A PROJECT REPORT

ON

" ARRANGEMENTS OF CENTRIFUGAL PUMPS IN SERIES AND PARELLEL"

Submitted by

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In partial fulfillment for the award of the Degree

Of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

UNDER THE GUIDANCE

Of

Prof. ASLAM HIRANI

DEPARTMENT OF MECHANICAL ENGINEERING

ANJUMAN-I-ISLAM

KALSEKAR TECHNICAL CAMPUS NEW PANVEL,

NAVI MUMBAI – 410206

UNIVERSITY OF MUMBAI

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ANJUMAN-I-ISLAM

KALSEKAR TECHNICAL CAMPUS NEW PANVEL

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CERTIFICATE

This is to certify that the project entitled

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To the Kalsekar Technical Campus, New Panvel is a record of bonafide work carried out by him under our supervision and guidance, for partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in Mechanical Engineering as prescribed by **University Of Mumbai**, is approved.

Project co-guide	**Internal Examinar**	**External Examiner**
(Prof.ASLAM HIRANI)	(Prof.______)	

Head of Department	**Principal**
(Prof. Zakir Ansari)	(Dr.Adbul Razzak Honutagi)

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APPROVAL OF DISSERTATION

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(Internal Examiner) **(External Examiner)**

__________________ __________________

Date: __________

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ABSTRACT

We take an opportunity to present this project report on "ARRANGEMENTS OF CENTRIFUGAL PUMPS IN SERIES AND PARELLEL" and put before readers some useful information regarding our project.

We have made sincere attempts and taken every care to present this matter in precise and compact form, the language being as simple as possible.

We are sure that the information contained in this volume would certainly prove useful for better insight in the scope and dimension of this project in its true perspective.

This work focused on the design and fabrication of arrangements of centrifugal pumps in series and parallel . The work demonstrates the application of engineering techniques to reduce human labour.

The task of completion of the project though being difficulty was made quite simple, interesting and successful due to deep involvement and complete dedication of our group members. This project report gives a great guideline about designing of low cost compare with the other competitive experimental setup.

CONTENTS

Chapter 1: Introduction

The industrial scenario is changing rapidly, new startups are coming every day, and every one want to start something on their own , The project is about combining setups of series , parallel and centrifugal pumps into a single setups. There are three different setups of series, parallel and centrifugal pumps experiments in the fluid mechanics laboratory. For each setup of experiments individual pumps ,motors and tanks are required. Therefore the cost of the total 3 setups of series parallel and centrifugal pumps is very high.Also due to the use of two tanks for each set up . The total number of tanks required is 6.the total area covered by the tank is very large . In order to reduce the cost of the overall setups and also to reduce the space requirement.We are making a three in one setup for series , parallel and centrifugal pumps. We are combining the individual setups of series , parallel and centrifugal pump in our study we have made pump setup which will be beneficial in the following ways

a. It will save space

b. it will save time

c. cost of setup will get reduced

PROBLEM DEFINATION

SERIES AND PARALLWL SET UP OCCUPIES MORE SPACE SERIES , PARALLEL , CENTRIFUGAL PUMPS EXPERIMENTS ARE CARRY OUT AT DIFFERENTS SET UPBUT IN THIS PROJECTS MAKING A SET UP WHICH ARE LESS SPACE OCCUPES LESS COST AND ALL THE THREE EXPERIMENTS ARE PERFORMED ON SINGLE SET UP.

FOR PUMPS IN SERIES =2 PUMPS

FOR PUMPS IN PARALLEL = 2 PUMPS

FOR CENTRIFUGAL SET UP = 1PUMPS

TOTAL = 5 PUMPS

BUT IN THAT WE ARE USING ONLY 2 PUMPS ARE USES MEANS 3 PUMPS ARE ELIMINATED

AIM /OBJECTIVE

AIM:

To design and fabricate grinding attachment for lathe.

OBJECTIVE:

To manufacture an attachment for lathe which perform grinding operations.

PURPOSE OF THE STUDY:

To minimize time by 2-3 min per job of equipment's and workers.

To perform grinding operations on single shaft such as external, internal. With work piece material as mild steel.

CHAPTER 2: LITERATURE REVIEW

For any new research to take place it is first necessary to take help from some external sources for analyzing the development which have been taken place in the field of research and the gap which needs to be filled for improvement. In our case, we have first referred various books on centrifugal pump some of them are by Stephen malkin, principles of modern pump technology, pump operation by henry d. Burghardt in the library of Indian institute of technology Mumbai. This helped us to know about the basic pump process and the various parameters which we need to consider for optimizing the grinding operation in terms of depth of cut, grinding wheel properties and feed velocity. Also, the research papers (Devarakonda Harish Kumar, vol. 4, no. 1, January 2015) and (Akash Tiwari, vol. 2, issue 03 2014) which involves fabrication of grinding setup and parameter optimization helped us to find lacunae present in their research work and the improvement we needed to make to correct them. Other sources such as internet surfing and guidance from expert also made it possible to carry our work in correct path.

K.T.AJAYI[1] :Presents an experiments investigation on which connection of all the muliple pumps while the head loss value is computed in the darcy equation,Hf= 4flu*U the experimental flow rate at BEF for pumps A and B in series connection 000302dg.

AMIT SUHANE[2] experimental study on centrifugal pumps to detetmine the effects vibration and noise pressure pulsation. Experiments were performed at five differents flow rate for differents radials clearance bet diffuser and impeller.
Comes with 30% reduction in vibration and 50% noise in radial clearance

.PhilippVinnemeier a,⇑,1 , Manfred Wirsum a,2 , Damien Malpiece b,3 , Roberto Bove: optimized recuperated heat pump designs using environmental heat as the heat source for the purpose of high temperature heat supply.

CHAPTER NO.3 COST ESTIMATION

Cost estimation may be defined as the process of forecasting the expenses that must be incurred to manufacture a product. These expenses take into a consideration all expenditure involved in a design and manufacturing with all related services facilities such as pattern making, tool, making as well as a portion of the general administrative and selling costs.

TYPES OF COST ESTIMATION:-

1) Material cost
2) Machining cost

1) Material cost :-

SR NO	PARTICULARS	COST
1.1	0.5 hp centrifugal pumps (2 pumps)	2450*2=4950RS
1.2	Vaccum gauge	540rs
1.3	Electric energy meter(2)	2*870=1740rs
1.4	Pressure gauge (2)	2*702=1404rs
1.5	Main Supply switch	150rs
1.6	Control valves(5)	50*5=250rs
1.7	Capacity tanks	800rs
2	**Set up**	
2.1	Stand for Set up	500rs
3	m/c work	450rs
	Total cost	12,224/-

2) Machining cost :-

Operation	Hours	Cost
Gas Cutting	½ hour	200
Welding	4 hour	500
Drilling	½ hour	50
Grinding	5 hour	200
Painting	2 hour	400
Total Cost	12 hours	1350

TOTAL COST : -

TOTAL COST = MATERIAL COST + MACHINING COST

= (RAW + FINISHED) + MACHINING COST

=(12,224)+1350

= 13574rs.

CHAPTER NO.4 METHODOLGY

The experimental setup of the project consists of 310 litrs tank,4 control valves, two 0.5hp motors, set of pvc pipes, two energy meters, two pressure gauges and stand of the setup.The water is stored in the tank, for the discharge of water one more tank is required.But we are going to discharge the water in the same tank in which the water is stored .To measure the discharge which is going to be in the same tank. we are using the flowmeter,which is a rotameter.

For centrifugal pump experiment:

The water enters in inlet pipe and there are two pumps A and B placed parallely. the pvc pipes attached to the pumps A and B are having valves 1 and 2.The valve 1 will be closed at the inlet so that no water enters through it.hence only a single pump is working. Therefore we get output of a centrifugal compressor.

Similarily if the all valves are placed open and water is allowed to pass through the parallel pumps then the output of the experiment will be of parallel pumps. The series setup will be similar to the method of centrifugal pump.

Hence the three operations can be done on a single setup by just controlling the flow with the help of controlling valve.The pressure head, discharge and efficieny of all the three experiment can be measu

Selection of centrifugal pumps

Description

A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps.[1]

Pumps operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work by moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps.

Mechanical pumps serve in a wide range of applications such as pumping water from wells, aquarium filtering, pond filtering and aeration, in the car industry for water-cooling and fuel injection, in the energy industry for pumping oil and natural gas or for operating cooling towers. In the medical industry, pumps are used for biochemical processes in developing and manufacturing medicine, and as artificial replacements for body parts, in particular the artificial heart and penile prosthesis.

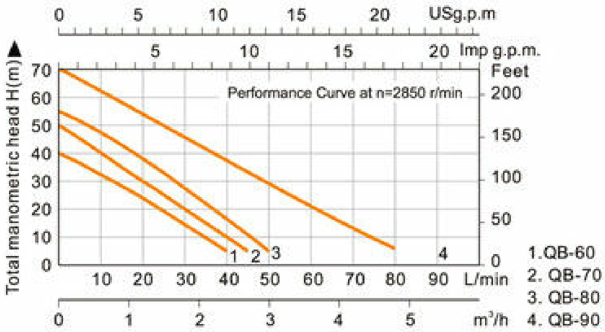
Single stage pump - When in a casing only one impeller is revolving then it is called single stage pump.

Double/ Multi stage pump - When in a casing two or more than two impellers are revolving then it is called double/ multi stage pump.

In biology, many different types of chemical and bio-mechanical pumps have evolved, and biomimicry is sometimes used in developing new types of mechanical pumps.

OPERATING CONDITIONS

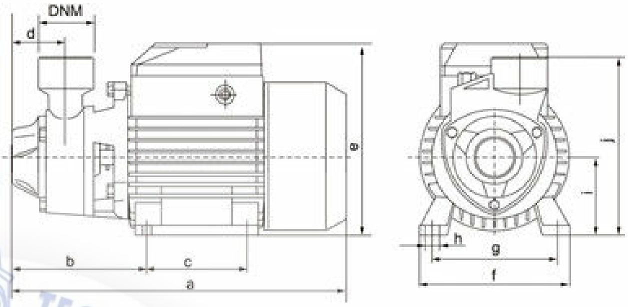
Liquid temperature up to 60℃
Ambient temperature up to 40℃
Total suction lift up to 9m
Continuous duty



CONSTRUCT

PUMP
Pump Body: Cast Iron/Brass/Stainless Steel
Impeller: Brass/Stainless Steel
Mechanical Seal: Carbon/Ceramic/Stainless Steel
Front Cover: Cast Iron/Stainless Steel/Aluminum with Brass Insert

MOTOR
Single Phase
Heavy Duty Continuous Work
Motor Housing: Aluminum
Shaft: Carbon Steel/Stainless Steel
Insulation: Class B /Class F
Protection: IP44/IP54
Cooling: External Ventilation



TECHNICAL DATA (220~240V/50Hz)

Model	Single-phase Motor				n=2850r/min			Q	US g.p.m	0	1.32	2.64	4	5.28	6.61	7.93	9.25	10.6	12	13	18	21.2
	Input max	Output Power		Current	Q.max	H.max	Suct.max		Imp g.p.m	0	1.1	2.2	3.3	4.44	5.55	6.66	7.77	8.88	10	11	16	17.76
									m³/h	0	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3	4.2	4.8
	kW	kW	HP	A	L/min	m	m		L/min	0	5	10	15	20	25	30	35	40	45	50	70	80
QB-60	0.55	0.37	0.50	2.5	40	40	9	H meter		40	37	33.5	29	24	19.5	15	10	5				
QB-70	0.80	0.55	0.75	3.8	45	50				50	45	39	34	28	23	18.5	13.5	9	5			
QB-80	1.10	0.75	1.00	5.2	50	55				55	52	48	43	39	33	28	22	17	11	5		
QB-90	1.50	1.10	1.50	7.0	80	70				70	66	62	57	53	49	45	41	37	33	29.5	13	5

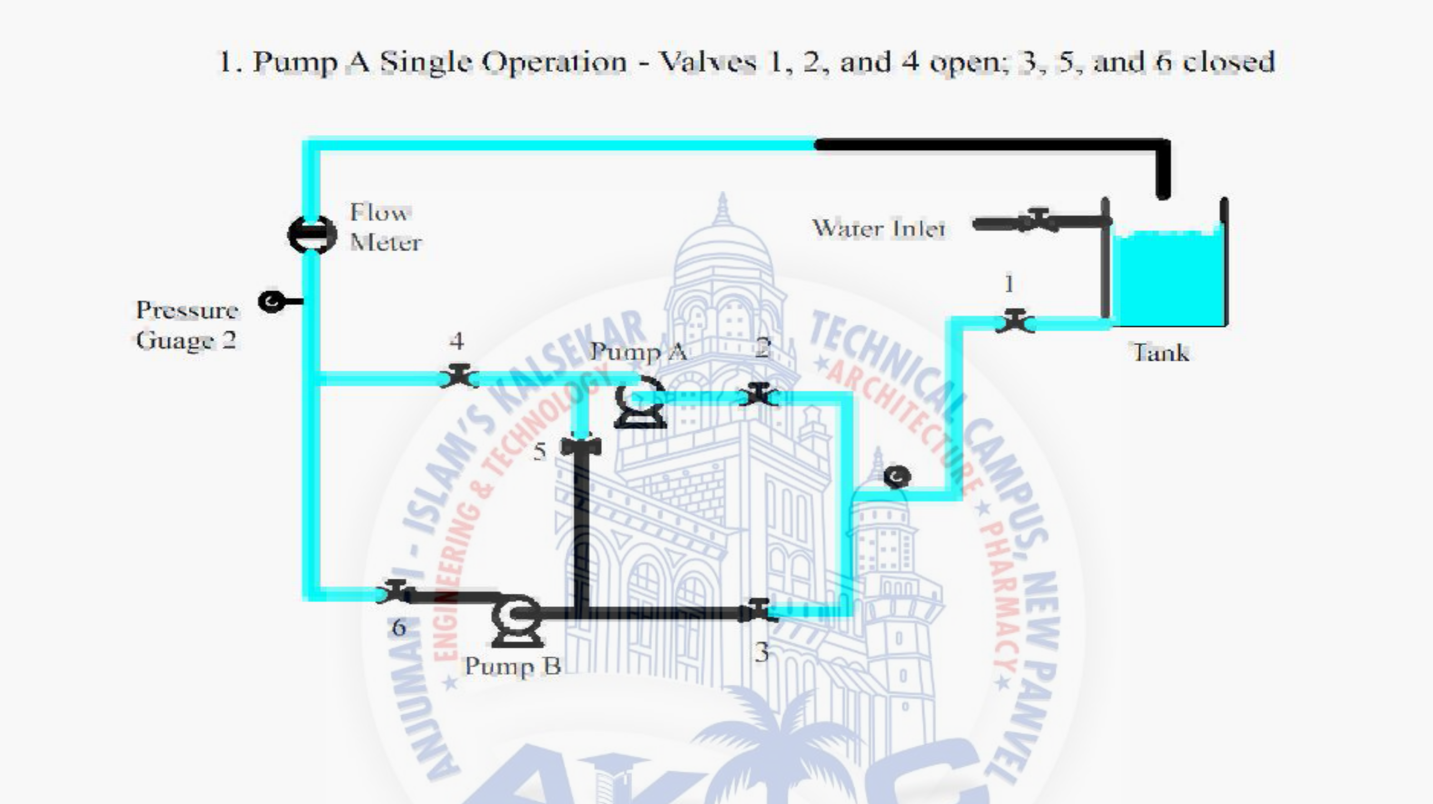
The normal power standard is 220v 50Hz single phase. Three phase 220V/380/50Hz, Single phase 230V/,240V,127V,110V115/60Hz models are available on request.

OVERALL & INSTALLATION DIMENSIONS

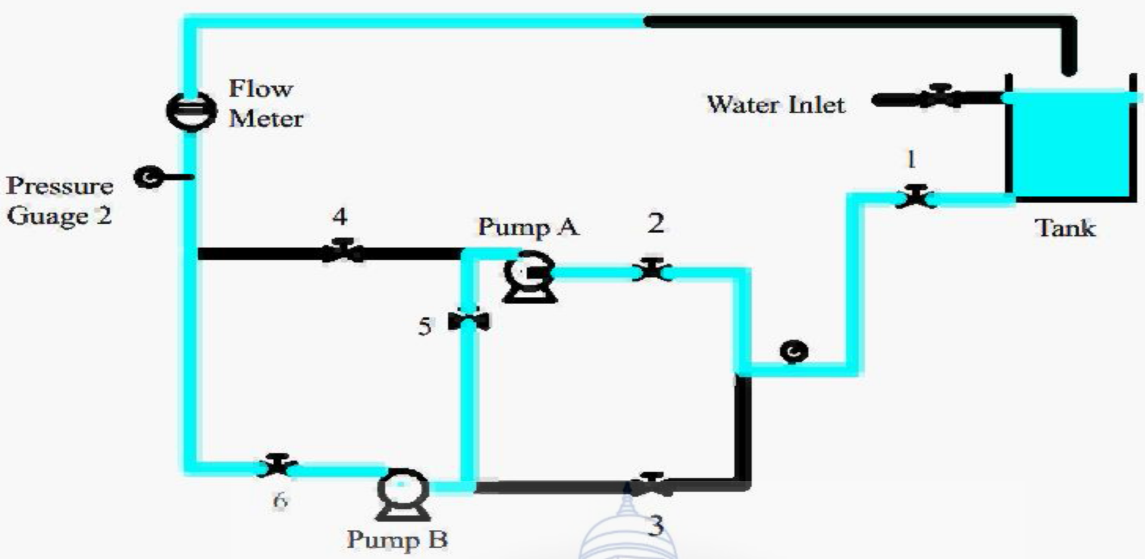
Model	DIMENSIONS (mm)																	PACKAGE DIMENSIONS & G.W.			
	DNA		DNM																		
	Inch	mm	Inch	mm	a	b	c	d	e	f	g	h	i	j	k	l	m	A	B	H	kg
QB-60	1"	25	1"	25	265	110	80	45	151	118	100	10	63	138	--	--	--	285	150	180	5.3
QB-70	1"	25	1"	25	305	122	90	50	181	136	112	10	71	150	--	--	--	320	180	200	9.5
QB-80	1.5"	40	1.5"	40	305	122	90	50	181	136	112	10	71	150	--	--	--	320	180	200	10.0
QB-90	1.5"	40	1.5"	40	380	138	100	68	182	180	162	10	80	156	--	--	--	415	190	230	22.0

PROJECT DESIGN

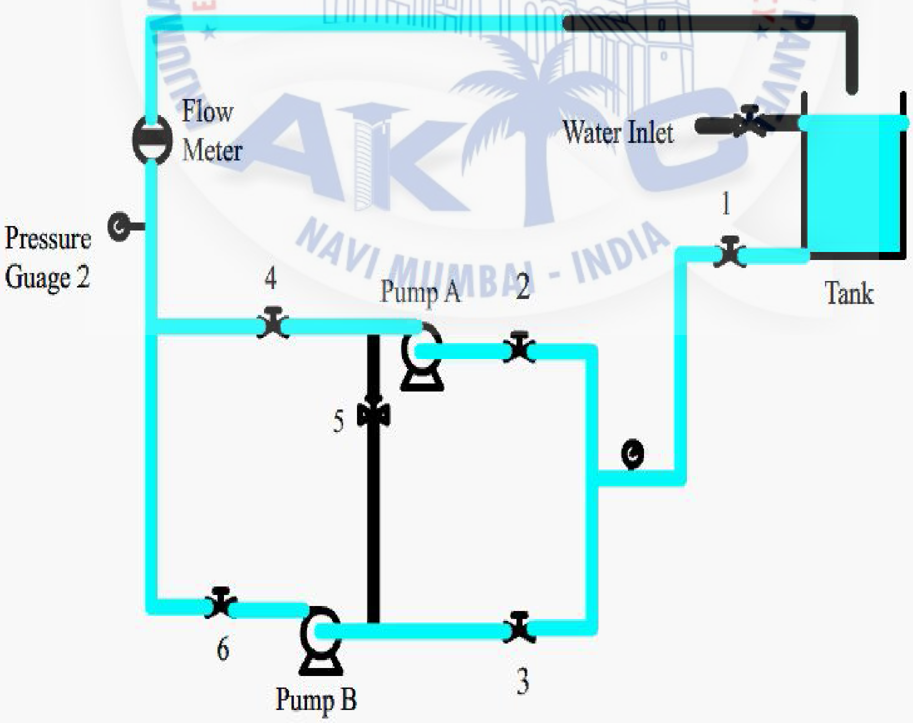
Three to four types of layout has been studied.Based on the cost and space requirement the following layout is considered is considered to be suitable.

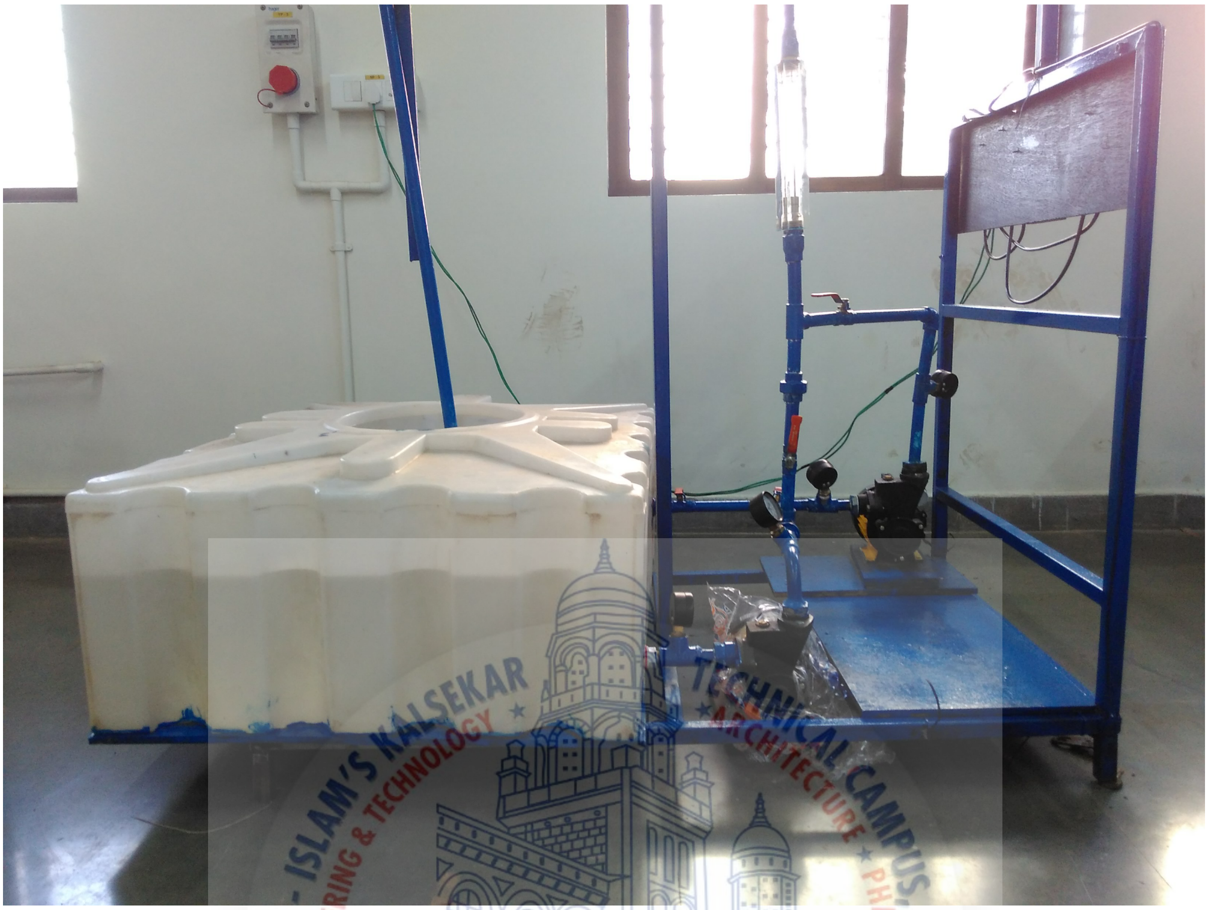


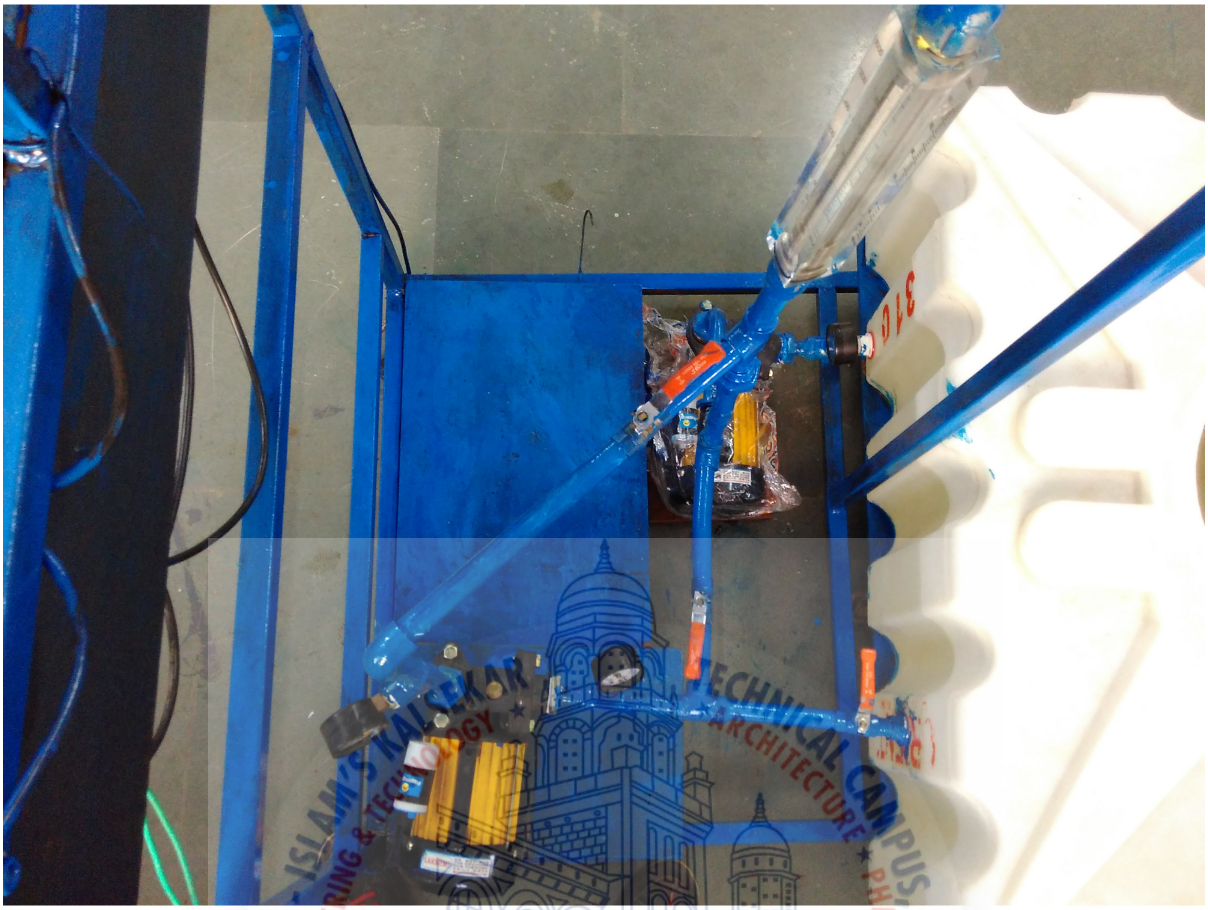
4. Serial Operation - Valves 1, 2, and 5 and 6 open; 3 and 4 closed



3. Parallel Operation - Valves 1, 2, 3, 4 and 6 open; valve 5 closed







PRESSURE GAUGE

Description

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 which both measures and indicates, and is probably the best known type of gauge.

A vacuum gauge is an absolute pressure gauge used to measure the pressures lower than the ambient atmospheric pressure.

(fig.Pressure gauge)

Absolute pressure:

It is zero-referenced against a perfect vacuum, using an absolute scale, so it is equal to gauge pressure plus atmospheric pressure.

Gauge pressure:

It is zero-referenced against ambient air pressure, so it is equal to absolute pressure minus atmospheric pressure. Negative signs are usually omitted. To distinguish a negative pressure, the value may be appended with the word "vacuum" or the gauge may be labeled a "vacuum gauge." These are further divided into two subcategories: high and low vacuum (and sometimes ultra-high vacuum). The applicable pressure ranges of many of the techniques used to measure vacuums have an overlap. Hence, by combining several different types of gauge, it is possible to measure system pressure continuously from 10 mbar down to 10–11 mbar.

Atmospheric pressure:

Atmospheric pressure, sometimes also called barometric pressure, is the pressure exerted by the weight of air in the atmosphere of Earth.

	PSI	Pascal	Bar	Torr	inHg	ftH2O @ 60C
1 PSI	1	6894.76	0.069	51.72	2.04	2.31
1 Pascal	0.00015	1	0.000001	0.0075	0.00030	0.0040
1 Bar	14.50	100,000	1	750.06	29.53	33.46
1 Torr	0.019	133.32	0.0013	1	0.039	0.045
1 inHg	0.49	3386.38	0.034	25.40	1	1.13
1 ftH2O @ 60C	0.43	2988.98	0.03	22.42	0.88	1

(Table:Pressure gauge units)

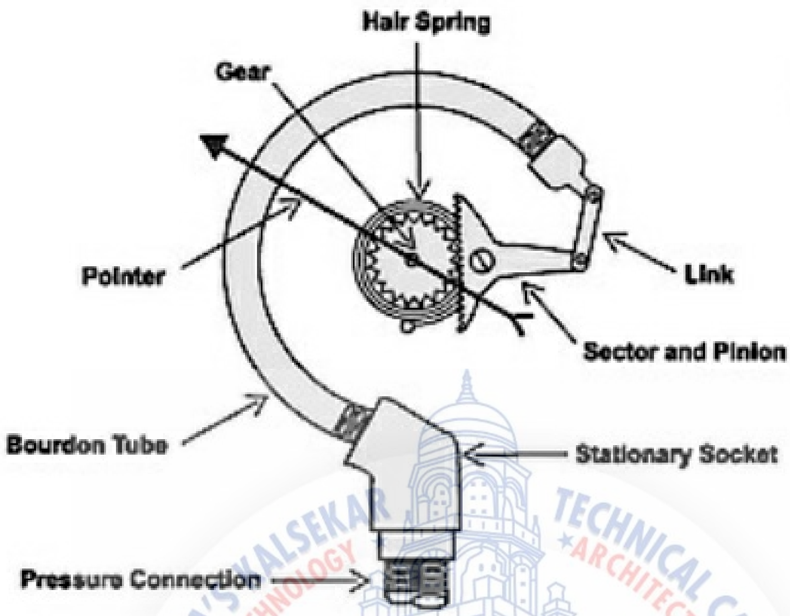
BOURDON

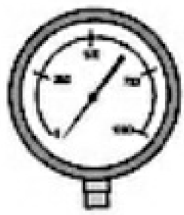
The Bourdon pressure gauge uses the principle that a flattened tube tends to straighten or regain its circular form in cross-section when pressurized. Although this change in cross-section may be hardly noticeable, and thus involving moderate stresses within the elastic range of easily workable materials, the strain of the material of the tube is magnified by forming the tube into a C shape or even a helix, such that the entire tube tends to straighten out or uncoil, elastically, as it is pressurized. Eugene Bourdon patented his gauge in France in 1849, and it was widely adopted because of its superior sensitivity, linearity, and accuracy; Edward Ashcroft purchased Bourdon's American patent rights in 1852 and became a major manufacturer of gauges. Also in 1849, Bernard Schaeffer in Magdeburg, Germany patented a successful diaphragm (see below) pressure gauge, which, together with the Bourdon gauge, revolutionized pressure measurement in industry.[7] But in 1875 after Bourdon's patents expired, his company Schaeffer and Budenberg also manufactured Bourdon tube gauges.

In practice, a flattened thin-wall, closed-end tube is connected at the hollow end to a fixed pipe containing the fluid pressure to be measured. As the pressure increases, the closed end moves in an arc, and this motion is converted into the rotation of a (segment of a) gear by a connecting link that is usually adjustable. A small-diameter pinion gear is on the pointer shaft, so the motion is magnified further by the gear ratio. The positioning of the indicator card behind the pointer, the initial pointer shaft position, the linkage length and initial position, all provide means to calibrate the pointer to indicate the desired range of pressure for variations in the behavior of the Bourdon tube itself. Differential pressure can be measured by gauges containing two different Bourdon tubes, with connecting linkages.

Bourdon tubes measure gauge pressure, relative to ambient atmospheric pressure, as opposed to absolute pressure; vacuum is sensed as a reverse motion. Some aneroid barometers use Bourdon tubes closed at both ends (but most use diaphragms or capsules, see below). When the measured pressure is rapidly pulsing, such as when the gauge is near a reciprocating pump, an orifice restriction in the connecting pipe is frequently used to avoid unnecessary wear on the gears and provide an average reading; when the whole gauge is subject to mechanical vibration, the entire case including the pointer and indicator card can be filled with an oil or glycerin. Tapping on the face of the gauge is not recommended as it will tend to falsify actual readings initially presented by the gauge. The Bourdon tube is separate from the face of the gauge and thus has no effect on the actual reading of pressure. Typical high-quality modern gauges provide an accuracy of ±2% of span, and a special high-precision gauge can be as accurate as 0.1% of full scale.

Bourdon Tube Pressure Gage





A fitting is used in pipe systems to connect straight pipe or tubing sections, adapt to different sizes or shapes and for other purposes, such as regulating (or measuring) fluid flow.

Piping and plumbing fitting

"Plumbing" is generally used to describe the conveyance of water, gas, or liquid waste in domestic or commercial environments; "piping" is often used to describe the high-performance (high-pressure, high-flow, high-temperature or hazardous-material) conveyance of fluids in specialized applications. "Tubing" is sometimes used for lighter-weight piping, especially that flexible enough to be supplied in coiled form.Fittings (especially uncommon types) require money, time, materials and tools to install, and are an important part of piping and plumbing systems.[1] Valves are technically fittings, but are usually discussed separately.

Standards

Standard codes are followed when designing (or manufacturing) a piping system. Organizations which promulgate piping standards include:

ASME: American Society of Mechanical Engineers
A112.19.1 Enameled cast-iron and steel plumbing fixtures standards
A112.19.2 Ceramic plumbing fixtures standard
ASTM International: American Society for Testing and Materials

API: American Petroleum Institute

AWS: American Welding Society

AWWA: American Water Works Association

MSS: Manufacturers Standardization Society

ANSI: American National Standards Institute

NFPA: National Fire Protection Association

EJMA: Expansion Joint Manufacturers Association

CGA: Compressed Gas Association

Pipes must conform to the dimensional requirements of:

ASME B36.10M: Welded and seamless wrought-steel pipe

ASME B36.19M: Stainless-steel pipe

ASME B31.3 2008: Process piping

ASME B31.4 XXXX: Power piping

The B31.3 and B31.4 codes have requirements for piping found in petroleum refineries; chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic plants, and related processing plants and terminals. These codes specify requirements for materials and components, design, fabrication, assembly, erection, examination, inspection and testing of piping. The codes are applicable to piping for all fluids, including raw, intermediate and finished chemicals; petroleum products; gas, steam, air and water; fluidized solids; refrigerants, and cryogenic fluids

Materials

The material with which a pipe is manufactured is often the basis for choosing a pipe. Materials used for manufacturing pipes include:

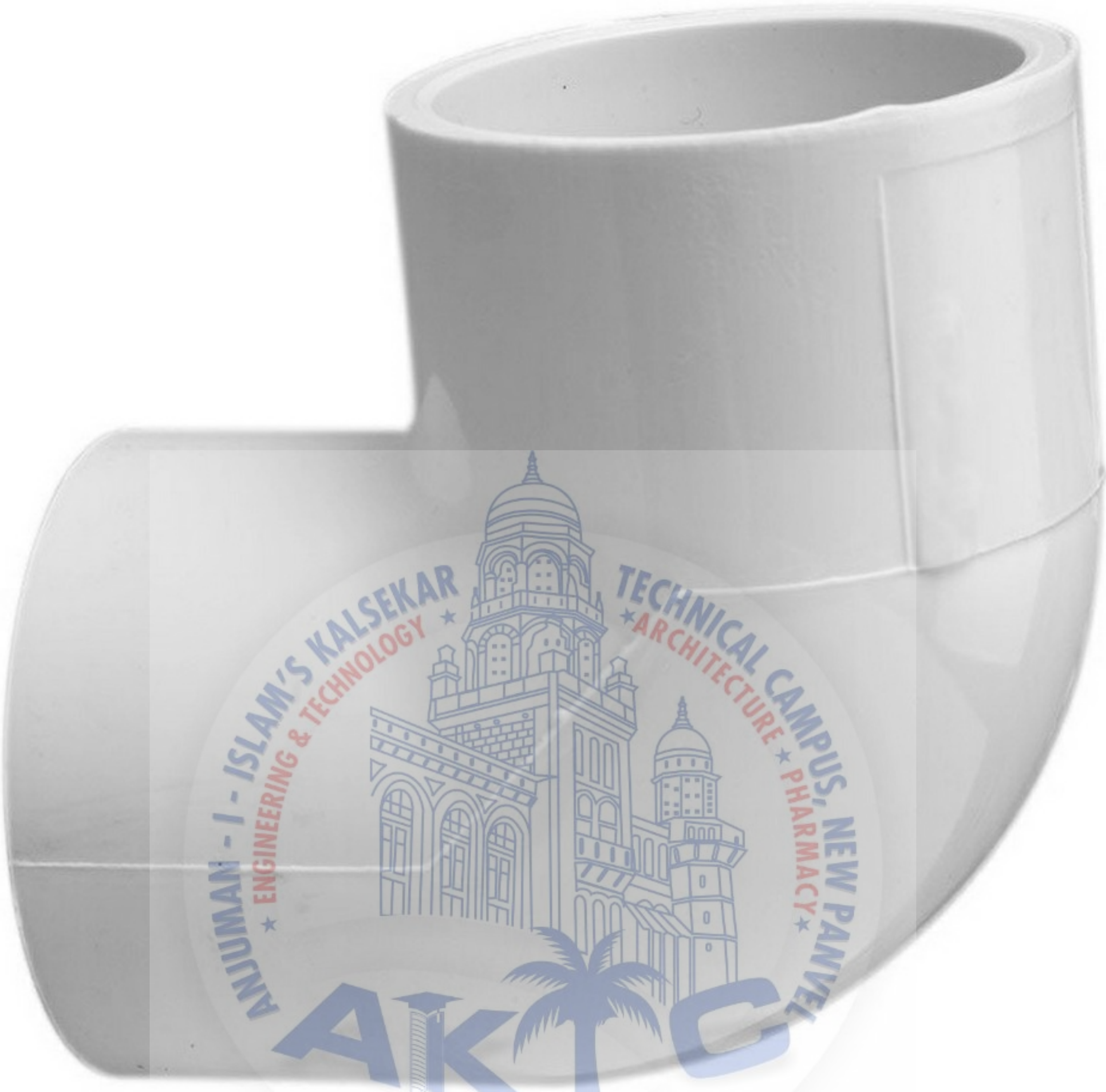
Carbon (CS) and galvanized steel
Impact-tested carbon steel (ITCS)
Low-temperature carbon steel (LTCS)
Stainless steel (SS)
Malleable iron

Non-ferrous metals (includes copper, inconel, incoloy and cupronickel)
Non-metallic (includes acrylonitrile butadiene styrene (ABS), fibre-reinforced plastic (FRP),polyvinyl chloride (PVC), high-density polyethylene (HDPE) and toughened glass)Chrome-molybdenum (alloy) steel — Generally used for high-temperature service. The bodies of fittings for pipe and tubing are most often the same base material as the pipe or tubing connected: copper, steel, PVC, chlorinated polyvinyl chloride (CPVC) or ABS. Any material permitted by the plumbing, health, or building code (as applicable) may be used, but it must be compatible with the other materials in the system, the fluids being transported and the temperature and pressure inside (and outside) the system. Brass or bronze fittings are common in copper piping and plumbing systems. Fire hazards, earthquake resistance and other factors also influence the choice of fitting materials.

Elbows

An elbow is installed between two lengths of pipe (or tubing) to allow a change of direction, usually a 90° or 45° angle; 22.5° elbows are also available. The ends may be machined for butt welding, threaded (usually female), or socketed. When the ends differ in size, it is known as a reducing (or reducer) elbow. A 90º elbow, also known as a "90 bend", "90 ell" or "quarter bend", attaches readily to plastic, copper, cast iron, steel, and lead, and is attached to rubber with stainless-steel clamps. Other available materials include silicone, rubber compounds, galvanized steel, and nylon. It is primarily used to connect hoses to valves, water pumps and deck drains. A 45º elbow, also known as a "45 bend" or "45 ell", is commonly used in water-supply facilities, food, chemical and electronic industrial pipeline networks, air-conditioning pipelines, agriculture and garden production, and solar-energy facility piping.Elbows are also categorized by length. The radius of curvature of a long-radius (LR) elbow is 1.5 times the pipe diameter, but a short-radius (SR) elbow has a radius equal to the pipe diameter. Short elbows, widely available, are typically used in pressurized systems, and in physically tight locations.

Long elbows are used in low-pressure gravity-fed systems and other applications where low turbulence and minimum deposition of entrained solids are of concern. They are available in acrylonitrile butadiene styrene (ABS plastic), polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), and copper, and are used in DWV systems, sewage, and central vacuum systems.



Tee-joint

A tee, the most common pipe fitting, is used to combine (or divide) fluid flow. It is available with female thread sockets, solvent-weld sockets or opposed solvent-weld sockets and a female-threaded side outlet. Tees can connect pipes of different diameters or change the direction of a pipe run, or both. Available in a variety of materials, sizes and finishes, they may also be used to transport two-fluid mixtures.[further explanation needed] Tees may be equal or unequal in size of their three connections, with equal tees the most common.

Rotameter

Description

A Rota meter is a device that measures the flow rate of fluid in a closed tube It belongs to a class of meters called variable area meters, which measure flow rate by allowing the cross-sectional area the fluid travels through, to vary, causing a measurable effect.

History

The first variable area meter with rotating float was invented by Karl Kueppers in Aachen in 1908. This is described in the German patent 215225. Felix Meyer found the first industrial company "Deutsche Rotawerke GmbH" in Aachen recognizing the fundamental importance of this invention. They improved this invention with new shapes of the float and of the glass tube. Kueppers invented the special shape for the inside of the glass tube that realized a symmetrical flow scale.

The brand name Rotameter was registered by the British company GEC Elliot automation, Rotameter Co, originally located on the Purley Way in Croydon after taking over the old Watermans Dry cleaning factory at the end of the Second World War, but later relocating in the 70's to Crawley, and still exists, having been passed down through the acquisition chain: KDG Instruments, SolartronMobrey, and Emerson Process Management (Brooks Instrument)in Great Britain. Whereas in many other countries such as Germany, Switzerland, Austria, Spain, Italy the brand name Rotameter is registered by Rota Yokogawa GmbH & Co. KG in Germany which is now owned by Yokogawa Electric Corpcross-sectional area the fluid travels through, to vary, causing a measurable effect.

Principle of Operation

The rotameter's operation is based on the variable area principle: fluid flow raises a float in a tapered tube, increasing the area for passage of the fluid. The greater the flow, the higher the float is raised. The height of the float is directly proportional to the flowrate. With liquids, the float is raised by a combination of the buoyancy of the liquid and the velocity head of the fluid. With gases, buoyancy is negligible, and the float responds to the velocity head alone. The float moves up or down in the tube in proportion to the fluid flowrate and the annular area between the float and the tube wall. The float reaches a stable position in the tube when the upward force exerted by the flowing fluid equals the downward gravitational force exerted by the weight of the float. A change in flowrate upsets this balance of forces. The float then moves up or down, changing the annular area until it again reaches a position where the forces are in equilibrium. To satisfy the force equation, the rotameter float assumes a distinct position for every constant flowrate. However, it is important to note that because the float position is gravity dependent, rotameters must be vertically oriented and mounted.

Working

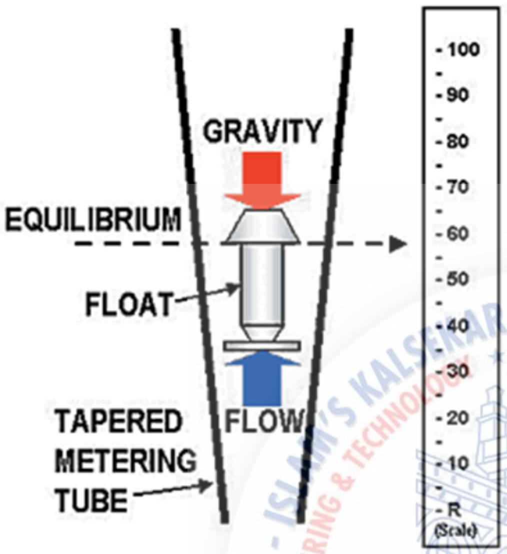
Flowmeters are used in fluid systems (liquid and gas) to indicate the rate of flow of the fluid. They can also control the rate of flow if they are equipped with a flow control valve.

Rotameters are a particular kind of flowmeter, based on the variable area principle. They provide a simple, precise and economical means of indicating flow rates in fluid systems.

This variable area principle consists of three basic elements: A uniformly tapered flow tube, a float, and a measurement scale. A control valve may be added if flow control is also desired. In operation, the rotameter is positioned vertically in the fluid system with the smallest diameter end of the tapered flow tube at the bottom. This is the fluid inlet. The float, typically spherical, is located inside the flow tube, and is engineered so that its diameter is nearly identical to the flow tube's inlet diameter.

When fluid — gas or liquid — is introduced into the tube, the float is lifted from its initial position at the inlet, allowing the fluid to pass between it and the tube wall. As the float rises, more and more fluid flows by the float because the tapered tube's diameter is increasing. Ultimately, a point is reached where the flow area is large enough to allow the entire volume of the fluid to flow past the float. This flow area is called the annular passage. The float is now stationary at that level within the tube as its weight is being supported by the fluid forces which caused it to rise. This position corresponds to a point on the tube's measurement scale and provides an indication of the fluid's flow rate.

One way to change the capacity or flow range of a rotameter is to change the float material, and thus its density, while keeping the flow tube and float size constant. Floats which are made from less dense materials will rise higher in the tube and therefore will yield lower flow capacities for the same diameter flow tube



Implementation

A rotameter consists of a tapered tube, typically made of glass with a 'float', made either of anodized aluminum or a ceramic, actually a shaped weight, inside that is pushed up by the drag force of the flow and pulled down by gravity. The drag force for a given fluid and float cross section is a function of flow speed squared only, see drag equation.

A higher volumetric flow rate through a given area increases flow speed and drag force, so the float will be pushed upwards. However, as the inside of the rotameter is cone shaped (widens), the area around the float through which the medium flows increases, the flow speed and drag force decrease until there is mechanical equilibrium with the float's weight.

Floats are made in many different shapes, with spheres and ellipsoids being the most common. The float may be diagonally grooved and partially colored so that it rotates axially as the fluid passes. This shows if the float is stuck since it will only rotate if it is free. Readings are usually taken at the top of the widest part of the float; the center for an ellipsoid, or the top for a cylinder. Some manufacturers use a different standard.

The "float" must not float in the fluid: it has to have a higher density than the fluid, otherwise it will float to the top even if there is no flow.

The mechanical nature of the measuring principle provides a flow measurement device that does not require any electrical power. If the tube is made of metal, the float position is transferred to an external indicator via a magnetic coupling. This capability has considerably expanded the range of applications for the variable area flow meter, since the measurement can observed remotely from the process or used for automatic control.

Rota meter Selection

- What is the minimum and maximum flow rate for the flow meter?
- What is the minimum and maximum process temperature?
- What is the size of the pipe?
- Would you like a direct reading rotameter or is a look up table acceptable?
- What accuracy do you need?
- Do you require a valve to regulate the flow?
- Will there be back pressure?
- What is the maximum process pressure?

Advantages

- A rotameter requires no external power or fuel, it uses only the inherent properties of the fluid, along with gravity, to measure flow rate.
- A rotameter is also a relatively simple device that can be mass manufactured out of cheap materials, allowing for its widespread use.

- Since the area of the flow passage increases as the float moves up the tube, the scale is approximately linear.
- Clear glass is used which is highly resistant to thermal shock and chemical action.

Disadvantages

- Due to its reliance on the ability of the fluid or gas to displace the float, graduations on a given rotameter will only be accurate for a given substance at a given temperature. The main property of importance is the density of the fluid; however, viscosity may also be significant. Floats are ideally designed to be insensitive to viscosity; however, this is seldom verifiable from manufacturers' specifications. Either separate rotameters for different densities and viscosities may be used, or multiple scales on the same rotameter can be used.
- Due to the direct flow indication the resolution is relatively poor compared to other measurement principles. Readout uncertainty gets worse near the bottom of the scale. Oscillations of the float and parallax may further increase the uncertainty of the measurement.
- Since the float must be read through the flowing medium, some fluids may obscure the reading. A transducer may be required for electronically measuring the position of the float.
- Rotameters are not easily adapted for reading by machine; although magnetic floats that drive a follower outside the tube are available.
- Rotameters are not generally manufactured in sizes greater than 6 inches/150 mm, but bypass designs are sometimes used on very large pipes

(FIG.ROTAMETER)

TANK:

size
L * B * H = 47 * 35 * 12.5
STORAGE CAPACITY= 310

VALVES:

SS(gases, liquids, fluidized solids, or slurries) by opening, closing, or partially obstructing various passageways. 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 *volver* , to turn, roll. Valves are found in virtually every industrial process, including water and sewage processing, mining, power generation, processing of oil, gas and petroleum, food manufacturing, chemical and plastic manufacturing and many other fields.

People in developed nations use valves in their daily lives, including plumbing valves, such as taps for tap water, gas control valves on cookers, small valves fitted to washing machines and dishwashers, safety devices fitted to hot water systems, and poppet valves in car engines.

In nature there are valves, for example one-way valves in veins controlling the blood circulation, and heart valves controlling the flow of blood in the chambers of the heart and maintaining the correct pumping action. Valves may be operated manually, either by a handle, lever, pedal or wheel. Valves may also be automatic, driven by changes in pressure, temperature, or flow. These changes may act upon a diaphragm or a piston which in turn activates the valve, examples of this type of valve found commonly are safety valves fitted to hot water systems or boilers.

More complex control systems using valves requiring automatic control based on an external input (i.e., regulating flow through a pipe to a changing set point) require an actuator. An actuator will stroke the valve depending on its input and set-up, allowing the valve to be positioned accurately,

To prepare any machine part, the type of material should be properly selected, considering design, safety and following points. The selection of material for engineering application is given by the following factors:-

- Availability of materials
- Suitability of the material for the required components
- Suitability of the material for the desired working conditions

- Cost of the materials

In addition to the above factors the other properties to be considered while selecting the material are as follows :-

Mechanical Properties: These properties are color, shape, density, thermal conductivity, electrical conductivity, melting point etc.

Physical Properties: The properties are associated with the ability of the material to resist the mechanical forces and load.

Strength : It is the property of material due to which it can resist the external forces without breaking or yielding.

Stiffness : It is the ability of material to withstand the deformation under stress.

Ductility: It is the property of material due to which it can be drawn into wires under a tensile load.

Malleability: It is the property of material which enables it to be rolled into sheetBrittleness: It is the property of material due to which it breaks into pieces with little deformation.

Hardness : It is the property of material to resist wear, deformation and the ability to cut another material.

Resilience : It is the ability of the material to store energy and resist the shock and impact loads.

Creep : It is the slow and permanent deformation induced in a part subjected to a constant stress at high temperature. We have selected the material considering the above factors and also as per the availability of the material.

The materials which cover most of the above properties are

MILD STEEL :-

Why steel in particular?

Mild steel contains approximately 0.05–0.25% carbon making it malleable and ductile. Mild steel has a relatively low tensile strength, but it is cheap and easy to form; surface hardness can be increased through carburizing. It is often used when large quantities of steel are needed, for example as structural steel.

In the States, "mild steel" refers to low carbon steel; typically the AISI grades 1005 through 1025, which are usually used for structural applications. With too little carbon content to through harden, it is weldable, which expands the possible applications.

Properties :

Tensile strength = 44.54 kgf/mm

Yield strength = 28 kgf/mm

Hardness = 170 B

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CHAPTER 5:EXPERIMENTATION

(for centrifugal pump)

Observation table:

Speed of the pumps N rpm	Pressure gauge reading p_2 kg/cm2	Vaccume gauge reading mm of hg	Time reqiured for 5 pulse of energy meter t sec	Total head or manometric head Hm=hs+hd +datum head	Actual discharge	Efficiency of the pumps
214.1	0.75	80	17.75	9.0332	4.2986*10^-4	12.01

Calculation:

Emc =3200 pulse/kwh

Level difference pressure gauge and vaccume gauge or datum head =300mm=0.3 m

Actual discharge (Qact)

$$= \frac{0.5 * 0.35 * 0.4}{40.71} = 4.2986*10^{-4} \text{ m3/s}$$

Suction head(hs) =p1*13.6*10^-3 m of hg

=80*13.6*10^-3

=1.088 m of hg

Delivery head (hd)= $\frac{0.75 * 10 ^ 5}{1000 * 9.81}$

=7.6452 m

Total head =Hd+Hs+datum head

=7.6452+1.088+0.3

=9.0332kw

Output power = $\frac{\rho gQHm}{1000}$

=1000*9.81*4.2986*10^-4*9.0332 *10^-3

=0.03809kw

Input power = $\frac{5 * 3600}{t * emc} = \frac{5 * 3600}{17.75 * 3200}$ =0.31690kw

Overall efficiency(η)= $\frac{output}{input} = \frac{0.03809}{0.31690}$ =12.01%

Pumps in series

Speed of the pumps N rpm	Pressure gauge reading p1kg/cm2	Vaccume gauge reading mm of hg	Pressure gauge reading p_2 kg/cm2	Vaccume gauge reading mm of hg	Time reqiured for 5 pulse of energy metert sec	Actual discharge	Efficiency of the pumps
2880	0.7	100	1.4	0.8	4.67	1.826*10^-3	30.9

Calculation

Emc =3200 pulse/kwh

Actual discharge (Qact)=

4.2986*10^-4 m3/s

Suction head(hs) =p1*13.6*10^-3 m of hg

=80*13.6*10^-3

=1.368 m of hg

Delivery head (hd)= $0.7*10 = 7\,m$

Suction head(hs) =p1*13.6*10^-3 m of hg

=0.0108m

Delivery head (hd)=1.4*10=14m

Total head =Hd+Hs+Hd+Hs+datum head +minor loss

=1.36+7+0.0108+14+2+0.215

=24.58m

Output power = $\frac{\rho gQHm}{1000}$

=1000*9.81*1.826*10^-3*24.586 *10^-3

=0.4404kw

Input power = $\frac{5*3600}{t*emc} = \frac{5*3600}{1.67*3200}$ =1.421kw

Overall efficiency(η)= $\frac{output}{input} = \frac{0.4404}{1.421}$ =30.9%

Pumps in parallel

Speed of the pumps N rpm	Pressure gauge reading p1kg/cm2	Vaccume gauge reading mm of hg	Pressure gauge reading p_2 kg/cm2	Vaccume gauge reading mm of hg	Time reqiured for 5 pulse of energy meter t sec	Actual discharge	Efficiency of the pumps
2880	2.8	90	2.8	90	4.07	1.926*10^-3	47.96%

Calculation

Emc =3200 pulse/kwh

Actual discharge (Qact)=

1.965*10^-4 m3/s

Suction head(hs) =p1*13.6*10^-3 m of hg

=1.22368 m of hg

Delivery head (hd)=26m

Suction head(hs) =p1*13.6*10^-3 m of hg

=1.224m

Delivery head (hd)=26m

Total head =Hd+Hs+Hd+Hs+datum head +minor loss

=1.224+26+26+1.5+0.496

=56.447m

Output power = $\frac{\rho gQHm}{1000}$

=1000*9.81*1.96*56.447 *10^-3

=1.085kw

Input power = $\frac{5 * 3600}{t * emc} = \frac{5 * 3600}{5.86 * 3200}$ =2.265kw

Overall efficiency(η)= $\frac{output}{input} = \frac{0.0845}{2.265}$ =47.96%

CHAPTER 6:RESULT AND CONCLUSION

As discussed above the use of three different setup of experiments will lead to a loss of cost and loss of time and loss of space which is undesirable for the college.

Time

Time is the most important factor affecting every aspect of life.A great proverb has been said that time and tide waits for no one.conducting the experiments individually on three different setup will take so much time.for each experiment we have to go for another setups and by moving here and there for the experiments conduction the time taken will be very much. By combining it into a single setup we dont have to go here and there for the conduction of experiments . It consumes less time as compared to the time required for conducting three different setups.

Accuracy

For attaining highest accuracy we are using flowmeter which directly measures the flow rate herer the human error get reduced because when we measure the discharge in a tank we have to measure the time fot 100mm rise and there we can miss out some observations due to which our discharge comes ouit to be different.herte we are using flowmeter where we dont need to observe the rise the flowmeter will directly give us the dicharge value in lpm.rs.

The scope of this project is limited only for centrifugal pumps in series and parallel.however if we use automatic sensors of flow and automation tools we can have even more accuracy which will help us to conduct experiment with higer accuracy.

Conclusion

- Human efforts will get reduced.
- Time for conduction of experiments will decrease.
- Space gets reduced

- Cost of equipment's will get reduced by large amount.
- Accuracy get increased by using flowmeter.

Chapter 7: Future Scope

- This attachment can be modified for different types of pumps
- Effect of opening and closing of valve 1/3rd and at other positions will affect the dicharge.this can be explained graphically
- In future by using sensors and automatic tools the efficiency can be easily predicted.
- The efficiency can be increased if used the automation in small scale industry. In future we can increase the mobility of the experimental setup.

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