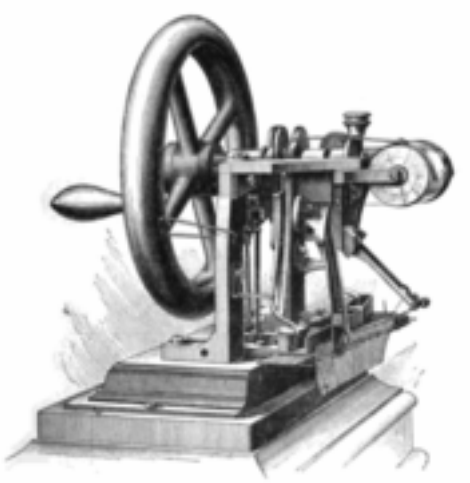
Sewing machine

A sewing machine is a textile machine used to stitch fabric or other material together with thread. Sewing machines were invented during the first Industrial Revolution with the intention of decreasing the amount of manual sewing work performed in cloth companies. Since the invention of the first working sewing machine, generally considered to have been the work of Englishman Thomas Saint in 1790,[1] the sewing machine has vastly improved the efficiency and productivity of fabric and clothing industries.



Elias Howe's lockstitch machine, invented 1845

Though some older machines use a chain stitch, the basic stitch of a modern sewing machine consists of two threads and is known as lockstitch, though industrial machines are usually specialized for a specific task, and so different machines may produce a different type of stitch. Modern sewing machines are designed in such a way that the fabric easily glides in and out of the machine without the hassle of needles and thimbles and other such tools used in hand sewing, automating the process of stitching and saving time.

The fabric shifting mechanism may be a simple workguide or may be pattern-controlled (e.g., jacquard type). Some machines can create embroidery-type stitches. Some have a work holder frame. Some have a workfeeder that can move along a curved path, while others have a workfeeder with a work clamp. Needle guards, safety devices to prevent accidental needle-stick injuries, are often found on modern sewing machines. This section does not cite any references or sources. (October 2007)
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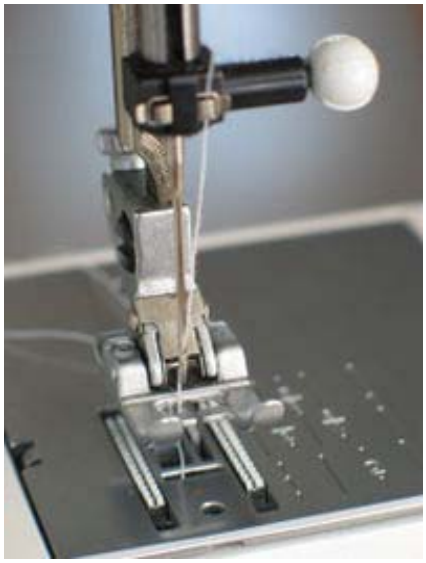


Needle plate, foot and transporter of a sewing

The main stitch of most older sewing machines, chain stitch, has one major drawback – it is very weak and the stitch can easily be pulled apart [2]. When the machines started being used, people realized a stitch more suited to machine production was needed, and it was found in the lock stitch. A lock stitch is created by two separate threads interlocking through the two layers of fabric, resulting in a sturdier stitch that looks the same from both sides of the fabric.

History of the Sewing Machine

In 1790 British inventor Thomas Saint was the first to patent a design for a sewing machine[4]. His machine was meant to be used on leather and canvas. A working model was never built.

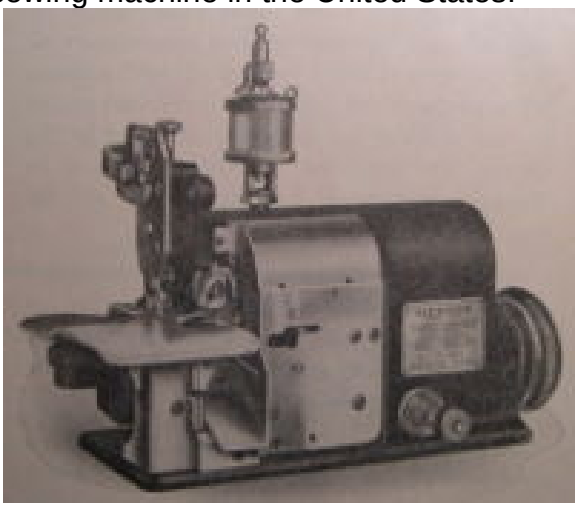
In 1830 a French tailor, Barthélemy Thimonnier, patented a sewing machine that sewed straight seams using chain stitch. By 1841, Thimonnier had a factory of 80 machines sewing uniforms for the French Army. The factory was destroyed by rioting French tailors afraid of losing their livelihood. Thimonnier had no further success with his machine.

Singer sewing machine

Although the credit for the lock stitch machine is generally given to Elias Howe, Walter Hunt developed it first over ten years before, in 1834[5]. His machine used an eye-pointed needle (with the eye and the point on the same end) carrying the upper thread, and a shuttle carrying the lower thread. The curved needle moved through the fabric horizontally, leaving the loop as it withdrew. The shuttle passed through the loop, interlocking the thread. The feed let the machine down – requiring the machine to be stopped frequently to set up again. Hunt eventually lost interest his machine and sold it without bothering to patent it.

In 1842, John Greenough patented the first sewing machine in the United States.

Elias Howe patented his machine in 1845; using a similar method to Hunt's, except the fabric was held vertically. The major improvement he made was to put a groove in the needle running away from the point, starting from the eye. After a lengthy stint in England trying to attract interest in his machine he returned to America to find various people infringing his patent. He eventually won his case in 1854 and was awarded the right to claim royalties from the manufacturers using ideas covered by his patent.

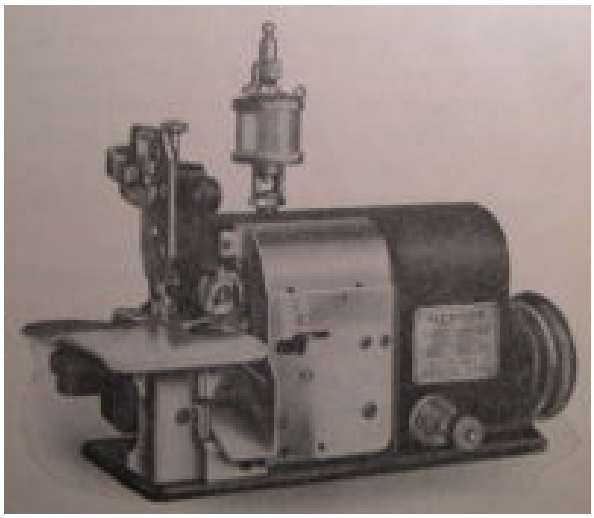


A Merrow A-Class machine

Isaac Merritt Singer has become synonymous with the sewing machine. Trained as an engineer, he saw a rotary sewing machine being repaired in a Boston shop. He thought it to be clumsy and promptly set out to design a better one. His machine used a flying shuttle instead of a rotary one; the needle was mounted vertically and included a presser foot to hold the cloth in place. It had a fixed arm to hold the needle and included a basic tensioning system.

This machine combined elements of Thimonnier's, Hunt's, and Howe's machines. He was granted an American patent in 1851 and it was suggested he patent the foot pedal (or treadle) used to power some of his machines; however, it had been in use for too long for a patent to be issued. When Howe learned of Singer's machine he took him to court. Howe won and Singer was forced to pay a lump sum for all machines already produced. Singer then took out a license under Howe's patent and paid him $15 per machine. Singer then entered a joint partnership with a lawyer named Edward Clark,

and they formed the first hire-purchase (time payment) scheme to allow people to afford to buy their machines.



A Merrow 70-Class machine(2007)

Meanwhile Allen Wilson had developed a reciprocating shuttle, which was an improvement over Singer's and Howe's. However, John Bradshaw had patented a similar device and was threatening to sue. Wilson decided to change track and try a new method. He went into partnership with Nathaniel Wheeler to produce a machine with a rotary hook instead of a shuttle. This was far quieter and smoother than the other methods, and the Wheeler and Wilson Company produced more machines in 1850s and 1860s than any other manufacturer. Wilson also invented the four-motion feed mechanism; this is still seen on every machine today. This had a forward, down, back, and up motion, which drew the cloth through in an even and smooth motion.

Through the 1850s more and more companies were being formed and were trying to sue each other. Charles Miller patented the first machine to stitch buttonholes (US10609). In 1856 the Sewing Machine Combination was formed, consisting of Singer, Howe, Wheeler and Wilson, and Grover and Baker. These four companies pooled their patents, meaning that all the other manufacturers had to obtain a license and pay $15 per machine. This lasted until 1877 when the last patent expired.

In the 1840s a machine shop was established at the Merrow mill to develop specialized machinery for the knitting operations. In 1877 the world's first crochet machine was invented and patented by Joseph M. Merrow, then-president of the company. This crochet machine was the first production overlock sewing machine. The Merrow Machine Company went on to become one of the largest American Manufacturers of overlock sewing machines, and continues to be a global presence in the 21st century as the last American overlock sewing machine manufacturer.

James Edward Allen Gibbs (1829-1902), a farmer from Raphine in Rockbridge County, Virginia patented the first chain-stitch single-thread sewing machine on June 2, 1857. In partnership with James Wilcox, Gibbs became a principal in Wilcox & Gibbs Sewing Machine Company. Wilcox & Gibbs commercial sewing machines are still used in the 21st century.

In 1905 Merrow won a lawsuit against Wilcox & Gibbs for the rights to the original crochet stitch.

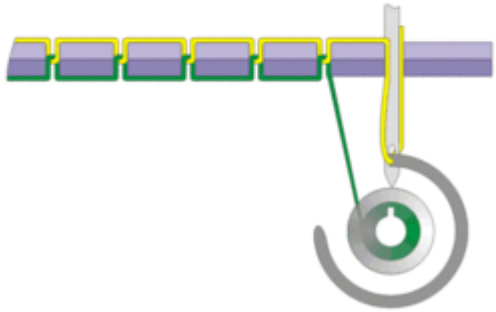
Sewing machines continued being made to roughly the same design, with more lavish decoration appearing until well into the 1900s when the first electric machines started to appear. The first electric machines were developed by Singer Sewing Co. and introduced in 1889[6]. At first these were standard machines with a motor strapped on the side. As more homes gained power, these became more popular and the motor was gradually introduced into the casing.

In 1946, the first TOYOTA sewing machine was built under the strict supervision of TOYOTA founder, Mr. Kiichiro Toyoda. Mr. Toyoda had a strong belief that home-use products must be "functional yet beautiful".

Modern machines may be computer controlled and use stepper motors or sequential cams to achieve very complex patterns. Most of these are now made in Asia and the market is becoming more specialized, as fewer families own a sewing machine.

Stitch formation

Sewing machines can make a great variety of plain or patterned stitches. Ignoring strictly decorative aspects, over three dozen distinct stitch formations are formally recognized by the ISO 4915:1991 standard (for a summary see [3], [4], or [5]), involving one to seven separate threads to form the stitch. Plain stitches fall into four general categories: lockstitch, chainstitch, overlock, and coverstitch.



Lock stitch is the familiar stitch performed by most household sewing machines and most industrial "single needle" sewing machines from two threads, one passed through a needle and one coming from a bobbin or shuttle. Each thread stays on the same side of the material being sewn, interlacing with the other thread at each needle hole. Industrial lockstitch machines with two needles, each forming an independent lockstitch with their own bobbin, are also very common.

Chain stitch is less widely used than lockstitch, but it is preferred over lockstitch for applications like sealing bags of grain, garment seams likely to be altered, and as a "safety stitch" on serging machines. A chain stitch may be formed with either one or two distinct threads, one passed through a needle and the other, if used, manipulated by a looper, a device which moves back and forth but does not pass through the fabric. The needle thread is formed on both sides of the material being sewn, and on the bottom of the material either crosses through loops of itself (single thread) or loops of the second thread to prevent it from pulling back to the top of the material. Most household chainstitch machines are either very old, or toys intended for children. Industrial chainstitch machines are still heavily used in their application areas.

Lockstitch and chainstitch can be formed any distance from the edge of the material being sewn.

Overlock can only be formed at the edge itself, where one or more threads pass over the edge. Varieties of overlock stitch can be formed with one to four threads, one or two needles, and one or two loopers. Overlock sewing machines are usually equipped with knives that trim or create the edge immediately in front of the stitch formation. Household and industrial overlock machines are commonly used for garment seams in knit or stretchy fabrics, for garment seams where a clean finish is not required, and for protecting edges against ravelling. Machines using two to four threads are most common, and frequently one machine can be configured for several varieties of overlock stitch. Overlock machines with five or more threads usually make both a

chainstitch with one needle and one looper, and an overlock stitch with the remaining needles and loopers. This combination is known as a "safety stitch". Household overlock machines are widely used.

Coverstitch is formed by two or more needles and one or two loopers. Like lockstitch and chainstitch, coverstitch can be formed anywhere on the material being sewn. One looper manipulates a thread below the material being sewn, forming a bottom cover stitch against the needle threads. An additional looper above the material can form a top cover stitch simultaneously. The needle threads form parallel rows, while the looper threads cross back and forth all the needle rows. Coverstitch is so-called because the grid of crossing needle and looper threads covers raw seam edges, much as the overlock stitch does. It is widely used in garment construction, particularly for attaching trims and flat seaming where the raw edges can be finished in the same operation as forming the seam. Machines with three needles are most common, and can be configured to use any two or all three of the needles. Machines with six or more needles are often used for applications like fastening elastic waistbands to garments. Household coverstitch machines are fairly rare, but are becoming more readily available.

Feed mechanisms_____

Besides the basic motion of needles, loopers and bobbins, all but the most trivial of stitches also requires the material being sewn to move so that each cycle of needle motion involves a different part of the material. This motion is known as feed, and sewing machines have almost as many ways of feeding material as they do of forming stitches. For general categories, we have: drop feed, needle feed, walking foot, puller, and manual. Often, multiple types of feed are used on the same machine. Besides these general categories, there are also uncommon feed mechanisms used in specific applications like edge joining fur, making seams on caps, and blindstitching.

Drop feed involves a mechanism below the sewing surface of the machine. When the needle is withdrawn from the material being sewn, a set of "dogs" is pushed up through slots in the machine surface, then dragged horizontally past the needle. The dogs are serrated to grip the material, and a "presser foot" is used to keep the material in contact with the dogs. At the end of their horizontal motion, the dogs are lowered again and returned to their original position while the needle makes its next pass through the material. While the needle is in the material, there is no feed action. Almost all household machines and the majority of industrial machines use drop feed. Differential feed is a variation of drop feed with two independent sets of dogs, one before and one after the needle. By changing their relative motions, these sets of dogs can be used to stretch or compress the material in the vicinity of the needle. This is extremely useful when sewing stretchy material, and overlock machines (heavily used for such materials) frequently have differential feed.

Needle feed moves the material while the needle is in the material. In fact, the needle may be the primary feeding force. Some implementations of needle feed rock the axis of needle motion back and forth, while other implementations keep the axis vertical while moving it forward and back. In both cases, there is no feed action while the needle is out of the material. Needle feed is often used in conjunction with a modified drop feed, and is very common on industrial two needle machines. The advantage of needle feed over drop feed is that multiple layers of material, especially slippery material, can not slide with respect to one another, since the needle holds all layers

together while the feed action takes place. Household machines do not use needle feed as a general rule.

A walking foot replaces the stationary presser foot with one that moves with the feed. A machine might have a single walking foot, or two walking feet with alternating action, and either drop feed or needle feed might be used as well. Walking foot feed is most often used for sewing heavy materials where needle feed is mechanically inadequate. It is also helpful with spongy or cushioned materials where lifting the foot out of contact with the material helps in the feeding action. Only a very few household machines have a walking foot, but this type of feed is common in industrial heavy duty machines.

Factory machines are sometimes set up with an auxiliary puller feed, which grips the material being sewn (usually from behind the needles) and pulls it with a force and reliability usually not possible with other types of feed. Puller feeds are seldom built directly into the basic sewing machine. Their action must be synchronized with the needle and feed action built into the machine to avoid damaging the machine. Pullers are also limited to straight seams, or very nearly so. Despite their additional cost and limitations, pulling feeds are very useful when making large heavy items like tents and vehicle covers.

Manual feed is used primarily in freehand embroidery, quilting, and shoe repair. With manual feed, the stitch length and direction is controlled entirely by the motion of the material being sewn. Frequently some form of hoop or stabilizing material is used with fabric to keep the material under proper tension and aid in moving it around. Most household machines can be set for manual feed by disengaging the drop feed dogs. Most industrial machines can not be used for manual feed without actually removing the feed dogs.

Finally, we turn to zig-zag and decorative stitches. Household machines perform only lockstitch, but almost all of them can do so in many different directions. By moving the needle from side to side, and changing the feed direction and distance, both fancy and utilitarian patterns can be sewn. The simplest example is zig-zag, where the needle moves to the left for one pass through the material, then to the right for the next pass. A household "blind stitch" takes several stitches in a straight line followed by one stitch to the right, then back to the original line. In older machines, the needle and feed motion is controlled by mechanical cams. Some household machines even offer a slot for user-replaceable custom stitch cams. In more recent designs, the needle and feed motion is controlled by electric motors. By adding controlled motion of the material being sewn through an additional set of motors, arbitrary customized patterns of 100cm or more in each direction can be sewn, opening the door to the very popular category of programmable household embroidery machines.

While even extremely basic household sewing machines have zig-zag and a small selection of other stitch patterns, industrial machines do not. Industrial zig-zag machines are available, but uncommon. There are essentially no fancy-pattern stitching industrial machines, other than dedicated embroidery and edge decoration machines. Most industrial machines sew only a straight line of stitches. Even something as simple as a bar-tack or a buttonhole stitch is usually done by a dedicated machine incapable of doing anything else. When a variety of decorative stitching is required rather than a single stitch, a "commercial" machine (basically a heavy duty household machine) is usually employed.