

PRODUCT AND MAINTENANCE EFFICIENCY BY APPLYING A NEW CONCEPT FOR PINCH-ROLL CHANGE FOCUS ON THE ROLLING AND PROCESSING INDUSTRIES¹

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Abstract

Siemens VAI Metals Technologies now offers hot-strip mill operators a new method for changing the pinch rolls in the down coiler. The pinch-roll unit, designed as a quick-exchange cassette, can be replaced within just ten minutes without additional interruption of production. This saves up to eight hours typically required when applying conventional solutions. The rolls can be cleaned and refurbished offline, thereby enhancing strip quality and personnel safety. This capability to quickly exchange rolls also reduces maintenance time and increases yield.

Key words: Hot-strip mill; Down coiler; Pinch roll.

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1 INTRODUCTION

The pinch-roll quick-exchange unit was developed to enable the change of pinch rolls during production within approximately 10 minutes. Today's operational challenge is to guarantee best possible strip surface quality. Therefore material deposited on the surface of pinch rolls during strip coiling which negatively affects the strip surface must be removed periodically by means of hand grinding by the line operators. Additionally production loss occurs due to unscheduled changes of damaged pinch rolls which happen typically several times a year and take up to 8 hours each. These activities pose significant physical risk to the operators.

2 NEW GENERATION EXCHANGE CONCEPT

Equipped with this knowledge and in dialogue with our customers, Siemens VAI sought to improve product, processes and safety, resulting in a new generation of pinch roll exchange system introduced at METEC 2011 in Düsseldorf. Since the changing process can be done during the production phase or within change of work rolls, pinch-roll change is no longer based on a maintenance shutdown but on product requirements such as material grades and surface requirements. As the grinding of a damaged roll can be done offline, the safety of plant personnel increases significantly, and the service life of the rolls is improved through optimized grinding intervals. Optional automatic detection of roll surface or fully automatic roll changing by an integrated manipulator enhances the flexibility of this quick exchange concept even further.

3 GENERAL FUNCTION OF PINCH-ROLL UNITS

The pinch-roll unit is located upstream the down coiler. The torque required for strip bending and tension is generated by two separate motors for the top roll and the bottom roll. The main function of the pinch rolls is feeding the strip-head end to the down coiler and building up the tension necessary during coiling by distributing strip tension between the last active stand and the mandrel.

The contact pressure of the top roll against the bottom roll is adjusted to ensure that the tensile forces set can be transmitted to the strip with the available friction without allowing the strip to slip. When the strip is in the coiler and in the finishing mill, the required back tension is provided both by the pinch roll and the last active finishing stand. After the strip-tail end has left the last active stand of the finishing train, the strip back tension is solely provided by the pinch-roll unit. For heavy gauge strip and/or small coils, the strip may not be in the coiler and finishing mill at the same time and therefore the pinch-roll unit will provide the full back tension throughout the coiling process (Figure 1).

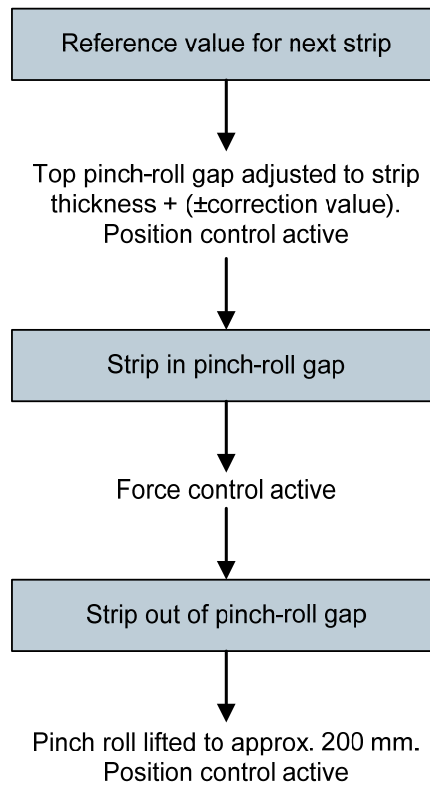


Figure 1. Coiling sequence.

4 HISTORICAL OVERVIEW OF PINCH-ROLL UNIT DEVELOPMENTS

4.1 First Generation of Pinch-Roll Unit

This widely used pinch-roll type was installed until the year 2000. With the first generation (Figure 2) of this equipment the pinch-roll exchange requires up to eight hours.

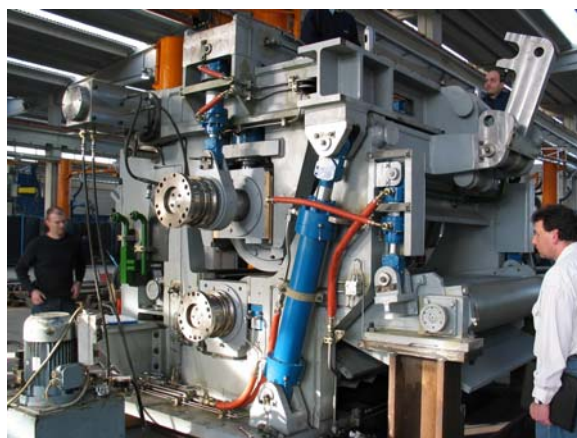


Figure 2. First generation of pinch-roll unit.

4.1.1 Design

The top pinch-roll unit is positioned on the top frame and is free to move. Two hydraulic cylinders adjust the roll gap, generate strip contact force and strip tension. It is time consuming and dangerous to turn the heavy top frame with the bay crane by

180 degrees which is necessary to change the top and bottom pinch-roll units (Figure 3).

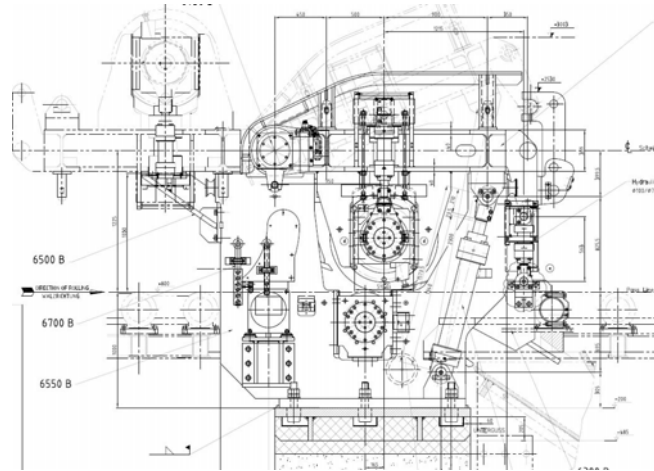


Figure 3. Pinch-roll exchange with first generation.

4.2 Second Generation of Pinch-Roll Unit

The second generation (Figure 4) of pinch-roll units was installed since the year 2000. Pinch-roll changes performed with the second generation of this equipment require between three and five hours.

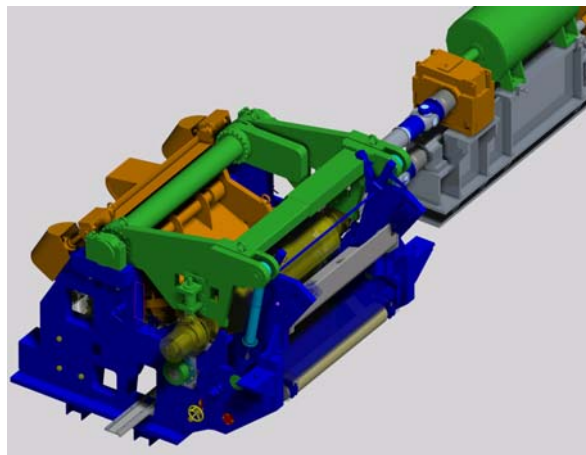


Figure 4. Second generation of pinch-roll unit.

4.2.1 Design

The top pinch-roll unit is screwed on the top frame. The complete frame, including the fixed pinch-roll unit, can be raised and lowered. Two hydraulic cylinders adjust the roll gap, generate strip contact force and strip tension. To steer the strip, different cylinder forces are applied.

The exchange of the top (Figure 5) and bottom (Figure 6) pinch rolls remains time-consuming and dangerous. For access to both rolls, the heavy top frame including the upper pinch roll assembly has to be removed by means of the bay crane.

Additional costs occur as an operational exchange set, consisting of a top roll unit connected to the top frame, is needed.

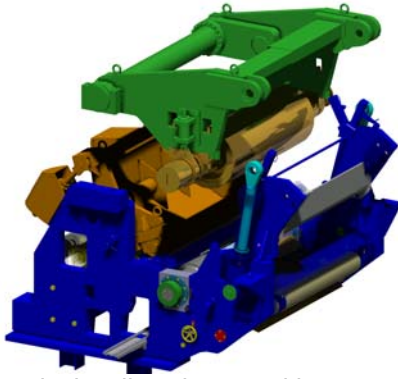


Figure 5. Top pinch-roll exchange with second generation.

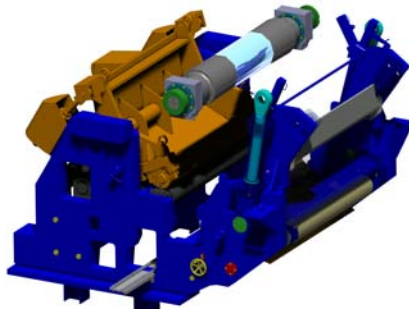


Figure 6. Bottom pinch-roll exchange with second generation.

4.3 Third Generation: The New Pinch-Roll Quick-Exchange Unit from Siemens VAI

The latest innovation, the pinch-roll quick-exchange unit (Figure 7), was developed to enable the change of pinch rolls in hot-strip mills within 10 minutes only. For the first time pinch-roll change is independent of a maintenance shutdown.

With an innovative cassette system the changing process can be done anytime preferably within change of work rolls, based on product requirements such as material grades and surface requirements. First installations of two units are already scheduled at a leading North American producer.

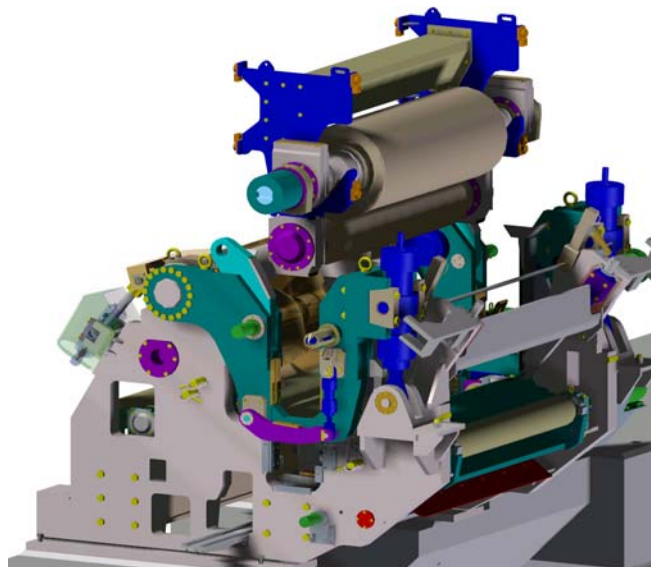


Figure 7. Third generation: new pinch-roll quick-exchange unit. International patent application PCT/EP2011/066707.

4.3.1 Design

Both pinch rolls are placed in a cassette. The exchange cassette, combined with an innovative mounting system, precisely positions the pinch rolls in the pinch-roll unit. Due to the full automatic opening and lock off function the roll change is performed by the bay crane in a very short time – only about 10 minutes.

4.3.2 Main benefits

For the first time it is possible to exchange the complete roll set, consisting of upper and lower pinch rolls based on product requirements, anytime which leads to the following benefits:

- Opportunity to change the rolls according to **higher strip-surface requirements** ⇒ e.g. to thin gauges (automotive grades)
- Opportunity to **flexibly react on production requirements**, like checker plate rolling, short-term during production process by exchange of pinch rolls (checkered strip surface damages the roll surface)
- Opportunity to easily **align pinch rolls with strip-material properties** in order to avoid strip surface defects and decrease wear on rollers
- Opportunity to **improve strip-surface quality** due to the possibility of exchanging used rolls by perfectly refurbished rolls anytime.
- **Increased yield** by gaining additional production time due to
 - shorter unscheduled changes (e.g. damaged pinch rolls) and
 - elimination of provisional manual inline grinding
- **Grinding** of damaged roll surfaces can solely be done **offline** which eliminates existing significant personal safety risks resulting from manual inline grinding activities.
- **Highest safety standards** due to fully automatic opening and lock off function are secured.
- Increased **roll life time** due to elimination of preventive roll exchange and grinding.
- Perfectly **reconditioned pinch rolls** are provided by a roll refurbishment station (Figure 8) with free access for pinch roll inspection and safe conditioning work.
- **Reduction** of existing **operational costs** for staff and bay crane due to
 - elimination of operational costs for manual inline grinding activities
 - elimination of operational costs for scheduled pinch-roll changes during shut down
 - tremendous reduction of operational costs for unscheduled pinch-roll change.

4.3.3 Additional equipment

4.3.3.1 Roll refurbishment and preparation station

The roll refurbishment and preparation station (Figure 9) can be used for all assembly and disassembly activities together with roll-surface enhancement activities like cleaning and grinding.

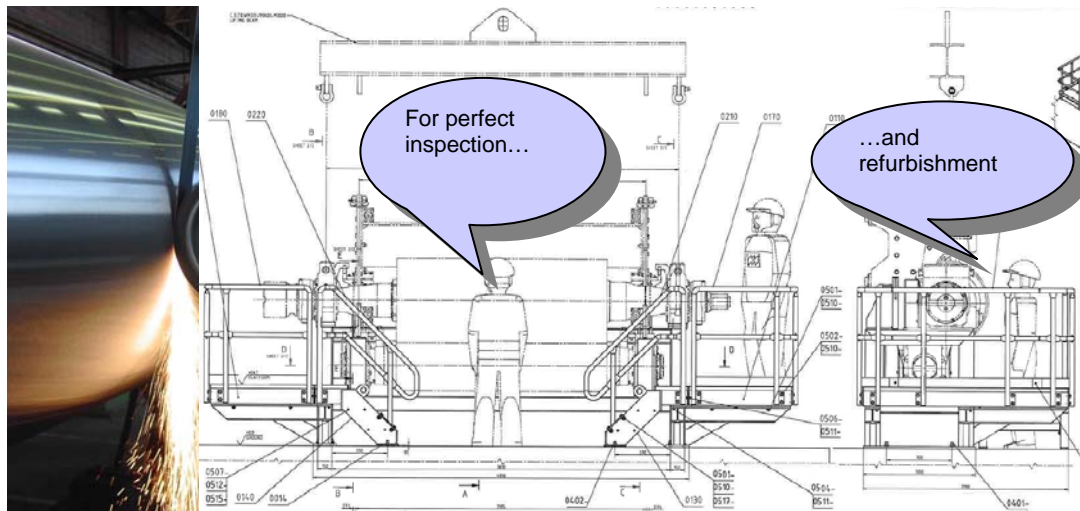


Figure 8. Roll refurbishment and preparation station.

Compared to the first and second generation of pinch-roll unit, where cleaning and grinding activities had to be done inline exposing the operator to extrem physical hazards, the third generation offers the opportunity for safe and high-quality offline roll refurbishment. A manually controlled rotary drive (Figure 9) enables to turn the rolls.

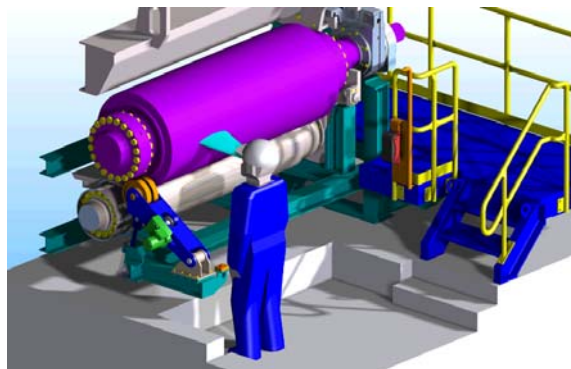


Figure 9. Rotary drive for pinch-roll inspection.

4.3.3.2 Fully automatic roll-change manipulator

The task of this manipulator (Figure 11) is the fully automatic roll change between

- Pinch-roll unit
- Inspection and refurbishment station and
- Pinch-roll store.

Thus all other necessary maintenance or exchange activities within the down-coiling area can be executed to release the bay crane operation.

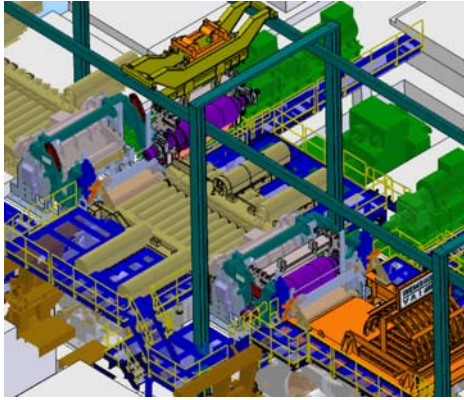


Figure 11. Fully automatic roll-change manipulator.

5 CONCLUSION

Siemens VAI is currently making tremendous research and development efforts to support its customers utilizing the latest available technologies enabling higher plant availability to be achieved. With the new pinch-roll quick-exchange unit, Siemens VAI proves once again being a pioneer in developing safe products which improve daily operations and maintenance business of its customers.