Machinery and Appliances.

APPARATUS FOR THE MANUFACTURE
OF ARTIFICIAL SILK FROM LIQUIDS:

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This paper is intended to describe the apparatus for the manufacture of artificial silk. In order to understand properly the function of each part, it is necessary to remember that artificial silk consists essentially of nitrate of cellulose in a state of solution. This solution is then treated as another liquid, which coagulates it. It is then passed through a series of tubes, which are formed into a thread which can be gathered and treated like a thread from a cocoon. In order to lessen the high combustibility of this substance, part of its nitric acid is taken from it by a carefully managed process of separation, and it is made at the

duced into a closed receiver, not shown in the illustrations, in which an air-pump maintains a pressure of from 10 to 12 atmospheres. The receiver, which is turned inside, communicates by a tube provided with a cock with the tube A, which bears the spinners and extends all the length of the machine. This tube A, shows on a larger scale in front and section in Figs. 2 and 3, is composed of three compartments: the central one B, which receives the solution, and two lateral ones C and C', which serve to maintain a circulation of water round the central tube B. Each spinner is composed of a tube e, which is attached a capillary tube b, and the lower orifice of which communicates with the cylinder e screwed in the tube A; the mouth of this cylinder opens in the solution. A cut-inlet p keeps each spinner on the corresponding cylinder, and makes the joint tight by means of a washer of leather or some other substance, which press against them the lower part of the tube e.

The flow of the liquid is regulated by means of the pin f, borne by the bar h, which can be screwed more or less into the cylinder f placed at the bottom of the tube A, in order to check or facilitate the passage of the liquid on its way into the spinner. Rond the extremity of the spinners a is found a tube-envelope B, supported by the plate l, which extends the length of the machine, and brings cold water to the extremity of the spinner; this cold water comes from the tube D, which distributes it to all the tube-envolopes by means of the cold water in which the thread is immersed on leaving the tubes; it is then withdrawn by the gutter F, which runs along the length of the machine, and forms the rim of the plate f, which is inclined transversely. When the machine is not working, the tubes A and D, which bring the water and the liquid, are kept closed, and the orifice of the apparatus is stopped by a drop of water, which prevents all contact of the air with the liquid or the water. When starting, there are sufficient to receive the liquid bladder of collodion solidified by its passage into the water, and instantly forms a thread, which, drawn by the water, bends round the tube k, where it is gathered up by means of a special nipper, shown in Figures 3, 4, and 6. Each of these nippers consists of two plates s, which are suitably curved so as to embrace the corresponding tube-envelope, and present an obtuse part which, sliding over the tube-envelope, forces the pliers to open when they arrive against the tube k. All these nippers are carried by a bar s, which is connected at each of its extremities with a square o, articulated with the two arms f and F, (Fig. 6), one of which receives an oscillating movement, drawing on the other by means of the square e. These arms are moved in the following manner: their axes bear on the outside of the box F, a crank q is then put in motion by the connecting rod r, which is moved by the toothed wheel s, which is actuated by the pinion fixed on the shaft of the motor p. The shaft of the pinions S and T of the wheels t extends the length of the machine.

Under the influence of the oscillating movement of the arms f and F, the two nipper-hearing squares occupy either the position indicated on the plan, or that indicated by the dots.

At the commencement of the work, the material having overflowed above the tube-envolopes k, the springs forming the nippers are stuck to the growing threads when the nippers rise; these threads are lifted on horizontal guides u and on other guides in the form of forks, which collect them by prongs in order to bear them to the bobbin s. These grouped threads adhere by capillarity and form a raw material with several fibres. When once the work of spinning has commenced there is no solution of continuity between the orifice of the spinner and the bobbin; the material proceeding from the spinner is constantly wound on to the bobbin which corresponds to the spinner; the thread breaks the new end is taken up by the nipper, as was said above. At the upper extremity of their course the nippers rub against a revolving brush, which cleans them. This brush consists of a cylinder on which are placed the plates s, which strip the nippers and take away all the superfluous matter attaching to

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them. The plates of the brush R are so arranged as to form a helical curve. The nippers are alternately long and short, as is shown in Figure 4, in order that they may not act all together on the tube envelope k, so as to avoid or at least to lessen the shock caused at the moment of their opening. Through the opening alternately the effect is more regular.

A current of air heated to about 50° enters by the lower part of the box F and rises to the upper part, charged with vapours of ether and alcohol. To recover the heat the air pass on leaving the machine through the three chambers, chilled by a current of water, two of which are shown in Figure 6.

The first chamber contains water saturated with an excess of carbonate of potassium. The water carried away is condensed by dissolving the excess of carbonate of potassium. The alcohol and ether (in part) are also condensed and, being insoluble in the aqueous liquid, they form on its surface a distinct layer, which is made to flow out by a gauge-tap g according as the products accumulate; another tap below, the ventilator or the blowing machine, as was said above. It is advisable to have three charges of sulphuric acid, of which two are in use. When the acid of the first is saturated, the air proceeding from the carbonate is sent into the second and third condensers, whilst the first is empty and charged afresh. Thus a constant movement is established between the three chambers. In order that the successive turns of the thread on the bobbins may not overlap each other and cross each other angularly the bobbins receive a horizontal movement or traverse. This movement is produced by a cam K formed by a drum, which presents an undulating edge fitting on it, which during the rotation of the drum carries to the right and left the sort of friction-roller x fixed on to the axis of the bobbins, whilst the latter turn by means of the grooved pulley y in relation with a suitable transmission. This friction-roller is formed of two spherical knobs of steel, which can be brought into proximity according to the measure of wear of the helical tooth, which is cut so as to fill in all positions the interval of the two knots.

The threads might be received on reels, but this method would involve the inconvenience of dismantling the shaft bearing the reels whenever it was desired to take away the skins; these latter having to undergo a special reeling as in ordinary silk-works.

The properties of artificial silk admit of a better process of reception of it on the bobbins themselves. These bobbins are mounted on special clamps, where they are maintained by springs.

The shaft O, which has a continuous rotary movement and at the same time a rectilinear one, and alternates according to its axis, bears a series of clamps mounted on it and on the discs Q. The bobbins R are strung on spindles S, which are kept on the clamps P by plated springs T; and each of the spindles S, which serve to them as axes of rotation, presents a small friction-roller U, which, being in contact with the circumference of the disc Q, which corresponds to it, causes the spindle to turn, and consequently the group of bobbins mounted on this spindle, which has for this purpose a square transversal section.

The clamps P are all connected with each other by bars V, which permit us to turn the whole system, to withdraw the full bobbins, and replace them by empty ones. It is possible to avoid turning the two systems of bobbins at the same time by giving them a little play to the eye a of the clamps P. The weight of the system admits of the application of the friction-rollers U of the upper bobbins on to the discs Q, and to disengage the friction-rollers of the lower bobbins in such a way that these latter do not turn.

In order to facilitate the removal of the loaded bobbins and the replacing of them by empty ones, a series of small valves X is arranged permitting of passing the hand into the cage of the machine.

To ensure the position of the system during its working there is put at each extremity a fork A which embraces the extremity of the bar V which is in the lower part; this fork permits the lateral movement of the system which bears the bobbins, but prevents it from being drawn in the direction of the rotation of the shaft O. The forks A are mounted on rods.
BLEACHING, DYEING, PRINTING, etc.

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The length of the boil depends upon the kier: with the closer the boil is usually given; with the Barlow and Injekor kiers, working at a pressure of 40 to 50 lb. per square inch, 7 to 8 hours are required.

5th. Lime or grey sour.—After the lime boil the next operation is that of the lime sour, or grey sour, as it is called. The kier is filled with water, and is heated with hydrochloric acid at 2½° T., which is kept ready prepared in a stone cistern and run into the machine and into the kettle to be used as the acid stronger than this). After passing through the sour, the goods are piled in a heap on the sillage for a few hours. The acid attacks the lime soap, which was formed during the boil, decomposes it, and dissolves out the lime with the formation of calcium chlorides, while the fat of the soap is liberated; the former is washed away in the subsequent washing, while the latter remains to a large extent on the goods and is removed by the boil that follows. Sulphuric acid is not so satisfactory to use for the lime sour as hydrochloric acid, because it forms with the lime the insoluble sulphate of calcium, which is difficult to entirely remove from the goods, whereas the acid chloride is entirely removed from the goods by the washing that follows.

It is advisable to keep the acid at a uniform strength in the machine. The Twaddell is here of no use as an indicator of the actual strength, because the chloride of hydrochloric acid, when it neutralises and reduces the strength of the acid, actually raises the Twaddell, under which circumstances the only safe method is a chemical test. This can be carried out very simply, and with a sufficient degree of accuracy by working on the strength at regular intervals during the souring, and the supply of fresh acid being regulated, the sour will be kept at a more uniform strength, and more uniform results will be obtained than if the souring were done in a more empirical fashion. The test is best and most quick as follows:—Prepare a solution of the Newcastle 77 per cent, caustic soda of 20° T. (By always using the make of soda specified, the strength of various batches of the test solution will vary but little from time to time, and such slight variations may be neglected in these works tests.) It is now necessary to prepare a graduated measure, for which purpose take a tall narrow glass beaker which has a shoulder, and fill it with the test solution. Now take exactly five ounces' measure of freshly prepared sour of 2° T.; pour into a carefully sealed bottle, and put out of the soda test solution until a piece of cloth dyed with tannin is turned brown, when the water in which the dye is neutralised is poured on the bottle of soda to show how much has been used. (In all subsequent tests of the sour 5 oz. should always take the same quantity of the soda to close it if it takes less than 1½ oz; if more it is too strong; the remedy in each case is obvious. It is worth while to get the test title for, it is not 1½ oz., but 2° T., and the a as well as for 2° T.

The goods should not be left too long piled up for souring, as they may become dry entirely or in part. In any case, as the goods dry the acid become sticky and attacks them, and makes them tender, which is not for any reasonable time. Therefore, if it is not convenient to wash them for souring, they should be moistened with water from time to time, but it is best to wash them off a part of the cloth is not yet ready for the next operation.

6th. Lea boil.—This is perhaps the most important operation in the process of bleaching, and unless it will be well done a thorough bleach cannot be obtained. It is more especially important to describe, as the boil must be thorough, and if the goods well bottomed when they are going to be printed in the so-called printed style, with almost enough dye absorbed. Wise stains are liable to occur in the final stage, and it is then sometimes difficult to put the beam for these upon the ease should.

In principle the boil is simple, consisting in boiling the goods with a solution of soda ash or caustic soda. In the early days of the process caustic soda was used, which was displaced by soda ash, but in more modern developments of the bleaching process caustic soda is used, with some advantages over soda ash. The quantity of ash used varies in different works, as it might be anticipated from 150°—200°, of which a sufficient proportion is to use. The length of boil averages about four hours—certainly not less than three hours should be given, and it is not necessary to give more than five hours in either ordinary kiers, with central puffer pipes, or in Injekor kiers; in Barlow kiers or in other kiers working at high steam pressures of half the time is required. Care should be taken to see that the goods are well packed into the kiers—otherwise they will be in trouble. The boil will fall to penetrate equally all through, and this is important if a uniform result be desired, except that it must be sufficient to keep the goods well covered and still have enough to keep the circulation up; when the water is insufficient in amount and the goods get somewhat dry there is a liability to tendering, but with plenty of water there is no fear of any damage being done during a boil with alkaline. Some works use caustic soda instead of soda ash, in which case it is in—I from 120°—150° of caustic soda to 10,000 lb. of cloth; otherwise no alteration is made in the mode of boiling.

This boil clears away the fatty and waxy matter left in the goods after the lime sour, and thus places the way for the next operation. It is found best to run the ley into the kier cold, and to boil up; some bleachers are in the habit of "sweetening" the boil by working the ley up to 10 lb. pressure, to cover them, leaving for a few minutes for the goods to become impregnated; next to run off and boil up to the boil. When the goods have got warm, to run in the ley and boil up. After the boil the goods are washed, when they are ready for the next boil with water and soda.

(To be continued.)