

HOSIERY, a term used to designate all manufactured textile fabrics which in their process of manufacture have been built on the principle of looping or loop structure. The origin of the term is obvious, being derived from "hose" or stocking, this being one of the earliest garments made by the process of knitting (*q.v.*). While it still forms one of the staples of the trade, it is only one of a very numerous and diversified range of applications of the entire industry. The elastic structure of knitting makes it very adaptable for all kinds of body or underwear. There is scarcely a single textile article manufactured but can be reproduced on the knitting or loop structure principle. The art of knitting is of very modern origin as compared with that of weaving. No certain allusion to the art occurs before the beginning of the 15th century. In an act of parliament of Henry VII. (1488) knitted woollen caps are mentioned. It is supposed that the art was first practised in Scotland, and thence carried into England, and that caps were made by knitting for some period before the more difficult feat of stocking-making was attempted. In an act of Edward VI. (1553) "knitte hose, knitte peticotes, knitte gloves and knitte sleeves" are enumerated, and the trade of hosiers, among others, included in an act dated 1563. Spanish silk stockings were worn on rare occasions by Henry VIII., and the same much-prized articles are also mentioned in connexion with the wardrobe of Edward VI.

Knitting, or loop formation by mechanical means, is divided into two distinct principles—frame-work knitting and warp knitting. Both principles may be employed in the formation of a large variety of plain and fancy stitches or a combination of the two.

Frame-work Knitting in its simplest form consists of rows of loops supporting each other—built from one continuous thread of yarn and running from one side of the fabric to the other and back

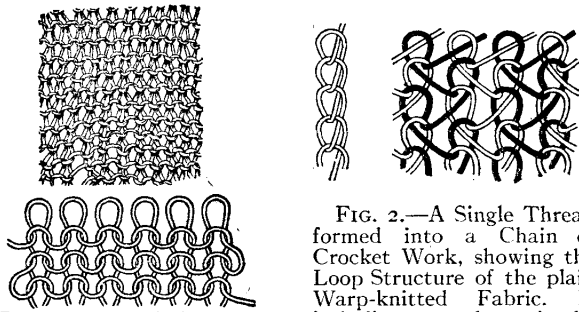


FIG. 1.—The Stitch or Loop Structure of Plain Knitting (back of fabric).

(fig. 1). It is on this principle of stitch that the greatest amount of hosiery is built (hose, shirts, pants).

Warp Knitting in its simplest form consists of rows of loops, but the number of threads employed are equal to the number of loops in the width of the fabric. Thus it will be seen that the threads run lengthwise of the fabric (fig. 2). This principle gives greater scope for reproducing designs in openwork and colour than that of

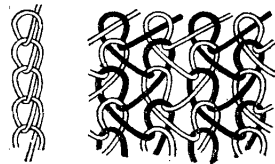


FIG. 2.—A Single Thread formed into a Chain of Crocket Work, showing the Loop Structure of the plain Warp-knitted Fabric. It is built up as shown in the diagram by a number of threads running up the fabric.

frame-work knitting. For this reason it is largely used in the shawl, glove and fancy hosiery industries.

Machinery.—In hand knitting the implements employed (a few needles or wires) are very simple and inexpensive. In the manufacturing industry the most complex and ingenious machinery is used. In 1589 the Rev. William Lee, a graduate of St John's College, Cambridge, while acting as curate (or vicar) of Calverton, Nottinghamshire, introduced his stocking-frame. This machine was the first mechanical means employed to produce a looped or knitted fabric. This frame or machine of Lee's was the origin of all the hosiery and lace machines at present in use. One of the most remarkable points about his invention was its completeness and adaptability for the work for which its inventor intended it. The main principles of Lee's frame are embodied in most of the rotary or power frames of the present day. Fig. 3 shows a hand frame of the present day.

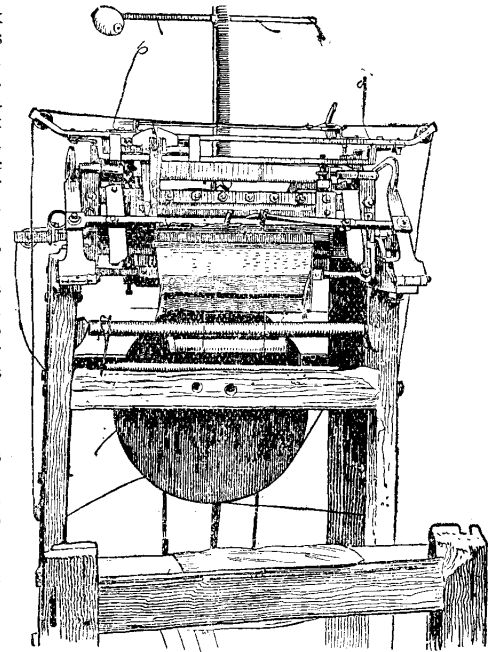


FIG. 3.—Hand Stocking Frame.

In hand knitting an indefinite number of loops are skewered on a wire or pin, but, in Lee's frame, an individual hooked or bearded needle is employed for the support and formation of each loop in the breadth of the fabric. This needle consists of a shank with a terminal spring-pointed hook (or beard), the point of which can be pressed at will into a groove or eye in the shank. For method by which the loops are formed on the needles of the frame see fig. 4. This shows a few of Lee's hooked or bearded needles having the old loops or work hanging round the needle shanks. The thread of yarn which is to form the new row of loops is laid over the needle shanks and waved or looped between each pair of needles. This waving or looping ensures sufficient yarn being drawn and loops of a uniform size being made, so that a regular and level fabric will be produced. The looping or waving is obtained by having thin plates of shaped metal, called sinkers, which have a nose-shaped point

and hang between the needles. When looping they have an individual movement downwards between the needles, and as they fall the nose-shaped point carries the yarn down, thus forming the new loop (fig. 5). The size of the loop is regulated by the distance the sinker is allowed to fall. After the thread of yarn has been looped between the needle shanks by the sinkers, the loops are brought forward under the needle beards or hooks. A presser bar is now brought down to close or press all the points of the needle beards into the eye in the shank. Thus all the hook ends of the needles are temporarily closed, with the newly formed loops under them. While in this position, the old loops hanging round the shank are brought forward and landed on to the top of the needle beard and off the needle altogether, being thus left hanging round, or supported by the loops newly formed. The needle beards are now released, and the loops drawn back along the shanks to be in position for next new course of loops. The foregoing is only an outline of how the loops are formed on the needles. It is not necessary here to enter into a description of the complex mechanical movements of Lee's stocking-frame. The first fabric made by Lee was of a

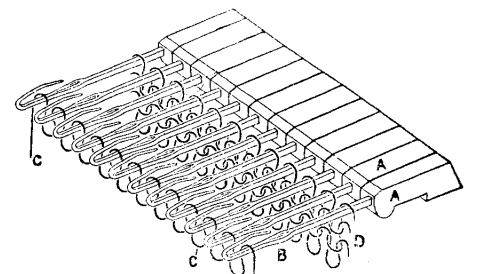


FIG. 4.

- A, The leads into which the needles (B) are cast.
- D, The old loops or work.
- C, The new loops formed and brought under the beards.

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D, The old loops or work.
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flat, even-selvedged nature, so that garments had to be cut to shape from the fabric. He soon learned to fashion or shape the garment at will, during the process of making, by transferring loops

practised his new art for a few years at Calverton he removed to London, but on his receiving no help or encouragement from Queen Elizabeth or her successor, King James, he was induced to cross over to France with his frames. There he built up a flourishing industry at Rouen, under the patronage of the French king, Henry IV. Through the murder of this monarch he lost his patronage and died of want about the year 1610. He was buried in an unknown grave in Paris.

A number of improvements had been made on Lee's frame during the 18th century. The one of greatest importance was the rib machine invented by Jedediah Strutt of Belper in 1758. It was not what could be actually termed an improvement on Lee's frame, but an addition to it. Lee's frame was not altered in any way, Strutt's machine being added to it, and the two being worked in conjunction produced a fabric of a more elastic nature and alike on both sides (fig. 6).

Strutt's machine consisted of a set of needles placed at right angles to and between Lee's plain needles, with the result that, when knitting, the frame needles drew their loops to one side and the machine needles their loops to the opposite side of the fabric. The first offshoot from frame-work knitting was the invention of the hand warp loom in 1775. It was improved by the addition of the Dawson wheel by William Dawson in 1791.

This machine is the origin of the various complex machines now working on this principle. Some of these have Jacquard mechanism attached, and nearly all of them are driven by motive power. About the middle of the 19th century close on 50,000 of Lee's hand frames were in use, finding employment for nearly 100,000 persons. Many attempts had been made previously to transform Lee's frame into a power or rotary frame. One of the first and most successful was that invented by Luke Barton in 1857. This frame was fitted with self-acting mechanism for fashioning, and was practically Lee's frame having rotary shafts with cams added to give the various movements, this type of frame being known as straight bar rotary frames. In 1864 William Cotton of Loughborough altered this frame by reversing the positions of the needles and sinkers. Although made by various builders it is still known as the "Cotton Patent Rotary Frame" (fig. 7). Since 1864 a great number of important improvements and additions have been made to this frame. Single frames are built which will turn off one dozen pairs of hose at once, with the attention of one person. One of the most important inventions in connexion with the hosiery trade was the latch, tumbler, or self-acting needle invented by Matthew Townsend and David Moulding of Leicester in 1858. Previous to this Lee's type of needle was the only one in use. This latch-needle (fig. 8) consists of a stem having a butt at lower end by which it receives its knitting action from cams,

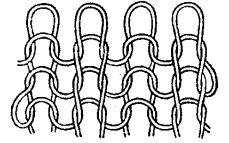


FIG. 6.—A 1/2 Rib Stitch.

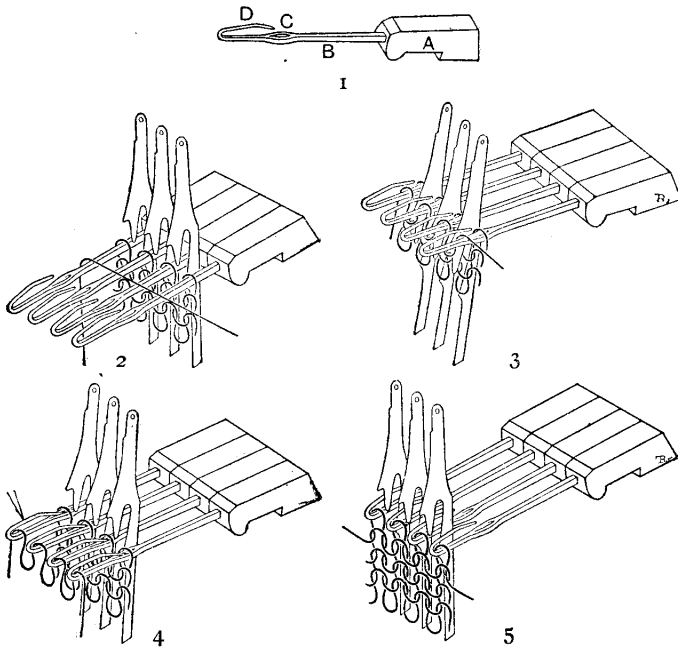


FIG. 5.—Formation of a Loop on a Hand Frame.

- 1, Bearded needle cast in the lead. A, Lead; B, Shank; C, Eye; D, Beard.
- 2, The thread is laid over the needles and formed into loops between the needles by means of the sinkers, those new-formed loops being brought under the needle beards (as at 3).
- 4, The beards pressed or closed to allow the old loops to be passed on to the top.
- 5, The old loops knocked off the needles and left hanging round the newly formed loops.

at the edges, inwards to narrow, or outwards to widen. This process at the present day is known as fashioning, and all garments of the best make are shaped or fashioned in this manner. After Lee had

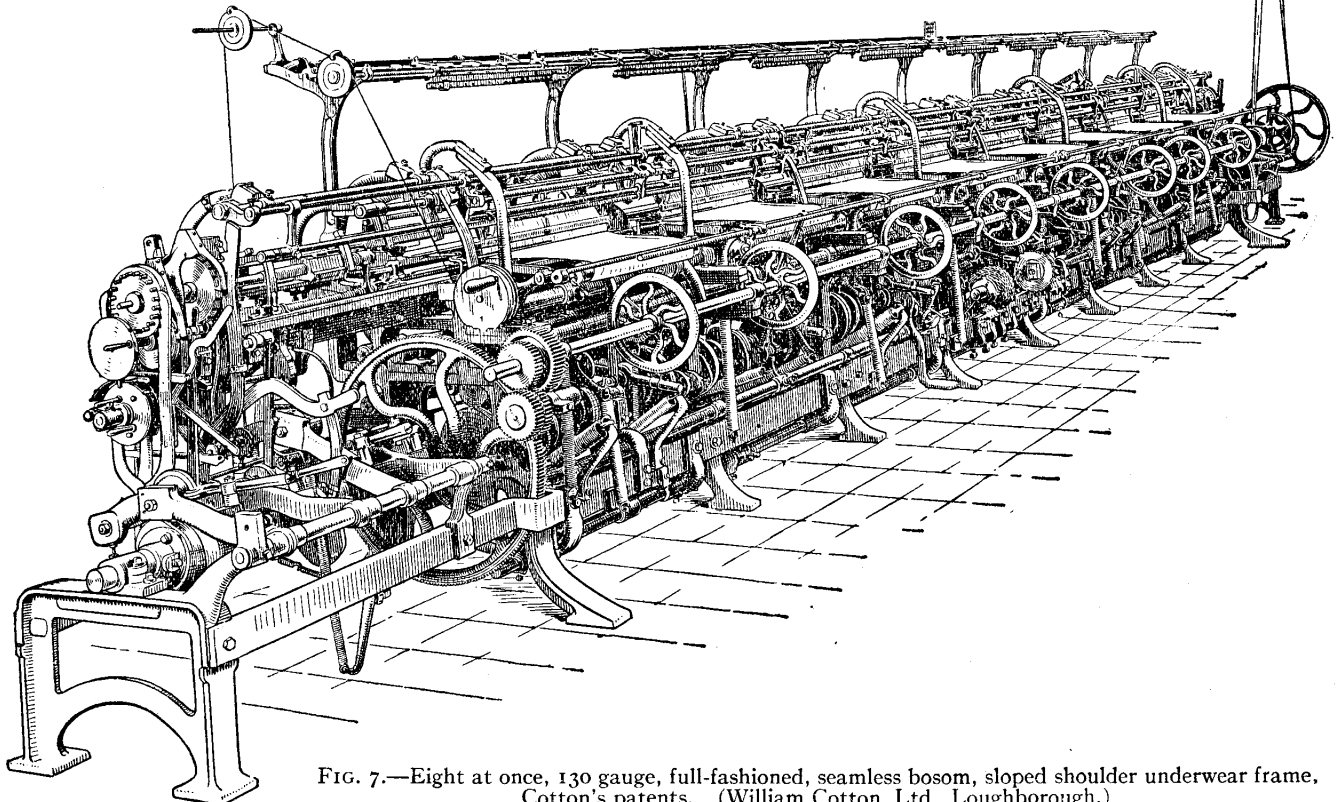


FIG. 7.—Eight at once, 130 gauge, full-fashioned, seamless bosom, sloped shoulder underwear frame, Cotton's patents. (William Cotton, Ltd., Loughborough.)

the upper end being turned into a hook. Near the hook end and attached to the stem by a pin is the spoon-shaped latch, which closes over the hook as required. Machines fitted with latch-

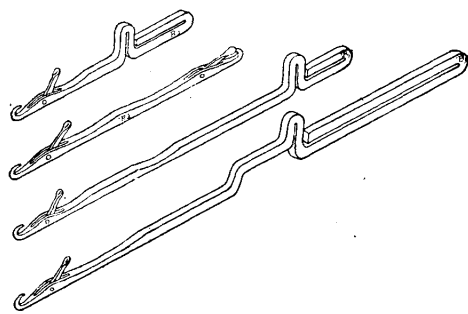


FIG. 8.—Various Shapes of the Latch Needle.

needles have grooves in which the stem of the needle works. Cams, which act on the needle butts, give the needles their individual knitting action in rotation. This needle is self-acting, in that it is made to draw its own loop, sinkers being dispensed with.

Fig. 9 shows the looping action of this needle. The needles when not knitting have a loop round their shank, thus hold-

ing the latch open. When about to knit, they are raised individually and in rotation (by the cams acting on the needle butts) to receive the new loop of yarn.

Down till almost the middle of the 19th century only a flat web could be knitted in the machines in use, and for the finishing of stockings, &c., it was necessary to seam up the selvages of web shaped on the frame (fashioned work), or to cut and seam them from even web (cut work). The introduction of any device by which seamless garments could be fabricated was obviously a great desideratum, and it is a singular fact that a machine capable of doing this was patented in 1816 by Sir Marc I. Brunel. This frame was the origin of the French-German loop-wheel circular frame of the present day. Brunel's frame was greatly improved by Peter Claussen of Brussels and was shown at an exhibition in Nottingham in 1845. This frame had horizontal placed needles fixed on a rotating rim. A few years later Moses Mellor of Nottingham transformed this type of frame by altering the position of the needles to perpendicular. This is now known as the English loop-wheel circular frame. After the invention of the latch-needle there was a revolution in the hosiery machine-building industry, new types of machines being

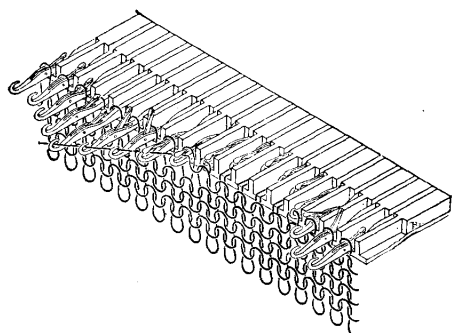


FIG. 9.—Individual Action of the Latch Needle.

invented, fitted to work with latch-needles. Among others there was the latch-needle circular frame, invented by Thomas Thompson, which was the origin of the English latch-needle circular frame, a frame largely used for the production of wide circular fabric.

A circular knitting machine of American origin is the type of machine on which is produced the seamless hosiery of to-day.

Like the sewing machine it is largely used in the home as well as in the factory. From this machine all the circular automatic power machines for making plain and rib seamless hose and half hose have been developed. The "flat" or "lamb" type of machine, an American invention, was introduced by J. W. Lamb in 1863. This machine has two needle beds or rows of needles sloping at an angle of nearly 90°.

A great many varieties of this type of machine have been invented for the production of all kinds of plain and fancy hosiery. It is built in small sizes to be wrought by hand or in large power machines. A large variety of sewing, seaming and linking machines are employed in the hosiery industry for the purpose of putting together or joining all kinds of hosiery and knitted goods. These machines have almost entirely superseded the sewing or joining of the garments by hand.

The principle centres in Great Britain of the hosiery industry are Leicester and Nottingham and the surrounding districts. It is also an industry of some extent in the south of Scotland. (T. B.*)