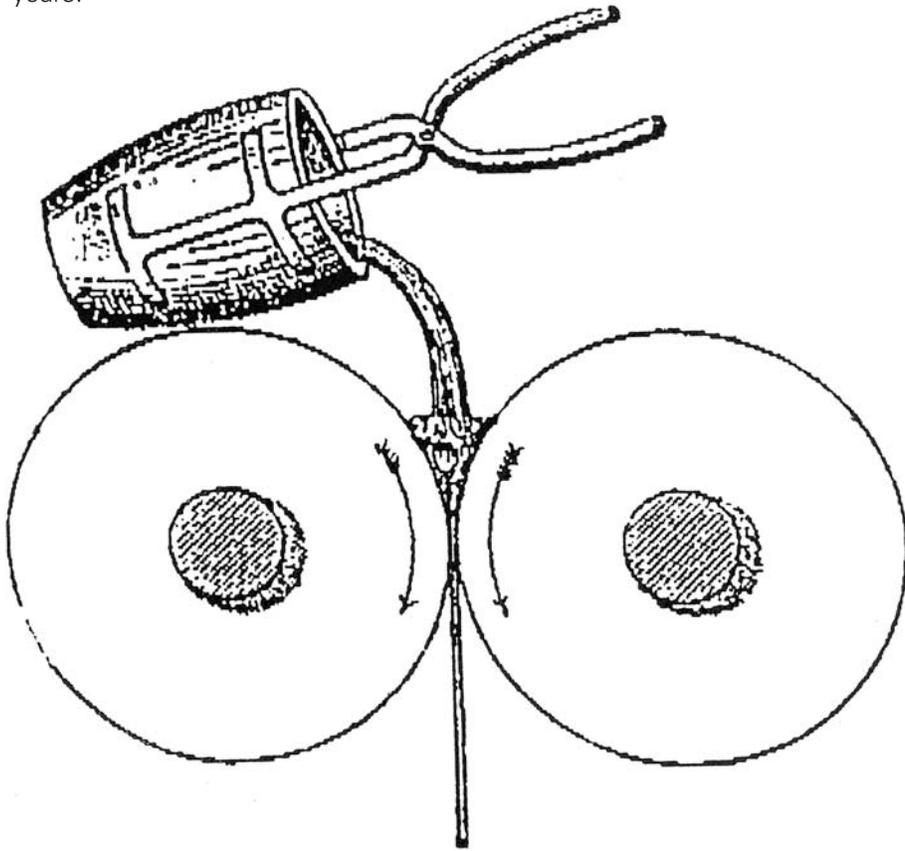


## The Original Concept

The year was 1857 when English inventor, Sir Henry Bessemer, patented the fundamentals of twin-roll casting of metals. But the full value of his contribution to strip casting - and its impact on the steel industry - would not be realized for generations. The exacting electronic controls, metallurgical knowledge and refractories necessary for commercial application were not yet available. Bessemer's concept, therefore, would sit idle for nearly 150 years.



Henry Bessemer's original drawing of twin-roll casting

## Project M

In 1988, steel industry leaders, BHP Steel of Australia and Ishikawajima-Harima Heavy Industries (IHI) of Japan, began a collaborative effort to determine the commercial feasibility of twin-roll strip casting of steel. Code-named Project M, their goal was to take Bessemer's concept, apply it to the manufacture of steel and make it a reality.

The BHP-IHI endeavor began with the casting of five-ton coils up to 600 mm wide. By 1991, commercially acceptable (Grade 304) stainless steel coils were cast and later rolled at BHP's stainless facilities. Strip casting of carbon steels proved to be much more difficult than stainless steels - but possible.



**The Project M plant in Port Kembla, Australia**

In 1993, BHP and IHI constructed a full-scale plant in Port Kembla, Australia to demonstrate the feasibility of carbon steel strip casting. By 1995, the first casts had been conducted utilizing sixty-ton ladles of carbon steels, which were cast into maximum 30-ton coils with a width of 1,345 mm.

Initially, the target thickness was 2.5 mm, but as Project M progressed, engineers learned that the process produced better quality, porosity-free material as thickness was reduced below 2.0 mm. This discovery forever changed the complexion of strip casting and began to alter the market expectations for the resulting products.

Over the course of the Project M development, many advancements were made to improve on Bessemer's original concept. Continuous research and development efforts focused on several key obstacles to the twin-roll process that needed to be overcome in order to produce commercial quality strip, including:

- Understanding of early solidification
- Containment of the melt pool edge
- Interactions between molten steel and refractory
- Uniform delivery of molten metal
- Control of mold (roll) distortion

Project M reached its conclusion in the latter part of 1999. During the decade-long development, more than 30,000 tons of carbon steel were cast. Many of these tons were used in commercial applications ranging from roofing and structural decking to mechanical tubing and packaging.

Although technical success was clearly proven, commercial feasibility could not be fully tested and determined without a supply of molten steel to conduct multi-heat sequences. BHP and IHI realized they needed a partner that could help them take this next step and bring the Castrip® technology to full-scale production.

## Formation of Castrip LLC

In March 2000, Nucor Corporation, the pioneering company that perfected the world's first thin-slab caster, joined BHP and IHI to form Castrip LLC. The new company's goal was to finally bring the Castrip® technology to commercial reality.

Nucor also became the first licensee of the Castrip technology. On February 27, 2001, ground was broken in Crawfordsville, Indiana on the world's first Castrip facility. Construction and commissioning of the Nucor Castrip plant was completed in May 2002, and the plant is expected to be fully operational by the fourth quarter of 2002.



**Groundbreaking for Nucor's Castrip plant in Crawfordsville, Indiana**

To further solidify its leadership role in thin strip casting, Castrip LLC formed a strategic alliance with the Industrial Solutions and Services Group of Siemens AG and Siemens Energy & Automation, Inc. in August 2001, making Siemens the exclusive supplier of core automation equipment and services to Castrip technology licensees. This agreement brought together Castrip LLC's expertise in thin strip casting with Siemens' expertise in mill automation.

All together, the Castrip patent portfolios of both companies are considered to be the most extensive in this field of use. Nucor, BHP, IHI, Siemens and Castrip LLC control more than 1,500 patents and patents pending worldwide related to the twin roll casting of steels. This enormous patent portfolio protects Castrip LLC licensees from illegal competitors.