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Pedal Powered Washing Machine

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Abstract

In many developing countries like Bangladesh, people spend almost seven hours each week washing their family's clothing by hands. Paddling washing machine can clean these cloths more efficiently and faster without using electricity and polluting the environment. It also consumes less water and protects skin from harmful chemical of detergent. In the rural areas where electric supply is unavailable and expensive electricity-powered washing machines becomes almost impractical, pedal powered washing machine comes to use. In developed countries too, it can be used to save electricity. Moreover, Paddling washing machine needs low initial cost of manufacturing and low maintenance cost.

I. INTRODUCTION

Cycle based washing machine is a low cost washing machine made up easily and readily available scrap parts in daily life .It is a machine which generates force through human pedaling and with the drive mechanism, converts the pedaling motion into required rotary motion of the drum. Its innovation lies in its simple design, use of inexpensive parts, very low repairing and maintained cost, affordability to each member of the new design for easy effort in washing, rinsing and drying cloths Laundering by hand involves beating and scrubbing dirty textiles. Clothes washer technology (CWT) developed as a way to reduce the manual labor spent, providing an open basin or sealed container with paddles or fingers to automatically agitate the clothing. The earliest machines were hand-operated and constructed from wood, while later machines made of metal permitted a fire to burn below the washtub, keeping the water warm throughout the day's washing (the entire process often occupied an entire day of hard work, plus drying and ironing).The earliest special-purpose washing device was the scrub board, invented in 1797.As electricity was not commonly available until at least 1930, some early washing machines were operated by a low-speed single cylinder hit and miss gasoline engine.

Fig 1: Hand driven washing machine

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Fig 2: Motor driven washing machine

Because water often had to be hand carried, heated on a fire for washing, then poured into the tub, the warm soapy water was precious and would be reused, first to wash the least soiled clothing, then to wash progressively dirtier laundry. Removal of soap and water from the clothing after washing was originally a separate process. After rinsing, the soaking wet clothing would be formed into a roll and twisted by hand to extract water. To help reduce this labor, the wringer/mangle machine was developed, which used two rollers under spring tension to squeeze water out of clothing and household linen. Each laundry item would be fed through the wringer separately.

The Pedal Operated Washing Machine is a project, which is under taken to solve the problem of electric supply of people. At village, to run washing machine source of power is electricity. In India most of village is suffering from shortage of electricity. So to overcome above problem we select the washing machine, which is operated manually. It required no power supply or diesel supply. This project is low weight & portable can be easily transported. We use simple cycling mechanism to run the washing machine shaft.

A washing machine, clothes washer, or simply washer, is a machine designed to wash laundry, such as clothing, towels and sheets. The term is mostly applied only to machines that use water as the cleaning solution, as opposed to dry cleaning (which uses alternative cleaning fluids, and is performed by specialist businesses) or even ultrasonic cleaners. All washer machines work by using mechanical energy, thermal energy, and chemical action.

Mechanical energy is imparted to the clothes load by the rotation of the agitator in top loaders, or by the tumbling action of the drum in front loaders. Thermal energy is supplied by the temperature of the wash bath. The spin speed in these machines can vary from 500 to 1600rpm. The machine ―Pedal Operated Washing Machine is innovative to manufacture and it requires skill to manufacture. The parts can be manufacture in our college. Its subcomponent price is also less, but its manufacturing requires sort of skill. This project gives us knowledge, experience skill and new ideas of manufacturing.

II. TYPES OF WASHING MACHINES:

Types of washing machines

- Top loaded washing machine
- Front loaded washing machine

Top Loaded Washing Machine:

The top-loading design or vertical-axis clothes washer, most popular in Australia, New Zealand, Canada, the United States and Latin America, places the clothes in a vertically mounted perforated basket that is contained within a water-retaining tub, with a finned water-pumping agitator in the center of the bottom of the basket. Clothes are loaded through the top of the machine, which is covered with a hinged door. During the wash cycle, the outer tub is filled with water sufficient to fully immerse and suspend the clothing freely in the basket.

The movement of the agitator pushes water outward between the paddles towards the edge of the tub. The water then moves outward, up the sides of the basket, towards the center, and then down towards the agitator to repeat the process, in a circulation pattern similar to the shape of a torus. The agitator direction is periodically reversed, because continuous motion in one direction would just lead to the water spinning around the basket with the agitator rather than the water being pumped in the torus-shaped motion. Some washers supplement the water pumping action of the agitator with a large rotating screw on the shaft above

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the agitator, to help move water downwards in the center of the basket.

Front Loaded Washing Machine

The front-loading design or horizontal-axis clothes washer, most popular in Europe and the Middle East, mounts the inner basket and outer tub horizontally, and loading is through a door at the front of the machine. The door often but not always contains a window. Agitation is supplied by the back-and-forth rotation of the cylinder and by gravity. The clothes are lifted up by paddles on the inside wall of the drum and then dropped.This motion flexes the weave of the fabric and forces water and detergent solution through the clothes load. Because the wash action does not require the clothing be freely suspended in water, only enough water is needed to moisten the fabric. Because less water is required, front-loaders typically use less soap, and the aggressive dropping and folding action of the tumbling can easily produce large amounts of foam.

III. HARDWARE SPECIFICATIONS

- Pedal power
- Pedal wheel
- Gear hub
- Shaft
- Chain sprockets.
- Washing drum

Block diagram

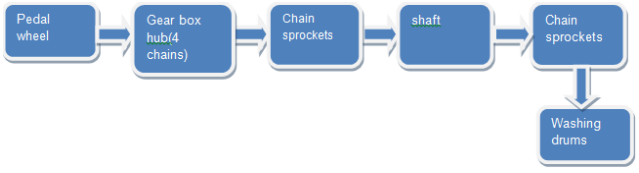

Fig 3: block diagram

Description:

Bicycle gearing is the aspect of a bicycle drive train that determines the relation between the cadence the rate at which the rider pedals, and the rate at which the drive wheel turns.On some bicycles, there is only one gear and the gear ratio is fixed. Many contemporary bicycles have multiple gears and thus multiple gear ratios. A shifting mechanism allows selection of the appropriate gear ratio for efficiency or comfort under the prevailing circumstances: for example, it may be comfortable to use a high gear when cycling downhill, a medium gear when cycling on a flat road, and a low gear when cycling uphill. Different gear ratios and gear ranges are appropriate for different people and styles of cycling. A cyclist's legs produce power optimally within a narrow pedaling speed range, or cadence. Gearing can be optimized to use this narrow range as efficiently as possible. As in other types of transmissions, the gear ratio is closely related to the mechanical advantage of the drive train of the bicycle. On single-speed bicycles and multi-speed bicycles using derailleur gears, the gear ratio depends on the ratio of the number of teeth on the chaining to the number of teeth on the rear sprocket (cog). For bicycles equipped with hub gears, the gear ratio also depends on the internal planetary gears within the hub. For a shaft-driven bicycle the gear ratio depends on the bevel gears used at each end of the shaft.

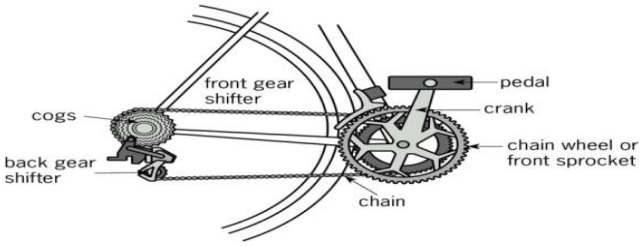

Fig 4:Bicycle gearing

General considerations

The gearing supplied by the manufacturer on a new bicycle is selected to be useful to the majority of people. Some cyclists choose to fine-tune the gearing to better suit their strength, level of fitness, and expected use. When buying from specialist cycle shops, it may be less expensive to get the gears altered before delivery rather than at some later date. Modern crank set chain rings can be swapped out, as can cog sets. While long steep hills and/or heavy loads may indicate a need for lower gearing, this can result in a very low speed. Balancing a bicycle becomes more difficult at lower speeds. For example, a bottom gear around 16 gear inches gives an effective speed of

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perhaps 3 miles/hour (5 km/hour) or less, at which point it might be quicker to walk.

Relative gearing

As far as a cyclist's legs are concerned, when changing gears, the relative difference between two gears is more important than the absolute difference between gears. This relative change, from a lower gear to a higher gear, is normally expressed as a percentage, and is independent of what system is used to measure the gears. Cycling tends to feel more comfortable if nearly all gear changes have more or less the same percentage difference. For example, a change from a 13-tooth sprocket to a 15-tooth sprocket (15.4%) feels very similar to a change from a 20-tooth sprocket to a 23-tooth sprocket (15%), even though the latter has a larger absolute difference.

Usable gears

On a bicycle with only one gear change mechanism (e.g. rear hub only or rear derailleur only), the number of possible gear ratios is the same as the number of usable gear ratios, which is also the same as the number of distinct gear ratios.On a bicycle with more than one gear change mechanism (e.g. front and rear derailleur), these three numbers can be quite different, depending on the relative gearing steps of the various mechanisms. The number of gears for such a derailleur equipped bike is often stated simplistically, particularly in advertising, and this may be misleading. Consider a derailleur-equipped bicycle with 3 chainrings and an 8-sprocket cogset:

- The number of possible gear ratios is 24 (=3×8, this is the number usually quoted in advertisements);
- The number of usable gear ratios is 22;
- The number of distinct gear ratios is typically 16 to 18.

Three cycle wheels

Three-wheeled bicycles, more commonly referred to as tries, come in a range of designs. Some resemble traditional two-wheeled bikes with frame modifications to accommodate a wider axle and additional rear wheel. Others are recumbent, supporting the rider in a chair-type seat, with a frame that is low to the ground. Three-wheeled bikes are known for their stability and ease of riding. However, they also have some drawbacks

Fig 5: 3-wheels cycle

Sprockets and Chains

A sprocket is a toothed wheel upon which a chain rides. Contrary to popular opinion, a sprocket is not a gear.

Fig 6: sprocket

IV. DEVELOPMENT OF MANUALLY DRIVEN PEDAL POWERED WASHING MACHINE:

Prior Art:

There are existing solutions to the clothes washing problem, but no existing technology is both practical and affordable for people in our target community. Existing solutions are either designed for industrialized nations with running water and electricity, or they are not practical for rural setting where replacement parts are difficult to find. Commercial washing machines have existed for many years, but they are expensive and require electricity to operate. Sometimes, they are available in urban settings, but the average family cannot afford to purchase one. In rural areas, commercial washing machines are not an option because electricity may be unavailable or extremely expensive. A number of groups have modified commercial washing machines to power them with human power.

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They attached a pedal-drive mechanism to the washing machine drum and attached a suspension system.

Probable Design Alternatives:

The team evaluated a number of mechanisms that could serve as the basis for the washing machine. Initial concepts were developed starting from the mechanical requirements of laundry washing, with inspiration drawn from existing and historical washing machines.

Vertical-Axis Agitator:

The usual washing machine found in American homes consists of two vertical axis concentric tubs. The inner tube, which holds the clothes, has densely-spaced perforations which allow the water to run in and out easily. Soap and water are kept inside the outer tub during the wash cycle. A central agitator alternating directions induces friction between the clothes to mechanically remove dirt and stains. For the spin cycle, water is emptied from the outer drum and the inner drum is spun to centrifugally extract water from the clothes.

Fig 7: vertical axis agitator

Horizontal-Axis Tumbler

Commonly used in European homes, this washer also uses two concentric tubs; however their revolution axis is horizontal

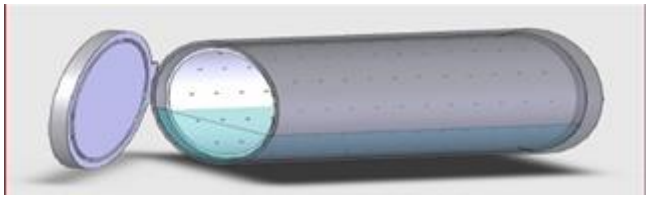

Fig 8: Horizontal axis tumbler

Instead of using an agitator, the horizontal washer utilizes fins along the inner barrel that lift the clothes on the side of the drum, and let them fall back in the water on top of other clothes.

Cycling the clothes through the water in this fashion eliminates the need for rapid changes in the direction of rotation of the agitator, which results in lower energy requirements. Since the drum is only filled up to one third with water, the machine realizes a sizeable water economy

Tilted-axis Tumbler

A tub spinning at a inclined axis using a helical fin would perform the same kind of action, in a fashion similar to a cement mixer.

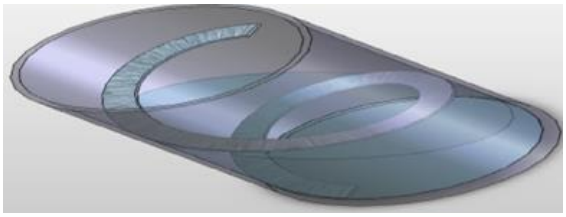

Fig 9: Tilted axis tumbler

The tilted design would allow for easier addition of water and clothes. No known commercial washers use this mechanism. Manufacturing of the helical fin proved to be problematic, and the other construction benefits we were hoping for in the tilted axis design did not end up materializing themselves. No conclusive cleaning experiments were performed using this design.

V. FINAL DESIGN OF WASHING MACHINE:

Our final design resembles a commercially available horizontal axis washer. The inner drum which holds the clothes is currently constructed by modifying a plastic utility tub. Tubes like these are widely available at scrapper but could easily be substituted for other types of buckets, perforated sheet metal or mesh, depending on availability.

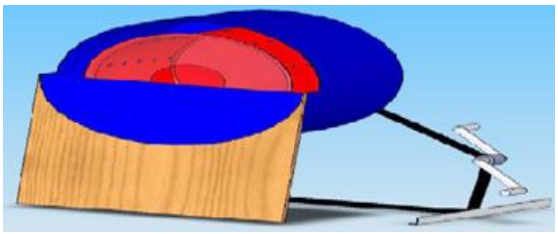

Fig 10: Basic design

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The inner drum is perforated, so that spinning the drum will extract water from the garments. There are also three triangular fins inside the inner drum that agitate the clothes during the wash cycle. The main structure of the machine consists of a simple tube frame. The frame can be built by modifying an existing bicycle frame. The inner drum is mounted on one side of a pedal shaft. Rotational force turns the drum via a drive gear attached to the opposite side of the pedal shaft.

A bicycle chain connects the gear at the drum to a set of pedals mounted on the frame. The operator loads and unloads clothing from the inner drum through a cut out on the side of the outer barrel. The operator drains the soapy water and rinse water by opening a drain value at the bottom of the barrel. The operator can use her hands to do manual work like weaving while pedaling the machine. Women expressed interest in this particular feature.

Fig 11:Pedal powered washing machine

Three Dimensional Designs in CATIA

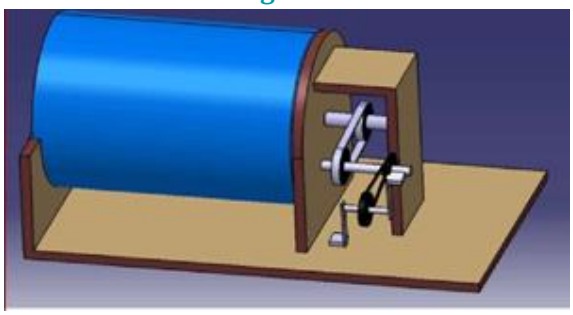

Fig.12 showing power transmission

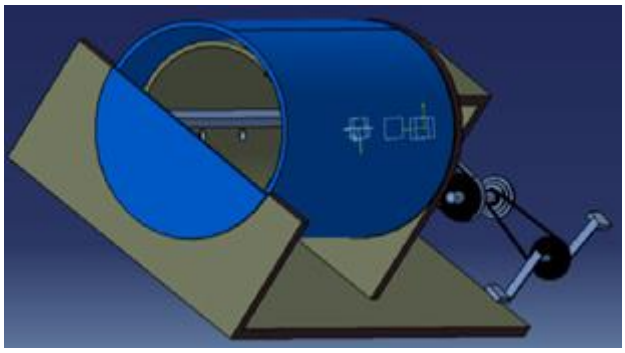

Fig 13:top view

Ease of Use

Washing machine will be easy to use by younger and older women. After loading the machine, washing requires three cycles. Between each cycle, the drum spins quickly to draw the water out of the clothing, as it drains out of the drum. In the first cycle, water and detergent are added to the drum. The operator pedals the machine for roughly 25 minutes, spins, and drains the water. The next two cycles are rinse cycles. In each rinse cycle, the operator pours clean water into the machine, pedals for 10 minutes, spins, and drains the drum. After the last rinse cycle, the operator spins the clothes dry and saves the slightly soapy water for the next wash cycle. Our research into existing washers and our earlier prototypes indicate that the power required for washing and spinning is relatively low.

For these experiments, we used a geared transmission from a bicycle. Both younger and older women can generate enough power for the wash and spin cycles. Estimated power generated 50-75 watts. While familiarity with pedaling in general and the machine in particular will reduce the effort expended by the user, no prior experience will be necessary for its operation. The ability to change gearing ratios will allow some level of tuning to individual users and also allow for shorter wash times with more power input or conversely less strenuous operation if the user can pedal for a longer amount of time.

Testing

This machine Work tested the concept by washing 4 T-Shirts and 2 Capris constituting the weight of dry cloth approximately 2Kg.

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The detergent used was one of the commonly recommended detergents for washing machine. Water approximately used 35L. The washing time was 15 min after that the detergent was drained out through gravity and fresh water used to rinsed the cloth. Then clothes are dried by draining out the absorbed water for this purpose there is a need to pedal the machine at higher rpm. The capability of machine to dry out the clothes depends upon rpm. So the extent of dryness is not better than the manual squeezing of the clothes.
Scope of Further Improvement.

Use of chair in place of cycle frame

For making washing of clothes more comfortable, the cycle frame can be replaced with a chair. Use of chair will be more convenient for women.

Use of Back Wheel of Bike

The required rotation speeds during the wash cycle are not especially high. The aim is to agitate the fibers in the cloths and work the water fully into and through the fabric. This is done by tumbling the clothes within the drum and if the speed was too high the clothes would remain static pressed against the side of the drum by centrifugal forces. On the other hand, this is exactly what's needed during the spin cycle in order to drive out the water.

Double Supported Inner Barrel

The inner barrel will be supported at both ends fixed to a rotating shaft. Since the first prototype had one open end to allow for side-loading, alternative loading mechanisms must be designed. One option is to have a trap door in both the inner and outer barrels. Another is to make one of the supports for the inner barrel movable so that the inner barrel can still be opened and accessed from the side.

Welded steel structure

To reduce the assembly time and prevent others from tampering with it in public areas, the structure will be made out of welded angle iron. Welding fixtures may be designed to make it easier to weld several structures with proper alignment of components.

Different Materials for Outer Barrel

Welded attachment points would not require any bolt holes that need to be sealed. The oil drum may also be shortened by cutting off the end, and welding on a steel lid. Steel would also be more rigid than the plastic drum we used for the initial prototype, so it would be easier to align the barrels and avoid collisions during rotation.

VI. CONCLUSION:

The pedal-powered washing machine is quite different from the community's current method of washing clothes; the community may be reluctant to try the new machine. Achieved what we desired i.e. to build a manually driven pedal powered low cost washing machine using locally available materials and performing necessary function of washing and rinsing with ease. Our washing machine doesn't consume electricity. The washing machine can be used by the urban people also while workout and exercises. It can serve dual purposes. While cycling, the clothes can be washed utilizing the pedaling of the human being. If the production of this washing machine is done at commercial scale then the total production cost of the machine can be reduced to 40% of estimated cost.

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