ISSN No:-2456-2165

Design and Fabrication of Chain of Office for the Chancellor of Knust Using the Lost Wax Casting Technique

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Abstract:- The main objective of this paper was to explore the suitability of the lost wax casting technique for the design and fabrication of a chain of office. A chain of office is a traditional symbol of power and prominence, usually made of medals which symbolizes a community or an institution. It is also an important piece of public history. The chain of office harkens back to medieval livery collars that were worn by high ranking state officials. These collars represented a tangible link between a monarch and his or her loyal subjects. Modern chains of office also allude to this symbolic duality. It is usually bestowed on the president of an academic institution as a leader and an executive authority and worn at the commencement and convocations and all official occasions requiring the wearing of academic regalia. It is a permanent insignia of office and is passed down to each succeeding president of the institution. The chain of office of an academic institution is usually a medallion engraved with the names of the presidents of the institution and the periods in the history of the institution, as well as the official logo, motto or seal of the institution. The official chain of office is highly regarded as part of the enduring legacy and permanent symbology of the institution. Different metalsmithing techniques have been used for the production of chain of office Studio-based and descriptive research were therefore employed to fabricate a chain of office for the Chancellor of K.N.U.S.T that represents the University, using the lost wax casting techniques. The logos of the six hall of residence and the six colleges were used with university's logo as the central design. The resultant is one-of-a-kind, unique product that shows the legacy of the university and commemorates achievement.

Keywords:- *Fabrication, Livery Collars, Regalia, Traditional Symbol, Lost Wax,*

I. INTRODUCTION AND LITERATURE REVIEW

Ceremonial Chains of Office have honored the highest officials of educational institutions for centuries, Chains of office are worn as part of the pomp and ceremony at official public celebrations of a college or university, such as the inauguration of a new president and at commencement events. The official chain of office is highly regarded as part of the enduring legacy and permanent symbology of the institution.

The history of chain of office dates back to medieval times, where it was traditional symbols of leadership and authority. Over time it was adopted by institutions of higher education for formal occasions. And while traditional chains of offices have common elements, different versions also feature distinctly local touches, such as decorations of pinecones and tobacco leaves and mottos related to the founding family and university.

A modern Chain of Office is composed of several elements joined together with pieces of chain, from which hangs a medallion. Chains of Office are almost always sewn onto a velvet collar, which is not only decorative, but makes the chain much more comfortable to wear. One of the oldest and best-known livery collars is the Collar of Esses, which has been in continuous use in England since the 14th century. (Roy, 1975)

Various forms of livery were used in the Middle Ages to denote attachment to a great person by friends, servants, and political supporters. The collar, usually of precious metal, was the grandest form of these, usually given by the person the livery denoted to his closest or most important associates.

Gold chains tended to replace collars, during the Renaissance and portrait miniature of the donor tended to replace the earlier badges with symbolic devices, although "picture boxes" containing miniatures could be highly extravagant pieces of jewellery. During the sixteenth century collars became marks of a specific office or Order, and subsequently remained so. (Roy, 1975)

According to Roy, (1975), most British and Irish mayors wear a collar/chain of office, and new ones are still designed for new municipalities. The mayor's spouse may have a much smaller version. These are worn over normal clothes when on official duties. Following British practice, most Canadian, Australian and New Zealand mayors also wear chains of office. The custom also spread outside the Commonwealth, to Germany (originally only Prussia) in 1808, to the Netherlands by royal decree in 1852 and to Norway after the mayor of Oslo received one as a gift

in 1950, and most Norwegian mayors now have mayoral chains.

Collars of various devices are worn by the knights of some of the European orders of knighthood. The custom was begun by Philip III, Duke of Burgundy, who gave his knights of the Golden Fleece, badges of a golden fleece hung from a collar of flints, steels and sparks. Following this new fashion, Louis XI of France, when instituting his order of St. Michael in 1469, gave the knights collars of scallop shells linked on a chain. The chain was doubled by Charles VIII, and the pattern suffered other changes before the order lapsed in 1830.

According to David (1968), a chancellor is a leader of a college or university, usually either the executive or ceremonial head of the university or of a university campus. In most Commonwealth and former Commonwealth nations, the chancellor is usually a ceremonial non-resident head of the university. In such institutions, the chief executive of a university is the vice-chancellor, who may carry an additional title, such as "president and vice-chancellor". The chancellor may serve as chairman of the governing body; if not, this duty is often held by a chairman who may be known as a pro-chancellor. In many countries, the administrative and educational head of the university is known as the president, principal or rector. The president of the university is the only individual allowed to wear the university's chain of office. A typical university chain of office consists of a single medallion on a chain of silver or gold. They are meant to be timeless emblems and used by multiple generations of presidents.

The tradition of recording honour and success in metal has been practiced since ancient Greek and Roman times. This has been updated with state-of-the-art manufacturing and production to create truly timeless pieces that celebrate the important events and commemorate achievement. Different metalsmithing techniques have been used for the production of chain of office. In this study the lost wax casting techniques was employed to create a new chain of office for the chancellor of KNUST.

Design which is inevitable in a research like this was opined by Simon (1996) a meta-discipline of all professions and not restricted to engineers but rather extend to other disciplines that seeks to convert an existing way of an art into a more modern way through a design work of such as this chain of office.

According to Ford (2001), design can also be defined by the consideration of the formation of a machine or a building for a particular usage. It's equally recognised to be the roadmap to the achievement of a unique expectation since it harbours the specifications as well as the parameters to be involved in the finishing of a product or project. The importance of design has been recognized by scholars from different field such as artificial science and engineering (Simon, 1996; Marc & smith, 1995; Hernia et al. 2004) innovation and statistics (Petroski, 1996; Walsh, 1996; Verganti, 2003) management (Potts & Cunnigham, 2008; Potts, 2009) despite a shared understanding of the role of design as a potential enabler of innovation, it still knowledge a wide range of meanings.

Gordon (1986) mentions that design approach could either include specified methods or not but are mostly to keep the general design goal in motion. There are others which are to ensure the proper trend to be followed by the designer and at times of no likely conflict, approaches can be combined. For this, the designers of this chain of office followed the design approach of Gordon.

Some popular approaches which were brought to bear in this chain of office are

- KISS principle, (Keep it Simple Stupid), with this any irrelevant difficulties are taken out.
- This encourages the use of several methods to achieve a result rather than depending on one.
- There shouldn't be reliance on end user, but rather an effort must be made towards an artefact centred tasks.
- There must also be a focus on design artefacts of end users by a cautious effort to remain focused on user-centred design.
- Designed artefacts are used to critique practices and other social acts.
- Services linked to the proper usage of a product through the use of a service design.
- Design products in such a way as it will remain useful despite changes in years as a means of catching attention to generations through trans-generational design.

After designing the work had to be fabricated or produced. Defectiveness relating to design may impact on the production processes and as such each process would have to follow some level of discipline as may be outlined by the designer as well as creativity or problem-solving skills from the designer (Getlein, 2008).

McCreight (1991) opines that the emphasis is on how technical insight of metal manipulation can lead to forging metals into desired shapes to serve a lot of purposes in our environment. That is precisely the point that this research is seeking to make design and fabricate chain of office for the Chancellor of KNUST. Schey (1997) defines fabrication process as the ability of a metal to be fabricated by various manufacturing processes such as formability, workability, castability, forgeability, machinability and weldability. Schey in his definition uses techniques in fabricating metal to elucidate what metal processes is all about. Schey's definition underpins some of the processes that the researchers used in producing the chain of office for KNUST.

Fabrication is when a particular form of metal is transformed, changed into another form. Industries, jewellery arts and crafts, and technological areas are mostly where metal fabrications are used. Procedures involved in the fabrication of metal are known to be metallurgy (Marcoe, 2003).

ISSN No:-2456-2165

Tammy (2012) describes fabrication as when using metal materials such as metal plate and wire for the purposes of jewellery making, very often the jewellery maker is required to shape and form the metal. The techniques used to do this are considered fabrication techniques where you use methods such as sawing, filing, and hammering to reform the metal piece into a different structure and shape as in the case of this chain of office for the Chancellor of KNUST.

Agyen-Gyasi (2008) narrates that Kwame Nkrumah University of Science and Technology is a University in Kumasi, Ghana is the second public university established in the country as well as the second largest University in Ghana. The University has its roots in the plans of the Asantehene Agyeman Prempeh I to establish a University in Kumasi as part of his drive towards modernization of his kingdom. This plan never came to fruition due to the clash between British Empire expansion and the desire for King Prempeh I to preserve his kingdom's independence.

However, his younger brother and successor, King Agyeman Prempeh II, upon ascending to the Golden Stool in 1935, continued with this vision. Events in the Gold Coast in the 1940s played into his hands. First there was the establishment of the University College of the Gold Coast. Second there were the 1948 riots and the consequent Watson Commission report which recommended that a university of sciences be established in Kumasi. Thus, in 1949, the dream of the King became a reality when building started on what was to be called the Kumasi College of Technology.

Currently Nana Osei Tutu II is the Chancellor of the University.

II. METHODOLOGY

2.1 Design Process

The design consisted of the main logo of the University, that of the Colleges and Residential Halls. Sketches were made to develop the right composition to communicate the concept. When the right composition was derived, the various logos were properly designed using the Corel Draw Software.

2.2 Product model

In order to better obtain a fair idea of the intended results of the project, a product model was fabricated. The model consists of the full arrangement of the design. Alterations were made to get the right size of the logos as well as the right length of the whole chain of office. The materials used in executing this model were copper wire and aluminium sheets. When the model met the requirement, the fabrication process was initiated which, consisted of model making, casting, sanding, links forming, polishing and gold plating.

2.3 Model making

Plaster of Paris (P.O.P.) was used to obtain an intaglio design. The designs which were rendered in Corel Draw were printed in reverse. The printed designs were then transferred unto the P.O.P. slab with the help of carbon paper and pencil. A scriber was used to draw over the faint pencil outline on the P.O.P. slab to make the outline more visible. Scriber and set of spatulas were employed in carving the design meticulously into the P.O.P. (Fig 1.1). Kiddy clay was used to assess the carved design to check if the right depth and shape has been achieved. This was done by pushing the kiddy clay into the carved shape. When the clay is removed, the design will be imprinted on the clay and hence, the design in the P.O.P. can be critically analysed to achieve the intended results. Wax was then prepared and placed in lukewarm water for it to soften. It was then rolled into a slab with the help of rolling pin and board. Oil lubricant was smeared on the carved P.O.P. slab and wax was used to pick the design (Fig. 1.2a) in the slap just like that of the kiddy clay. It was then allowed to dry (Fig. 1.2b) and then taken from the P.O.P. slab. The excess wax outside the boarder of the design was trimmed off.

Before the coating was done, wax rod was erected on a number of models in order to cast about five models per mould. Each wax model was permanently attached with a sprue. These sprues were made to converge at a point in order to create the pouring gate for those models. Some of the models were gattered in groups to attach sprues and to also give then a pouring gate.

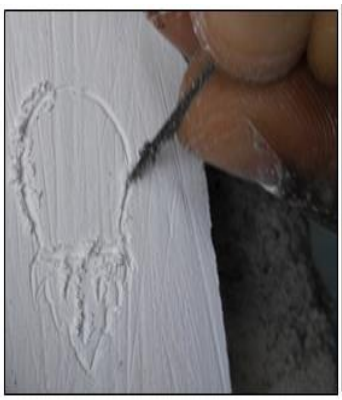

Fig. 1.1a: Marking out the pot

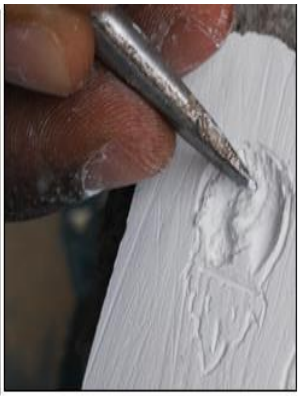

Fig. 1.1b: Carving the pot

Fig. 1.2a: Pot P.O.P. mould smeared with oil

Fig. 1.2b: Pushing the wax into the mould

Fig. 1.3: Wax model of the pot

Fig. 1.4: Complete KNUST wax model

Fig. 1.5: Wax model attached with wax sprues

2.4 Coating

The wax model was soaked in water overnight. The first coat (Fig. 1.6a &b) was applied unto the wax model and placed under the shade to dry. Since the first coat is the first contact of the model to the mould, it consisted of a finer refractory material which will give it a finer surface finish after the casting process. The second coat was applied unto the second coat and also allowed to dry (Fig. 1.7). The second coat however consist of a much coarser grains as compared to the first coat. The third coat was then applied to complete the coating process (Fig. 1.8).

Fig. 1.6a: First coat process of one model

Fig. 1.6b: First coat of a couple of wax models

Fig. 1.7: Complete first coat

Fig. 1.8: Complete second coat

Fig. 1.9: Complete third coat

2.5 Dewaxing

The mould was subjected to heat in order to remove the wax content in the mould. A hollow cavity, which is the design created by the wax model, was heated again in order to receive the molten metal during the casting process.

2.6 Casting

Pieces of brass were collected into a crucible to be melted. Big metal scraps were cut into smaller sizes in order to speed up the melting process. When enough metal was collected, borax was added in order to facilitate the melting

ISSN No:-2456-2165

process. The crucible was placed inside the furnace and subjected to intense heat. The mould was also heated to make it easy for the metal to flow easily into all areas of the mould. When the metal reached the pouring stage, it was poured into the mould through the pouring gate. When the mould cooled down, it was destroyed to retrieve the cast (Fig. 1.10). The metal sprues were then cut off (Fig. 1.11) and prepared for the sanding and polishing processes.

Fig. 1.10: Complete cast of a couple of logos

Fig. 1.11: Complete cast after removing sprues

2.6 Sanding

After cutting the metal sprues off, the back of the model was levelled using the grinding machine. Other areas which were very rough were also grinded to level the surface. Sand paper of grade p20 was used to remove all rough areas left by the grinding process. Emery papers with different grades were used to obtain a very smooth surface for the polishing process. The background of the cast was textured with the texturing bur and the flexible shaft.

2.7 Forming the links

All the cast had to be linked to each other in a systematic order according to the design. The jump rings were soldered at the edges of the cast in order to receive the links. The type of links which were used in connecting all the cast pieces is termed as the box links. It consisted of a strip of brass which was bent in an angular shape and fixed in the receiving end of the cast which are the jump rings and closed. When closed the link looks angular like a hollow box. After these links have all been arranged and closed, they were joined permanently by soldering (Fig.1.12a &b).

Fig. 1.12a: Forming the links

Fig. 1.12b: Soldering the links

2.8 Polishing

When the soldering of the links was complete, the chain of office was polished using the polish machine together with the buff and buffing compounds. The buffing compound which was used was the rouge. It was applied to the buff and used to polish the whole chain of office. When the polishing was complete, the polishing compounds had to be removed. In order to do so, the whole work was place in a metal container containing soupy solution and subjected to heat so as to boil the solution. When the solution was hot enough, the work was brushed in the solution with a toothbrush. The work was however placed in an ultrasonic machine to further remove any compound that was hidden. When the work was removed from the ultrasonic machine, it was dried and wiped clean with a clean cloth (Fig. 1.13). The work was then packaged for the plating process.

Fig. 1.13: After cleaning with warm water solution

ISSN No:-2456-2165

2.9 Finishing

Work was finished by gold plating. Colour was also applied to the K.N.U.S.T logo to distinguish them from the other and also to give it precedence.

2.10 Gold plating

To enhance the appearance and to also ensure the durability of the work. The metal pickled was scratch brushed to remove all impurities and polishing compound which were trapped in pores of the cast piece. The chain was then hung on jigs and immersed a nickel solution. When the nickel plating was done, it was then washed with water and 10% pickle solution. The work was then placed in gold solution which was prepared with pure gold and dissolved in Hydrochloric and Nitric acid. Ammonia was used to take the gold out for the plating process. When the gold plating was completed, the work was dried and wiped clean (Fig. 1.14).

Fig. 1.14: Plated work

2.11 Colouring

The colouring agents that were used were cutex of different colours. The colours were black, red, green, black and grey. Syringe was used to pick small quantities and applied to the targeted areas (Fig 1.15 a&b). The cutex cleaner was used to remove stains.

Fig. 1.15a: Application of colouring agents

Fig. 1.5b: Complete colouring of the logo

Fig. 1.16a: Front of the work placed on the background

Fig. 1.16b: Back of work placed on the background

Fig. 1.17: Chain of Office fixed in jewellery box

ISSN No:-2456-2165

III. DISCUSSION

The lost wax casting technique was appropriate for the fabrication of the chain of office. The technique has a range of advantages. One of these is that it's able to accommodate the intricate patterns during the model formation. The P.O.P. was a suitable moulding material for the carving of the designs for the wax model. The cast was able to display all the designs which were represented on the wax model. A careful and meticulous application of the coating material in the mould preparation process resulted in a fine finished cast.

Brass was also suitable for the lost wax casting process. It melts faster and give a fascinating appearance after polishing. The gold plating however, gave the work the aesthetic factor and the resultant one-of-a-kind, unique chain of office.

IV. CONCLUSION

The results of this study justify the suitability of the lost wax casting technique both technically and economically, for the design and fabrication of chain of office. It allowed a great design flexibility and offered an excellent degree of precision of product design. The main economic advantage resides in the possibility of replacing, with a single casting, with a consequent decrease of cost and weight.

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