Machinery and Appliances.

M. VIVIER'S ARTIFICIAL SILK FROM WOOD OR COTTON.

This new method of making silk out of cotton or wood cellulose, which bids fair to rival the already well-known process of M. Chardonnet, is described at length in the columns of our contemporary *La Revue Industrielle*. The material is obtained by heating tri-nitric cellulose, obtained by alkalisation and nitrification of cotton, with a mixture of acetic acid and gelatine or other equivalent re-agents. This material is transformed into pure filaments, which are a little less tenacious than natural silk, but quite as lustrous, and cost, according to the inventor, about 2s. 10d. per kilogramme, or about 1s. 3½d. per lb. of yarn. The first part of the process consists in the economical and rapid manufacture of pyroligneous acid, from which is then easily extracted the crystallisable acetic acid necessary for the elaboration of the filaments. The succeeding processes are three in number: (1) The preparation of the tri-nitro-cellulose; (2) its treatment by acetic acid; (3) its treatment by the re-agents which convert it into silk, or, to be more exact, into a silky material, which must then be transformed into silk again. Taking these processes in their order, we have:—

(1) *The preparation of the tri-nitro cellulose*: This comprises two operations:—alkalisation and nitrification. The alkalisation of the cotton is effected by treating it with an ammoniacal solution of caustic soda. For this purpose 4 kilos. of caustic soda are dissolved in 20 litres of water, and to this solution, after it has cooled, are added 10 litres of commercial ammonia at 22° Be. One kilo. of cotton is steeped in this solution of ammoniacal soda for three days and three nights, and stirred once a day. The cotton is then pressed and washed in water up to complete neutrality. It is next carded, after drying, in order to open the fibres so as to prepare it for nitrification. Nitrification is effected in an apparatus with a capacity of about 120 litres. This apparatus is charged with about 20 kilos. of saltpetre, dried at 45°, on which are poured, at two or three times, 30 kilos. of pure sulphuric acid at 66° Be., the mass being stirred until the ingredients are thoroughly mixed. It should then have a temperature of 85°. Into this liquid at this temperature tufts of cotton are introduced in small quantities. The apparatus is closed and made to revolve with a double revolution round its horizontal axis and round its vertical axis, for five or six minutes. Then it is stopped, the lid is lifted, and the material dropped into a tub of water. After washing and drying in an oven, the nitrated cotton is ready to be used for the preparation of silk.

(2) *The Treatment by Acetic Acid.*—Three solutions are prepared. (*a*) A solution of gutta-percha in sulphide of carbon; (*b*) a solution of isinglass in crystallisable acetic acid; (*c*) a solution of tri-nitrated cotton in acetic acid. These solutions are mixed cold, so as to obtain a final solution in which the pyroxiline or tri-nitrated cotton forms 70 per cent, the isinglass 20 per cent, and the gutta-percha 10 per cent. To this is added a very small quantity of glycerine or castor oil, and the whole is blended together in a mixing apparatus. After this mixing process the material is twice filtered, first roughly, and then more delicately.

(3) *Its treatment by re-agents which convert it into silk.*—There has been obtained by the preceding methods a semi-fluid viscous substance, which is made into a filament under water by driving it through a small orifice. The thread thus produced passes, with the aid of appropriate machinery, through the following six chemical baths:—

a A bath of soda, to remove the excess of acetic acid.

b An albuminous bath (of 3 per thousand), to make the fibre supple.

c A bath of bi-chloride of mercury (25 per 100), to coagulate the fibres; the coagulation is accelerated by passing t material afterwards through an atmosphere of carbonic acid.

d A 10 per cent. solution of ammonia.

e A bath of sulphate of alumina, which impregnates the fibres with a deposit of alumina. These two last baths are intended to lessen the combustibility.

f A second bath of albumen (3 per 1,000) to render the fibre supple.

The proportions can be varied to a certain extent, or even replaced by equivalents, according to the particular results which it is desired to obtain. The filament which remains after this series of chemical processes is now wound upon a drum P (see Figure 1 and 1*a*), before which the carriage G is made to travel by means of a worm R. This carriage is provided with burnishers, S S, which polish the thread, and guides T T, which ensure its regular arrangement

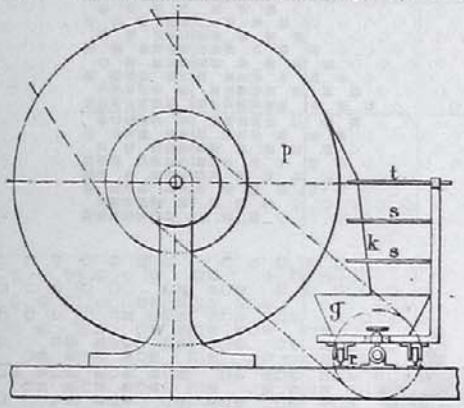

Fig. 1.

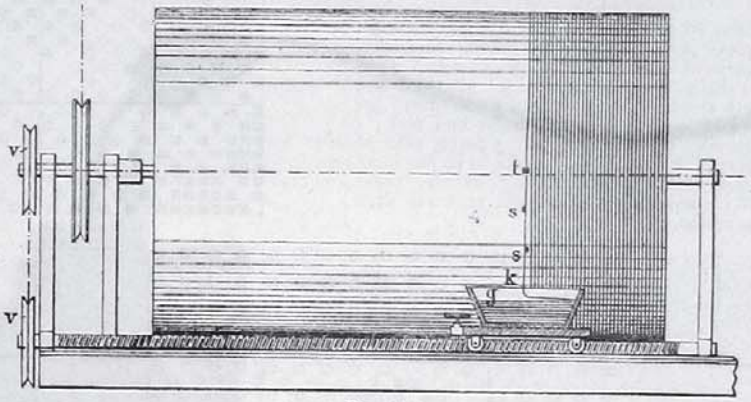

Fig. 1*a*.

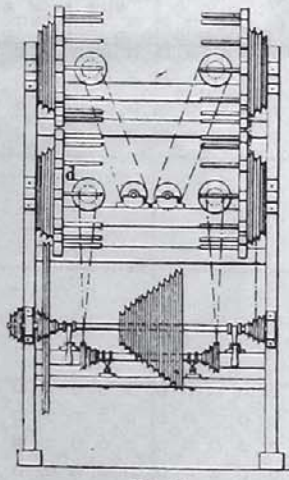

Fig. 2.

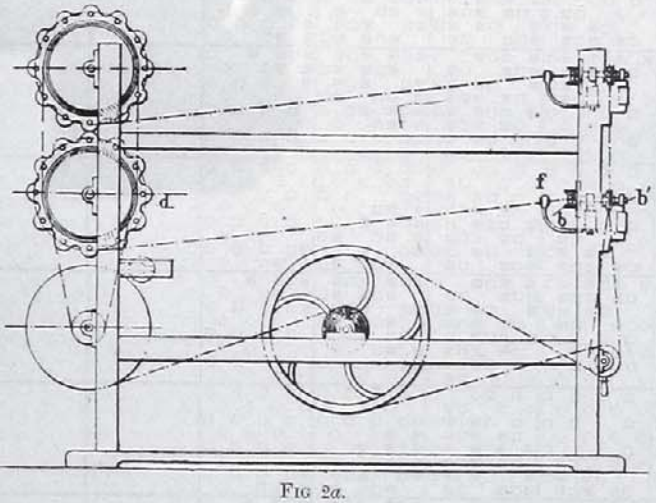

Fig 2*a*.

on the drum. When the drum and its fibre have been dried in a stove, it is carried to the winding machine. The bobbins of fibre thus obtained are next carried to the twisting machine, where the yarn is formed by twisting together a number of filaments sufficient to constitute a thread. This machine is represented in Figures 2 and 2a. The filaments on the bobbins B, which are reeled as they turn round their common axis B, are twisted into one single thread before reaching the drawer F, which takes the thread to the reel D. The shafts B are hollow, so that, if desired, a liquid jet can be projected on the thread as it is forming.

Bleaching, Dyeing, Printing, etc.

NOTES ON FINISHING OF COTTON CLOTHS.

Calicoes and other cloths made of cotton go through quite an extensive series of operations to give them what is called a finish—a most important feature of the finished cloth, and one that has an influence by no means unimportant on its merchantableness. It is here intended just to notice briefly a few points in the various operations by which the finish is imparted to the cloth.

Generally, the goods are first mangled in what is called a water mangle. This machine resembles an ordinary domestic wringing machine, with the bottom roller or bowl revolving in a box that holds the water through which the cloth passes. Sometimes the water is used cold, at other times warm, but rarely boiling, because boiling water has too great a tendency to cause the cloth to shrink, and it is an essential point to keep the fabrics as wide and as long as possible. Shrinking does occur in finishing cotton cloths, and the colder the water, etc., used, the less is the shrinkage. Cloths, however, that have shrunk in the process have a fuller and thicker feel than unshrunk cloths. The mangles have often 7 or 8 bowls, sometimes made of wood, sometimes partly wood, and partly of copper. The passage round the bowls gives a flat appearance to the fabric and makes it appear to be closer woven than what it really is. Sometimes the cloths are chased or run round, that is, the passage of the cloth is so arranged that several thicknesses of the cloth pass between the bowls at the same time, which gives a thready appearance and makes the cloths look more like linen. After the mangling, the cloths are dried, which is generally done by passing them over a number of hollow metal cylindrical vessels, generally made of tin, but sometimes of copper; these are heated by steam and are technically called the "tins." The cloths are dried either thoroughly or only partially; the latter is known as "conditioning," but is never very satisfactorily done, and it is best to dry thoroughly on the tins and then, by means of a damping machine, bring the cloth to the required degree of dampness or feel. After being dried, the goods are passed through a second mangle; this may be only a duplication of the first mangling machine, or it may be what is called a "stiffening mangle," that is, a mangle where the cloth is impregnated with a mixture of China clay, barytes, minerals, starch, flour, soap, etc., for the purpose of weighting or stiffening the cloth, making the finished fabric feel fuller than it really is. This stiffening is an important matter; the amount put in depends upon the market to which the finished goods are ultimately sent; some countries require the cloths to be heavily weighted, and will not buy pure cloths at any price, while others are quite content with a modicum of weighting material in their cloths. The stiffening mangle generally has three bowls; sometimes these are all of wood, at others one is made of brass and the others of wood. When the cloths are to be heavily filled, the brass bowl is made to revolve quicker than the others, whereby a certain amount of friction is produced which forces the weighting material into the pores of the cloth. These mangles are commonly known as "Scotch mangles."

One variety of these stiffening mangles is known as "back-filling mangles," and their purpose is simply to place the stiffening mixture on one side, generally the back of the cloth, so that the finished cloth, when looked at from the face, does not shew any trace of filling, and is so far as the purchaser can see, a pure cloth.

After the stiffening, the cloths are again dried, and are then conditioned on a dampening machine, or "canroy," as it is sometimes called. The term, "canroy," is a survival from an older period in the history of finishing, when the conditioning was done by passing the cloths over a roller covered with felt, or even left bare, which revolved in a box filled with water. The operation was never done with perfect satisfaction, some parts of the cloth getting damped more than others, and the machine is now entirely obsolete. The modern damping machine consists of a box filled with water, in which a brush revolves, thus causing the water to be sprayed up to a narrow slit, over which the cloth passes, and is damped in a very uniform manner, the amount of damping or conditioning being capable of being regulated with the greatest nicety.

After this the goods are beetled. They are rolled on to an iron roller, and placed under what are called the "beetles," which are beams made of beech wood, shod with iron, which are made to rise and then fall suddenly with some force upon the cloth. The cloth is caused to revolve at the same time, and thus a fresh surface is always exposed to the action of the fallers. The old-fashioned wood faller beetle still keeps its ground among Lancashire finishers, although other forms have been introduced which do their work quicker, but still not so well; at all events, practical finishers assert that they can distinguish a marked difference between the results of the two beetles. A beetle finish is a peculiar one, and is characterised by a full soft feel of a thready appearance not attainable by other means. Cloths intended for beetle finishes are rarely filled or weighted, or, at the most, very little is put in.

Another finishing machine is the calender, which resembles the mangle in appearance. There is a great variety in the construction of the calender, some having three bowls, some four, some five, and occasionally more. These bowls may be made of paper, copper, steel, or chilled iron. Some calenders are made to be used cold, others hot; some with light pressures for light goods, others with heavy pressures for heavy cloths. Calender finishes generally have a lustre, but there is an immense variation in this respect. In some the lustre is but slight, produced by only lightly calendering; others are very glossy, obtained by heavy calendering with hot bowls on cloths filled with starch. The lustre can be made to equal that of silk, but is far from permanent; the first time the cloth is washed, out it comes. By having one of the bowls of the calender engraved, an embossed design may be impressed on the cloth; but this also disappears on washing. Then there are one or two minor operations, such as folding the cloth, pressing it in a hydraulic press, stamping, etc., which all contribute their quota to the finishing of a piece of cotton cloth.

RE-HARDENING OF SOFTENED WATERS.

Water softening by Clark's process consists in adding a certain amount of lime, sufficient to precipitate all the carbonates of lime and magnesia formerly in the water. It has been observed that if the softened water remain in long contact with the precipitate it again becomes hard, although it is not as hard as it originally was. Neugebauer has recently published the results of some experiments on the subject which are of interest.

Four litres of a spring water of 93° hardness were poured into a wide cylinder provided with a sliding tube and a movable syphon, the inner branch of which was slightly turned upwards. The water was softened by precipitating with the necessary quantities of lime water and solution of soda. Samples were drawn from it from time to time, and their hardness determined by means of a solution of soap. The hardness was:—

After 1 day	2·5°	After 8 days	9·0°
,, 2 days	1·7°	,, 76 ,,	12·0°
,, 5 ,,	5·0°	,, 100 ,,	15·6°

Quantitatively there were found:—

	Milligrammes. CaO	MgO
Per litre of original water	771	114
,, ,, softened water after 1 day	8	11
,, ,, ,, ,, 100 days	20	96

The hardness of the water had therefore increased in the course of 100 days by 13°, and that chiefly at the expense of the carbonate of magnesia in the precipitate. In the cold the water was not coloured by a solution of phenolphthalein; when evaporated to one third, it shewed a weak red colour, indicating a small quantity of undecomposed soda that had been transformed into bicarbonate. The determination of the temporary hardness by titration of 100c.c. of water, with deci-normal sulphuric acid, using methyl orange as indicator, shewed 16·8°. The magnesia is therefore in solution as carbonate or bicarbonate.

As a further confirmation of the results obtained, 8 litres of a water of 31·8° hardness was precipitated with the requisite quantities of limewater and soda solution; 4 litres of it were poured into an open cylinder, and 4 litres into a glass-stoppered bottle. The hardness was:—

	In the cylinder.	In the bottle.
After 1 day	3·4°	3·5°
,, 2 days	2·25°	3·4°
,, 3 ,,	2·0°	3·5°
,, 13 ,,	5·75°	3·3°
,, 25 ,,	8·3°	3·0°
,, 38 ,,	16·0°	2·8°

The quantitative analysis shewed:—

In the original water 24·73 CaO, 5·04 MgO.

In the softened water after 38 days	3·64 ,,	4·41 ,,

The titration with sulphuric acid and methyl orange, as well as the estimation of the carbonic acid, shewed that the magnesia was in the solution as bicarbonate. Precipitated waters allowed to remain standing for some length of time, therefore, absorb carbonic acid from the atmosphere, the solvent effect of which manifests itself chiefly in the formation of magnesium bicarbonate.

Further experiments shewed that freshly precipitated calcium carbonate absorbs carbonic acid from the atmosphere by small degrees only, while the magnesium carbonate absorbs it much more greedily.

A solution of gypsum free from magnesia of 42·34° of hardness and a solution of magnesium nitrate of 24·72° of hardness were separately precipitated with 95 per cent. of the theoretical amount of soda, and allowed to stand in glass jars. The hardness was:—

	Lime solution.	Magnesia solution.
After 2 days	4·0°	3·7°
,, 4 ,,	4·2°	4·0°
,, 6 ,,	4·5°	4·9°
,, 8 ,,	4·75°	9·0°
,, 10 ,,	5·3°	11·0°
,, 12 ,,	5·6°	11·8°

Here it is again evident that the magnesia precipitate is much more soluble than the lime precipitate.

FREE ACID IN THE ALUMINA SULPHATE.

For certain technical purposes where sulphate of alumina is used, it is necessary to have it free from free sulphuric acid, which, unless proper care has been taken in its preparation, it is very liable to have. This is by no means easy, and nearly all processes hitherto used are subject to errors of various kinds. The most commonly-used method consists in treating the sulphate with alcohol, in which the salt is insoluble, and titrating the filtrates with standard caustic soda, using one of the tropœolins as an indicator. Recent writers, however, consider this to be inaccurate, and better applicable as a qualitative rather than a quantitative test. Beilstein and Grosset recommend the following process:—Dissolve 1—2 grms. of the substance, according to its proportion in free acid, in 5c.c. of water; add 5c.c. of a cold saturated solution of ammonium sulphate; allow to stand for a quarter of an hour with repeated shaking, and precipitate with 50c.c. of 95 per cent. alcohol. Filter, wash with 50c.c. of 95 per cent. alcohol, evaporate the filtrate on the water bath, dissolve the residue in water, and titrate with deci-normal caustic potash, using litmus as an indicator. All the