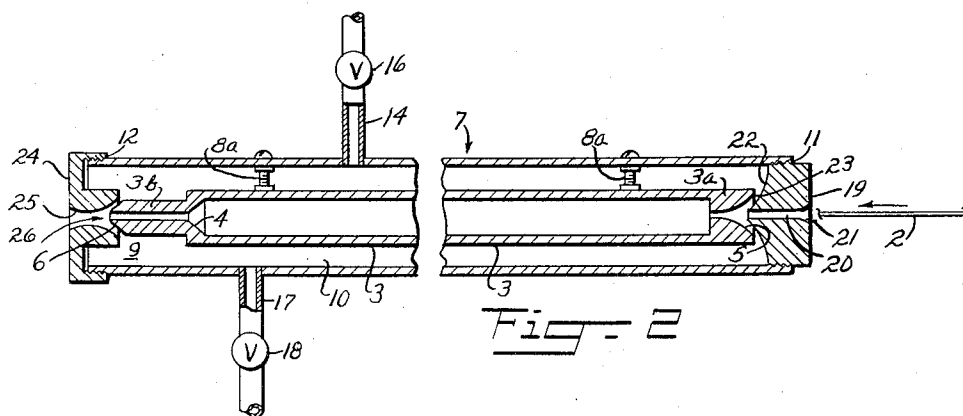
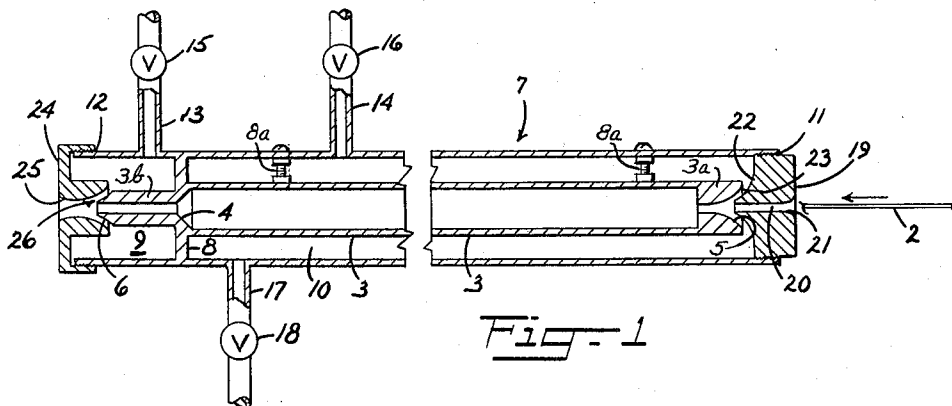


Dec. 8, 1953

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TUBE FOR TREATING FIBERS AND THE
LIKE WITH FLUID UNDER PRESSURE
Filed Jan. 17, 1950

2,661,618



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2,661,618

TUBE FOR TREATING FIBERS AND THE LIKE
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Application January 17, 1950, Serial No. 139,107

3 Claims. (Cl. 68—6)

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This invention relates to improved apparatus for treating fibers, filaments, yarns, and filamentary bundles generally with fluid under pressure.

It is an object of this invention to provide a novel and extremely compact device comprising a tube in which running lengths of filamentary material, yarns or the like are treated with fluid under pressure which flows in non-turbulent condition concurrently with the filamentary material and both the rate and condition of flow of the fluid in contact with the filamentary material are controlled by means of an adjustable end piece or closure associated with the tube.

In the drawing, which is illustrative of preferred embodiments of the invention,

Figure 1 is a longitudinal cross-sectional view of one embodiment, and

Figure 2 is a similar view of another embodiment.

In Figure 1, the fiber or filamentary bundle 2 is passed through an elongated straight tube 3, suitable forwarding and take-up devices such as godets, thread-advancing reels, or the like (not shown) being provided for feeding the fibers to the tube 3 and drawing the fibers through the tube. The tube 3 is provided at its opposite ends with entrance and exit extensions 3a and 3b respectively which have openings or bores of reduced internal diameter as compared to the internal diameter of the tube proper with which they communicate to permit the pressure to build-up in the tube, the bore of reduced diameter at the exit end of the tube being joined to the bore of the tube by the flared face 4. The tube entrance opening terminates in a convexly curved or flared face 5 and the exit extension 3b terminates in a concavely curved or flared outer face 6. A casing indicated generally by the reference numeral 7 surrounds the tube 3 and its extension 3a and 3b, and the partition 8 supports the tube centrally within the casing and divides the casing into two separate jackets surrounding compartments 9 and 10. One or more perforated partitions, spacers, or supports 8a may be spaced axially along the length of compartment 10 for supporting tube 3 centrally of the casing, if desired. Casing 7 is internally threaded at 11, and externally threaded at 12, and provided with pipes 13 and 14, connected to suitable sources of fluid, such as steam under pressure, the flow of fluid into the compartments within the jackets through the pipes being controlled by valves 15 and 16. A pipe 17 provided with a valve 18 is connected with the jacket around compartment 10 for the withdrawal of condensate or exhaust steam.

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To control the flow of fluid from the jacket 7 compartment 10 into tube 3, and to insure streamlined flow of the fluid into the tube, so that the fibers passing into and through the tube are not deflected from a straight-line course or subjected to fluid in turbulent condition, which might damage them, an annular end-piece or closure 19, having an axial strand passage 20, which may terminate in a portion of gradually increasing diameter 21, is provided and has external threads which engage the internal threads 11 of the casing 7. The end-piece comprises a central projection which extends into the bore of extension 3a and has a concavely curved or flared outer face 22 a portion of which is more or less complementary with the convexly curved face 5 on tube 3, when the end-piece is in place, to provide an annular channel 23 between the faces 22 and 5. The channel 23 surrounds the central projection of the end-piece 19 and communicates with both the bore of tube 3 and with the compartment 10. The fluid is guided in a streamlined condition into tube 3 along the channel 23 which serves to distribute it uniformly around the central projection of end-piece 19 and insures streamlined, non-turbulent flow thereof. End-piece or closure 19 thus functions as a valve and is adjustable manually toward and away from the entrance end of tube 3 to vary the width of channel 23. The diameter of the axial passage in the end-piece 19, other than the portion thereof of gradually increasing diameter, if the passage has such a portion, may be the same as, less than, or greater than the internal diameter of tube 3, and is the same as or greater than the diameter of the entrance opening of the tube. In the particular embodiment shown, the internal diameter of tube 3, between the portions of reduced diameter adjacent its opposite ends, is greater than the diameter of the passage in the end-piece 19.

The opposite or exit end of the apparatus is provided with a cap 24 having internal threads which engage the threads 12 of the casing 7. Cap 24 has an axial strand passage defined by a curved face 25 which passage gradually narrows and then widens in a manner similar to a Venturi throat. A portion of the curved face 25 and the concavely curved face 6 on tube 3 are more or less complementary and define an annular channel 26 therebetween through which steam, air, or other fluid under pressure flows in a streamlined condition to the exterior of the apparatus, in the direction of travel of the fibers. Channel 26 communicates with both the bore of extension 3a and with compartment 9 of casing 7.

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Cap 24 functions as an ejector to assist in lacing tube 3 and is adjustable manually to vary the width of channel 26.

To lace the tube, valve 15 is opened, valve 16 being closed, and or other fluid under pressure is delivered to compartment or chamber 9 through the pipe 13. The fiber or filamentary bundle is introduced manually into the end-piece 19 and drawn through tube 3 by suction created by the fluid flowing to the exterior of the apparatus through channel 26. After the device has been laced, valve 15 is closed, valve 16 is opened, and steam under pressure is delivered to chamber 10 through pipe 14. The fluid flows in a streamlined condition along channel 23 into extension 3a and then into the tube 3, end-piece 19 being adjusted manually to control the rate of flow of the fluid into the tube. The streamlined fluid flows in an annular path through channel 23 and surrounds the fibers entering and passing through tube 3 and its extensions to assist in centering the fibers therein so that they are not deflected and do not rub against the internal wall or walls thereof.

The apparatus shown may be modified in various respects. For example, partition 8 and branch pipe 13 may be omitted. For lacing this construction, the end-piece 19 is adjusted to close channel 23, channel 26 being left open, and steam is delivered to the jacket through branch pipe 14. By adjusting cap 24 to close channel 26 and unscrewing end-piece 19 to open channel 23, after the device has been laced, the treating fluid, such as steam, delivered to the jacket through pipe 14 will flow through channel 23 into tube 3 to provide the fluid atmosphere in which the fibers are to be treated during normal operation.

Tube 3 may be of any length depending on the speed of the fibers, yarn or the like, the temperature to which the fibers must be heated by the steam, if they are being steam-treated, and whether the fibers are to be stretched, shrunk, or otherwise modified. In general, the tube may have a length of from 1 to 4 feet, although large fibers which are to be given a high stretch may require longer tubes to provide a fluid treating zone of sufficient length.

The tube may be of any suitable diameter, for example, from capillary dimensions to an inch or more, depending on the fiber denier and whether a single fiber or yarn, or a bundle comprising a multiplicity of fibers or yarns, such as a tow, is to be treated.

The apparatus has been described in detail in connection with the steam treatment of fibers or yarns, for which purpose either dry, wet, saturated, or superheated steam may be used. However, the apparatus of the invention may be used for the treatment of fibers, filaments, or filamentary bundles, generally, whether natural or synthetic, artificially formed fibers, with various fluids under pressure. For instance, the fibers or filamentary bundles may be of regenerated cellulose, cellulose derivatives of the cellulose acetate type, vinyl resins, polyamides, polyesters, polyethylenes, proteins, acrylonitrile polymers including polyacrylonitrile and acrylonitrile copolymers, etc. Any fluid under pressure may be used to treat the fibers or yarns, for any purpose. Regenerated cellulose fibers or yarns may be treated with steam or other gaseous fluid for setting them in a crimped, twisted, or otherwise distorted condition previously imparted thereto; or wet fibers, filaments or yarns may be dried in the tube; or synthetic or other fibers, filaments, or

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yarns may be treated with solvents or swelling agents for modification of the properties thereof, or the fibers, filaments or bundles may be stretched or shrunk during the fluid treatment.

The end-piece 19 and cap 24 may have a length of about one inch.

Since variations and modifications may be made in the apparatus specifically illustrated without departing from the spirit and scope of the invention, it will be understood that the invention is not to be limited except as defined by the appended claims.

I claim:

1. Apparatus for treating continuously moving filamentary material with a fluid which comprises an elongated, relatively narrow, straight tube provided at its opposite ends with entrance and exit extensions, an opening in each extension communicating with, and having reduced diameter as compared to, the interior of the tube proper, the entrance opening terminating in a gradually tapered portion increasing in diameter in a direction away from the tube, the exit extension terminating in a gradually tapered outer face decreasing in diameter in a direction away from the tube, means for enclosing the tube and its extensions comprising a casing surrounding the tube and its extensions, means extending between the tube and the casing for supporting the tube in fixed position in the casing, an annular member having an axial passage mounted on the casing adjacent the entrance extension with its axial passage in alignment with the opening in the entrance extension, and an annular member having an axial passage mounted on the casing adjacent the exit extension with its axial passage in alignment with the opening in the exit extension; means for introducing a fluid into the casing; the annular member adjacent the entrance extension comprising a central projection having a gradually tapered inner face decreasing in diameter toward the tube, said projection normally extending into the opening of the tube entrance extension and defining with it an annular channel through which the fluid flows in streamlined condition from the casing into the tube, the axial passage in the annular member adjacent the exit extension terminating adjacent the exit extension in a gradually tapered portion increasing in diameter toward the tube, the exit extension normally extending into the last-mentioned tapered portion, the mounting of the annular members in the casing comprising means for adjusting the members axially toward and away from the tube.

2. Apparatus for treating continuously moving filamentary material with a fluid which comprises an elongated, relatively narrow, straight tube provided at its opposite ends with entrance and exit extensions, an opening in each extension communicating with, and having reduced diameter as compared to, the interior of the tube proper, the entrance opening terminating in a gradually tapered portion increasing in diameter in a direction away from the tube, the exit extension terminating in a gradually tapered outer face decreasing in diameter in a direction away from the tube; means for enclosing the tube and its extensions comprising a casing surrounding the tube and its extensions, means extending between the tube and the casing for supporting the tube in fixed position in the casing, an annular member having an axial passage mounted on the casing adjacent the entrance extension with its axial passage in alignment with the opening in the en-

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trance extension, and an annular member having an axial passage mounted on the casing adjacent the exit extension with its axial passage in alignment with the opening in the exit extension; means for introducing a fluid into the casing; the annular member adjacent the entrance extension comprising a central projection having a gradually tapered inner face decreasing in diameter toward the tube, said projection normally extending into the opening of the tube entrance extension and defining with it an annular channel through which the fluid flows in streamlined condition from the casing into the tube, the axial passage in the annular member adjacent the exit extension terminating adjacent the exit extension in a gradually tapered portion increasing in diameter toward the tube, the exit extension normally extending into the last-mentioned tapered portion, the mounting of the annular members in the casing being effected by means comprising screw threads, the helices of which have axes substantially in alignment with the centers of the axial passages.

3. Apparatus for treating continuously moving filamentary material with a fluid which comprises an elongated, relatively narrow, straight tube provided at its opposite ends with entrance and exit extensions, an opening in each extension communicating with, and having reduced diameter as compared to the interior of the tube proper, the entrance opening terminating in a gradually tapered portion increasing in diameter in a direction away from the tube, the exit extension terminating in a gradually tapered outer face decreasing in diameter in a direction away from the tube; means for enclosing the tube and its extensions comprising a casing surrounding the tube and its extensions, means extending between the tube and the casing for supporting the tube in fixed position in the casing, said supporting means comprising a partition extending around the tube adjacent the exit extension generally radially thereof to the casing and separating the region between the tube and the casing into

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axially-spaced compartments, an annular member having an axial passage mounted on the casing adjacent the entrance extension with its axial passage in alignment with the opening in the entrance extension, and an annular member having an axial passage mounted on the casing adjacent the exit extension with its axial passage in alignment with the opening in the exit extension; separate means for introducing a fluid into each of the compartments; the annular member adjacent the entrance extension comprising a central projection having a gradually tapered inner face decreasing in diameter toward the tube, said projection normally extending into the opening of the tube entrance extension and defining with it an annular channel through which the fluid flows in streamlined condition into the tube from the compartment of the casing around the tube, the axial passage in the annular member adjacent the exit extension terminating adjacent the exit extension in a gradually tapered portion increasing in diameter toward the tube, the exit extension normally extending into the last-mentioned tapered portion, the mounting of the annular members in the casing being effected by means comprising screw threads, the helices of which have axes substantially in alignment with the centers of the axial passages.

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