Automatic Job Cleaning Machine

Vikas Dilip Wagh, Aniket Pagar, Valmik Navale, Swapnil Rajole

Abstract: Material cleaning by general definition is to make free the material from contaminants that are adhered chemically, physical or mechanically to that material. Contaminants are soils or impurities either generated during the forming process of new surfaces or deposited foreign matter from surrounding environments on material. Contaminants adhered to the material under high mechanical pressure, or by products of chemical additives or chemical protective films are common in metal forming processes and are difficult to remove. The degree of required cleanliness can range from practical cleaning needed in in-process operations to precision or critical cleaning required prior to coating or final assembly.

Keywords: adhered chemically, physical or mechanically, Contaminants, mechanical pressure, chemical additives or chemical protective.

I. INTRODUCTION

The project comes under Research and development Department. A company's research and development department plays an integral role in the life cycle of a product. Even though the department is usually separate from sales, production and other divisions, the functions of these areas are related and often require collaboration. The activities that are classified as R&D differ from company to company, but there are two primary models. In one model, the primary function of an R&D group is to develop new products; in the other model, the primary function of an R&D group is to discover and create new knowledge about scientific and technological topics for the purpose of uncovering and enabling development of valuable new products, processes, and services. In actual practices, the job is cleaned in various steps. Firstly dip the job in oil solution then placing in water solution. After that manual handling and air cleaning is done. Overall it is time consuming process. The cleaning objectives to be achieved are material properties must remain same as original, process must be economical, ease of handling the job. There are many types of cleaning processes used viz. Aqueous cleaning, Ultrasonic cleaning process, pickling cleaning process, manual cleaning process, Electrical cleaning process, Compressed air cleaning process etc. Research on job cleaning using modern technologies started nearly, and many useful ideas have since been employed worldwide. Using these technologies combined with power sources is one of the methods for reducing the negative effects. However, there are still problems in the modern industry for such large-scale work systems.

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Job cleaning technologies are still hot research topics in the manufacturing industry field. We manufactured the job cleaning machine. The machine is having the water-Quaker solution, compressed air spraying system, pneumatic air cylinder arrangement to lift the tray. We used an electrical component to form a simple circuit. The time required for overall process is less than conventional process and proper cleaning is achieved. The advantages this machine is simple structure, better efficiency and low cost compared with the other cleaning processes and does not need skilled labor to operate it.

II. BACKGROUND

In earlier days, Fortuna Company is using the conventional process for the job cleaning. This conventional process has some limitations. This process takes more time for cleaning the job. It requires more manpower, more cost, and it is not economical one. Following is the flowchart for the conventional process used in the Fortuna.

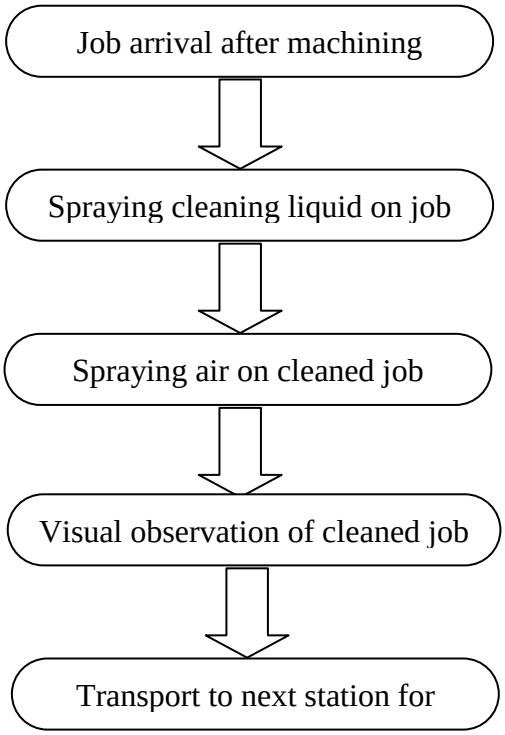


Fig. 1.1: Existing Process Chart

III. PROBLEM DEFINITION

The cleaning of job in many steps and station is time consuming process. As per the company planned process they follow the conventional manual cleaning approach and accordingly they clean the job one by one in one complete cycle of cleaning process.

Also the techniques used to clean the job are not giving output as cleaned up to required need. Handling of job is not proper. For all these, manpower required is more in number. So, there is need to develop the machine which is automatic and easy to operate. The developed machine has minimum cost of cleaning of individual part. It can be overcome the total disadvantage of existing process and achieve all objectives of cleaning process.

IV. OBJECTIVES

i) To clean the job properly.
ii) Reduction in cleaning time and complexity.
iii) Less manpower required for the process.
iv) To reduce the process cost.
v) Reduce space required for total setup.

V. LITERATURE SURVEY

Himanshu Agarwal, Kaushalendra Kr. Dubey and Subhash Kamal[1] in their paper, "Development of Mechanical Fuel Injector Cleaning Machine in Cost Effective Manner", has suggested that fuel Injector cleaning machine is used to clean the injectors with the help of controlled gasoline spray system. When fuel injectors get polluted, it create obstruction in fuel flow and unable to allow spray pattern for proper combustion. In the present market Fuel Injector cleaning machine is used to clean the injectors with the help of controlled gasoline spray system. We have designed and developed for the most cost effective Rs 20,500 this is 10 times less than the existing fuel injector cleaning machine. The development of this work explaining conversion of electrical fuel injection system into mechanical type fuel injection system is cost effective, manually operated, multiple flow, single man powered and equally efficient with electrical system. The conclusion is that now a day's company manufacture electronic fuel injector cleaning machine which is very costly with Rs. 1,90,000/- Mechanical fuel injector cleaning system cost is 10 times less than the existing electronic type fuel injector cleaning system. All assembled parts of mechanical type fuel injection cleaning system available in market, and easy to install in small scale of automobile workshops. It is simple operating system and less maintenance. Pawe Fabijanski, Ryszard Lagoda from Warsaw University of Technology, Institute of Control and Industrial Electronics [3], in their paper **"**Intelligent Control Unit for Ultrasonic Cleaning System" presents the results of simulation and experimental investigation concerning intelligent automatic control of output voltage of Frequency on ultrasonic generator supply sandwich transducers unit in an ultrasonic cleaner. The mechanical resonance frequency of the oscillating system is a function of many parameters and varies during the process to obtain high efficiency cleaning should be continuously monitored and fine tune the frequency inverter to the resonant frequency band transmitters. The ultrasonic piezoelectric ceramic transducers are now the most popular source of high power ultrasound and are used in many industrial applications. High power ultrasonic waves are generally used in such industrial processes as welding, acceleration of chemical reactions, scavenging in gas medium, echo sounding and Under water communication (sonar systems), picture transmission, and, above all, ultrasonic cleaning .In practice is now the most widely used the sandwich type power transducers. Typical units of the ultrasonic generators attuning these transducers operate at frequencies between 20 kHz and 100 kHz with output power to 5 kW. In this case the group of piezoelectric ceramic transducers is the source of power ultrasounds and the vibration is activated by a ultrasonic generator. The output voltage frequency of generator most by equals the mechanical resonance frequency of the transducers and most by tuning with high precise. In the case of un tuning, the frequency feed-back control system of the generator change the output voltage frequency and tuning the inverter to the mechanical resonance frequency of transducers. The task of the control system is therefore the output voltage control frequency inverter, piezoelectric ceramic transducers to vibrate with the greatest efficiency. In real circuit the mechanical resonant frequency is function of many parameters of piezoelectric material, among others, the most important are temperature, time, and for industrial cleaning systems also factor of the column, and the surface of the cleaned elements. For automatic control of output frequency voltage Power converter we proposed intelligent adaptive system with fuzzy logic algorithm. Sami B. Awad in September 2004[4] in this paper Aqueous Ultrasonic Cleaning and Corrosion Protection of Steel Components has given about the material cleaning by ultrasonic method. Surface preparation of steels and other metals and alloys is essential prior to most finishing processes, particularly coating and vacuum coating. Otherwise, yields will suffer. Aqueous and solvent ultrasonic processes have been developed with the specific objectives of achieving the highest quality surfaces without inflicting any damage to components. For steels, the major concern when components are to be cleaned aqueously is flash rusting, which occurs when clean active steel surfaces are exposed to water and oxygen. Ironically, some halogenated (nonaqueous) solvents used to clean ferrous components have periodically, for other reasons, manifested flash rusting problems. Aqueous ultrasonic cleaning offers excellent cleaning results. The method is preferred over solvent based methods for well-known environmental reasons. The challenge always has been on how to clean steels aqueously without having flash rusting or worst pitting occur. Selecting the proper cleaning ultrasonic equipment is equally important as selecting the appropriate cleaning chemistries and process parameters to achieve two goals when dealing with steel components. The first is to accomplish the desired cleanliness level and the second is to protect the steel components from any potential for flash rusting or corrosion. Both goals can be successfully achieved with properly designed ultrasonic aqueous process.

VI. METHODOLOGY

Methodology is the systematic theoretical analysis of the methods applied to a field of study, or the theoretical analysis of the body of methods and principle associated with a branch of knowledge.

In this chapter we have done the complete design of project also manufacturing process of the all parts. Also we collect the all data regarding to the standard parts use in complete assembly of project.

VII. WATER -QUAKER SOLUTION

1. Quaker

The Quaker solutions are used with water for metal cleaning process. The solutions that are normally used are

i) Quakeral

It is a water-soluble, ester-based metal removal fluid containing high-performance soluble oil and semi-synthetic emulsion technology. It provides a wide range of performance capabilities to meet industrial requirements in machining & grinding operations with emphasis on aluminum.

ii) Quakercool

It is a water-soluble, metal removal fluid containing soluble oils, semi-synthetics and true solution synthetics. It provides a wide range of performance capabilities to meet industrial requirements in machining operations. Used in multiple industrial applications such as drilling, milling, tapping and reaming.

iii) Quakercut

Quakercut provide a wide range of performance capabilities to meet metal working industrial requirements in machining operations.

Table 1: Properties of Quaker Solution

Property	**Typical value**
Appearance	Milky white
Pounds per gallon at 60°F	8.79 lbs/gal
Neat pH at 77°F	12.0
Flash Point	Boils at 212°F / 100°C
Odour	Citrus

3.3 SELECTION OF PNEUMATIC CYLINDER

1. **Step 1- Calculate the force**

   We are resting 14 jobs on the tray. Each job has 2 Kg Weight. Metal tray has 8 Kg weight. So the total Force is 40 Kg.

   Force= 40Kg.

2. **Step 2-Determine the operating pressure**

   Industry sets the operating pressure 5 bar for each machine. So the operating pressure is 5 bar.

   Operating pressure = 5 bar.

3. **Step 3- Determine the load factor**

Table 3.3.1: Selection of Load Factor

Purpose of operation		Load factor η
Static operation (clamping, low speed vise crimping, etc.)		0.7 or less (70% or less)
Dynamic operation	Horizontal movement of load on guide	1 or less (100% or less)
	Vertical and horizontal movement of the load	0.5 or less (50% or less)(1)

Our purpose of operation is vertical movement of the load. So we select the 0.5 load factor.

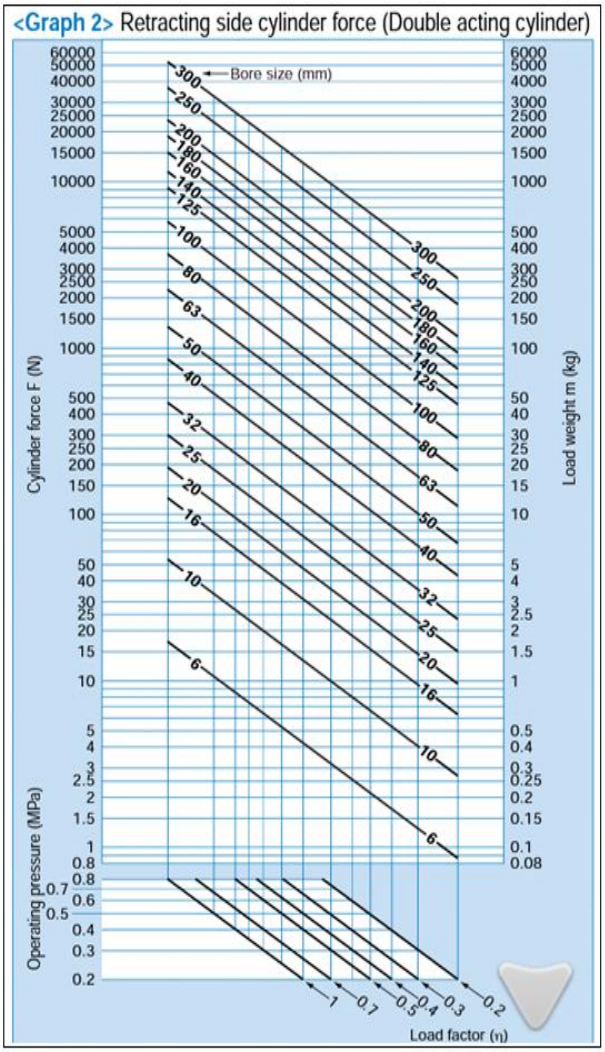
4. **Determine the bore diameter of cylinder**

   Force = 40Kg.

   Operating Pressure =5 bar.

   Load factor = 0.5.

   So for selecting the Bore Diameter of cylinder we use the graph which is given below-



Graph 1- graph between the load vs. operating pressure and load factor.

So by using the above graph we select bore diameter of cylinder is 80 mm. Bore diameter of cylinder =80mm.

3.4 METAL NET AND PNEUMATIC CABLE SUB-ASSEMBLY

The job or work piece which is to be cleaned needs the working space. For this purpose we used a high mesh standard net available in company. The fabricated frame of L-section bar is used to hold the net & move it up-down for the operation. Also the standard pneumatic cables are used to carry the pressurized air through compressor to tank. Also the sheet metal cover is provided to isolate the process for environment & foreign particles. Two small windows covered with glass fiber are there to visualize the process. The assembly is shown in fig.3.4.

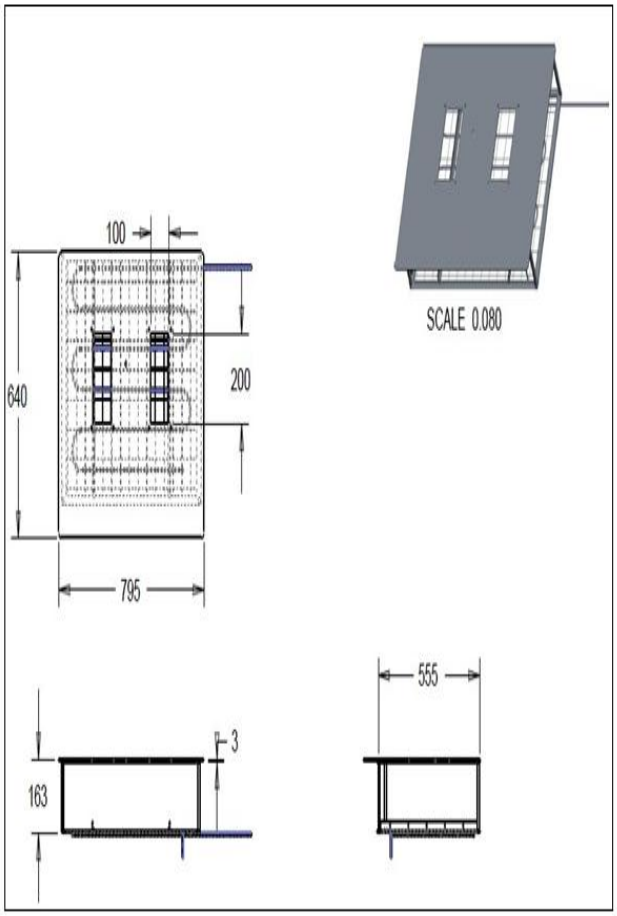


Fig. 3.4: Metal Net and Pneumatic Cable Sub-Assembly

3.5 LEG SUPPORT

To support the tank we used the L section bars. Also considering the ergonomics to handle the job by worker at proper height, leg supports are given to tank. The standard L-section bar is used for this purpose. The material of bar is M.S. It has dimensions 50mm x 50mm and thickness of 5 mm. Analysis is done on bar to check it for the safety point of view.

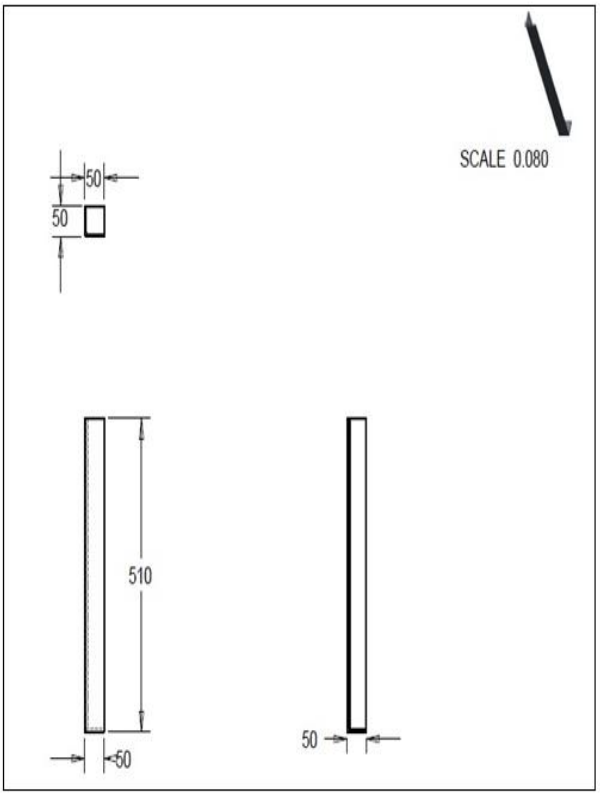


Fig. 3.5: Leg Support

3.6 SHAFT SUPPORT

The job or work piece which is to be cleaned needs the support. For this purpose we used a standard shaft support. The material of support used is plastic fiber. It is as shown in fig.3.6.

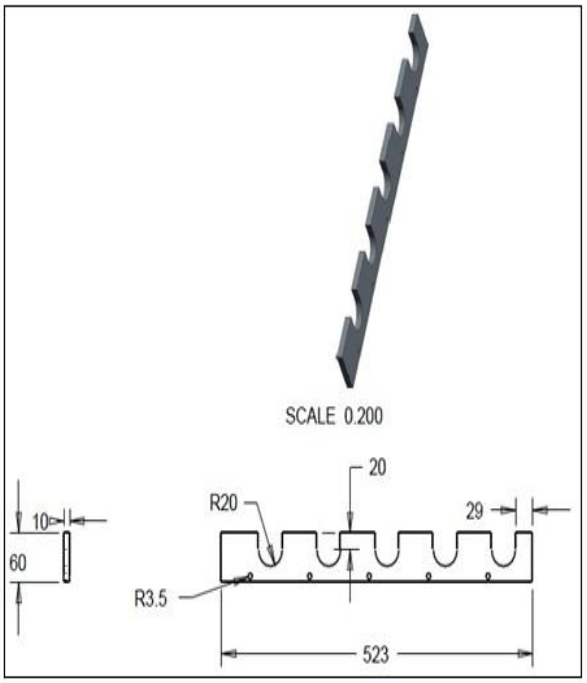


Fig. 3.6: Shaft Support

3.8 BLOCK DIAGRAM FOR ELECTRICAL COMPONENT

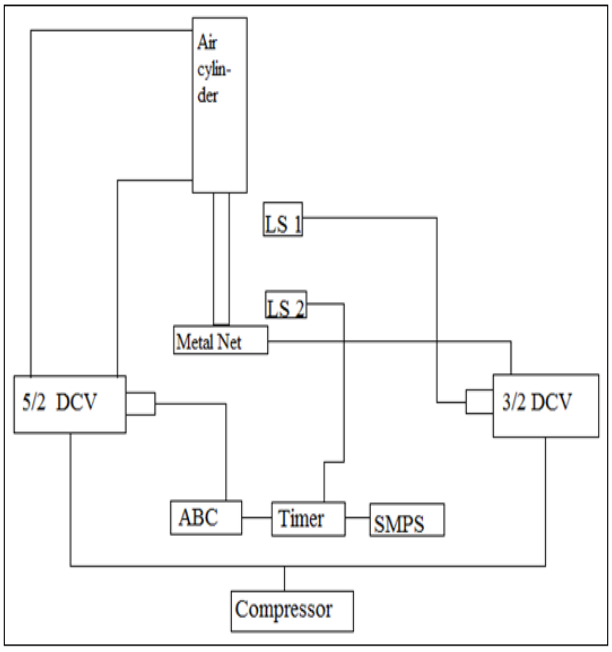


Fig. 3.14: Block Diagram for Electrical Component

The electrical components used in machine are shown in above block diagram. The air compressor is connected to the solenoid valve by pneumatic cables to carry the air. Solenoid valve is electrically actuated by the timer. Timer is connected to SMPS in series which is input for timer. Push button is also connected to the timer. As tray moves down it actuates the timer connected to SMPS. Then timer operates solenoid valve for predefined time. After that when tray is

bringing to initial position then again air is used to clean and dry the job with the help of push button.

3.9 ASSEMBLY OF ALL PARTS

After completing total design and manufacturing of all required parts of the machine the next and most important task is to assembled the all parts to get complete working model of the machine for that we assembled all designed and standard parts together these are shown in Fig.3.14.

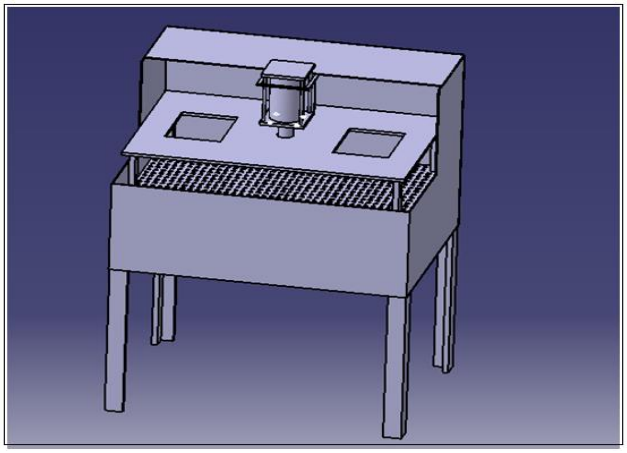


Fig. 3.15: Assembly of Project

3.10 ACTUAL ASSEMBLY OF PROJECT

Fig. 3.16: Actual Assembly of Project

4. EXPERIMENTAL PROCEDURE

In our project we have used pneumatic cylinder arrangement for lifting and settling down the work piece. After Deeping the job in the solution same arrangement is used for the lifting the job. After the high pressure air is forced on the job to remove the burr. This process is economical than the conventional process used in the company. The experimental procedure conducted on our project is explained with the help of following flow chart.

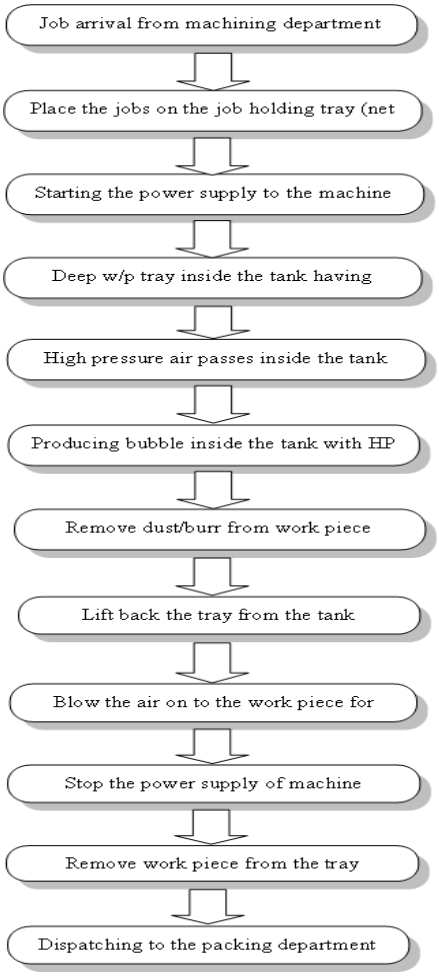


Fig. 4.1: Developed Process Flow Chart

4.1 ACTUAL WORKING OF MACHINE

1) The job from the manufacturing department is coming to the cleaning machine for cleaning it. And also for removing all burrs, dust, oil, grease present on the surface of the cam shaft.
2) After arrival of job placing job on the work piece holding tray which holds the work piece correctly with the help of job holding plates.
3) Actual electrical supply is given to the machine for it's operation. Also the electrical supply is give to the SMPS for actuating the solenoid valve, limit switch, timer, etc. the AC supply is given to the SMPS which converts AC to 24 volt DC supply.
4) Then deep the work piece holding tray inside the tank with the help of pneumatic cylinder arrangement which lowers the tray inside the tank. After that the tank is made closed with upper plate. The work piece holding tray is deep in the oil for 55 second.
5) The high pressure air having 6 bar is passed inside the tank from compressor with the help of solenoid operated 3/2 direction control valve. That air comes out in the tank from the holes provided on pneumatic tube which produce bubbles inside the tank.
6) That bubbles of cleaning liquid having high pressure are strike on the work piece. Due to that effect the burr and oil particles stick to the job are separated from work piece and settled down to the bottom of tank.
7) The clean objects are removed from tank by raising the holding tray. Then air is passed over the work piece which dries it.
8) Cut all the electrical supply given to the machine and other auxiliaries of the machine.
9) After completing all cleaning process on work piece it can be remove from the holding tray manually and send to the packing.

VIII. CONCLUSION

The method shown for cleaning of connecting rod and cam shaft are of great significance for modern industrial subjects. The situations where objects are so small, that it is almost impossible to cleaning the objects are very often. Although we used relatively imprecise measurement equipment in our project, we obtained a clear view of areas in which each of those methods is appropriate for cleaning of jobs. So the efficiency of cleaning process can be significantly improved with the procedures defined in this project. After observing the results obtained from the project study we are able to know that time required for the cleaning of the job is almost less than conventional process and also from economical study we conclude about saving in cleaning time, labor cost, electricity cost, reduce machine idle time. Our project has the advantages of simple structure, high efficiency and low cost compared with the other cleaning processes and does not need skilled labor to operate it. The approach for cleaning process developed in this paper can also be applied for cleaning of other parts in manufacturing industries, *e. g*. nut, bolts in some factories. For that purposes, in order to get valid results, it is necessary to make measurements with appropriate measuring equipment, based on the procedures defined in this project.

REFERENCES

1. Himanshu Agarwal, Kaushalendra, Kr. Dubey, Subhash Kamal, " Development of Mechanical Fuel Injector Cleaning Machine in Cost Effective Manner ", International Journal of Engineering and Advanced Technology (IJEAT), April 2013.
2. Pawe FABIJAŃSK Ryszard ŁAGODA, "Intelligent Control Unit for Ultrasonic Cleaning System", University of Technology, Institute of Control and Industrial Electronics, Feb 2012.
3. Sami B. Awad, "Aqueous Ultrasonic Cleaning and Corrosion Protection of Steel Components", September 2004.
4. R.S. Khurmi and J. K. Gupta, "Machine Design", Eurasia Publishing House (Pvt.) Ltd.
5. V.B. Bhandari, "Design of Machine Element".
6. http://en.wikipedia.org/wiki/Ansys
7. http://www.selec.com/din-rail-mounted-timers
8. http://en.wikipedia.org/wiki/Limit_switch
9. http://www.janatics.com/simple%5Cimages%5CDirectional_Control Valves%5CDS2%2018%20valve.pdf
10. http://www.quakerchem.com/product/metal-removal-fluids/
11. http://fortunaengineering.com/company.html