May 1, 1951 R. Y. HAYS ET AL 2,550,808

COAGULATING BATH CIRCULATING EDUCTOR

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Fig. 2.

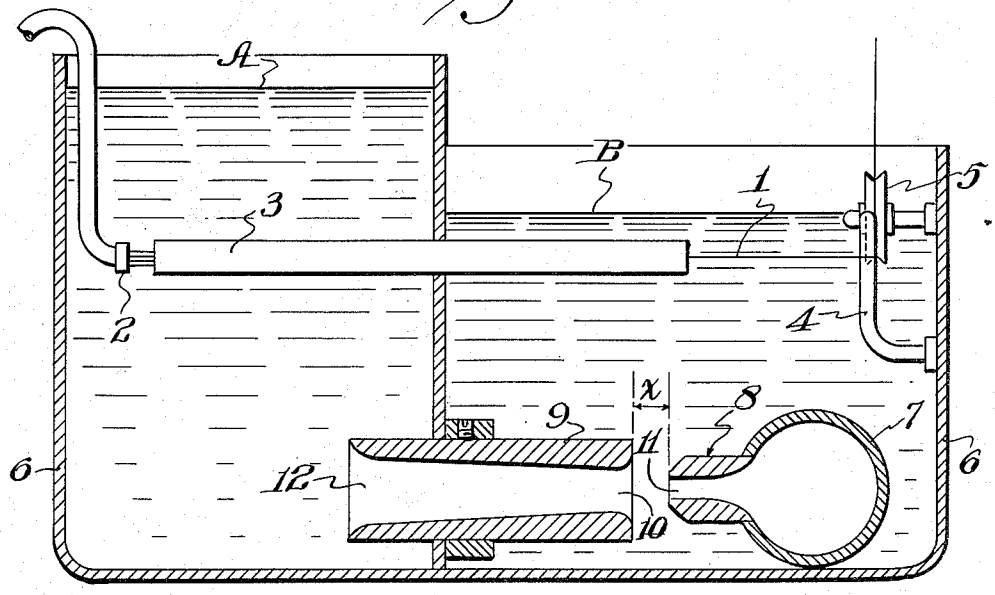
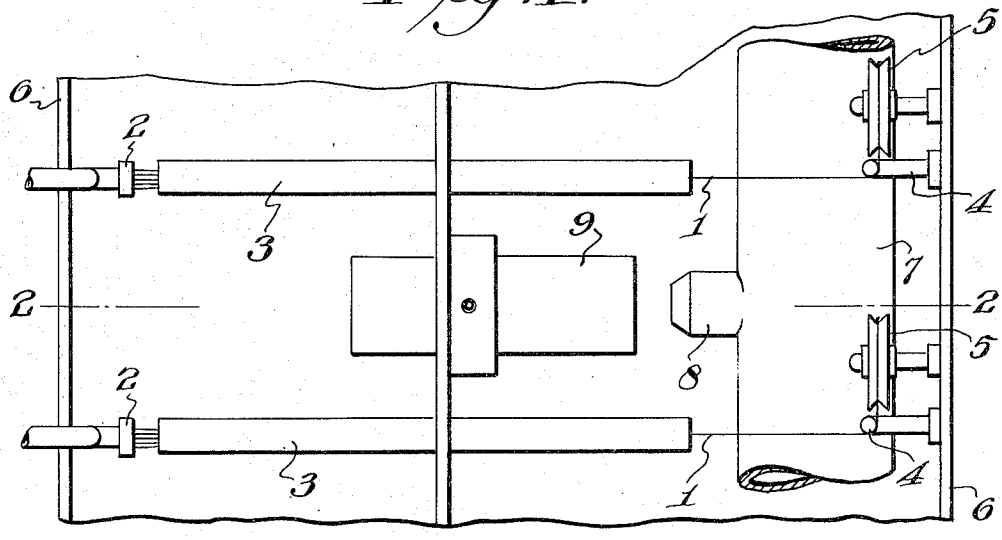


Fig. 1.



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COAGULATING BATH CIRCULATING EDUCTOR

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6 Claims. (Cl. 18—8)

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This invention relates to an improvement in the handling, circulating and mixing of coagulating bath. More particularly, the invention relates to recirculation and blending of used coagulating bath with fresh coagulating bath and distributing this blended bath uniformly along the length of a viscose rayon spinning machine coagulating bath trough.

A desirable arrangement for spinning viscose into rayon filaments and yarns involves the use of a tube through which the freshly formed filaments are passed along with concurrent flowing coagulating bath. The entrance end of the tube is quite close to the face of the spinneret and the induced flow of bath through the tube helps to relieve the tension on the delicate slightly coagulated filaments until they reach a state where substantial tension can be applied. (For details of this spinning process, see Millhiser, U. S. Patent 2,440,057.) This desirable spinning process requires that considerably more bath be flowed through the tube than is needed to effect coagulation of the freshly formed viscose filaments. For instance, spinning at yarn speeds of approximately 140 yds./min. requires a 2" head of bath at the spinneret to cause co-current bath flow through the tube at the desired velocity. When spinning 50-denier yarn, only about 0.24 gal./min. of fresh bath are needed to maintain the proper acidity and temperature of the coagulating bath, but because of the flow requirement in tube spinning about 0.8 gal./min. of bath flow through the tube must take place. In other words, over three times as much bath is needed to satisfy the flow requirements as is needed to maintain the acidity and temperature requirements for good coagulation.

It can be readily seen that considerable expense could be incurred in providing the necessary recirculation, heating, and buckup of the coagulating bath.

It is, therefore, an object of this invention to provide an efficient and economical arrangement for circulating, mixing, and distributing fresh bath and partially spent bath. Other objects will be apparent from the description that follows.

These objects are accomplished by pumping fresh bath through a jet immersed in partially spent bath and located to cooperate with a mixing tube which is positioned in the partition separating the primary and secondary baths. As the fresh bath is forced out of the jet through the secondary bath and into the mixing tube and from this into the primary bath, it carries with it a large volume of the secondary bath. In this manner the necessary head is maintained in the primary bath and economic reuse of the secondary bath is effected.

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For further understanding reference is made to the discussion below and the figures which are given for illustrative purposes only and of which

Figure 1 is a plan view and

Figure 2 is a longitudinal cross-section through the center of the jet and cooperating tube taken on 2—2 of Figure 1.

The primary bath A is at a higher level than secondary bath B, as shown in Figure 2. The difference is generally about 2 inches. The yarn 1 is formed by extrusion of viscose through spinneret 2 into primary bath A and immediately into tube 3. The coagulated filaments and the bath pass through tube 3 into secondary bath B. The yarn 1 is passed around suitable guides 4 and 5 and is then passed to stretching and/or wind-up devices (not shown).

Located at the bottom of the trough 6 is a pipe line 7. As shown in Figure 1, this runs the length of the trough 6 and has a plurality of jets 8 suitably located at intervals along the length of the bath trough. Cooperating with each of these jets 8 is a mixing tube 9 which is internally tapered as shown. The pipe line 7 is connected to a supply source of and heating means for fresh bath.

The fresh bath is pumped through pipe line 7 and forced through jet 8 and into tube 9 and then into primary bath A. As the fresh bath passes from jet 8 into tube 9 it picks up and carries with it some of the spent or partially spent bath in secondary bath B. The efficacy of primary bath A is retained at a high level and considerable economy is effected.

The ratio of old bath pickup by the new is dependent on the pressure in the header 7 and the distance "X" between the jet 8 and tube 9. In a table below are given some typical flow and recirculation figures at various manifold pressures and with some variation of jet-tube spacing, i. e. dimension "X."

Manifold Pressure, lbs./In.	"X", Inches	Total Circulation, Gals./min.	Jet Flow, Gals./min.	Ratio of Total Cir. to Jet Flow
1.08	¾	6.88	3.01	2.29/1
1.78	31/32	8.70	3.05	2.89/1
2	⅞	8.40	3.40	2.47/1
2¼	½	10.13	3.63	2.78/1
2¾	½	12.10	4.35	2.78/1
3	½	12.75	4.50	2.83/1

The mixing tube 9, jet 8 and pipe line 7 need not be located at the bottom of the baths as shown. Any location which leads to the required mixing and circulation of baths may be used. The smaller annulus 10 of the internally tapered tube 9 is located in the secondary bath near the annulus 11 of the jet 8. The larger annulus 12 of tube 9 is located in the primary bath. The juxta-annular positioning of 10 and 11 may vary somewhat, as, for example, between ½ to 1 inch, but preferably the distance separating these annuli is about ½ inch.

Generally, a ratio of total flow through tube 9 to the jet flow through 8 can be readily adjusted as indicated in values between 2.5 and 3.0, and for practical purposes this is just about what is desired. At the same time the two streams are blended in tube 9 and are delivered to the primary bath at the right velocity to spread and mix with the bath already in the primary bath trough without setting up undesirable turbulence that could deleteriously affect the fresh viscose streams at the spinneret. With this double bath trough serving 50 spinning positions, the use of about six of these eductors uniformly spaced along the trough provides good uniformity of bath composition from spinning position to position. Obviously the number of these eductors per spinning machine side may be varied within reason.

The eductors consisting of a simple jet 8 and the cooperating mixing tube 9 are easily fabricated and installed. Friction losses are at a minimum due to the elimination of any housing for the jet. Furthermore, baffles around the distributing system are eliminated as unnecessary because the velocity head is spent by recirculation. With this arrangement full available head is utilized for distribution, thereby obtaining good efficiency and distribution. Inasmuch as the new bath brought to the spinning trough is under the same low pressure normally used, there is no additional cost of operation by this installation, and since the full available pressure head in the manifold is used in inducing bath flow from the secondary bath at lower level to the primary bath of higher level, the introduction of fresh bath into the primary bath is done with a minimum of undesirable bath disturbances, such as turbulence, induced eddy currents, etc. because the velocity of bath flow from the exit end of tube 9 is very low and diffusion of the new bath with the old takes place under optimum conditions. Finally, the equipment is easily cleaned and maintained.

Efforts were made to circulate part of the used bath with some fresh bath through jets or eductors commercially available. Such eductors were designed to work at high pressures of from about 30 to 60 lbs./sq. in. and failed completely under a head pressure of only about 1 to 3 lbs./sq. in., the prevailing pressure in the supply coagulating bath header at the spinning machine. Notwithstanding the discouraging results obtained with commercially available eductors, design work was undertaken and the suitable low pressure eductor jet described above was developed which admirably satisfied all the requirements. Not only does

the low pressure eductor of this invention induce adequate recirculation of the partially spent bath but it causes excellent mixing of the used bath with fresh bath and by suitably locating a number of these eductors at intervals along the length of the bath trough very satisfactory distribution of fresh bath at the high level of the primary bath was made possible.

Any departure from the procedure described herein which conforms to the principles of the invention is intended to be included within the scope of the claims below.

We claim:

1. In spinning apparatus comprising a primary spinning bath container and a secondary spinning bath container connected by a spinning tube positioned in a partition between said containers, the improvement comprising a low pressure jet in said secondary bath container and positioned in said partition a mixing tube located juxta-annularly to said jet.

2. In spinning apparatus comprising a primary spinning bath container and a secondary spinning bath container connected by a spinning tube positioned in a partition between said containers, the improvement comprising a low pressure jet in said secondary bath container and a mixing tube positioned in said partition to have an annulus in said primary bath container and an annulus in said secondary bath container near the annulus of said jet.

3. Apparatus in accordance with claim 2 in which said annulus of said jet is about one-half of an inch from said annulus of said mixing tube in said secondary bath container.

4. Apparatus in accordance with claim 2 in which said mixing tube is internally tapered with the smaller annulus located in said secondary bath container.

5. In spinning apparatus comprising a primary spinning bath container and a secondary spinning bath container connected by a spinning tube positioned in a partition between said containers, the improvement comprising in said secondary bath container, a low pressure jet connected to a pipe line and positioned in said partition, a mixing tube located juxta-annularly to said jet.

6. In yarn spinning apparatus in which the coagulating liquid flows from a primary bath container to a secondary bath container in the direction of yarn travel, the improvement comprising means for pumping fresh bath under low pressure through a portion of said secondary bath thereby mixing it with a portion of said secondary bath; and means for forcing the resultant mixture into said primary bath container thereby replenishing said primary bath.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,243,116	Ostermann	May 27, 1941