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Designing a Sustainable Pedal-Powered Washing Machine for Rural Areas

S.A. Ladkat[1,*], Dnyanesh R. Kende[2], Adesh S. Gore[3], Aditya S. Gosavi[4], Athrava R. Gulave[5]

Abstract

The ingenuity can be found in its simple construction, sparse use of pricey components, extremely low upkeep and repair costs, accessibility to all segments of society, and lack of environmental impact. According to the environmental issue, it is essential to use energy in alternative ways in order to conserve it. The PPWM additionally conserves time, water in a container and power while being reasonably priced. The leg-powered washing machine (PPWM) is a fantastic invention all of its own; it evolved specifically to be used for washing clothes by pressing a pedal. PPWM is made up of easily and readily available scrap components of washing machine and bicycle. In PPWM, bicycle assembly is used as frame and power transmission unit and this assembly is welded to a prefabricated assembly of washing machine drum which also consists of bevel gear mesh arrangement. It is an equipment that transfers human peddling action into the rotational motion of the wheel; the present project is an attempt for a concept for a fabric washing machine that can match the criteria. Despite the machine's driving motor differs in comparison with that of other akin machines, this concept's basic principle is identical as well. In the moment's effort, given the job's limits, the goal of minimizing the starting cost and running cost of machine washing is virtually realized. The primary objective is to minimize the amount of labor required to give light washing in isolated, gloomy places that are far from construction and power.

Keywords: Pedal-powered washing machine, PPWM, pedal, chain, bevel gear, sustainable

INTRODUCTION

Women may clean garments more quickly and easily through a pedal-powered machine. It addresses a routine home function (cleaning clothing), but it additionally presents solutions to an extensive list of other issues. We all choose to wash our clothes in person or with electric dryers. Over many years, this has either been a very taxing and extended procedure or a costly one. The purpose of the project is to find a way of dealing with the issue that so many people encounter every day. Powered washing machines are almost pointless in areas with expensive and intermittent electricity. The effort aims to address the question of the public's access to electricity. Electricity represents the village's main source of power to run washing machines. A lot of villages in India experience an electrical limited resource. For dormitory men in particular, doing something like this is extremely valuable [1].

***Author for Correspondence**
S.A. Ladkat
E-mail: saladkat.sae@sinhgad.edu

[1]Assistant Professor, Department of Mechanical Engineering, NBN Sinhgad Technical Institutes Campus, Pune, Maharashtra, India
[2-5]Students, Department of Mechanical Engineering, NBN Sinhgad Technical Institutes Campus, Pune, Maharashtra, India

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Problem Statement

Women in India frequently washing their garments by conjunction, but the chemicals in the chemicals are hazardous for one's hands, and the repetitive act of rubbing puts stress on their skeletal muscles. Our objective is to create a

sturdy, affordable pedal-powered laundry machine that can be used to gently clean garments in isolated locations. The clothes washer must be utilized by numerous households due to financial restrictions, or it may be utilized by a local businessperson to conduct a laundry service. The washing machine must be simple to construct and maintain locally using materials that are available, simple to use (minimum actions required), and simple for women or young ones to execute. Additionally, it should be more convenient to utilize than manual techniques as well as accepted ethically in India.

Objectives

- Low-cost and low maintenance.
- It operates with less water.
- It will be easy to repair when things go wrong.
- Easy to operate and maintain as readily available parts.
- Women do not have to be in contact with soapy water, which may damage their hands.
- Another way to reuse energy that we do not utilize during exercise.

Scope

- *Energy storage:* The flywheel may be utilized to store the energy lost during bathing and use it while spinning cloths to dry them. Besides increasing the tool's whole capacity, this would require fewer hours since there exists more energy obtainable for spin curing.
- *Designing a multipurpose machine:* By employing the energy produced during washing in an additional household gadget that operates continuously with the washing, it may be used most effectively. The strain placed on the fresh device would be such that all the energy could be soaked up and not be lost. Additional energy can be used to produce office for battery charging. It may be utilized for controlling a pump with a pedal. Other equipment that run on pedal power have been was established, among cassava graters, coffee/grain hullers, oil palm nut crackers, potters' wheels, flexible shaft drivers for portable grinders and other power tools, wheel pumps and sewing devices [2].
- *Technically creating and implementing a drainage valve:* The rate of removal of trash out of a typical washer or dryer is managed by a mechanical control valve of the sewer system. Motorcycle brakes can be used to technically manufacture this type of valve. When washing, rinsing, or drying the garments, the stopping mechanism would obstruct the silicone outlet line.
- *Increasing washing capacity:* To make use of the lost energy, the machine's capacity can be educated to allow for the laundering of more garments. If you wanted to increase the washing capacity, it would be needed to rinse and dry the clothing one at a moment. After that, the dishwasher wouldn't finishes a whole load of clothing in the same cycle.
- The pedal can be used to operate both a hacksaw and a centrifugal pump.

Methodology

In the beginning, it is the gear that uses a linkage drive to transmit horsepower to the chainring. By employing rivets in order, the outer shaft is fastened to the inner dram. The internal drum turns along with the driveshaft. The cylinder that houses the clothing is the outer cylinder. The exterior walls are furnished with straight supports that aid in raising the clothing through the laundering procedure. It has a door at the top. The outer drum is the one which contains the water. The sprocket is a standard 18 teeth back flywheel of a bicycle. The components are Gear, Pedal, Chain, Rear Sprocket/Flywheel, Shaft, Outer Drum, and Inner Drum (Figures 1 and 2).

LITERATURE SURVEY

An analysis of the published material on pedal-powered laundry machines and their application for drying garments. PPWM mechanism helps achieve effortless uniform washing. Mobility of this machine helps to shift easily anywhere. It may be the greatest choice for laundering garments in secluded locations wherever water is not often accessible. Pulley is part of the equipment's design, chain drive, and multi utility drum.

It passes from chain drive to gears, and to the pedaling rotation, who turns the impeller multiple uses drum for cleaning.

As a consequence of this, we are able to do laundry devoid needing any external power sources such as diesel or electricity. The best and cheapest approach is to not use any energy sources to power the machine [3].

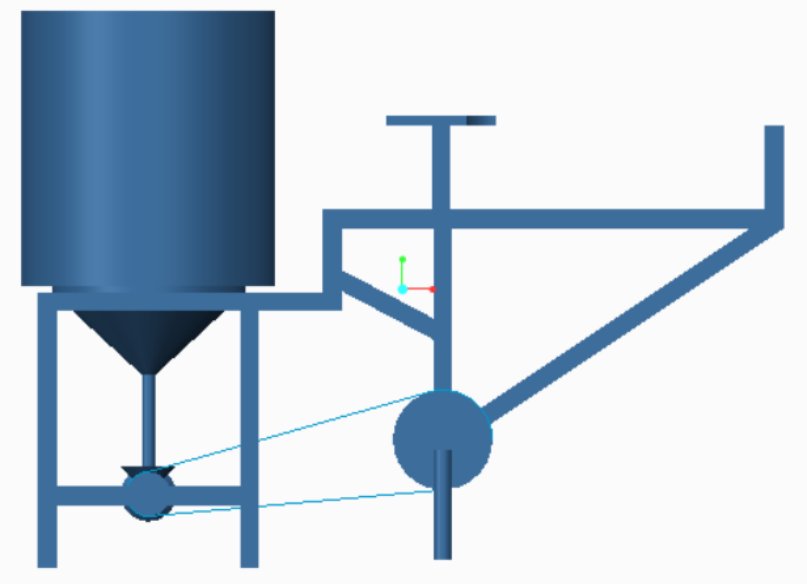

Figure1. Front view of PPWM.

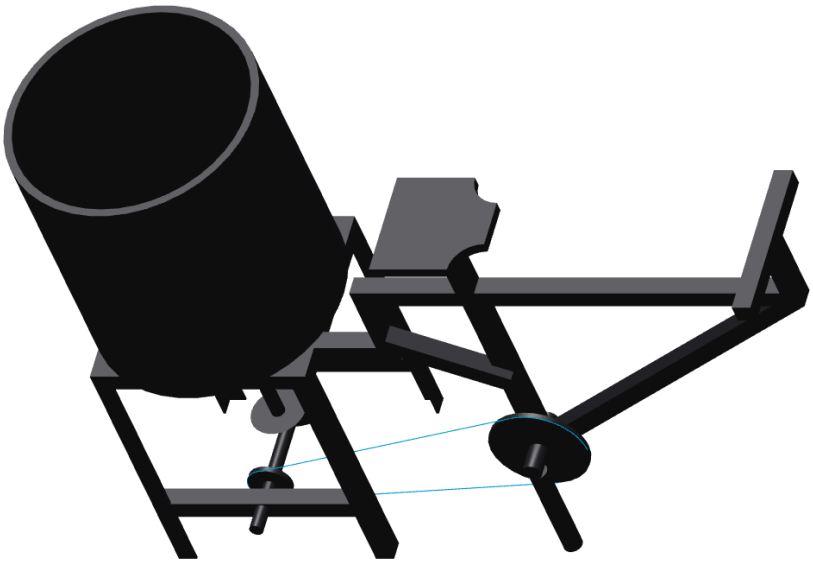

Figure 2. Isometric 3D view of PPWM.

As it operates on chain drive mechanisms mostly using the efforts of humans, this machine recognizes a human driven mechanism. With only a few simple actions, we could power this machine. As it does not require any other sources of energy and can be constructed using a metal start a chain pulley, a tire belt, a grinding wheel, a saw, a bearing, an accelerator, an electric motor, and another chain socket, this mechanism is appropriate for usage in today's developing world. The appliance was created in a way that it can effectively produce 14 volts, 4 amps of electrical energy while lifting fluid up to a height of 10 meters. Any average healthy person is capable of producing this power. Due to the fact that pedaling acts as exercise, this technique is also handy for fitness purposes [4–6].

CONSTRUCTION

The washing tub must first be obtained; however, it may also be found in any junkyard where it is frequently discarded as garbage. To minimize weight and increase efficiency, the insufficient portion of the drum must be replaced. Using the metal bracing and rods we bought, the build process next moves on towards constructing a frame. The final design of our washing machine is made from iron rods that are the right length, and the support system is fastened using bolts or welding. We have just reviewed a few of the many features that are offered by the product to consideration before letting the buyer make the decision for themselves (Table 1) [7].

Table 1. Dimension of product design.

S.N.	Parameters	Dimension (mm)
1	Inner drum diameter	430
2	Outer drum diameter	460
3	Height of inner drum	458
4	Height of outer drum	500
5	Total volume of inner drum	658656
6	Total volume of outer drum	785000
7	Height of frame	500
8	Width of frame	360
9	Diameter of Bevel Gear	80
10	Diameter of front sprocket	180
11	Diameter of rear sprocket	80
12	Length of chain	580

PEDAL-POWERED WASHING MACHINE COMPONENTS

Following are the components of PPWM:

- Pedal
- Chain
- Bevel gear
- Washing tub
- Frame
- Seat
- Bearing

Pedal

The component of an automobile whereby the bottom post and shoe spindle are called the rider pushes with their foot to propel the bicycle. It provides the connection between the cyclist's foot or and the allowing the leg to turn the spindle and propel the bicycle's wheels. Pedals were initially attached to cranks connecting directly to the driven (usually front) wheel. The safety bicycle, as it is known today, came into being when the pedals were attached to a crank driving a sprocket roller chain. That transmitted power to the driven wheel by means of a Pedals usually consist of a spindle bearing those threads into the end of the crank and a body, on which the foot rests or is attached, that is free to rotate on with respect to the spindle.

Chain

The bike connection is a kind of roller chain that transfers the acceleration generated by cycling to the motor's tool, which moves the machine ahead. Most bicycle chains are constructed from basic carbon or alloy steel, even though some are nickel-plated either to prevent oxidation or merely for aesthetic purposes. Energy efficiency of up to 98.6% was recorded in one research for bicycle chains. Efficiency was not greatly affected by the level of lubrication, according to the study, it was

conducted in a sterile room. When it shifts the stress position out to the axle, an increased cog will provide better transmission.

Lowering the load on the rolling elements and lowering friction within the interior of the wheel. It was discovered that higher network pressure was more effective: Because of wear and tear, this really goes in another direction than you might anticipate.

Sharp gearboxes: Bevel gears, also called bevel gears, are motor transmission components used to change the direction of shaft tilt, slow down irregular shafts that rotate, and increase horsepower. They can be applied to shafts containing connecting axes in addition, in specifically, to problems on shafts with non-crossing dimensions. Shafts that are always parallel to one another; however, they do not exist at this time. In essence, the dental shape of bevel gears—either bent or straight—can be used to classify them. Here, bevel gears are described accompanied by an analysis of their functionality or typical uses [8].

Cleaning tub: Since the beginning, producers of automated cleansers have taken considerable pains to make their products more affordable.

In particular, as the acceleration of motors might be adjusted digitally, costly transmission boxes have become longer necessary. The outside wheel using upfront loading dishwashers can frequently be constructed of flexible, even on some more costly models. The process of replacing the main bearings is challenging since, in most cases, the rubber circle needs to be split in half to allow for the removal of the drum inside to gain entrance to the external component. Some modern machines use a small aspect ratio for direct-driven generators, which include a coaxial blade that stands on the center drum's driveshaft and a stator arrangement that is fastened to the underside side of the outermost wheel. A pulley, belt, and belt idler are not required with direct drive. Early 1990s up-market consumer machines included microcontrollers for the timing process, as seen by a see-through Bosch machine at the IFA 2010 in Berlin. Since they were dependable and cost-effective, and microcontrollers are now replacing electromechanical timers in many inexpensive equipment.

Seat

A chair is a location to sit; it frequently refers to the surface one sits on rather than additional parts like backrest. Any motorbike that allows a person to sit safely has a seat. The artistic aspect of seating layouts is always taken into account in accordance with their application in any kind of car. The material for a seat might be composed of material such as rubber, plastic, metal, and so on. In certain seat agreements, cushion is further taken into consideration. This means that suspension can come made of springs or food.

Bearing

A machine's journal is a moving machine an element that is supported by a bearing. While carrying the load, it allows for relative mobility between the contact surfaces of the members. Consideration will reveal that some energy is lost in an attempt to overcome frictional resistance as the consequence of the relative motion between the surfaces that are touched, and that fast wear results from close contact between the rubbing surfaces. A thin film of fluid (sometimes referred to as lubricant) may be applied to lessen frictional resistance, wear, and in certain situations to take up the heat created [9].

OPERATING PROCEDURE

A pedal-powered clothes washer cleans clothing by turning an impeller that spins with the help of paddling. The fundamental concept is to use a bicycle pedal stands as an energy generation and connect it to an old, salvaged washing machine hub using a chain-driven mechanism and ring combination. Since the venture is pedal-powered, it is devoid of a power supply from the outside, such as petrol or gasoline. When the pedal start rotating manually the rotation is transmitted from the

chain to the sprocket, which is mounted on hub of the cycle ring the sprocket is totally jam on the hub by means of welding thus the ring start rotating on the speed of sprocket thus the chain drive is mounted on the shaft hence the shaft is connected to small pulley which is mounted on the shaft hence the shaft start rotating and also the bevel gears are mounted on the same shaft thus the rotation is transmission to the dishwasher using gears with a bevel. Eventually, the rotation is transferred to the dishwashing shaft, and the impeller begins to rotate. The normal operation involves the middle impeller rotating, which makes the washing cycle. When the dry procedure engages, however, each drum of the washing machine is starting to rotate, which makes the dry cycle. This is given that the plastic gears beneath the washing tub are engaged. Prior to performing the dry cycle, nonetheless the rinse is run and the water that is not clean is drained from the washing machine's drum [10, 11].

CONCLUSION

Its primary objective is to create anything that offers a different method of washing clothing in the absence of light. It must be recognized that this is an extremely trying and exhausting undertaking in the country. Therefore, by providing rural residents with an alternate method of laundering apparel that is fast, inexpensive, and ecologically sound, the product—which is a pedal-driven machine—satisfies what they want. The item that was developed is easy to operate and use, efficient, and offers no operational expenses.

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