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METHOD OF TREATING WET MOVING TOW BANDS OF FILAMENTARY MATERIAL

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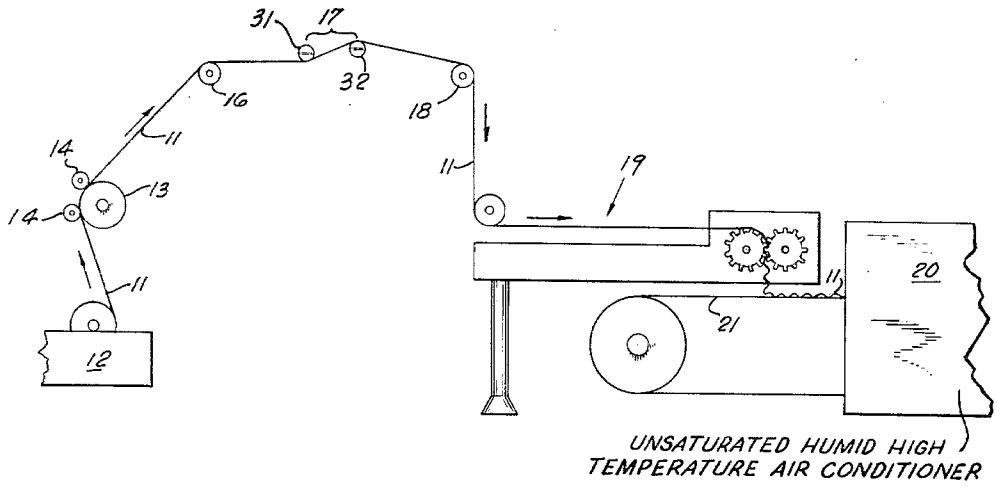


Fig. 1.

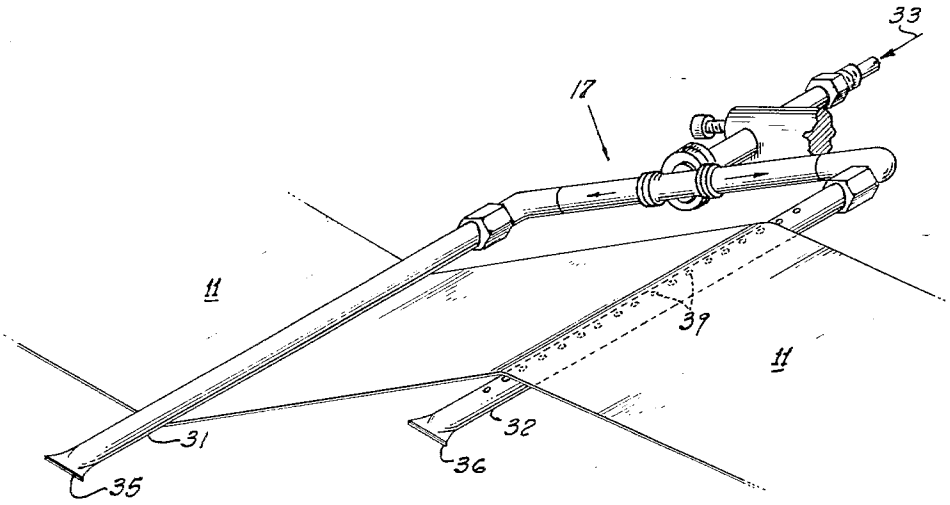


Fig. 2.

INVENTORS.
WILLIAM R. OSBAN
JOHN W. LANE

BY Philip Mintz

ATTORNEY.

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METHOD OF TREATING WET MOVING TOW BANDS OF FILAMENTARY MATERIAL

William R. Osban, Gulf Breeze, and John W. Lane, Pensacola Beach, Fla., assignors to American Cyanamid Company, New York, N.Y., a corporation of Maine

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This invention relates to processing wet filamentary material in the form of a band of tow containing a relatively large number of filaments. More particularly, this invention relates to method and apparatus for treating a wet moving tow band with gaseous materials, such as with heated unsaturated humid air for evaporation of moisture from the tow, and for preparing such wet tow for such treatment.

In the manufacture of synthetic fibers, it frequently is necessary or desirable to process continuous filaments in the form of a tow comprising from several thousand up to a million or more continuous filaments arranged in a single strand, rope, or band. In order to process such a tow uniformly, it is important that each filament therein receive as nearly the same treatment as each other filament. When the process includes treatment of the tow by an ambient gaseous environment, this means that the entire surface of each filament in the tow should be accessible to the gases in such environment.

When such a tow is wet, the surface tension of the liquid entrained therein will tend to adhere the filaments to each other. This impedes or precludes diffusion of environmental treating gases through the tow to the surfaces of all the filaments making uniform treatment thereby difficult or impossible.

It is an object of this invention to provide method and apparatus for treating a moving tow band to remove excess liquid and to slightly open up the tow so as to provide passageways from each filament communicating with the surrounding environment.

It is another object of this invention to provide such method and apparatus for treating the moving tow band continuously without disarranging the tow pattern or damaging the filaments and which is adaptable to continuous manufacturing operations from the standpoint of efficiency, reliability, low capital cost, economy of operation, etc.

It is a further object to provide method and apparatus for continuously conditioning a moving tow band, and particularly by evaporation of moisture therefrom by a heated unsaturated humid ambient atmosphere, in as uniform a manner as possible utilizing less stringent conditions than previously were used.

These objects, and other objects and advantages which will become apparent as the specification proceeds, are mainly achieved by passing the wet tow band under tension across a wall of a conduit means provided with orifice means through which gas moving at a high velocity is directed against the tow band as it passes across and is deflected by the conduit wall. This removes excess liquid from the tow band and slightly opens up the tow to provide passageways communicating between each filament of the tow and the surrounding environment. The thus prepared tow may next be treated by placing it in an environment containing treating gases, such as an environment containing a heated unsaturated humid atmosphere for conditioning the tow by the evaporation of moisture therefrom.

For a clearer understanding of this invention, reference may be had to the following description taken in conjunction with the accompanying drawing of a specific embodiment of this invention in which:

FIGURE 1 is a schematic view of an apparatus for conditioning a continuously moving tow band; and

FIGURE 2 is a simplified perspective view of an apparatus for preparing a wet tow band for subsequent treatment.

Referring next to the drawing and more particularly to FIGURE 1, there is illustrated schematically a portion of a tow producing and treating apparatus utilizing this invention therein. In this apparatus, a continuously moving band of wet tow 11 emerging from a liquid bath 12 is passed between roll 13 and squeeze rolls 14 which compress the wet tow 11 to remove a portion of the excess free liquid from tow 11. The pressure between squeeze rolls 14 and roll 13 also serves to compact the filaments of tow 11 into a relatively dense impermeable mass.

Tow band 11 then passes over guide roll 16, through tow preparing apparatus 17, and over guide roll 18. The detailed structure and functions of tow preparing apparatus will be described hereinafter in connection with FIGURE 2 of the drawing. Briefly, tow preparing apparatus 17 prepares the tow 11 for subsequent treatment by impinging gas moving at high velocity against the surface of tow band 11 to remove excess liquid therefrom and to slightly open up the tow structure.

From guide roll 18, tow band 11 then passes through plaiting mechanism 19 to conditioning chamber 20. Plaiting mechanism 19 may be any known apparatus for that function, but preferably is of the type described and claimed in application Serial No. 133,214 filed August 22, 1961 by Ponson and Becker now United States Patent No. 3,095,615 issued July 2, 1963. As explained in the aforesaid application, plaiting mechanism 19 feeds tow 11 onto the moving conveyor belt 21 of conditioner 20 in a particular pattern suitable for the treatment of tow 11. In conditioner 20, tow 11 on conveyor belt 21 may be surrounded by any suitable gaseous environment for effectuating a desired treatment of the filaments comprising tow 11. For example, conditioner 20 may be supplied with heated unsaturated humid air for conditioning the filaments by evaporation of moisture therefrom. From conditioner 20, tow 11 may be further processed in any desired apparatus (not shown) to obtain as product either packaged tow or staple fibers.

Referring next to FIGURE 2, it is seen that the tow preparing apparatus 17 mainly comprises a pair of substantially parallel hollow conduits 31 and 32 each joined at one end through suitable piping to a source of gas under pressure indicated by arrow 33, and each having its other end sealed as by crimps 35, 36 or by plugs or other suitable closure means. Tow band 11 passing under tension from guide roll 16 to guide roll 18 passes under hollow conduit 31 and over hollow conduit 32 and is somewhat deflected from a straight path by these conduits.

Extending longitudinally along a section of the upper portion of conduit 32 is a plurality of orifices 39 located along that portion of conduit 32 in contact with tow band 11 passing thereover. Extending longitudinally along a portion of the bottom of conduit 31 is a similar plurality of orifices (not shown) also in the region where tow band 11 contacts conduit 31. It is to be noted that the length of the row of orifices 39 is slightly greater than the width of tow band 11 passing thereover.

In operation, wet compacted tow band 11, after being pressed between roll 13 and squeeze rolls 14, is passed through apparatus 17 where high velocity jets of gas issuing from orifices 39 in conduit 32 and from orifices (not shown) in conduit 31 act to remove from tow band 11 a portion of the liquid entrained therein and to slightly open up the tow 11 to slightly separate the filaments therein from each other. The high velocity gas jets issuing

from the orifices also serve to keep the tow from being abraded by contact with conduits **31** and **32**.

In conditioning chamber **20**, the slightly opened tow can be conditioned by the ambient environment therein more rapidly, more uniformly, and under less stringent conditions by virtue of the passageways between such environment and the surfaces of the individual filaments within tow band **11**. For example, if conditioner **20** is provided with circulating heated unsaturated humid air, evaporation of moisture from the surfaces of the individual filaments of slightly opened tow band **11** may proceed more rapidly, at lower dry bulb temperatures and with greater uniformity than if apparatus **17** were omitted from the combination illustrated in FIGURE 1.

As an illustrative example, about 153,000 filaments of an acrylonitrile polymer whose total denier is approximately 459,000, arranged in a tow band **11** whose width is approximately 4" and whose thickness is approximately 0.035" to 0.045" having a moisture content of approximately 0.7 pound of water per pound of fiber is passed through the apparatus illustrated in FIGURE 1. Apparatus **17**, provided with a plurality of orifices **39** of approximately 0.03" to 0.04" diameter spaced ⅛" to 3/16" apart, is supplied with air at a pressure of 40 to 50 p.s.i.g. which serves to slightly open up the structure of tow **11** while slightly reducing the moisture content of tow **11** to 0.55 to 0.60 pound of water per pound of fiber. Under these conditions, it has been found that air having a dry bulb temperature of about 230° F. in the first half of conditioner **20**, and about 212° F. in the last half of conditioner **20**, and having a wet bulb temperature of about 150 to 155° F. would satisfactorily reduce the moisture content of tow **11** to approximately 0.012 pound of water per pound of fiber in twenty to twenty-three minutes residence time within conditioner **20**.

Where apparatus **17** is omitted from the combination illustrated in FIGURE 1, operation of conditioner **20** with a dry bulb temperature of 245° F. throughout the conditioner and a wet bulb temperature of 155° F. was required to reduce the moisture content of tow **11** to a comparable value. It is thus seen that the use of apparatus **17** permitted the operation of conditioner **20** at a temperature of 15° F. lower on the wet or inlet end and 33° F. lower at the dry or outlet end while still maintaining the same production rate.

Not only does apparatus **17** permit this reduction in dry bulb temperature in the conditioner **20** (thereby minimizing the possibility of scorching, charring, or yellowing individual filaments or fusing thermoplastic filamentary materials) but the treatment of the individual filaments is much more uniform since the ambient conditioning atmosphere is permitted to contact all filaments in the tow **11** much more uniformly through the open passageways introduced by the apparatus **17**.

It is thus seen that this invention serves to prepare a wet moving tow band for subsequent conditioning by an ambient atmosphere so as to permit the ambient atmosphere to more easily and more uniformly reach and treat the individual filaments therein. While this invention has been illustrated and described in connection with a specific embodiment thereof, it is to be expressly understood that the invention is not limited to the details of the specific embodiment illustrated and described but that the invention also embraces the equivalents thereof.

For example, this invention may be used for the treatment of filamentary material in tow form regardless of the chemical composition of the filaments, whether rayon, nylon, etc. Also, this invention may be used regardless of the nature of the subsequent conditioning, whether it involves chemical reactions or merely physical interaction with the ambient gaseous conditioning environment.

Further, apparatus **17** may be provided with only a single conduit having a plurality of orifices longitudinally arranged in the wall thereof, or may have three or more orificed conduits as may be desired. Also, each conduit may have one or two or more rows of orifices longitudinally disposed along the wall thereof in operative association with the tow band passing thereover. Additionally, each conduit may be straight (as illustrated in FIGURE 2) or arcuately curved.

It is intended that all such equivalents, whether enumerated above or not, as may be embraced within the scope of the subjoined claims are to be considered as part of this invention.

We claim:

1. A method for preparing a wet moving tow band for subsequent treatment by removing a portion of the excess liquid entrained therein and slightly opening up the tow to provide gas passageways therein, comprising passing one side of the wet tow band under tension across a wall of a first conduit means provided with orifice means; directing gas moving at high velocity from said orifice means against said one side of the tow band as it passes across and is deflected by said conduit wall; passing the other side of the wet tow band under tension across a wall of a second conduit means provided with orifice means; and directing gas moving at high velocity from said orifice means against said other side of said tow band as it passes across and is deflected by said second conduit wall.

2. A method for treating a wet moving tow band with gaseous conditioners, comprising, passing one side of the wet tow band under tension across a wall of a first conduit provided with orifice means; passing the other side of the wet tow band under tension across a wall of a second conduit provided with orifice means; directing gas moving at high velocity first against one side of said tow band and then against the other side of said tow band from said orifice means as the tow band passes and is deflected by said conduits to remove a portion of the excess liquid entrained in said wet tow and to slightly open up the tow to provide gas passageways therein; and thereafter introducing said tow into an environment containing a gaseous conditioner.

3. A method of treating a wet moving tow band with gaseous conditions, comprising, passing one side of the wet tow band under tension across a wall of a first conduit provided with orifice means; passing the other side of the wet tow band under tension across a wall of a second conduit provided with orifice means; directing gas moving at high velocity first against one side of said tow band and then against the other side of said tow band from said orifice means as the tow band passes and is deflected by said conduits to remove a portion of the excess liquid entrained in said wet tow and to slighlty open up the tow to provide gas passageways therein; and thereafter circulating unsaturated humid air at a relatively high temperature around said tow and through said gas passageways therein to condition said tow by evaporation of moisture therefrom.

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NORMAN YUDKOFF, *Primary Examiner.*