

“Experimental Investigation of Human-Powered Flywheel Motor for A Tandem Drive for Power Enhancement by Using Various Cycling Mechanisms.”

Roshan Mahagan Hatwar¹RavikantDamodhar Chopkar²

Ritik Omkar Lende³JagdishsinhSitaramsinh Somanshi⁴

Lokesh Prakash Wanjari⁵ Bhavesh Sureshrao Dhole⁶

Prof. Hemant Baitule⁷

^{1,2,3,4,5&6}(Students, Department of Mechanical Engineering, J D College of Engineering & Management, Nagpur affiliated to Dr. Babasaheb Ambedkar Technological University, Lonere. Dist – Raigad. Maharashtra (India))

⁷(Assistant Professor, Department of Mechanical Engineering, J D College of Engineering & Management, Nagpur affiliated to Dr. Babasaheb Ambedkar Technological University, Lonere. Dist – Raigad. Maharashtra (India))

Abstract:

The Main Aim of This Paper Design and Fabrication of a Human power flywheel motor (HPFM) is to get maximum energy in a minimum amount of your time. The word tandem drive means double pedal in the machine. The main component of this machine is a flywheel, pedal, chain sprocket, shaft, freewheel, pump, and gear. The machine is extremely simple and cozy, it is often easily operated by either males or females. The machine is economically viable and it is often operated by skilled and unskilled people. In India, most individuals are affected by electricity. To overcome this problem, we select HPFM, which operated manually. This machine is used in so many applications. In rural and remote areas where electricity is required and not possible to reach. Energy crises need to search for an alternate source of energy that is specifically renewable energy. Human power credit is more because of health benefits as a source of energy. More effective use of human power could be achieved through properly designed mechanisms. Human power as the prime mover used to operate a working unit is termed a human-powered machine. This machine worked so many applications like water purification, seed oil extraction, grass cutter machine, and sugarcane cutting machine. This machine uses agricultural and industrial areas. This machine is also used near ponds and rivers in rural and urban areas.

Key Word: Human power flywheel motor (HPFM); maximum energy; minimum time; rural and remote areas. etc.

Date of Submission: 25-06-2022

Date of Acceptance: 07-07-2022

I. Introduction

The main components of this machine are a flywheel, pedal, chain sprocket, shaft, freewheel, and gear. The Word tandem drive means double pedal in the machine. The machine is very simple and comfortable, it can be easily operated by either males or females. It can be operated by skilled and unskilled people. In India, most people suffer from electricity, Mostly in Rural or remote areas. To overcome this problem, we select HPFM, which operated manually. Rural and remote areas keep energy requirements for various work, that's why our team is working on the energy created by simply Paddling methods. Different Researchers/authors have worked with this motor in different applications. Our main motto for this project is to generate maximum energy in the least amount of time by humans.

II. Material And Methods

This prospective comparative study was carried out on our college workshop of the Department of Mechanical Engineering, J D College of Engineering & Management, Nagpur affiliated to Dr. Babasaheb Ambedkar Technological University, Lonere. Dist – Raigad. Maharashtra (India), under the Co-ordination of our project Co-ordinator Prof. Rahul G. Deshmukh & under the guidance of Asst. professor Hemant Baitule. For our research work we have adopted some of material and Methods which are explained as enlisted below:

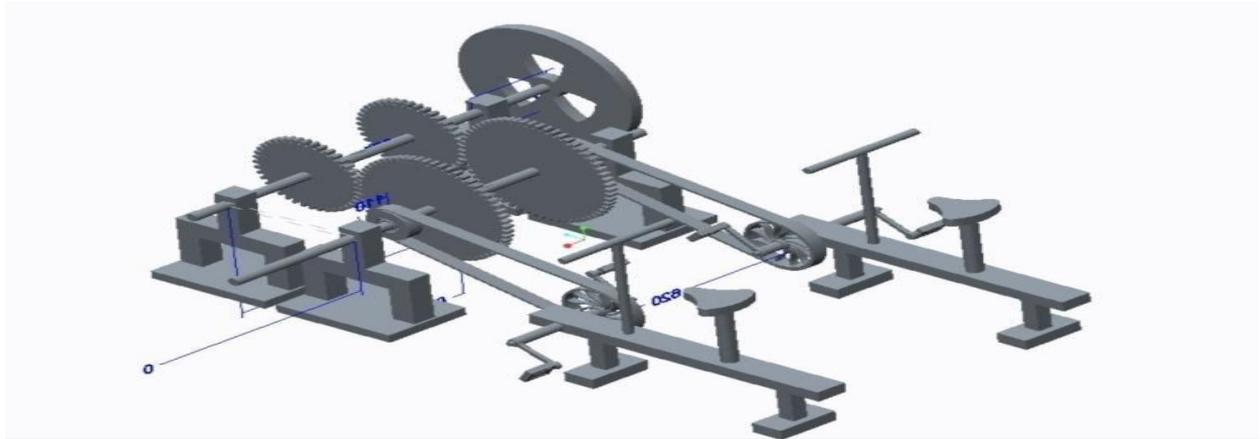


Fig1.1-CADmodeloftandemdrivehumanpowerflywheelmotor



Fig1.2–fabricatedmachineoftandemdrivehuman powerflywheelmotor



Fig:Flywheel(ReferencebyGoogleimages) for Design of Flywheel

A flywheel is a rotating mechanical device that is used to store rotational energy. Flywheel have an inertia called the moment of inertia and thus resist changes in rotational speed amount of energy stored in a flywheel is proportional to the square of its rotational speed. Energy is transferred to a flywheel by the application of a torque to it, thereby increasing its rotational speed, and hence its stored energy. Conversely, a flywheel releases stored energy by applying torque to a mechanical load, thereby decreasing the flywheel's rotational speed.



Fig 4.1.1- Flywheel of machine

Where,

E= flywheel kinetic energy (Joule)

I= moment of inertia (Kgm²)

ω = angular velocity (rad/s)

K= inertial constant depends on the shape of the flywheel

m= mass of flywheel (Kg)

r= radius (m)

The thickness of the rim =0.06

Width of the rim= 0.08

Density=7200kg/m³

$E=1/2 I\omega^2$

$I=mk^2$

$m=0.06*0.08*2\pi*0.5*7200$

$m=108.58\text{kg}$

$K=D/2=1/2=0.5\text{m}$

$I= 27.14\text{kgm}^2$

Design of Gear

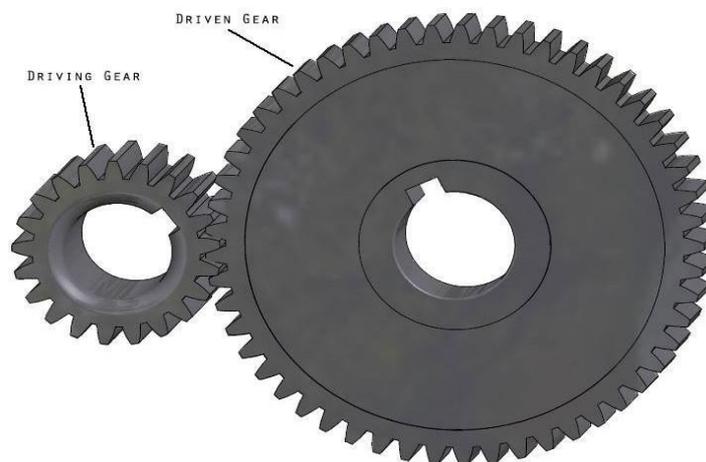


Fig:gearpinionReferencebyGoogleimages(<http://thereviewstories.com>)

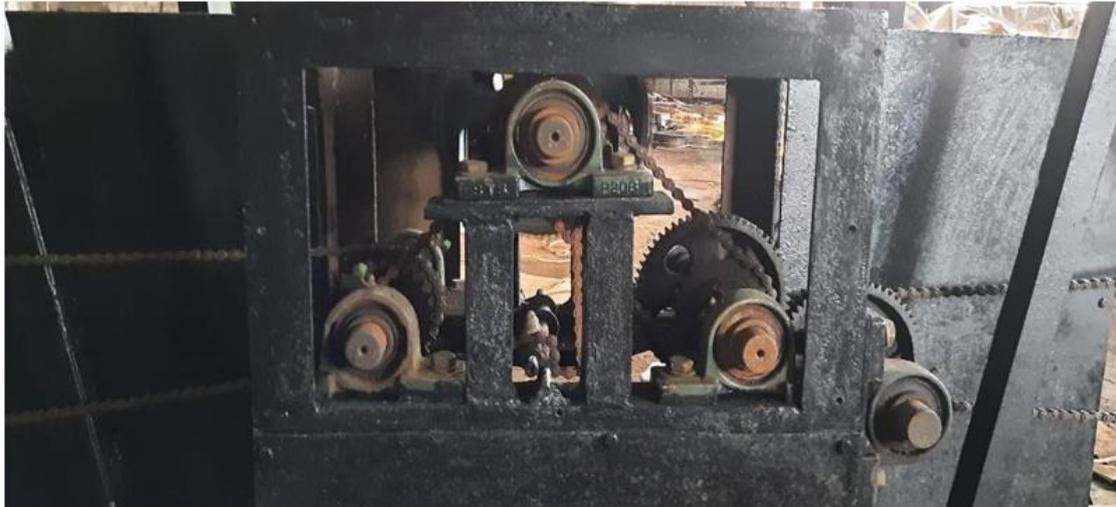
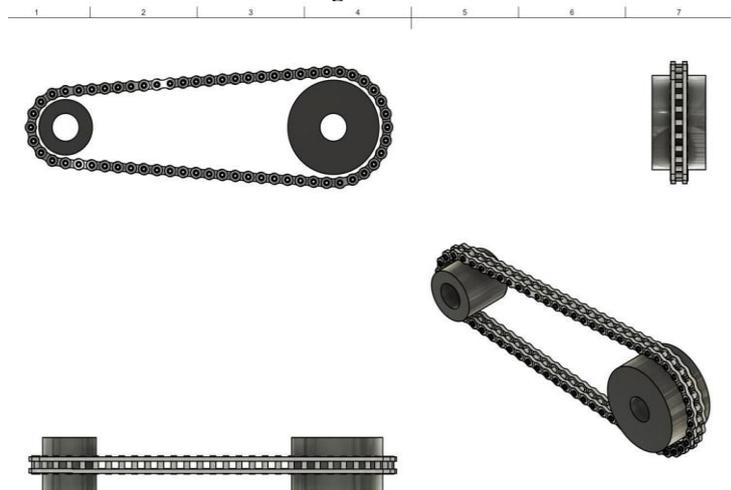


Fig :Gearpinionarrangement

A gear is a rotating circular machine part having cut teeth or, in the case of a cogwheel or gearwheel, inserted teeth, which mesh with another toothed part to transmit torque. A gear may also be known informally as a cog. Geared devices can change the speed, torque, and direction of a power source. Gears of different sizes produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The rotational speeds, and the torques, of two meshing gears differ in proportion to their diameters. The teeth on the meshing gears all have the same shape.

Two or more meshing gears, working in a sequence, are called a gear train or a transmission. The gear in a transmission are analogous to the wheels in a crossed, belt pulley system. An advantage of gears is that the teeth of a gear prevent slippage. In transmissions with multiple gear ratios-such as bicycles, motorcycles, and cars-the term “gear” refers to a gear ratio rather than an actual physical gear. The term describes similar devices, even when the gear ratio is continuous rather than discrete, or when the device does not actually contain gears, as in a continuously variable transmission. Furthermore, a gear can mesh with a linear toothed part called a rack, producing translation instead of rotation.

Design of Chain



Design of Shaft

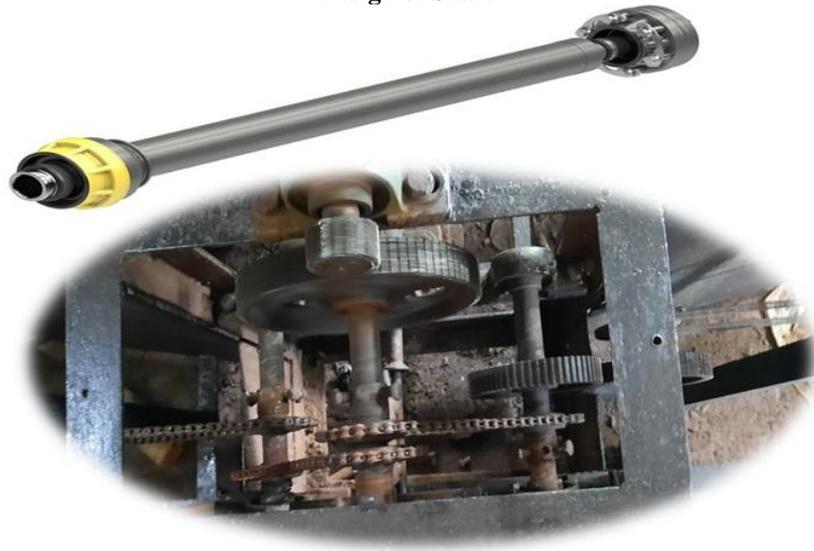


Figure: Shafts are connected to the gear.

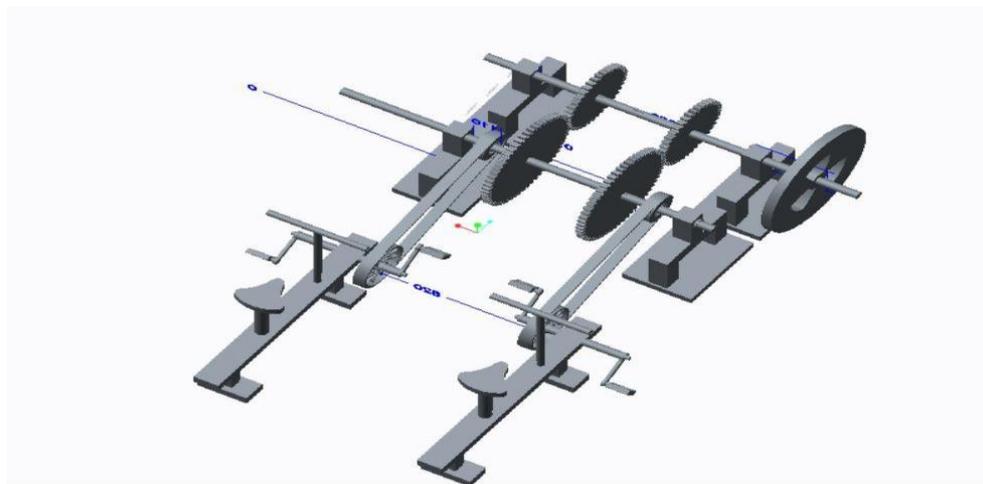


Fig:--TopCADModelof HPFM

III.Problem Statement

A single pedal machine produced minimum power up to 4 HP. The problem identified was that it required a maximum effort which was not viable as the output power generated was very little as compared with the effort required. This problem was identified by our group and our group decided to design a double pedal machine also called as tandem drive for maximum output generation of power. This helped in designing such a machine which could produce a great amount of power with the help of human power. The power we produced was maximized with the help of proper gear ratio and proper lubrication of machine parts. We also placed components in proper manner so that the vibrations should be minimum so as to prevent any power losses in our machine.

III. Results

In this, we calculated the maximum output from a Human-powered flywheel motormachine i.e., approximately 1 hp. We also calculated the Manpower applied in nos., Power Generated by Peddlers (P) in Kgf-m, Duration Taken in Second and as an outcomes Power (hp) for approx. 500 rpm, as given in the table.

Peddler1 + Peddler 2		INPUT		OUTCOMES
Sr. No.	Manpower (nos.)	Power Generated by Peddlers (P)-in-kgf.m	Duration (Sec)	Power(hp)
1	2	22.85714	300	0.44
2	2	9.589767	300	0.35
3	2	15.25333	300	0.34

Peddler 1+ Peddler 2		INPUT		OUTCOMES
Sr. No.	Manpower (nos.)	Power Generated by Peddlers(P)(Kgf-m)	Duration (Sec)	Power (hp)
4	2	22.85714	300	0.36
5	2	9.589767	300	0.34
6	2	15.25333	300	0.35

V. Conclusion

- 1) The HPFM is studied and the design model is formed for different variables or values similarly found the value of power, shaft diameter, module of gear, the diameter of gear and pinion.
- 2) By using HPFM model find out the values of machine parts for different rpm that is 590 rpm, 514 rpm, 523 rpm in LOT-1 & 530 rpm, 519 rpm, and 520 rpm in LOT-2.
- 3) The maximum power output for 590 rpm is 0.44 hp.
- 4) Human-powered flywheel motor is a promising energy source that can be used to energize various others process units requiring energy.
- 5) Human Power can be widely used in spite of fossil fuels and electricity-powered machines.
- 6) Human Power can generate power as maximum as 0.44HP by using proper machinery and proper design of machines.
- 7) Human Power can be greatly used in any part of world if used by doing proper research and design.

VI. Future Scope

The machine can be modified in the future so as to get a power maximum than the present power if the research and proper study of the recent machine are done. Also, if this machine is used in various diesel-powered or Solar powered machines, it can provide a great amount of saving on non-renewable energy resources. Human Power can be widely used in spite of fossil fuels and electricity-powered machines. Future Work can be done in this machine by increasing the number of pedals and also, we can increase the number of flywheels to get maximum power storage thereby getting a huge amount of output power greater than the power which our machine had generated. Human power can be used in every aspect of the world if proper future research is done on this basis.

Acknowledgement

We express our sincere gratitude, for giving us the opportunity to work on the project during our final year of B.Tech. We owe our sincerest gratitude to **Dr. S. V. Sonekar**, Principal, **Dr. Bhushan R. Mahajan**, Head, Department of Mechanical Engineering, **Prof. S. S. Ghosh**, Project Coordinator & our Guide **Prof. Hemant K. Baitule**, J D College of Engineering & Management, Nagpur, for providing the platform, guidelines, support, and necessary facilities. This Research work is dedicated to our Parents who always supported us with their blessings. During Project work, Team Coordination & Spirit will always be a bound and memorable for us.

References

- [1]. S.N.Waghmare, Dr.C.N.Sakhale (2015), “ Formulation Of Experimental Data Based module using SPSS for stirrup Making Operation by Human Power Flywheel Motor”, (IRJET) Vol. 02, Jul-2015
- [2]. V. D. Ghuge, J. P. Modak (2013), “Developing a Constant Output Speed Transmission for Human Powered Flywheel Motor (HPFM) with Variable Input Speed-a Novel Gearbox”, (AJAR) Vol. 3, Jun-2013
- [3]. Y.M. Sonkhaskar, Swapnil S. Asati, Abhinav M. Purohit (2015), “Human Power Flywheel Motor-Driven Process Units”, (IJIRSET) Vol. 4, Nov-2015

- [4]. Pawan Chandak, Arti Lende, J.P Modak (2017), Modeling of Human Power Flywheel Motor Through Neural Network- A Novel Approach”, (ICSCC), Dec-2017
- [5]. Vivek Padole, Laxminarayan M. Patorkar (2017), “Design and Fabrication of Pedal Operated Thresher Machine”, (IOSRJEN), 2017
- [6]. Ketan Tekale, Yashodip Chawre, Akshay Kapre, Shailesh Kumar, Praveen Mali (2017), “Design and Development of Groundnut Oil Extracting Machine by the HPFM Concept”, (IRJET) Vol. 04, Jan-2017
- [7]. M.S. Giripunje (2016), “Literature Review Paper on Human Powered Food Grain Crusher”, (IRJET) Vol. 03, May-2016
- [8]. Vijaykumar S. Shende, Girish D Mehta, Jayant P. Modak, Pravin V. Jadhav, Vishal Kaushik, Krunal Mudafale, Akshay A. Pachpor (2019), “Concrete Mixture Energized By Human Power Flywheel Motor”, (IJITEE) Vol. 8, July-2019

	<p>Mr. Bhavesh Sureshrao Dhole student of Mechanical Engineering from JD College of Engineering and management Nagpur affiliated DBATU. I have participated in various project competitions and workshops.</p>
	<p>Mr. Ritik Lende student of Mechanical Engineering from JD College of Engineering and management Nagpur affiliated DBATU. I have participated in various project competitions and workshops.</p>

	<p>Mr. Ravikant Damodhar Chopkar student of Mechanical Engineering from JD College of Engineering and Management Nagpur affiliated DBATU. I have participated in various project competitions and workshops.</p>
	<p>Mr. Lokesh Prakash Wanjari student of Mechanical Engineering from JD College of Engineering and Management Nagpur affiliated DBATU. I have participated in various workshops.</p>
	<p>Mr. Jagdishsinh Sitaramsinh Somanshi student of Mechanical Engineering from JD College of Engineering and Management Nagpur affiliated DBATU. I have participated in various project competitions and workshops.</p>
	<p>Mr. Roshan Mahagan Hatwar student of Mechanical Engineering from JD College of Engineering and management Nagpur affiliated DBATU. I have participated in various project competitions and workshops.</p>