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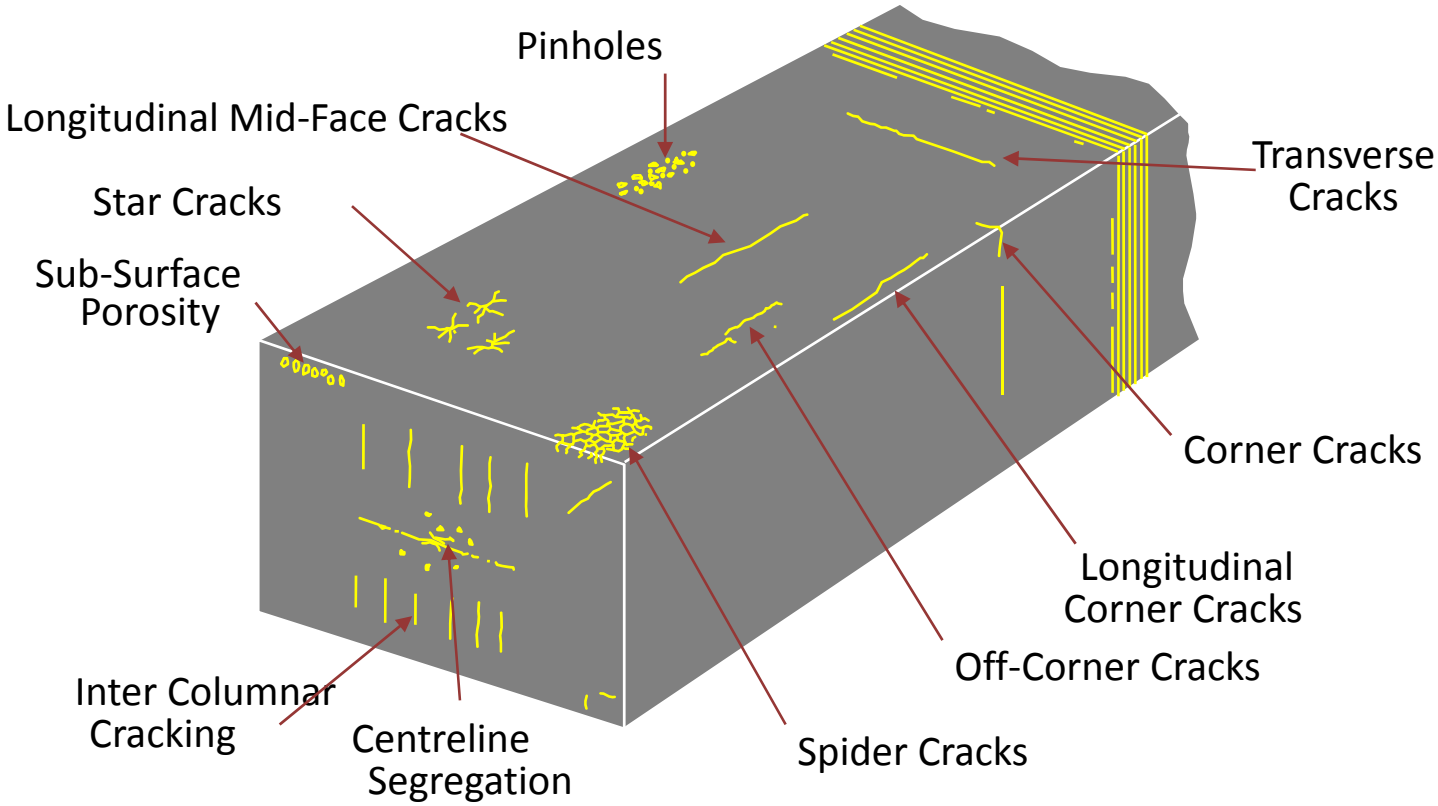
CCM – Mould Level Control

Stopper Rod versus Slide Gate

Surface and Inside Defects formed during Solidification



SHEFFIELD HI-TECH REFRACTORIES

CCM – Mould Level Control

Stopper Rod versus Slide Gate

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ITEM	STOPPER ROD	SLIDE GATE
Regulation	Variation of stopper rod position	Variation of slide gate plates respective position
Actuator	Generally electromechanical	Hydraulic
Starting position	Closed (no flow)	Open (flow), requires use of starter tubes
Shrouding	SES or SEN possible	SES only
Regulation capability	Good, best results for small sections and high speed	Good, often used for bigger flow (slab / blooms)
Air suction	When SEN applied null, when SES applied possible air suction due to Venturi effect through nozzle / SES junction	Possible air suction due to Venturi effect through nozzle/SES junction and between slide gate plates
Turbulence or vortexing effect	Null	With low opening of the plates possible creation of turbulence. At low tundish level more prone to vortexing phenomena.
Preheating	Required	Required

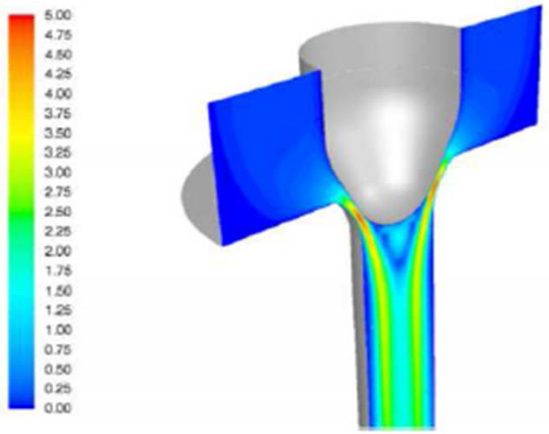
Stopper is preffered used for billet sections and when a more quick and precise regulation is needed, it allows start of strands even in different heats of the same sequence, and in any case with any required staring sequence.

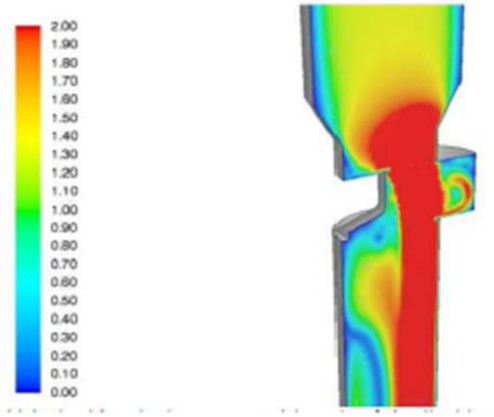
CCM – Mould Level Control

Stopper Rod versus Slide Gate

In the case of Stopper control, regulation is made by variation of position of the stopper rod tip respect to the tundish outlet, i.e. variation of dimension of the annular chamber created by the two parts.

In the case of Slide gate control, regulation is made by variation of respective position of bores drilled on
refractory plates, sliding one over the other





As evident in above figures, use of slide gates is sometimes causing asymmetrical flow inside shroud. In case of single bore (bottom) and with small opening of the plates, this can generate some turbulence inside the mould.

CCM – Mould Level Control

SES versus SEN Application

SEN (Submerged Entry Nozzle is installed into Tundish and therefore fixed.
Especially at small Billet Section geometric centring with Mould will become a difficult task.

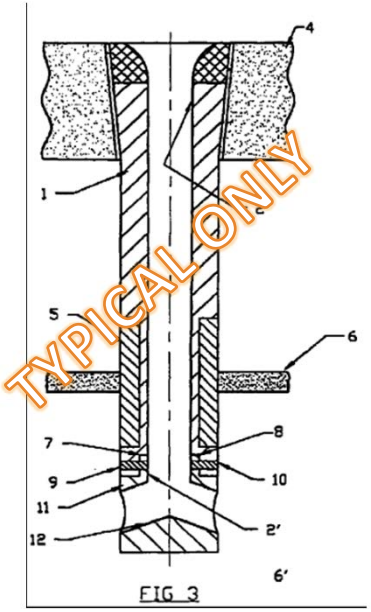
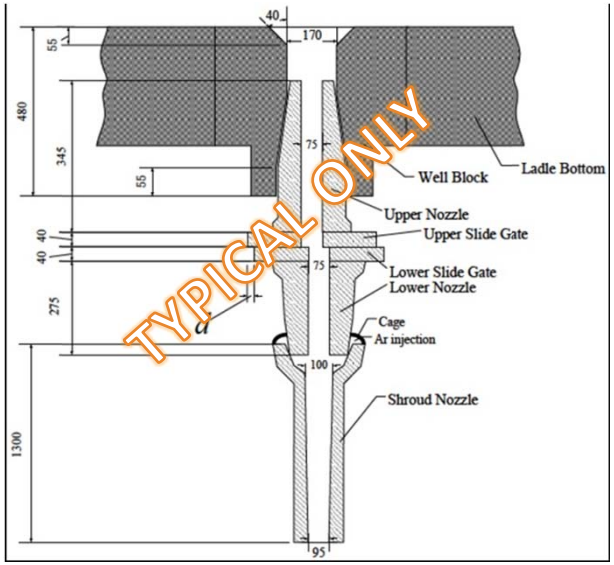


FIG 3

SES (Submerged Entry Shroud) is fixed to the Tundish Nozzle or to the Tundish Slide Gate System, and centric positioning to the Mould remains possible.



Compared to SEN, with SES system the risk of air suction stays remaining because of several ceramic parts involved.

- Immersion Depth SES / SEN with Vertical Outlet (standard version): 90 – 100 mm approximately
- Immersion Depth SES / SEN with Horizontal Outlet: 120 – 140 mm approximately

SHEFFIELD HI-TECH REFRACTORIES

CCM – Mould Level Control

Stopper Rod versus Slide Gate

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ITEM	STOPPER ROD	SLIDE GATE
Protection from re-oxidation of liquid steel	++ (SEN or SES)	0 (SEN only)
Tendency to clogging	+ (better, reduced)	0
Reliability / Failure rate	0	++ (less connections)
Cost of Refractory material per ton of casted steel	+ (longer sequence rates)	0
Need of dedicated hydraulic power unit	++ (servo – drive, improved safety)	0
Maintenance requirements	++ (simple and reduced	0
Installation and alignment procedure	0	++ (less prone to operator - mistakes)

SHEFFIELD HI-TECH REFRACTORIES

CONTINIOUS CASTING OPERATIONS

Stopper Rod versus Slide Gate

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ITEM	STOPPER ROD	SLIDE GATE
Refractory Cost	++ (more manufacturer / more competition)	0 Less manufacturer / possible patents
Manual Mould Level Control	+ (potentiometer, hand – wheel or lever)	0 (difficult)
Tundish Pre-Heating	0 (thermal expansion of Stopper Rod)	++
Start of Casting	++ (no. of strands individually controlled)	0
Starter Tubes	0	(slag impact at cast starting)
Section Size Range	+ (small billet sections possible)	0

CONTINIOUS CASTING OPERATIONS

Stopper Rod versus Slide Gate

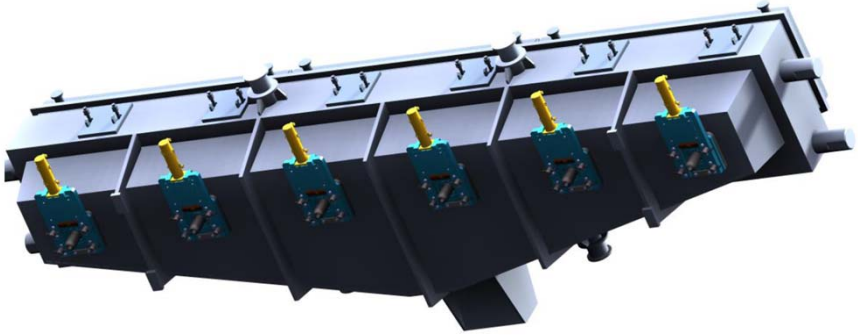
ITEM	STOPPER ROD	SLIDE GATE
Slab casting / Tube Changer / long Casting Interruptions	++	0 (more prone to freezing)
Installation Cost	++	0
TOTAL	18 +	7 +

Applicable Standard:

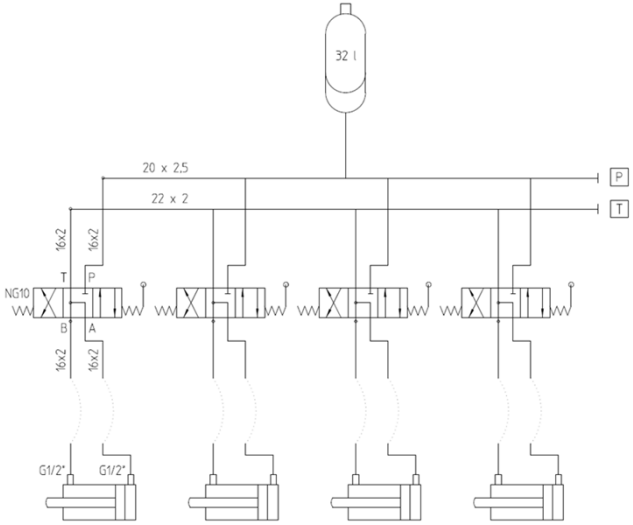
EN 14753 Safety of machinery -
Safety requirements for machinery and equipment for continuous casting of steel

CONTINIOUS CASTING OPERATIONS

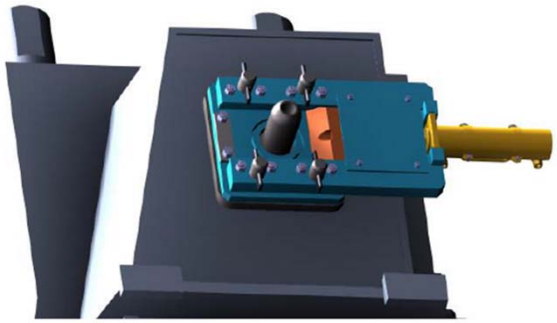
Stopper Rod versus Slide Gate



Typical Emergency Slide Gate arrangement on a 6-Strand Caster



TYPICAL ONLY



Source: RHI Magnesita

CONTINIOUS CASTING OPERATIONS

SHEFFIELD HI-TECH REFRACTORIES

Stopper Rod versus Slide Gate

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STEEL / FLOW CONTROL TECHNOLOGY

Stopper Rod Mechanism INTERSTOP® SRM-T

RHI MAGNESITA

Overview

- High-precision tundish stopper gear for accurate flow control
- Electric or hydraulic driven actuators
- Manual operation always possible
- Easy installation and operation
- Integrated solution for precise mold level control

System Characteristics

- High-precision stopper rod mechanism
- Electrical or hydraulic driven actuators
- Manual intervention possible anytime

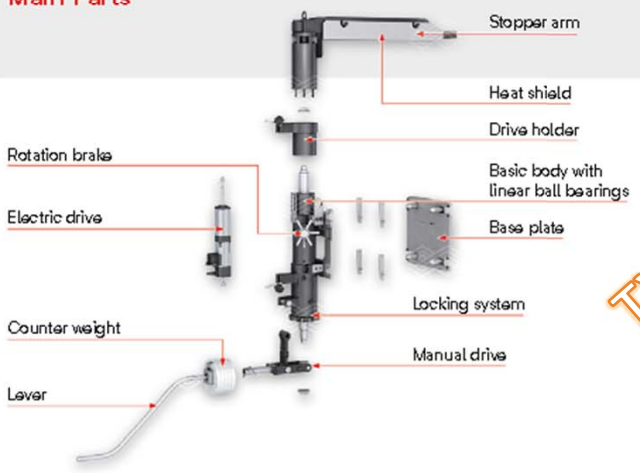
Integrated System Solution

- Automatic mold level control
- Mono Tube Changer (MTC) and/or Emergency Gate (EG)
- Inert gas
- Tundish level and mold level detection system EMU
- Customer-tailored refractories solution

Maintenance and Support

- Minimal maintenance work required
- Long lifetime of parts
- Long inspection intervals, short inspection time
- INTERSTOP® after sales service

Main Parts



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CONTINIOUS CASTING OPERATIONS

Stopper Rod versus Slide Gate

STEEL / FLOW CONTROL TECHNOLOGY

Tundish Gate INTERSTOP® 13QC/A

RHI MAGNESITA

Overview

- Tundish slide gate for billets and blooms
- Air tight system
- Play-free drive
- Process control technology for automatic casting
- Compact design

System Characteristics

- Three-plate gate system
- Fully automatic casting operation
- Inert gas application on tundish nozzle and joints
- Gate assembly online or off-line
- Minimized number of components
- Easy assembly and maintenance
- Fastening with wedges or bolts

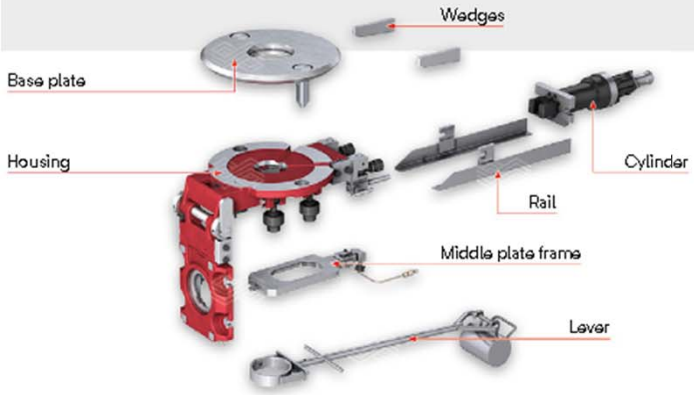
INTERSTOP® Flow Control Technology

- Monitoring by process visualization
- Automatic start-up
- Automatic mold level control
- Automatic emergency functions
- Precise steel flow regulation
- End of casting program

Maintenance and Support

- Minimal maintenance work required
- Long lifetime of parts
- Long inspection intervals, short inspection time
- INTERSTOP® after sales service

Main Parts



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