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THE MANUFACTURE OF SPOOL COTTON.

The manufacture of spool cotton requires machinery and processes so elaborate and so expensive, that the industry cannot be profitably conducted except on a very large scale. For this reason the making of the spool cotton used in this country is mainly confined to a few large factories, and we are informed that there is but a single company in America that makes all numbers of six-cord sewing cotton from the raw material. This is the Willimantic Linen Company, whose works we illustrate.

The company began business in the manufacture of linen; being deprived of flax by the breaking out of the Crimean war, they turned their attention exclusively to cotton thread, but the original style of the firm was retained.

The business offices of this company are located at Hartford, Conn.; the works are at Willimantic, on the river of the same name, about 125 miles from New York and 90 miles from Boston, on the New York and Boston Air Line Railroad. Two other railroads—the Hartford and Providence and the New London Northern—pass through the place, and hundreds of their passengers every day catch sight of the great, gray, six story mills of the thread company, built up of granite quarried out of the very ground on which they stand; and see, too, the rows of neat and comfortable tenements ranged along the streets. There are four large mills, picturesquely set upon the east bank of the river, and stretching, with their surrounding grounds, over a space of three quarters of a mile. The buildings and grounds are noticeably clean and orderly in appearance. By a series of dams, aided by a sharp natural fall, a force of fifteen hundred horse power is secured from the river for the factories. In these mills, as we learn from the elaborate description of them in *Scribner's Monthly*, to which we owe much of the information here given, more than a thousand workpeople—women and men, and girls and boys—are kept constantly busy at the various labors that combine to make thread.

The first operation in the preparation of the raw material for spinning is to run it through a machine called a "picker," which cleans about a thousand pounds a day.

The picker picks or beats out the dirt and seeds, and the cleaned cotton rolls out of the machine in laps, which are carried to the carding room, shown in one of the lower views in the engraving on the first page. The carding machine arranges the cleaned fibers parallel to each other, and delivers the cotton in a thin, narrow ribbon. After this operation the strand is run between sets of rollers, one set revolving faster than the other. This is called "drawing," and it is one of the most important parts of thread making. If one set of rollers, for instance, turns ten times as fast as the other, the strand that passes out between them is, of course, ten times lengthened and ten times as fine as the original. This is a "draught of ten," as it is called. The drawing may be in any ratio, and any number of strands may be run together into one at the same time that that is drawn. Five strands, for example, drawn with a draught of ten, would make a new strand half the size and ten times as long. This process of uniting strands is called doubling, and the doubling, running together, drawing down, and reuniting and redrawing are carefully watched, so that the size of the strand and the amount of work on it may be at any time known. The operation is repeated again and again; but all this doubling is not done without interruption. After the first few drawings, the long white ribbons of cotton which, in this condition, are called "slivers," are passed through another machine, which combs them again to remove all foreign substances; it also takes out all of the short fibers, leaving only the longer fibers to be worked into thread. The short fibers which are removed are sold for other manufactures. After combing, the sliver is doubled and again reduced in size, and then twisted for the first time in the roving frames and wound upon large spools, and it is afterward drawn and twisted in two separate machines before it is carried to the spinning mules.

The room in which the spinning is done is represented in the larger view in the engraving. In each of these machines there are several hundred spindles, which revolve very slowly as they are carried forward by the carriage in winding the thread on the spindle, but revolve with great speed as the carriage draws back in the operation of spinning. The spinning mule is entirely automatic in its action. The marvel of it all is the mathematical precision with which it begins, stops, and reverses, and the care with which it suitably varies its work each time to the needs of its case. The mule is all the while attended by a barefooted and lightly-dressed man or boy, whose business it is to unite such strands as accidentally part. On these mules the yarn is made of any size that is required. It is at Willimantic spun down to a fineness that rivals even the spider's web.

From the spinning mules the cops go to the cop winders, where two strands are wound together on a single spool. These two strands are twisted in a machine in which the bobbins revolve at a speed of about 5,000 revolutions per minute, and the thread is wound on the bobbins by a simple differential arrangement, which accommodates itself to the increasing diameter of the bobbin. Three of these double strands are twisted together, forming the well-known six cord spool cotton.

The spools from the twisting machines are conveyed to reeling machines, which form hanks suitable for bleaching, dyeing, etc.

During every step in the progress of the cotton, from the raw state to the finished thread, it is repeatedly examined by experts, and if at any stage it is not in all respects up to the standard it is rejected and never finished. Delicate instruments, which are used in testing the thread, are to be seen in all departments of this immense establishment. It is only by continually and closely watching the various steps in the manufacture of thread, that a uniformity in quality is secured.

It is established by all spinners that 7,000 grains shall be a pound in cotton, and that yarn of which 840 yards weigh this pound, shall be number "1." Every now and then, therefore, all through the mill, a very accurately gauged reel, or some similar instrument, is used to measure off an even fraction of 840 yards. The measurer may be careless in taking off his sample, but that makes no matter. At exactly the right point the reel breaks the strand and calls attention to the fact by ringing its signal bell. Then this sample, say 120 yards or one seventh of "a hank," is weighed on scales also gauged to show the most delicate variations. If the yarn or roving is number one, and weighs one-seventh of 7,000 grains, it is exactly correct; if 120 yards of No. "30," for instance, were being sampled, it should weigh one-thirtieth of one seventh of 7,000 grains. Every time a variation appears, the cotton is made to thicken up or thin out as is needed. This testing is done repeatedly, and the results are recorded in books kept for the purpose, so that the course of any of the cotton on its three weeks' cruise of three thousand miles through the factory, can always be traced and faults found and corrected at once. Nothing more impresses one with the wonderful accuracy of the process than to watch one of these testings, note the exact measurement of the sample, and rigidly careful weighing, and see the gravity with which the overseer marks down the pettiest variations to the 28,000th of a pound! It all tells upon the thread, and making it correct through all its processes guarantees it correct, of course, when finished.

After the thread is made the work on it is by no means finished. To prepare it for market it must be inspected, washed, bleached, dried, perhaps dyed, spooled, and boxed, and the spools and boxes are also made in the factory.

After the operations already described the hanks of thread are placed upon reels and transferred to large spools in the department represented in one of the upper views. The thread is then conveyed to the winding machines which take the spools, and, holding them between centers, revolve them, start the thread, wind it back and forth with the utmost precision, making allowance for the beveled ends, stop when the required 200 yards are wound, nick the spool, put in the thread, cut it off, and release the spool, all without attention. All that is required of the attendant is to see that thread is supplied, and to keep the hoppers full of spools.

One of the most interesting machines in this establishment is the machine for ticketing the spools. One girl supplies it with sheets of printed labels, and another feeds it with spools; it does the rest automatically. Provided with the labels, it cuts out, pastes, and fastens the proper mark for each end of the spool, and prepares a hundred spools a minute. The machine does the work of many girls, and it never tires.

The winding machine, the ticketing machine, and the automatic spool-making machine—inventions belonging to the Willimantic Company—are so essential to the thread business that the privilege of using them is rented by other manufacturers.

Everybody knows the sizes of thread. Every seamstress knows whether she wants No. 30 or 60 or 120, and knows, when she hears the number, about what is the size of the strand alluded to; but how the numbers happen to be what they are, and just what they mean, not one person in a thousand knows. It is a simple matter to explain. The standard of measurement is the same already recited. When 840 yards of yarn weigh 7,000 grains (a cotton pound), the yarn is No. 1; if 1,680 yards weigh a pound it will be No. 2 yarn. For No. 50 yarn it would take 50x840 yards to weigh a pound. This is the whole of the yarn measurement. Thread measurement rests on it. The early thread was three-cord, and the thread took its number from the number of the yarn it was made of. No. 60 yarn made No. 60 thread, though in point of fact the actual caliber of No. 60 thread would equal No. 20 yarn, being three 60 strands. When the sewing machine came into market as the great consumer, unreasoning in its work and inexorable in its demands for mechanical accuracy, six-cord cotton had to be made, as a smoother, rounder product. As thread numbers were already established, they were not altered for the new article, and No. 60 six-cord and No. 60 three-cord are identical in size as well as number. To effect this, the six-cord has to be made of a yarn twice as fine as the three-cord demands. The No. 60 six-cord would be six strands of No. 120 yarn. To summarize: yarn gets its number from the arbitrary formula that 840 yards weigh 7,000 grains. Three-cord spool cotton is the same number as the yarn it is made of. Six-cord spool cotton is made of yarn that is double its number.

As simple a thing as thread seems to be, the Willimantic Company makes 1,200 different kinds, and it takes 10,000 dozen spools to hold each day's product.

THE St. Gothard tunnel makes steady progress, no less than 3,000 workmen being engaged upon it. Nearly 10 tons of dynamite are used per month.

MISCELLANEOUS INVENTIONS.

Mr. A. Edward Barthel, of Detroit, Mich., has invented a hammerless self-cocking and rebounding firearm, the improvements being applicable to shotguns, rifles, or revolvers, either single-loaders or magazine arms.

Mr. Zebina M. Hibbard, of Brooklyu, N. Y., has patented a trace fastener provided with a screw stem that works in the threads of the ferrule, and is provided with a shoulder that fits within a rabbet of the ferrule.

Mr. Simeon Garratt, of Columbus, O., has patented a self-acting car coupling, which will couple high or low, which, when running, will only come apart by the use of the lever, but which will immediately separate should the cars run off the track.

An improved adjustable harness pad has been patented by Jacob Johnson, of Ashland, Neb. The object of this invention is to provide a harness pad which may be adjusted to the back of a horse of any shape or size.

An improved bale tie, patented by Mr. William H. Roane, of Pine Bluff, Ark., consists of a rectangular plate, having opposite edges bent over toward the outside, forming flanges or lips, through one of which is made a transverse rectangular slot in line with the outside of the plate, while the other is provided with a similar slot, and with an opening through from the edge of the lip or flange.

An improved spark arrester, patented by Messrs. Silas Byram, of Middletown, Ind., and William R. Hansford, of Hicksville, O., consists of two pipes set one within the other, with an annular space between them, the inner pipe being constructed in vertical sections, with lower edges inclined or drawn inward that are held apart by lugs or straps extending from one to the other, while fixed in the longitudinal axis of each section is a conical deflector, and encircling each section is an annular flange whose diameter is the same as the internal diameter of the outer pipe.

An improvement in candlesticks, patented by Mr. Andrew J. Smith, of Ukiah City, Cal., consists in providing a slitted match box rising up in the candle holder from the bottom of base.

Mr. John Henry Hettinger, of Bridgeton, N. J., has invented an improved can cover, which is simple, readily adjustable, and efficient, and may be used for cans and jars, paint cases, etc. It may also be applied to barrels, boxes, or cases of wood, as well as of metal, by only changing the material of which it is constructed.

An improvement in electric speaking telephones has been patented by Mr. Frank P. Mills, of Ishpeming, Mich. The object of this invention is to increase the sensitiveness of speaking telephones and the resulting effects by a new arrangement of the permanent magnet and the armatures thereof; and it consists, essentially, of a circular or cylindrical magnet surrounding the helix, the poles of which are brought close together, but insulated from each other by a peculiar arrangement and construction of armatures.

Mr. Oscar Kleinberger, of New York City, has patented a suspender having its ends formed of braid or cords which cross and overlap each other two or more times, and are fastened together at their junctions by threads or cords, thus forming a series of button holes or loops of like size.

Mr. Charles P. Blatt, of Elizabeth, N. J., has patented a simple and effective device for keeping beer and other liquids when "on tap" cold and supplied with common air or carbonic acid. It consists of a box or cabinet containing an air-tight chamber, an ice chamber, and a place for the barrel or other vessel containing the liquid.

Messrs. Hartwell A. Crosby and George F. Thompson, Jr. (administrator of Michael W. Thompson, deceased), of St. John, N. B., have patented an improved sash stop and lock. The object of this invention is to provide a more simple and durable sash stop and lock than those now in use. To close a window provided with this device, one has only to reach up and pull down on the thumb piece. If the window is partly open and it is desirable to raise it higher, it is only necessary to push it up, and the pawl will hold it at any point.

An improvement in riding plows, patented by Mr. Alfred Belchambers, of Ripley, Ohio, consists in a riding attachment composed of a frame mounted on wheels and drawn behind the mouldboard.

Commercial Enterprise.

Our English contemporaries seem to be awakening from their lethargy and to realize the cause for the depression in trade among their manufacturers.

Acute observers of the "spirit of the age," says one of the foremost trade journals of England, must have noticed the inborn love of conservatism, and the desire to follow in the footsteps of our fathers or predecessors that distinguishes us from our Continental neighbors and our American cousins. Progression in this country is usually the result of competition, or the force of circumstances, frequently impelling our ironmasters and our colliery owners to move with the times, and the steady-going British manufacturer to remodel his plant, improve his patterns, print his catalogues, and advertise his productions.

There can be no question that in many departments of trade the English name was at one time pre-eminently conspicuous, and our foreign rivals had to be content to follow the lead we were setting them. But, in too many cases now, the position is reversed, and "Jack is as good as his master."

It is unfortunate that such should be so, but a great deal of the present depression in trade is to be attributed to the

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