DIY Washing Machine

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Abstract

The Hand-Operated Washing Machine Description presents a highly cost-effective and easily constructed solution, ideal for a DIY mechanical project. While market alternatives like leg-operated machines exist, they tend to be prohibitively expensive and limited in capacity. Our unique model, designed for hand operation, offers a practical and scalable alternative. This machine represents a stride towards green technology, offering an eco-friendly solution that particularly supports impoverished and rural women who endure skin problems from traditional cloth washing methods. Main objective is to introduce a hand-operated washing machine designed is to benefit individuals residing in rural areas. Crafted from simple, affordable materials, this innovation aims to alleviate the burden of manual laundry tasks for households, particularly reducing the workload of women. Additionally, the machine is engineered to conserve river water,

A. Parts of the constructed machine: The first practical model of Hand-Operated Washing Machine consisting of following parts

1. The Spin Mop Stainless Steel Rod (Figure 1) converts the linear downward force exerted by the human arm into torque.

2. The Inner washing Tub (Figure 2**,** paint pvc Bucket**)** is rotated by the mop rod, which is securely fixed to the tub's base using nut bolts. This arrangement ensures that when the mop rod is pushed down, the inner washing tub rotates clockwise. The inner washing tub features numerous of size 2mm and 3mm holes drilled into it to facilitate water drainage during the rinse and spin cycles, ensuring thorough rinsing and drying of the clothes. This setup provides the following functions:

I. Balancing: The distribution of holes around the inner drum helps to balance the load of laundry during the spin cycle. This balancing reduces vibrations and noise, improving the overall performance of the washing machine.

II. Air Circulation: The holes facilitate air circulation within the drum, which helps to speed up the drying process during the spin cycle. This helps to prevent dampness and musty odors from developing in the washing machine.

III. Preventing Overloading: The presence of holes in the drum acts as a visual indicator for users, reminding them not to overload the washing machine. Overloading can lead to poor washing results and damage to the Mop Rod, so the holes help to encourage proper loading practices.

IV. Draining water: In the absence of water, wash tub spins rapidly to extract water from the clothes. The extracted water then drains out through the holes in the tub, leaving the clothes damp rather than soaking wet.

The design and placement of holes in the inner wash tub of play a crucial role in the efficiency and effectiveness of the washing process. Here's a strategy for the placement and sizing of these holes:

I. Even Distribution: Holes distributed evenly throughout the surface area of the inner wash tub to ensure uniform water flow and coverage over the clothes during the washing cycle. This helps in preventing areas of excessive agitation or stagnation.

II. Strategic Positioning: More holes concentrated towards the top and sides of the inner wash tub to target areas where dirt and stains tend to accumulate. Additionally, ensure that there are sufficient holes at the bottom to allow water drainage and prevent pooling.

III. Variable Sizes: Incorporate a variety of hole sizes to accommodate different fabric types and washing needs. Smaller holes provide gentler agitation for delicate fabrics, while larger holes allow for more robust cleaning of heavier items.

IV. Adequate Spacing: Maintain an appropriate distance between holes to prevent clothes from getting caught or tangled during the washing cycle. The spacing should be optimized to promote efficient water circulation while minimizing the risk of damage to clothing.

V. Directional Flow: Consider the direction of water flow during the washing cycle and position the holes accordingly to maximize the effectiveness of rinsing and detergent distribution. This may involve angling some holes to direct water towards specific areas of the inner wash tub.

VI. Customizable Options: Provide options for users to adjust the hole patterns or configurations based on their specific washing preferences or needs. This could include interchangeable panels with different hole layouts or adjustable baffles to control water flow direction.

By these strategies implementation for the design and placement of holes in the inner wash tub, this machine optimize the washing performance, ensuring thorough cleaning while minimizing wear and tear on clothing items.

3. The Pulsator is attached at the base of the Mop rod. The pulsator in a washing machine serves the function of generating the necessary movement and agitation within the wash drum. It creates a pulsating motion, usually through the rotation of a disc or other mechanism, to agitate the water and clothes inside the drum. This agitation helps to dislodge dirt, stains, and debris from the fabric, ensuring thorough cleaning during the washing process. Additionally, the pulsator aids in distributing detergent and water evenly throughout the load, promoting effective cleaning action. Overall, the pulsator plays a crucial role in achieving efficient and thorough washing results in a washing machine.

4. The Swivel Caster Wheels 360 Degree Rotation Pulley is installed at the bottom of the inner washing tub, serving as a bearing. When the mop rod is pushed down, it imparts torque to the inner wash tub. These wheels enable the inner wash tub to rotate freely.

4. The bearing with plate arrangement (figure 4) involves a temporary setup where three rods are welded onto the outer surface of the bearing. Additionally, a plate with a welded nut is incorporated, with the nut inserted into the inner circle of the bearing and secured in place using a bolt. This part will replace with more suitable arrangement shown in figure 8.

5. The outer tub used in this device is 35L x 40cm H x 35.5 cm W bucket. We made water inlet and outlet to this bucket. At the base of this bucket we kept smooth surface tiles to provide low friction to the caster wheels. This bucket comes with a cover. A hole a made on a cover to insert Mop rod.

6. Caster PU-Wheels Plate 4 Small Fix Roller Moving Castors Single Wheel: This will install in the inner upper part of outer bucket to provide stability to inner rotating tub

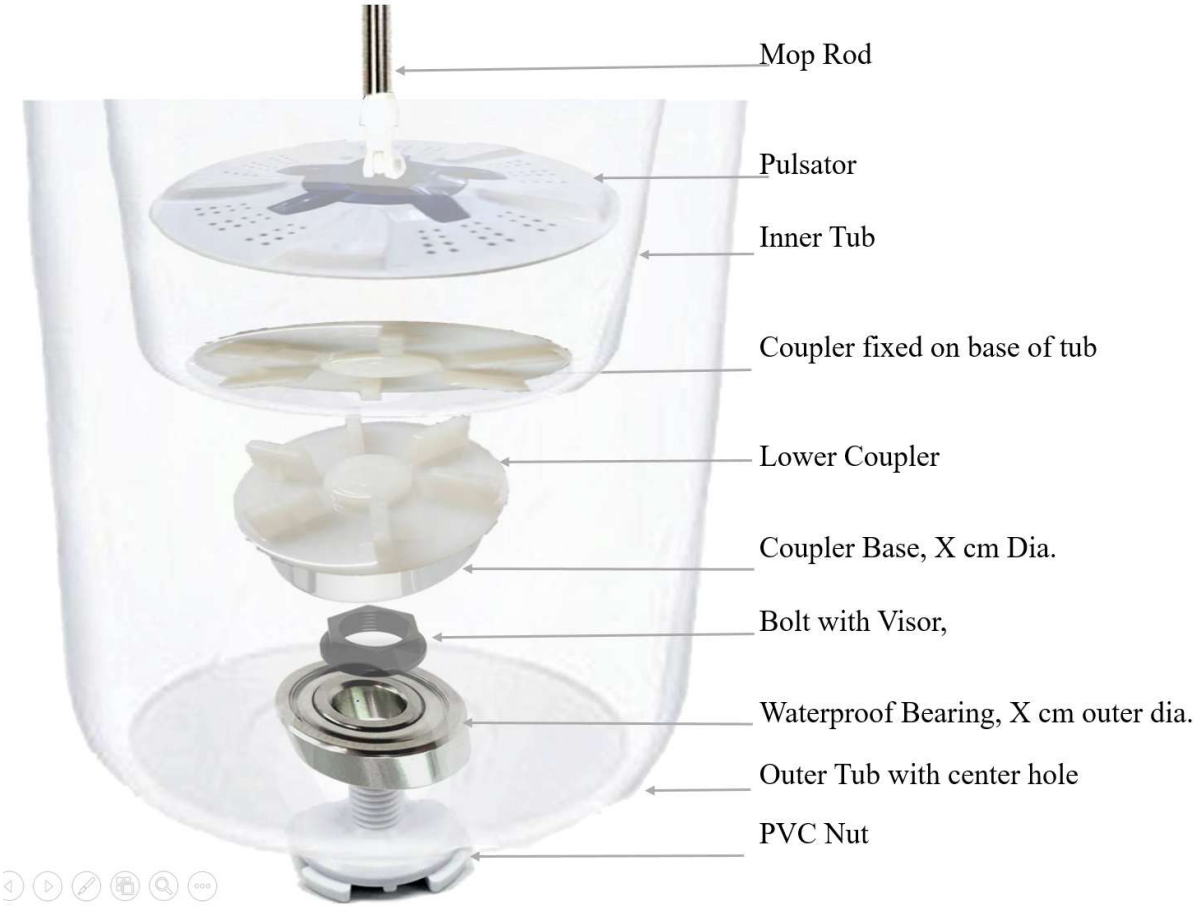
B. Hand Operated Washing Machine Assemble diagram (figure 6): The image shows a complete, ready-to-use hand operated washing machine.

C. Capacity and Torque of the constructed washing machine:

This 23-liter inner wash tub can generally accommodate about 3-4 kg of laundry, depending on factors such as the type of fabric and how tightly packed the clothes are. Torque needed for inner wash tub depend on factors such as the diameter of the wash tub, the rotational speed, and the desired acceleration or force applied to the clothes during washing. The rotation speed of a hand-operated mopping rod can vary widely, but a rough estimate could be around 60-100 rotations per minute (RPM) for an average person with moderate strength.

Torque exerted by an average person would also vary, but it's generally in the range of 10-30 Nm (Newton-meters) depending on the force applied. If wash tub is rotating at 80 RPM, its angular velocity will be = $(80 \times 2\ \pi)/60 = 8.377$ red/s. The mass of the water in the tub is 22 liters which is equal to 22kg. If the tub is rotating at a constant speed, there's no change in velocity, and therefore no acceleration. So, the force is simply the weight of the water ≈215.82N. Thus the approximate torque produce is 30.77 Nm (Torque =215.82 x 0.1425)

Assembly design for Rotation (Figure 8):



For a Electronics washing machine with a 5kg capacity, the average torque applied during a typical washing cycle might range from 10 Nm to 30 Nm, depending on factors such as the rotational speed of the drum and the design efficiency of the motor. It's important to note that this estimation is very rough and actual torque values can vary significantly between different models and manufacturers.

References

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