A Review on Nonelectric Washing Machine Evolution

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Abstract

Using a sprocket and chain or gear system, power can be generated by a person cycling. Since many years ago, peddling by human power has been utilised frequently in bicycles. A few examples of applications for this idea include pedal-powered water wells, grinders, and electricity generation. Here, the fundamental idea is that pedalling is transformed into circular motion. In modern society, washing clothes is one of the most common routine tasks performed by the human population. Because it requires human labour, time, and expense in a water environment, this normal task is more painful. The goal of the current study is to create a nonelectric washing machine (NEWM) that can accommodate the needs of the majority of the population in any given nation. This machine's mechanism and its working principle are practically identical. The primary goal of the current Endeavour was to create inexpensive initial and operating cost machinery that could be used in places without access to electricity.

Keywords: *turbulent flow, gear system, electricity, Pedal power, washing machine, foot pedal, nonelectric mechanism,*

INTRODUCTION

Many decades ago, bicycles were designed with the idea of pedaling by human force. In order to conserve gasoline and electricity and to operate in distant areas without power, pedal-powered tools have grown more and more prevalent. The current nonelectric washing machine utilises the peddling principle with an oscillating mechanism. Compared to a hand crank, a regular person can produce four times as much power by pedalling. Peddling differs from person to person, and age plays a significant role. Peddle-powered washing machines enable people to wash clothes more quickly and with less effort than hand or manual washing. The energy could be used to complete other lucrative or enjoyable tasks [1]. It is a suitable alternative to fossil fuel- or electricity-powered equipment that is also good for the environment. Additionally, it is a human workout that aids in maintaining fitness. [4-8]

Types of Washing Machines

There are two main configurations for washing machines. The layout depends on how the clothes are displayed and the rotational axis. Top loading and front loading are the two main configurations.

Top Loaded

These washing machines have an agitator that uses agitation to transfer mechanical energy from the motor to the clothing. Dirt is removed and kept in suspension by mechanical agitation and detergent. The central cylinder will be made of steel and enamel-coated steel. Water is extracted from the fabric as the cycle is finished through the perforated cylinder.

A vertical fibre basket with perforations is used to hold clothes, and this basket is placed within the tub to keep the water out. The centre of the fibre basket has a vertical fin-like structure. Through a hinged door, clothing is loaded into the machine at the top. The top-loaded machine is depicted in Figure 1.

Fig. 1: Top Loaded Washing Machine (www.google.co.zw)

Front Loaded

The washing drum revolves horizontally in this kind of machine. Figure 2 illustrates how to load the machine with the clothing through the front glass door. Less water and detergent are used by this kind of machine.

Fig. 2: Front Loaded Washing Machine. (www.google.co.zw)

Design Specifications

The ability of the washing machine to facilitate quicker and easier laundry is the most crucial element in its design. The current pedal-operated washer is necessary to wash the clothing efficiently and with little harm to the fabric. It must be both transportable so that families may share the device and portable so that it can be brought close to a water source for use. To fit in a small space, the machine must be small. The number of garments varies from family to family; the initial size was chosen based on the current washing machines available and designs that allow for simple scaling up or down, depending on the needs. [1- 3]. The specifications are as follows: cleanliness of the clothing, washing rate, capacity, affordability, durability, ease of maintenance, simplicity of spare parts availability, etc.

TYPES OF WASHING CHAMBERS

Vertical Axis Chamber

Two vertical axis concentric tubs make up the typical washing machine seen in American homes. With its closely spaced perforations, the inner tube used to hold the clothes allows water to flow in and out without any issues. Throughout the wash cycle, cleaner and water are retained in the exterior tub. As seen in Figure 3, a central agitator revolving in one direction causes Friction between the clothing to precisely remove dirt and stains.

Fig. 3: Vertical Axis Chamber. [9]

Horizontal Axis Chamber

As seen in Figure 4, a horizontal washer lifts clothing from the side of the drum using fins aligned with the inner barrel. Less water is used as a result of this.]

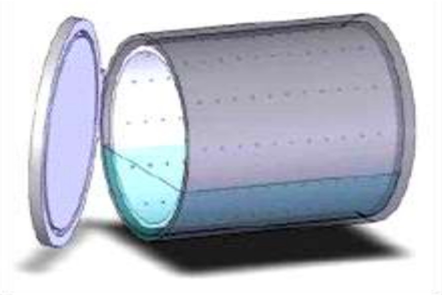

Fig. 4: Horizontal Axis Chamber. [9]

Tilted Axis Chamber

Figure 5's tilted axis functions similarly to a cement mixer. The design makes it simpler to add garments and water. Compared to horizontal manufacturing, this type is a little more challenging.

Fig. 5: Tilted Axis Chamber. [9]

Drum as a Washing Chamber

It is merely a chamber in which water is filled with detergent before clothing is placed inside it for washing. There are two drums used in this type of machine: an inner drum and an outer drum.

Inner drum

This drum, seen in Figure 6, is made up of clothes and has a smaller diameter than an external drum. Its entire body has an inner drum blank. It rotates at the optimal speed for the purpose with the help of a compound gear and chain system.

Fig. 6: Inner Drum

Outer drum

Figure 7 below demonstrates how the outer drum is used to store the water used to wash the clothing.

Fig. 7: Outer Drum

Mechanism (Basic Layout and Assembly)

CAD model of the driving mechanism is shown in Figure 8.

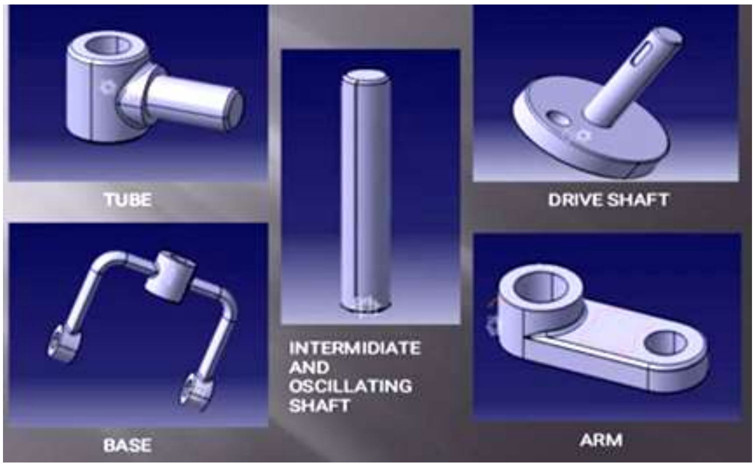

Fig. 8: Mechanism Parts Made in CATIA Software.

The mechanism consists of the following parts:

1. Base.
2. Oscillating Shaft.
3. Intermediate Shaft.
4. Drive Shaft.
5. Arms.
6. Tube

The assembled perspective of the mechanism is depicted in Figure 9(a). Figure 9 depicts the mechanism's actual model (b).

Fig. 9 (a): Driving Mechanism of NEWM

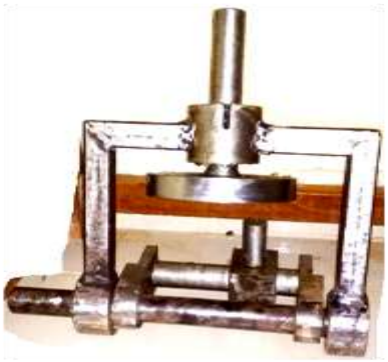

Fig. 9 (b): Actual Model of NEWM

Working on a New Machine

Water is used to clean during the washing process in all washing machines. When washing garments, they are submerged, dipped, scrubbed, or rubbed with water while being treated with detergent or stain remover.

Two tubs will be utilised in straightforward semi-automatic machines for washing and drying. However, in the case of automatic machinery, both procedures would take place in a single drum. After cleaning, the majority of machines drain the water from the clothing, but they don't entirely dry them. The drum can rotate in the study at hand by rotating the wheel. Chain drive turns the wheel. When a person starts pedalling, the gear that is chained to the sprocket begins to transmit power. The mechanism depicted in Figure 9 (a) is the focus of the current project (b).

Wash Cycles

A standalone spin dryer used to remove water from textiles. When piled with clothing and detergent, filled with hot water, and started, the most punctual washers essentially performed a washing operation. Customers load clothes into the machine, choose a logical programme using a switch, start the machine, and then respond by pulling out clean, slightly damp clothes at the end of the cycle. Over time, machines became increasingly automated, first with complex electromechanical controllers, then completely electronic controllers. The controller starts and stops a variety of processes, such as pumps and valves that fill and empty the water-filled drum, as well as warming and rotating at different speeds with different combinations of parameters for different textures.

Washing

The water used for washing in front-loading washers is typically heated using electric heating coils, up to boiling if necessary. For improved results, a variety of detergents, including stain removers and perfumed solutions, can be utilised. Naturally, using higher temperatures for washing consumes more energy. In addition, using higher heat damages many soft textiles and causes them to wrinkle more. Many machines only need cold water, which they reheat to operating temperature and are therefore cold-fill. Cold-fill activity is ineffective in situations where warming water with electricity can be done more affordably or with fewer emissions of carbon dioxide.

Front-loaders must use low-sudsing cleansers because the tumbling motion of the drum causes air to be folded into a load of clothing, which can lead to over-sudsing and overflows. However, the sudsing problem with front-loaders can be limited by simply using less cleanser without reducing cleaning activity because water and cleaner are used effectively.

CALCULATIONS AND RESULTS

A typical human can generate power at a variety of pedalling speeds. A person can produce more power for a much longer period of time by pedalling at a given rate. The pedalling rate varies from person to person as well as depending on the individual's physical health. The average person will typically deliver power continuously for an hour or longer at a rate of 50 to 70 rotations per minute (rpm). As a convenient benchmark for estimates, 60 rpm is employed for simplicity. Different pedalling rates are needed during the washing procedure, as shown in Table 1 below.

According to the above data, the full process will take 35 minutes. However, a healthy person generates 125 watts of power when pedalling at 60 revolutions per minute, as seen in Fig. 10. A healthy man can produce up to 200 watts of power at their peak. Table 2 displays three distinct procedures.

Table 1: Operating Specifications of a Conventional Washing Machine.

Process	Time Taken	RPM Required
Washing	30min	20 rpm
Rinsing	5min	500 rpm

Table 2: Required Power and Torque.

Sr. No	Process Type	Required speed (rpm)
1	Washing	20
2	Rinsing	500

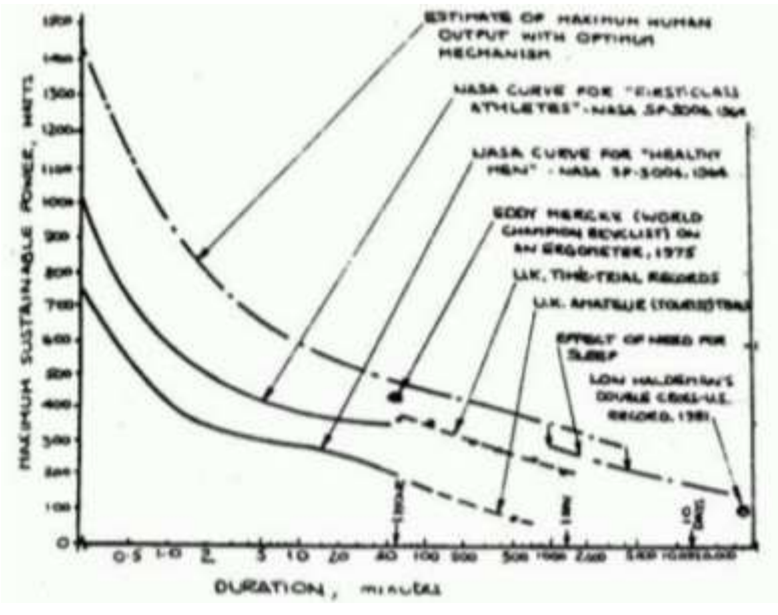

Fig. 10: Maximum Sustaining Power vs. Time, or Human Power Available as Dependent on Exercise Duration [1]

CALCULATIONS

Power,

P = 2π NT/60

Torque available at the tub for washing,

T = (60×125)/ (2π×20) = 59.68*N*m

Now calculating the actual power available for **washing,**

P = (2π×20×59.68) / 60 = 2.5 *W*

Torque available at the tub for **rinsing,**

T = (60×125) / (2π×500) = 2.38 *N*

Now calculating the actual power available for **rinsing,**

P = (2π×20×59.68) / 60 = 62.5 *W*

The minimal torque necessary for all processes is used to determine the machine's capacity. It is taken as 1.2 kg when safety is taken into account.

Conduction of Experiment and Tabulation of Results

Outcomes were seen and displayed as shown in Figure 11.

- Pour enough cleanser powder into the water in the drum.
- Place the clothing inside the inner drum, then seal the spread.
- Begin pedalling while observing the machine's demonstration.

Time is measured with a stopwatch at varying working loads and speeds. The results for the washing cycle are plotted and categorised as shown in Table 3, as shown below.

Table 3: Tabulation Shown for Washing Cycle.

Sr.No.	Speed (rpm)	Load (kg)	Time (min)
1	60	1	20
2	60	1.5	30
3	60	2	40

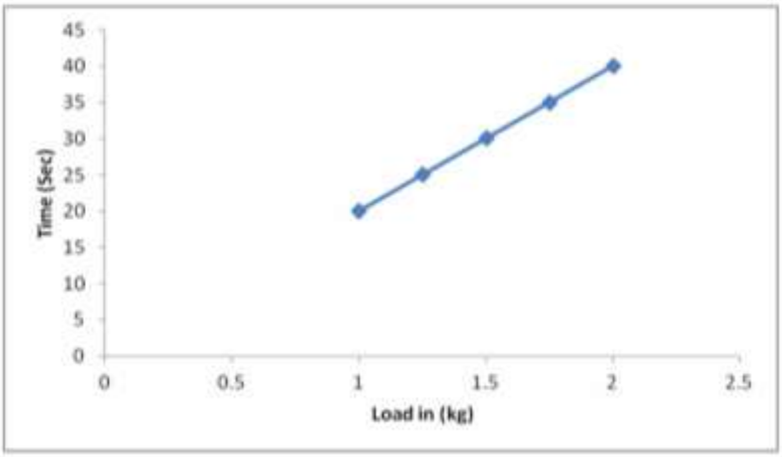

Fig. 11: Graph Representing Load V/s Time.

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RESULTS AND DISCUSSIONS

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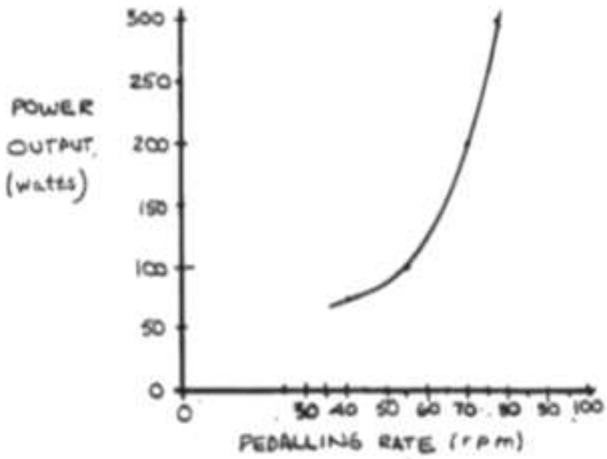

Fig. 12: Pedaling Rate V/s Desired Power O/p [1]

Fig.13: Fabricated Washing Machine

MERITS, DEMERITS AND APPLICATIONS

Merits

The machine is inexpensive to produce. It is extremely cost-effective and accessible to individuals of all socioeconomic backgrounds.

Because no energy is necessary for the machine to function, it is great for those living in remote Indian communities.

When compared to traditional hand washing, less effort is required, which increases human productivity. Failure probability vs electronic machine. The machine employs a mechanical mechanism, which reduces the likelihood of failure. Because the design is simple, the dependability is higher. Lubricating the various components is more than enough to keep the machine running smoothly.

DEMERITS

1. It is heavy in weight.

2. Clothing that is extremely thick and lengthy cannot be cleaned (eg: Carpets, Blankets, Bed sheets etc.)

3. Children under the age of 12 are not permitted to use this. More clothing cannot be washed at the same time.

APPLICATIONS

These devices are useful in rural regions. The designed gadget can potentially be utilised as workout equipment. It is utilised in places where there is no power.

CONCLUSIONS

When compared to hand washing, the proposed nonelectric washing machine will allow individuals to wash clothing faster and with less exertion. Students who stay in hostels can save money and time. It is also beneficial for staying fit. We hope that our study and analysis have resulted in the design or clarification of a pedal-powered nonelectric washing machine. Hopefully, in the near future, such useful instruments will become a standard addition to communities throughout all countries.

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