Bell founding – the past and the present

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Abstract
This paper outlines the history of bell founding. The exceptional character of bells, which are products of supracultural importance, was stressed. The complexity of the bell manufacturing process and a unique approach to the technology design were highlighted. Basing on the data obtained from foundry shops currently operating in Poland, known as bell-casting foundries, the main guidelines for the bell casting process as used nowadays by the Felczyński Foundry with long-standing traditions and Wojdak’s Foundry, both of which are casting bells according to modern technologies, using modern moulding materials and metal alloys, were described.

Keywords: founding, history of casting technology, moulding materials

Introduction

With the progress of humanity, a new term was created which nowadays accompanies man in nearly all facets of his life. Technology verbally means "a method of making" and can serve as a kind of formula which, when applied correctly, allows us to create various goods used by man. The word goes back in its meaning to the times when man had mastered and successfully implemented into his everyday activities the first technical inventions, like fire or wheel; it survived until the present day, when the demand for new inventions and new solutions is more urgent than it has ever been.

1. The history of bells and their role in man’s life

Bells were always important in the life of societies, no matter what place they occupied on earth, and what culture and customs they represented. The oldest finding, a small bronze bell, dates back to the 19th century BC. Bells were important as pieces of art, worship and culture. They have invariably accompanied man since the time when he mastered the skill of changing shapeless raw metals into specific objects, using for this purpose high temperature and the casting process, one of the oldest metal forming techniques. Casting had been known to mankind many centuries ago and was used as a method for shaping tools, weapons, objects of everyday life, kitchenware, and pieces of art.

Fig. 1. The Russian bell „Kolokol"
Bells perform several “functions”. First and foremost, they are pieces of art, the sculptures that enjoy our eyes when looked at; they are also musical instruments which belong to the group of instruments called idiophones, i.e. the instruments producing sound by their own vibrations. They can be used either as single instruments, or can operate in duos or trios, or form carillons composed of many bells, usually hit by hammers moved by hand or by a clock-operated mechanism. A loud voice of the bell hanging in a church tower woke up the citizens in small cities calling them for morning prayers. Bells took part in various ceremonies; on ships they warned the crew of an imminent danger.

There are many bells in Poland that deserve our attention as regards the history of their creation and functions they were expected to perform. The history of each of them is well known to the successive generations, because – contrary to people – bells live a long life, which enables them to witness numerous events and see people passing away.

„Tuba Dei”, one of the oldest and largest swung bells in Central Europe, is hanging in the tower of Ss. Johns Cathedral in Toruń. Cast by local founder Marcin Szmidt in 1500, it managed to preserve its original wooden yoke. Nowadays it raises vivid interest as an object quite unique that has managed to survive when other innumerable bells in Poland were robbed during wars, partitions and other historical events. It weighs nearly 7,5 tons and is the instrument of a very high precision, emitting sounds of the same timbre for over five hundred years.

Larger than „Tuba Dei” and twenty years „younger” is the „Royal Sigismund Bell”, hanging in the Sigismund Tower of the Wawel Cathedral. Every day, hundreds of people from different nations, cultures and religions visit this Bell. Famous all over the world, the bronze giant weighs over 9 tons (the body alone) and in terms of size is the second bell in Poland. Larger is only the bell called „Maria Bogurodzica” (Mary the Mother of God), hanging in the Licheń Basilica. The Cracow bell was cast by Hans Behem from Nurnberg and hung in the Wawel Cathedral on 9 July 1521. Since that time its voice can be heard on the most important occasions.

2. Polish bell-casting foundries

Bronze foundry was the handicraft targeted mainly at casting of heavy objects like guns, grates, monuments and bells, using bronze and gun metal. The guild of bronze founders derived from the guild of tin founders. Since 1808, the family of Felczyński have been operating in one of the bronze founding sectors of the industry, called bell founding. Figure 3 shows different bell profiles.

At the Felczyński Foundry, bells are cast by the traditional method passed down as a heritage from generation to generation. The process starts with the determination of sound profile or tone the bell should have after casting. Next, the core of the bell is designed to match the predetermined tone, the dimensions are calculated, and a strickle is made, i.e. the device used for shaping the external surfaces of the individual mould components, which include the four main parts:

- core
- cope (false bell)
- waist (body, shirt)
- crown

The successively prepared mould parts are assembled together according to a strictly predetermined procedure, they are clamped and placed in a pit made in the earth, which has been rammed very thoroughly. The moulding material is loam mixed with water and horse manure.

The chemical composition of an alloy from which the bell is cast is left to the discretion of worker responsible for melting down of the charge. The worker assigned to do this job is also responsible for proper furnace operation and for all the successive
steps of the charge melting process, ensuring the required temperature inside the furnace, and tapping molten metal when the temperature has reached a level optimum for the mould pouring process. At the Felczyński Foundry, the metal for castings is melted in a reverberatory furnace, the operation of which requires great skill and experience. Warming up of the furnace since the moment of lighting off until the moment of releasing the steel pin can take the time as long as several days, with process parameters depending on numerous external factors, e.g. on temperature and humidity of the surrounding air.

The bell after casting has to be finished, because poured in a loam mould it has a dull grey colour. There are fragments of mould sticking to its surface, and they have to be removed very thoroughly. The next step is careful examination of the bell timbre. It is done with special tuning forks. Adjusting the required timbre is absolutely necessary and must be followed very rigorously as no deviations from the required sound level are permitted. Instruments out of tolerance are remelted and cast again. The next step is cleaning and grinding. The last step is mounting of the bell in yoke. After this operation the bell is ready for hanging.

The casting techniques available nowadays enable modernisation of this process and reduce considerably the time of the bell manufacture. Various metallurgical plants offer the ready-for-use, most often standardised, alloys. Modern induction furnaces melt down the metallic charge within the time of about two hours. The optimum melt temperature to start pouring is controlled by thermocouples.

The use of synthetic moulding sands with natural (and not only) binders has opened new possibilities for the bell founding technology, and therefore nowadays various techniques of bell founding can be successfully applied. For example, at Wojdak’s Foundry, several modern techniques are used, to mention only the lost wax process and hand moulding in bentonite sands. In the lost wax process, cope is the first element to be moulded. A wooden pattern is made and it is coated with silicone. The silicone after hardening is coated with wax; onto thus prepared wax pattern a cast metal is poured. Drying is carried out at the temperature of 350°C for 8 hours.

3. Summary

Summing up it can be concluded that differences in technology are the reason why some crafts undergo transformation into more modern techniques, other disappear, or are combined with similar ones to form large plants manufacturing related product assortments. The process of bell founding has changed in practically every aspect, starting with the choice of cast material, the chemical composition of which is no longer adjusted by the craftsman, through modern measuring instruments and furnaces of advanced design, and in various new moulding technologies ending. All these changes and modifications introduced to a bell founding plant make the traditional ritual of creating an instrument – sculpture disappear. On the other hand, the manufacturing process becomes more efficient, allowing for the time and money savings. It also implies that older experienced craftsmen are less needed in the eyes of the young generation, quickly absorbing all innovations and learning faster how to use them in practice.

References


