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DESIGN, FABRICATION AND EXPERIMENTAL INVESTIGATIONS OF SEMI-AUTOMATIC DISHWASHING MACHINE FOR DOMESTIC PURPOSE

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ABSTRACT

In this paperobjective of the project is to design and fabricate semiautomatic dishwasher that is efficient and overcome the human work. In market existing dishwasher, the spray arm is not sufficient to spray water in each part of the dish. So keeping this in mind, we designed thecircular rack and spray arm in center of the machine which will spray the water equally and effectively in each and every area of dish. The machine has less cycle time, less energy consumption, less water required for cleaning as compare to manual machine.

Keywords-*Energy consumption, Rack, Spray arm, , Semi-automatic*

I. INTRODUCTION

In India most of the women wash the dishes with their hand scrubbing on it which is giving strain to the muscles. Therefore purpose of this research is to reduce human efforts in dish washing. Thedish washing machine has made cleaning and drying dishes much easier and more efficient. Investigations shows the problem faced in uses of automatic dish washer and solution on the same. Large amount of electricity, time and cost is required in case of existing dish washer machine, because of this reason the uses of dish washer machine in our country is very less. Currently the chores of washing the dishes is being performed by the women which results in the labor work as it is carried out for up to several hours each week. So by developing semiautomatic dishwashing machine we can overcome the above mentioned problems significantly. Also by using plastic material for casingpart , the overall weight of the assembly also reduced.

The dishwasher has made cleaning and drying dishes much easier and more efficient. This project work has been conceived having studied the difficulty in washing the any type of plates. Our survey in the regard in several home, revealed the facts that mostly some difficulty occurs in washing the dish in Hand. The washing power contains the chemical substances and this is reacting with human hand. Now the project has mainly concentrated on this difficulty, and hence a suitable device has been designed. Such that the dish washing can be done without application of any impact force. By using semi-automatic dishwasher, we can reduce time as well as human efforts significantly. In conventional dish washing process large amount of human power as well as quantity of water is used. So keeping that in mind, to reduce this semi-automatic dish washing machine is developed.

II. NEED

We all know that dish and utensil washing are most difficult and time consuming work. But if it is done byAutomatic dish washing machine it become costly for every person. So that we introduce Semi-automatic dish washing machine. In India everyone cannot afford dish washer so our aim is to reduce the overall cost. Dishwasher is now very helpful for the women having jobs. Its time saver.

III. OBJECTVES

1. To study the status of market and customer expectations regarding dishwashing machine.
2. To study alternate design solutions of dishwashing machine for domestic purpose.
3. To fabricate semi-automatic dishwashing machine.
4. To study the quantity of water and detergent required depending upon the dishes loaded.
5. To study performance of the dishwashing parameters using manual dishwashing, semi-automatic and automatic dishwashing machine.

IV. LITERATURE REVIEW

1. .Hoak, D. Parker, D. Hermelink, A. American Council for an Energy Efficient Economy, Washington, DC, August 2008. This Journal helps that present measurements of three recent vintage dishwashers are very different efficiencies showing that while they substantially more efficient than older dishwashers, those tested will still use electric resistance elements for supplement heat ,even when supplied by solar water heating system producing very hot water.
2. .Shilpa N Dehedkar- "Design of basic model of Semi-Automatic Dishwasher machine". (2016): This paper use brief idea and analysis of the Semiautomatic Dishwasher machine. It also state the mechanisms incorporated in this model for process of washing the dish. In this research the dishwashers operate with help of DC motor, Universal motor, Conveyor belt and Microcontroller for time delay.
3. Shaila S. Hedaoo- "Design and Fabrication of Semi-Automatic Dish and Utensil washing machine". This paper discuss the main objective of Semi-Automatic Dishwashing machine is to reduce the cost of fully automatic dishwashing machine and giving good Cleaning Performance. It requires less energy and less water consumption. Time of washing dish can be adjusted as per customer requirements
4. PranaliKhatake- "Design of gears in semiautomatic dishwashing machine". This paper discuss about design of gear in semiautomatic dishwashing machine. The result indicate that in India semiautomatic dishwashing machine are used than fully automatic dishwashing machine as it is chip, preferably gears are used in this semiautomatic dishwashing machine with the belt drive for better life and high efficiency.
5. Dhale A. D.- "Design and Development of semiautomatic dishwasher". This paper discuss about the design, construction and evaluation of dishwashing machine. The capacity of machine was 20 plates per min (i.e. 1880 plates per hour). The design dishwasher is very efficient and easy to operate.
6. J. G. Gochran- "Dishwashing machine". The paper gives brief idea describe about improvement of dishwashing machine. It related to improvement in machine washing a dishes in which continuous stream of either soap-soda or clean water is supply to crate holding the rack or cage hot water is supplied to crate is rotate so as to bring the greater portion there of under water.

7. International Journal for Scientific Research and Development Vol.4,Isssue 05,2016 | ISSN (online): 2321-0613. This journal explain that using Galvanized iron material for inner and outer part, the overall weight of the assembly is also reduced. The capacity of machine is to wash 24 pieces of dinner set at a time by using two rotary jet controlled by single pump using parallel connection.
8. International Journal for Scientific Research and Development| Vol. 3, Issue 11,2016 | ISSN (online):2321-0613. This Journal represents the modified design of utensils automatic washer machine. In this, the adjustable conveyor containing utensils tends to rotate, and passing these utensils under three section scrubbing, water sprinkler and cleaner. The dishwasher has made cleaning and drying dishes much easily and more efficiently. Conveyor is rotated by using motors. This leads to making the design simpler and better than the present dishwashers.
9. International Journal for Scientific Research and Development 2016 IJEDR | ISSN: 2321-9939.This journal suggests that this system multi jet technology is used to clean Utensils. Any type of Utensils will be washed in our system, No electronic circuit will be used. Multi jet system will be used to clean utensils from all side.

V. DESIGN CALCULATIONS

5.1 Selection of Motor

We know,

Power = $\frac{2\pi NT}{60000}$

Where,

P = Power in kW,

N = Speed in rpm,

T = Torque in Nm

We have,

Torque = Force x Perpendicular distance

Where,

Force = (Load applied on the rack + Mass of shaft) x Gravitational force

Let, the average load applied on the rack will be 10kg, the mass of rack will be 4kg and mass of shaft be 1kg.

We get,Force = (10 + 4 + 1) x 9.81 = 147.15N

Perpendicular distance = 20cm = 0.2m

 Torque = 147.15 x 0.2 = 29.48

Now, Power = $\frac{2\pi NT}{60000}$

$= \frac{2 \times 3.14 \times 20 \times 29.48}{60000}$

= 0.0771kW = 0.10hp

Therefore, select standard motor as 0.5hp.

5.2 Dimensions of Dishwashing Machine

The entire body of dishwasher that is outer surface was made of metal sheet which is of dimension,

Length=70cm, Height=60cm and Width= 70cm.

∴ Volume of dishwasher = 70 x 60 x 70

= 294000 cm^3

5.3 Dimensions of Water Storage Tank

The entire body of water storage tank is made of plain sheet G.I. which is of dimension, Length = 70cm, Height = 50cm and Width = 5cm.

∴ Volume of Water storage Tank = 70 x 50 x 5

= 17500 cm^3

= 17.5 liters

5.4 Dimension of rack

Height of the rack = 50cm =0.5m

Diameter of outer ring = 45cm = 0.45m

∴ Area of outer ring A = 0.1590m^2

Diameter of inner ring = 15cm = 0.15m

5.5 Electricity Consumption

Given Powers-

Pump = 0.3875 KW = 0.5 hp

Metal Heating Element = 2 KW

Dispenser = 0.025 KW

∴ Total Power Used = 0.3875 + 2 + 0.025

= 2.39785

5.5.1 For 5 Plates,

Power = $\frac{2.39785 \times (45+30)}{3600}$= 0.04995 KW6.5.2 For 10 Plates,

Power = $\frac{2.39785 \times (45+60)}{3600}$

= 0.06993 KW

5.5.2For 15 Plates,

Power = $\frac{2.39785 \times (60+90)}{3600}$

= 0.0999 KW

5.5.3For 20 Plates,

Power = $\frac{2.39785 \times (100+120)}{3600}$

= 0.1465 KW

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Fig 1.Experimental setup of dish washing machine

VI. CAD SETUP

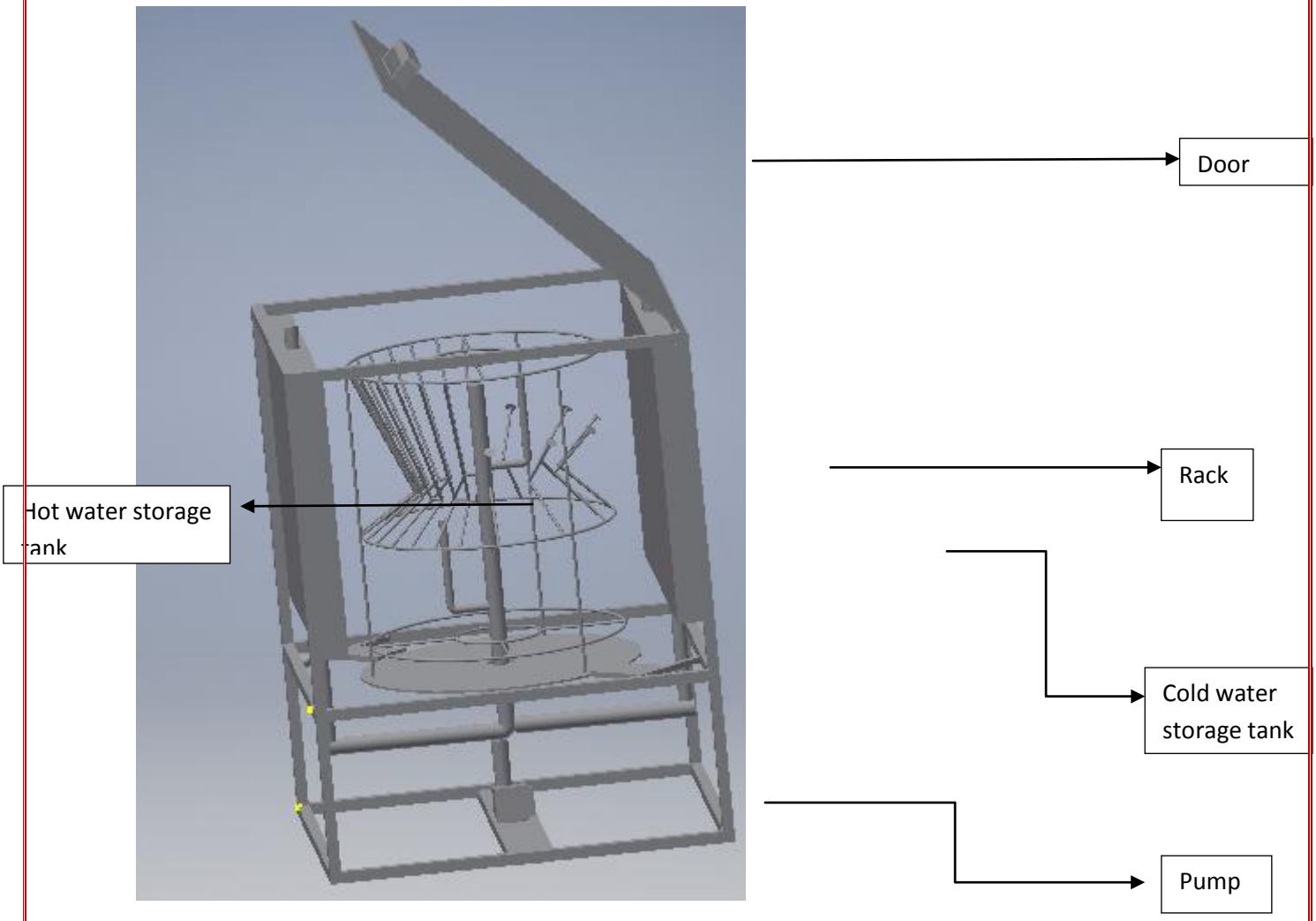

Fig.6.1 CAD model of set up

VII. RESULTS AND DISCUSSION

Series of test were carried out in order to determine the performance and efficiency of the machine. This was done by comparing the rate of washing with the designed Dishwasher to the hand washing (manual). In carrying out these test, six parameters were taken into consideration, they are: No. of plates washed; Quantity of water used in washing (liters); Quantity of detergent used (ml); Time of washing (sec); Quantity of water used in rinsing (liters); Time of rinsing (sec). These are shown in table 1 & 2 below-

Table 1: Performance evaluation of the Machine

Sr.No.	No. of Plates	Quantity of water used in washing	Quantity of detergent used (gms)	Time used in washing (sec)	Time used in rinsing (sec)	Quantity of water used in Rinsing	Electricity consumption for each cycle

		(litres)				(litres)	(kW)
1	5	8	8	30	45	12	0.0499
2	10	10	15	45	60	18	0.0699
3	15	12	20	60	90	24	0.0999
4	20	15	25	100	120	30	0.1465

Table 2: Performance evaluation of the Manual Dishwashing

Sr.No.	No. of Plates	Quantity of water used in washing (litres)	Quantity of detergent used (gms)	Time used in washing (sec)	Time used in rinsing (sec)	Quantity of water used in Rinsing (litres)
1	5	3	10	60	50	5
2	10	5	18	90	65	8
3	15	8	22	110	100	12
4	20	10	26	130	130	15

VIII. CONCLUSION

A comprehensive review of the literature on the semi-automatic dishwashing machine was successfully carried out on various aspects of energy analysis, time consumption and requirement of efforts. The design, construction and evaluation of a dishwashing machine were successfully carried out. The capacity of machine was 20 plates per 4 minutes. The design Dishwashing machine is very efficient & easy to operate.

By knowing the failures from the machine, it is necessary to do some changes in this machine in future. In future the rack of the Dishwashing machine can be revolved by using the gear mechanism for more effective cleaning of utensils. Also by doing this, the less amount of water will be used by the machine for cleaning purpose.

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REFERENCES

[1] Hoak, D. Parker, D. Hermelink, *A. American Council for an Energy Efficient Economy, Washington, DC, August 2008.*

[2] Shilpa N. Dehedkar- *"Design of basic model of semi-automatic dishwasher machine". National Conference On Innovative Trends in Science and Engineering (NC-ITSE 16) Volume:4 Issue: 7 2016 pp.18-21*

[3] Shaila S. Hedaoo, Dr. C.C. Handa ,V.D.Dhopte-*"Design and fabrication of Semiautomatic dish and utensils washing machine. International Journal of Engineering Development and Research Volume 4, Issue 3 2016 pp.292-296*

[4] PranaliKhatake- *"Design of gears in Semiautomatic Dishwashing machine". International Journal for Scientific Research & development Vol.3, Issue 3, May-June,2015 pp.108-112*

[5] "Fabrication of semi-automatic Dishwasher and Utensils Washing Machine".*International Journal of engineering Development and Research (www.ijedr.org) 292 Volume 4, issue 3| ISSN; 2321-9939 IJEDR 1603047.*

[6] ChavanShrikant et.al.*" Automatic dishwashing Machine". International Journal for Scientific Research & Development Vol.3, issue 11,2016 | ISSN (online) : 2321-0613, [7] International Journal for Scientific Research and Development Vol.4,Isssue 05,2016 | ISSN (online): 2321-0613.*

[7] International Journal for Scientific Research and Development| *Vol. 3, Issue 11,2016 | ISSN (online):2321-0613.*

[8] J. garis-Cochrane*, " Dishwashing machine", United statesbPatent Office, Patent no. 355,139, December 28, 1986.*

[9] J. garis-Cochrane, *" Dishwashing machine", United statesPatent Office, Patent no. 835,299, April 24 1917.*

[10] W.r. Walker, *" Dishwashing Machine", United states Patent Office, Patent No. 249, 645, November 22, 1921.*

[11] Shilpa N. Dehedkar- "Design of basic model of semi-automatic dishwasher machine". National Conference On Innovative Trends in Science and Engineering (NC-ITSE 16) Volume:4 Issue: 7 2016 pp.18-21

[12] Shaila S. Hedaoo, Dr. C.C. Handa ,V.D.Dhopte-*"Design and fabrication of Semiautomatic dish and utensils washing machine. International Journal of Engineering Development and Research Volume 4, Issue 3 2016 pp.292-296*

[13] PranaliKhatake- *"Design of gears in Semiautomatic Dishwashing machine". International Journal for Scientific Research & development Vol.3, Issue 3, May-June,2015 pp.108-11*