

DESIGN AND FABRICATION OF MULTI UTILITY MOTORCYCLE FOR AGRICULTURAL PURPOSE

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ABSTRACT

The main objective of designing and fabrication of multi utility motorcycle is to provide farmers an ease of doing various operations in any place at any time. The few commonly performed operations by farmers are water pumping using conventional water pump, cutting grass manually and spreading fertilizers by hand or by tractor. Farmers find it difficult to use different machines for these operations. It also increases the cost for performing the operations individually. The multi utility motorbike will aid farmers perform the mentioned operation at ease and economically.

The 0.5 HP water pump to pump the water, grass cutter assembly and fertilizer spreader assembly will be attached to Pulsar 150 cc motorcycle using frames as a support. The power to run these components will be derived from the IC engine of the motorcycle. The ignition and combustion of the petrol occurs within the engine. The expanding combustion gases push the piston which in turn rotates the crankshaft. Ultimately, through the system of gears in the powertrain, this motion drives the motorcycle wheels. The power is transferred from motorcycle to these components through chain drives and bevel gears. Thus using multi utility motorcycle, farmers can pump water, cut grass and spread fertilizers, one at a time using a single source which saves both money and time.

Keywords: Grass cutter, fertilizer spreader, water pump, multi utility motorcycle

1. INTRODUCTION

1.1 AGRICULTURE IN INDIA

Agriculture is the most significant sector of Indian Economy. Indian agriculture sector accounts for 18 per cent of India's gross domestic product (GDP) and provides employment to 50% of the country's workforce. India is the world's largest producer of pulses, rice, wheat, spices and spice products. India has many areas to choose for business such as dairy, meat, poultry, fisheries and food grains etc. India has emerged as the second largest producer of fruits and vegetables in the world. In line with the information provided by Department of Economics and Statics (DES) the production of food grains for the year 2013-2014 is 264 million tons which is increased when compared to (2012-2013) 257million tons. This is a good symptom for the Indian economy from the agriculture sector. India remains among main three as far as production of different agricultural things like paddy, wheat, pulses, groundnut, rapeseeds, natural products, vegetables, sugarcane, tea, jute, cotton, tobacco leaves and so on. On the contrary, on advertising front, Indian agribusiness is as yet confronting the issues, for example, low level of business sector reconciliation and integration, availability of dependable and convenient information needed by farmers on different issues in farming.

Indian is an agriculture based nation, where over half of populace is rely upon agriculture. This structures the fundamental wellspring of pay. The dedication of agriculture in the national pay in India is even more, therefore, it is said that agriculture in India is a spine for Indian Economy. The commitment of farming in the underlying two decades towards the all-out national yield is somewhere in the range of 48% and 60%. In the year 2001-2002, this commitment declined to simply around 26%. The total Share of Agriculture and Allied Sectors, Including agribusiness, tamed creatures, and officer administration and fishery sub fragments the extent that rate of GDP is 13.9 percent amid 2013-14 at 2004-05 costs. Rural fares comprise a fifth of the complete fares of the nation. In context of the mind-boggling position of the Agricultural Sector, assembling and backing of Agricultural Statistics anticipate fantastic hugeness.

Most of the Indians are directly or indirectly depending on the agriculture. Some are legitimately connected with the cultivating and some other individuals are associated with working with these merchandise. India has the capacity to produce the food grains which can make vast difference in Indian Economy. To achieve targeted mark by the government it needs to provide support in case of land, bank loans and other machineries to the small farmers along with the big farmers with this we can expect some improvement in Indian economy.

Some of the salient features of Indian agriculture are subsistence agriculture, pressure of population on agriculture, mechanisation of farming, predominance of food crops, seasonal patterns, variety of crops, importance of animals and dependency upon monsoon. And the problems faced by agriculture sector are stagnation in production of major crops, soil exhaustion, decrease in fresh ground water, agricultural marketing, costly farm inputs, lack of storage facilities, effect of global climate change and farmer suicides

1.2 MULTI UTILITY MOTORCYCLE

To solve some of the above mentioned problems such as mechanisation of farming, importance to animals and costly farm inputs, we chose this project. The main objective of designing and fabrication of multi utility motorcycle is to provide farmers an ease of doing various operations in any place at any time. The few commonly performed operations by farmers are water pumping using conventional water pump, cutting grass manually and spreading fertilizers by hand or by tractor. Farmers find it difficult to use different machines for these operations. It also increases the cost for performing the operations individually. The multi utility motorbike will aid farmers perform the mentioned operation at ease and economically.

Millions of people in the villages of India without having reliable energy sources and means of power supply needed for the domestic or agricultural fields. Considering this, an attempt is made to develop a water lifting system using motorcycle. This setup is portable (mobility) as it is mounted on the same motorcycle. The time of operation depends upon the efficiency of this centrifugal pump used to lift the water. This mechanism is more reliable and useful in the remote village to get the sufficient source of power. The multi ability makes it more special.

Grass cutter machines have become very popular today. Most common machines are used for soft grass furnishing. In our project Grass cutter machine we are aimed to develop for operation and construction. Agriculture is the most important sector in the Indian economy. In India there is a great scope of grass cutter machine. In our country as well as other countries has also it is used in various fields for cutting the grass. The machine may consist of two, three or four blades depending upon the machine. The grass cutting machine is known as lawn mower. The grass cutting machine is available in the various types like reel (cylinder) mower, rotary and mulching mower, hover mower, riding mower, professional mower etc. but these are very costly and unaffordable also. Also, it requires a skilled person to operate it. Hence, it was found necessary to have a grass cutter with minimum initial cost and can be operated by unskilled labour.

India is agriculture based country. Near about 70% people of our country are farmers. Our economy also depends on agricultural products. Nowadays tremendous changes have occurred in conventional methods of agriculture like seed plantation, irrigation system, pesticides and spray used. For developing our Economic condition, it is necessary to increase our agricultural productivity and quality also. Farming process includes many stages, out of which fertilization is one of the important stages and which is not exploded up to the mark up till now. Nowadays, we are used to do spreading of fertilizer in traditional way which is time consuming, costlier as well as not provide comfort to the labour. Also, some tractor operated machines for spreading of fertilizer are available. So, what we need is an alternative to the traditional as well as tractor operated fertilizer spreading machine which will fulfil all the requirements. So, we are going to design a manually operated machine for fertilizer spreading by taking into consideration the user group and their needs which helps to them to work easy and functional.

The 0.5 HP water pump to pump the water, grass cutter assembly and fertilizer spreader assembly will be attached to Pulsar 150 cc motorcycle using frames as a support. The power to run these components will be derived from the IC engine of the motorcycle. The ignition and combustion of the petrol occurs within the engine. The expanding combustion gases push the piston which in turn rotates the crankshaft. Ultimately, through the system of gears in the powertrain, this motion drives the motorcycle wheels. The power is transferred from motorcycle to these components through chain drives and bevel gears. Thus using multi utility motorcycle, farmers can pump water, cut grass and spread fertilizers, one at a time using a single source which saves both money and time.

2. LITERATURE SURVEY

Indian agriculture has marked its presence at the global level. India ranks among the top countries in the world in production of a number of crops including rice, wheat, sugarcane, fruits and vegetables. However, despite this potential, two prime bottlenecks that have emerged and can become insurmountable problem in the foreseeable future are the stagnant productivity per hectare and shortage of agriculture labour. There is ample evidence which suggests that productivity improves dramatically with usage of more farm power. It has been further estimated that use of proper equipment can increase the productivity by up to 30 percent and reduce the cost by about 20 percent. There are millions of people live in the villages of India without having reliable energy sources and means of power supply needed for the domestic or agricultural fields. Considering this, an attempt is made to develop a water lifting system using motorcycle. Grass cutter machines have become very popular today. Most common machines are used for soft grass furnishing. In our project Grass cutter machine we are aimed to develop for operation and construction. Nowadays, we are used to do spreading of fertilizer in traditional way which is time consuming, costlier as well as not provide comfort to the labour. Also, some tractor operated machines for spreading of fertilizer are available. So, what we need is an alternative to the traditional as well as tractor operated fertilizer spreading machine which will fulfil all the requirements. So, we are going to design a manually operated machine for fertilizer spreading by taking into consideration the user group and their needs which helps to them to work easy and functional.

[1] Narode R. R , Sonawane A. B, Mahale R. R, Nisal S , Chaudhari S and Bhane A, designed and fabricated a manually operated fertilizer spreader. A method was generated to spread the fertilizer uniformly over a fallow land by dropping the fertilizer over the impeller disc. The system consists of a three wheels, two at the front and one at the back. These two wheels at the front are used to impel the fertilizer. The two hoppers are used to store the fertilizer; these hoppers are placed at some height from the wheel axle so that the fertilizer falls on to the impeller. The hopper is provided with flow control mechanism. In fertilization, the flow maintenance is necessary. Generally every crop should get sufficient amount of fertilizer. This condition is satisfied by Spring Mechanism. In normal conditions spring is not in tension and hopper is closed. As operator apply tension on the spring, controlling plate moves backward and hopper is open. Below this system there is an impeller. It is mounted on output shaft. Hooper opens on Impeller eccentrically and due to centrifugal action fertilizer spreads in the farm. This high value of centrifugal force is generated by the help of proper gear reduction ratio. The gears are coupled to the shaft of wheel. With this machine, percentage reduction in time required for Fertilization was observed to be 50% and reduction in labour cost as compared to conventional method was 80%. It has solved the problem of traditional way of Fertilization.

[2] Dileep KJ, Mushabir Hussain and Geetha S found that there are millions of people live in the villages of India without having reliable energy sources and means of power supply needed for the domestic or agricultural fields. Considering this, an attempt is made to develop a water lifting system using the pedal operated power with additional features as a sprayer for pesticides and insecticides. This setup is portable (mobility) as it is mounted on the same bicycle. The pedal operation of this cycle reduces alternate source of energy. At the same time it can be used for spraying the liquids (chemicals) with the same pedal power. The time of operation depends upon the efficiency of this reciprocating pump used to lift the water. This mechanism is more reliable and useful in the remote village to get the sufficient source of power. The multi ability makes it more special. The pump setup includes a housing in which a foot pedal and drive shaft rotate an eccentric disc rotating with the drive shaft moves a connecting rod which in turn causes push rod to move linearly.

[3] Kartik R. Khodke, Himanshu Kukreja , Sumit Kotekar, Nital kukade, C. J. Shende designed and fabricated a manually pushed lawn mower model of simple mechanism and low cost. A large pulley will be coupled to the driving wheel. A smaller pulley will be joined with the larger pulley through a belt drive. A bevel gear pair will transmit power from the smaller pulley to the cutting blades. In our seminar we fabricate the grass cutting machine for the use of agricultural field, to cut the crops in the field. This is a new innovative concept mainly used in agricultural field. It is simple in construction and its working is easy. The components that are used are motor, gear arrangement, cam, chain and sprocket, lead screw, wheel, control unit. Below the gear arrangement

cutting blade is fixed. When the motor starts running by the use of power supply, the shaft also rotates and that rotates the gear arrangement which is coupled with the motor. As the gear arrangement rotates the cam arrangement, it operates the sickle bar which tends to cut the plants or crops. The sickle bar has one is fixed cutter and another one is movable cutter which is placed on it. The whole set up is placed on a movable base which has a wheel arrangement.

[4] Sheikh Mohd and Shahid Mohd says that agriculture being one of the major occupations in India, Agriculture plays a vital role in the Indian economy. Indian agriculture has registered impressive growth over last few decades. It is very essential to discover and implement new idea in this field, though lot of work has been done in this area. It is unfortunate that, these ideas are not being implemented properly in actual field. This is due to high cost and is complicated for rural people. Multipurpose agriculture or farming machine is basic and major machine involved in agriculture for maximum yielding. The Conventional method of ploughing and seed sowing is a laborious process and hence for that reason there is a scarcity of labours and basically, many farmers in India also use bullocks, horses and he-buffalo for farming operation. This will not satisfy need of energy requirement of the farming as compared to other countries in the world. This result in delayed agriculture crop production practices to overcome these difficulties, I am thinking that human and animal efforts can be replaced by some advance mechanization which will be suitable for small scale farmer from economical and effort point of view. So, developing this machine will satisfy all this need and to solve labour problem. A multipurpose farming machine is designed. The multipurpose farming machine is doing four operations i.e. ploughing, seed sowing, and irrigation and transportation purpose. The multipurpose farming machine is driven by 100cc engine.

[5] Imhade P. Okokpujie , Kennedy Okokpujie , Enesi Y. Salawu and Abdurrahman O Ismail designed, constructed and tested a single stage centrifugal pump. Electric motor drives the centrifugal pump, which draws fluid (water) from a water storage wall and delivers same through a flow control valve to a tank. The experimental results obtained shows that the tested pump can develop a head, (H) of 30m, volumetric discharge, (Q) of 9m³/hr and the speed of 2900 rpm for an input power of 1.5HP (1.1k). The operation of the pump was observed to be very smooth with low vibration and noise level on the pump and motor respectively, this guarantee the reliability of the pump in service.

3. WORKING

3.1 WORKING OF A 4 STROKE ENGINE

A four-stroke cycle engine is an internal combustion engine that utilizes four distinct piston strokes (intake, compression, power, and exhaust) to complete one operating cycle. The piston makes two complete passes in the cylinder to complete one operating cycle. An operating cycle requires two revolutions (720°) of the crankshaft. The four-stroke cycle engine is the most common type of small engine. A four-stroke cycle engine completes five Strokes in one operating cycle, including intake, compression, ignition, power, and exhaust Strokes.

Intake stroke: The intake event is when the air-fuel mixture is introduced to fill the combustion chamber. The intake event occurs when the piston moves from TDC to BDC and the intake valve is open. The movement of the piston toward BDC creates a low pressure in the cylinder. Ambient atmospheric pressure forces the air-fuel mixture through the open intake valve into the cylinder to fill the low pressure area created by the piston movement. The cylinder continues to fill slightly past BDC as the air-fuel mixture continues to flow by its own inertia while the piston begins to change direction. The intake valve remains open a few degrees of crankshaft rotation after BDC. Depending on engine design. The intake valve then closes and the air-fuel mixture is sealed inside the cylinder.

Compression stroke: The compression stroke is when the trapped air-fuel mixture is compressed inside the cylinder. The combustion chamber is sealed to form the charge. The charge is the volume of compressed air-fuel mixture trapped inside the combustion chamber ready for ignition. Compressing the air-fuel mixture allows more energy to be released when the charge is ignited. Intake and exhaust valves must be closed to ensure that the cylinder is sealed to provide compression. Compression is the process of reducing or squeezing a charge from a large volume to a smaller volume in the combustion chamber. The flywheel helps to maintain the momentum necessary to compress the charge. When the piston of an engine compresses the charge, an increase in compressive force supplied by work being done by the piston causes heat to be generated. The compression and heating of the air-fuel vapour in the charge results in an increase in charge temperature and an increase in fuel vaporization. The increase in charge temperature occurs uniformly throughout the combustion chamber to produce faster combustion (fuel oxidation) after ignition.

The increase in fuel vaporization occurs as small droplets of fuel become vaporized more completely from the heat generated. The increased droplet surface area exposed to the ignition flame allows more complete burning of the charge in the combustion chamber. Only gasoline vapour ignites. An increase in droplet surface area allows gasoline to release more vapour rather than remaining a liquid. The more the charge vapour molecules are compressed, the more energy obtained from the combustion process. The energy needed to compress the charge is substantially less than the gain in force produced during the combustion process. For example, in a typical small engine, energy required to compress the charge is only one-fourth the amount of energy produced during combustion.

The compression ratio of an engine is a comparison of the volume of the combustion chamber with the piston at BDC to the volume of the combustion chamber with the piston at TDC. This area, combined with the design and style of combustion chamber, determines the compression ratio. Gasoline engines commonly have a compression ratio ranging from 6:1 - 10:1. The higher the compression ratio, the more fuel-efficient the engine. A higher compression ratio normally provides a substantial gain in combustion pressure or force on the piston. However, higher compression ratios increase operator effort required to start the engine. Some small engines feature a system to relieve pressure during the compression stroke to reduce operator effort required when starting the engine.

Ignition event: The ignition (combustion) event occurs when the charge is ignited and rapidly oxidized through a chemical reaction to release heat energy. Combustion is the rapid, oxidizing chemical reaction in which a fuel chemically combines with oxygen in the atmosphere and releases energy in the form of heat. Proper combustion involves a short but finite time to spread a flame throughout the combustion chamber. The spark at the spark plug initiates combustion at approximately 20° of crankshaft rotation before TDC (BTDC). The atmospheric oxygen and fuel vapour are consumed by a progressing flame front. A flame front is the boundary wall that separates the charge from the combustion by-products. The flame front progresses across the combustion chamber until the entire charge has burned.

Power stroke: The power stroke is an engine operation Stroke in which hot expanding gases forces the piston head away from the cylinder head. Piston force and subsequent motion are transferred through the connecting rod to apply torque to the crankshaft. The torque applied initiates crankshaft rotation. The amount of torque produced is determined by the pressure on the piston, the size of the piston, and the throw of the engine. During the power Stroke, both valves are closed.

Exhaust stroke: The exhaust stroke occurs when spent gases are expelled from the combustion chamber and released to the atmosphere. The exhaust stroke is the final stroke and occurs when the exhaust valve is open and the intake valve is closed. Piston movement evacuates exhaust gases to the atmosphere. As the piston reaches BDC during the power stroke combustion is complete and the cylinder is filled with exhaust gases. The exhaust valve opens, and inertia of the flywheel and other moving parts push the piston back to TDC, forcing the exhaust gases out through the open exhaust valve. At the end of the exhaust stroke, the piston is at TDC and one operating cycle has been completed.

3.2 TRANSMISSION OF POWER TO THE WHEELS

The piston performs the reciprocating motion which is converted into the rotary motion. Next, a transmission system is present that transfers the power to rear wheel of the motorcycle. The motion of rear wheel propels the motorcycle in the forward direction. To steer the motorcycle, the front wheel is connected with a handlebar that can be turned by the driver. There are two hand levers present on both the sides of the handle. These levers allow riders to operate the clutch and the front brake. Also, there are two-foot pedals on either side of the engine. These pedals enable a rider to change gears and operate rear wheel brake.

3.2.1 POWER TRANSMISSION TO GRASS CUTTER EQUIPMENT, FERTILIZER SPREADER EQUIPMENT AND WATER PUMP

The power transmitted to the chain drive from the gears is used to run the equipments. The shaft is welded with two sprockets at each end, first one is connected to the main chain drive and the second one to the chain of the equipments. For grass cutter, third sprocket is welded to the frame and the 2nd and 3rd sprocket are connected together with a chain. The frame of the grass cutter consists of 2 bevel gear sets which will change the axis of rotation and thus rotating the cutter blades.

For fertilizer spreader machine, the shaft is attached with a blade inside the hopper as shown in the figure. The shaft is supported by the bearings and the one end of the shaft is welded with a fourth sprocket. Now the 2nd and 4th sprocket is connected together with a chain. So when the chain rotates, the shaft rotates which will in turn rotate the blade. The rotating blade will push the fertilizer in the hopper out through outlet.

For water pump, the shaft of the pump is welded with a fifth sprocket as shown in the figure. Now, the 2nd and 5th sprocket are connected with a chain. When the chain rotates, the shaft of the pump rotates thereby creating vacuum in the centrifugal pump. This vacuum will help in sucking the water through the inlet and discharging it through the outlet.

4. MODELLING AND FABRICATION

We chose Bajaj Pulsar 150 cc bike for modification. Firstly, we took dimensions to design the frame with respect to the bike design. We drew and modelled the framework, fertilizer spreader machine and the grass cutter in CATIA V5 Software.



Fig 4.1 – Model of grass cutter

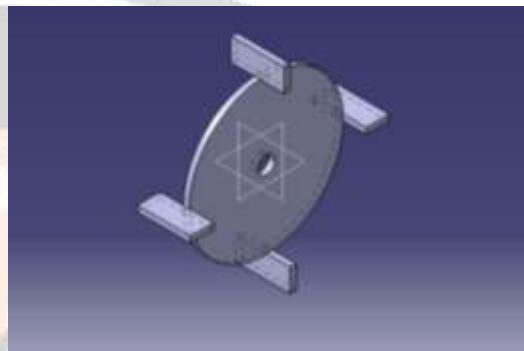


Fig 4.2 – Model of fertilizer spreader blade

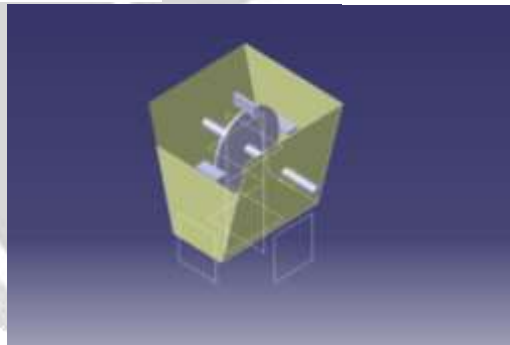


Fig 4.3 – Model of fertilizer spreader

Then using 1 inch square tubes, we fabricated and welded the frame using arc welding to the bike foot rest as shown in the figure. After fabricating the frames, we started to fabricate the components one by one. Using 1 inch square tube, bevel gears and circular shaft, we fabricated the grass cutter equipment as shown in the figure. After fabricating the grass cutter equipment, we started fabricating fertilizer spreader equipment. Using 16 gauge mild steel sheet metal, circular shaft and journal bearings we fabricated fertilizer spreading equipment. At last, we purchased a centrifugal water pump, removed an electric motor and welded a sprocket to it using arc welding. The final fabricated water pump is as shown in the figure. All the equipments are fitted to the frame using 6 mm nuts and bolts.



Fig 4.4 – fabricated model of grass cutter



Fig 4.5 – grass cutter attached to motorcycle



Fig 4.6 – fertilizer spreader attached to motorcycle



Fig 4.7 – water pump attached to motorcycle

5. POST FABRICATION TEST

5.1 PERFORMANCE OF FERTILIZER SPREADER

Amount of fertilizer in the hopper: 1 Kg

Speed of the rotor: 1500 rpm (1st gear)

Length of field where fertilizer was applied: 17300 mm

Apply the fertilizer the length of the run

Width of the spread: 850 mm

Remaining fertilizer in hopper: 0.5 Kg

Area of spread = length*breadth = $14.71 \text{ m}^2 = 190.5 \text{ Sq. ft.}$

To cover the area of 14.71 m^2 , we need 0.5 Kg of fertilizer

5.2 PERFORMANCE OF WATER PUMP

Discharge of the pump: 10 LPM

Speed of the pump: 2500 rpm

Head: 4 m

5.3 PERFORMANCE OF GRASS CUTTER

Speed of the cutter: 2000 rpm

Types of grass: Bermuda grass, rye grass, tall fescue, wheat, panic grass, etc.

Minimum length of grass: 50.8 mm

6. CONCLUSION

The design and fabrication of multi utility motorcycle can be successfully made by modifying an ordinary bike and can be implemented in real life agricultural practices such as pumping water, cutting grass or bushes and fertilizer spreading purposes. All the parts are connected in such a way that all three equipment can be used one at a time and can be rearranged or easily assembled with fasteners. Our team has successfully combined many ideas from various fields of mechanical engineering and agricultural knowledge to improve farming and commercial uses of the equipment by reducing the labour effort and expenses. Thus the farmer or any other user can use the mentioned operations at any time and place. The motorcycle is user friendly and hence does not require skilled operator for its operation. This machine will surely provide a better option when compared to the present conventional methods.

7. SCOPE FOR FUTURE IMPROVEMENT

Multi utility motorcycle is a project which is designed and fabricated as a step taken to mechanise agriculture and to benefit farmers by saving time and money. There is still a scope for improvement such as:

- The IC Engine of the motorcycle can be replaced by an electric motor which will run using battery. The batteries can either be charged by domestic electric supply or by solar panels. Thus the pollutants produced from the IC engine's exhaust can be stopped which can help in reducing global warming and saving fossil fuels for future generations.
- Fertilizer spreader blade and the hopper can be modified to control the flow rate of the fertilizer at the outlet.
- The size of the hopper can be increased in order to carry more amount of fertilizer.
- The height of the grass cutter blade from the ground can be made adjustable by using fasteners.
- The frames welded to the motorcycle can be made retractable to make the motorcycle more compact and user-friendly
- Off road tires can be used for perfect grip in less friction areas to improve off road capabilities.

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