

Developing the modern toe laster

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Sincron TS pull-toe laster. CREDIT: MOLINA E BIANCHI SPA

Lasting involves stretching leather over a last and fastening it to an insole in such a way that it takes the shape of the last and then retains it after the last has been removed. It might therefore seem that mechanisation of the process would be easy. This would however ignore the practical problems caused by the fact that a lasting machine has to process all sizes of boot and shoe from smallest child's to largest man's, cope with different last shapes and styles, varying substances and qualities of leather and their differing ability to stretch without damage. Bearing all this in mind, it becomes easier to understand why lasting was in fact the final department in the shoe factory to be mechanised.

A TENTATIVE BEGINNING

In 1809, D.M. Randolph, an American living in London, was granted a patent to make boots and shoes by attaching a sole to the upper with rivets instead of thread. The key aspect of this patent was the use of a last with a metal bottom plate so that when the rivets were driven through the sole and lasted upper they would be clenched against it. By this means upper and sole could be firmly united.

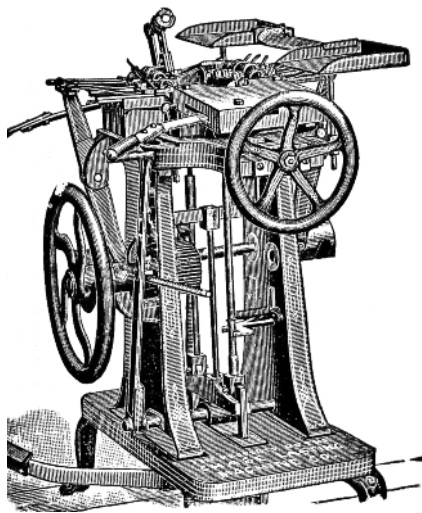
Randolph's method was developed the following year by Marc Isambard Brunel to produce boots for the Royal Navy in a purpose-built factory. This was the first boot factory to be fully mechanised and introduced the concept of division of labour. The upper was

placed on a last which was then turned bottom upwards. Clamps held the lasting margin tight to the last while the upper was pulled over by hand and stuck to the insole with paste. This was the first tentative use of a machine to stretch an upper over a last and enabled 25 men to produce 100 pairs of boots per day. The factory was nevertheless closed in 1817, its contents disappeared and traditional shoe making methods again prevailed.

In 1853 Thomas Crick, a Leicester boot and shoe manufacturer, was granted a patent that, in many ways, developed on Brunel's ideas. Crick's method made the shoe inside out on the turn shoe principle and again used rivets to attach upper to sole. The process reduced the cost of production and enabled Crick to undercut his competitors. While it forced them all to follow suit, the system had a weakness in that it was unable to process all types of leather. Although these early systems used jaws as a mechanical aid to hold the upper taut while it was pulled over the last or insole, this aspect only formed part of a single patented process.

AN IRREGULAR PROCESS

Technical effort during the 1860s and 1870s was centred on development of stitching, both for producing uppers and sole attachment. By the time engineers turned their attention to lasting, a greater range of footwear was being manufactured using a wider variety of types and grades of leather. Better standards of living had also led to greater customer expectations in regard to both fashion and quality. Lasting was already a challenge to engineers' ingenuity but changes in sole attaching technology and more complicated last shapes added new dimensions to the problem. On the other hand, the introduction of steam and, later, gas and electrical power in factories allowed them to introduce new approaches to mechanisation.



Early bed lasting machine by Chase Lasting Machine Co. CREDIT: DAVID HOLMES

Mechanisation between 1850 and 1900 was not a smooth process and four distinct stages can be identified: upper sewing (1850s-60s), sole stitching (1860s-70s), Goodyear welted process (1870s-80s) and finally lasting (1880s-90s). These extended periods were directly due to the time gap between granting of the original patent and the stage when a commercially viable machine was introduced. For example, while Elias Howe's sewing machine patent was taken out in 1846, the first machine was not installed in a shoe factory until 1852. Much development was then required during the next decade to produce a machine that overcame all problems.

The Goodyear welted process took even longer to develop. Auguste Destouy's first patent for a welt and turn-shoe sewing machine was granted in 1862 but a fully practical set of machines to produce welted shoes was not available until 1887. In the case of lasting machines, although patents were taken out as early as 1872, the first practical machine used in production—a bed laster—was not installed until 1881.

BED LASTERS

Many versions of the bed lasting machine were produced, all using the same principle. After initial hand pulling over, the shoe was placed bottom upwards in a cradle and leather clamps closed to hold it at toe and heel. Wiper plates then wiped the upper over the insole prior to inserting lasting tacks

using a 'hand tacker'. These had a raceway fed from a box at the top. When a tack had been delivered to the nozzle, it could be driven home by the operator manually using a hammer or the plunger could be activated by the operator.

In 1891 the Boston Lasting Machine Co. introduced its Boston Lasting Machine. Shoes were placed on a jack with the bottom facing upwards, the upper having previously been pulled over by hand with pincers. When the shoe was presented to the machine, the upper was wiped over the insole before the machine delivered a tack from a stationary tacking head. The jack rotated so that all parts of the shoe could be presented to the tacker head. Originally designed for flat lasting, the machine had been modified by 1897 to process welted shoes.

CONSOL LASTERS

Jan Matzeliger was granted a patent in 1883 for a Hand Method Lasting Machine, so called because it replicated the movements of manual lasting. Following a number of years of development, the Consolidated Hand Method Lasting Machine was introduced commercially in 1890. This machine, usually referred to as the 'Consol', could work on all types of leather from the lightest to the heaviest. It could also process men's, women's and children's work without requiring any adjustment.

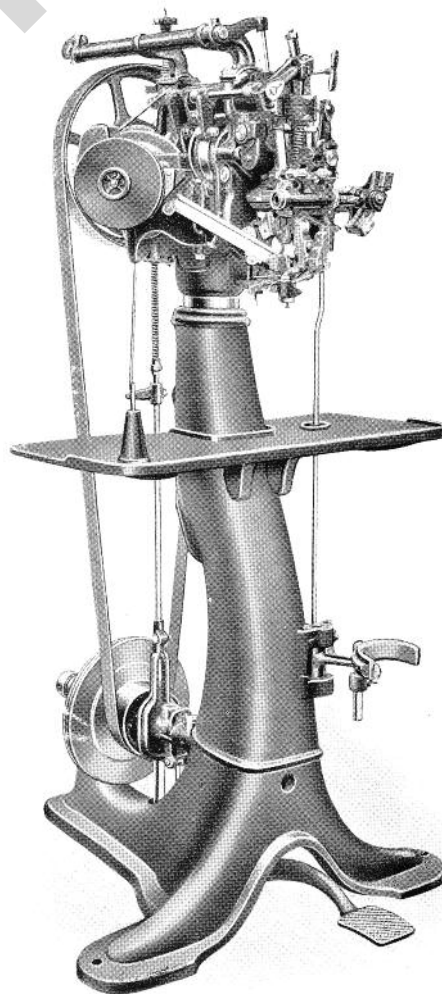
The upper having been pulled over and fastened with three or five tacks, the shoe was presented bottom upwards to the machine. The upper was drawn over by a pair of power-operated pincers and after each pull a tack was driven in to secure upper to insole. Tension was adjustable for different leathers. The pincer could also be set at any angle in relation to the side of the shoe thereby ensuring it exactly replicated the hand operation and could last all round the shoe making neat pleats at toe and seat as necessary. The Consol quickly gained international acceptance due to its versatility, ease of use and quality of finished product.

PULL-OVER MACHINES

It is strange to note that pulling over, the first operation in the lasting sequence, was the last to be mechanised. The first machine to do

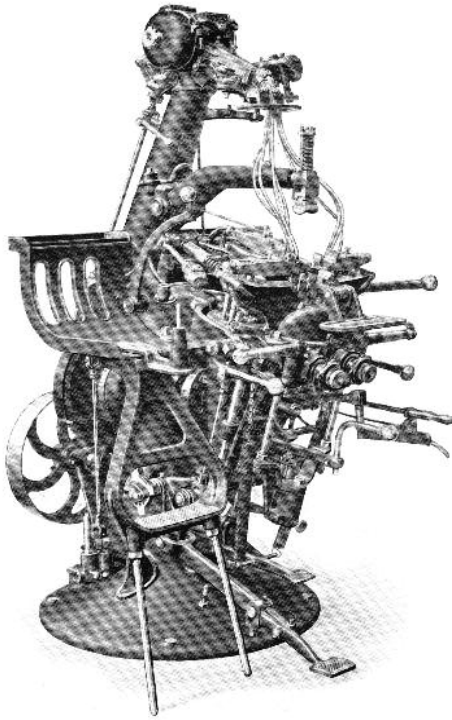
this successfully was the Consolidated Hand Method Pulling Over Machine in about 1897. The upper was placed with the toe pointing upwards and the upper outwards towards the operator. Five pairs of pincers gripped the upper, one at the toe and two at each side of the forepart. The toe pincers pulled first, with the others following closely. If the upper was not straight, it could be released and readjusted. A second depression of the treadle activated wipers and simultaneously released the pincers. The wipers then held the upper in place while the tacks were driven in.

An easier, and certainly more comfortable, machine for the operator was introduced about 1901. Using the principles of the earlier machine, the shoe was this time located with the upper facing upwards towards the operator, thus making it easier to adjust the position of caps and decoration on the vamp. Like the Consol, it could process all types and sizes of shoe and cope with all types and qualities of



Hand Method Lasting Machine (Consol).

CREDIT: DAVID HOLMES



National Pulling Over Machine.

CREDIT: DAVID HOLMES

leather. Introduction of the pulling over machine effectively completed mechanisation of the industry. By 1914, very few factories existed that did not use all the key machines introduced during the previous forty years.

CONSOLIDATION

The period between 1918 and 1939 was not one of major change in lasting technology but rather one of consolidation, with models introduced during the previous period updated and improved. Technical effort centred on increasing output and reducing the amount of labour required. Machines were also modified to cope with changes in shoe construction and design.

The focus post-1945 was one of reducing the cost of production, initially due to labour shortages and later to meet the threat from lower labour cost producers. Lasting was normally completed in four operations: pulling over followed by toe, seat and side lasting, so designers concentrated on reducing this number so that fewer operators would be required. The answer was to build a machine that would combine pulling over and toe lasting in one operation. Major developments in adhesives also now made it possible to design a machine that did not require a tack delivery mechanism and was therefore cheaper to produce.

EARLY PULL-TOE LASTERS

The first pull-toe lasters appeared at the beginning of the 1960s among which was the USM Combined Pulling and Lasting Machine. It was so successful that it became a template for all future development of this type of machine. It still required an extremely high degree of operator skill however as last and upper had to be clamped perfectly so that they were well centred and the upper then adjusted using manual controls prior to the actual lasting sequence. The lasting margins of both upper and insole were pre-cemented with neoprene adhesive which was activated by heated wiper plates and this often led to problems of the upper slipping if the dwell time was insufficient.

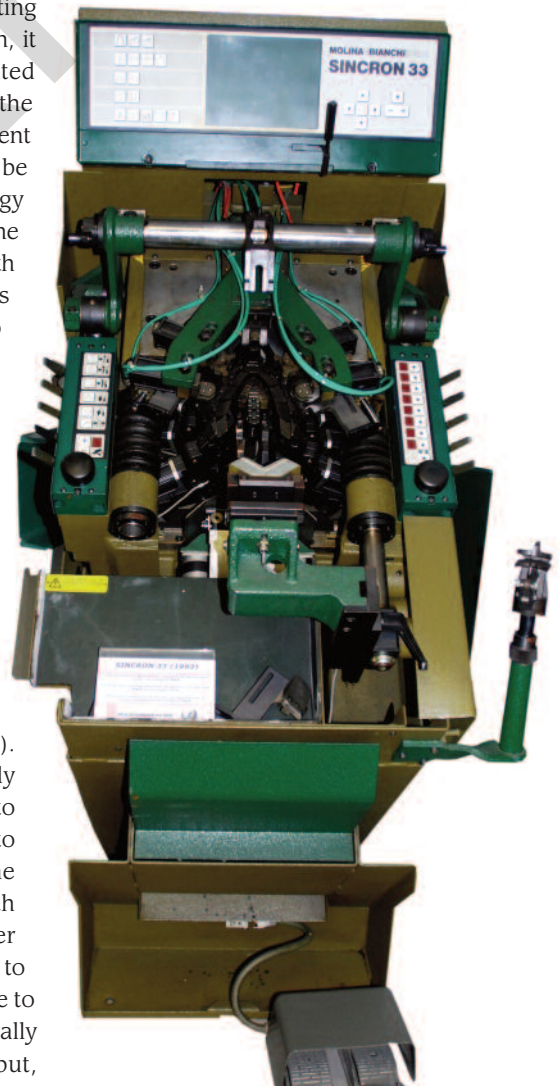
The 1970s saw a breakthrough in adhesive technology with the introduction of thermoplastic or 'hot-melt' adhesive which could be injected directly onto the insole and would then set almost immediately as the lasting margin was wiped in. To begin with, it was in granular form and heated externally before being fed to the injectors. While a great improvement on neoprene, the system proved to be expensive in terms of energy consumption and material waste. The answer came later in the decade with the introduction of rod cement. This enabled machine improvements to be made that greatly reduced both problems and also reduced the size of melting and injecting systems.

MAJOR ADVANCES

The 1980s were a time of major advances in the way machines operated, the first of which involved microprocessors. At that time, lasting machines all functioned using either pneumatic or hydraulic systems activated by telemechanics (remote control). Microprocessors enabled fully electronically controlled machines to be built that were faster and easier to maintain. They also led to the development of machines with simple managing computer applications that made it possible to quickly switch from one style of shoe to another without having to manually reset the machine every time but, simply, move from one pre-arranged program to another.

The other big change came about with regard to seat and side lasting machines. There were still three operations in lasting a shoe, toe, seat and sides, and manufacturers were pushing for a further reduction in order to save labour costs. Thanks to the degree of automation provided by microprocessors, a new breed of machine appeared that was able to last the seat and sides in one operation so that only two operators were now needed to last a shoe.

Advances in the management and control of lasting machines continued into the 1990s when Molina e Bianchi became the first to design and produce a pull-toe laster operated by electronic actuators. The advantage of this new concept was a machine where all the movements in the pulling and lasting cycle could be finely regulated to provide maximum precision combined with high machine efficiency. The machine was the Sincron 33 which



The ground breaking Sincron 33.

CREDIT: MOLINA E BIANCHI SPA



The first pull-toe lasters had complex manual controls. CREDIT: MOLINA E BIANCHI SPA

electronic control has seen the user interface become increasingly important, firstly through alphanumeric displays and, more recently, touch screens. Easier use and exchange of outside information has also been made possible with barcode reading, RFID and remote assistance systems. Even so, all machines still retain to varying degrees, electro-mechanical controls and functions.

Two further innovations have come from another Italian company, Cerim. The first is the use of water-based adhesive instead of hot-melt. This is currently exclusive to Cerim and covered by a patent application. It has been developed in response to the push for ever more eco-friendly materials in footwear production and, once again, to reduce energy consumption and cost. The water-based adhesive is applied cold on its K78TP machine (see also *World Footwear May/June 2013*) and therefore requires a fraction of the energy needed to melt a thermoplastic one.

The second (also exclusive and covered by a patent application) is a system to help the operator ensure consistent quality lasting even if they are not particularly skilled. Referred to as a 'calibrator', it makes a comparison between the shoe presented for lasting and a previously stored reference image in order to show the operator what the machine settings should be and how to proceed. We have indeed come a very long way from the old shoemaker sitting at his bench and lasting each shoe by hand. One wonders what he would think of today's state-of-the-art lasting machines where science has largely replaced skill but still produces a top quality result at a speed he could never have envisaged. 📌

went on to become a blueprint for a new generation of machines, the evolution of which has continued to this day. The Sincron Zero appeared in 1997 and proved so effective that, with various improvements, it remained in production until the Sincron TS appeared in 2012.

THE LATEST TECHNOLOGY

With the Sincron TS, the managing system has taken another step forward and now uses an advanced numeric control. Above all, its main feature is flexibility in that the time needed to switch from one style of shoe to another is very brief and programmable functions are unlimited. This is all made possible by the use of a multifunction video camera which not only provides an innovative system of data identification that instantly recognises the insole profile and sends the data to the program controlling adhesive distribution, but also informs the operator.

Like many of today's footwear producing machines, particular attention has been paid to its environmental impact by the use of recyclable materials and new mechanical actuators that reduce adhesive wastage. The software has been designed to reduce energy waste by controlling the machine's hydraulics on the 'start and stop' principle to drastically reduce energy consumption when it is both operating and at rest. Seat and side lasting machines have followed the same route and the two types of machine are able to exchange data in order to follow the same lasting programs, either via wi-fi or by direct cable link.

There has also been a need to make machines as flexible as possible in order to meet the needs of shoe manufacturers forced by lower price competitors to move up-market in terms of quality and, as a consequence, to produce more styles in smaller quantities. This focus on



Special injectors are used for water-based adhesive on the Cerim K78TP. CREDIT: MOLINA E BIANCHI SPA