AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
MECHAINCAL POWER ENGINEERING DEPARTMENT

Studying the Swirling Effect on the Thermal and Combustion Characteristics for the Gas Domestic Burner

A Thesis Submitted in partial fulfillment of the requirements of the degree of

Master of Science in Mechanical Engineering

(Mechanical Power Engineering)

By

Ahmed Adel El-Sayed Moustafa

Bachelor of Science in Mechanical Engineering
(Mechanical Power Engineering)
Faculty of Engineering, Ain Shams University, 2011

Supervised By

Prof. Mahmoud Mohammed Kamal Abd El Aziz

Dr. Hany El-Sayed Abdel Halim

Cairo – (2019)

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Examiners' Committee

Name and Affiliation	Signature
Prof. Mahmoud Abd El Fattah El Kady Mechanical Power, El Azhar University	……..
Prof. Mahmoud Abd El Rasheed Nosier Mechanical Power, Ain Shams University	……..
Prof. Mahmoud Mohammed Kamal Abd El Aziz Mechanical Power, Ain Shams University	……..

Date: 14 March 2019

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Prof. Mahmoud Mohammed Kamal Abd El Aziz Mechanical Power, Ain Shams University	.....
Dr. Hany El-Sayed Abdel Halim Mechanical Power, Ain Shams University	.....

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Statement

This thesis is submitted as a partial fulfillment of Master of Science in Mechanical Engineering, Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis, and no part of it is been submitted for a degree or a qualification at any other scientific entity.

Ahmed Adel El-Sayed Moustafa

Signature

…….

Date: 14 March 2019

Researcher Data

Name	: Ahmed Adel El-Sayed Moustafa
Date of birth	: 18th November, 1989
Place of birth	: Cairo, Egypt
Last academic degree	: Bachelor of Science
Field of specialization	: Mechanical Power Engineering
University issued the degree	: Ain Shams University
Date of issued degree	: June, 2011
Current job	: Senior Laboratory Engineer – Electrolux Egypt

Thesis Summary

An experimental study carried out, to investigate the thermal efficiency and carbon monoxide emissions for different gas domestic burner designs, these designs included a number of approaches that were determined to influence of these aspects on the overall performance of the burner. In this research, two types of burner were examined a single ring burner and a double ring burner. Testing each burner on multiple pan support heights at different air to fuel ratios to see the tangible enhancement.

For the single ring burner three burners were tested a radial ordinary design, a swirl design and an impinging flames design. The highest efficiency was for the swirl single ring, and the achieved efficiency was 60.4% with a rise of 1.5% from the radial design at the lowest pan support height and highest Reynolds number.

The main reason behind this high efficiency is that the swirling flow allowed for a longer residence time between the flames and the heated load transferred more heat to the load while this measured the highest emissions out of all single ring burners.

The carbon monoxide emissions in the impinging flames burner were as low as 0.008%; this was due to the long flames propagating radially by impinging flames that resulted to a lower contact area between the flames and the heated load, adding on the impinging flames allowed more secondary air to surround the flames lengths.

For the double ring burner four burners were examined a radial design, swirl design, counter swirl design, and impinging flames design. The counter flow in the double ring burner showed the best thermal efficiency with a value of 57.4%, with a rise also of 1.5% the same as the single ring burner.

The double ring burner with impinging flames was the lowest emissions out of all designs with lowest emissions achieved 0.018 % of carbon monoxide emissions, but the best practical burner for the limits of international standards was the impinging flame burner.

To conclude the impinging flames and swirl flow when added to the gas domestic burners tend to improve the performance of the burners. More combinations need to be experimented to work more on enhancing the thermal efficiency and lowering the combustion emissions.

Key words:

Gas domestic burner, Swirl flow, Impinging flames.

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