

Pedal Powered Clothes Washer

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Abstract— Pedal Powered Clothes Washer is a low cost machine made up of easily and readily available scrap parts in daily life. It is a machine which generates power through human pedaling and with the drive mechanism, converts the pedaling motion into required rotary motion of the washing drum. Its innovation lies in its simple design, use of inexpensive parts, very low repairing and maintenance cost, affordability to each member of the society and it does not affect the environment. Our team intends to directly address the problems faced in washing clothes, and thus have developed a new design for easy effort in washing, rinsing and drying clothes. The Pedal Powered Clothes Washer is a completely new concept, which in its one laundry cycle does washing, rinsing and drying of clothes similar to that of an automatic washing machine available in the market.

Keywords - Pedal powered washing machine

I. INTRODUCTION

We all wash clothes either by our hands or use power driven washing machines. Traditionally and even in today's India, washing clothes by hand is a common practice. Over the years, this has been either a very strenuous and time consuming or an expensive process. The project intends to solve the problem faced by so many persons in their day-to-day life. In the rural areas where electric supply is unavailable and expensive, powered washing machines becomes almost impractical. Several attempts have been made to develop a solution for these areas and to solve these problems. Thus the project has the following objectives –

- A very effective machine which is not only cheap but has low maintenance cost. It should have readily available components and should be ergonomically efficient. .

- Must have all the mechanisms – Washing, Rinsing, and Spinning.

II. DESIGN

This section gives a brief idea and analysis of the pedal powered washing machine. It also states the mechanisms incorporated in our model for the process of washing the clothes.

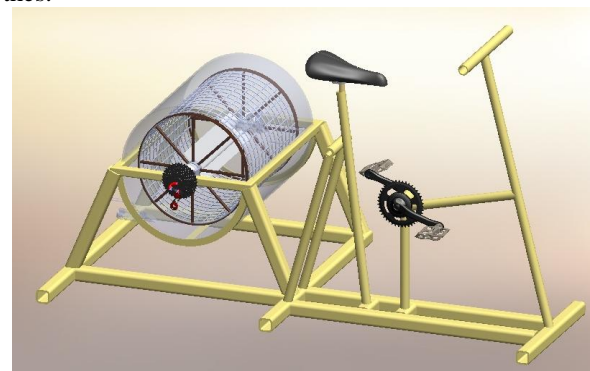


Fig. 1 Assembly of the pedal powered clothes washer.

A. Mechanism.

Clothes are washed in pedal powered clothes washer like in any other washing machine in 3 basic steps:

- Washing
- Rinsing
- Spinning

The pedal powered clothes washer incorporates the mechanisms used in washing machines as well the one used in hand washing to ensure effective washing .

1) *Washing* : The mechanism of washing is based on the tumbling action of the drum. The clothes in the drum rub against each other like in the washing machine and the

resulting friction loosens the dirt. Water turmoil removes dirt away from within folds of clothes. Brushes incorporated along spindle ensure brushing of the clothes thus imitating the action used in hand washing. Since the brushes are not fixed on the rotating shaft, there is relative motion between the brush spindle and the rotating shaft that enables efficient brushing. The net, a new feature of this machine provides friction from the outer side ensuring brushing from all directions. Paddles provided in the inner cage ensure proper tumbling movement of clothes inside the drum. These together constitute the mechanism of washing.

2) *Rinsing*: The process of rinsing is similar to that of washing. No detergent is added in the rinsing process. The water turmoil ensures that the clothes are free from soap and lather. The rinsing process is carried out at a slightly higher rpm than washing so that the clothes are lather free. Now there might be a problem of clothes tangling with the brushes and themselves. However due to the design itself pedalling at a faster speed will detangle the clothes automatically due to the added centrifugal force.

3) *Spinning*: The mechanism of spinning is based on centrifugal force. When the drum is rotated at higher speeds, the centrifugal action takes the water droplets away from the clothes. The faster the speed greater will be the drying efficiency.

B. Design of components.

1) *Frame*: The frame is made of mild steel hollow rectangular bars of 50x30x2 mm dimensions. The frame has been ergonomically designed for operator comfort and also been analyzed for static loading. The finite element analysis of frame is done using ANSYS® software for static loads. The assumptions in static analysis are that the frame is placed on the ground. An appropriate point load for the rider and an UDL for the drum is assumed. The frame is evaluated for equivalent stress, shear stress and total displacement.

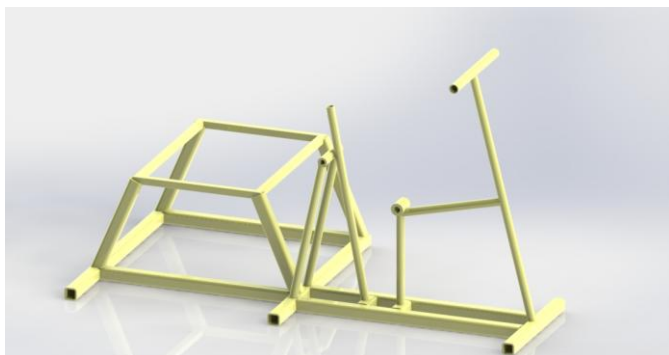


Fig. 2 Model of the frame.

From the ANSYS® report it can be concluded that, the equivalent stress is concentrated point of support of the seat. Even though the stress is within the permissible values the point stresses are undesirable, hence the frame was optimized further. The size of base members of the frame was changed from 1 inch square tubes to 2 x 1inch rectangular tubes for

better ground support. The support structure to the seat was altered leading to reduction in stress concentration. The equivalent stress in the area was reduced to half its original value along with a considerable reduction in the displacement. The frame was also checked for toppling and since, the reaction force at base is not zero, and therefore we can say that the frame is not losing any contact.

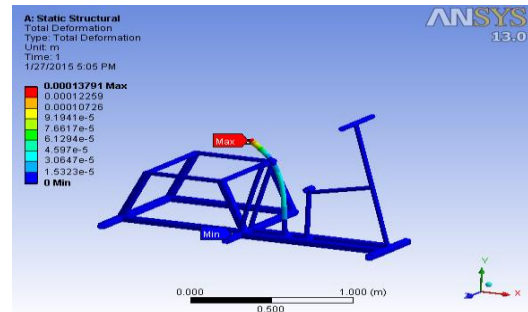


Fig. 3 Displacement analysis for frame

2) *Outer Drum*: The outer drum is where the water is during the washing process. Plastic drum sealed at its lid. To fit the inner drum and the spindle in their positions as seen in the figure, the outer drum has to be cut halfway along the section midway in the front view. The two parts hence obtained would be hinged with the help of door hinges so as to facilitate inlet to clothes as well as performing cleaning actions inside the plastic drum. The cut portion would be made leak-proof by introducing gaskets throughout the cut section. The outer drum would be bolted and screwed to the main frame with the supports. Also the inlet and outlet valves and pipes would be fitted in the outer drum.

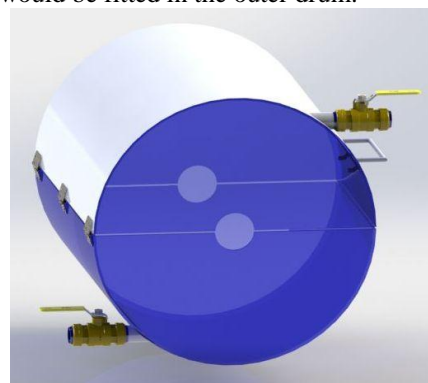


Fig. 4 Outer Drum

3) *Inner Drum*: The inner drum has a caged structure and is planned to be manufactured in stainless steel. The inner drum is bolted to the driven shaft and encloses the clothes. The drum also has a frictional net to ensure that the clothes do not get out of the drum. The drum also incorporates the paddles that are bent in triangular form out of stainless steel sheets. The paddles ensure that the clothes are taken to the top and not stagnated at one place. The paddles have one long edge and one short one to ensure efficient tumbling.

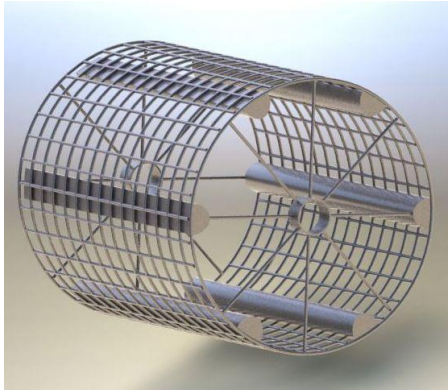


Fig. 5 Inner Drum

TABLE II
VALUES OF CADENCE OF 120 RPM

Rear Gear Number	Rear Gear Teeth	MPH	KPH	RPM
1/1	60/28	12.0	19.4	257.3
1/2	60/24	14.1	22.6	299.74
1/3	60/20	16.8	27.1	359.86
1/5	60/17	19.8	31.9	424.08
1/6	60/14	24	38.7	514.12

4) *Shaft*: The shaft is the main driving element. The shaft material selected is mild steel solid shaft in order to optimize the cost. The shaft is coated with a layer of red oxide and oil paint so that the shaft is rust proof. The shaft diameter chosen is 25mm and is simply supported by means of bearings. The shaft is analyzed and calculations are done to check it against bending and torsional moment. The analysis determines that the stress values are well within permissible limits. The shaft also has another hollow PVC shaft over it. This shaft holds the brushes. The shaft is not fixed to the steel shaft and hence achieve relative motion between the drum and the brush shaft thus enhancing the washing mechanism.

5) *Chain Drive*: The most vital part of the pedal powered clothes washer was the chain drive that transmits the human power to the drum. The gear mechanism provides lesser torque even at load and allows to incorporate the spinning feature because of the high gear ratio available. The chain drive comprises of a driving sprocket, a driven gear cassette, a derailleur to shift gears and the chain to transmit the power. This gearing mechanism caters to the varied torque and speed requirements during the various cycles of operation. The washing process requires high torque and hence the highest gear reduces the effort required and the spinning process requires high speed which is possible by the lowest gears. The chain selection was done on basis of the analysis of the breaking load of the chain. Accordingly 08B chain was selected. The chain wheel has 60 teeth and the freewheel: 14-17-20-24-28.

TABLE I
VALUES FOR CADENCE OF 60 RPM

Rear Gear Number	Rear Gear Teeth	MPH	KPH	RPM
1/1	60/28	6.0	9.7	128.25
1/2	60/24	7.0	11.3	149.87
1/3	60/20	8.4	13.6	179.93
1/5	60/17	9.9	16.0	212.20
1/6	60/14	12	19.4	257.14

6) *Miscellaneous parts*: Along with these prominent parts the washing also has numerous parts viz.

- The derailleur and shifter assembly: To change the gears without stopping.
- Valves: For efficient draining.
- Bearings: Mounted on the frame for supporting the shaft.
- Gasket lining: To ensure that outer drum is leak proof.

III. SALIENT FEATURES

The pedal powered clothes washer offers a number of salient features. Listed below are some of them.

- Provides efficient washing.
- Eco friendly and non-polluting in every way.
- The machine has low manufacturing cost. It is highly economical and affordable to all class of people.
- Works without electricity so it can be an ideal machine for the people in the electricity deficient regions.
- Less tiring than conventional washing techniques by hand and hence eases the effort.
- The spin dry mechanism provides drying of clothes that is not possible with hand washing.
- The components used are easily available and hence the machine is easy to manufacture and maintain.
- It would help to reduce the physical stress which is applied on the hands during washing clothes.
- It encourages pedaling which is a good physical exercise and keeps oneself fit

IV. CONCLUSION

The main objective is to provide a product with an alternative way to wash clothes when there is no electricity. It has to be understood that in rural areas, it is a very stressful and laborious task. So the product which is a pedal driven machine, it satisfies the need of rural people by giving them an alternative way of washing clothes which is quick, cost-effective and eco-friendly. The product designed has zero operating cost, cost-effective, and it can be used with minimal effort.

ACKNOWLEDGEMENT

We are thankful to our college Fr.C.R.I.T. and our entire Mechanical department for extending so much support to us. We thank our HOD, Dr. Khot for having extended the support and to have believed in us that we can do justice to such an idea. This project idea was greatly supported by our guide Mr. Kamlesh Sasane. We would also like to thank our professors of Central workshop, Fr.C.R.I.T. for their co operation and guidance in fabrication of our model.

REFERENCES

- (1) Carl S. M. Hartwig, "WASHING MACHINE", Patent US 4446706, May 1984.
- (2) Ysunari Motoki, Yuji Ohkuma, "SPIN DRYER", Patent US 4637146A, January 1987
- (3) International sports med journal by Dr. Abyss
- (4) Yi Hsung Hsu, "REAR DERAILLEUR MECHANISM FOR A BICYCLE", Patent US 5346434A, September 1994
- (5) International journal of industrial ergonomics, 0169 8141
- (6) *PSG Design Data Book*
- (7) *Design of Machine Elements* by V.B. Bhandari
- (8) Web link: http://en.wikipedia.org/wiki/Washing_machine
- (9) Web link: <http://esporta.ca/evolution-of-washing-technology/>
- (10) Web link: <http://www.arachnoid.com/bike/>
- (11) Web link: <http://front-load-washer-review.toptenreviews.com/front-load-washer-tips-and-tricks.html>
- (12) Web link: <http://home.howstuffworks.com/washer.htm>
- (13) Web link: <http://www.greeniacs.com/GreeniacsGuides/Energy/Manual-Washing-Machine.html>
- (14) Web link: <http://gadgether.com/bicycle-powered-washing-machine-is-a-boon-for-the-people-of-developing-countries/>
- (15) Web link: <http://www.homecrux.com/2014/02/04/11894/indian-school-girl-develops-pedal-powered-washing-machine-runs-without-electricity.html>