The Shell Moulding Process: A German Innovation

U. Recknagel

To mark the 50th anniversary of the death of the inventor Johannes Croning

Johannes Croning
1886 – 1957

The inventor and entrepreneur

Johannes Carl Adolf Croning was born on May 22, 1886, in Hamburg as the son of a tradesman.

As a technically interested young man, Johannes Croning served his apprenticeship in a Hamburg machine and fitting works to which also belonged a metal foundry. He went to mechanical engineering school in Altona, worked as a designer for a shipyard, as a sales engineer for electrical car equipment, and served in the Navy.

After the First World War, he designed and built machines for the manufacture of cylinder locks based on his own patents. Selling these patents to the USA enabled him to start his own company “Croning-Schloß AG” that also included a foundry. In 1929, Johannes Croning sold his shares in the locks factory to concentrate fully on his work as an inventor. To this end, he installed a laboratory in his residential house in Hamburg-Nienstedten. During the eight years following he carried out research on the application of high-frequency technology for the melting and pouring of metals, for which he received several patents between 1932 and 1936. When his entire capital and a loan had been spent on these trials, he founded Croning & Co. on October 1, 1937, as a patent exploitation company and Mikroforma Giesserei-Gesellschaft Johannes Croning to earn money for further developments. Until his death, Johannes Croning was Managing Director of both companies. He continued with his inventions in the rooms of an old accumulator magazine of the Hamburg Electric Works where he installed a high-frequency plant and a crucible furnace. Based on his knowledge of high-frequency technology, Johannes Croning tried to develop a permanent mould made of ceramic material, which finally led him to invent the shell moulding process in 1944 [1].

Johannes Croning’s inventions and patents awakened the interest of the Allied forces. Members of an “American Industrial Intelligence Team” visited Johannes Croning on his then premises as early as on April 24 and 25, 1947.

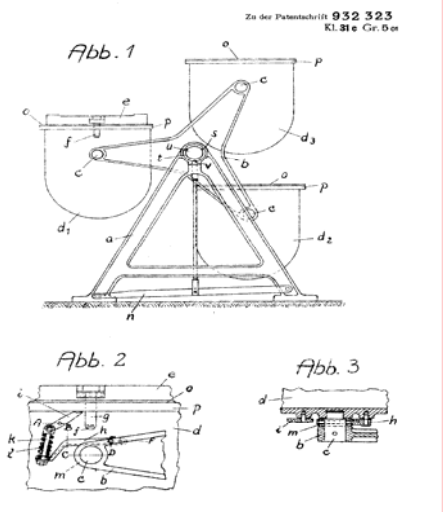
The complete report, FIAT Final Report No. 1168 dated May, 30, 1947, and entitled “The “C” Process of Making Molds and Cores for Foundry Use”, was issued by the Office of Military Goverment for Germany (US), Author William W. McCulloch, Technical Industrial Intelligence Division U.S. Department of Commerce, and contains six pages of detailed information by Johannes Croning about his inventions [2, 3, 4].

After the end of World War II, he continued with his developments in Hamburg, and further patents for an improved shell moulding process were to follow. The first licensees, Eisengießerei Adolf Hottinger oHG (1947) and DEW Deutsche Edelstahlwerke AG (1948), also paid royalties. The money enabled Mikroforma Giesserei Gesellschaft to move from the HEW accumulator magazine to

Borselstraße in Hamburg's district of Altona. As a foundry school and test and customer foundry for bronze casting and, later on, for special steel casting, especially water meter housings, pumps and accessories, the economic foundations were laid for a continuation of the development work.

In parallel with the casting activities, the development of machine technology for the shell moulding process was spurred on, which from 1950 on led to the construction of fully operational machines.

The huge interest of the American foundry industry in the novel German moulding process became obvious in 1952 during the foundry exhibition in Atlanta City, on the occasion of the 56th Annual Meeting of the American Foundrymen's Society, where the new technology was one of the highlights of the exhibition [5].



At GIFA 1956, the shell moulding process was presented in great detail [6]. The committee of the international foundry associations appreciated Johannes Croning's developments by presenting him an Honour Award. On the occasion of his 70th birthday, Johannes Croning was honoured with the Federal Cross of Merit, First Class, by the German Federal President in recognition of his services [1, 7].

Shortly before he died, Johannes Croning was awarded the John A. Penton gold medal by the American Foundrymen's Society.

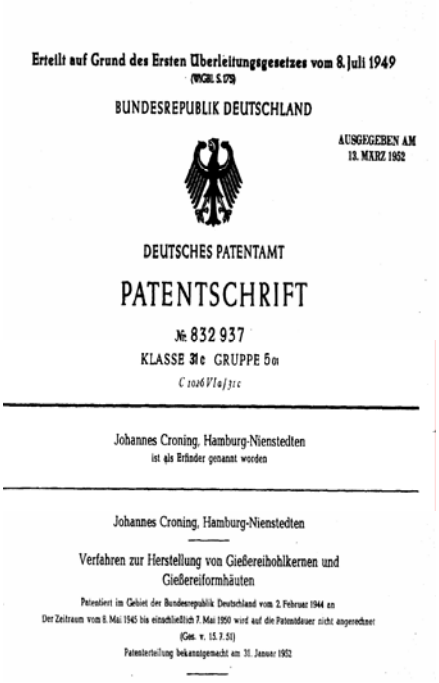
Johannes Croning died suddenly and unexpectedly in Hamburg on May 12, 1957. In 1958, the shell moulding process was presented during the world exhibition in Brussels with the support of the Federal Republic of Germany. One of the first shell moulding machines designed by Johannes Croning and the first steel fittings cast with the shell moulding process were part of the exhibition of the German Museum in Munich. In 1958, at the request of the German Foundrymen's Association (VDG), a street was named after Johannes Croning with a resolution of the municipality of Wedel [8] (Croningstraße, D-22880 Wedel). The companies Croning & Co. and Mikroforma Giesserei Gesellschaft stopped their business activities at the Wedel site on December 31, 1993.

The invention

As mentioned before, from 1929 on, Johannes Croning performed extensive tests on the application of high-frequency melting equipment, which should make it possible to perform all three parts of the casting process, namely melting, pouring and solidification, in a permanent mould. It is with this idea in mind, i.e., the search for a suitable permanent mould, that he began in 1936 to develop a process which preoccupied him until his death and which intrinsically tied his name to founding technology, namely the shell moulding process [1].

He started his considerations with experiments on a transfer of the slip casting process developed for the manufacture of ceramic products, which led to Patent

Specification No. 767 075 of May 10, 1936. The process uses a split plaster mould of the object to be cast to produce hollow bodies. Kaolin slurry is poured into these moulds by slush casting. The plaster mould dehumidifies the slurry, creating a shell on the mould wall which later forms the core or mould, while the slurry in the centre of the hollow body remains liquid and is poured out for reuse. Now the foundations were laid that led to a continuous advancement of the shell moulding process through numerous development steps.



Erteilt auf Grund des Ersten Überleitungsgesetzes vom 8. Juli 1949
(WGBl. S. 175)

BUNDESREPUBLIK DEUTSCHLAND

AUSGEGEBEN AM
13. MÄRZ 1952

DEUTSCHES PATENTAMT

PATENTSCHRIFT

№ 832 937

KLASSE 31c GRUPPE 5 01

C 1026 VI a/31 c

Johannes Croning, Hamburg-Nienstedten
ist als Erfinder genannt worden

Johannes Croning, Hamburg-Nienstedten

Verfahren zur Herstellung von Gießereihohlkernen und Gießereiformhäuten

Patentiert im Gebiet der Bundesrepublik Deutschland vom 2. Februar 1944 an
Der Zeitraum vom 8. Mai 1945 bis einschließlich 7. Mai 1950 wird auf die Patentdauer nicht angerechnet
(Ges. v. 15. 7. 51)

Patenterteilung bekanntgemacht am 31. Januar 1952

Slip casting tests undertaken by J. Croning at Giesserei Meier & Weichelt in Leipzig in 1940 were disappointing for both sides [9].
Success came when Johannes Croning found that the “mould skin” had to be made up of a free flowing mixture of dry, granular filler, dry resin and dry hardener.

In his patent specification No. 832 937 “Method for making foundry hollow cores and foundry mould skins”, he described the method as follows:

“If this method is used, the addition should be completely dry and free-flowing. It is mixed with dry resin and a dry hardener and poured into the mould, which has been heated to approximately 200°C, and poured out again after 2 to 5 seconds. The heat of the mould wall causes the outer layer of the bulk material to become soft and cohesive so that when the mould is tipped it sticks to the inner wall and cures within a few minutes either due to the heat released by the mould or supplied separately and can be removed from the mould as solid skin or hollow. The longer the bulk material is exposed to the heat, the thicker the wall of the moulded body becomes.”

This patent specification laid the technical foundation for the further development of the shell moulding process, which threw the gates open for a new era in the foundry industry.

For the first time, a synthetic resin bonded moulding material, a method which made the production of volume castings of high dimensional stability, with little rework and improved working conditions, had become possible.

Application in foundry practice

Patent specification No. 832 937 spelt out the fundamental principles of the shell moulding process but conditions in the foundries were not developed sufficiently for the new method. More patents which made the shell moulding process fit for foundry practice were granted to Johannes Croning and his co-workers in the years 1945 to 1952 (e.g., patent specifications No. 810 174 of October 2, 1948, No. 965 065 of February 8, 1952). Despite this, authors still insist that the shell moulding process had been used for making cores for hand grenades [10, 11] and V2 missile parts [12] as early as World War 2.

This opinion is rejected by F. Pölzguter, who says “that an affidavit of Haller-Werke exists according to which at no time had any rights protected for J. Croning under the generic term “C method” been used. This affidavit includes the production of arms of any kind” [13].

The shell moulding process was practiced in the UK, the U.S.A., and Germany under the conditions of the post-war years. Johannes Croning was not only an inventor, he was also a businessman and wanted to sell his patents and machine developments under license and earn royalties.

In the UK, Johannes Croning had become a shareholder of the Polygram Casting Company Ltd. in 1947. That firm had been given the right of dispersing the shell moulding process and issuing licenses for it [1].

Polygram Casting developed and built machines for the shell moulding process, suitable core and mould blowers as well as gluing presses and advanced the introduction of the method in foundries in the UK and the Commonwealth countries [14].

In the U.S.A., J. Croning founded Crown Casting Associates in Boston to look after trading licenses for his inventions in the U.S.A. and Canada. Croning himself went to the United States at the end of 1948 to explain the method to interested bodies and foundries [16].

The author of [15] reports that Builders Iron Foundry, a Meehanite foundry, bought a license for the “C process” from Crown Casting Associates at the end of 1948. In [17], there are reports of substantial amounts of money which Ford and General Motors invested in the practical application of the shell moulding process in their foundries. The great interest with which the new method for making cores and moulds met is underlined by numerous publications in American trade journals. Another report by the U.S. Department of Commerce [18] in 1952 provides an overview of the patent situation and technical development of the shell moulding process in the American foundry industry. In 1957, some 500 foundries in the United States produced over 225,000 tons of castings by shell moulding [19].

In Germany, the “Croning method” was mentioned first by W. W. Magers [20] and F. Pölzguter in his paper “Formmaskenverfahren nach Croning” at the annual convention of VDG in September 1949 [21].

As stated earlier, the first licensees in Germany were DEW Deutsche Edelstahlgießerei AG and Eisengießerei Adolf Hottinger oHG. Both companies used the shell moulding method for making castings (e.g. finned cylinders), and also developed and built machines for this method. In 1949, the foundry of Volkswagen followed suit and changed the production of cores for cylinder heads from oil sand to shell moulds [22].

By 1957, the number of licensees had gone up to over 300, and over 1,500 foundries worldwide used the shell moulding process [23]. In 1957, Croning & Co started organising international meetings of licensees in Hamburg to discuss the latest developments, and pool experience [24].

The community of licensees dissolved when the basic rights lapsed on May 8, 1967 [1].

At that time, the shell moulding process had reached the climax of its global application and had to face the competition of new moulding methods based on other organic binders.

Johannes Croning's intention "by new technical ways to make the heavy physical work in the foundries easier and improve hygiene", as he put it in the thank you speech on the occasion of his 70th birthday, had become a reality.

Literature

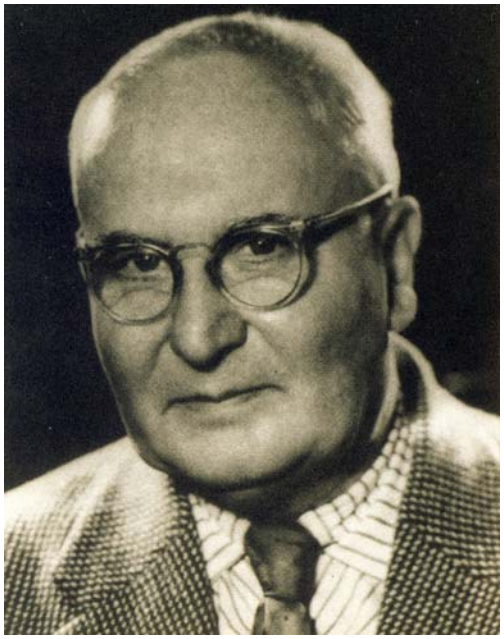
[1] Klemmer,M.: 50 Jahre Guss in Maskenformen, Firmenschrift der Croning & Co. + Mikroforma Gießerei Gesellschaft, Wedel/Holstein, 01/10/1987
[2] FIAT Final Report No. 1168 of 30 May 1947
[3] Foundry Trade Journal, December 4, 1947, p. 289 - 290 "A New Moulding Process" (Publication of FIAT Final Report No. 1168)
[4] McCulloch, W.W.: The Foundry October, 1948, p. 130/131 "Precision Molding Process" (Comment on FIAT Final Report No. 1198)
[5] Gießerei 40 (1953) p. 32 - 33
[6] Gießerei 43 (1956) issue 11, p. 301
[7] Gießerei 43 (1956) issue 11, p. 269 - 270
[8] Street names of Wedel/Germany, www.wedel.de
[9] Metallurgie und Gießereitechnik 4 (1954) issue 6, p. 225 - 264
[10] Foundry Trade Journal February 14, 1948, p. 181 "The "C" Process"
[11] Ames, M.B. *et al*.: Foundry, Cleveland, 78 (1950) No. 8, p. 92 - 96 and p. 206 - 217, see also Gießerei 37 (1950) issue 19, p. 418 - 420
[12] Foti, R.: Modern Casting 90 (2000) issue 7, p. 32 - 33, A Look Back, Part 7, "The Shell Process"
[13] Pölzguter, F.: Gießerei 41 (1954) p. 10 - 13
[14] Fallows,J.: Gießerei 43 (1956) issue 11, p. 287 - 291
[15] Calder,A.W.: The Iron Age (1951) Nov. 15, p. 111 - 116
[16] Gießerei 43 (1956) issue 11, p. 295
[17] Patton,W.: The Iron Age (1950) Aug. 3, p. 89 -90
[18] Tindula, R.W.: Current Status of the Shell Molding Process, Foundry July 1952 p. 201 - 202, 204, 206, 208, 210
[19] Foundry Trade Journal 86 (1958) No. 4, p. 80/82
[20] Magers,W.W.: Gießerei 36 (1949) p. 10 - 13
[21] Gießerei 36 (1949) issue 10, p. 313 - 31
[22] Serwe, G.: Gießerei 43 (1956) issue 11, p. 285 – 287
[23] Gießerei 44 (1957) issue 19, p. GK 45
[24] Gießerei 47 (1960) issue 10, p. 370

Chronology of the Shell Moulding Process According to Johannes C.A. Croning

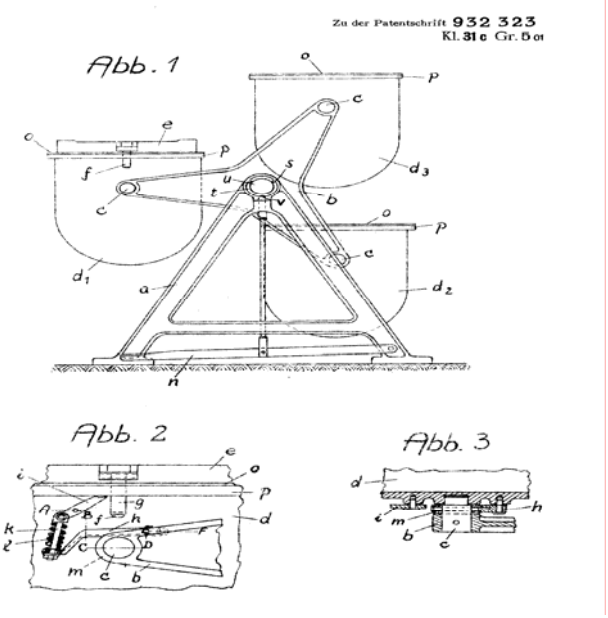
1940 Pouring trials at Meier & Weichelt, Leipzig, prove to be unsuccessful
1944 Patent Specification No. 832 937 of February 2, 1944

1947 FIAT Report “The ‘C’ Process of Making Molds and Cores for Foundry Use”
1947 First machines built for the shell moulding process
1947 Eisengießerei Adolf Hottinger is first licensee
1948 Patent Specification No. 810 174 of October 2, 1948
1949 Initial publications in the German trade journal “Gießerei”
1951 Gebr. Hüttenes receive the right to supply binding agent to licensees of Croning & Co.
1952 Patent Specification No. 965 065 of February 2, 1952
1950 Builders Iron Foundry first licensee in the U.S.A.
1952 Foundry exhibition in Atlanta City/U.S.A.
1952 Croning® wordmark of May 20, 1952, for D
1954 Croning® wordmark of April 3, 1954 for A, B, NL, L, F, I, CH, KO, VN
1956 GIFA and 23rd International Foundry Congress in Düsseldorf/Germany
1957 300 licensees; throughout the world, approx. 1,500 foundries manufacture with the shell moulding process
1958 Shell moulding process presented during the World Exhibition in Brussels
1959 Quarzwerke GmbH (Haltern) first external manufacturer of shell sand in Germany
1963 Patent Specification No. 1109839, A.J. Schmitt Foundation, U.S.A., hot coating
1967 Expiration of basic property rights
1979 Sandtechnik Pohl, Braunschweig/Germany, builds coating plant, shell core production and sand regeneration
1994 Direkt-Croning® Process of ACTech GmbH Freiberg/Sachsen, Germany

Croning® and Direkt-Croning® are registered work marks of ACTech GmbH Freiberg in Sachsen, Germany



Johannes Croning
1856 – 1957



Tilting device for shell moulding machines
Patent No. 932 323 of May 6, 1943


Erteilt auf Grund des Ersten Überleitungsgesetzes vom 8. Juli 1949
(WiGBl. S. 175)
BUNDESREPUBLIK DEUTSCHLAND
AUSGEGEBEN AM
13. MÄRZ 1952
DEUTSCHES PATENTAMT

Title of Patent Specification No. 832 937 of February 3, 1943

Dipl.-Min. Ulrich Recknagel is a member of staff of Hüttenes-Albertus Chemische Werke GmbH

Hüttenes-Albertus Chemische Werke GmbH is one of the largest European competence centres for foundry auxiliary materials: binding agents, coatings, special sands, ready-to-use sands. With its sand coating plants in four countries, HA is the largest external manufacturer of resin coated ready-to-use sand in Europe.

Hüttenes- Albertus Chemische Werke GmbH
Wiesenstr. 23/64
D- 40459 Düsseldorf
Tel: +49 (0) 211/ 5087 - 0
Fax: +49 (0) 211/ 500560
www.huettenes-albertus.de

Private address: Ulrich Recknagel
Ernst-Fabian-Str. 12
D-08058 Zwickau

Tel. 0172/ 9654715
Fax: +49 (0) 375/ 5976930
E-mail: urecknagel@huettenes-albertus.com

Supplemented version of an article published in Gießerei-Praxis 5/2007, p. 182 - 184 Zwickau