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APPARATUS FOR THE TREATMENT OF ARTIFICIAL MATERIALS

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Fig. 1.

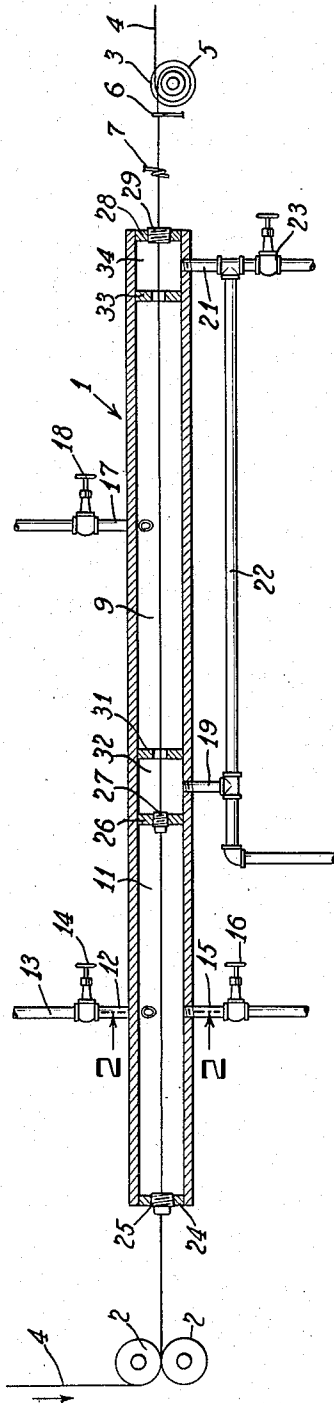


Fig. 3.

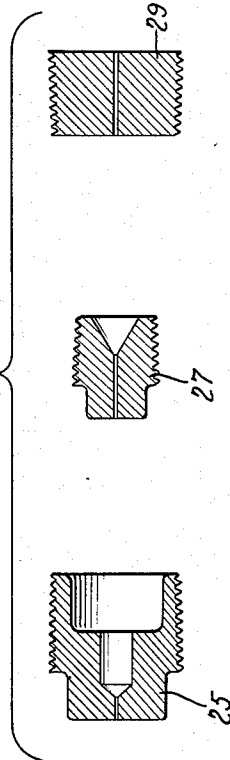
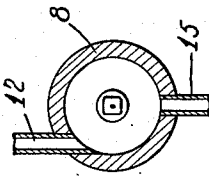


Fig. 2.



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APPARATUS FOR THE TREATMENT OF
ARTIFICIAL MATERIALSRaymond D. Reel, Keyser, W. Va., assignor to
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7 Claims. (Cl. 68—9)

This invention relates to apparatus for the treatment of filaments, yarns, threads and like materials, and relates more particularly to improved apparatus for treating such materials with fluid treating media under pressure.

Filaments, yarns and threads of improved strength and having other desirable properties are formed by subjecting the same to stretching or other treatments in the presence of fluid media under pressure in an apparatus comprising a substantially closed chamber for the fluid media, the chamber being provided with orifices for the passage of the material through the apparatus. In addition to the treatment chamber containing the fluid media under pressure, there may be provided one or two end chambers for inert fluid under pressure communicating by means of orifices with the treatment chamber. The provision of an end chamber containing an inert fluid under pressure reduces or prevents the flow of fluid medium through the orifice between the end chamber and the treatment chamber. The treatment of the materials has heretofore been effected by grouping a large number, say, 10 to 200, ends in the form of a warp or in the form of a rope before subjecting the same to treatment and, after treatment, separating the warp or rope into individual ends for packaging. It has been found, however, that better results are obtained by treating single ends of thread. For example, by treating single ends there is obtained better control of the product. Moreover, the excessive waste incidental to the starting up and stopping of the treating operations employing warps or ropes having a large number of ends is substantially eliminated.

It is an important object of this invention to provide an improved apparatus for treating a single end of thread with fluid treating media under pressure which will be especially efficient in operation.

Another object of this invention is the provision of apparatus for treating a single end of thread having novel orifices for the passage of the thread through the apparatus.

A further object of this invention is the provision of an improved treatment chamber wherein means are provided for vaporizing and controlling the water entering therein.

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

In the drawing wherein a preferred embodiment of my invention is shown,

Figure 1 is a horizontal cross-sectional view of a thread treating apparatus constructed in accordance with my invention.

Figure 2 is a vertical cross-section of the end chamber taken along line 2—2 of Figure 1, and

Figure 3 is a showing of the novel orifices used in my apparatus, in cross-section and on an enlarged scale.

Like reference numerals indicate like parts throughout the several views of the drawing.

Referring to the drawing, the reference numeral 1 indicates a sectional treatment vessel outside one end of which is a device 3 for positively drawing a thread 4 through the vessel in such a manner as to impart the desired degree of stretch to the thread. The device 3 comprises preferably a positively driven conical roller 5 and a movable guide 6 for directing the thread along the surface of the conical roller. Although but one movable guide 6 is shown in the drawing, it is to be understood that there may be employed a pair of guides, one on each side of roller 5. These guides may be manually operated, or they may be arranged to move automatically in response to the condition of the thread being treated, particularly when the treating apparatus is being started up or being stopped. Stationary guides, such as pigtail guide 7, may also be provided.

The treatment vessel may be of any suitable cross-section. It is preferred, however, to employ one of circular cross-section as shown at 8 in Figure 2 of the drawing. Conveniently, the treatment vessels may be arranged in the form of a bank. Each treatment vessel may be divided into two or more zones or chambers such as a treating fluid chamber 9 and an inert fluid chamber 11. Although steam or hot water may be employed as the treating fluid in the stretching of the thread, and water, air or other suitable medium may be employed as the inert fluid, the present apparatus is designed to employ steam as the treating fluid and water as the inert fluid and, accordingly, will be described in connection with their use.

Water under pressure is supplied to chamber 11 by means of a pipe 12 which is connected to a suitable source of supply 13 through a valve 14. To withdraw all or part of the water and to maintain the desired pressure within chamber 11, a discharge pipe 15 having a valve 16 is placed at the bottom of chamber 11. As is shown in Figure 2, pipe 12 is positioned in chamber 11 at a point where the incoming water fed there-through would avoid coming into direct contact

with the thread 4. Steam is supplied to chamber 9 by a pipe 17 having a valve 18, the inlet end being arranged in such a manner as to prevent the impinging of the steam or vapor upon the thread 4 directly. The treatment chamber 9 is provided with drain pipes 19 and 21, connected to a header 22, for withdrawing condensate and water entering from chamber 11. One or more valves 23 are supplied which, together with valve 18 in the steam supply, are employed to regulate and maintain the temperature and pressure in the treatment chamber 9. The steam pressure in treatment chamber 9 is maintained somewhat below that of the water in chamber 11 so that there is a slight flow of water into chamber 9.

The entrance end of chamber 11 is closed by an end plate 24 having an orifice 25 for the passage of the thread to be treated into the chamber. A plate 26 separates chamber 11 and chamber 9 and is provided with an orifice 27 for the passage of thread 4 from chamber 11 to adjacent chamber 9. An end plate 28 closes the exit end of treatment chamber 9, this end plate being provided with an orifice 29. Orifices 25, 27 and 29 are each of different construction, particularly with respect to diameter and length of bore of the thread passageway therethrough which control to a great extent the handling of and the effects produced on the thread by the steam in this case. Thus, the orifice 25, or input orifice, has the smallest diameter and length of bore in order to insure small water loss and low frictional counter-effect against the thread entering water chamber 11, since the direction of travel of the thread through the orifice 25 is opposite to the flow of water therethrough. The intermediate orifice 27 located between connecting chambers 11 and 9 has a diameter and length of bore that can vary from $1\frac{1}{2}$ to 4 or more times that of input orifice 25. This increase in size of diameter and length of bore is the controlling factor in the injection of the thread and water into the steam chamber 9, since the water will tend to flow through the larger orifice 27 into chamber 9 rather than through the smaller orifice 25. Because of the direction of flow of the water towards the chamber 9 and the length of the orifice, the thread will be carried towards said chamber 9 by the water flowing through the orifice 27. The output orifice 29 can vary in diameter and length of bore from slightly more than the diameter and length of bore of input orifice 25 to three times those of intermediate orifice 27. The optimum size of each orifice is a function of the denier, finish, filament count of the stretched thread integrated with the temperatures and pressures of the water and steam being used. Preferably the bore of the input orifice 25 has a diameter of from slightly more than 1 to $1\frac{1}{2}$ times the diameter of the unstretched thread and a length of from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch.

The orifices may be made of any suitable material such as, for example, iron, steel, copper alloy, plastics or porcelain, the suitability of the material depending upon the degree of expansion thereof under the conditions obtaining in their employment. Too great an expansion of the orifice will nullify the satisfactory operation of the apparatus.

The treatment chamber is provided with an apertured baffle plate 31 near intermediate orifice 27 forming with plate 26 a small chamber 32 which is drained by pipe 19. Water forced into chamber 32 from water chamber 11 im-

pinges against baffle plate 31 and is broken up into a more easily vaporized spray in a zone in which a temperature lower than that in the main part of chamber 9 prevails. An apertured baffle plate 33 similar to baffle plate 31 is positioned adjacent the exit end of chamber 9 to form a small chamber 34 wherein, due to the lower temperature obtaining therein, there is condensed a substantial proportion of the steam vapor which would normally pass through output orifice 29 with the stretched thread. Small chamber 34 is drained by pipe 21.

The length of the tube comprising the treatment vessel 1 may vary within wide limits, depending upon the type of thread and the effect desired to be produced thereon. For stretching cellulose acetate or other thermoplastic derivative of cellulose employing steam as the softening agent and water as the inert liquid, both under pressure, highly satisfactory results have been obtained employing a vessel having chambers of the following dimensions: water chamber 11—12 inches, chamber 32—2 inches, steam treatment chamber 9—14 inches, and chamber 34—2 inches, the over-all dimension of the tube, accordingly, being 30 inches.

This invention is applicable to the stretching of thermoplastic threads or threads capable of being softened by solvent vapors and/or liquids such as those made of or containing derivatives of cellulose. Examples of derivatives of cellulose are the organic acid esters of cellulose such as cellulose acetate, cellulose formate, cellulose butyrate, cellulose propionate and cellulose acetate-propionate; the cellulose ethers such as ethyl cellulose, methyl cellulose and benzyl cellulose; the partial or completely saponified esters of cellulose; regenerated or reconstituted cellulose; and the linear polymers of high molecular weight such as the linear condensation products of a polyamide, condensation products of dicarboxylic compounds with diamine compounds and condensation products of diketenes with compounds containing two reactive hydrogens as diamines, glycols, etc. The threads may be monofil or a plurality of filaments grouped together either with or without twist to form a thread.

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 my invention.

Having described my invention, what I desire to secure by Letters Patent is:

1. Apparatus for treating a running thread, which comprises a substantially closed pressure chamber for a treating vapor under pressure, means associated with said chamber for introducing the treating vapor therein, a second chamber connected to the inlet end of said treating chamber for a liquid under a pressure greater than said vapor pressure, an input orifice at the free end of said second chamber, a divider orifice between said second chamber and said treating chamber for passage of the materials into said treating chamber and an output orifice for passage of the materials out of said treating chamber, said orifices progressively increasing in diameter of bore from the input end to the output end of the apparatus.

2. Apparatus for treating a running thread, which comprises a substantially closed pressure chamber for a treating vapor under pressure, means associated with said chamber for intro-

ducing the treating vapor therein, a second chamber connected to the inlet end of said treating chamber for a liquid under a pressure greater than said vapor pressure, an input orifice at the free end of said second chamber, a divider orifice between said second chamber and said treating chamber for passage of the materials into said treating chamber and an output orifice for passage of the materials out of said treating chamber, said orifices progressively increasing in diameter and length of bore from the input end to the output end of the apparatus.

3. Apparatus for treating a running thread, which comprises a substantially closed pressure chamber for a treating vapor under pressure, means associated with said chamber for introducing the treating vapor therein, a second chamber connected to the inlet end of said treating chamber for a liquid under a pressure greater than said vapor pressure, an input orifice at the free end of said second chamber, a divider orifice between said second chamber and said treating chamber for passage of the materials into said treating chamber, an output orifice for passage of the materials out of said treating chamber, said orifices progressively increasing in size of bore from the input end to the output end of the apparatus, and a baffle plate in said pressure chamber spaced from said divider orifice, whereby liquid issuing through said divider orifice is broken into a readily volatilizable spray by impinging against said baffle plate.

4. Apparatus for treating a running thread, which comprises a substantially closed pressure chamber for a treating vapor under pressure, means associated with said chamber for introducing the treating vapor therein, a second chamber connected to the inlet end of said treating chamber for a liquid under a pressure greater than said vapor pressure, an input orifice at the free end of said second chamber, a divider orifice between said second chamber and said treating chamber for passage of the materials into said treating chamber, an output orifice for passage of the materials out of said treating chamber, said orifices progressively increasing in size of bore from the input end to the output end of the apparatus, and baffle plates in said pressure chamber spaced from said divider orifice and said output orifice thus forming zones at each end of the pressure chamber capable of having temperatures different from that of the pressure chamber.

5. Apparatus for treating a running thread, which comprises a substantially closed pressure chamber for a treating vapor under pressure, means associated with said chamber for introducing the treating vapor therein, a second chamber connected to the inlet end of said treating chamber for a liquid under a pressure greater than said vapor pressure, an input orifice at the free end of said second chamber, a divider orifice between said second chamber and said treating chamber for passage of the materials into said treating chamber and an output orifice for passage of the materials out of said treating chamber, said divider orifice having a diameter and length of bore of from $1\frac{1}{2}$ to 4 times that of the input orifice.

6. Apparatus for treating a running thread, filaments, yarns and similar materials, which comprises a substantially closed pressure chamber for a treating vapor under pressure, means associated with said chamber for introducing the treating vapor therein, a second chamber connected to the inlet end of said treating chamber for a liquid under a pressure greater than said vapor pressure, an input orifice at the free end of said second chamber, a divider orifice between said second chamber and said treating chamber for passage of the materials into said treating chamber, an output orifice for passage of the materials out of said treating chamber, said divider orifice having a diameter and length of bore of from $1\frac{1}{2}$ to 4 times that of the input orifice, and baffle plates in said pressure chamber adapted to aid in vaporizing liquid from said pressure chamber.

7. Apparatus for treating a running thread, filaments, yarns and similar materials, which comprises a substantially closed pressure chamber for a treating vapor under pressure, means associated with said chamber for introducing the treating vapor therein, a second chamber connected to the inlet end of said treating chamber for a liquid under a pressure greater than said vapor pressure, an input orifice at the free end of said second chamber, a divider orifice between said second chamber and said treating chamber for passage of the materials into said treating chamber and an output orifice for passage of the materials out of said treating chamber, said output orifice having a diameter of bore of from slightly more than that of the input orifice to three times that of the divider orifice.

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