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Experimental study of micro industry of animal powered mechanical device for battery charging

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Abstract

In this paper authors designed, fabricated, cost estimated and experimentally studied the animal powered mechanical device to establish micro industry for electric generation to charge the batteries for home lighting, cooking food and minor irrigation at rural areas where grid power is not available and population rely on kerosene, wood and diesel pump-set for light, cooking food and irrigtion. Although animals have been using for domestic works since beginning of mankind, but the electricity generation by animal power is a novel technology. This invention provides animal powered mechanical device to charge the batteries. It has unique features of using animal power as prime mover for electric generator. Animal energy in the form of high-torque low-speed can be converted into low-torque high-speed through speed increaser to energize the electric generator.The electricity generated is stored in the batteries of different capacity and used for lighting, coocking and minor irrigation. This equipment is emission free, low cost and has long life. Also this equipment needs less maintenance and any person can run either skilled or unskilled.

Keywords: Animal power, micro industry, speed increaser, mechanical device, battery charging, electric generation.

1. Introduction

Over 1.5 billion people rely on kerosene for light. Lack of suitable home lighting is directly linked to illiteracy, poverty and health problems. The current widespread burning of kerosene also results in environmental pollution. Also over 17% of deforestation is because of cutting wood for cooking food at rural and remote areas. Wood is still used today for cooking in many places, either in a stove or an open fire. As with any fire, burning wood fuel creates numerous by-products, some of which may be useful (heat and steam), and others that are undesirable, irritating or dangerous. Smoke, containing water vapour, carbon dioxide and other chemicals and aerosol particulates, including caustic alkali fly ash, which can be an irritating (and potentially dangerous) by-product of partially burnt wood fuel. The other source using to cooking is a kerosene stove and gas flame which are very costly and harmful for health and also not available everywhere. Another method to cook food is using electric heater or induction cooker which needs continuous electric power. Similarly in developing countries like India who depend on agriculture need

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continuing power supply for irrigation etc. It is very costly and very difficult to availability of grid power at the remote areas but it is necessary of continuing power supply. To achieve this goal consists of using renewable energy sources, not only for large-scale energy production, but also for stand-alone systems.

In this paper authors introducing the animal power as new forms of renewable energy source. The force exerted by a working animal is approximately equal to 10-12% of its live weight, and this means for example, that a buffalo has a power output of about 300 W, or 5.4 MJ/d, if it is assumed that the animal works for 5 h per day [1-5]. Table 1 shows the weights, speed and output powers of different animals. However, many factors can reduce this output significantly.

1.1. Methodology

In many countries in Asia and Africa, and in Madagascar, the crop is threshed by being trodden underfoot (by humans or animals) in India (Chhattisgarh) it calls "Dhouri" The same method, but using a vehicle (tractor or lorry) is also commonly applied. The vehicle is driven in circles over the paddy bunches as these are thrown on to the threshing area (5m to 10m in diameter around the stack) in India (Chhattisgarh) it calls "Belan". In this study authors selected to use the animal pulled belan.

The device called belan comprises of a mechanical link means provided with an extended pipe to transmit animal power in form of high-torque low-speed to a speed increaser; a speed increaser provided with an input shaft mounted with 68 teeth gear and an output shaft mounted with 15 teeth gear for converting animal power received from a mechanical link in the form of a high-torque low-speed to low-torque high-speed in four stages; a belt and pulley system which is connected to the output shaft of the speed increaser for transmitting mechanical energy in form of low -torque high- speed received from the speed increaser to generator; generator to convert mechanical energy into electrical energy; and a storage system. The prime mover is preferably at least one draught animal such as a bullock. More preferably, the prime mover comprises of a pair of bullocks.

Table 1. Sustainable power of individual animals in good condition [1].

Animal	Typical weight kN (kgf)	Typical pull N (kgf)	Typical working speed m/s	Power output W	Working hours per day	Energy output per day MJ
Ox(Bullock)	4.5(450)	500(50)	0.9	450	6	10
Buffalo	5.5 (50)	650 (65)	0.8	520	5	9.5
Horse	4.0 (400)	500 (50)	1.0	500	10	18
Donkey	1.5 (150)	200 (20)	1.0	200	4	3
Mule	3.0 (300)	400 (40)	1.0	400	6	8.5
Camel	5.0 (500)	650 (65)	1.0	650	6	14

2. Experimental details of animal power system

2.1. Draught animal

The authors' main object is to use the animal power for generating electricity for domestic and agriculture use. And bullocks are mainly used in Indian agriculture for different purposes. For this experimental study authors use the pair of bullocks. The weights of bullocks are 456 kg and 478 kg. The mechanical link is fitted with a device pulled by pair of bullocks called belan which is made of wood and has the weight of 105 kg