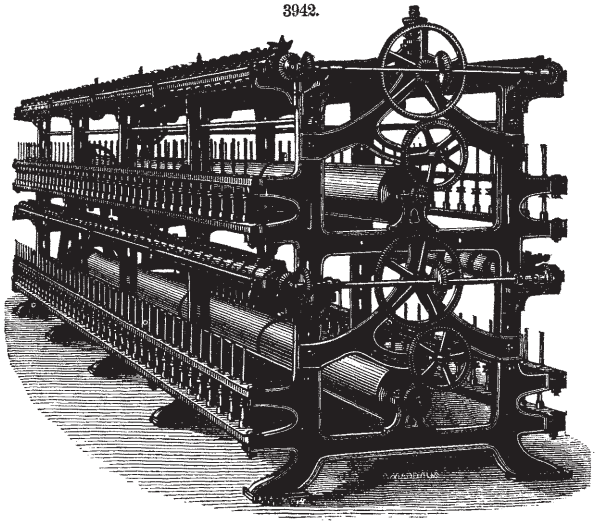
SILK-SPINNING MACHINERY. The machinery used in the fabrication of silk is very simple, as compared with that required for cotton or wool. The long and ingenious series of processes by which an even and continuous thread is produced from a tangled collection of short fibres are here unnecessary, the only end to be accomplished being that of uniting a sufficient number of the

delicate fibres spun by the silk-worm to form such a thread as is required for the purpose for which it is intended; to clean the raw silk from the gum which it holds in its natural state; and to free it from knots and imperfections.

The thread as produced by the worm is composed of two filaments, which are spun simultaneously and cemented together. When wound into the cocoon the coils mutually cohere to each other, but readily separate upon being immersed in warm water, so that the entire thread may be reeled off. As many of these filaments as may be desired are reeled off together, and become cemented so as to form a thread. In this state it is the *raw silk* of commerce, and is exported to the United States from China, Japan, and Italy, made up into hanks or bundles. The length of each filament is usually about 300 yards. Of average cocoons, 250 weigh about a pound, and 12 lbs. of cocoons yield a pound of silk.

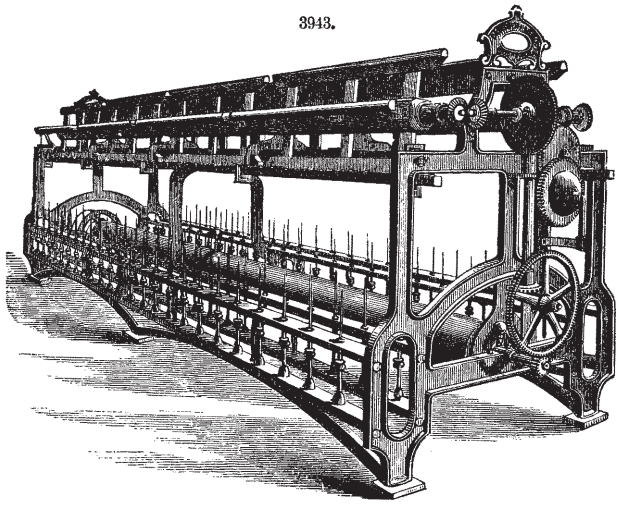
3942.



Washing and Winding.—The raw silk is first inclosed in a light cotton bag and soaked in warm water at 110° F. for a few hours. The water is then removed, and the silk left in a softened state by the hydro-extractor. The silk is then placed upon reels and thence wound upon spools. The reels are six-sided, and are technically called *swifts*. They are adjustable to suit the sizes of the hanks, and are balanced so that they will not break the threads by irregular motion. By means of weights enough friction is produced upon their axes to keep the threads stretched. The bobbins have each an independent motion, and any one can be taken off and replaced without interfering with the others. An eye through which the thread passes to the bobbin has a traverse motion by which the thread is wound obliquely and lateral adhesion is prevented.

Cleaning—or, as it is sometimes termed, "clearing"—is performed by fixing the bobbins horizontally on plain spindles and passing the thread between two adjustable pieces of metal. Should a knot or other unevenness chance to be on the thread, these metal blades prevent its passing through, one of the plates becomes depressed, and the bobbin is lifted off the friction-roller which gives it motion. The stoppage being perceived by the attendant, the defect is removed and the work proceeds.

3943.



Twisting or Throwing.—Silken thread merely wound and cleaned is called *dumb singles*. If twisted to add to its strength and firmness, it is termed *thrown singles*, or simply *singles*. Two or more singles twisted together—that is, single-twisted loosely—form *tram*, which is used as the weft in weaving. When two singles are twisted together in an opposite direction to that in which the singles themselves are twisted—that is, so that the resulting thread is double-twisted—the process is called *throwing*, and the product *thrown silk* or *organzine*. This is generally used as the warp in weaving. For silk gauze dumb singles are used; for ribbons and common silk, thrown singles; for the best silk, tram and organzine. *Doubling* is the process of bringing two or more twisted threads into one and winding them preparatory to spinning.

The Silk-Spinning Frame constructed by the Danforth Locomotive Works of Paterson, N. J., is represented in Fig. 3942. On this the spools of doubled thread are placed, and a certain number of turns per inch is given to the filaments, this twist being regulated by the speed of the delivery rolls,

which are in single pairs, and not compound as in cotton-spinning, no stretch being given or required. The threads are again doubled or twisted by a second operation.

From the spinning frame the silk is transferred to the reel-mill, Fig. 3943, where it is again wound into skeins, and is ready for the dyer.

Spinning Waste Silk.—Waste silk is of two kinds—that produced directly from the cocoons, and that which accumulates in the course of manufacture. It is first submitted in short lengths or "stricks" to the processes of softening, washing, opening, filling, and dressing, when it is ready for the first machine of the series, which is the *spreader*, and in which the silk passes over a porcupine roller and through a series of combs, and is delivered upon a drum. From the spreading machine the silk is taken to the *sett* or *slivering machine*, which is constructed similarly to the spreader, with the exception that the silk is delivered into a can instead of being wound round a roller. From the slivering machine the silk is taken to the *drawing machine*, which has fine gills placed closely together. The sliver then passes to the *roving frame*, where it is still further reduced by being passed through a very fine screw-gill. The rove is now ready for spinning, and is removed to the spinning frame, which is similar in construction to those used in dry flax- and worsted-spinning. Here the rove is greatly reduced in size, and is twisted and wound upon a bobbin, to be afterward doubled in similar manner to cotton, flax, and other yarns. Finally, the silk thread is taken to the reeling machine, where it is made into hanks. A very full illustrated account of the machines devised by Messrs. Greenwood & Batley of Leeds, England, and by which the above-described process is accomplished, appears in *Engineering*, xviii., 6 *et seq.*