HIGH SPEED CHAIN TRACK DRAWING OF FERROUS AND NON FERROUS MATERIALS[1]

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Abstract
The critical component in traditional combined drawing lines is the pulling unit, consisting consisted of a rotating cam system used to generate a reciprocating movement of two drawing carriages. The main limitation is that due to the reciprocating motion, the maximum speed of the carriages and therefore of the drawing action is limited by physics to about 120-150 m/min. Furthermore, the "handover" mechanism results in a non constant speed of the material through the drawing line, that can cause cut to length inaccuracies. Over the past 30 years Danieli has developed the fastest and most reliable drawing system based on the chain rack drawing unit that replaces the traditional cam based system. The latest chain track system consists of two caterpillar type chains that rotate at a high, constant speed- ensuring drawing speeds of up to 400 m/min for non ferrous materials and up to 180 m/min for ferrous materials. Up to 48 bars drawn bars per minute from coil can be produced.
Key words: Chain track; Drawing; Productivity; Innovation.

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1 INTRODUCTION

Over the past 50 years, value has been added to hot rolled steel and extruded non ferrous coil by the combined drawing line process whereby the wire of incoming diameter 5.5 to 45 mm is pulled through a drawing die to greatly improve the material dimensional tolerances as well as increasing its mechanical properties. The core equipment item in a combined drawing line is the pulling unit that traditionally consists of a rotating cam that converts rotary motion into the linear reciprocating motion of two pulling carriages that grip the wire and overcoming the resistance of the material area reduction as it passes through the drawing die, pull the wire onto the secondary processes in the production line.
As with all production processes subject to the pressures of increasing competition, reducing profit margins, increasing labor costs and ever-more demanding customers, an innovative solution was developed by Danieli to replace the reciprocating motion cam based pulling unit with a chain track, continuous motion, high speed, alternative process that substantially increases the line productivity while maintaining the required tolerances of the finished drawn product.

2 MATERIALS AND METHODS

The key to the development of the new system was to overcome the main technical drawbacks of the cam based drawing system: (a) drawing speed limitation due to the reciprocating motion system (b) speed variation of the material being pulled due to the "handover" from one pulling carriage to the other (c) difficulty in set up that requires a highly skilled operator for best results (d) maintenance difficulties.

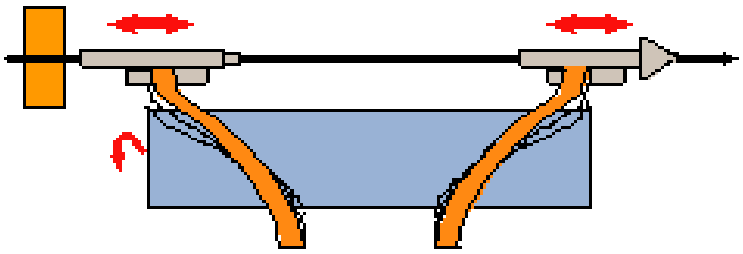

Figure 1. Cam based reciprocating motion pulling system.

Since the company Danieli already manufactured cam pulling systems, the drawbacks were well known and intense development efforts resulted in the development of an alternative pulling system, nominated "Chain track" or "Caterpillar", now in the 5th generation version.

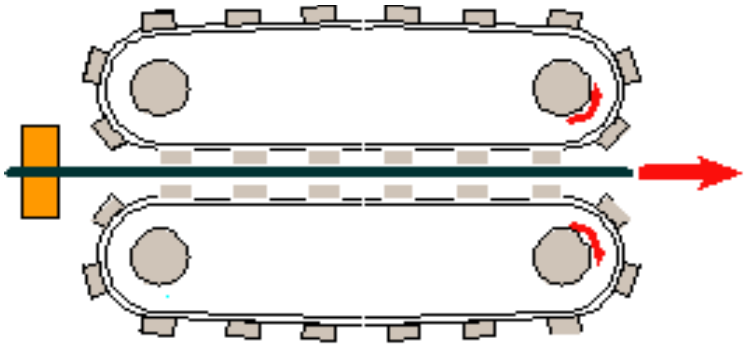

Figure 2. Chain track / caterpillar motion pulling system.

The fundamental technical aspect of the new system, now patented, was to create a chain design that would be capable of pulling high loads (up to 260 KN) while being able to maintain very high speeds of up to 400 m/min for long periods to ensure reliable production of drawn bars. The concept developed was on the basis of a roller bearing, whereby the pulling chain was split into two separate, concentric chains (inner and outer). This design ensured that the speed of each chain was substantially lower than the resulting pulling speed, guaranteeing a long chain life even under high loads.

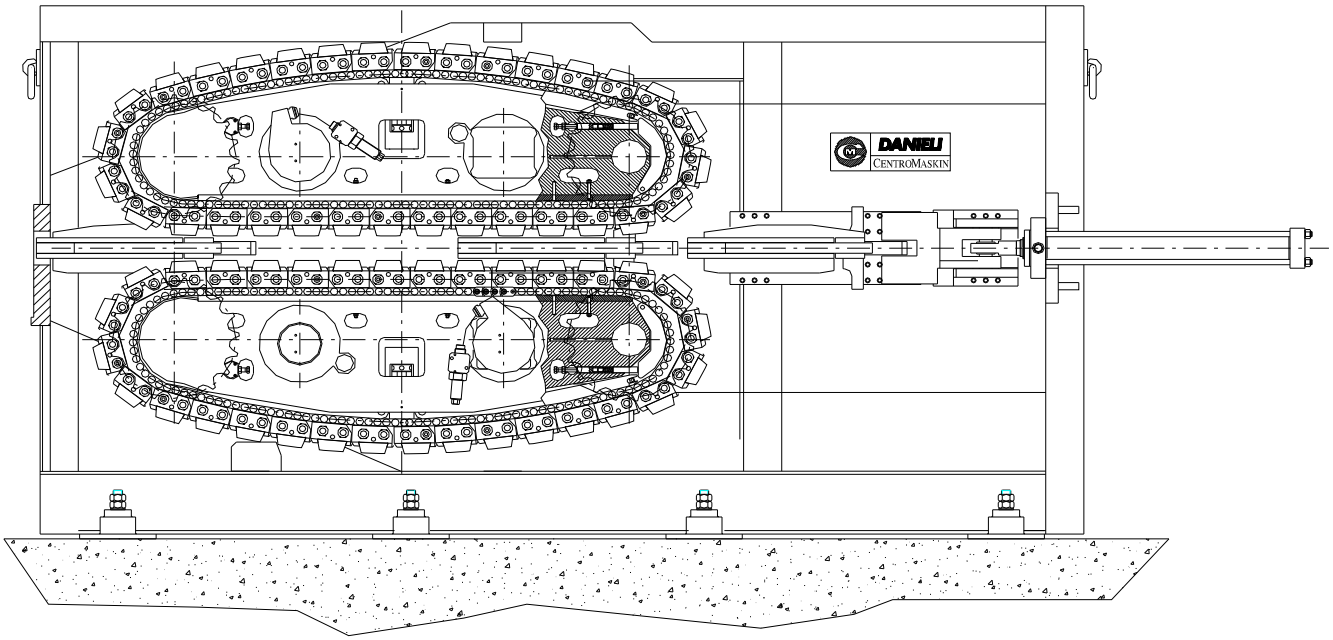

Figure 3. Chain track / caterpillar pulling unit.

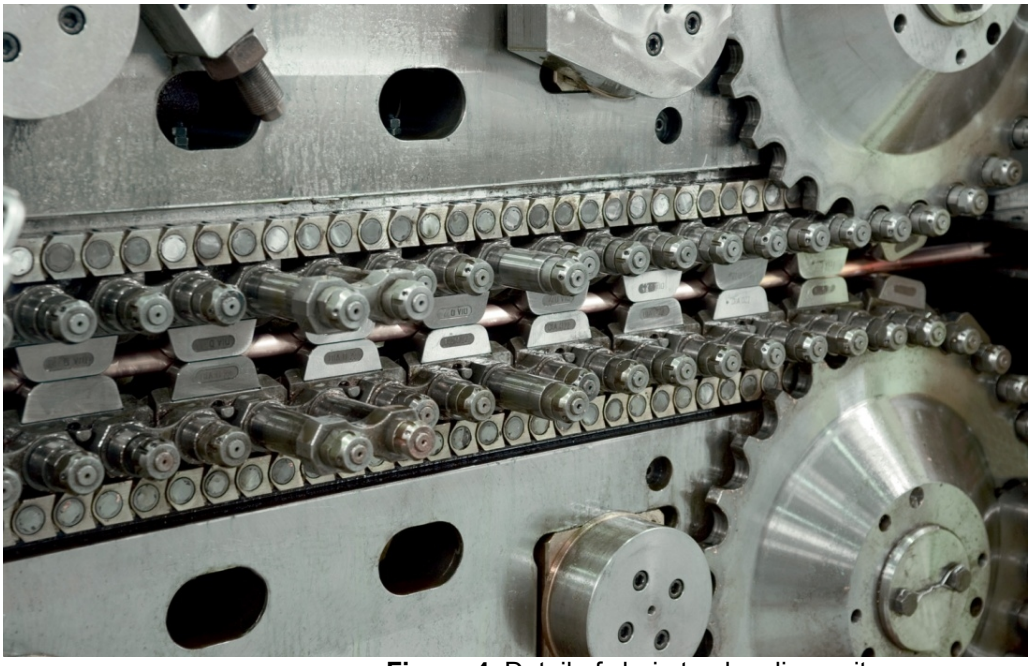

Figure 4. Detail of chain track puling unit.

The continuous motion system furthermore guarantees a constant speed of the material through the drawing die, ensuring less die wear, higher drawing speed for equivalent drawing material and area reduction parameters, as well as less maintenance since the considerable G forces of the reciprocating carriages are not involved. An added bonus is that due to the constant speed, the downstream flying shear used to cut the coil into bars is able to cut with a higher precision (0+1 mm) since the shear carriage is able to synchronize its speed very precisely with the moving material.

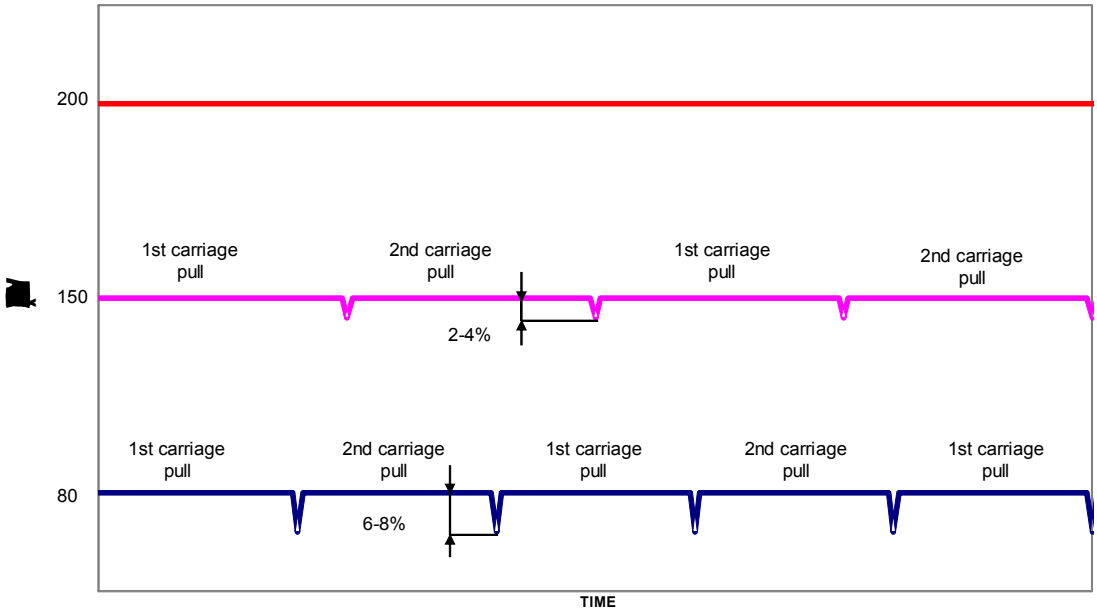

Figure 5. Speed variation comparison.

The net result of the chain track development was to raise the drawing speed from the previous maximum of 150 m/min achieved by cam based systems to 400 m/min (for non ferrous materials) or 180 m/min (for ferrous materials) for the chain track systems. The speed of the chain track machine is not limited so much by the machine design but by the drawing die process limitations and by the required performances of the remaining in-line equipment downstream of the pulling unit such as two roll straightening and chamfering machines. The increased performance of the pulling unit has required Danieli to develop a new high speed two roll straightener capable of straightening at speeds up to 240 m/min, a new flying shear as well as a 4 head chamfering unit processing up to 48 bars/minute.

3 RESULTS AND DISCUSSION

Increasing the drawing speed using the chain track pulling unit with respect to cam system has naturally increased the productivity of the plant in proportion, meanwhile the number of operators does not increase. Due to the continuous speed system less maintenance is required while set up for size changes is simplified because the carriage handover synchronization complexity does not exist for the chain track system.

4 CONCLUSIONS

The high speed drawing technology developed by Danieli has significantly helped steel processors make considerable productivity gains while guaranteeing the form and length tolerance of the drawn bars. This has both increased their profit margins as well as strengthening their position in the highly competitive market as suppliers to the automotive and similar industries.