بسم الله الرحمن الرحيم

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تم رفع هذه الرسالة بواسطة / منى مغربي أحمد

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

ملاحظات: لا يوجد

NUMERICAL MODELING OF REFRIGERATOR VORTEX TUBE COOLING PERFORMANCE

By

Mahmoud Mohamed Abdelghfar

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE

In

MECHANICAL POWER ENGINEERING

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis: NUMERICAL MODELING OF REFRIGERATOR VORTEX TUBE COOLING PERFORMANCE

Key Words: Vortex, Separation, Refrigeration, Swirling, Turbulence

Summary:

The refrigerator vortex tube is an industrial simple device that used for generating cold and hot air streams from one pressurized air source. Diverse clarifications for the phenomenon of the temperature separation were introduced last years, but till now there isn’t a clear proposal that explains this phenomenon completely. This effort is devoted to simulate the flow within the refrigerator vortex tube and explain its operating mechanism. Furthermore, this study shows the influence of cold mass fraction, air inlets number and shape and the divergence angle of the hot tube on the cooling performance to provide optimum geometrical and operational properties.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.
I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Date:

Signature:

Dedication

To all my family members, my brother Khaled, my wife, and my daughter Reem.

Acknowledgments

I would like to express my honest appreciation and infinite thanks to my supervisors; **Prof. Dr. Essam E. Khalil, Prof. Dr. Karam Ramzy Beshay, and Dr. Gamal Abd El-Moniem El-Hariry** for their support, continuous encouragement and distinctive supervision. They helped to provide me with up to date technical knowledge and references that were of great help in the present work.

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NOMENCLATURE

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A_c	Area of the vortex tube cold outlet, m^2
A_i	Area of the vortex tube inlet, m^2
D	Vortex tube diameter, m
d_c	Cold orifice diameter, m
d_c/D	Ratio of the cold orifice diameter to the tube diameter
$d_{plug,i}$	Control valve inner diameter, m
$d_{plug,o}$	Control valve outer diameter, m
E	Energy, J
K	Thermal conductivity, W/mK
k	Isentropic coefficient
L	Vortex tube working length, m
L/D	Ratio of the tube length to its diameter
$\dot{m}$	Mass flow rate, kg/s
$\dot{m}_c$	Cold side mass flow rate, kg/sec
$\dot{m}_h$	Hot side mass flow rate, kg/sec
$\dot{m}_{in}$	Mass flow rate at the inlet, kg/sec
P	Total pressure, N/m^2
P_{atm}	Atmospheric pressure, N/m^2
P_o, P_{in}	Inlet pressure, N/m^2
P_r	Radial pressure, N/m^2
R	Gas constant, J/kg.K
r, z, θ	Cylindrical coordinates
T	Total temperature, K
T_c	Cold temperature, K
T_h	Hot temperature, K
T_o, Tin	Inlet temperature, K
V	Volume, m^3
V_r	Radial velocity, m/s
Vz	Axial velocity, m/s
Vθ	Tangential velocity, m/s
ρ	Density, kg/m^3
ΔT_c	Cold temperature drop, K