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Enhancement of Energy Generation in Tandem Drive Human Powered Flywheel Motor by Using Elliptical Sprocket and Double Lever Mechanism

Aditya R. Agare¹, Aditya V. Nagarare², Ahant S. Ambade³, Chaitanya D. Gadpayale⁴, Chetan D. Uikey⁵, Deepak C. Amde⁶, Deep T. Mhase⁷.

^{1, 2, 3, 4, 5, 6, 7}Students of Mechanical Engineering, J D College of Engineering and Management, Nagpur, Maharashtra, (INDIA)

Abstract: The main motive to publish this paper is to reduce the human effort and enhancement of energy in tandem drive Human Powered Flywheel Motor. So, we arrange pedaling system opposite to each other having double pedal known as tandem drive. We use double lever mechanism and elliptical sprocket having the major axis 200 mm and minor axis 180 mm. Here we check how much rpm will generate in flywheel before elliptical sprocket is fitted and after elliptical sprocket is fitted. It also reduces pollution as it is works on human power and improving environmental conditions. Our second objective is to maximize the use of this machine in agricultural areas and rural areas and generate the employment. Also, it is work as new non-conventional energy source which could be considered as PEDDLE POWER.

Keywords: Elliptical Chain Sprocket, Flywheel, HPFM, Rural Area, Employment.

I. INTRODUCTION

In today's scenario the revolution technology is very fast. Therefore, the use of electricity, fossil fuels, petrol diesel is in very high amount. Many machines require non renewable energy sources to run machines or to energized the machines. Due to this the use of fossil fuel, petrol, diesel is increasing day by day. Due to use of

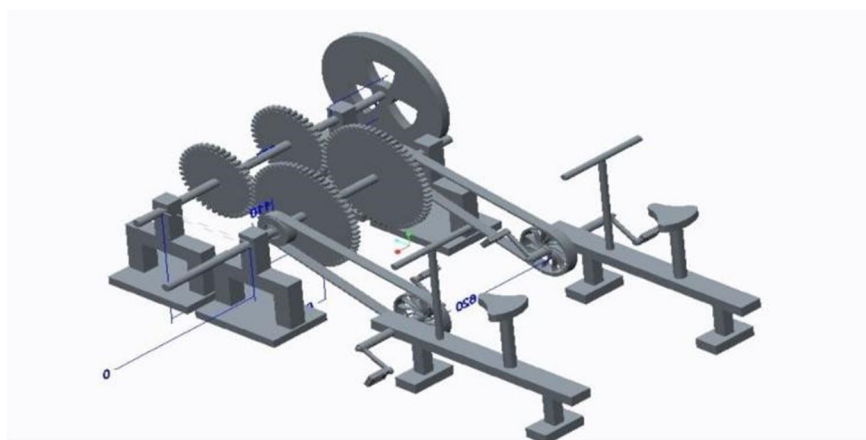


Fig - 1 CAD model of tandem drive human power flywheel motor

this non-renewable energy sources the pollution is increasing daily. So, to reduce this problem and dependence on the fuels we developed HPFM motor. This motor stored the energy in flywheel and use this energy into useful work. In rural areas there is a shortage of electricity and we have many work and machines which can not be completed or run without an electricity like brick making of rectangular cross section, wood cutting, chaff cutting, food grain crushing, seed oil extraction, water purification, etc. machines require electricity to run. So, we can energized this types of machine with help of HPFM. It is work as renewable or non-conventional energy source as it has energized by human power. In villages or rural areas there is many work present on food grain crushing as it is agricultural area. So, it is very good opportunity to generate employment with help of HPFM. We need two people to operate the motor by only pedaling whether they are skilled or unskilled no problem.

II. DESIGN AND ANALYSIS

1) R.P.M. (by practical) and Energy generation (by theoretical) in flywheel before elliptical sprocket is fitted.



Fig 2-A FLYWHEEL

So, we check the rpm of flywheel with the help of tachometer before elliptical sprocket is fitted. Then we found that 1151 rpm is generate in flywheel. So, we calculate the energy generation in flywheel theoretically,

Where, E_1 = Energy stored in flywheel before elliptical sprocket is fitted

I = Moment of Inertia (Kg m^2)

ω = angular velocity (rad/s)

k = constant inertia

m = mass of flywheel (kg)

r = radius (m)

b = width of flywheel

t = thickness of flywheel

Thickness of the rim= 0.04, width of the rim= 0.08 Density = 7280 kg/m

$$E = \frac{1}{2} I \omega^2$$

$$I = mk^2$$

$$m = 0.04 * 0.08 * 2 * 0.5 * 7280$$

$$m = 93.26 \text{ kg}$$

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

$$I = 93.26 * (0.5)^2 = 23.315 \text{ kgm}^2$$

$$N = 1151 \text{ rpm}$$

$$\omega = 2\pi N/60$$

$$= 120.471 \text{ rad/s.}$$

$$E = \frac{1}{2} I \omega^2$$

$$= 0.5 * 23.315 * (120.471)^2$$

$$E = 169188.3499 \text{ Joule.}$$

$$P = E/60 = 2819.805832 \text{ Watt}$$

$$P = 3.781 \text{ HP} \quad \dots\dots \text{ (by calculation)}$$

2) R.P.M. (by practical) and Energy generation (by theoretical) in flywheel after elliptical sprocket is fitted.



Fig 2-B elliptical sprocket

then, we check the rpm of flywheel with the help of tachometer after elliptical sprocket is fitted. Then we found that 1313 rpm is generate in flywheel. then, we calculate the energy generation in flywheel theoretically,

Where, E_2 = Energy stored in flywheel after elliptical sprocket is fitted

$$N = 1313 \text{ rpm}$$

$$\begin{aligned} \omega &= 2\pi N/60 \\ &= 137.42 \text{ rad/s.} \end{aligned}$$

$$\begin{aligned} E &= 1/2 I \omega^2 \\ &= 0.5 * 23.315 * (137.42)^2 \end{aligned}$$

$$E = 220143.219 \text{ Joule.}$$

$$P = E/60 = 3669.053 \text{ Watt}$$

$$P = 4.92028 \text{ HP}$$

..... (by calculation)

3) Elliptical Sprocket

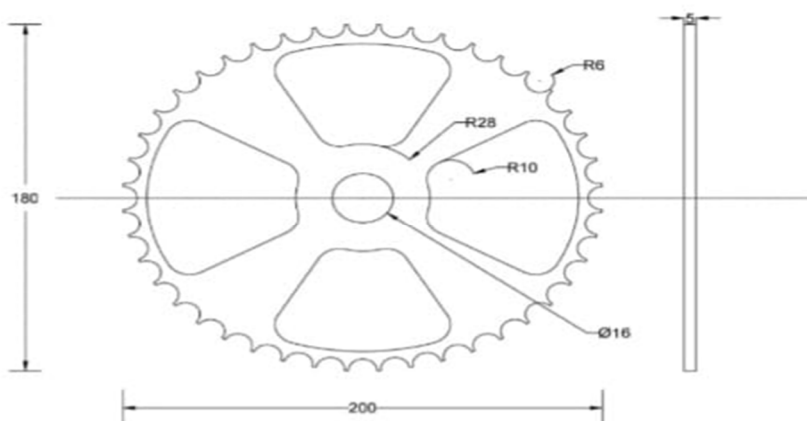


Fig 2-C 2D CAD model of elliptical sprocket.

This is the elliptical chain sprocket which is made by mild steel material. Having a major axis 200 mm and minor axis 180 mm and having 44 teeth on the outer surface. With the help of these we practically found that when its is fitted we require less amount effort to pedaling and by tachometer we found that flywheel generate more rpm.

III. LITERATURE REVIEW

A. *Dr. R. A. Kubde, Shahajad Khan, Swapnil Bodade, Showbuddinmulla, Roshan Ughade, Shubham Lonkar, Vitthal Bangar (2017)*

Design and fabrication of manually operative wood working machine.

In this paper we are studied mainly for small wood factory, The machine operated by human peddling so no any other extra energy it's needed.

Power required for pedalling is above the capacity of an average healthy human being. But with the Help of pulley, we supply the more power this is used to increase the communication with workpiece which is away from the machine us multipurpose machine makes the machining operation like grinding and wooden cutting operation etc. Very easy without electricity. In this machine one alternator is attached to flywheel which transmits to mechanical power into electrical power.

B. *M. P. Mohurle, D. S. Deshmukh, P. D. Patil (2016)*

Human power Using Bicycle Mechanism as an Alternative Energy sources -A Critical Review

In This paper importance of human power as an alternative energy source is investigated, to present state and its future scope. In bicycle technology operator uses mostly pedal to operate machine and transmits power through crank, chain and freewheel to the working unit. In the paper, a method of harnessing the power of children play in playground and public places, on devices such as seesaw, marry-go-round and swing is proposed Owing to the linear dependence of energy with IG, the generated, current can be used as a measured of the energy produced by the system.

C. *D. Mohammed Rafi, Mr.B. Raja Kumar, G.S.R. Nagamalleswar A Ram (2016) Design and development of gear box for multipurpose Milling Machine (5 pm)*

The concept of purpose of a gear reduction system is to convert input a speed and torque into a different output speed and torque. This paper is a partial full fillment to the present market needs to understand the variation in machine design accessories. The progress in non-linear dynamics of gear driven system is received, especially the gear dynamic behaviour by considering the backlash and time-varying mesh stiffness of teeth. The method of introducing the frictional torque between teeth into the dynamic equation is given in his paper.

D. *Prof. Vivek padole, Laxminarayan m. Patorkar*

Design and fabrication of pedal operated thresher machine.

In this paper we learn the process of machine less bulky and the ergonomic consideration in the design would allow for its comfortable use for it can easily be operated by either male or female. The thresher can help to sub substantial reduce the human labour involved in threshing at an affordable cost 8e also reduces the time used for threshing operation on small farms.

E. *Gaurang Bhatawadekar, Budye Salman, Nilesh Chiplunkar, Swapnil Devrukhakar, Singh Akashdup (2015)*

Design and fabrication of pedal powered washing machine.

As we know HPFM machine can be used in various applications. In this experiment the human power is utilizing for washing machine. This machine is developed because of the lack of electrical energy in rural as well as urban areas. This machine doesn't require power supply or diesel supply and it is portable as it is low in weight. This experiment works on the principle of rotating impeller by peddling and cause to washing cloth. The outlet grey water from machine can be recycled for filling toilet tanks or for watering plants.

G. *P. B. Khope, J. P. Modak (2013)*

Design of experimental set up for establishing empirical relationship for chaff cutter energized by human powered flywheel motor. In this research paper we learn the process of system for pumping using muscular energy in the flywheel is feasible and then the energy stored in flywheel can used for different application.

The design of experimental set up for carrying out the experimental ion to establish empirical relationship for chaff cutter energized by human power flywheel motor. This human energy out-put is in the low range and the process could be operated intermittently can be considered for utilization.

H. A. D. Dhole, J. P. Modak (September 2012)

Formulation of experimental data-based model for oil press using human power flywheel motor as energy sources.

For extraction of oil from the oil seed we use electric power but from this experimental research we can also use the human power for this extraction. As in rural areas, especially in Maharashtra (India) there are 10 to 12 hours load shedding of electricity hence this experimental research is very useful to farmers small scale entrepreneurs in rural areas to enhancement of technology for low profile farmers in view of human power mechanization of agriculture operation.

I. K. S. Zakiuddin, H. V. Sondawale, J.P. Modak (March 2012)

Human power an earliest source of energy and it's efficient use.

The concept of paper is the importance of human power from the earliest times to the present and its future scope. For development of industries, we use the natural fuels as a source hence now we need to come with alternate source of energy, i.e., non-conventional energy. There are many applications of this machine such as domestic use, commercial and industrial use, agricultural use, transportation, electrical generator, physical fitness etc.

IV. METHODOLOGY

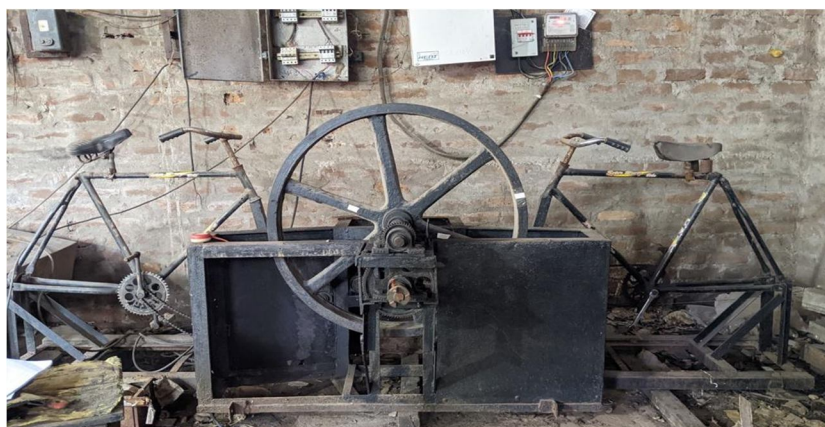


Fig. 4 Human Powered Flywheel Motor

The HPFM motor consist of double pedal arrangement opposite to each other. When operator pedal the chain sprocket the chain transmit motion to another chain sprocket which is connected to the shaft. Then shaft is rotate and transmit the power and motion to the gear. The gear is assembled in such a way called as pinion gear arrangement which transmit motion and power to another shaft which is connected to the flywheel. Then flywheel rotate and stored the rotational energy which we can use into some useful work. It is the non-conventional energy which is fully operated by human power.

V. RESULT

So, we found practically that elliptical sprocket can reduce human effort and enhance the energy generation and save human energy.



Fig 5 Tachometer

This is the tachometer which is used to measure rpm. With help of this device, we measure rpm generate before elliptical sprocket is fitted and after elliptical sprocket is fitted.

A. Calculation Based on Data

| | Before elliptical sprocket is fitted | After elliptical sprocket is fitted |
|--------------------------|--------------------------------------|-------------------------------------|
| R.P.M. | 1151 | 1313 |
| Angular Velocity (rad/s) | 120.471 | 137.42 |
| Energy (Joule) | 169188.3499 | 220143.219 |
| Power (HP) | 3.781 | 4.92028 |

VI. CONCLUSION

- 1) We can use HPFM as non-conventional energy source as it is fully operated with human power.
- 2) By using elliptical sprocket, the human effort is reduced and enhancement in energy generation.
- 3) Also, it is work as human exercise machine.

VII. ACKNOWLEDGEMENT

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