Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 02, February -2018

Design of Barrel Pump

Santosh S. Kumar[1], Ritesh R. Junghare[2], Rajat B. Kadbe[3],
Prabal G. Meshram[4], Shubham R. Sahare[5]

[1] *Asst. Professor, Department Of Mechanical Engineering,*
J D College of Engineering and Management, Kalmeshwar Road, Nagpur – 441501, Maharashtra.

[2, 3, 4,5] *UG Scholar, Department Of Mechanical Engineering,*
J D College of Engineering and Management, Kalmeshwar Road, Nagpur – 441501, Maharashtra.

Abstract- *The purpose of this paper present is to design an effective barrel pump which can control by a single switch, light in weight and use in majorly all the places (i.e.) manufacturing and production companies, workshops, In-house hold applications etc.*
Today, one of the biggest problems of the barrel pumps are it is too much heavy and manually effort is required to fill the container/ barrel by rotating a handle continuous unless the container cannot fill completely which takes a lot off time to fill the container.

Keywords- *Barrel Pump, Centrifugal Pump, Semi-Closed Impeller, Volute Casing, 12V DC Motor, 12V DC Battery*

1. INTRODUCTION

Barrel pumps are used for extract or suck the oil from barrel, the major objective of this study is to design a barrel pump which is light in weight, cheapest in cost and it not affected due to environment. So, to solve that problem we are introducing a new design of plastic barrel pump in which there is centrifugal type of barrel pump which works on the principle of centrifugal force its gets a high output and high efficiency, which sucks the oil axially from suction pipe and delivers it radially from delivery pipe for this we select and design volute casing and semi closed impeller which is attached with rotating shaft and enclosed in housing or casing.
This rotating shaft is coupled with 12V DC Motor having 4000rpm and driven by 12V Lithium Ion DC Battery of 7ampere which is operated by a single On-Off Switch. There are also few types of barrel pump which are available in market .

1.5. AIR-DRIVEN PISTON DRUM PUMPS

These types of air-driven piston drum pumps are compressed air operating pumps with medium pressure type in piston reciprocating in nature and self-priming type. This is used for viscous liquid like varnishes, chemicals, lubricants and other suitable liquids at shorter distance with high speed flow rate. It has a ratio of 1:1 it means that the pressure of air from compressor is equal to the pressure of fluid which is coming out of the pump.

1.6. PAIL PUMPS

These pumps are also manual hand operating type of pump and made up of thermoplastic in material these pumps have a horizontal discharge port and vertical suction port in construction. These types of pumps are used in agricultural sector, automobile industries, waste water treatment plant, chemical plants etc. which are easy to operate and light in weight.

2. CONSTRUCTION

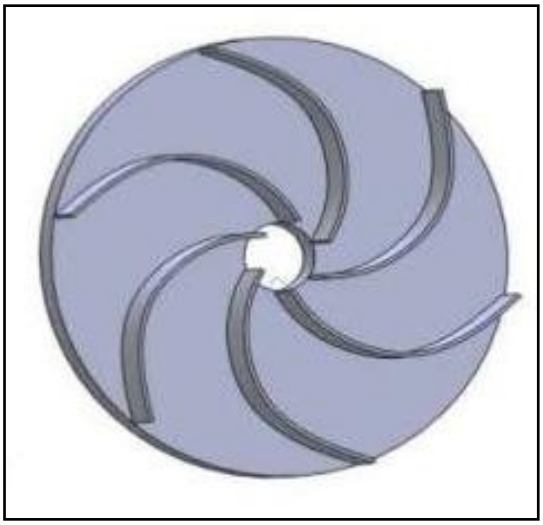
Barrel pump is simple in construction and in its construction there are number of components are used for achieving required power output through which suction head can de achieve and we extract the oil from barrel for which it is to be design, the following components are:-

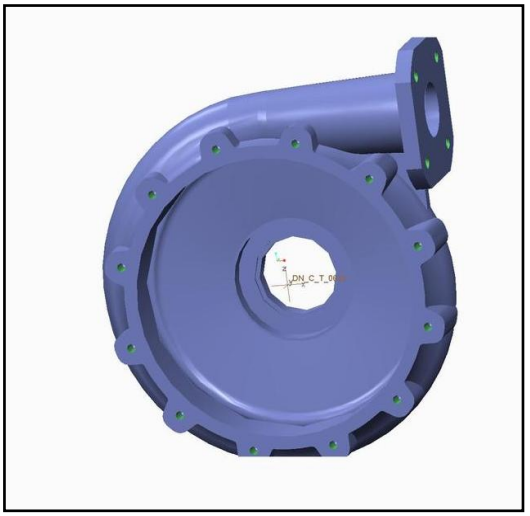
2.1. IMPELLER

Impeller is a rotating device is mounted on a shaft it is used to create suction from the eye of the impeller, according to this pressure difference is created by balancing this pressure difference liquid flow higher pressure reason to lower pressure reason and finally is pressurised by rotating action of the impeller in casing of a pump and finally it will be discharged through the delivery pipe of the pump.

2.2. CASING

Casing is a device which acts as a housing of the pump. It is used to protect the impeller of inside area of pump from the atmosphere to prevent leakage of liquid and hold the air in the liquid is come from axially and delivery it radially.





2.3. NOZZLE

There are normally three types of nozzle are available in market convergent type of nozzle, divergent type of nozzle and convergent-divergent type of nozzle but we are using convergent type of nozzle because its cross sectional area is continuous decreases from inlet to exit due to which its pressure is decreases and its velocity is increases due to which we get a high flow rate.

2.4. SUCTION STRAINER

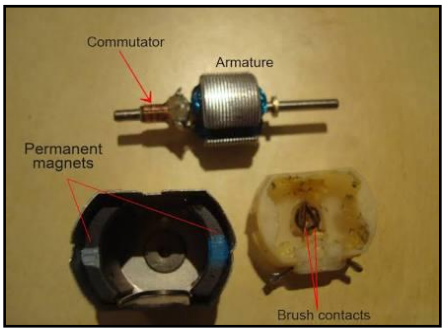
Suction strainer is a type of valve which is connected at the suction line at inlet to protect it from impurities and debris after the pumping operation is to be completed it integrates with foot valve and prevents suction line and pump from empty running of pump it also protect pump downstream components and filter the liquid which we required for full-fill the requirement**.**

2.5. DC MOTOR

Dc motor is an electrical device which consists of armature and flux winding along with the magnetic area, in which the flux is to be generated. Where electric flux passes through armature to the wire wound on soft iron core due to this rotational motion is to experienced.

Table 1. Specification of servo motor

S.NO.	PARAMETERS	RATINGS
1.	Continuous Output Power	84w
2.	Shaft Speed	4000 rpm
3.	Terminal Voltage	12 V DC
4.	Continuous Torque	2.0053Nm
5.	Continuous Current	4 – 8 Amps



2.6. BATTERY

Battery is an electrical device having one or number of cells which is electrochemical which stored electric energy in it, we are using this battery in our project because it is rechargeable battery and cheapest in cost when electric charge is supplied to it chemical reaction take place inside the cell into this electrical energy chance save into the cell. This electrical energy releases or extract when we required.

3. OBJECTIVES

Our main objective is to design a switch operated barrel pump, which can reduce the human effort and to design a light weighted barrel pump. We are manufacturing it of plastic material, due to which it is cheapest in cost. It can give a continuous flow Do not dirt to environment, leakage proof operation. To perform design, modeling, testing and analysis of the closed impeller by using software with modification in inlet and outlet blade angles of the impeller and optimization of number of vanes of the impeller to investigate the changes in head as well as efficiencies.

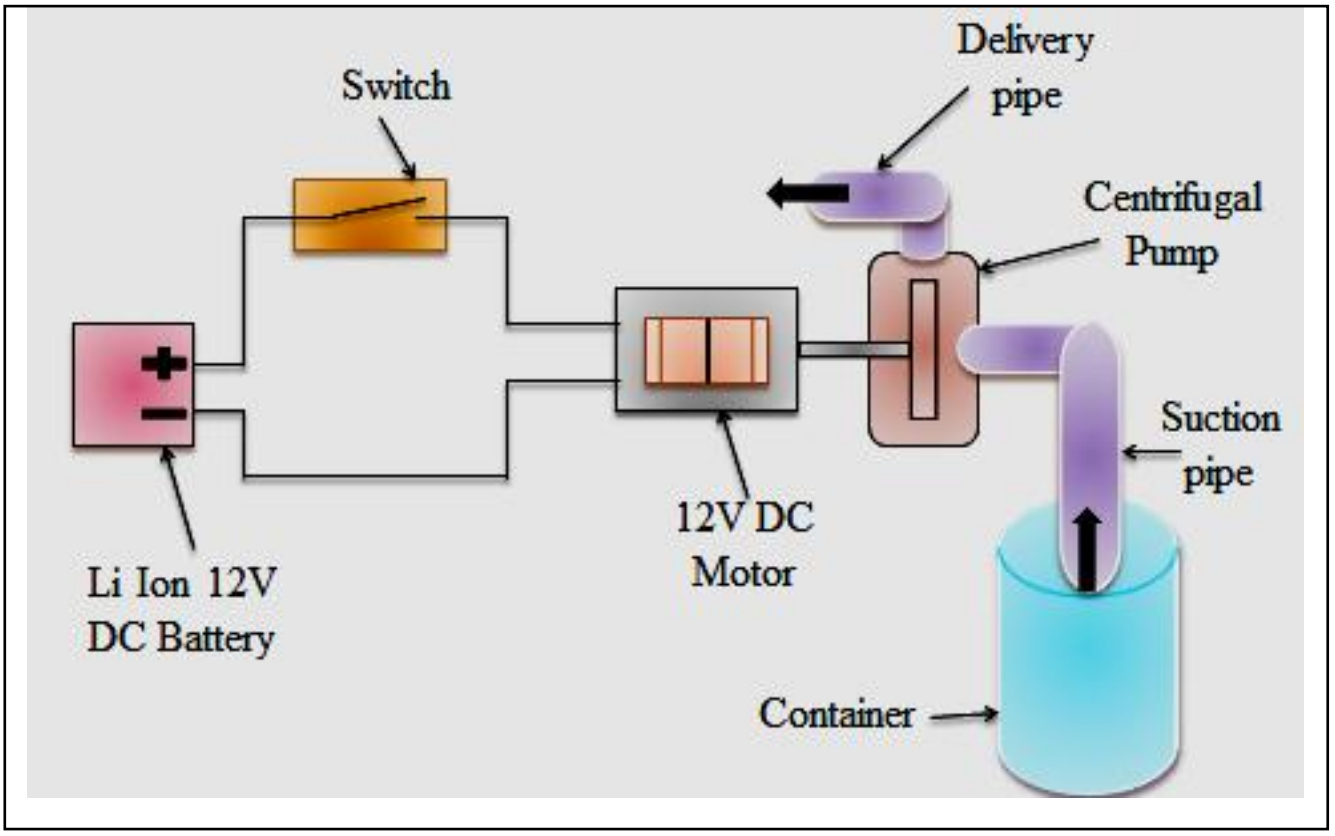
4. WORKING

To design and develop a barrel pump we are using 12V DC Motor, Lithium Ion 12V Battery and switch initially the power r electrical power will flow from DC battery and its positive supply will pass from switch and the negative line is directly connected with 12V DC Motor, the switch is a controlling device which can control the working of motor if the switch is on the supply will pass from positive side and the motor will started and vice- versa, we are design this system for easy operetable and controllable.

For design this barrel pump we are using centrifugal type of pump for sucking the oil or to fill the container in required time limit with achieving continuous flow. In this type of barrel pump we are concentrating to achieve our aim, we have to design this system and manufacturing it in cheapest cost a make a ecofriendly material which can not affect the work area as well as oil for which it is to be used.

Due to use of plastic material for manufacturing it is light inn weight and non-corrosive in nature, due to motor mechanism pump it can reduce the human effort, due to which it can be used in basically all the places in house hold applications as well as in companies also.

5. FLOW CHART



6. SPECIFICATIONS

For design this barrel pump we required following parameter and specification of component due to which we determine it and select the proper material of the component with its application, utility and strength of the product

Table1. Specifications of barrel pump

SR.NO	COMPONENT	MATERIAL OF COMPONENT
1	Impeller	Teflon
2	Impeller Shaft	Stainless Steel
3	Suction Pipe	Polypropylene
4	Delivery Pipe	Polyvinylchloride
5	Strainer	Polypropylene
6	Casing	Teflon
7	Nut Bolts	Alloy Of Stainless Steel
8	12v Battery	Lithium Ion
9	Bearing	Stainless Steel
10	DC Motor	Laminated core and copper winding
11	Nozzle	Viton
12	Bung Nut	Stainless Steel
13	Gasket	Cork/Nitrile

7. DESIGN AND CALCULATIONS

Initial we consider suction some parameter of pump
Suction pipe diameter is 0.018m
Discharge pipe diameter is 0.015m
Impeller inlet diameter is two times of shaft diameter (2*8)
Where shaft diameter is 8mm=0.008m
Outlet diameter of impeller is approximately three times of inlet diameter of impeller
(3.125*16=5cm) is 0.05m
Suction head of pump is 2m and discharge head is 2.5m
Discharge at the outlet of pump is 0.0005m^3 /sec (5 litter)
Assuming a friction factor is 0.010
Speed of a servo motor is 4000rpm
Absolute angle of inlet is 90^o for better efficiency and entry of flow at inlet axle
On the consideration of above parameter we are calculation following design parameter
Absolute velocity at inlet

$$\frac{Q\times 4}{\pi\times ds}=2\text{m/s}$$

Absolute velocity at outlet

$$\frac{Q\times 4}{\pi Do}=2.829\text{m/s}$$

in centrifugal pump at the inlet of absolute velocity is equal to the flow velocity and this flow velocity is constant for inlet and outlet. its means that flow velocity at inlet and out let same which can be denoted by Vw1 and Vw2 is equal to 2m/s.

On the basic of speed and the diameter of impeller ,at the inlet and outlet we get the runner velocity at the inlet and outlet is (3.35,10.47 m/s)
The inlet blade angle calculated by using the velocity triangle at inlet of the centrifugal pump,

$$\beta_1 = 30.83^o$$

the outlet blade angle is 44.98º it is one of the importing factor affecting on the monomeric efficiency of the pump, if its value is less than the 20º than the efficiency of the pump is reduces or its value is also more than the 90º than also its monomeric efficiency is decreases due to the blade friction. i.e the blade angle is must be lies in between (20º to 90º)for the better efficiency of the pump.

Relative Velocity
The relation in between absolute velocity and the runner (blade) velocity is called as the relative velocity. Which is denoted by Vr_1 and Vr_2 . The value of relative velocity at the inlet is calculated by using the relation between absolute velocity and blade velocity at the inlet. Its value is 3.90 and the relative velocity at the outlet is 8.71.

Tangential Velocity
When the jet of absolute velocity is striking on the impeller blade at an inclined position mount on the motor shaft its to be resolve in two component X and Y. the component in X-direction called as the relative velocity and its is responsible to producing the work. The relative velocity at inlet and outlet is denoted by Vw_1 which is zero (0) at the inlet and the tangential velocity at the outlet is 8.48

Table2. Barrel pump notations and its unit

SR.NO	NOTATIONS	PARAMETERS	UNITS
1.	Q	Discharge	m3/sec
2.	N	Rotational speed	Rpm
3.	A	Area	M
4.	P	Pressure	N/M^2
5.	U	Tangential velocity	m/sec
6.	β	blade angle	℃
7.	P	Density	kg/m^3
8.	h_s	Suction head	M
9.	h_d	Delivery head	M
10.	H_s	Static head	M
11.	H_m	Manometric head	M
12.	H_{fd}	Head loss due to friction in discharge pipe(m)	M
13.	H_{fs}	Head loss due to friction in suction pipe(m)	M
14.	M	Mass of flow	M

8. PROBLEM IDENTIFICATION

We are analysing the number of problems which occurred in normal barrel pumps after analysing market situation we observer that the barrel pumps are too much heavy and it is costly, for reduce the cost of the pump and to make it light in weight we design it of plastic material.

In manual barrel pumps there is handle for rotation the impeller of pump to extract a oil from container we make it of motor operated and controlled by a switch, normal barrel pumps are get a lot off time to fill the container or barrel so for over come from this situation we are designed this software.

In normal pumps there is also problem of oil leakage which can dirt the environment and work place and due to made up of metal material it can corroded which increases the maintenance.

9. RESULT

For calculating lo of parameter of barrel pump we are using some of the assumption got a required result.

Table.3. Result of barrel pump

Sr. no	Design factor	Calculated values
1	Inside diameter of impeller (D_i)	0.016 m
2	Outside diameter of impeller (D_o)	0.05 m
3	Suction pipe diameter (D_s)	0.018 m
4	Discharge pipe diameter (D_d)	0.015 m
5	Discharge (Q)	0.0005 m^3/sec
6	Speed (N)	4000 rpm
7	Density (δ)	960 kg/ m^3
8	Blade inlet velocity (u_1)	3.35 m/sec
9	Inlet blade angle (β_1)	30.83◦
10	Relative velocity of inlet (V_{r1})	3.90 m/sec
11	Absolute velocity angle at inlet (α_1)	90◦
12	Blade outlet velocity (u_2)	10.43 m/sec
13	Outlet blade angle (β_2)	44.98◦
14	Relative velocity of outlet (V_{r2})	8.71 m/sec
15	Absolute velocity angle at outlet (α_2)	5.85◦
16	Manometric head (H_m)	8 m
17	Overall efficiency ($\eta_{overall}$)	80%
18	Manometric efficiency ($\eta_{manometric}$)	86%
19	Mass flow rate (m·)	0.418 kg
20	Specific speed (N_S)	1200

10. CONCLUSION

On the basis of the result and calculations of this research, we obtained all the parameter which we required for obtaining the required flow rate after that we conclude that the design is reliable and feasible and it can easily operate to user, after facing the various problems which are arising at the time of designing we solve that problem at achieve the required goal at perform all the task and find out the overall pump efficiency and monomeric efficiency of pump.

11. REFERENCES

[1] “Design and Experimental Setup Water Pump” by Visal Garg & Gautam Yadav of International Journal for Scientific Research & Development| Vol. 3, Issue 04, 2015.
[2] “Design and Development of Centrifugal Pump Impeller as BIS” by Boby George and Shaji George of International Journal of Scientific & Engineering Research, Volume 7, Issue 3, March-2016.
[3] “Fluid Mechanics and Hydraulic Machine” by R.K. Bansal – Laxmi publications – New Delhi – 2014.
[4] “A Text Book of Fluid Mechanics” by Rajput – Schand and Company Ltd.
[5] “Machine Design” by R. S. Khurmi and J. K. Gupta.

AUTHORS PROFILE

Santosh S. Kumar is Assistant Professor in Department Of Mechanical Engineering at J D College Of engineering and Management, Nagpur. He has 4 years of teaching experience at Under Graduate Level. He received his Master's Degree in Design From Priyadarshini College of Engineering and Management, Nagpur in the year 2015.

Ritesh R. Junghare is Under Graduate Scholar in Mechanical Engineering at J D College of Engineering and Management, Nagpur.

Rajat B. Kadbe is Under Graduate Scholar in Mechanical Engineering at J D College of Engineering and Management, Nagpur.

Prabal G. Meshram is Under Graduate Scholar in Mechanical Engineering at J D College of Engineering and Management, Nagpur.

Shubham R. sahare is Under Graduate Scholar in Mechanical Engineering at J D College of Engineering and Management, Nagpur.

