March 6, 1956 R. H. CARTER 2,737,372

MIXING APPARATUS

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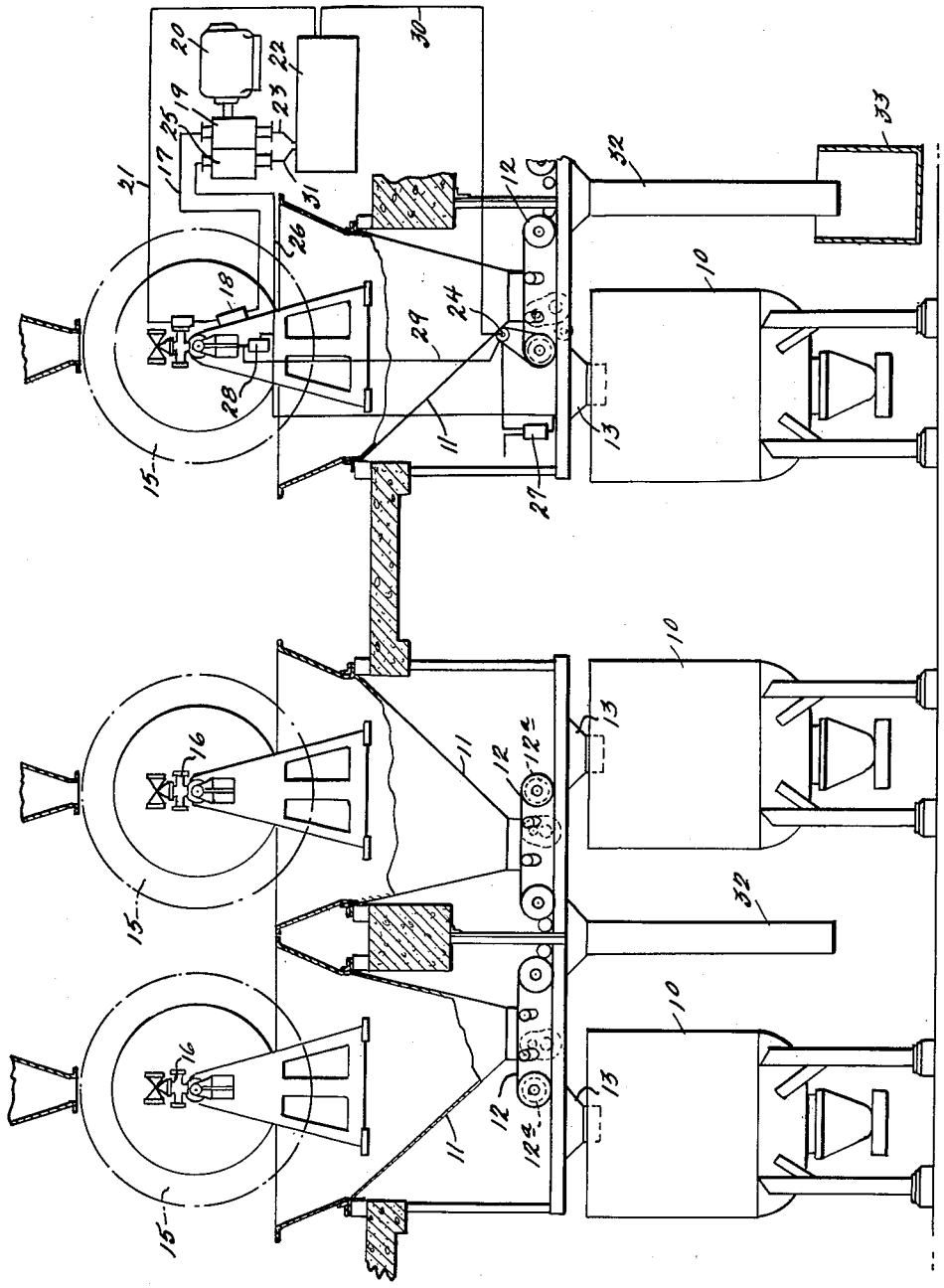


FIG. 1.

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MIXING APPARATUS

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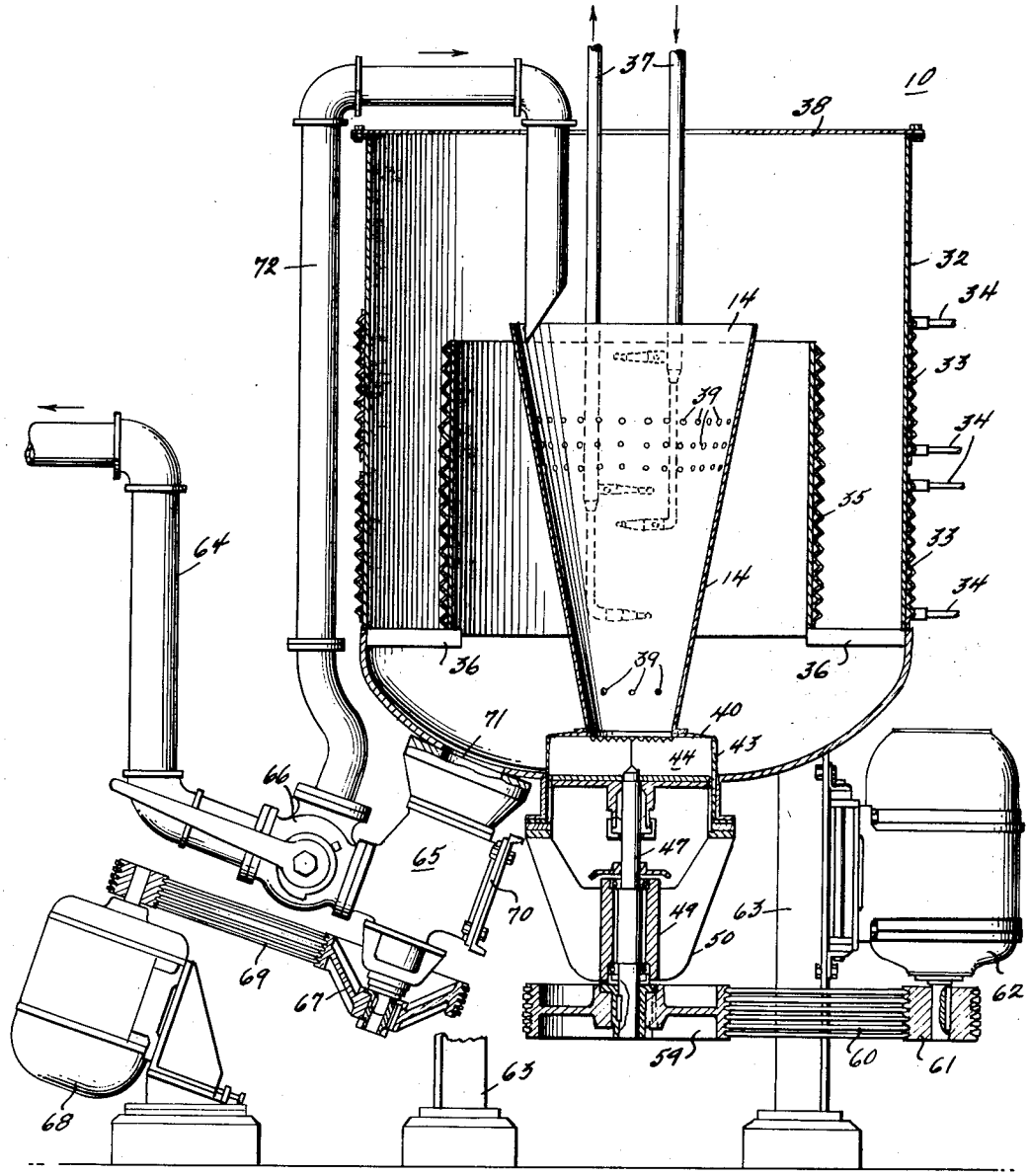


FIG. 2.

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MIXING APPARATUS

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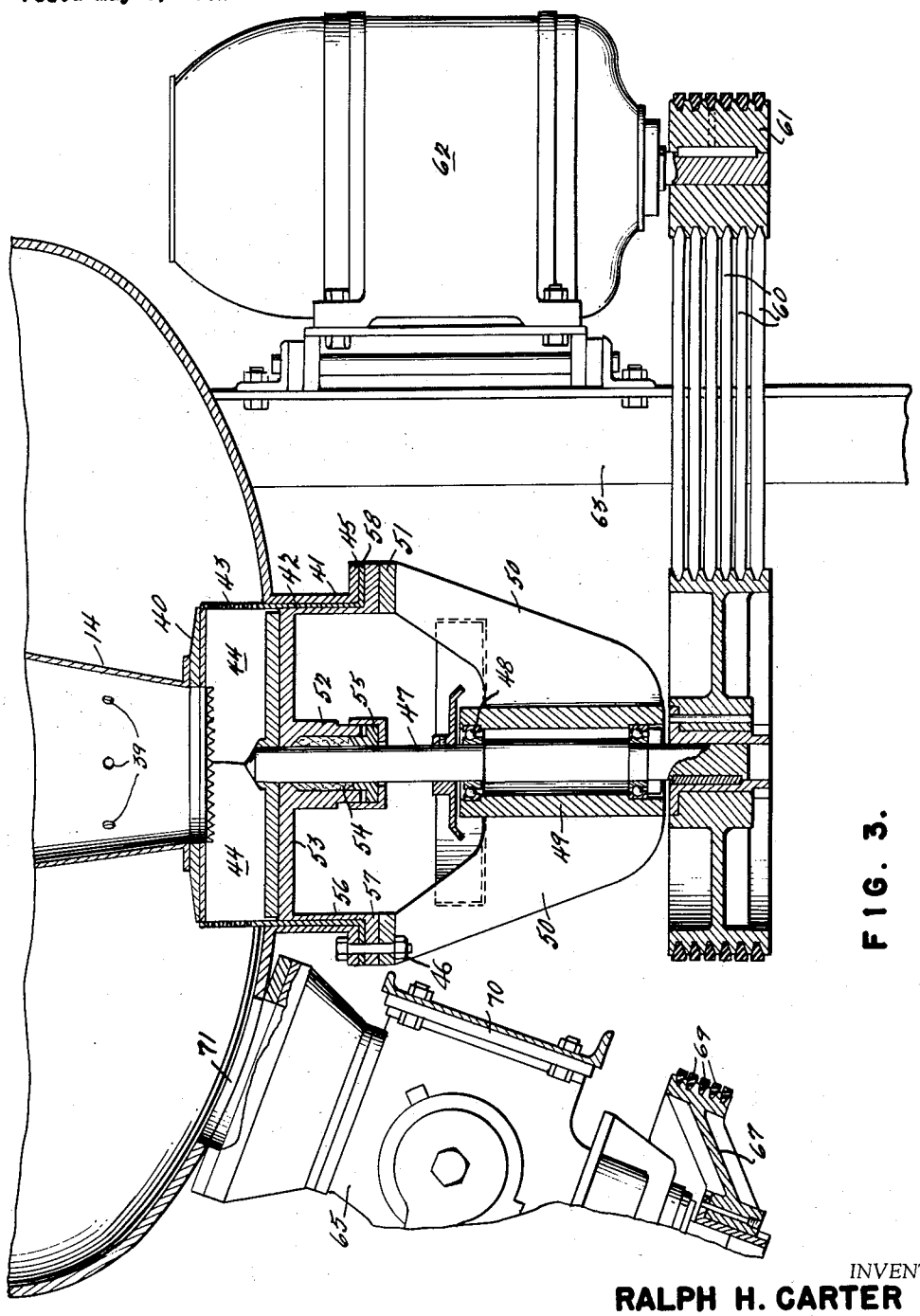


FIG. 3.

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MIXING APPARATUS

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FIG. 5.

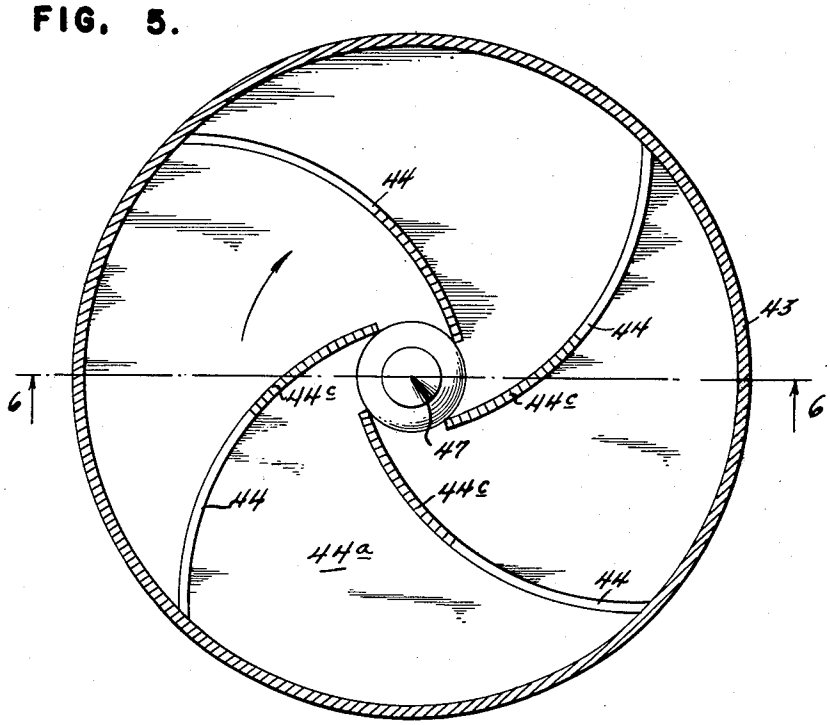


FIG. 4.

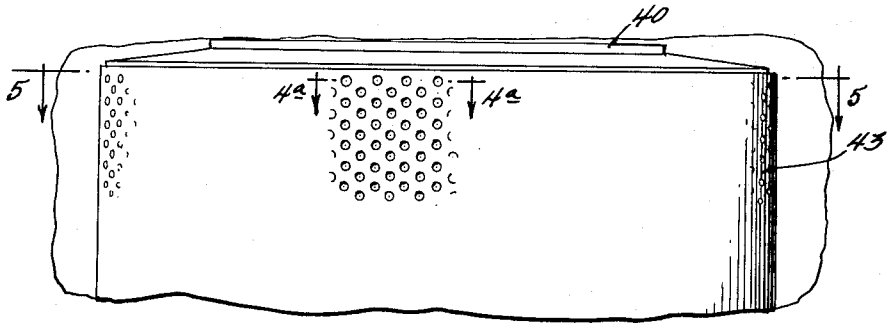
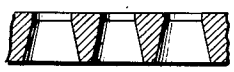


FIG. 4a



INVENTOR
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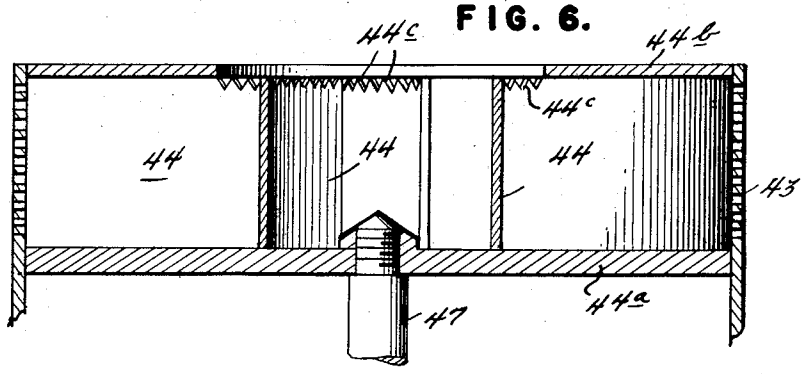
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March 6, 1956 R. H. CARTER 2,737,372

MIXING APPARATUS

Filed May 9, 1952 5 Sheets-Sheet 5

FIG. 6.



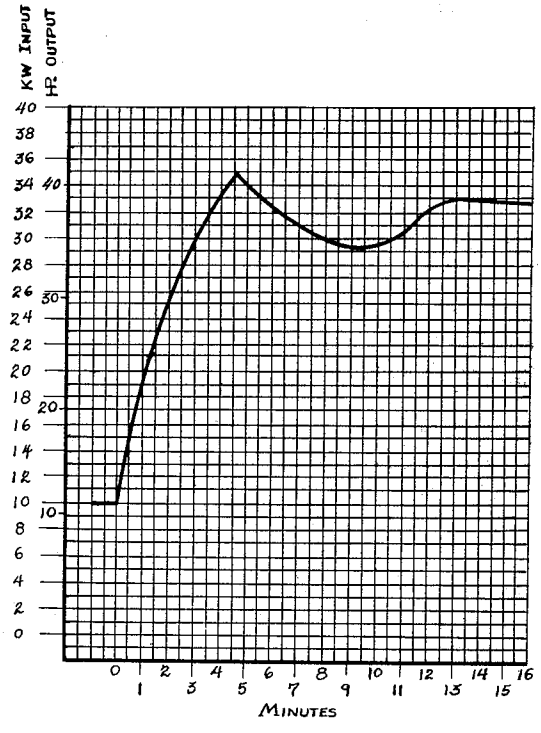


FIG. 7.

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United States Patent Office 2,737,372 Patented Mar. 6, 1956

2,737,372

MIXING APPARATUS

Ralph H. Carter, Johnson City, Tenn., assignor to North American Rayon Corporation, New York, N. Y., a corporation of Delaware

Application May 9, 1952, Serial No. 287,062

6 Claims. (Cl. 259—24)

This invention relates to an apparatus for dissolving cellulose xanthate to produce viscose from which rayon threads and transparent cellulose sheets may be manufactured.

Cellulose xanthate is a reaction product obtained by treating alkali cellulose with carbon bisulphide. It is an orange-colored, sticky, amorphous mass which is soluble in water and/ or a dilute caustic solution.

In the dissolving process used heretofore, it has been customary to dump the cellulose xanthate from a xanthating churn or baratte into a so-called mixer containing a dilute caustic dissolving solution which was rapidly agitated. The balls or large lumps of xanthate which were discharged into the mixer had a tendency to become coated on the outside and even though the agitation was rather violent the buoyancy of the balls consisting of an agglomeration of the cellulose xanthate floated on top of the solution and did not circulate through the grinding mechanism that was provided in the mixer for disintegrating the balls. These balls varied in size from 1 to 2 inches up to 6 to 8 inches or even larger, depending to a certain extent on the xanthating process methods used and type of churn used.

With the conventional methods, the mixing time was determined by the time required to finally dissolve the large particles which floated on the top of the mass. This required a mixing cycle extending over a long period of time. This necessitated the use of considerable equipment to mix the required amount of xanthate and considerable power was wasted in driving the mixers since it has been found that the actual dissolving of the xanthate in the caustic solution required only a few minutes if certain basic principles incorporated in this invention are followed.

It has been proven that it is possible to make a satisfactory viscose solution from cellulose xanthate in 10 to 15 minutes, whereas according to past customary methods the time required is from 120 minutes up to 240 minutes or longer depending on equipment used.

It is therefore an object of this invention to provide an improved apparatus for dissolving cellulose xanthate to produce viscose.

Another object of this invention is to provide an improved apparatus for dissolving cellulose xanthate which reduces the time required for this operation.

Still another object of this invention is to provide an improved apparatus for dissolving cellulose xanthate of greatly increased efficiency.

A further object of this invention is to provide an apparatus for dissolving cellulose xanthate in which the particles and lumps of the cellulose xanthate are first wetted with a limited amount of dilute dissolving solution and thereafter cut up to reduce the size of the particles and lumps in order to be more rapidly dissolved.

Still a further object of this invention is to provide an apparatus for dissolving cellulose xanthate to produce viscose, the apparatus consisting of a funnel shaped tube into which a quantity of cellulose xanthate is dumped in

a limited time to be simultaneously moistened with a dilute dissolving solution fed into said funnel shaped tube through a plurality of small holes in the side walls thereof. The particles and lumps of moistened cellulose xanthate are reduced in size by being forced through a stationary circular screen which is around the periphery of the pump impeller. The xanthate particles of reduced size are thus forced into the main body of dissolving solution and as the volume thereof is increased the solution is caused to flow over the top of the funnel shaped tube and is in turn re-circulated by the impeller pump located in the bottom of the funnel shaped tube.

Other and further objects of this invention will be apparent to those skilled in the art to which this invention relates from the following specification, claims and drawings.

Referring to the drawing briefly:

Fig. 1 is a view in vertical elevation and fragmentary cross section of an embodiment of this invention;

Fig. 2 is a sectional view in vertical elevation of one of the mixer units constructed in accordance with this invention;

Fig. 3 is a sectional view of the lower portion of the mixer unit;

Fig. 4 is a side view of the perforated wall of the impeller pump employed in the mixer unit;

Fig. 4*a* is an enlarged sectional view taken along the line 4*a*—4*a* of Fig. 4;

Fig. 5 is a sectional view taken along the line **5**—**5** of Fig. 4 showing the impeller blades and perforated wall of the impeller pump of the mixer unit;

Fig. 6 is a sectional view taken along the line **6**—**6** of Fig. 5; and

Fig. 7 is a graph employed to explain the operation of the mixer unit.

Referring to Fig. 1 of the drawing in detail, there is illustrated an arrangement employing three mixers **10** for dissolving cellulose xanthate. The cellulose xanthate is supplied to these mixers **10** by the conveyors **12** that are positioned under the hoppers **11**. Thus, the cellulose xanthate dropped from the bottom of each of the hoppers **11** may be dumped into the corresponding tube **13** through which it is dumped into the funnel shaped tube **14** positioned inside of the corresponding mixer **10**, one of which is shown in Fig. 2.

The cellulose xanthate is dumped into the top of the hopper **11** from the mixing churn or baratte **15** that is positioned over the top of the hopper. This mixing churn is rotated by a hydraulic motor **16** which is supplied by fluid under pressure through the pipeline **17** and manually operable valve **18** from the pump **19** that is driven by the motor **20**. The return fluid line **21** is connected to the tank **22** which is also connected to the suction side of the pump **19** through line **23**. The operator can, thus, control the rotation of the churn **15** by manipulating the valve **18**.

The conveyor **12** is driven by a reversible hydraulic motor **24** which is connected to pump **25** through the tubular line **26** and valve **27** which controls the rotation of the hydraulic motor **24** to cause rotation of conveyor **12** in the counterclockwise direction for the purpose of dumping the cellulose xanthate received from the hopper **11** into the tube **13**. This operation of dumping the cellulose xanthate from hopper **11** into the tube **13** and the funnel shaped tube **14** inside of the mixer **10** must procede at a certain definite rate under the control of the operator having control of the valve **27**, in order that the cellulose xanthate batch is dumped into the mixer **10** in a predetermined time interval so that the mixer **10** may mix the cellulose xanthate at optimum efficiency as will be described hereinafter. To this end two hydraulic pumps **19** and **25** are provided, the pump **19** supplying the driving fluid for driving the motor of the churn **15** and the

pump 25 supplying the driving fluid for the conveyor motor 24. In this way the operation of the churn 15, whether it be fast or slow or intermittent, does not affect the fluid supplied to the hydraulic motor 24 and this latter motor may be driven at a uniform rate if desired.

The hydraulic motor 24 may be reversed by manipulating the valve 28 which is also connected to the line 26 and which is connected through the additional line 29 to the motor 24. The motor 24 is also connected by the line 30 to the tank 22 and the suction end of the pump 25 is also connected to the tank 22 through the line 31.

After the batch of cellulose xanthate in the hopper 11 is dumped into the mixer 10 by the conveyor 12, the operator of the churn 15 may reverse the direction of the conveyor 12 and dump the remaining cellulose xanthate that he cleans out of the churn 15 into the hopper 11 and out of the bottom of the hopper. This cellulose xanthate may be dumped upon the conveyor 12 which in turn dumps it into the tube 32 which empties into a refuse box 33.

While only one churn 15 has been shown for each mixer 10, it is desirable to provide two churns 15 for each mixer 10. The reason for this lies in the fact that approximately 140 minutes are required for the churn to mix up a batch of cellulose with carbon disulphide whereas the mixer 10 can receive the batch of cellulose xanthate from the churn 15 and thoroughly mix it in 70 minutes or less. Thus, two churns may be employed to supply the xanthate to the hopper 11 alternately at 70 minute intervals in order to keep the mixer 10 running continuously.

The mixer 10 is shown in detail in Fig. 2 which is a view in vertical elevation. The mixer consists of a tank 32 which is provided with cooling jackets 33 that are connected to suitable supply of cooling liquid through the pipe 34. A supplementary cooling tube arrangement 35 is supported on a suitable circular wall and bracket arrangement 36 inside of tank 32 and this cooling tube arrangement 35 is connected to a supply of cooling fluid through the pipe 37. A cover 38 is provided to the tank 32 and a central opening is formed in this cover through which the tube 13, shown in Fig. 1, extends into the tank 32 so that cellulose xanthate may be dropped through this tube 13 into the funnel shaped tube 14 positioned in the center of the tank 32.

The tube 14 is provided with several rows of holes 39 in the side walls thereof. The purpose of these holes 39 will be more fully described hereinafter. The bottom of the tapered tube 14 is attached to the top 40 of the pump housing that is positioned in the bottom of the tank 32, as shown in detail in Fig. 3.

The impeller pump unit is supported in a hole cut into the bottom of the tank 32 around which a short tube 41 is welded or otherwise attached. The pump housing 42 fits into the tube 41 and the perforated portion 43, shown in detail in Fig. 4, extends into the inside of the tank, a distance equal to the height of the impeller blades 44 and the top and bottom plates 44*a* and 44*b* associated therewith.

The whole pump unit is supported on the bottom of the tank 32 by means of the tube 41 which is provided with a flange 45 to which the pump unit is bolted by the bolts 46. This construction permits easy removal of the entire pump unit from the bottom of the tank 32 in case the unit requires servicing or replacement.

The mixer pump is preferably of the closed impeller type and is provided with four blades 44 positioned between a bottom plate 44*a* and a top plate 44*b*. These plates 44*a* and 44*b* are attached to the impeller blades 44 and form a unit that is fixed on the upper end of the shaft 47 which is rotated by the motor 62. A central opening is provided to the top plate 44*b* and this central opening corresponds to the bottom hole in the funnel shaped tube 14 through which the cellulose xanthate is dropped into the impeller pump. The top edges of the impeller blades 44 exposed in this hole are provided with serrations 44*c*, to facilitate cutting up of the xanthate. The outer edge of the impeller blades 44 are in close proximity to the inner surface of the perforated wall 43 and for best results the clearance between the ends of the impeller blades and the inner surface of this perforated wall is between 0.010 and 0.040 inch.

It has been found that a comparatively small impeller pump running at high speeds is more effective than a large impeller pump running at low speeds. A certain amount of cutting up of the particles of cellulose xanthate is accomplished by the blades because of the velocity of the blades as well as the cutting action obtained between the impeller blades and the edges of the perforations in the wall 43.

The pump shaft 47 is provided with a pair of ball bearings 48 which are supported in the flange 49 that is supported by means of the arms 50 that are attached to the ring 51 which is also supported by the bolts 46. A suitable stuffing box 52 is attached to the bottom of the plate 53 for the purpose of receiving the packing 54. This packing 54 may be forced against the shaft 47 and into the cavity in the stuffing box 52 by means of the members 55.

The plate 53 is attached to the tube 56 which fits inside of the tube 42 and is provided with a ring-shaped flange 57. The bottom on tube 42 is also provided with a ring-shaped flange 58. All of the flanges 45, 51, 57 and 58 are held in assembled relation by bolts such as the bolts 46.

The bottom of the shaft 47 is provided with a multiple-V pulley 59 which is keyed thereto and which is connected by the V-belts 60 to the pulley 61 of the motor 62. This motor 62 is supported on one or more of the legs 63 of the tank 32.

The mixed xanthate is supplied to the various spinning devices through the pump 64 that is connected to the pump 65 through the valve 66. The pump 65 is provided with a multiple-V pulley 67 that is connected to the motor 68 by the V-belts 69. Pump 65 is supported on the plate 70 by suitable bolts and is held with the mouth thereof sealed around the hole 71 provided in the tank 32.

The pump 65 may be employed to assist in the mixing of the cellulose xanthate and for this purpose the outlet of this pump is connected through valve 66 to the pipe 72 which extends into the top of tank 32. When the outlet of the pump 65 is connected to feed the mixture into the pipe 72, the mixture may be pumped from the bottom of the tank 32 into the top of the funnel shaped tube 14 and re-circulated through the impeller pump connected to the bottom of this tube 14.

The tube 14 is made of tapered or funnel shaped configuration in order to facilitate getting the cellulose xanthate through it to the impeller pump in the largest volume. However, the cellulose xanthate must not be fed to the impeller pump too rapidly so as not to exceed the capacity of the pump and allow it to become clogged. On the other hand, if the cellulose xanthate is supplied to the mixer too slowly the viscosity of the mix in the tank 32 rises rapidly and reaches a point when it is not receptive to more dry xanthate.

At the beginning of the mixing operation, the water or caustic solution supplied to the mixer tank 32 reaches a level that is below the top of the tapered tube 14. However, a small amount of water or caustic solution is permitted to enter this tube 14 through the holes 39 in order to moisten the cellulose xanthate dropped into this tube 14 before the cellulose xanthate is forced through the perforated wall 43 by the impeller pump. Thus, the moistened cellulose xanthate is supplied to the impeller pump and forced by this pump out into the water or caustic solution in the bottom of the tank and the volume of the solution is increased as this operation proceeds. Accordingly, the liquid level rises in the tank 32 and the liquid flows over the top of the tube 14 into this tube. The agitation of the solution is continued by the impeller pump at the bottom of the tube 14. The pump 65 which is driven by the motor 68 may also be utilized to circulate

the solution from the bottom of the tank through the valve **66** and the pipe **72** into the top of the tube **14** as mentioned above, in order to assist in the agitation of the solution.

In the operation of this mixer it is, therefore, important to start with the water or caustic solution at a low level below the top of the tube **14** and feed the charge of cellulose xanthate into the tube **14** of the mixer at a constant predetermined rate during a period of from two to five minutes or before the cellulose xanthate, added to the mixer, causes a marked increase in the viscosity of the water or caustic solution to an extent that the flow of the solution through the impeller pump would be retarded.

The action which takes place in the mixer is illustrated in the graph shown in Fig. 7. This curve is a plot of horsepower required to rotate the impeller pump against the mixing time, the horsepower being represented on the ordinate and the time being represented on the abscissa. It will be observed that approximately 10 horsepower was required to overcome the friction in the impeller unit and for circulating a small amount of the solution allowed to enter the tube **14** through the holes **39**. The cellulose xanthate was dumped into the tube **14** at a predetermined uniform rate by the conveyor **12** in a period of two minutes. The power supplied to the motor of the impeller pump thereafter continued to rise and reached a maximum of 35 kilowatts or approximately 47 horsepower after a period of operation of 4½ minutes. Then, the power gradually decreased to about 35 horsepower after 8 minutes of operation and then gradually rose again to about 38 horsepower and levelled off, indicating that the mixing cycle was completed after a period of about 15 minutes. The drop in power required, shown by the dip in the curve, is the result of most of the particles of cellulose xanthate in the mixer having gone into solution. The increase in power up to 38 horsepower shown by the curve at about 13 minutes operation is the result of increased viscosity in the solution establishing a vortex through the tube **14**.

The cellulose xanthate must, therefore, be supplied to the mixer at a predetermined rate in order to secure the optimum results as pointed out above. The water or caustic solution employed has a relatively low viscosity, however, as the cellulose xanthate is added, the viscosity rises and, at the same time, the volume of the solution increases. The cellulose xanthate must not be dumped into the tube **14** too fast so that the impeller pump does not become clogged.

Furthermore, whether or not the cellulose xanthate contains balls of sizes that are 2 inches or less in diameter is of no consequence provided the tube **14** is made with a suitable number of holes **39** through which water or caustic solution may enter this tube in order to moisten the balls of cellulose xanthate dumped into this tube. However, only enough water or solution must enter this tube **14** through these holes **39** to moisten the cellulose xanthate.

As described above, the conveyor **12** is driven through a reversible hydraulic motor and speed reducer and when this conveyor is not in motion it is not possible to drop foreign particles into the mixer through the chute **13**. The pulley **12***a* provided to the conveyor may be of the permanent magnet type so that any tramp iron which may be in the cellulose xanthate will be carried around this pulley and be dropped clear of the top of the chute **13** so as not to enter the tube **14** and the impeller pump.

While I have described this invention in detail with respect to a preferred embodiment, it is, of course, understood that I do not desire to limit this invention to those details except insofar as they are defined by the claims.

What I claim is as follows:

1. An apparatus for dissolving cellulose xanthate to produce viscose comprising in combination a tank for holding an aqueous solution for dissolving cellulose xanthate, an impeller mixer pump and housing therefor positioned in the bottom of said tank, a funnel shaped tube comprising a cellulose xanthate wetting chamber having the bottom thereof positioned over the mouth of said pump housing, said tube having a mouth at the top thereof positioned well below the top of said tank, means for gradually dumping a predetermined charge of cellulose xanthate into said tube through the mouth thereof, said tank being partially filled with the aqueous solution to a level substantially below the mouth of said tube, said tube being provided with a plurality of holes for passing a limited quantity of the aqueous solution into said tube simultaneously as said charge of xanthate is dumped into said tube, the number, size and distribution of said holes being such as to supply streams of the aqueous solution in said tube to moisten the cellulose xanthate as it is dumped into said tube, and means for driving said impeller mixer pump for reducing the moistened cellulose xanthate to small particles and forcing said small particles into the aqueous solution in said tank.

2. An appaartus for dissolving cellulose xanthate to produce viscose comprising in combination a tank for holding an aqueous solution for dissolving cellulose xanthate, a tube positioned in said tank, said tube having a mouth at the top thereof positioned well below the top of said tank, means for gradually dumping a predetermined charge of cellulose xanthate into said tube through the mouth thereof, said tank being partially filled with the aqueous solution to a level substantially below the mouth of said tube, said tube being provided with a plurality of holes for passing a limited quantity of the aqueous solution into said tube simultaneously as said charge of xanthate is dumped into said tube for moistening the cellulose xanthate as it is dumped into said tube, an impeller mixer pump connected to the bottom of said tube for receiving said xanthate after it is moistened by streams of the aqueous solution passing into said tube through said plurality of holes, and means for driving said mixer pump for reducing said moistened cellulose xanthate into small particles and for forcing said small particles into the solution in said tank to be dissolved thereby, said dissolved xanthate raising the level of the solution in said tank over the mouth of said tube so that said last mentioned solution may thereafter be recirculated through said tube and said pump until it is thoroughly mixed.

3. Apparatus for dissolving and thoroughly mixing cellulose xanthate to produce viscose comprising a wetting chamber being in the form of a vertical open mouth funnel shaped tube for receiving a predetermined batch of cellulose xanthate, a tank surrounding said tube, said tank containing an aqueous solution to a depth well below the mouth of said tube, said tube having a plurality of holes formed in the sides thereof for introducing aqueous solution into said tube in the form of a plurality of streams, means for gradually dumping a predetermined batch of cellulose xanthate into said tube through the mouth thereof, said batch of cellulose xanthate being gradually dumped into said tube thereby intercepting said streams of aqueous solution so that the lumps of said cellulose xanthate are moistened by said solution in passing to the bottom of said tube, an impeller pump having a housing connected to the bottom of said tube so that the moistened cellulose xanthate is fed from the bottom of said tube to said pump, and means for driving said pump at a relatively high rate of speed so that the lumps in the batch of moistened cellulose xanthate contained by said tube are all reduced in size by said pump and forced out of said tube into said tank through said pump to mix with said aqueous solution before the viscosity of the aqueous solution and xanthate mix reaches a point where the mix will dissolve the final part of said batch of xanthate only with great difficulty.

4. Apparatus for dissolving and thoroughly mixing cellulose xanthate to produce viscose comprising a wetting chamber being in the form of a vertical open mouth

funnel shaped tube for receiving a predetermined batch of cellulose xanthate, a tank surrounding said tube, said tank containing an aqueous solution to a depth well below the mouth of said tube, said tube having a plurality of holes formed in the sides thereof for introducing aqueous solution into said tube in the form of a plurality of streams, means for gradually dumping a predetermined batch of cellulose xanthate into said tube through the mouth thereof, said batch of cellulose xanthate being gradually dumped into said tube thereby intercepting said streams of aqueous solution so that the lumps of said cellulose xanthate are moistened by said solution in passing to the bottom of said tube, an impeller pump having a housing connected to the bottom of said tube so that the moistened cellulose xanthate is fed from the bottom of said tube to said pump, means for driving said pump at a relatively high rate of speed so that the lumps in the batch of moistened cellulose xanthate contained by said tube are all reduced in size by said pump and forced out of said tube into said tank through said pump to mix with said aqueous solution before the viscosity of the aqueous solution and xanthate mix reaches a point where the mix will dissolve the final part of said batch of xanthate only with great difficulty, and an auxiliary pump connected to the bottom of said tank, said auxiliary pump having means for feeding the solution from the bottom of said tank into the mouth of said tube.

5. Apparatus for dissolving and thoroughly mixing cellulose xanthate to produce viscose comprising a wetting chamber being in the form of a vertical open mouth funnel shaped tube for receiving a predetermined batch of cellulose xanthate, a tank surrounding said tube, said tank containing an aqueous solution to a depth well below the mouth of said tube, said tube having a plurality of holes formed in the sides thereof for introducing aqueous solution into said tube in the form of a plurality of streams, means for gradually dumping a predetermined batch of cellulose xanthate into said tube through the mouth thereof, said batch of cellulose xanthate being gradually dumped into said tube thereby intercepting said streams of aqueous solution so that the lumps of said cellulose xanthate are moistened by said solution in passing to the bottom of said tube, an impeller pump having a circular housing connected to the bottom of said tube so that the moistened cellulose xanthate is fed from the bottom of said tube to said pump, said impeller pump having a plurality of blades extending toward the inner wall of said circular housing, said circular housing wall having a plurality of apertures through which the moistened xanthate pieces of reduced size are forced by said pump, and means for driving said pump at a relatively high rate of speed so that the lumps in the batch of moistened cellulose xanthate contained by said tube are all reduced in size by said pump and forced out of said tube into said tank through said pump to mix with said aqueous solution before the viscosity of the aqueous solution and xanthate mix reaches a point where the mix will dissolve the final part of said batch of xanthate only with great difficulty.

6. Apparatus for dissolving and thoroughly mixing cellulose xanthate to produce viscose comprising a wetting chamber being in the form of a vertical open mouth funnel shaped tube for receiving a predetermined batch of cellulose xanthate, a tank surrounding said tube, said tank containing an aqueous solution to a depth well below the mouth of said tube, said tube having a plurality of holes formed in the sides thereof for introducing aqueous solution into said tube in the form of a plurality of streams, a conveyor positioned above said tank, means for controlling said conveyor for gradually dumping a predetermined batch of cellulose xanthate into said tube through the mouth thereof, said batch of cellulose xanthate being gradually dumped into said tube thereby intercepting said streams of aqueous solution so that the lumps of said cellulose xanthate are moistened by said solution in passing to the bottom of said tube, an impeller pump having a housing connected to the bottom of said tube so that the moistened cellulose xanthate is fed from the bottom of said tube to said pump, and means for driving said pump at a relatively high rate of speed so that the lumps in the batch of moistened cellulose xanthate contained by said tube are all reduced in size by said pump and forced out of said tube into said tank through said pump to mix with said aqueous solution before the viscosity of the aqueous solution and xanthate mix reaches a point where the mix will dissolve the final part of said batch of xanthate only with great difficulty.

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