Development and Fabrication of Pedal Operated Multi-Operational Machine

Akshay N. Shirbhate, Alok S. Sharma, Palash R. Shrirao, Kunal H. Sharma, Vijay B. Talan, Chetan S. Tayde
Department of Mechanical Engineering, Dhamangaon Education Society's College of Engineering and Technology, Dhamangaon (Rly), Dist. Amravati, Maharashtra.-444709.

Abstract – This project represents the concept of Human Powered Multi-Operational Machine mainly carried out for production based industries. Industries are basically meant for Production of useful goods and services at low production cost, machinery cost and low inventory cost. Today in this world every task have been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure, every industry desires to make high productivity rate maintaining the quality and standard of the product at low average cost. We have developed a conceptual model of a machine which would be capable of performing different operation simultaneously and individually also and it should be economically efficient .This pedal operated multi-operational machine can be used in remote places where electricity is irregular or insufficient. It is designed as a portable one which can be used for cutting operation using hacksaw assembly, grinding and buffing operation using grinding and buffing assembly, also generation of electrical energy using (dc generator) assembly and water lifting using centrifugal pump assembly. It can be used for cutting materials like wood, PVC, metal pipes and bars plywoods. The material can be cut without any external energy like fuel or current. Since machine uses no electric power and fuel, this is very cheap. Energy is the most vital aspect in the development of modern technological civilization. The system is also useful for the work- out or exercise purpose because pedaling which will act as a health exercise and also doing a useful work and this machine promotes the use of conventional energy sources.

Index Terms – Hacksaw assembly, Grinding, Buffing, DC generator, Reciprocating pump etc.

1. INTRODUCTION

Throughout history human energy has generally been applied through the use of the arms, hands, and back. With minor exceptions, it was only with the invention of the sliding-seat rowing shell, and particularly of the bicycle, that legs also began to be considered as a "normal" means of developing power from human muscles. The main use of pedal power today is still for bicycling, at least in the high-power range (75 watts and above of mechanical power). In the lower-power range there are a number of uses of pedal power--for agriculture, construction, water pumping, and electrical generation--that seem to be potentially advantageous, at least when electrical or internal-combustion engine power is unavailable or very expensive.

The Pedal Driven Hacksaw (PDH) is working on Slider Crank Mechanism. The PDH is used to cut plywood in small scales. PDH helps to obtain a less effort uniform cutting. It can be used in places where electricity is not available. It is designed as a portable one which can be used for cutting in various places.

Thus the plywood can be cut without any external energy like fuel or current. Since this uses no electric power and fuel, this is very cheap and best. Pedal power is the transfer of energy from a human source through the use of a foot pedal and crank system. This technology is most commonly used for transportation and has been used to propel bicycles for over a hundred years.

1.1 Objectives of study:

- The main objective is to provide a multi-operational machine which can work where there is no availability of electricity.
- To provide a multi-opertional machine which runs without electricity and which can perform machining and water lifting operations.
- To provide pedal operated machine in rural or remote areas where there is problem of electricity.
- To fulfill the need of rural people by giving them an alternative way of performing machining operations such as cutting, grinding, buffing, electricity generation using dc motor and water lifting from well for irrigation and domestic purpose.
- To make the machining operations cost-effective and eco-friendly. The product designed has zero operating cost, maximum profit.

The main benefit from this project work is to understand the fabrication and development of most beneficial pedal powered multipurpose machine in rural and industrial areas. Bicycle is the most popular vehicle which is used for transportation, business, and it also used for exercise purpose. It is human power system, the inventions on cycling system arrise. People used bicycle for machining operation, household purposes. As per civiliasation and globalization in the field of bicycle. Point of view get changed. And industrialists are attracted towards it.

Industries which are basically meant for Production of useful goods and services at low production cost, machinery cost and low inventory cost. Today in this world every task have been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure, every industry desires to make high productivity rate maintaining the quality and standard of the product at low average cost.

2. CONSTRUCTION

2.1 Project consist of following assemblies:

Bicycle frame

Hacksaw assembly

Water pump assembly

DC Motor assembly

Grinding assembly

Lever arrangement

The frame will support the whole assembly of the multi-operational machine. The frame structure is hard enough to withstand the machine structure. The pedal powered hacksaw set up, has a simple mechanism operate with chain and sprocket arrangement. The chain is placed on the teeth of the wheel and pinion. Pedal and connecting rod are interconnected to each other with the help of bolts. Bearing is provided between the centre of the wheel or pedal and to delivers a smooth running of the hacksaw in to and fro motion during pedaling. The hacksaw is connected to the end of a rod. As by pedaling the wheel, the flywheel connected nearer to the pinion also rotates and to reduce the fluctuation of speed and also provide a uniform cutting. The work piece is placed on the work piece holder, which is to prevent the movement of work piece during cutting. The size and shape of this setup is similar to cycle. Here for reducing the power loss chain mechanism and lever arrangement is also used for proper functioning of hacksaw assembly.

Fig. 2.1 Hacksaw Assembly

Pumps come in a variety of sizes for a wide range of applications. They can be classified according to their basic operating principle as dynamic or displacement pumps. Dynamic pumps can be sub-classified as centrifugal and special effect pumps. Displacement pumps can be sub-classified as rotary or reciprocating pumps.In principle, any liquid can be handled by any of the pump designs. Where different pump designs could be used, the centrifugal pump is generally the most economical followed by rotary and reciprocating pumps. The impeller shaft is connected to the rear tire of the bicycle and as tire rotate the impeller rotate at very high speed.

In human powered power generating system, the mechanical power is converted into electrical power. Pedal power is used to charge simple electrical appliances. Figure shows the system setup. In this, a motor is attached to the bicycle's tire for power generation. When the rider pedals, the motion of the tire in contact with the motor shaft results in the rotational motion of the shaft. This motion causes the motor to produce electrical energy.

Grinding Machines are also regarded as machine tools. A distinguishing feature of grinding machines is the rotating abrasive tool. Grinding machine is employed to obtain high accuracy along with very high class of surface finish on the workpiece. However, advent of new generation of grinding wheels and grinding machines, characterised by their rigidity, power and speed enables one to go for high efficiency deep grinding (often called as abrasive milling) of not only hardened material but also ductile materials. The grinding assembly of a pedal operated multipurpose machine is shown below.

A lever is a rigid rod or bar capable of turning about a fixed point called fulcrum. It is used as a machine to engage or to disengage of gear. Sometimes a lever is merely used to facilitate the application of force in desired direction. A lever may be straight or curved and the forces acting on it may be parallel or inclined to one another. The principal on which the lever works is same as that of moment.

Fig.2.2 Lever Arrangement

2.2 Sample Calculation:

Consider mass of operator (m) = 60 kg

Therefore,

Force = mass × acceleration = m × g

= 60 × 9.81

= 588.6 N

Torque = Force × radius (front sprocket wheel)

= 588.6 × 70

= 41202 N-mm

= 41.20 N-m

Power = $\frac{2\pi NT}{60}$

= 258.86 Watt

Speed of rear wheel sprocket = Teeth ratio × Speed of front sprocket wheel (measured)

= 2.58 × 60

= 154.8 rpm

A. Calculation for grinding assembly

Back wheel dia. (small)/ Dia. V-belt pulley = $\frac{508}{25}$

= 20.32

Speed of V-belt pulley = 12.32 × speed of back wheel (small)

= 20.32 × 154.58

= 3141.06 rpm

B. Calculation for water pump assembly

Diameter of rear wheel (Big) = 610 mm

Diameter of impeller shaft = 50 mm

Therefore,

Diameter ratio = 610/50

= 12.2

Therefore,

Speed of pump = 12.2×155

= 1890 rpm (approx).

The power is transmitted to the pump, after considering all the losses ie.(15%) =215 Watt.

Therefore,

Water power (W.P.) = Density ×g × Q × Ht

(W.P) = Density × Gravity × Discharge × Total head

(W.P). = 1000 ×9.81× Q ×10 (Considering 10 meter head)

Discharge (Q) = 2.191 litres / second.

Discharge (Q) = 7887.6 litres / hour.

Table No.: 4.6 Total Head and Discharge of Centrifugal pump

Total head meters	10	20	30	40	50	60
Discharge liters/ sec.	2.191	1.095	0.7305	0.5479	0.4383	0.3652
Discharge liters/ hrs.	7887.6	3924	2629	1972	1577	1314

C. C. Calculations for hacksaw assembly:

In hacksaw assembly after testing result found that

Hacksaw = 60 strokes / minute.

This Hacksaw assembly can cut up to 30 mm diameter workpiece.

D. D. Calculation for D.C. generator assembly:

Speed of shaft = speed of generator

Supply storing/ utilization capacity.

12 Volt D.C. power, 12 V, 1 Ampere.

3. PROPOSED MODELLING

Fig 3. Overall Setup

3.1 Working Principles:

There are only two major principles on which our proposed machine generally works:

Scotch-Yoke mechanism: It converts rotary motion to reciprocating motion of hacksaw which is used for cutting operation i.e. sawing.

A Water system includes a reciprocating pump operated by pedaling power. The pump set and includes a housing in which a foot pedal and drive shaft rotate an eccentric pin rotating with the drive shaft moves a connecting rod which in turn causes push rod to move linearly. The pushrod extends into a pressure tight chamber formed above the rising main. A pump rod connected to the push-rod extends to the conventional plunger through verified motion

The working principle of pedal operated multipurpose machine is based on flywheel driven V-belt drives and pulleys. this dc generator by pedaling the shaft of the dc motor is rotating with required rpm and electricity generates and stores or utilizes it for our purpose. When pedal arrangement is connected to pulley of the grinding machine and dc motor through sprocket wheel chain arrangement, (v-belt) pulley and when pedaling done the shaft of grinding machine gets rotating and grinding operation performs.

Power transmission through v belt and pulleys: It transmits power through the v belt and pulley to the drilling and grinding attachments.

When the pedal is rotated, the wheel is also rotated this in turn rotates the motor shaft connected to the wheel. This rotation of the motor produces current, this current is an alternating current.

4. RESULTS AND DISCUSSIONS

Thus we have developed and fabricated the pedal operated multi-operational machine, by evaluation of performance of machine the following results are observed.

- We observed that in hacksaw assembly we get 60 strokes per minute and it can cut a 30 mm diameter work piece of various materials like wood, PVC, plywood, hollow metal pipes and bars
- The effective lever arrangement allows successful engagement and disengagement of the assemblies
- We observed that grinding wheel speed we attended is 3141 RPM which is sufficient for performing the required grinding operation
- The water pump can lift up the water from 10m to 16m by attaining speed up to 1890 to 1900 RPM
- We observe that using this machine we can generate up to 12 volt DC power and we can use it to run the small equipments like mobiles, laptops, lamps etc.
- We can perform various operations efficiently by using this machine and we can perform it simultaneously or individually
- This machine also used for exercise purpose.
- We can replace number of machines by single multi-operational machine

5. CONCLUSION

In the view of current rural electrification program of government, a consideration to fabricate and develop pedal operated multi-operational machine will perform various operation without use of electricity. This multi-operational machine can perform operations simultaneously or individually like machining operation cutting, grinding, electricity generation and water lifting for agriculture and domestic purpose This machine is durable, portable, easy to maintain and can be used in remote or rural places. This machine is cost efficient. This machine also promotes physical fitness of human body.

We can see that all the production based industries wanted low production cost and high work rate which is possible through the utilization of multi-function operating machine. It requires less power as well as less time, since this machine provides working at different center it really reduced the time consumption up to appreciable limit. In an industry a considerable portion of investment is being made for machinery installation. Its working can be done in less floor space. Unskilled labour can also handle it, efficiently because of this we can reduce the cost of production which is the most important factor in production industry. The system described above is being developed with these problems in mind. it is being designed with specific goals to make the greatest impact possible with multi tasks. low cost, portability, reliability, and ease of use are all essential to the success of the system.

In this way we have concluded that the power is generated and which can be used to operate small power devices such as mobile, laptops, LED lights, charging units. Hacksaw assembly is used to cut the MS bar up to 20 mm diameter, PVC pipes, plywood etc. Grinding operation can be done with good finish. The centrifugal pump assembly is applicable where we want to lift the water at required height.

REFERENCES

[1] David Gordon Wilson "UNDERSTANDING PEDAL POWER" ISBN: *0-86619-268-9 [C] , Volunteers in Technical Assistance",* Technical paper 51 VITA 1600 Wilson Boulevard USA 1986

[2] DharwaChaithanyaKirthikumar, "A Research on Multi Purpose Machine", *International Journal for Technological Research in Engineering,* (Vol.1, Issue.1, ISSN:2347-4718) 2013

[3] Dr.Pulak M. Pandey http://paniit.iitd.ac.in/~pmpandey "Selecting and Planning the Process of Manufacture"

[4] Dr.ToshimichiMoriwaki "Trends in Recent Machine Tool Technologies*" Professor Department of Mechanical Engineering Kobe University* ,NTN Technical Review No.74 2006.

[5] Frankfurt am Main "Multi-purpose machines ensure enhanced ", 1 January 11.
[6] Heinrich Arnold, "The recent history of the machine tool industry and the effects of technological change", *University of Munich, Institute for Innovation Research and Technology Management,* November 2001.
[7] Linxu, WeinanBai, JingyuRu, Qiang Li, "Design and Implementation of the Reciprocating Pedal Powered Electricity Generating Device", *Advanced Materials Research* (Vol.282-283 (2011) pp 735-738.
[8] S.D. Moghe and J.P. Modak, "Design and Development of a human powered machine for manufacture of lime flash sand bricks" *Technical journal of IHPVA*, 139(2) PP35 1998
[9] S.G.BahaleyDr.A.U.Awate, S.V.Saharkar, "Performance Analysis of Pedal Powered Multipurpose Machine", *International Journal of Engineering Research and Development* (IJERD) (Vol.1, Issue.5,e-ISSN:2278-0181) 2012
[10] T. Moriwaki, "Multi-functioning machine tool", tool and *manufacturing department* , Technical review no:74 2006
[11] V. Jayakumar,"Design of Transmission Elements", *Laxmi publication Pvt. Ltd, 4th edition.*
[12] R.S. Khurmiand J.K. Gupta, "Theory of Machines".ISBN NO :8121901324.
[13] R.S. Khurmi "Design of Machine Elements" ISBN NO:81-219-2537-1
[14] S. Raghuwanshi,"WORKSHOP TECHNOLOGY VOL-01" 9th edition.