The Manufacture of Fancy Laces by Machine

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Manufacturing laces by machine is a highly developed branch of the textile industry, but in each country, it is almost without exception, confined to a small district or area. Practically all lace machines are built in Barmen and nearby.

The industry has developed remarkably well, many of the improvements made being protected by patents. There is hardly any literature available in any language, except patents. The few published articles available, in the main, cover designs of laces and the construction of machines. Scientific investigations are not available at all.

Practically all machines are built with the same gauge, i.e., 55 or 65 mm., and are operated between 140 and 160 revolutions per minute, as many years' experience has proven this range the best in actual practice. At a higher speed, there is more yarn (thread) breakage, especially with the finer yarns where frequent stoppages, decreased production, and the many knots made necessary by the breaks, lower the quality of the finished product. No matter how low the speed, it is impossible to use as fine yarns as are used in hand lace making.

Emil Krenzler of Barmen, in reducing the gauge from 55 mm. to 32 mm. has permitted the use of quite fine yarn. The small gauge machine makes possible, therefore, the production of very fine laces, and the production has been increased 100%. There is less space needed, less cost for the machine, and easier operation.

Hand Made Lace

The principle of making lace by hand, is shown by Figure 1. The bobbins are divided in pairs, i.e., a_1, a_2; b_1, b_2; c_1, c_2. The pairs of bobbins are interchanged, as can be seen, for instance, with a_1 and a_2, which are crossed half a turn with another pair. By repetition of the half turns, a "two-thread" lace is formed. See A—A. If it is desired to make wider interlacings, as, for instance, at B, then an interchange between the neighboring pair of threads takes place. Every thread alternates with the adjacent ones, over and under with a half turn. By ingenious interlacing, it is possible to produce the most varied designs.

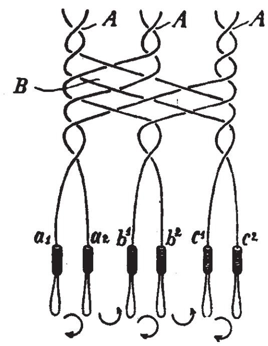

Figure 1

Figures 2 and 3 are samples of fancy machine made laces.

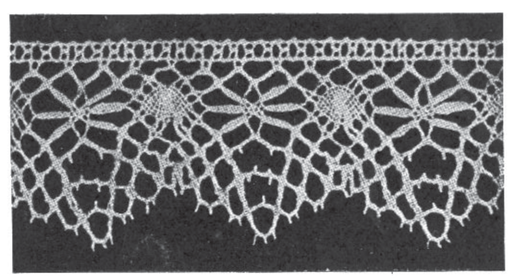

Figure 2

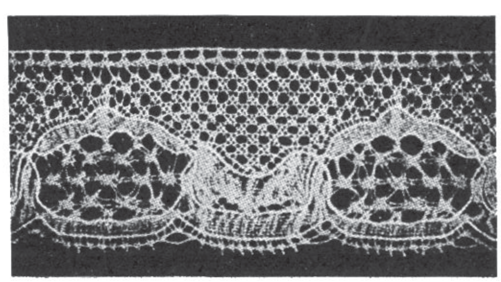

Figure 3

Editor's Note: Lace making is a branch of the textile industry about which textile men, as a rule, know but very little. This article, therefore, should be of educational interest to those in other divisions of the trade.

This same principle is carried out by mechanical means with machine made lace, as can be seen from Figure 4. The various

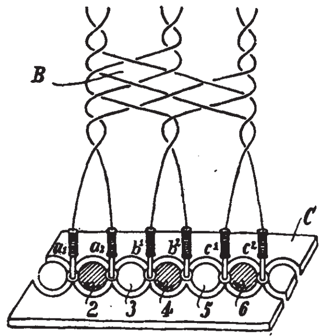

Figure 4

pairs of threads are grouped in rows with circular slits on plate C. The threads are guided in plate slits, 2, 3, 4, 5, and 6. A mechanism, underneath the plate, turns the even numbered threads, 2, 4, 6, etc., clockwise, and the uneven numbered, 3, 5, 7, etc., counter-clockwise. This operation is exactly the same as when done by hand. The threads are guided by means of "switches" or "couplings." Their motion is controlled by a Jacquard head, permitting designs of any description to be produced. Only one-half turn with any set of threads is carried out at one time, the other set of threads remaining motionless in the meantime, which is necessary to avoid interference of the bobbins holding the yarn. The machine works in a jerking manner as the threads are interchanged from one plate to another.

Machine Made Lace

Figure 5 is a photograph of a Jacquard lace machine manufactured by Gustav Krenzler, Barmen, Ger. Figure 6 is a cross-section drawing of this machine. Figures 7 and 8 show the details of important mechanisms of the same machine. As can be seen in detail from Figure 6, the machine consists

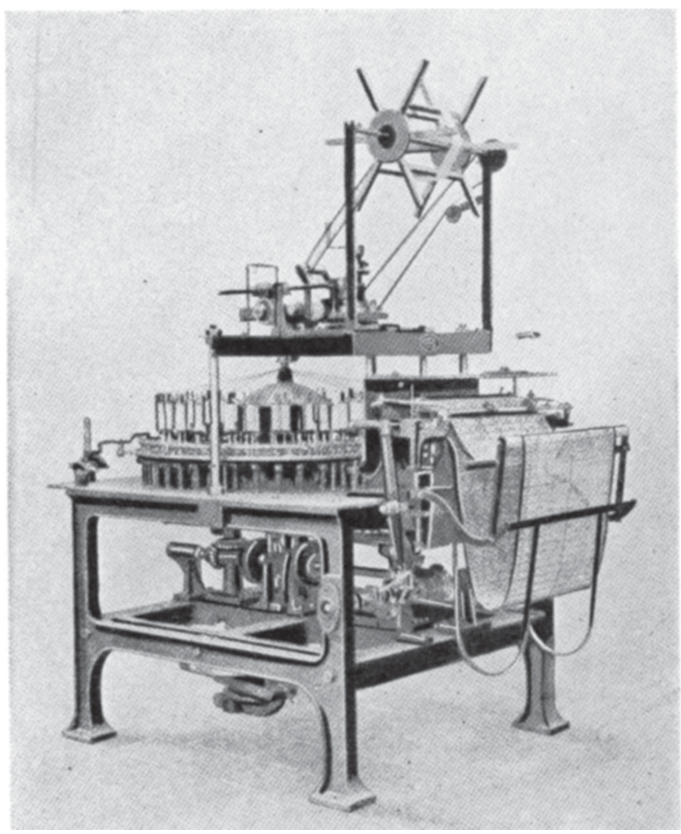

Figure 5

of a frame, 1, with a bottom plate, 4. A little above, is the motion plate, 6, holding the lace bobbins (yarn or thread). Between the bottom plate and motion plate, the driving mechanism (3) for the guide plates, is placed. This can be seen more plainly in Figure 8, and is described later on more fully.

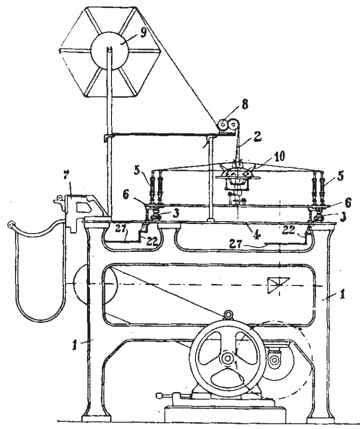

Figure 6

It should be noticed in Figure 5, that the guide plates with their lace bobbins, are placed around the machine in a circle. In the center is a spindle, around which the manufactured lace forms. At the top, this spindle ends in the shape of an S and is placed around the drawing-off rolls, 8 (Figure 6), from which the lace is wound on reel, 9. The tubular form of the lace is maintained by temporary stitches made in the machine. After the lace is finished, these threads are cut, and the material is spread out to its proper width.

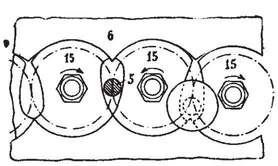

Figure 7

The lace bobbins (Figure 8) are driven by a gear, 17, placed on the rigid pin, 16. The upper part of the gear is set in motion by clutches, 18 and 19. One-half of the clutch in motion, bears on the sleeve, 20, of shifter, 15, which is actuated by the Jacquard levers mechanism, shown by 21, 22, 27 and fork, 24, on spring, 23. The upper end of fork, 24, reaches into the unlocked coupling of the lower side of plate, 15, into nut, 26, thereby holding the motion plate (with the lace bobbins) securely in position. All plates ordinarily are stationary, and are joined by parts 25 and 26. When a pair of lace bobbins are in motion, the unlocking is accomplished by the pull of the Jacquard mechanism connecting with the gear, 17, which is in motion continuously.

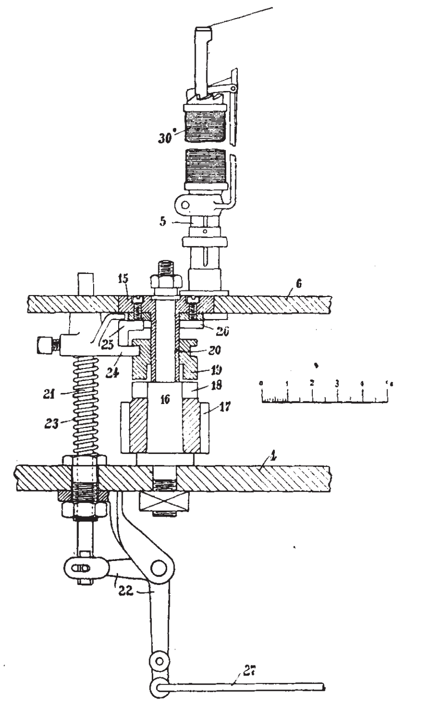

Figure 8

The Jacquard mechanism (Figure 5) consists of perforated cards laced together with cords, the same as for a loom or knitting machine. These holes control the design of the lace, each hole causing a crossing of a thread belonging to a particular plate.

After interlacing, the individual threads are shifted by a reciprocating motion of the knives to the center of the machine, and kept there until the next interlacing of threads takes place. These knives are for machine knitting, what needles are for hand making.

A modern lace machine produces such excellent lace, that often it is very hard to differentiate between machine and hand made lace. Instead of the one pair of threads used in hand work, the machine uses 50 pairs, or even more. It operates four to five times faster than the hand method, therefore, on the average, works 100 times more rapidly than the fastest hand lace maker. Furthermore, one operator can tend 20 to 25 machines of medium size, with approximately 75 lace bobbins. He is occupied principally in replenishing empty bobbins. One operator is, therefore, able to produce 1,000 to 2,000 times as much by machine, as one making lace by hand.

In the machine just described, every bobbin plate works independently in each section. These machines are known as one-thread machines. There are also two-, three- and four-thread machines. In the multiple thread machine, the separate sections are studded with the proper number of bobbins. These sections are connected with crossing (interchanging) plates for exchanging lace bobbins between sections, but they cannot perform any twisting of threads between themselves. These machines operate without stoppage for lace bobbins. The separate sections produce narrow "lace-braidings," which are joined at intervals, by means of the crossing plates. These machines have replaced, of late, the one-thread machines to a great extent.

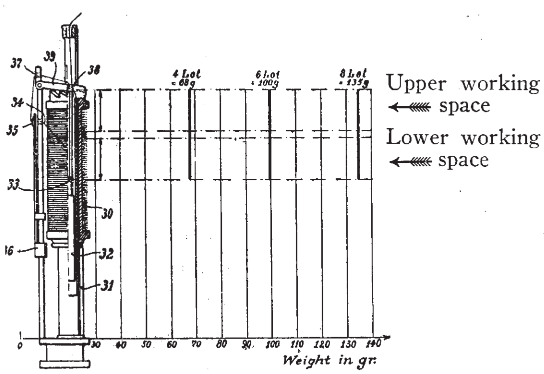

Figure 9

Tension Devices Important

Due to the rotary motion of the lace bobbins, and because of their movement to and from the center of the machine, a special device has to be provided to keep the threads at a uniform tension. For this purpose, the thread from the bobbin is guided over a tension device, consisting of a weight placed within the bobbin or a helical spring.

Lace Bobbin with Tension Weight

Figure 9 shows a lace bobbin, within which is a shell with adjustable weight. Upon the lace shell is a yarn bobbin, 30, which rotates and which is kept in place by a ratchet. The thread is guided through eyelet, 34, then to eyelet, 35, to the thread stop-motion, and then to the drop-and-lift device, 36. From there, it is led through stationary eyelet, 37, and eyelet, 38, of ratchet lever, 39, and to eyelet, 33, of tension weight, 32. From there, the thread is guided from the upper end of the lace bobbin to the place of interlacing.

The feeler of the thread stop-motion, 36, is kept in a high position. If the thread breaks, or if the bobbin runs out, the feeler drops and the stop-motion stops the machine.

Tension weight, 32, hangs on the loop of the thread, and is raised when the lace bobbin recedes from the point of interlacing, and sinks when it is nearing the point of interlacing, thereby equalizing the length of the thread. A continuous rising and falling of the tension weight takes place with the motion of the lace bobbin. The distance, or rise, of the weight, is equal to half the diameter of the plate. When the machine is in operation, the thread is pulled off gradually from the bobbin about $^{4}/_{100}$ of an inch for each turn of the plate, thereby the weight is raised gradually, until it reaches the highest point and touches the ratchet lever, 39. The weight is then moving in the upper working space. By further unwinding of the thread, the weight lifts ratchet lever, 39, and the unlocking of the bobbin takes place. Under the influence of the weight, a portion of the thread is drawn off, until the ratchet lever falls back again. Due to the release of the thread, the weight is hanging lower in the lace bobbin, and moves to and fro in the lower working space. Gradually, as the thread is used, the weight is raised until the ratchet lever is raised again for the next repeat of the operation.

The functioning of the machine described shows that the pull on the thread, due to the weight, is uniform, no matter whether the lace bobbin is away or near the end point of thread interlacing.

Lace Bobbin with Tension Weight

Figure 10 shows that in principle, the construction is the same as the lace bobbin with the tension weight. Only the slide clamp, 36, acts as a thread stop-motion, and is replaced by a ring, 40, which is hooked into the helical spring, 41, and kept in an elevated position. The upper slide clamp of the helical spring, 42, moves the same way as the weight of lace bobbin during the rotation, in a semi-circular form about the plate, a distance of half the diameter upward and downward. According to the amount of thread used, it moves from the lower working space to the upper working space, until it is checked by the release of the ratchet lever, thus permitting the unwinding of the thread. The release of the thread is taken up by the spring, and the spring eye recedes to the lower working space.

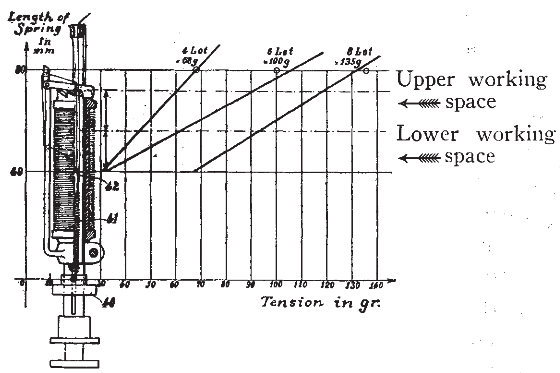

Figure 10

The tension which the spring exerts is called the "lot." By "lot number" is meant the elongation of twice the length of the spring in its original position. The lace bobbin in Figure 10 belongs to a 32 mm. gauge machine. The spring, in its resting position, is 4 cm long. The spring has 32 mm. to rise, to go to the limit of the full gauge before the ratchet lever is raised, this being double the length of the general traverse. If the spring is stretched out to its full length, the "lots" will be 4, 6, and 8, respectively.

As can be seen from Figure 10, the maximum elongation of 4, 6 and 8 lot is not obtained in practice, because the ratchet lever has acted before the elongation had reached this point, and the thread has been drawn off.

To reduce variation in tension as much as it is consistent with the proper working, it is necessary to insert preliminary tension on the springs. The 4-lot and the 6-lot springs have a 30-35 gram tension, while the 8-lot spring has a 68 gram tension. Regardless of this precaution, the variation in tension on the 8-lot spring may vary from 67 to 118 grams. A uniform tension is best obtained when the tension line runs more in a vertical than in a horizontal direction. The 6-lot spring does not work as efficiently as the other two springs.

Comparison Between Weight and Spring Tension

Each of the tension systems has merits and demerits. It is claimed that the tension weight gives a more uniform tension, and that it is more durable and dependable, while the spring in the spring tension system, being stretched continuously during the operation of the machine, soon weakens and thus becomes less reliable. Some even claim that a better fabric is produced by the weight tension system. As a rule, the weight tension is preferred.

On the other hand, the speed of the machine is somewhat retarded when the weight tension is used, on account of the rotation of the weighted lace bobbins. Due to the jerky stopping and starting of the lace bobbins, the weight tension is not universally liked. The tension spring has in its favor that by small measurements, great tensions can be obtained, and the adjustment measurements of the lace bobbins, as well as other parts of the machine, can be kept at a minimum.

In practice, it is the rule to use weight-tension for braiding machines and multiple thread lace machines, but when it is intended to imitate hand made laces, the one-thread machine is used with the spring tension device.

The tension of the thread depends upon the design to be made. As a rule, threads running horizontally in the design are run tighter than threads running the other way. It requires great skill to select the proper weights for the various threads, and the quality, as well as the appearance of the fabric, depends upon this to a great degree.