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# Cast Iron in The 19<sup>th</sup> Century Building Equipment

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**Abstract.** Cast iron is a material, characteristics of which enable to receive extremely artistic elements. It maintains good strength properties at the same time. That combination of these seemingly contrary traits makes it a commodity that was widely used in the 19th century industry and architecture. These usages were not only as decorative elements, technical and structural ones. The production of new household utilities started, which made people's lives more comfortable. Cast iron allowed for fast and cheap production while maintaining high aesthetic qualities. Useful elements, which often were ornamental parts of buildings were created. The aim of the article is to characterise elements of interior equipment of the 19th century building that are made of cast iron. As it appears from performed bibliography, archival and field studies, the ways of exploitation are very broad. Some were mounted into the building; the others were a mobile equipment. As it occurred they were most commonly used as functional items. Cast iron was used to produce the minor elements, which were only parts of the bigger wooden or stone items. Notwithstanding, there were also bigger ones casted as a whole, and frequently ones that were assembled from many elements. Nowadays, elements of an interior feature are one of the subjects of study during the restoration work of the buildings. They can provide important information about the building and the way people lived and are considered as the essential part of historical objects.

## 1. Introduction

Traditional materials such as wood, metal and glass are still used today for the production of household items. Often they are enriched with relatively new materials or replaced by cheaper alternatives. Ways of processing these items, as well as the quality of workmanship and artistic form, can be different nowadays. The use of cheaper alternatives in the production process (eg. particle board instead of solid wood) affects the high affordability of goods. However, this is at the expense of the durability of manufactured items, including those of everyday use. In the past, they were made from materials that provided them with long life. They had a considerable value which was manifested among other matters, by the fact that in the rural communities' collection of them was part of the dowry. The objects manufactured for the higher societal spheres had frequently very decorative forms. They were often made to an individual order.

The smaller number of manufactured items of this type in the past resulted from economic reasons. The desire to possess and surround with beautiful and unique objects was satisfied both among the poor and the more prosperous. However, only that second social class could acquire things done with precision and durable enough that they survived to this day. These two aspects made the resulting objects rare and in some cases even unique. This gives them a great deal of value, especially when contrasting with popular, uniform goods, available in chains of shops with a European and global



reach. Both among the usable and decorative elements of the historic interiors, you can list many that are made of cast iron. This durable material provided great plasticity for moulding the manufactured elements. It was fully meeting the needs of users of that time with available technological possibilities [1]. Most of these devices have disappeared from a typical set of home appliances. However, some can be found as relics of the old days in the still used premises. Others may become part of a museum collection that presents house equipment typical for a particular social group within a specified time frame. The remaining examples show a wide range of cast iron applications [2]. Items made of this material were used much more frequently by people living in the 19th century, especially in its second half than today.

## 2. The cast iron characteristics and their impact on the way of usage

Cast iron is an alloy of iron that contains the admixtures of many different elements. The most important carbon (C) is most commonly found in the amount of 2.8 to 3.4%. Its content determines the strength, casting and useful properties of this alloy. The increase of it contributes to the improvement of the castability (ability to fill molds), machinability and to the reduction of the shrinkage that can cause defects in finished castings. Cast iron is much more than steel resistant to high temperatures, humidity and chemicals. It is also resistant to abrasion and bending. It is quite easy to get from it various shapes, sometimes even rich patterns. These features were taken into account in the production of many household items.

### 2.1. High-temperature resistance

This feature in the household was used especially often. Cast iron was used to manufacture equipment that has direct contact with fire, but also items that are in contact for a short time or longer with high temperatures.



**Figure 1.** Heating devices. From the left: fireplace with cast iron grating and plate securing the wall from a heat; cast iron doors in the ceramic room furnace; cast iron doors in the kitchen oven; cast iron free-standing, cylinder oven with grating.

2.1.1. *The oldest cast iron elements should be linked to **stoves and fireplaces** heating the interiors of rooms 'figure 1' [2].* Tiled stove in the 19th century got the furnace from the inside of the room. It was, therefore, necessary to protect from the ashes and burning embers spilling out. To this end, the furnaces were equipped with a pair of different heights cast iron doors. The higher of them were closing furnace with cast iron grate, while lower ones were covering the tank for ash remaining after burning wood or coal. Sometimes this tank contained a cast iron drawer (ash box). The doors were most often decorated with simplified geometric forms. Cast iron in tile stoves has also another application. From this material were created frames in which ceramic tiles were placed. In this way, the construction of the stove was strengthened. Without these elements, due to the high temperature, it was sometimes exposed to damage and the necessity of dismantling and setting it up again.

Cast iron was also used in wealthier houses for less frequently used fireplaces. Their firebox was closed with doors similar to those of the stoves. Also here used ash box. Its function was fulfilled by cast iron drawer often with four feet. Three walls - front and side ones - were about 10-15 cm high and the back one only about 2-3 cm. This difference stemmed from slanting sliding ash pan pointing downwards so that all its contents do not spill over. Visible primarily the front wall could contain decorative patterns. Sometimes the ash pan was made in a tray-like shape. Then the decorations were contained only on the upper plain. It was usually a relief of floral motives. Like before in the 19th century the rear wall of the furnace was still protected from overheating by installing a cast iron plate on it. Cast iron and ceramic elements, as well as the stone ones from which fireplaces were built, were often sophisticated.

New types of **stoves - completely made of cast iron-** have been widely used since about 1800 [3, 4]. The subsequent development of metallurgy enabled the production of various ovens in shape and size. They often had a stem similar to a cylinder. It was embedded on the legs. There were also prismatic stoves gradually tapering upwards. They were created on the plan of an elongated rectangle or square. There was a door in the center of the shaft, which was covering the furnace with a grate. From the top, the stem has covered with a tube in the middle of it. It was used to remove smoke into the chimney. The decorations of cast iron stoves were on the legs, the door, rarely on the base of the stem and on its cover. The dimensions of these furnaces and their cheapness caused them to become quite popular rapidly. They were bought by less affluent people, and such in the cities were the biggest social group. They were also used in offices and temples. Some stoves had a flat lid that was movable.

It consisted of several decreasing rims. Once they were removed, the stove could be fired from the top, and that's why the smoke pipe was embedded in the stem. This type of furnace was also used for cooking. Some cast iron cookers in France were equipped with ovens in which you could bake cakes or warm up other food products.

At the end of the nineteenth century in Europe, several companies have specialised in the manufacture of cast iron products, including the most marketable furnaces and free-standing ovens. Among them were factories known since the 15th century (egg. Austrian Sommerhuber factory in Steyr) and those founded in the first half of the 19th century in France (Godin in Guise), Norway (Kjvarner Jernstoberi – Jøtul), Germany (Schmidt and Lehmann factory) and in Denmark (Morsø).

*2.1.2. Cast iron was used to cast the ironing machines for fabrics.* In Poland, **irons** began to be produced at the beginning of the 19th century [2]. Initially they were inserted into the heat, and then, after reaching the right temperature and cleaning the dirt, they were moved over the damp material. The more favorable version of the device, over time generally accepted, consisted of three parts. The first was a flat base called a foot which was subjected to heating. The second part was a thin side with variously formed holes: longitudinal, triangular, circular in one or two rows, comb. The third part consisted of hinged cover. A handle was attached to the middle of its upper surface. By lifting the cover, the tray to which the glowing coals were inserted was exposed. Gradually they were warming up the foot. Some irons contained extra holes in the side. They were assuring the inflow of oxygen and thus the longer efficiency of the iron 'figure 2'. This solution was at the same time a disadvantage. Sometimes the ashes that stained the fabric were coming out through the holes. Another negative feature was warming up aside from foot the other parts of the iron. It made it difficult to keep it in hand and to tilt the cover to add a new fuel. The second one was removed by a patent from 1871 by the use of a detachable handle, as well as the insertion of a wooden insert in it.

In order to decorate cast iron irons they gained additional interesting items. The side edge of the foot was decorated with engraving. Various forms of holes in the side of the iron were also created as mentioned. Sometimes they were renounced. Instead, the oxygen was supplied by pipe mounted on the top of the iron. Frequently it was shaped as dragon's neck and head. In this case, when the smoke was emitted, the iron produced additional visual effects. In addition, information about the state of the



batch and necessity of its replacement was obtained. Some of the irons had additionally decorative covers and handles.



**Figure 2.** Cast iron irons with holes assuring the inflow of oxygen into the device with burning embers inside. On the left example: semi-circular holes on sides; on the right example: the hole in shape of pipe above the handle and a metal plate protecting hand from high temperature

**Figure 3.** Cast iron elements mounted on the outside of the building: on the left side: the decorative mailbox with a pair of horses on the front wall; on the right side the knocker in a shape of a lion's head

2.1.3. *With Irons, another cast iron element is related - the stand.* It was designed to prevent scorching the fabric or table while the heated iron is not in use. The device could be set aside without any fear. The stand had a thickness of about 1 cm and was supported on 3-4 small legs. Its form was adjusted to that of the iron. However, in the plane of its plate, the handle was attached to the straight side. It allowed to move this item freely and in that way adapting to the current needs. The base surface contained patterns with holes to not overheat. Decorations often had floral motifs (flowers with leaves), geometric patterns or only longitudinal breaks. They referred to the period of neo-baroque or secession.

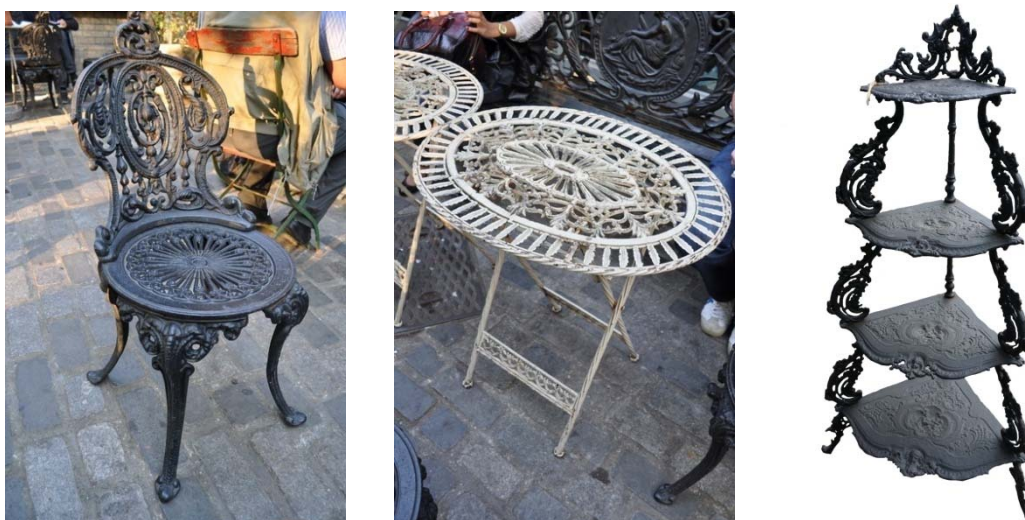
## 2.2. *Resistance to weather conditions*

Cast iron is a durable material, quite resistant to rain and snow. Rather swiftly began to produce objects from it often replacing those made so far from wood. Because they weren't items necessary in the household, the upgrade was usually made by middle-wealthy people who could afford it.

2.2.1. *In wealthy detached houses, next to the doors, at the side of the street, letter boxes were hung on the walls or posts 'figure 3' [5].* They were used to periodically store messages posted by the postman during the absence of the owners. They were fairly flat and not very wide. The upper part contained a long and narrow hole through which the letter was thrown. In order not to get soaked, the opening was covered by the moving flap. The front of the box contained a lockable door. The owner who had the key to them could easily pick up the package at the suitable time. The boxes were not very decorative. Ornaments were mostly on the doors and were presenting convex Post Office symbols (trumpet, postilion) or only vertical, convex-concave strips. Some had the address of the house or the name of the owner.

2.2.2. *From the street side, near to the door of houses, also single-family houses, were placed outside **bells or knockers** 'figure 3'.* The first ones were round or square with a ball in the middle. Its push or ejection triggered a bell to indicate that a visitor or a client was waiting outside the door. A knockout function was similar. A knocker function was similar. It consisted of a fixed element, mounted to the door and connected to it, which was used to knock on the door. The fixed part could have a simplified form (eg. a sphere) or a decorative one (cast of an animal or its head). Knocker has been known since medieval times, thus the decoration was sometimes a lion's head holding a circle. The newer solutions were the head of an elephant with a moving trumpet, a leaf with a moving frog. In order to protect the impact place from damage, a metal plate was attached to it. Simultaneously it was enhancing the sound.

2.2.3. *Gardens with greenery and flowers were often adjacent to wealthy people's house. The inhabitants were using that space for recreational purposes that is why they were setting **tables and chairs** there.* The qualities of the cast iron resulted in making that furniture from it [6]. Tables most often had circular tops with cut out openings, reminiscent of a lace tablecloth. The chairs, apart from the circular seat, also had a backrest. They were also openwork. Furniture with narrow legs constituted not only useful elements but also the decoration of home gardens.



**Figure 4.** Cast iron garden furniture; on the left side: the chair with decorative seat, seatback and legs; in the middle elliptical table with folding legs; on the right side: the corner shelf

### 2.3. Abrasion resistance

Cast iron exhibits low abrasion. This feature was used to create items and appliances to help maintain cleanliness, as well as keeping kitchen work easier. Such differential use indicates the increasing popularity of cast iron in the 19th century. The ingenuity of the people at that time seemed to be unrestricted. Items that were used frequently, as well as those which were used occasionally, were manufactured, mostly in series.

2.3.1. *At the very entrance to the interior of the house, on the external stairs, a special element – **scraper or wiper**, was mounted 'figure 5'.* It could have different forms. The simplest (scraper) was a thin plate 25-30 cm long, set on two legs. Its upper edge was sharpened. A man walking into the building with muddy boots, could scrub the soles of his shoes and remove that way the accumulated soil. Then walking down the corridor to the apartment he had at least the bottom of the shoes clean and did not dirty the floor.



**Figure 5.** Cast iron items related to the shoes. On the left side: flat wiper with floral motifs; in the middle: the scraper with decoration on both sides and a tray for the dirt; on the right side: the puller used to remove the boots in a shape of angled plate with decorations and an indentation for the back of the shoe

The more impressive form was flat, rectangular ‘figure 5’, frequently semi-circular, cast iron panel of about 2-3 cm thick. Wiper could gain decoration with plant or geometric motifs between the holes. The upper surface of it was sharpened so that the incoming people, rubbing shoes on it, could get rid of the mud. Dirt was gathering in vacant places. The degree of filling the holes was an indication that the wiper had to be cleaned. Wipers of rich forms were also made and were located in the corridor.

To clean the most visible parts of the shoe from dust and fine dirt, a **horse hair brush** was needed. Instead of a wooden handle, frequently cast iron was used. As with some wipers, animal castings were found here. The hair was set on the lower abdomen. The animals were presented standing so that the soft bristles did not touch the base. This allowed for a prolonged use of the brush and even the descent of unnecessary dirt. This allowed for a prolonged use of the brush and even the descent of dispensable dirt.

2.3.2. Another one of the tools created in the 19th century is **the puller used to remove the boots** ‘figure 5’. It weighed about 1 kg and consisted of a flat plate with an indentation for the back of the shoe, precisely that part, behind which the heel hides. The plate was set at an angle by touching one side to the floor. The puller was stabilized by placing the foot on the plate. The other foot with the boot on was placed against the indentation and by lifting the leg itself, the shoe was pulled out. An interesting solution is a puller in a shape of the beetle on 6 legs. Its wings were rough not only to be more like the original but primarily to increase friction and hold the tool securely. Its horns were arranged in the form of indentation on the shoe.

2.3.3. In the kitchen, it was often necessary to grind hard products such as sugar lumps, especially coffee. For this purpose, **the mill** has been used since a long time ago. Because of the resulting stresses and the need to use abrasion resistant materials, cast irons was particularly suitable. The construction

of the mill did not differ from the earlier ones. It consisted of a funnel through which the product was poured in, a screw embedded in a small tunnel, a crank that was moving the screw and the container for the already milled material. In more expensive mills, the cast iron funnel was replaced with a ceramic one, sometimes with paintings.

*2.3.4. The meat grinder was very helpful in the kitchen for grinding down of the meat.* It consisted of three parts. The first was a sleeve-shaped body. The cone-shaped upper part of it was the input part where the pieces of meat were put in. At the bottom of the sleeve the brackets were situated. They were used to screw the machine to the table and stabilize it that way. The second part was a screw in the sleeve ended with a handle. By turning it, the screw was moving forward the meat which was put into the cone. The third part consisted of blades and a strainer. Blades were cutting the meat into fine pieces and the strainer allowed the product to slide out of the device. These machines served also to crumb other products like white cheeses, poppy seeds.

#### *2.4. Mechanical resistance*

The technology of cast iron production allows to create several types of this material, each with different properties. One of them - malleable cast iron - is characterized by very good tensile, flexural and compression strengths. These features were used for other household items.

*2.4.1. In order to ensure the durability of the front door, a **bumping block** was provided near them.* It was a small element fixed permanently, mostly on the platform, which was limiting the angle of opening the door. Thanks to that the increased durability of the door joinery has been achieved, as well as the lack of damage of the door handle by hitting the wall of the building. In the 19th century, cast iron bumping blocks could be cylindrical or more decorative. Some of them were also attached to the walls of the building. They were given leaf forms or other convex bas-reliefs.

*2.4.2. A device called "**nutcracker**" was invented for breaking nuts.* It consisted of two arms connected to each other by a hinge. Each was equipped with a handle above which was slightly recessed, often oval surface with indentations. By placing a walnut there and pressing on the arms (handle), the crust was crushed and the edible part was reached. Only the outer surfaces of the part holding the walnut were suitable for decorating. When the nutcracker design referred to the press, due to the lack of space, the decorations were dropped.

*2.4.3. The construction characteristics of the cast iron were used to create **the opener**.* You could use it to open metal hopper containing food. The can opener was invented in 1858. It was usually the handle with one sharp edge that cut the metal lid of the cans. It could have a simple form and could take for example one of a fish.

*2.4.4. The structural properties of the cast iron were used to produce **hangers** placed in the corridors.* They could be single or collective. The single ones had a hook with a metal plate attached to it, which was nailed to the wall. The form of this hook often took the shape of an "S" letter. Its surface or only the lower part received small patterns. The collective hangers consisted of a horizontal decorative list and hooks attached to it. Lists often included bas-relief with floral motifs. In longer hanger, in the middle of it, a scene was made, so that the whole was an interesting decoration of the interior, even when the hanger was not in use.

*2.4.5. The various qualities of the cast iron allowed the use of this material for kitchen utensils.* They have repeated the previous shapes but they were undoubtedly more durable than cheap clay pots or more expensive porcelain. Among these for everyday use were cast iron **plates, cups and jugs**. The first of them could be perforated. It gained plant-geometric patterns then, designed by artists. Dishes decorated in this way not only had aesthetic value but also a practical one. They have been used to put



the washed fruit on them so they could gradually dry out. More frequently used cast iron cups on the outside surface did not have any artistic patterns. Mainly the signature of the production plant was imprinted on it (eg. Gliwice factory from the beginning of the 19<sup>th</sup> century). It consisted of various symbols like the first letters of the manufacturer (eg. „HH” what would mean Huttzcki Hütte). By adding a crown, it was reported that it was royal iron works. Cast iron pitchers with handles and spouts could have slight convex patterns most often with motifs similar to plant motifs both on the surface or handle. Another cast iron cookware was **a mortar**. It was used to crush hard substances into dust. It had the shape of a goblet tapering downwards. An essential part was the pestle rounded at the edges, which was used to rub the product put into a vessel. In wealthy houses, bronze or brass mortars were bought.

Much more cast iron products were made when the vessels were exposed to high temperatures. Among them, the most popular were pots, roasting pans and frying pans which could be singular or designed with compartments for several eggs (5-7 pieces). Because the products placed in them, subjected to high temperatures could adhere more closely to the surface, for health reasons, the surfaces that come into contact with food were covered with white enamel. The cast iron **teapots** were very popular, as well as waffle makers, especially in the late nineteenth century and early twentieth century. The first one was sphere shaped, slightly flattened from the top. It had a metal handle and inlet. It could have decorations mainly on the cover of the inlet. In most of them, the spherical water tank had the protuberance in the half of the heights, but it resulted from the functionality. It was a support causing that only the bottom of the kettle was closer to the fire and directly exposed to the higher temperatures. This resulted in a rapid boiling of water while a safer handling because of not too much preheating of the part of the above the protuberance. **The waffle makers** have been known since the Middle Ages, but only now have they been given the most favorable forms. They consisted of two cast iron panels with a grooved surface and a handle ‘figure 6’. Small decorations could cover the outer surfaces of the panels. The plates could be rotated in the stove to avoid burning the wafer. The poured mass was made of flour, eggs and milk. In less prosperous homes, it was made only from water and poor quality flour.



**Figure 6.** The cast iron kitchen utilities. On the left side: the waffle maker as a part of kitchen oven; on the right side: weighing machine with decoration of roses and information about maximum load

To allow temporary setting aside the hot pot from the stove furnace it was possible to use cast iron **stands**. In half of the 19<sup>th</sup> century was particularly popular were circular rims or circular plates sometimes with holders, supported on three legs. Richly developed stands contained reliefs referring to the rococo period. They covered all visible surfaces. Less ornamental stands were cast as rosettes.

### 2.5. The ease of obtaining different shapes and patterns

The ease of production of the various forms, coupled with the other advantages of this material, made it possible to produce many different objects and instruments with different functions.

2.5.1. In the 2nd half of the 19th century, several window elements were made from the cast iron. They were situated on the outside as well as on the inside part of it. On the outside, they were assembled as modern metal **lambrequins**. These were flat lists behind which rolled shutters/blinds were hidden 'figure 7'. The list from the bottom contained a serrated pattern imitating cut fabric decoration, historically preceding the cast iron version. Clearly marked scallops contained convex ornaments, most often referring to the palmette. If the windows were semicircular then an openwork grating with a radiant decoration was placed between the palmette and the bow of the window opening. Medium-wealthy residents of tenements could afford to set up palmettes. The same social class in the windows of the dwellings on the ground floor, in order to protect the dwellings from thieves, installed forged or casted in iron **window grating**. Most often they were vertical bars, sometimes in the upper part decorated with forms resembling leaves and flowers, or geometric patterns. Many types of door and window handles were used to open and close these elements of every building. Their forms were often simple (in the poorer residents) or less often - more elaborate because these were usually made of brass. The richer designs referred to interior decoration, which could consist of: window frames, decoration of walls and ceilings (houses richer). Baroque and rococo designs were fashionable. The shapes looked like curled leaves, lion head 'figure 7' and even containing mini scenes are examples of the elaborate forms.



**Figure 7.** Cast iron elements of the elevation of the building; on the left side: lambrequin in form resembling the fabric; in the middle: window-handle; on the right side: door-handle in a shape of a lion.

2.5.2. With the increase in the level of hygiene in the kitchen began to use cast iron **sinks**. In the apartments of wealthy people, they began to ringfence the bathroom in which cast iron **bathtubs** started being in use. The sinks had a semi-circular shape with which a flat plate was attached to protect the wall from moisture. The baths were similar in plan to the rectangle. One of the shorter sides could be semicircular. Semicircularly ended edges made it easy and safe to enter and exit the bath. They stood on four feet sometimes reminiscent of animal feet. For obvious reasons, the interior of the sinks and baths were covered with white enamel. Poor people were still washing themselves in wooden dishpans and tubs or were using public baths. Their access to cast iron sinks and bathtubs was gradually progressing throughout the nineteenth century and beginning of the next century.

2.5.3. In the household, **the weighing machine** was always important to measure the amount of products intended for the creation of various pastries. Only fully accurate use of the recipe guarantees a successful product. The beam balance was consisting of a base and lever with two equal arms

'figure 6'. At the end of the arms, there were stands (often made of brass). On one stand, products were placed on the other cast iron marked weights. The balance of the arms was the moment of the orientation of the weight value determined by the size of the weights. The balance could also have a different design. The lower part was equipped with a base with an indicator and a scaled round dial. The upper part consisted of a movable mandrel to which the tray was attached. The weight of the product put on it was read according to the value that the indicator indicated. Decorations on scales were placed mainly on stands.

*2.5.4. Among the inventions that emerged in the nineteenth century one of the most interesting was the sewing machine.* It was used to join materials by a thread by creating a seam. In the first half of 19th century several improvements were patented, but have been implemented only in mass production workshops. An individual purchase was possible to made in 1851 thanks to I. Singer. The used method of sale has made it easier to buy machines even for people less prosperous. Due to the need of precision of elements of the machine, cast iron was used only to produce auxiliary parts. These included a table to which the proper machine and elements of the foot pedal were attached. Their ornamentation was mainly about propulsion.

### 3. Conclusions

The cast iron in the household of the nineteenth century was an exceptional versatile material. Some items made of it are still being reproduced in the latest productions, others are gradually displaced. Much of it has disappeared over time as cast iron proved to be not as useful as popular steel nowadays. It seems that the impact on this has had its ratio of considerable weight to tensile strength in comparison to the same ratio for steel. Thanks to the development of the metallurgy it was also easier than before to manufacture of good steel. In the 19th century cast iron was cheap and fast in production. For these reasons, products made of it initially acquired only by rich, gradually began to be found in middle-wealth homes to finally find buyers mainly among the poorer. The decoration of cast iron parts produced during the casting process eliminated the need to employ additional artists. Quickly obtained product was useful and artistically refined. This was giving, especially to the poor people, the substitute of using luxury items that were not available to them. In terms of functionality, they were even comparable. In the applied decoration of products made of cast iron, there were strong tendencies to patterns from the baroque and rococo periods. Undoubtedly, one of the reasons of this was the desire to make artistic references to original works. Not without significance was the love for these forms of the French king Louis Philip I (1773-1835), and later Emperor Napoleon III (1808-1873). Not only in the functional art, historicism and later Art Nouveau became popular. Cast iron products have been kept up with fashionable patterns.

The popularity of cast iron items was also a result of the passion for inventive craftsmanship so common in the 19th century. The unemployed, fabricators and the aristocracy were overpowered with it. This also should be seen as the cause of the emergence of new, unknown equipment and devices that meet the needs of homes. Old items have also been upgraded to adapt to current manufacturing capabilities. As in the examples presented above, the production of cast iron items in the household was primarily focused on functionality. The decoration was used in a variable amount but a minor effort in having it made it easy to put it on objects that had been deprived it so far. Thanks to the use of cast iron, many historic household items have survived to the present day, which most likely would not have survived in case of use of the other, previous used material.

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