

## **Design of Multipurpose Cleaning System by Using Steam**

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**Abstract:** The multipurpose cleaning system by using steam uses steam force which can clean up things that are used by human in day to day life. The commercial detergent washers are compared with the system and it was found that the washing is very convenient and soapy forms are not produced that made the washing very clumsy. The removal of bacterial populations formed on surface of any material would be totally eradicated. The reason behind using the steam for washing purpose is the less wastage of water and also its availability. The development of steam based cleaning system has revolutionized the process of washing. One can choose an appropriate type of high power steam cleaners for challenging cleaning applications in office, commercial and industrial settings. The steam does that thing that commercial washing system cannot do. A steam can remove grease and grime while for normal cleaning requires expensive detergents. So our prime focus is to use the steam and make multiple cleaning.

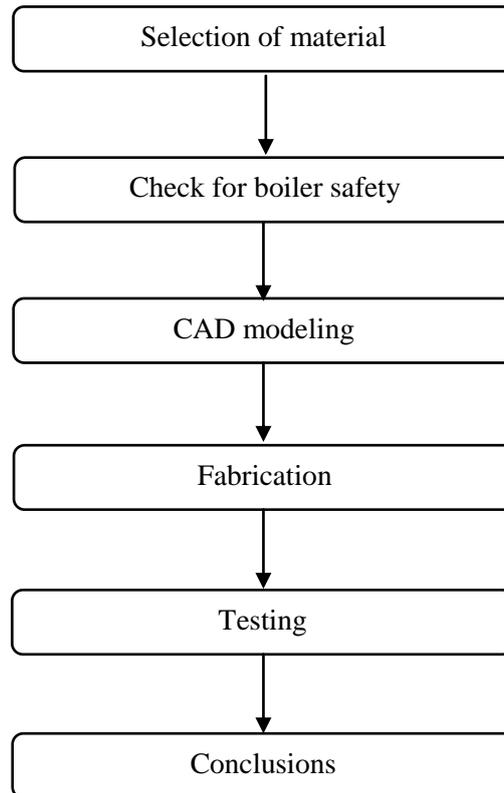
**Keywords:** Boiler, Pressurize, Steamer, Surfaces, Vaporize.

### **1. Introduction**

Multipurpose cleaning system by using steam is truly revolutionary, innovative and eco-friendly. It uses less amount of water to wash a car as compared to 200 liters with high pressure water jet. It is safe and gentle enough to be used for cleaning on all car surfaces, car paintwork, interiors, car engine bay and other household purposes. It gives a perfect exterior finish without any spots or streaking. And when it comes to the interior, not only they do clean thoroughly they also sanitize and deodorize too. Steam washer is a combination of heat and pressure which quickly removes dirt, bird droppings, oil and stains on the car body, sport rims without the need for a hard rubbing or scrubbing. Steam cleans without leaving any water mark on the surfaces. It keeps the car with a good shining condition. Steam is also highly effective in cleaning away stubborn stains on fabric seats, carpets and mats. Steam cleaning has wide applications in human life as they are better than the detergents used for cleaning. All household surfaces can be cleaned by the use of steam, but one must always keep in mind that the materials cleaned will react directly with steam and heat, hence before directly cleaning the surface, the person should take a small area of surface to clean and check so the surface doesn't undergo any changes because of hot steam to be cleaned gets major changes in its appearance, such as colour change etc. Steam cleaning is process through which one can clean any type of surface very efficiently. Steam cleaning is deep cleaning process that makes use of a high-pressure blast of hot water and steam to remove germs and other bacteria from different materials and surfaces. Steam has been used in recent times for cleaning purpose but hasn't been the major alternative still. Compared to normal wash, the steam cleaning has significant benefit which is the main purpose of this paper. With high steam pressure one can cleaning those surface where stains and germs are unreachable. From an industrial worker to housewife, the steam washer plays a significant role.

### **2. Methodology**

Basic steps involved in this paper are selection of materials according to the requirement. In this we have used a commercial geyser drum. The material chosen for this is stainless steel drum. Chosen drum is checked for safety by calculating the thickness required for the drum to operate at the safe working pressure of the boiler drum. CAD model of the drum, pressure relief valve, heating coil and various other components has been done. Thus finalized the assembly of the various components of the boiler drum. Fabrication of the various components to the drum has been carried out as per the assembly of the CAD model is created. Testing of the assembled and fabricated component is done. Testing is done on various dirt surfaces and even greasy surface.



### 3. Components

Main components used in multipurpose cleaning system are:

- Boiler Drum
- Heating Coil
- Pressure Relief Valve
- Water Closing Knob
- Nipple Valve
- Nozzle
- Nozzle Pipe
- Control Valve
- Pressure Gauge
- Trolley



Fig. 1 Assembled view

Fig.1 shows the assembled view of the multipurpose cleaning system by using steam

**Boiler Drum:** A boiler is a closed vessel in which water is heated as shown in fig. 2. It's used to convert water into steam for a variety of applications. The heated or vaporized fluid exits the boiler for use in various

processes or heating applications including heating, boiler-based power generation, cooking, and sanitation. The pressure vessel of a boiler is usually made of steel. Stainless steel, especially of the austenitic types, is not used in wetted parts of boilers due to corrosion and stress corrosion cracking. However, ferric stainless steel is often used in super heater sections that will not be exposed to boiling water. Cast iron may be used for the heating vessel of domestic water heaters. Their purpose is usually to produce hot water, not steam, and so they run at low pressure and try to avoid boiling. The brittleness of cast iron makes it impractical for high-pressure steam boilers.



Fig.2 Boiler Drum

**Heating Coil:** Heating coils are designed to efficiently transfer heat from a steam, boiler water, solar water or high temperature hot water (HTHW) system to the domestic potable hot water system as shown in fig. 3. The primary heat source (steam, boiler water, solar water or HTHW) travels through the tubing in the Hubbell heating coil and transfers heat to the secondary system (potable water) without allowing either system to come into direct contact with the other. Hubbell heating coils are designed and constructed for maximum efficiency and longevity and additional features are readily available to provide the most appropriate style and material of construction for virtually any application. When you specify and install a Hubbell water heating coil, you will have confidence in knowing the owner will be provided with a trouble-free and long lasting source for hot water. Heating coil is the tool that is used to generate heat they are used in industrial, commercial and consumer appliances and equipment for an extensive variety of applications.



Fig. 3 Heating Coil

**Pressure Relief Valve:** A relief valve or pressure relief valve (PRV) is a type of safety valve used to control or limit the pressure in a system; pressure might otherwise build up and create a process upset, instrument or equipment failure, or fire as shown in fig. 4. The pressure is relieved by allowing the pressurized fluid to flow from an auxiliary passage out of the system. The relief valve is designed or set to open at a predetermined set pressure to protect pressure vessels and other equipment from being subjected to pressures that exceed their design limits. When the set pressure is exceeded, the relief valve becomes the "path of least resistance" as the valve is forced open and a portion of the fluid is diverted through the auxiliary route. In this we have considered a spring loaded pressure relief valve which opens or relieves the pressure when the pressure inside the drum exceeds 8 bar.



Fig. 4 Pressure Relief Valve

**Water Closing Knob:** A valve is a device that regulates, directs or controls the flow of a fluid (gases, liquids, fluidized solids, or slurries) by opening, closing, or partially obstructing various passageways as shown in fig. 5. Valves are technically fittings, but are usually discussed as a separate category. In an open valve, fluid flows in a direction from higher pressure to lower pressure. The word is derived from the Latin *valva*, the moving part of a door, in turn from *vulvar*, to turn, roll. The simplest and very ancient valve is simply a freely hinged flap which drops to obstruct fluid (gas or liquid) flow in one direction, but is pushed open by flow in the opposite direction. This is called a check valve, as it prevents or "checks" the flow in one direction



Fig. 5 Water Closing Knob

**Nipple Valve:** In plumbing and piping, a nipple is a fitting, consisting of a short piece of pipe, usually provided with a male pipe thread at each end, for connecting two other fittings as shown in fig. 6. The length of the nipple is usually specified by the overall length with threads. It may have a hexagonal section in the center for wrench to grasp (sometimes referred to as a "hex nipple"), or it may simply be made from a short piece of pipe (sometimes referred to as a "barrel nipple" or "pipe nipple"). A "close nipple" has no unthreaded area; when screwed tightly between two female fittings, very little of the nipple remains exposed. A close nipple can only be unscrewed by gripping one threaded end with a pipe wrench which will damage the threads and necessitate replacing the nipple, or by using a specialty tool known as a nipple wrench (or known as an internal pipe wrench) which grips the inside of the pipe, leaving the threads undamaged. When the ends are of two different sizes it is called a reducer or unequal nipple. Such type of hose nipple is fitted on to the tank and a pipe is connected to the one end of the nipple and other end of the nipple is fitted on to the tank by brazing.



Fig. 6 Nipple Valve

**Nozzle:** Nozzle is a device designed to control the direction or characteristics of a fluid flow (especially to increase velocity) as it exits (or enters) an enclosed chamber or pipe as shown in fig. 7. A nozzle is often a pipe or tube of varying cross sectional area and it can be used to direct or modify the flow of a fluid (liquid or gas). Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and/or the pressure of the stream that emerges from them. In a nozzle, the velocity of fluid increases at the expense of its pressure energy. The Nozzle used in our paper uses a simple venturimeter design, the steam enters the nozzle from the inlet as

shown in Fig. 4.6 where the inlet diameter is maximum and the nozzle diameter keep decreasing till the outlet, and this increases the steam velocity when it exits the nozzle.



Fig. 7 Nozzle

**Nozzle Pipe:** Nozzle pipe as shown in fig. 8 is used to supply steam from boiler to nozzle spray, for this nozzle pipe a control valve is attached to it. Control valve helps in controlling steam pressure by maximizing or minimizing the steam flow. The specification of nozzle pipe is; Length of the pipe = 2m, Outer diameter of pipe = 15mm, Inner diameter of pipe = 13mm



Fig. 8 Nozzle Pipe

**Control Valve:** Control valves automatically regulate pressure and/or flow rate, and are available for any pressure as shown in fig. 9. This enables the direct control of flow rate and the consequential control of process quantities such as pressure, temperature, and liquid level. Pressure-control valves are found in virtually every hydraulic system, and they assist in a variety of functions, from keeping system pressures safely below a desired upper limit to maintaining a set pressure in part of a circuit. Types include relief, reducing, sequence, counterbalance and unloading. All of these are normally closed valves, except for reducing valves, which are normally open.



Fig. 9 Control Valve

**Pressure Gauge:** Pressure measurement is the analysis of an applied force by a fluid (liquid or gas) on a surface. Pressure is typically measured in units of force per unit of surface area. Many techniques have been developed for the measurement of pressure and vacuum. Instruments used to measure and display pressure in an integral unit are called pressure gauges or vacuum gauges. A manometer is a good example as it uses a column of liquid to both measure and indicate pressure. Likewise the widely used Bourdon gauge is a mechanical device as shown in Fig. 10, which both measures and indicates and is probably the best known type of gauge.



Fig. 10 Pressure Gauge

**Trolley:** The trolley used in this paper is an L-shaped box-moving handcart with handles at one end, wheels at the base, with a small ledge to set objects on, flat against the floor when the hand-truck is upright. The objects to be moved are allowed to rest on the ledge. Then the truck and object are tilted backward until the weight is balanced over the large wheels, making otherwise bulky and heavy objects easier to move. The whole assembly of portable car wash is mounted on the trolley. The trolley consists of a main frame and an extension to it. The pump will be mounted on the front extension and the tank will be placed on the main frame. The Model of the trolley is shown in the Fig.11.



Fig. 11 Trolley

The width of the trolley is 400 mm and the length of the trolley is 300 mm and the height of the trolley is 1000 mm. The trolley frames is made using angle channels and its material is Mild Steel. The main frame is made using the angle of outer sides 50 mm and thickness 7 mm. The extended frame is made up of angle channels of sides 40 mm each and the thickness 5 mm. The two pillars of height 320 mm are welded at the front of main frame to which the pump will be clamped. Another two pillars of height 690 mm are welded to which a handle is fixed which will be used to move the trolley.

#### 4. Conclusion

By application of steam based washing system we can save huge amount of water giving high return to environment. Thus, it is a very wide field still to be explored and can be pioneered in saving water and good condition of vehicles can be maintained. Stain free cleaning of the surface, since no cleaning agents are used here thus there won't be any water pollution from this steam car washer.

Thus, by using steam for car washing following things can be achieved:

- Chemical free sanitation.
- Eliminate waste water
- Remove dirt, stains and grease.
- Deodorize and sterilize surfaces
- Remove stains from upholstery in less time.
- Clean interiors, exteriors, engine compartments, door jams, floor mate, tire.

Steam washer made by us is a portable one and thus can be used anywhere by just doing some small modification to the component, that is just attaching wheels to it and a heat shield for the boiler drum.

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