July 8, 1969 J. E. NOVAK ET AL 3,453,818

PRODUCTION OF ASBESTOS YARN

Filed Nov. 29, 1967 Sheet 1 of 2

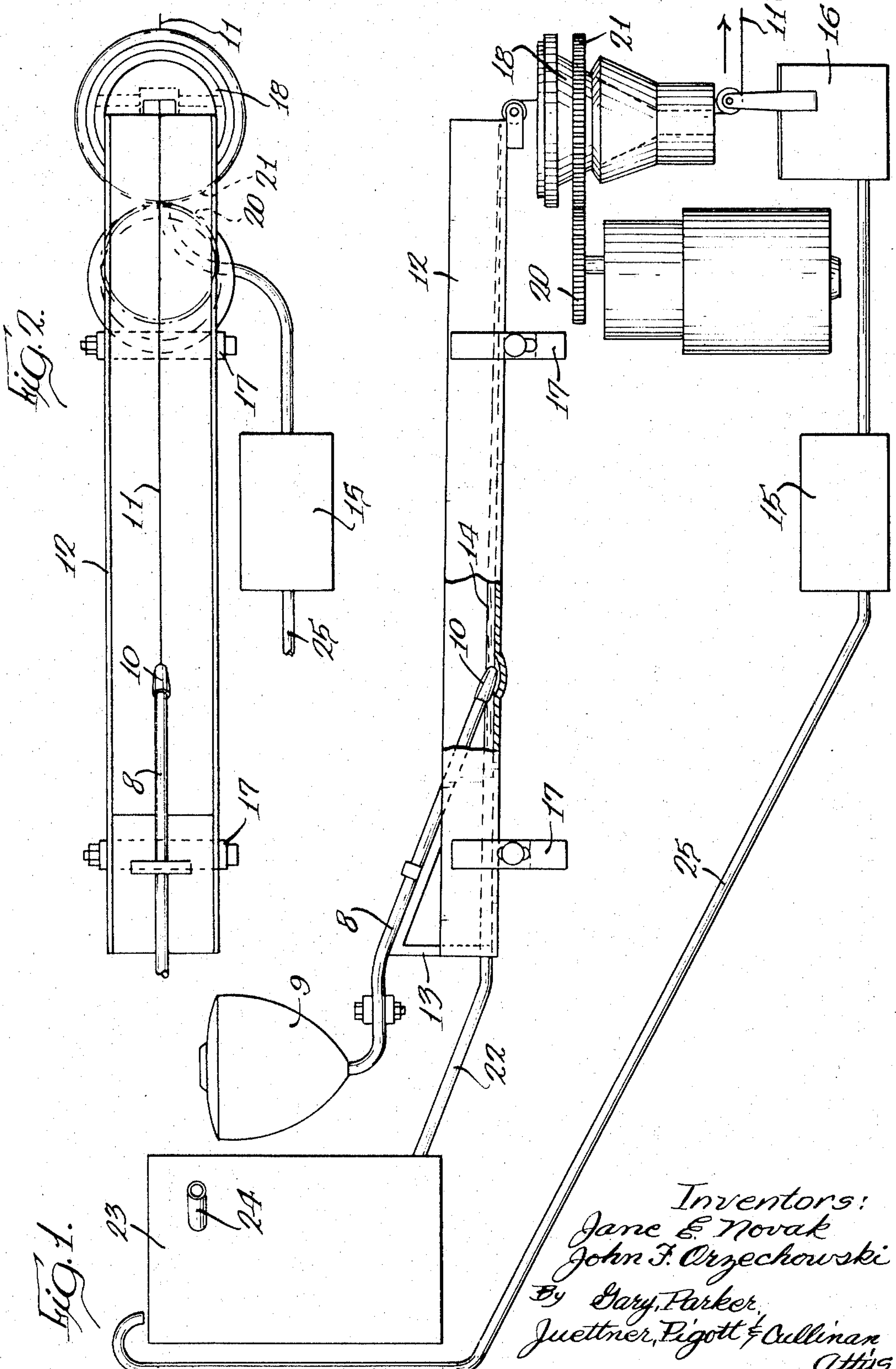

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Fig. 3.

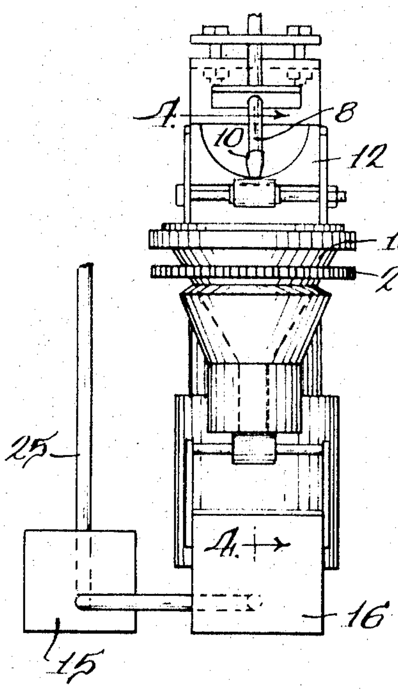
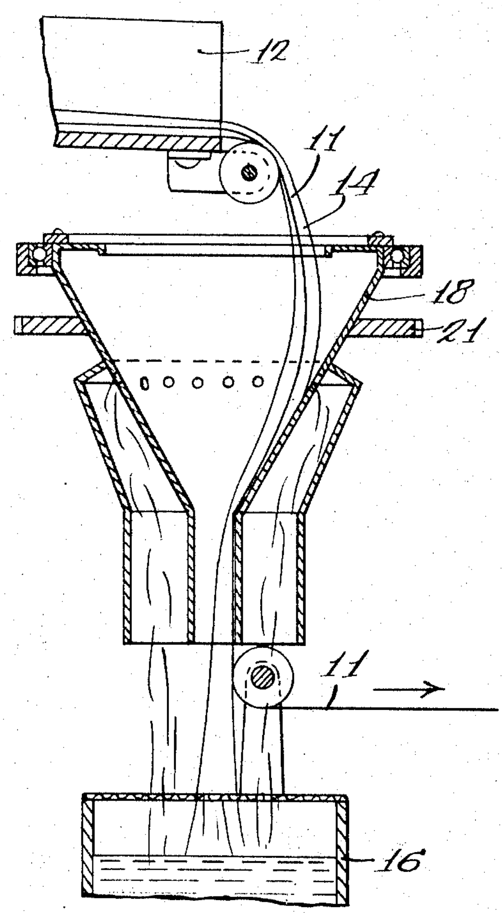


Fig. 4.



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PRODUCTION OF ASBESTOS YARN

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U.S. Cl. 57—164 7 Claims

ABSTRACT OF THE DISCLOSURE

Process for the production of asbestos yarn by coagulating extruded filaments of colloidally dispersed chrysotile asbestos fibers.

The present invention relates to a process for producing yarn from a colloidal dispersion of chrysotile asbestos fibers wherein said asbestos dispersion is extruded in the form of a filament, subjected to contact with a coagulating liquid, then twisted to yarn form, while wet and finally dried to produce fine cut asbestos yarns heretofore unavailable commercially.

The process is characterized by the step which comprises continuously extruding said asbestos dispersion into or near one end of a substantially horizontally disposed open top elongated receptacle and collecting the extrudate at the opposed end while continuously flowing a coagulatory liquid into said receptacle prior to the point of introduction thereto of said extrudate to thereby envelop and cushion said filament and to coagulate it in its passage to self-sustaining form while stretching the filament a desired and controllable amount dependent on the relative velocities of the precipitate and filament, and substantially separating the coagulating liquid from the resulting yarn at said opposed receptacle and where it is collected prior to being twisted while wet or twisted first, and then used wet or dry.

The chrysotile asbestos fiber used may come from any of the available areas such as Quebec, British Columbia, or Arizona and is not limited to the so-called spinning grades. The colloidal asbestos dispersions used in this process are based on Novak Patent 2,626,213, Jan. 20, 1953, entitled "Asbestos Dispersions and Method of Forming Same." Any of the dispersants which are capable of making a good colloidal dispersion may be used in the process; however, the fatty acid soaps are more easily coagulated by conventional acid salts used in the following process to form asbestos yarn and are, therefore, preferable.

The amount of dispersant necessary to form the colloidal dispersion for this process varies with the type of fiber used, the surface area of the fiber, and the dispersant used. If, for example, Aerosol OT (American Cyanamid trademark for the dioctyl ester of sodium sulfosuccinate) is used, the weight of dispersant solid should be about 10–30% based on the weight of the fiber for chrysotile fiber of a #4 grade or longer. If a fatty acid soap such as ammonium linoleate is used, a minimum of 20% based on fiber weight is necessary to get a good dispersion. These dispersants may also be used in combination for varying effects. The life of the dispersion in stable colloidal form is dependent upon the excess of dispersant available in solution to be used as the fiber bundles of asbestos continue to open.

The solids of the dispersions used for the yarn forming process should be between ½% and 10% in water. Below ½% the colloidal dispersion does not have the necessary viscosity to be formed by the process and above 10% the viscosity becomes excessive for flow under a hydraulic head.

Any one of a number of binders or additives may be added to the colloidal dispersion once formed, depending on the properties desired in the final yarn. Natural or synthetic latices are generally quite compatible in amounts up to 30% by weight. These latices should have a pH between pH 6 to pH 11. A wide variety of fibers may also be added; either organic (such as nylon, rayon, cotton, Teflon) or inorganic (glass [Novak, Cilley & Moore Patent 2,772,157] graphite, silica). The amount of added fibers may range from 0–60% based on asbestos weight. Fillers of the following type may also be used: Avicel (microcrystalline cellulose), carboxy methyl cellulose, starch, carbons, graphites, fluorocarbons, or clay. A wide variety of water-soluble dyes may also be used as the colloidal asbestos takes readily to color.

The mixing procedure used for the formation of colloidal asbestos slurry is described in detail in Novak Patent 2,626,213 and also in Moore, Cilley & Novak Patent 2,772,151. The equipment should be of a type which offers a minimum of shearing action which would break down fiber length. A conventional hydrapulper such as that used in papermaking, or a vessel equipped with vertical cylindrical mixing bars is adequate. The asbestos fiber and colloidizing agent are added to a selected amount of water in any convenient manner and blended until a major portion of the fiber has been reduced to its unit diameter. The amount of colloidizing agent used should be in excess of the amount necessary to achieve this condition so that the dispersion will remain stable for a period of time sufficient to carry out further operations. Any binders or additives are generally added after the formation of the colloid with care taken to add them slowly so as to avoid "shocking" of the dispersion and formation of clots. Dilution of solids may also be done at this point with the same care taken to avoid clotting from a too rapid addition of water, or with soap solution.

The dispersion is then cleaned of any remaining foreign matter such as rocks or unopened bundles of fiber by passing it through papermaking cleaning operations such as a centrifugal cleaner or it is cleaned in accordance with the process described in Novak Patent 3,035,698 to produce a fine colloidal dispersion without rocks, splints, or other such foreign matter.

The refined dispersion is then placed under vacuum to eliminate entrapped air which might cause a lack of uniformity or weak spots in the final yarn. The minimum vacuum which will do the evacuation efficiently is 25 mm. Hg, however, a vacuum of 15 mm. Hg is more efficient.

The deaerated dispersion is then fed through an orifice of selected diameter by means of pumps, air pressure, or hydraulic head into a shallow trough which contains coagulant which is also being flowed in the same direction and at higher speed as the dispersion as illustrated in the accompanying drawings wherein:

FIGURE 1 is a side elevational view of an arrangement of apparatus for carrying out the present invention, and

FIGURE 2 is a fragmentary plan view thereof.

FIGURE 3 is an elevational view of the apparatus of FIGURES 1 and 2 shown at the delivery end, and

FIGURE 4 is a section on the line **4—4** of FIGURE 3.

Referring to the drawings, the reference numeral **10** diagrammatically indicates an extrusion nozzle which at its outlet end may have any desired configuration such as circular, angular, star-shaped or other. An asbestos dispersion as aforesaid is flowed, which term will be understood herein to mean either pumped or caused to flow under a hydraulic head, from the reservoir **9** through conduit **8**. The resulting extruded filament is introduced through the trough **12** over the support **13** where the extruded filament is contacted by coagulating liquid **14** introduced through line **22** from reservoir **23**.

The liquid is supplied under hydraulic head pressure to the trough **12** where a constant head is maintained through pump **15** and line **25** from receptacle **16**, the reservoir **23** having an overflow **24**. Although the trough **12** is disposed substantially horizontally, it is preferably mounted on the adjustable brackets **17** to provide desired pitch for gravitational flow of its contents, at least in part. When the extruded filament comes in contact with the coagulant **14** in the trough **12**, the dispersant is precipitated. The extruded filament **11** is then carried with a differential slip sufficient to give an elongation of the extruded filament to the final wet filament of between about 100 to about 400 percent elongation. This allows the use of larger diameter extrusion nozzles with consequent less problems with foreign contamination in the asbestos dispersion. Thus, when employing a nozzle having a circular orifice of .090 inch in diameter, and a slurry of 2½% solids content to make 100 cut yarn, the diameter becomes reduced to .064 inch by stretch due to flow velocity of the liquid over the length of the trough.

Various chemical coagulants can be employed as indicated by Novak Patent 2,626,213. Thus, for example, any one of a number of bi- and trivalent acid salts in weight concentrations of from about one to about five percent in water are effective as coagulants. Aluminum sulfate, the commercial alum of the papermaking trade is sufficient for other acids salts may be used depending upon the effectiveness of their reaction with the dispersant chosen for colloidizing the asbestos such as aluminum chloride, ferric sulphate, ferric chloride, and the like. The speed at which the coagulant is flowed is in excess of and associated with the extrusion speed of the colloidal dispersion to achieve an extruded filament which travels in a straight line down the length of trough without bunching up with controlled stretch ratios. These coordinated speeds may product a filament traveling at speeds from 15 to 100 feet per minute depending upon the strength of the extruder filament to the desired cut of the final yarn of practical length (i.e., 1–10 feet).

The size and shape of the orifice used for the extrusion is largely dependent upon the desired cut of yarn and the solids of the colloidal dispersion used. Another way of regulating the desired cut is to work with an acceptable slurry of proper solids and viscosity and varying the hydraulic head of the slurry to vary the feed rate and the cut. A simple circular orifice is generally acceptable in diameters from .020" to .125". By varying solids of the dispersion, yarns of 25 to 500 cut in single filaments may be produced. For example, using an orifice of .040" diameter, a 3.8% solids dispersion extruded at 40 feet per minute will produce in final spun form a yarn of approximately 110 cut. Using a 1.5% solids dispersion extruded through the same orifice with the same speed, the final yarn produced will be approximately 220 cut (cut in this case, being the common asbestos yarn terminology of hundreds of yards per pound). Other nozzle configurations may be more suitable for good penetration at higher solids for heavier yarns. For example, a rectangular cross section or star-shaped cross section is preferable for heavy yarns using dispersions of solids higher than 5% or of larger cross-sectional area than circular orifices of 0.125" diameter. The increased surface area of these configurations allows better penetration of coagulant in shorter trough lengths.

The extruded filament **11** after it has traveled the length of the trough **12** has enough strength to support a number of differing methods of collection prior to spinning. Uniquely, it is also not tacky. A tangled mass of filaments may be squeezed between the fingers and thereafter is capable of being untangled with no tendency to adhere to itself. This property allows the filament to be collected into a perforated container **18** in an orderly manner, for instance by rotating the container, through the motor **19** and gears **20**, **21**, to lay the filaments down evenly. A container holding miles of extrusion may be set aside to drain excess precipitant and to age and further insolublize the fatty acid soaps and/or it may also be placed in an oven at close to 100% relative humidity at moderate temperatures, i.e., 180° F. to 250° F. for 1 to 6 hours to hasten the curing process of the fatty acid soaps. Filaments which are heat cured in this manner may be spun on conventional ring frame spinning equipment immediately thereafter.

The extruded filament **11** may also be guided from the end of the trough **12** into a funnel **18** spinning at high speed. As the filament touches the wall of the spinning funnel, some twist is introduced and the filament gains strength and can then be wound up for completion of spinning on the conventional ring frame.

Another method, not shown, of handling the extruded filament is to run it through a couch roll of the type used by the papermaking industry to remove a large amount of the excess coagulant and water from the filament. The same wet filament may then be heat aged at 100% relative humidity at 180° F. to 250° F. for from 1 to 6 hours to increase strength before spinning on conventional ring frame spinning equipment or it may be spun immediately after the wet pressing.

It is possible to spin the filaments in their approximately 90% water condition, reducing the water content to an average of 50% in the wet yarn. It is more desirable, however, to reduce the water content by either wet pressing or draining to 50%–70% before spinning to reduce splashing as the yarn is spun. Water content of the yarn produced from 50–70% wet filament is approximately 25–45% depending upon starting conditions.

We claim:

1. In a process for producing yarn from a colloidal dispersion of chrysotile asbestos fibers wherein said asbestos dispersion is extruded in the form of a filament, subjected to contact with a coagulating liquid and then twisted to yarn form, the step which comprises continuously extruding said asbestos dispersion into one end of a substantially horizontally disposed elongated receptacle and collecting the extrudate at the opposed end while continuously flowing a coagulatory liquid into said receptacle adjacent the point of introduction thereto of said extrudate to thereby envelop, cushion and stretch said filament and to coagulate it in its passage, and substantially separating the coagulating liquid from the resulting yarn at said opposed receptacle end.

2. The process of claim **1** wherein the recovered coagulating liquid is recirculated to the process.

3. The process of claim **1** wherein the coagulating liquid is an aqueous solution of aluminum sulphate.

4. The process of claim **1** wherein the colloidal dispersion of chrysotile asbestos is subjected to evacuation prior to extrusion.

5. The process of claim **1** wherein the colloidal dispersion of chrysotile asbestos is admixed with a latex.

6. The process of claim **1** wherein the yarn is twisted while still wet and then dried.

7. The process of claim **1** wherein the coagulating liquid is pumped to the receptacle at a rate coordinated to the extrusion rate of the asbestos filament.

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U.S. Cl. X.R.

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