A Review on vortex tube refrigeration system
Shrikrushna Nagane¹, Sagar Vanage² Anandsinh Anpat³ Sarang Hole⁴

¹ Mechanical Engineering Department, S.I.E.T.C, Paniv, Maharashtra, India krushnanagane47@gmail.com
² Mechanical Engineering Department, S.I.E.T.C, Paniv, Maharashtra, India. sagarvanage5959@gmail.com
³ Mechanical Engineering Department, S.I.E.T.C, Paniv, Maharashtra, India, Anandanpat41@gmail.com
⁴Mechanical Engineering Department, D.P.C.O.E, Wagholi (Pune), Maharashtra, India, saranghole441089@gmail.com

Abstract
A cooling purpose is very important for both man and machine. In general vapour compression refrigeration system and vapour absorption refrigeration system are used for refrigeration purpose. Non-conventional type of cooling system means Vortex tube cooling system which is not used widely for cooling purpose. Vortex tube has many advantages over the conventional cooling system. Separating cold and hot streams by using vortex tube can be used in industrial application such as cooling equipment’s and refrigerants. Important parameters in vortex tube are cross section area of cold and hot end, nozzle area of inlet compressed air, cold orifice area, and hot end area of the tube.

Keywords: vortex Tube, nozzle, material, Efficiency, Mach Number.

1. Introduction
Vortex tube is a mechanical device which is used for cooling machine without any moving Parts, by separating a compressed air stream into a low temperature region and a high temperature region. This compressed air is divided in to two streams such as low and high temperatures. It also divided into two types counter flow type and parallel flow type. Vortex tube consist some important parts such as inlet nozzles, vortex chamber, cold-end orifice, hot-end control valve and a tube. When compressed air which is high pressure is entered in vortex chamber tangentially through vortex chamber, then a swirling flow is created in vortex chamber. Then the air swirls toward the centre of the chamber and it is expanded and cooled. In the vortex chamber, part of the gas swirls to the hot end, and another part go through the cold end. At the exhaust of hot end, the high temperature air exhausted, at the exhaust of cold end, it exhaust at lower temperature. This tube can be used spot cooling and spot heating application. Vortex tube have number of advantages over other refrigeration devices that is simple in construction, no any moving parts, do not required electricity, light in weight, low cost, etc. vortex tube is a device which is used for heating gas, cooling gas, cleaning gas, drying gas, and separating gas mixtures, etc.

2. Literature Review:-
Deepak Patel [1] Investigate experimentally coefficient of performance by using compressor. It is used for industrial spot cooling and process cooling. The commonly used cooling systems use the gas and liquid. It include various aspects for achieving maximum C.O.P. the experiment is carried out with a series of different physical, thermal and mechanical conditions and analysis of difference in temperature, cooling and heating effect, and C.O.P. with different working conditions and constructional features. SarathSasi [2] Experimental Investigation of Vortex Tube Refrigeration. Construct a vortex tube with maximum efficiency at minimum cost. The aim is to increase within effectiveness of merely one this kind of green technique named vortex tube used for commercial location cooling along with process cooling requirements, for instance Place cooling, Weld cooling etc. They had optimized the vortex tube and done experimental investigation on the vortex tube by changing different variable such as number of nozzle, vortex tube material, and different cone angles and different mass fraction. The actual vortex tube is does not have a transfer elements and also normally consists of a sale paper tubing using nozzles and a throttle control device. The performance of poly vinyl chloride vortex has higher temperature difference than copper tube, that is hot temperature and cold temperature difference. Increasing the number of nozzles the temperature difference between hot end and cold end also increases.
manujendrasharma [3]Design an Experimental Setup for counter flow vortex tube. The aim of this experiment is to determine the performance of counter flow vortex tube by changing the number of geometrical parameters such as length and diameter of hot end pipe and cold end pipe and change the nozzle number of the orifice also determine the Variable geometrical parameters effects on the temperature separation. Vortex tube is made up of
stainless steel, aluminium and plastic. Result of this experiment is increase the COP of the vortex tube.

Mahmood Farzaneh [4] Experimental set up has been conducted to determine the effect of geometrical parameters on vortex tube performance. To achieve the maximum efficiency of vortex tube form the data which obtain experimentally, optimum values for cold orifice diameter to the vortex tube inlet diameter(d/D) and the length of vortex tube to its inlet diameter(L/D) for this experiment proposed. Some errors are occurring during experiment is Error in temperature measurement, Error in pressure measurement, Error in flow rate measurement.

Y. Dinga [5] A new nozzle with equal gradient of Mach number and a new intake flow passage of nozzles velocity at equal flow generated and used to reduce the flow loss. A new kind of diffuser invented to reducing friction loss of air flow energy at the end of the hot end tube of vortex tube, which can greatly improve the performance of vortex tube. Modifications are Nozzle intake, Diffuser of vortex tube, nozzle of vortex tube. In nozzle innovation equal the Mach number gradient and intake flow passage with equal flow velocity. The diffuser is installed between outlet of vortex tube and hot valve aiming for reducing the peripheral speed greatly reduced ratio of length to diameter. Nozzle was designed for minimize flow losses.

H. Thilakan [6] the experimental was started from the design and fabrication stage of vortex tube refrigerator. Cold orifice diameter is important part in performance Vortex tube. This paper describes the experimental study on vortex tube refrigerator with conical valve angle at the hot side and the effect of cold orifice diameter at cold side on the performance of vortex tube refrigerator. The diameter of orifice influences the expansion that take place in vortex chamber. Temperature also changes at opening of stop valve. When it opens at few variations then air allow to escape at hot end reduces and maximum temperature difference increases. If opening is increases air escaped from pipe easily which is turn decreases maximum temperature difference is obtained.

Chetan D Bhimate [7] This investigation the counter flow vortex tube has been designed, manufactured and tested. The vortex tube is non-conventional cooling device which operates as a refrigerating unit without effecting environment. There are two parameters which are controls the working of pressure tube. First is inlet pressure of compressor air & cold mass fraction. & geometric parameters & Second is material of vortex tube affect coefficient of performance (COP). CPVC material is used for manufacturing of the vortex tube as which has lower thermal conductivity than metals & less fluid friction losses. The temperature drop increases with increase in inlet pressure. A Vinash Patil [8] This investigation to understand the heat transfer properties in vortex tube with respect to number of parameters i.e. cross section area of hot and cold end, nozzle area of inlet compressed air, cold orifice area, hot end area of the tube, and L/D ratio. There are two design features associated with a vortex tube which is maximum temperature drop vortex tube design for producing small quantity of air with very low temperatures and maximum cooling effect vortex tube design to produce air at large quantity with different temperatures. Vortex tube can be used for any type of spot cooling or spot heating application.

3. Conclusions

Vortex tube also obeys second law of thermodynamics which shows the decreasing of energy from a higher quality and quantity to lower quality and quantity using of separate compressor it is successfully used. Numbers of geometrical Parameters have been tested in this experiment, and this effect is occurred on vortex tube that means temperature separation. When temperature drop is increases then inlet pressure also increased. When increase of inlet pressure then coefficient of performance, cooling effect and isentropic efficiency of the vortex tube are increases.

References