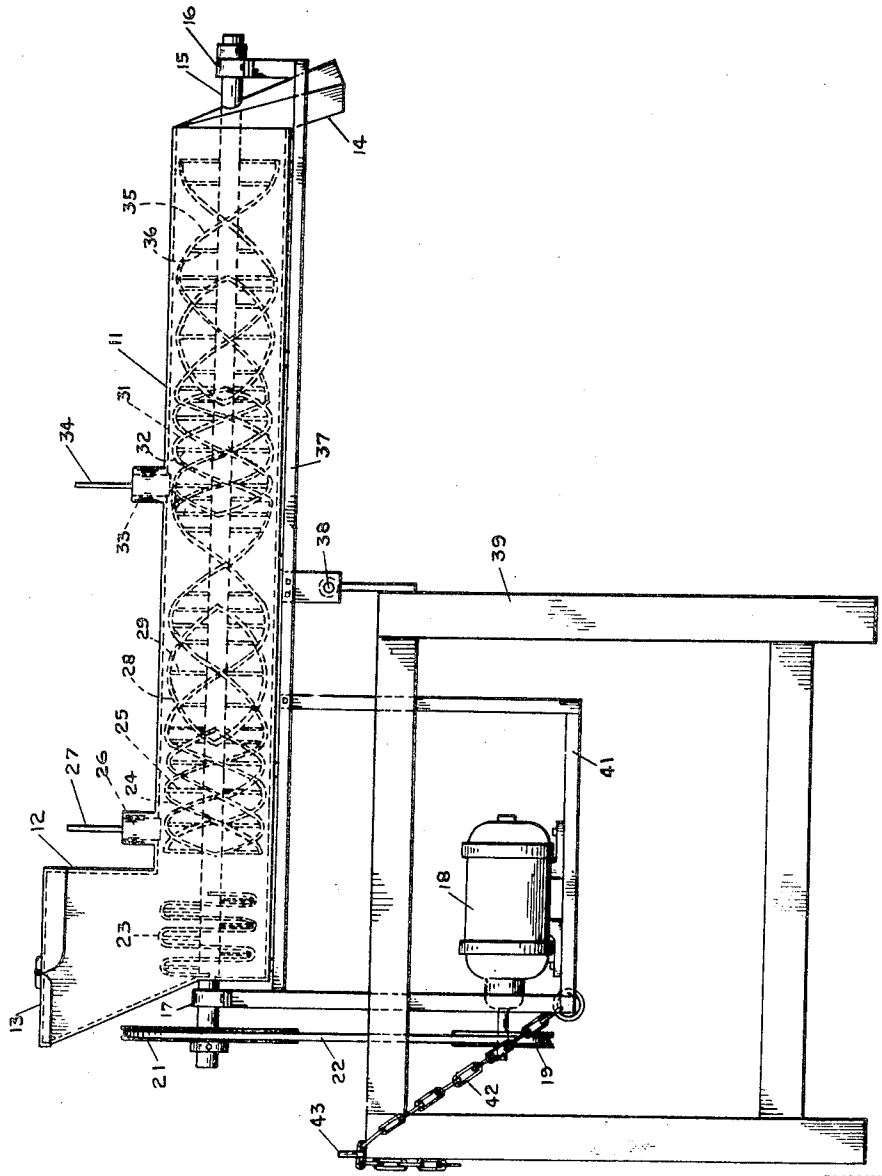
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MIXING APPARATUS

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MIXING APPARATUS

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This invention relates to mixing apparatus, and relates more particularly to mixing apparatus adapted for the pretreatment of cellulosic material.

In the production of organic acid esters of cellulose, cellulosic material is usually esterified with an organic acid anhydride in the presence of an esterification catalyst and an organic acid which acts as a solvent for the cellulose ester, forming a viscous solution or dope. It has been customary to pretreat the cellulosic material before esterification to render said material more reactive during the esterification step. In the co-pending application of Seymour et al., Serial No. 58,028, filed November 2, 1948 there is disclosed a two-stage process for pretreating cellulosic material which materially reduces the time necessary for said pretreatment and renders the cellulosic material more highly reactive. As disclosed in said co-pending application, the cellulosic material is treated with a lower aliphatic acid during the first stage of the pretreatment and, during the second stage of the pretreatment the cellulosic material is treated with an additional quantity of a lower aliphatic acid containing a relatively high concentration of an esterification catalyst such as sulfuric acid.

During the pretreatment, the pretreating agents must be so distributed as to reach all of the cellulosic material, since any cellulosic material which is not pretreated will remain unesterified during the subsequent esterification producing a cloudy dope. It is also important in carrying out the pretreatment process to limit the period of time during which the cellulosic material is left in contact with the pretreating agent applied during the second stage of the pretreatment, since the high concentration of esterification catalyst in said agent has a strong degradative effect on the cellulosic material. In certain cases it may be desirable to allow a short interval of time to elapse between the first and second stages of the pretreatment to permit the pretreating agent applied during the first stage to diffuse through and into the cellulosic material.

It is an important object of this invention to provide a mixing apparatus for pretreating cellulosic material in accordance with the process disclosed in the said co-pending application, which will be especially simple in construction and efficient in operation.

A further object of this invention is to provide a mixing apparatus in which cellulosic material may be continuously subjected to a two-stage pretreatment.

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Another object of this invention is the provision of a mixing apparatus in which a material may be continuously mixed and in which said material may be treated with a fluid agent.

Other objects of this invention, together with certain details of construction and combinations of parts, will be apparent from the following detailed description and claims.

In accordance with our invention, we provide a mixing apparatus having a cylindrical shell through which the cellulosic material is fed by means of a helical conveyor. Nozzles are provided at spaced points on the shell for spraying the cellulosic material with the pretreating agents during its passage therethrough, whereby upon leaving the shell the cellulosic material may be esterified without further pretreatment. The helical conveyor has a large number of turns per unit length in the vicinity of the nozzles through which the pretreating agents are applied than at points spaced therefrom. Because of this variation in the number of turns per unit length, the conveyor moves the cellulosic material past the nozzles at a relatively slow rate permitting the application of large quantities of pretreating agents from a small number of nozzles. This effectively reduces not only the number of nozzles, but also the total required length of the mixer.

The helical conveyor, in addition to moving the cellulosic material through the cylindrical shell, serves to distribute the pretreating agents so as to reach all of the cellulosic material. The efficiency with which such distribution is effected is higher at those points where the helical conveyor has a lower number of turns per unit length, since the cellulosic material is moved forward more rapidly at those points and the loading of the cellulosic material per unit length of the mixer is thereby reduced. By holding the clearance between the conveyor and the entire periphery of the cylindrical shell at a minimum, the opportunity for any of the cellulosic material to pass through the cylindrical shell without being pretreated is substantially prevented. Similarly, there will be no opportunity for any of the pretreated cellulosic material to remain in the cylindrical shell and become degraded which would affect the properties of the dope unfavorably. To obtain an adequate distribution of the pretreating agents through the cellulosic material, it is preferred that the helical conveyor be operated at speeds ranging from 400 to 1200 R. P. M., or

more. The cylindrical shell may be tilted from the horizontal to permit the throughput of the cellulosic material to be varied over a wide range without changing the speed of the helical conveyor or lessen the efficiency with which said conveyor distributes the pretreating agents through the cellulosic material.

A preferred embodiment of our invention is illustrated in the accompanying drawing in which the figure is a side elevation of a mixer embodying this invention.

Referring now to the drawing, the reference numeral 11 designates a cylindrical shell, which opens at one end into a feed hopper 12 having a hinged cover 13 and at the other end into a discharge hopper 14. A shaft 15 journalled in bearings 16 and 17, extends through the cylindrical shell 11 and the feed hopper 12, and is driven at any desired speed by the motor 18 through the pulleys 19 and 21 and the belt 22. A screw conveyor 23 is fastened to the shaft 15 in the feed hopper 12 and serves to feed the cellulosic material in said hopper into the cylindrical shell 11. As the cellulosic material enters said shell, it is drawn forward by means of the helical conveyor 24 which is fastened to the shaft 15 with rods 25 that also serve to agitate the cellulosic material. A pretreating agent from any suitable source (not shown) is supplied under pressure to a nozzle 26 through a conduit 27, the said nozzle spraying the pretreating agent onto the cellulosic material. After leaving the vicinity of the nozzle 26, the cellulosic material is moved forward by means of a helical conveyor 28 which is fastened to the shaft 15 by means of rods 29. The helical conveyor 24 is constructed so as to have a larger number of turns per unit length than the helical conveyor 28, as a result of which the cellulosic material is moved past the nozzle 26 at a relatively slow rate, and after passing said nozzle is moved forward at a relatively faster rate.

The helical conveyor 28 feeds the cellulosic material to a helical conveyor 31 that is fastened to the shaft 15 with rods 32. The conveyor 31 moves the cellulosic material past a nozzle 33 to which a pretreating agent from a suitable source (not shown) is supplied under pressure through a conduit 34. The helical conveyor 31, like the helical conveyor 24 has a larger number of turns per unit length as a result of which the cellulosic material remains in the vicinity of the nozzle 33 for a relatively long period of time. From the conveyor 31, the cellulosic material passes to a helical conveyor 35 that is fastened to the shaft 14 with rods 36. The helical conveyor 35 has a small number of turns per unit length and moves the cellulosic material rapidly to the discharge hopper 14.

The cylindrical shell 11 is fastened to a framework 37 which is mounted for pivotal movement on a shaft 38 carried by a base 39. A framework 41 depends from the framework 37 and serves to support the motor 18 at a fixed distance from the cylindrical shell 11. The cylindrical shell 11 may be inclined to the horizontal by rotating the framework 37 about the shaft 38 to any desired position, and may be fastened in said position by means of the chain 42 which engages a pin 43. By tilting the cylindrical shell 11 so that the discharge hopper 14 is positioned above the feed hopper 12, the passage of the cellulosic material through said shell will be retarded; whereas by tilting the cylindrical shell 12 so that the discharge hopper 14 is positioned below the feed hopper 12, the passage of the cellulosic material through said shell will be accelerated.

During operation, the feed hopper 12 is charged with a mass of cellulosic material which is fed to the cylindrical shell 11 by means of the screw conveyor 23. As the cellulosic material enters the cylindrical shell 11 it is sprayed with a pretreating agent from the nozzle 26 and is moved forward and thoroughly agitated by the helical conveyor 24. The cellulosic material then passes to the helical conveyor 28 which agitates it further and moves it along the cylindrical shell 11 to the helical conveyor 31 and the nozzle 33. During the passage of the cellulosic material to the nozzle 33, the pretreating agent applied from the nozzle 26 diffuses through and into the cellulosic material. As the cellulosic material is drawn past the nozzle 33 it is again sprayed with a pretreating agent, and it is thoroughly agitated by the helical conveyor 31. The cellulosic material then passes to the helical conveyor 35 which agitates it further and moves it to the discharge hopper 14. After being discharged, the cellulosic material may be esterified directly without further pretreatment.

Although the mixer of this invention has been described with particular reference to the two-stage pretreatment of cellulosic material to which it is especially adapted, it may also be employed for other purposes.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of our invention.

Having described our invention, what we desire to secure by Letters Patent is:

1. A mixing apparatus comprising a shell, a rotatable shaft in said shell, a conveyor on said shaft for rotation therewith for simultaneously agitating and moving material through said shell, said conveyor comprising a plurality of helices mounted on said shaft in such relation that helices having a relatively large number of turns per inch alternate with helices having a smaller number of turns per inch, and means in said shell adjacent to the helices having a relatively large number of turns per inch for supplying fluid to the material passing through said shell, the construction and arrangement being such that the material is moved through the shell by the helices having a large number of turns per inch at a slower rate than by the helices having a small number of turns per inch.

2. A mixing apparatus comprising a shell, a rotatable shaft in said shell, a conveyor on said shaft for rotation therewith for simultaneously agitating and moving material through said shell, said conveyor comprising a plurality of helices mounted on said shaft in such relation that helices having a relatively large number of turns per inch alternate with helices having a smaller number of turns per inch, and nozzles in said shell adjacent to the helices having a relatively large number of turns per inch for spraying fluid on to the material passing through said shell, the construction and arrangement being such that the material is moved through the shell by the helices having a large number of turns per inch at a slower rate than by the helices having a small number of turns per inch.

3. A mixing apparatus comprising a shell, a rotatable shaft in said shell, a conveyor on said shaft for rotation therewith for simultaneously agitating and moving material through said shell,

said conveyor comprising a plurality of helices mounted on said shaft in such relation that helices having a relatively large number of turns per inch alternate with helices having a smaller number of turns per inch, nozzles in said shell adjacent to the helices having a relatively large number of turns per inch for spraying fluid on to the material passing through said shell, and means for tilting said shell from the horizontal whereby the throughput of the material through said shell may be varied without changing the speed of said conveyor, the construction and arrangement being such that the material is moved through the shell by the helices having a large number of turns per inch at a slower rate than by the helices having a small number of turns per inch.

4. A mixing apparatus comprising a hopper, a shell adjacent to said hopper for receiving material therefrom, means in said hopper for supplying material to said shell, a rotatable shaft in said shell, a conveyor on said shaft for rotation therewith for simultaneously agitating and moving the material through said shell, said conveyor comprising a plurality of helices mounted on said shaft in such relation that helices having a relatively large number of turns per inch alternate with helices having a smaller number of turns per inch, the helix closest to the hopper being one having a large number of turns per inch,

nozzles in said shell adjacent to the helices having a relatively large number of turns per inch for spraying fluid on to the material passing through said shell, and means for tilting said shell from the horizontal whereby the throughput of the material through said shell may be varied without changing the speed of said conveyor, the construction and arrangement being such that the material is moved through the shell by the helices having a large number of turns per inch at a slower rate than by the helices having a smaller number of turns per inch.

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