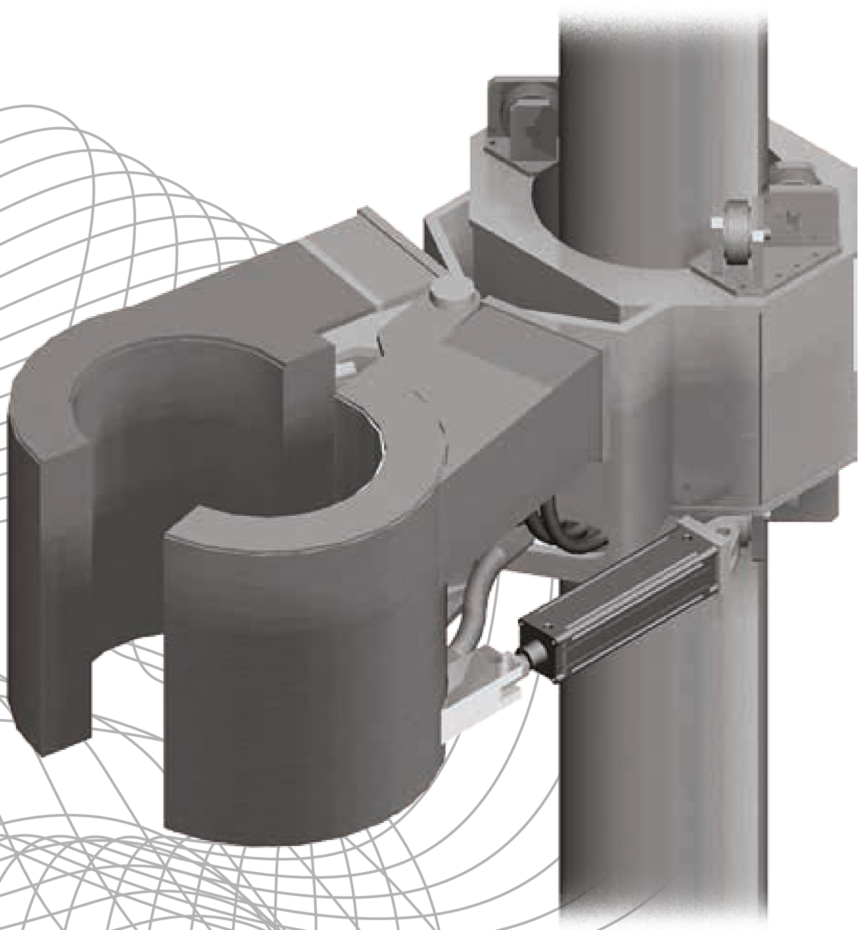
MOVING AND OPENING EMS.

The diversification of production and the constant addition of new casting sections and steel grades have become a need within the dynamic steel market. The need to manage very different casting sizes and steel grades has led to a more complex design of casting machines, equipment for process control and devices aimed at the quality of the cast product.

In order to meet the quality requirements of plants offering a wide range of formats and steel grades, Ergolines developed a particular stirrer series that can be moved along the casting line so as to be always positioned in the position granting the best metallurgical results. The stirrer can be also composed of two halves which can be opened by a peculiar pneumatic system to ease the extraction of both the cast product and dummy bar.



BENEFITS

The components of the stirrer and the handling and opening system are designed to work in the harsh environment of steel plants; they are therefore resistant to high temperatures, dust and vapor present in the secondary cooling zone.

Benefits obtained with moving stirrers are the following:

STRAND-STIRRER (S-EMS) POSITION

- Improvement of primary solidification structure (in the product area where the steel is still liquid at the position of S-EMS)
- Internal cracks reduction
- Centre segregation reduction
- Porosity and central cavity reduction.

FINAL STIRRER (F-EMS) POSITION

- Improvement of the solidification structure of the central zone
- Central segregation reduction, especially for high carbons and high alloy steels (e.g. segregation of chromium)
- "V" segregation reduction
- Porosity and central cavity reduction
- "Mini-ingots" phenomena prevention.

ERGOLINES TECHNOLOGY

The stirrer design is made through the use of FEM computer-aided techniques which grant product optimization in accordance with customers' specific requests. The design activity aims at achieving the following targets:

- to ensure the optimal magneto-hydrodynamic efficiency
- to ensure an optimal stirrer cooling
- to ensure the appropriate sizing of all components to avoid to withstand any temporary overload conditions.

In order to investigate the optimal stirrer position along the casting strand for different operating parameters, Ergolines developed a software to calculate the solidification process of the cast product, capable of providing temperatures, growth of the solidification front, extension of the mushy zone, percentage of solid on the sections and finally providing the optimum position for strand and final stirrers.

The position of the mobile stirrers can therefore be managed in two ways:

- off-line calculation: the stirrer position is a casting parameter of the steel grade
- real-time calculation: a real-time solidification algorithm manages the stirrer positioning in order to achieve the best metallurgical performance also if the casting parameters change during the cast and during transient situations.

As for stirrer cooling, this is designed to operate with **low water pressure**. The internal water circuit is designed to guarantee a well balanced cooling for an **optimal heat distribution**. This prevents areas with excessive accumulation of heat. The cooling is designed to have the **lowest temperature difference into the stirrer** to avoid dilatations. The water cooling flows from bottom to top to avoid the rubbing of any residual micro-particles against coils and guarantee a long stirrer lifespan.

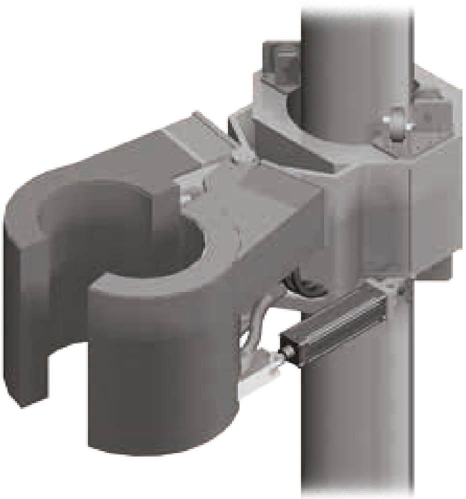
TYPICAL ERGOLINES EMS SYSTEM DESCRIPTION

MOVING STIRRER

Cooling is accomplished by a closed-loop de-mineralized water circulation system. The coil manufacturing technology is "wet insulation" type.

High, reliable and long-lasting insulation properties are given by a special insulation technique with an overlapped double kapton-ribbon winding, and by a special proprietary resin treatment based on VPI (Vacuum-Pressure-Impregnation) technology, which ensures longer coils lifespan.

Moving stirrer can also be provided in the "dry insulation type", meaning that the copper conductor is a hollow tube with the cooling water flowing inside.



MOVING AND OPENING SYSTEM

The moving system consists of a tubular guide with prismatic guides with eccentric pins and jog wheels.

The support of the coil, manufactured in two halves, is implemented with support arms and moved by pneumatic cylinders; the support is fixed to a guide concentric with the tubular column.The entire complex can slide on the column by means of a kinematic controlled system of chains and sprockets.

In cases where the installations are inside the cooling chamber, materials, treatment and coatings are designed to withstand temperatures of 100 ÷ 120 °C in an environment saturated of steam and chemically aggressive.

POWER TRANSFORMER AND FULL-DIGITAL FREQUENCY UNIT CONVERTER

are provided to guarantee the power supply and manage electrical parameters (current, voltage and frequency). The Frequency Converter is specifically designed for operation at the low frequencies involved with EMS equipment.

COOLING WATER SYSTEM (DE-MINERALIZED WATER)

equipped with 2 pumps, one bag filter, one heat exchanger, one stainless steel water tank and all necessary automation components and sensors for safe operations, -including a water conductivity meter- is designed depending on number of strands and stirrers design. The system is locally controlled by a dedicated PLC switchboard with all commands, alarm signals and auxiliary devices. One system is intended to cool the EMSs of all strands, in parallel.

Power cables, junction boxes, stainless steel flexible hoses, cooling water instrumentations pipes are included in the supplies and are chosen according to steel plant characteristics and customer requirements.

Ergolines provides services for EMS system installation check-up, commissioning and personnel training.

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