Feb. 12, 1935. M. T. SANDERS ET AL 1,990,617

APPARATUS FOR SIMULTANEOUSLY SPINNING, TWISTING, AND PURIFYING RAYON

Filed Nov. 1, 1930

Fig. 1.

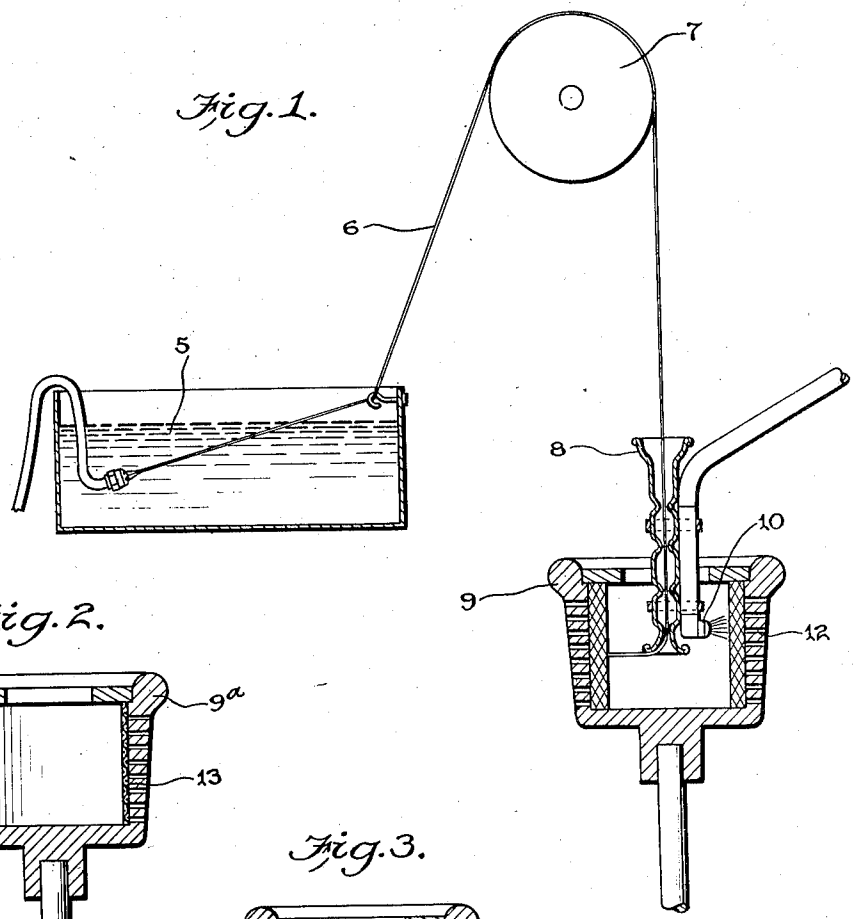



Fig. 2.

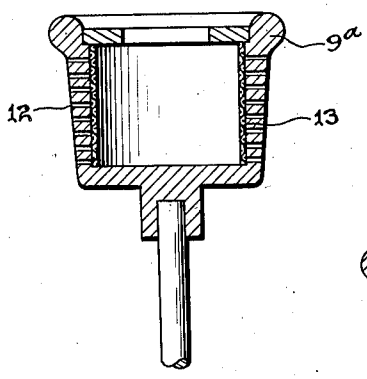
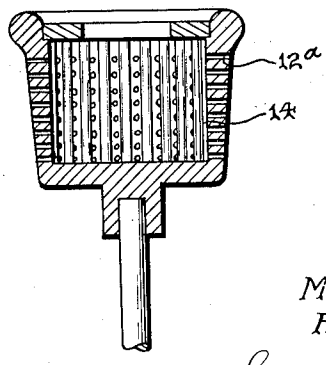



Fig. 3.




Inventors
Marshall T. Sanders
Ralph A. Hales,
By Samuel Herrick,
Attorney

Patented Feb. 12, 1935 1,990,617

# UNITED STATES PATENT OFFICE

1,990,617

## APPARATUS FOR SIMULTANEOUSLY SPINNING, TWISTING, AND PURIFYING RAYON

Marshall T. Sanders, Wilmington, Del., and Ralph A. Hales, Passaic, N. J., assignors to Atlas Powder Company, Wilmington, Del., a corporation of Delaware

Application November 1, 1930, Serial No. 492,830

3 Claims. (Cl. 18—8)

This invention relates to an apparatus for simultaneously collecting, twisting and purifying a textile fibre. In our co-pending application, Serial No. 492,829 we have described a process of collecting set thread in a spin pot and simultaneously treating the said thread with a purifying liquid. This application relates to the equipment used in carrying out the above process. The objects of the invention are to produce a rayon which will have (1) a uniform dye adsorbing power throughout its length, (2) an increased elongation at the break point, (3) less denier difference between the thread at the two ends of the pot cake; and to cheapen the cost of manufacture by (4) combining the operations of setting, twisting and purifying the thread, and (5) by collecting a greater yardage of thread in a spin pot of given size, thus reducing the labor required to doff the cakes by increasing the time between doffs. We will describe the invention as it relates to the cuprammonium process when using an alkaline setting bath. It will be obvious to those skilled in the art that the apparatus can also be used advantageously in those other rayon processes in which the thread requires a purifying treatment after the spinning and twisting operation. Heretofore it has been customary to spin cuprammonium cellulose solution into an alkaline setting bath and collect the precipitated thread on bobbins or in spin pots.

This set or precipitated thread still contains copper and ammonia which must be removed in a subsequent treatment with a liquid (usually dilute sulphuric acid) capable of removing them from the thread. This decopperizing operation is usually performed by unwinding the set thread from the bobbin or pot and collecting it on a bobbin or swift which rotates, partially submerged, in a bath of dilute acid. The thread is then subjected to the washing, finishing, drying and packaging operations. In the case of bobbin spun thread, a twisting operation usually follows that of drying.

One embodiment of the invention is illustrated in the accompanying drawing, wherein;

Fig. 1 is a diagrammatic view illustrating the apparatus for carrying out the invention; and

Figs. 2 and 3 are sectional views of modified forms of the spin pot, hereinafter described.

The embodiment of the invention relates to the cuprammonium process. The cuprammonium solution of cellulose is spun into a setting bath 5 comprising a caustic soda solution. The set thread 6 is conducted over a godet wheel 7, through a funnel 8 and into a spin pot 9. The funnel and spin pot are co-axial and reciprocate relative to each other in the direction of their axes. A spray nozzle 10 is attached to the funnel and so directed that it sprays dilute sulphuric acid against the face of the cake of thread as the thread collects in the spin pot. In this manner the thread is collected, twisted and decopperized simultaneously. If the alkaline precipitating bath be of such composition that some copper hydrate tends to collect in the funnel, we may flow a small quantity of dilute acid into the funnel along with the thread. The spin pot is provided in each form illustrated with a relatively large number of holes 12, for the escape of the excess liquid fed to the pot.

In Fig. 2 we have illustrated, in addition, a lining of porous cloth 13 for the pot; while in Fig. 3, we have shown a plurality of vertical channels 14 into which the openings $12^a$ lead and these vertical channels may be used either independently or in conjunction with the cloth lining.

The apparatus described above will be found to be of great value in view of the following facts.

In the old processes the set thread is continually washed with the setting bath carried to the pot or bobbin by the set thread. This alkaline bath has a slight solvent action on the copper contained in the thread. Thus the oldest thread collected will contain less copper per unit of cellulose than the youngest thread. Furthermore, water and ammonia are gradually lost by the thread, and the quantity of these, per unit of cellulose varies with the age of the thread. To obtain thread of uniform dye adsorption, the amounts of the various constituents of the set thread, per unit of cellulose, must be constant, and the composition of the decopperizing bath must be constant. These conditions are achieved by the apparatus of this invention.

The elongation at the break point, of the finished rayon is influenced by the tension or the degree of stretching to which the thread is subjected at the instant of decopperization. During this period the thread momentarily becomes easily elongated by even small amounts of tension. The more the thread is elongated during the period of decopperizing, the less the elongation at the break point of finished rayon. In old processes where the thread is pulled through the acid bath, it is subjected to appreciable tension by the drag of the thread through the bath and over the various guides. In the process of this invention, the set, undecopperized thread is laid against the cake of already decopperized thread in the spin pot, and

being thus supported, is not elongated during the period of decopperization.

We have observed that under the old methods of manufacture, especially when collecting set, undecopperized thread in a pot, that the denier of the thread at the outside of the cake is usually less than that at the inside of the cake. We have also observed that the thread made according to the new process shows no appreciable difference between the two ends of the cake. The set, undecopperized thread is much more bulky than the decopperized thread. This enables one to collect several times the amount of decopperized thread than undecopperized thread in a cake of a given volume. Our experience has been that we can collect approximately four times as much decopperized thread as undecopperized thread in a cake of a given volume. This enables one to spin four times as much thread in a pot, as previously, before it becomes necessary to change spin pots. The economic advantages in the reduction of labor through this effect are obvious. The combining of the decopperizing with the spinning operation effects economies through the saving of the cost of decopperizing machines and the labor necessary for their operation. It is obvious that the compositions of the cellulose solution, the setting bath, and the decopperizing acid, also the length of the thread in the setting bath, the relative locations of the parts of the machine, etc., may be varied to suit the local conditions and the denier of the thread being spun, without departing from the scope of the invention. In one embodiment of this invention we spun a cuprammonium solution containing 3.6% cellulose, 1.5% of copper and 4.3% of ammonia into a setting bath containing 80 grams of NaOH per liter. The resultant thread (of 100 denier size) was collected in a spin pot and simultaneously sprayed with 340 cubic centimeters per minute, of 20 gram per liter sulphuric acid. The finished rayon had a uniform dye adsorbing power throughout its length, was of even denier, had excellent elongation and high strength.

The adaptation of the apparatus of this invention to other rayon processes is within the skill of those versed in the art. For example, in the viscose process, the thread may be simultaneously spun and desulphurized; in the nitro process the thread may be collected in the pot and simultaneously be denitrated.

The spin pot or centrifuge basket ordinarily used in the manufacture of rayon cannot be used successfully with our new process because the thread will not build into a cake which can be unwound without spoilage and excessive loss of thread through tangling. We have discovered that this tangling of the thread may be prevented if the inner face of the pot be lined with a porous substance such as the cloth shown, or if the channels 14 be cut in the inner face of the pot and drain holes or openings 12 be provided to take the run off from these channels, or if a large number of such holes be formed in the wall of the pot.

We ascribe the failure of the usual type of pot, to the fact that it has insufficient drainage facilities to handle the relatively large flow of liquid used in our process, and that this liquid collects in the pot, forming a layer which tries to escape through the joint between the pot body and its cover. The movement of this layer washes the thread away from its normal position.

The ordinary type spin pot usually has eight holes, $\frac{3}{32}$ inch in diameter, in the cake zone and four such holes in the lid zone. The area of a $\frac{3}{32}$ inch circle is 0.0069 square inches. Eight $\frac{3}{32}$'' holes would have a combined cross-sectional area of 0.0552 square inches. The holes in the cake zone are soon covered with thread and their effectiveness is seriously reduced. They have, however, sufficient drainage capacity to pass the small quantities of liquor usually carried into the pot when merely collecting set thread. This volume of liquor is on the order of ten cubic centimeters per minute.

In our process of combined collecting, twisting and purifying the thread we use quantities of liquid on the order of one hundred to seven hundred cubic centimeters per minute. Such an amount of liquor cannot be handled by the usual drain holes.

It is within the scope of this invention to use a rigid, permeable, removable liner between the pot and the cake. In such a case the liner would be removed from the pot with the cake and the liner and cake would be separated at a subsequent time. Thus the liner might be used as a support for the rayon in transferring it from the spinning to the washing pot, and in subsequent operations, such as that of drying. In some cases it may prove desirable to use a rigid, impermeable liner, with longitudinal drainage channels.

Having described our invention, what we claim is:

1. Rayon manufacturing apparatus comprising a spin pot having a multiplicity of openings formed through its walls and a plurality of substantially vertical ribs exposed at and constituting a part of the inner face of the wall of said pot, said openings being located in the recesses between said ribs and said ribs being in sufficient number and close enough to each other to prevent the thread laid up in a cake upon the interior face of the spin pot, from being forced outwardly into said openings under the influence of centrifugal force.

2. Rayon manufacturing apparatus including a centrifuge having its inner face composed of a plurality of substantially vertical ribs and provided with liquid escape openings outwardly of and between said ribs, said ribs being in sufficient number and close enough to each other to prevent the thread laid up in a cake upon the interior face of the spin pot from being forced outwardly into said openings under the influence of centrifugal force.

3. Apparatus as recited in claim 2 wherein said openings and the channels between said ribs are of such capacity as to complementally conduct at least 100 cubic centimeters of liquid per minute.

MARSHALL T. SANDERS.
RALPH A. HALES.