

Design & Fabrication of Rotating Domestic Dishwasher

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ABSTRACT

Dish washing is a routine activity in households as well as in commercial places such as restaurants, hotels, and canteens. Traditional manual cleaning of utensils requires significant time, effort, and water, which makes the task inconvenient in a fast-paced lifestyle. To address this issue, the present work focuses on the design and fabrication of a Domestic rotating dishwasher that minimizes manual effort while maintaining effective cleaning performance at a lower operational cost. The proposed system includes a washing chamber, dish holding rack, spray arm, water pump. During operation, water is pumped through rotating spray jet nozzles that strike the surface of the dishes and remove food residues and grease. The design operates on the concept that pressurized water jets can provide sufficient scrubbing action to clean ceramic dishes without causing structural damage to keep the manufacturing cost low, the machine was constructed using readily available materials such as mild steel sections, angle frames, and PVC piping. Performance testing showed that the machine effectively cleaned dishes with good results in terms of appearance, odor removal, and surface cleanliness. The developed unit can wash six dishes, six glasses and 12 spoons at a time. The developed Domestic rotating dishwasher therefore offers a practical, economical, and energy-efficient alternative for dish cleaning in domestic kitchens and small food service establishments, while significantly reducing human effort, water usage, and overall operating time.

Keyword: - Dishwasher, Domestic, Nozzles, PVC piping, Low operational cost

1. INTRODUCTION

Cleanliness is an essential aspect of modern living and has become increasingly important with improvements in economic conditions and lifestyle standards. As people seek greater comfort and convenience in daily activities, the demand for efficient cleaning methods has also increased. A **dishwasher** is a mechanical appliance designed to wash dishes and other eating utensils and is commonly used in both households and commercial establishments such as restaurants. Unlike traditional hand washing, which depends mainly on manual scrubbing to remove dirt and food residues, dishwashers perform the cleaning process through automated mechanical action. Conventional dishwashers generally contain several mechanical and electrical components, which can increase maintenance requirements and operational costs. In many cases, water used in these systems must be heated using gas or electricity, leading to higher energy consumption. To overcome these limitations, the proposed dishwasher is designed to be economical and energy efficient. The system is constructed at a relatively low cost and does not require an external mechanism to rotate the dish holder, which helps reduce power consumption. The working principle of the machine is based on spraying water at high pressure onto the utensils. A pump circulates a mixture of water and detergent through pipes and spray nozzles that direct the cleaning solution onto the surfaces of the dishes. After the washing stage is completed, the used water is drained from the chamber. Fresh water is then introduced for the rinsing process, and once the rinse cycle is finished, the water is again discharged from the system. This process ensures effective cleaning while maintaining simple operation and lower energy usage.

2. DESIGN OF COMPONENTS

2.1 Design of dish holder

Dimension of the dish holder:

Effective diameter of dish holder:

Diameter of one dish-20 cm

No of dishes-6

Total circumference for 6 dishes= 20×6

=120cm Therefore, diameter of dishes $120 + \pi$

= 38.19cm

1. Inner diameter of dish holder= 38cm
2. Effective diameter of dish holder= 38.19cm
3. Outer diameter of dish holder = 52cm
4. Clearance between casing & holder = 8cm
5. Angle of dish holding = 110
6. Diameter of wire = 3mm
7. Cross-section of wire = circular cross-section
8. Height of shaft = 50cm
9. Length of slant edge of holder =20cm



Fig -1 Dish holder

2.2 Selection of bearing

Type of bearing- Thrust ball bearing

Total force acting on Bearing load acceleration due to gravity

$$= 3.2 \times 9.81$$

$$F = 31.39 \text{ N}$$

Dimensions of bearing:-

1. Inner diameter of bearing-6cm
2. Outer diameter of bearing- 4.5cm
3. Load acting on bearing:

Weight of dish holder- 2kg

Weight of single dish - 135gm

Total weight of 6 dishes- 810gm

Total weight of 6 glasses- 390gm

Total load acting on bearing -3.2kg



Fig -2 Bearing

2.3 Selection of Electric pump

Centrifugal regenerative pump (self-priming pump)

Technical specification

Discharge: 1000 LPH

Power rating: 0.37 kW (0.5 HP)

Voltage Range: 180-240

Head: 6-30 meters

Features

Withstand wide voltage fluctuation from 180 volts to 240 volts.

Self-priming up to 7.5 meters.

Thermal overload protector (TOP) prevents motor burning.

High quality aluminum extrude motor body with chrome plated shaft.

TEFC capacitor starts and run motor with IP-44 protection and class 'B' insulation.

Light weight pump for easy handling.

Easy maintenance and spares availability



Fig -3 Electric pump

2.4 Design of plumbing system

Types of pipes

1. PVC Pipes-Diameter of PVC pipes 25mm
2. Flexible pipes- Diameter of flexible pipes = 5mm
3. Nobs-2
4. Elbow-20mm
5. Female 20mm

Discharge of Pump= 250 LPH

1LPH=0.001 M³

Q= 250 LPH

Discharge (Q) = Velocity (V) x Area (A)

Diameter of Pipe (D1) = 0.025m

Diameter of Jet (D2) = 0.001m

Velocity of Pipe (V1) =?

Velocity of (V2) =?

Discharge (Q) = Velocity (V1) x Area (A1)

Velocity (1) = Discharge ÷ Area (A1)

= 250 ÷ 0.001

$\pi \times 0.025^2 \times 3600$

V1 = 0.1414m/Sec

By Continuity Equation,

A1V1 = A2V2

V2 = (A1xV1)/A2

V2 = $\pi \times 0.025^2 \times 0.1414 \times 4$

$4 \times \pi \times 0.001^2$

V2 = 88.36 M/Sec

No. Of Nozzles Used = 6 No's

Velocity of Jet = V2 ÷ 6

= 88.36 ÷ 6

= 14.72 M/Sec



Fig -4 Plumbing system

2.4 Selection of nozzles

Total number of nozzles used = 6 no's

Jet type nozzles = 4 no's

Sprinkle type nozzle used = 2 no's

Material of nozzle = plastic material

Diameter of nozzle= 1mm

Function of nozzle: The nozzles are used to strike the jet of pressurized water on the holder vanes for rotation of the dish holder and for washing of the dishes.

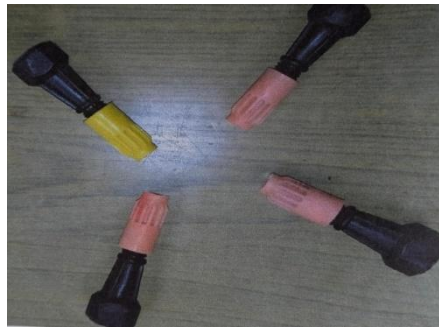


Fig -5 Nozzles

3. CONSTRUCTION

In domestic dishwasher machine the casing is made up of mild steel. A hollow shaft of pure steel is mounted at center of casing by welding process. The thrust type bearing used to easy removal of dish holder which is fixed to the hollow shaft. Dish holder is design by fabrication process made from pure steel to avoid corrosion of it. It freely rotates on bearing and is easily removed for loading or unloading of utensils. Pump of 0.5 HP is used to pressurize the water and PVC pipes are used to circulate the pressurized water through nozzles. Four Plastic type nozzles are used to rotate the dish holder and other two nozzles to wash the dishes.

3.1 Arrangement of components

- Pump: Pump is placed outside the casing which connected with water container and outlet to the PVC pipes.
- PVC pipes: PVC pipes are used for connection of the nozzles and to circulate the water. This all connection plumbing system is done from inner surface of casing.
- Hollow shaft: - The hollow shaft is fixed at the center of the casing.
- Dish holder: - Dish holder is placed on the bearing which freely rotate over it.
- Bearing: bearing is fixed on the shaft at a desired height to hold the dish holder at a certain height.
- Nozzle: nozzle is placed inside the casing in desired position to rotate the holder and also to wash the dishes.
- Water container: - It is placed beside the pump to suck the water from it. It used to store water.

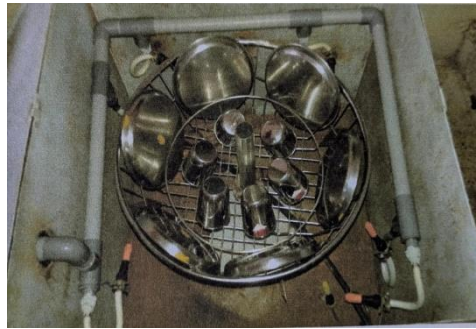


Fig -6 Arrangement of utensils in the container

4. WORKING

Load the utensils in a dish holder of dishwasher. Put the detergent in the water and get proper mixture of water-detergent in water container. After this start the pump of dishwasher which sucked the mixture of water-detergent and discharged with high pressure through the nozzles. The jet of water coming out of the nozzle will strike the vanes of the dish holder which cause the dish holder to rotate about its own axis in 360 degrees. As a result of this the utensils kept in dish holder also rotate along with it. Thus, holder is rotated from the pressurized water not from any external sources. Other spray type nozzle is used to strike the mixture of water-detergent with high pressure on the exposed surface of the utensils. As the utensils are also rotating with the holder so the spray will strike on each utensil to wash through it. Then this mixture of water-detergent mixture is drain out through the drain port provided at the bottom of the casing. After this clean water is drawn into the water container from the water storage tank. The clean water is used to rinse off the detergents on the utensils. This clean water is circulated until all the utensils get properly cleaned to rinse of the utensils. As a result of this we get our utensil washed. Used water is drained out of the casing through the drain port.

5. CONCLUSIONS

We have designed and fabricated a dish washer for cleaning the utensils in houses, industries, shop, hospitals, canteens, restaurants etc. Also with the help of this machine we can reduces the human efforts required for cleaning of the utensils. It also save time for washing of utensils. We have carried much confidence in doing this project successfully. We have learn about analysis of a problem, how to solve it, design of the dish washing machine, design of parts, fabrication of parts, material purchase, assembling of parts and successful testing the machine.

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