

Invention or Solving the Mystery of Water Clock of the Lion Court Fountain in Alhambra palace (Granada)

Case Study as an Example of other Water Engineering Inventions such as The Elephant Clock, al-jazari Robotics and etc

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Abstract:- The objective of this paper is to analyze and model the water engineering of the court of lion fountain that have used to work as clock according to the stories. Each hour, the water spills out of each lion in sequence. So that the water spills out of all 12 lions at the midd day. This water mechanism is fully natural.

Keywords:- Water Engineering, Greedy Cup, Marble Basin, Ibn Aljazari, Ibn Al Razzaz, Ibn Alzamrak Poem.

I. INTRODUCTION

The Andalusia civilization in Spain developed many mechanism in water engineering this was done by professional engineers such as Aljazari and Ibn Alrazzaz and Ibn Alawam. The purpose of such mechanism was either for irrigation or decoration. The Lion Court Fountain in Alhambra palace in Granada was one of such decorative richness and hydraulic complex system. It was built between 1362 and 1391. There are stories that this fountain used to work as a water clock. The water come out of each lion mouth hour after hour, so that at the midday all of the twelve lions spill water out of their mouths. There are no recent photos prove that this fountain work as clock in recent ages. Rather, there is a poem wrote by Ibn Zamrak that is carved around the rim of the basin (Appendix [1]).

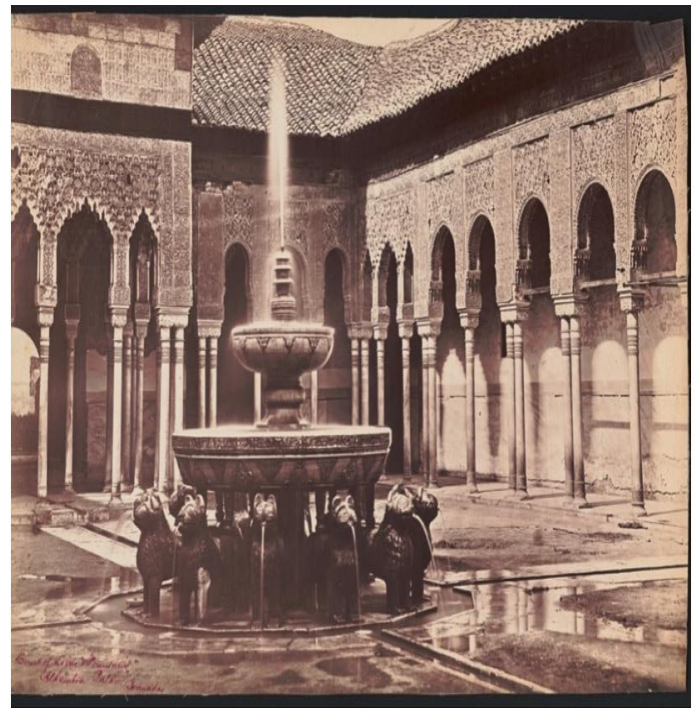


Fig (1): Court of lion and fountain “Granada”

II. METHODOLOGY AND THEORIES

Discovering different photos of the court of lion fountain. Also, Reading and analyzing through different works of Ibn Aljazari, Ibn Al Razzaz and bani Mousa. It is founded that the court of lion fountain has the possibility to work as water clock. It is possible that the fountain was based in two methodology:

A. Filling and maintaining the water level in the bowl-like marble basin surrounded by the sculpture twelve lions

The bowl-like marble basin work as the main tank supplying water for the twelve lions that are surrounding the bowl. This bowl-like marble basin work as a large Pythagorean cup (greedy cup) figure (1). This bowl is filled naturally by the water pressure. This done gradually during which it feeds the sculpture lions drains water hour after hour until they all together drain water out of their mouths at noon. At specific level the bowl starts to drain water under its pressure through siphon effect, hence the lions stop draining water one after other until the last lion at mid night. The flooding water start the cycle again after the bowl is totally drained.

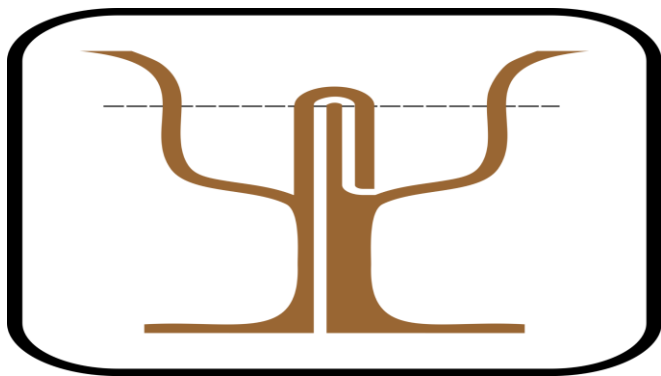


Fig (2): Pythagorean bowl with specific level

B. The water clock of the twelve lions' sculpture

There are twelve sculpture lions that appears to support the bowl in their backs while facing outward. These twelve lions apply the same principle of the Pythagorean cup. That is, there is tunnel that apply Pythagorean siphon effect and located inside the side wall of the bowl at the same position of the lion figure (2). The level of water at which the sided Pythagorean tunnel of a lion start draining rise gradually upon the position of the lion. It starts low and increase until the last 12th lion where it is lower than the main Pythagorean tunnel of the main bowl.

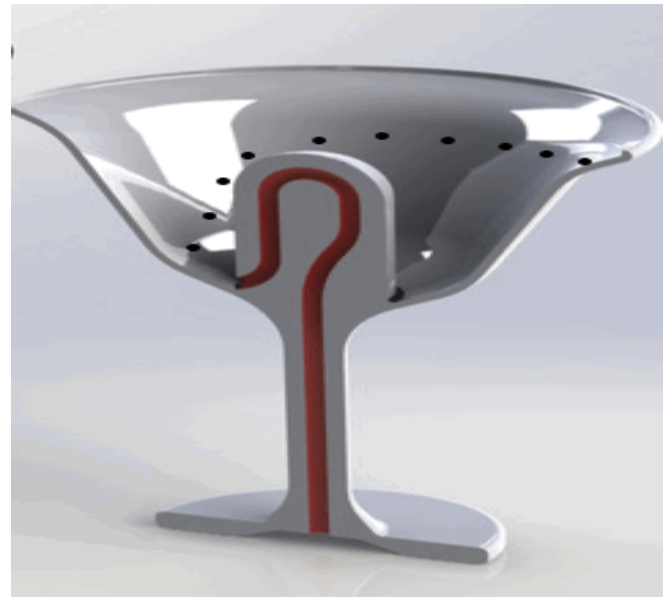


Fig (3): Pythagorean tunnel feed the sculpture lion at its side

III. RESULTS

As a result of this study, the court of lion fountain can work as water clock as it is mentioned in some stories. The structure of this fountain can be modeled using the principle of Pythagorean cup for both the main bowl and the side twelve lions as it mentioned in the methodology.

IV. CONCLUSION

In conclusion, this paper was written to analyze and prove the concept that the court of lion fountain in Alhambra palace at Granada has used as water clock. Reviewing the water engineering principles that were used at the same age period during which fountain was built, indicates that the principle of siphon effect applied in the greedy cup (Pythagorean cup) explain many tricks that engineered Ibn al-jazari and other talented engineers. These inventions were not built as suggested for decoration only but in addition they have a practical use also.

APPENDIX

[1] Ibn Zamrak's poem

{ Such a translucent basin, sculpted pearl!

Argent ripples are added on it by the quiet dew And its liquid silver goes over the daisies, melted, and even purer.

Hard and soft are so close, that it would be hard to distinguish liquid and solid, marble and water. Which one is running?

Don't you see how water overflows the borders and the warned drains are here against it?

They are like the lover who in vain tries to hide his tears from his beloved }

ألم ترى أن الماء يجري بصفحةا ** ولكنها سدت عليه المجاريا
كمثل محب فاض بالدمع جفته ** وغيض ذاك الدمع إذ خاف واشيا

REFERENCES

- [1]. Library of Congress/photograph” Court of Lion & fountain, Granada”/1854.
- [2]. Arabic books “the combination of science and useful work in the craftsmanship” / ibn- aljzari and other books and articals
- [3]. www.wikipedia.org
- [4]. Guiding the Imagination: Perception and Inscriptions/The court of lions at the Alhambra/ Manzar Journal/ Gillian Baker.