Fluid Flow Measuring Devices used in an Inertial Measurement Unit Based on Different Flow Measurement Sensors.

Kumaraswamy K L, T. Krishna Rao, Praveen Math.

Abstract: ***The current work is focused on flow measuring devices which are based on sensors. Precise measurement of flow rate of fluids is established for a vital condition for quality analysis of various industrial applications. Measurement of a large mass fluid movement is called as flow rate measurement. Flow measurement are wide applications and every places its features are unique in engineering requirements and limitations. Fluid flow meters are the devices that are employed to enumerate the movement of fluids through a pipes, it is mentioned as flow rate. In the present research paper, different devices used to Fluid flow Measurement, Sensors, principle and operation, also benefits of using sensors based on Inertial Measurement Unit, which will be involved in evaluation of Flow Parameter. Fluid flow measurement will be comprise the ability to transduce the fluid flow rate into movement of an arm which can be acquired by the inertial measurement devices. Inertial measurement unit are known for its capacity to acquire the acceleration in 3 dimensions and this phenomenon will be utilized in the proposed research paper is to obtain the positional coordinates of the inertial measurement unit by a specific signal processing technique.***

Keywords: Sensor, Measuring Devices, Fluid Flow

I. INTRODUCTION

Accuracy flow meters are used to get precise in monitoring or flow control measurements. The progressive industrial field needed precise calculation of quantity, they are named as precision servo-valve expansion for the petroleum, and aerospace industry. And also importantly an application to determine the water flow to a domestic supply system, may only necessitate a measurement accuracy of 10% to 25%.

The flow meters are used in the industrial applications are listed as fallows, Obstruction type, Inferential, Electromagnetic, Positive-displacement flow meters, Fluid dynamic or Vortex shedding, Anemometer, Ultrasonic, Mass flow meter.

Obstruction type Flow meters

Obstruction or Head type flowmeters are of two types they are differential pressure type and variable area type. Orifice meter, venture meter, Pitot tube come under the first type, while Rota meter is come under in the second type.

Inferential flow meters 'rate through calculating one or more dynamic properties of the moving gas stream. A serious factor in the use of inferential flow meters is to realize their compassion to misrepresentations in the gas flow through the meter.

Electromagnetic flow meters

This type of electromagnetic flow meters are applying to notice the flow by using Faraday's Law of induction. Inside of this flow meter there is an electromagnetic coil that creates a magnetic field, and conductors that reluctance electromotive force.

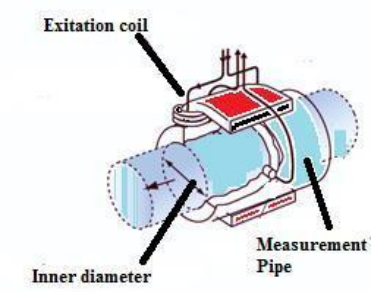

Figure 1: Electromagnetic flow meters

Positive-displacement flow meters

This type of flow meters are require, when fluid is to be mechanically interrupt modules in the meter in direction to require flow measurement. These flow meters are applied to identify the volumetric flow rate of a moving fluid or else gas by distribution of the media into static, metered volumes. A basic similarity would be farm a bucket below a tap, considerable it to a set level, then quickly replacing it with another bucket and timing the amount at which the buckets are filled with suitable pressure and temperature benefit and same the mass flow rate can be accurately determined.

Vortex flow meters or Dynamic flow meters

This category of flow meters are operating under the principle of vortex shedding and in case of oscillating vortexes arise when a fluid such as water flow past a bluff body, and the occurrence that the vortexes are shed depending on the scope and shape of the selected body.

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***** Correspondence Author

Kumaraswamy K L Assistant Professor, School of Mechanical Engineering, REVA University, Bangalore, India. Email: kumaaraswamykl@gmail.com

Dr T Krishna Rao Associate Professor, Department of Mechanical Engineering, Global Institute of Technology, Bangalore, India Email: krishnaraot@rediffmail.com

Praveen math Assistant Professor, School of Mechanical Engineering, REVA University, Bangalore, India. Email: praveen6.math18@gmail.com

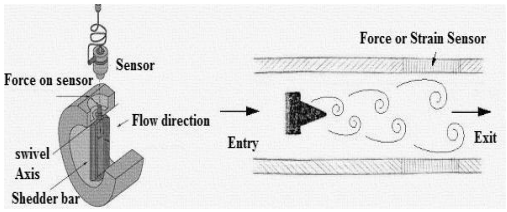

Figure 2: Vortex flow meters or Dynamic flow meters

Anemometer Type flow meters

Anemometer is the type of instrument which is used to determine the velocity of gases both in a confined flow and in unconfined flows. To decide the velocity of air, anemometers notice that the variation in some physical properties of the fluid or the result of the fluid on a mechanical device introduced into the flow.

Ultrasonic flow meters

Ultrasonic flow meters regulates velocity of a fluid with ultrasound to compute volume flow.

Mass flow meters

This is also called as an inertial flow meter. This instrument measures the mass flow rate of a fluid moving through a pipe. It is the mass of the fluid moving past a fixed point per unit time.

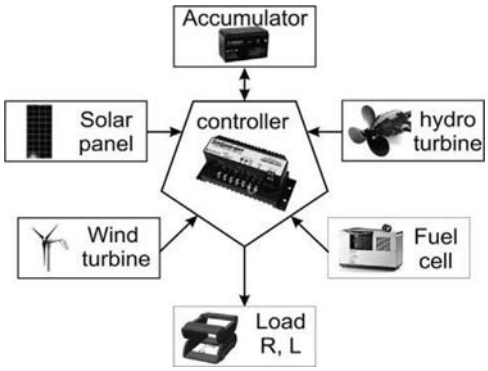

Figure 3: Anemometer Type flow meters

The encountered relationship is signal to noise ratio is one of the greatest challenging issues of them all. It requires using highly compound measurement algorithms. Among these most significant advance trends, the problematic of a low energy flow meter idea of as such a flowmeter and efficiency first of such resolutions data was confirming defined.

Ting-Ao Shen,et.al, has presented a novel signal processing method for Coriolis Mass Flowmeter

for this time fluctuating signal, which is included of a modified adaptive lat reviewed descending recursive discrete-time Fourier transform algorithm. In this method it is not only path the change of frequency constantly, and also certify the calculation with precision when computing phase difference. Computational load of the applied method is small with greater accuracy. Imitation and also experiment results prove that the planned method is effective and useful [3].

L. Cordova, et.al, has proposes an idea which is effectively used to measure the presentation of a gravimetric flow test It was a potential rig to determine not only the statistical variances of the diverter system, but also the variances of the distinctly meter. It was the planned under test method allows and also under diverse conditions, the purpose of regular errors in the mass determination. This method has been applied fruitfully at the bulky water flow caliber facilities of PTB in Braunschweig and Berlin and is suggested as to test periodically the performance of gravimetric amenities flow [11].

E. von Lavante, et.al, has presented an investigation on a kind of sensor arrangement in a DN25 vortex shedding flow meter in the Present paper. He was studied the flow field at a gas temperature of 773 degree kelvin at two different pressures and three different velocities. He noticed that the Mach number levels lesser were than in the significantly less temperature stages, in the leading of incompressible behavior fluid flow. For larger temperatures the electronic processing unit pressure in the duct chamber is probably higher side, so it is recommended that the requirement of cooling. The new concept of meter is under development, no proper improbability economical is available at this time. It will be providing in near future [17].

C.L. Ford, et.al, the periodic vortex shedding off from bluff bodies may be used in applications. However, because the bluff -body is highly confined thein shed a vortices pipe may interact with the pipe wall and causing an undesirable non-linear behavior. An experimental investigation has been conducted to examining the vortex shedding characteristics of highly confine bluff-bodies in fore large pipe Reynolds flow, number (Re 4_{ff}.4 10^4 to ×4.4 10^5). The bluff - bodies were comprised of a fore body and tail, both of which a acted the primary shedding characteristics. Shedding are typically created two unsteady modes.

Mode-I resulted with the vortex shedding and mode-II resulted to from a separation of the pipe wall boundary layer [15].

II. BENEFITS OF USING INERTIAL FLUID FLOWMETER

In the year 1687, the British mathematician Sir Isaac Newton invented the law of universal gravitation. The process of angular momentum type mass flowmeters is built directly on Newton's second law of angular motion. In 1742 the French mathematician Ronald d'Alembert proved that Newton's third law of motion applies not only to stationary bodies and also to substances are in motion.

In 1883 the British mechanical engineer Osborne Reynolds suggested a single dimensionless ratio to define the velocity profile of flowing fluids.

$$Re = DV\rho/\mu$$

In the above equation, we can observe that the fluid density, Pipe and μ Fluid diameter viscosity. And he expressed that at Reynolds numbers below 2000 the flow is exposed by viscous forces and the velocity curve is parabolic. The Reynolds numbers above 20000, the flow is exposed by inertial forces, ensuring in a large uniform axial velocity across the flowing stream and it will give a flat velocity curve. And the transition is in between laminar and turbulent flows.

III. SELECTION AND CHARECTERSTICS OF FLOW SENSORS

There are many different types of technique tool are used in the measurement of fluid flow. The selection of sensors subjected on so many different aspects like viscosity of the fluid, flow rate range and accuracy required for the measurement.

The different types of sensors are.

Differential pressure flowmeters addition an obstacle in the flow stream to diminish the flow rate and thus the pressure. Flow rate is determine by considering the difference between upstream and downstream pressures.

Positive displacement flowmeters capture a liquid sample in a small container and find the flow rate by counting the number of imprisonments and fills.

Magnetic flow meters working on the basic principle on Faraday's an electromagnetic law of induction and work only with the conductive liquids. It can be applied to coils mounted on or outside the flow pipe to generate a magnetic field inside the tube. The fluid going through a pipe to form a voltage proportionate to the flow rate, which is noticed by electrodes on both side of the pipe.

The vortex flowmeters are used to identify the flow by using a bluff body through the stream. The flow rate is evaluated by cumulative the pipe area by the fluid stream velocity, which is proportionate to the frequency of the vortices caused by the bluff body. These equipment's are used to apply with steam liquid and gas.

Multivariable differential pressure transmitters by attaching or participating with a primary element to measure temperature or pressure and use these values calculated by mass flow.

Thermal flowmeters are used to identify the mass flow directly. Some of these equipment's are placed into the flow stream and measure how long it takes to dissolve and measure the amount of energy required to maintain a constant temperature in the stream.

Below the Table tells about characteristics of the some important flowmeters:

Feature	Differential pressure	Electromagnetic	Curious	Ultrasonic
Volume or mass measurement	volume	volume	mass	volume
Fluid or flow rate	It is not fit for gases with less flow rate	It is not fit for gas flow	It is not fit for very high flow rates (more than 20000 lit/min)	It is not fit for gas flow
Particulate flow/slurries	Provisionally suitable	It is suitable	Provisionally suitable	Provisionally suitable
Liquid/gas mixture	It is not suitable	Provisionally suitable	Provisionally suitable	Provisionally suitable
Liquid conductivity	It is fit for all	Only limited liquids	It is suitable for all	It is Suitable for all
Food and beverage (consumable liquids)	It is not suitable	It is suitable	It is suitable	Best fit for non-intrusive measurement
Installation/ Maintenance	Easily installation, timely cleaning is required	Reasonable installation effort, less maintenance	Installation expenditure is more, relatively maintenance is free	Easy for the installation and maintenance
Typical precision	0.6 to 2% of the full scale	0.2 to 1% of analysis	0.1 to 0.5% of analysis	Doppler:1%of the analysis and 2% of the full scale Transit time meter: 0.35% of analysis and 2% of the full scale

IV. CONCLUSION

This paper is focused towards on the types of fluid flow measuring devices, its working principle, characteristics and selection of sensors in the field of the inertial flow meter measurement are employing with greater accuracy and even greater scope in industrial applications, as it also influence the standards of the industry. Sensors that are need to be used in flow measuring systems must be capable of producing the results repetitively with same higher accuracy. A section in this paper has shown the comparison on different sensors that can be used in inertial flow measuring devices in a flow through a pipes

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AUTHOR PROFILE

Mr. Kumaraswamy K L, Working as Assistant Professor in the School of Mechanical Engineering, at Reva university has teaching experience of 16 years. Master degree in Thermal Power Engineering and Bachelor of Engineering from Visveswaraya Technological University, Belagavi and currently pursuing Ph.D in Fluid flow measurement from Visveswaraya Technological University, Belagavi. published four technical papers in international and national journals, attended many Seminars, workshops and FPDs, handled various subjects such as Thermodynamics, Turbo machines, Heat and Mass transfer, energy engineering, Hydraulics and pneumatics, Fluid Mechanics, CAED and Elements of Mechanical Engineering. My areas of interests are Thermodynamics, Fluid Mechanics and heat transfer.