A Review Paper on Fabrication of Vortex Tube & Its Analysis

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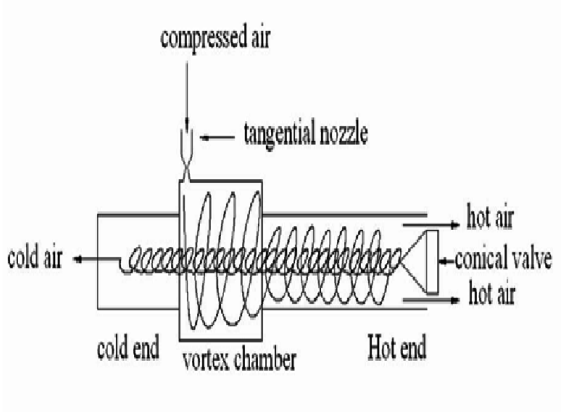
***Abstract*- A vortex tube is a simple device which splits a high pressure gas stream into a cold and hot stream without any chemical reactions or external energy supply. It is a mechanical device without any moving parts. The splitting of flow into regions of low and high temperature range is referred to as the temperature separation effect. The performance of vortex tube depends on two basic parameters, first is the working parameter such as inlet pressure of compressed air, and the other one is geometric parameters such as number of nozzles , diameter of nozzle, diffuser, length of hot side tube, cold orifice diameter, and as well as material of vortex tube. Vortex tube has interesting functions and several industrial applications, and, as a refrigerator, it is used as a spot cooling device in industry.**

***Index Terms*- Vortex Tube, nozzle, material, diffuser**

INTRODUCTION

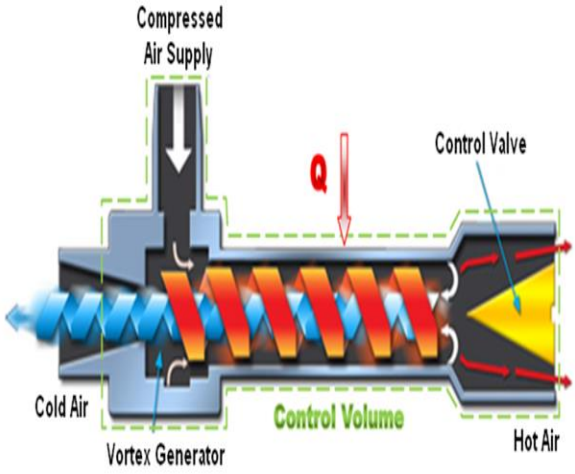
Refrigeration is the practical application of thermodynamics where heat is transferred from low temperature region to high temperature region through refrigerant which is the working fluid. But the refrigerants used causes environmental problems such as ozone depletion and global warming which have gave us a way to think about non- conventional systems. Vortex tube is one of the non-conventional systems where air can be used as working fluid to achieve refrigeration. Vortex tube is a simple device without moving mechanical parts, which converts high pressure gas stream into two separate flows of different temperatures (cold and hot). Vortex tube consists of compressor, pressure gauge, control valve, thermocouple and temperature indicator. Compressed air from the compressor enters into the vortex tube tangentially. Due to tangential entry of compressed air into vortex tube swirling flow takes place in vortex chamber. The compressed air expands in vortex tube and divides into cold and hot stream. The cold air leaves the cold end orifice which is near inlet nozzle and hot air discharges at far end of the tube i.e. hot end. Thermocouples measure temperature at cold end and hot end. Vortex tube has many advantages such as no moving parts, no chemicals or electricity, low cost, light weight, maintenance free, durable, temperature adjustable. Vortex tube are commercially used for low temperature applications such as cool electronic parts, testing of thermal sensors, to set solders, cooling of electric or electronic control cabinets, cooling of cutting tools. Other industrial application of vortex tube includes fast starting up the steam power station, nuclear reactors, gas separation and liquefaction of natural gas.



VORTEX TUBE

Ranque-Hilsch vortex tube is a device with no moving parts. When a highly pressurized stream of air is allowed to pass through its inlet nozzle the

vortex is generated which produces two air streams namely hot and cold air stream. The cold air leaves from the outlet near the inlet nozzle and hot air in the opposite side. The fig. 1 shows the vortex tube. Vortex tube mainly consist of inlet nozzle form were the highly pressured air is passed. Vortex tube were the vortex is generated which separates the air in two streams namely hot and cold which are obtained at cold end nozzle and hot end nozzle. At the end of hot nozzle there is a nozzle cap which controls the mass flow rate of hot and cold air and is also adjustable. This movement of nozzle cap also affects the performance of vortex tube. Still many research is going on to determine the energy separation effect in the vortex tube.



The layout of a Vortex Tube Fig. 1

SCHEMATIC OF VORTEX TUBE IT CONSISTS OF THE FOLLOWING PARTS:

1) DIFFUSER: Diffuser is the device that allows the high velocity air to expand and lowers the temperature as well as pressure of the air. By the installation of a diffuser it affects the temperature of cold air.

2) CHAMBER: Chamber is portion of nozzle and facilities the tangential entry of high velocity air stream into hot side. Generally the chambers noncircular form, but they are gradually converted into spiral form.

3) COLD AIR SIDE: Cold side is cylindrical portion through which cold air is passed.

4) VALVE: A device used for controlling the flow of fluid in the pipe or other enclosure. Control is by means of a movable element that opens, shuts, or partially obstructs an opening in passage way.

5) NOZZLE: A nozzle is a device designed to control the direction or characteristics of a fluid flow (especially to increase velocity) as it exists (or enters) an enclosed chamber or pipe.

6) DIAPHRAGM: A diaphragm is a sheet of a semi flexible material anchored at its periphery and most often round in shape. It serves either as a barrier between two chambers, moving slightly up into one chamber down into the other depending on the differences in pressure, or as a device that vibrates when certain frequency are applied to it.

7) HOT AIR SIDE: Hot side is cylindrical in cross section and is of different length design as per.

WORKING OF VORTEX TUBE

Pressurized air flow is usually transferred with the nozzle since revealed throughout Fig 1. The following, air flow increases and receives excessive velocity as a result of particular shape of the nozzle. A new vortex stream is made inside chamber and air flow vacations throughout spin out of control including motion on the periphery in the hot area. This stream is fixed with the valve. When the force in the air flow around valve is made over exterior through partially closing the valve, a reversed axial stream with the core in the hot area begins from high-pressure place in order to low- pressure place. On this practice, temperature move develops involving reversed mode and ahead mode. Consequently, air flow mode with the core will get refrigerated underneath the inlet temperature in the air flow inside vortex pipe, while air flow mode throughout ahead way will get warmed way up. Your cool mode is usually steered clear of with the diaphragm ditch in the cool area, while hot mode is usually transferred with the cracking open in the valve. By simply controlling the cracking open in the valve, the quantity of the cool air flow and temperature can be diverse.

It becomes greater than the outside pressure i.e., atmospheric pressure, a flow in reversed direction is generated. This flow moves to the opposite direction of original flow from vortex

CONCLUSION

As above thesis we can conclude that vortex tube is done and the performance of modified vortex tube is

analysed. The results of the experiments show that the performance of PVC vortex has higher temperature difference than copper tube, that is hot temperature and cold temperature difference. Also the number of nozzle number is analysed here, the investigations showed that four nozzles gives maximum temperature difference.

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