.

Control panel

This unit was provided in electricity generated unit for the placement of voltmeter, ammeter and their controls. A box type arrangement has been made in the system to observe the readings of voltmeter as well as ammeter also.

Bullocks are main source of power in agriculture fields as well as for pulling of carts. Rural electrification is one of the main requirements for a country like India with majority of the population lives in remote rural areas with no utility grid and still uses kerosene for lighting. The one way of utilizing bullock power could be for electricity generation to meet out the demand of the house hold purpose in villages. The present work provides a method for developing bullock cart mounted electricity unit by using draught animal power which helps to generate electricity. Small battery can be charged through the electricity generation unit and that can be used in farmer's house. This is concluded that draught animals are the great energy source for generating electric power and also meet the demand of electric power in rural areas.

Table.1 Specification of double bullock cart

Sl. No.	Components	Dimensions
1	Pneumatic wheel diameter (cm)	70
2	Axle diameter (cm)	6
3	Axle length (cm)	122
4	Platform size (cm)	168 × 90
5	Yoke length (cm)	200
6	Height of platform from ground (cm)	80
7	Length of cart from rear to yoke (cm)	368
8	Ground clearance (cm)	20
9	Distance between wheels (cm)	108
10	Weight (kg)	302

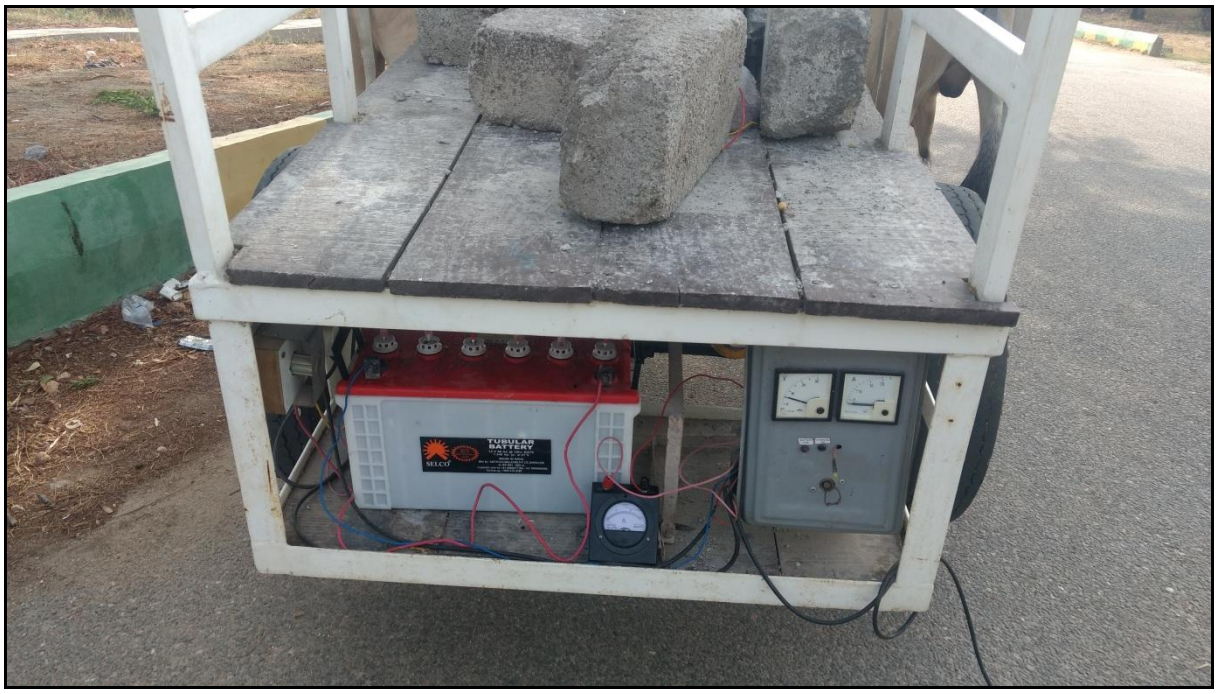
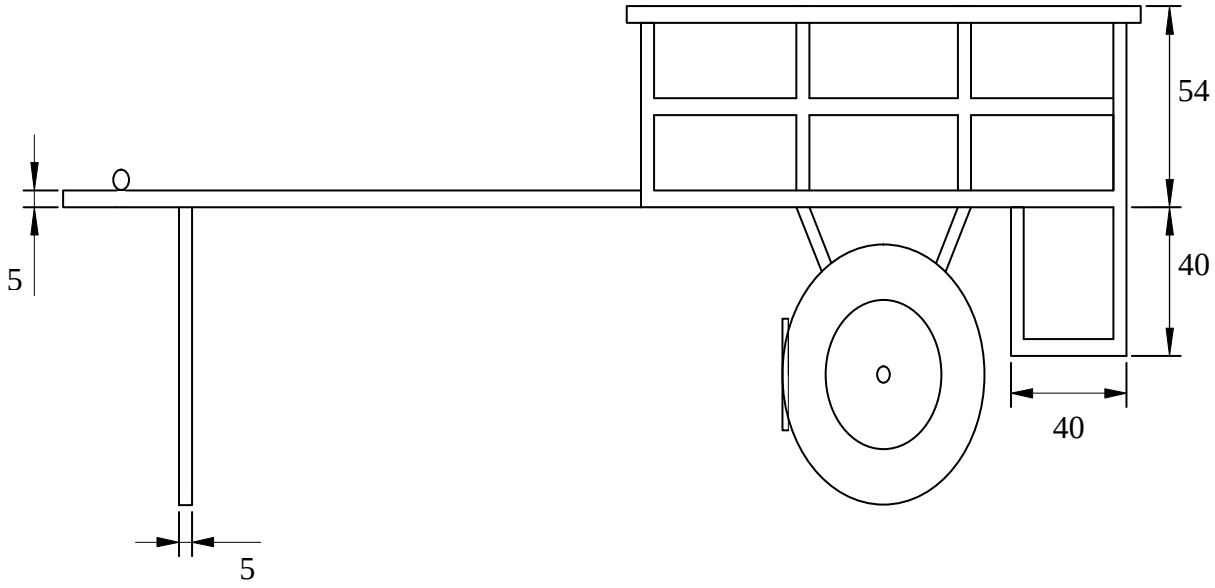
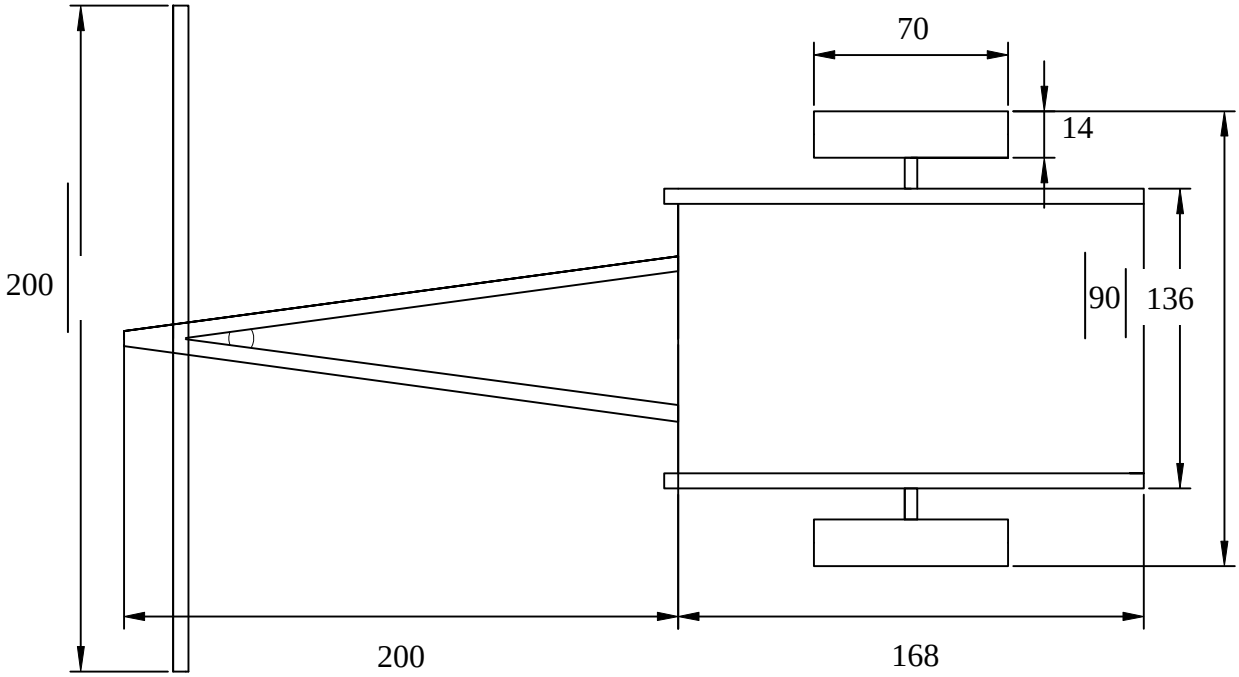


Plate.1 The experimental setup of the electricity generation unit in bullock cart

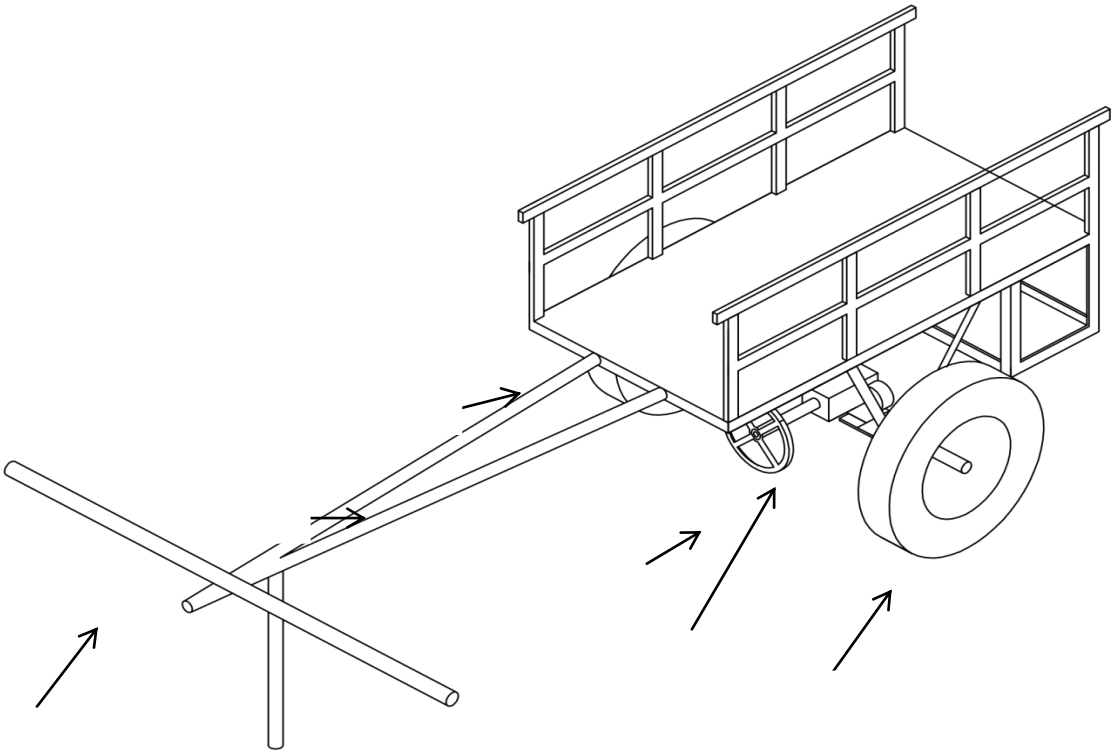
Plate.2 Power transmission system of the electricity generation unit installed in the bullock cart



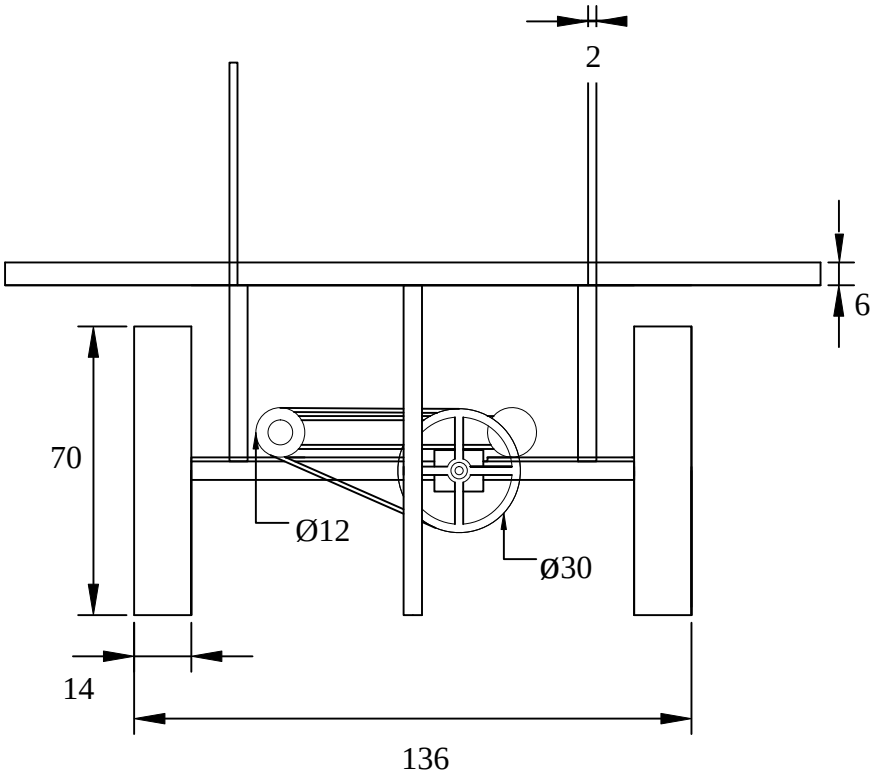
a) Side view of bullock cart



b) Top view of bullock cart



c) Three dimensional view of bullock cart



d) Front view of bullock cart showing power transmission system

Fig.1 Drawing of double bullock cart (dimensions in cm)

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