March 7, 1950 H. CREWDSON 2,499,464

APPARATUS FOR FLUID TREATMENT OF ARTIFICIAL FILAMENTS AND THREADS

Filed May 10, 1944 2 Sheets-Sheet 1

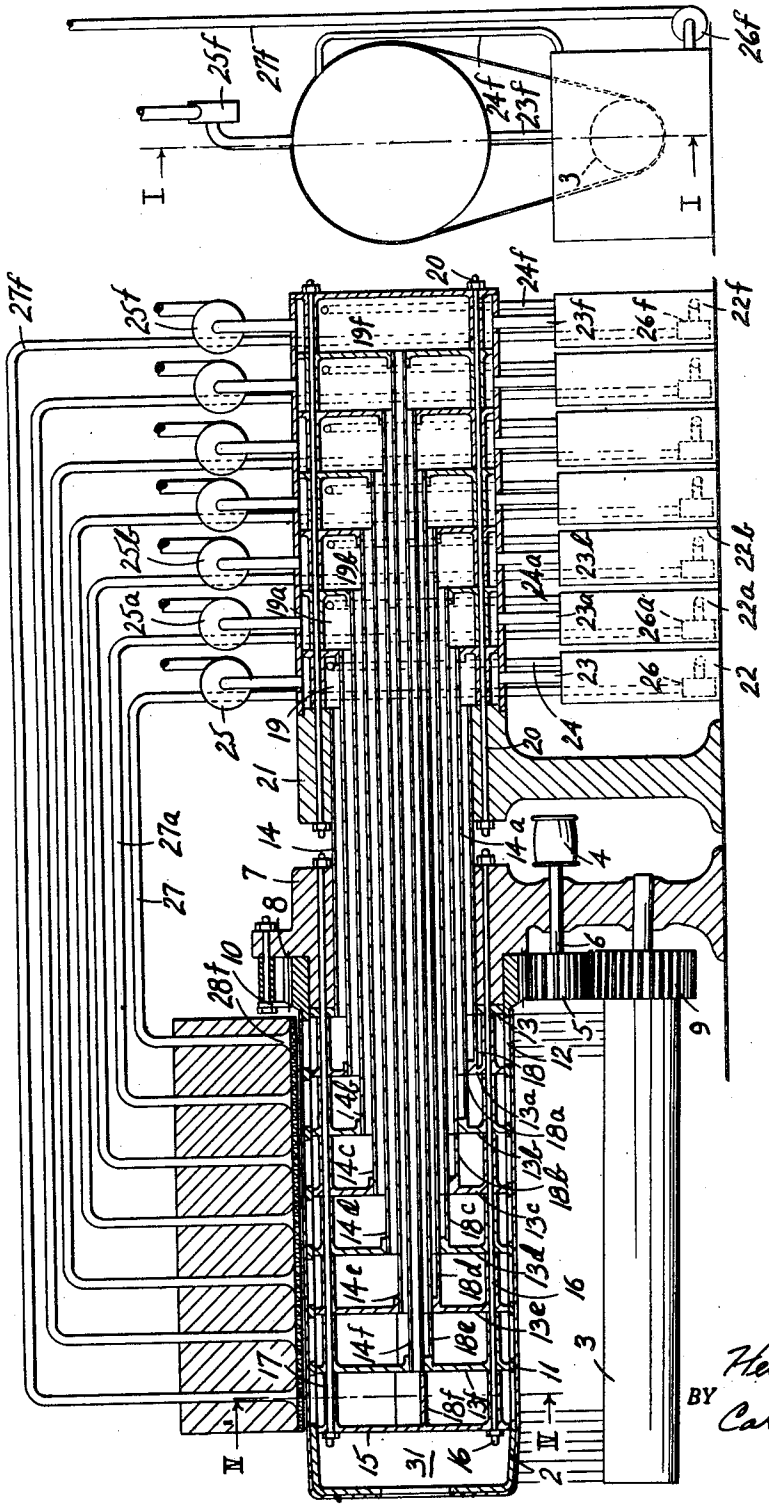


FIG. 1



FIG. 3

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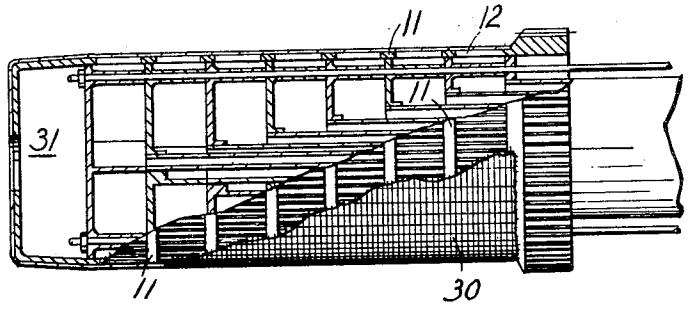



Fig. 2

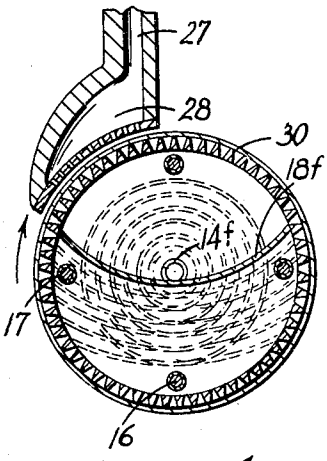



Fig. 4

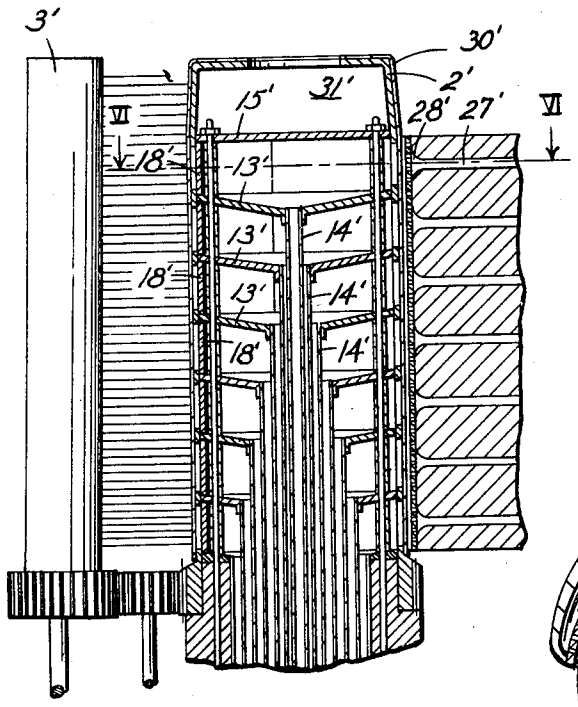



Fig. 5

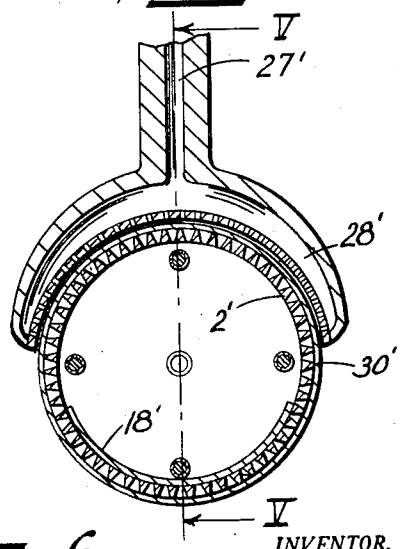



Fig. 6

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2,499,464

## APPARATUS FOR FLUID TREATMENT OF ARTIFICIAL FILAMENTS AND THREADS

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Application May 10, 1944, Serial No. 534,970

12 Claims. (Cl. 68—205)

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This invention relates particularly to apparatus for the treatment of threads, filaments, yarns and the like by means of fluids, especially liquids, and its object is particularly to provide for a simple, compact and efficient arrangement for subjecting the strands while passing through a helical path to a plurality of treating liquids in successive zones along the path of travel of the threads, while preventing commingling of different liquids applied in adjacent zones.

In general, the invention contemplates the passage of the thread through a helical path about a thread-advancing device comprising a rotating cylindrical thread-carrying member having a plurality of separate annular fluid-permeable zones, a stationary partitioning means within the member for dividing the space therein into a plurality of separate chambers communicating with corresponding zones of the member, and a plurality of fluid-conveying conduits disposed outside the member in close proximity to the fluid-permeable zones thereof and opposite the respective chambers provided therein by the partitioning means. This general arrangement and the ancillary specific structure and advantages will be apparent from the drawing and the description thereof hereinafter.

In the drawing, which is illustrative of the invention—

Figure 1 is a side elevation with parts in section on line I—I of Figure 3 and with other parts somewhat diagrammatically shown;

Figure 2 is a side elevation, with parts cut away of the main fluid-treating member of Figure 1;

Figure 3 is an end elevation of the embodiment shown in Figure 1;

Figure 4 is a transverse cross-section taken on the line IV—IV of Figure 1;

Figure 5 illustrates another embodiment of the invention and is a section on line V—V of Figure 6; and

Figure 6 is a transverse cross-section taken on the line VI—VI of Figure 5.

With reference to Figures 1 to 4, the fluid-treating device of the invention comprises a thread-advancing device comprising the rotatable cylindrical member 2 with which there is associated a wrap-displacing means in the form of a cylindrical member 3 which is rotatable upon an axis somewhat inclined with respect to that of member 2, so that a thread or strand passing thereabout is advanced in a generally helical path about the device. The thread-advancing device may be driven by the pulley 4 and pinion 5 carried by the shaft 6 mounted in a suitable

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support 7 which may also provide the bearings permitting rotation of the cylindrical members 2 and 3. The members 2 and 3 are provided at one end with external annular gears 8 and 9 respectively which mesh with pinion 5. The ratio between the teeth of gears 8 and 9 is substantially equal to the ratio between the diameters of cylindrical members 2 and 3 respectively, so that the peripheral linear speed of the strand upon the device is substantially the same throughout its extent, regardless of whether it is in contact with the member 3 or the member 2. Any suitable means, such as the inwardly extending guide 10, may be provided to prevent axial motion of the cylindrical members 2 and 3. If desired, gear 9 may be omitted and cylindrical member 3 may be rotatably mounted for idling.

As appears more particularly in Figure 2, the cylindrical member 2 is provided with a plurality of fluid-permeable zones which lie between the dividing bands 11. As shown, the permeability may be provided by the axially extending slots 12, but any other sort of perforation may be provided instead. Alternatively, spaced annular sections of porous ceramic material may be provided.

Within the cylindrical member 2, there is provided a stationary partitioning means comprising a plurality of approximately centrally perforated plates 13, 13*a*, 13*b*, 13*c*, 13*d*, 13*e* and 13*f*, the central perforations decreasing in diameter in the order stated. Each of the central openings in these plates receives one end of a respective individual of a plurality of concentric pipes 14, 14*a*, 14*b*, 14*c*, 14*d*, 14*e*, and 14*f*. End plate 13 receives the open end of pipe 14 which is concentric with, and of greater diameter than, any of the others. A final plate 15 without a central opening is provided to close the last chamber within the member 2. The assemblage of partitions may be held by a plurality of tie bolts 16, spacer sleeves 17 (which may be separate from or integral with the plates 13 et al. and 15 respectively), being provided to set the plates at proper distances apart.

There is associated with each of the chambers thus provided by the partitioning means, a septum which may form one wall of its respective chamber, such as septum 18 between the plates 13 and 13*a*, and each such septum extends entirely across its chamber between the adjacent walls of the partitioning means bounding the chamber and serves to control the drainage of any liquid introduced therein, so that it is directed into the pipe opening out into that cham-

ber, such as the pipe 14 for septum 18. The other septa are indicated by reference characters 18a, 18b, 18c, 18d, 18e, and 18f. Preferably such septa are of arcuate shape as shown in Figure 4, with the lowermost point of the arc approximately tangent to the pipe associated therewith. These septa may be made integral with one of the adjacent plates; for example, 18f may be made integral with plate 15, 18e with 13f and so on.

The pipes 14 et al. communicate at their other ends with a group of adjacent chambers 19a, 19b, 19c, 19d, 19e, and 19f. These chambers 19 et al. are supported by tie rods 20 on the support 21. As shown, each of the chambers 19 et al. communicates with storage receptacles 22 et al. by means of pipes 23 et al. and vent pipes 24 et al. Furthermore, as shown, a set of vacuum pumps 25 et al. may be associated with the chambers 19 et al. to reduce the pressure in the chambers 19 et al., pipes 14 et al., and the chambers within the fluid-treating device 2.

Pumps 26 et al. communicating with the respective storage receptacle 22 et al. communicate also with the respective fluid-permeable zones of the member 2 by means of the fluid-conveying conduits 27 et al. Each of these conduits may be provided with a spray head 28 et al. which may be adapted to follow the contour of the cylindrical member 2 without substantially making contact with the filamentary material thereabout. These heads 28 et al. may extend about the cylindrical member 2, so that they correspond approximately to the entire arc subtended by the corresponding septa in the partitioning means within the cylindrical member 2, but, as shown in Figure 4, this is not necessary. Before recirculation of the liquids they may be fortified, refreshed or replenished in the receptacles 22 et al., or in advance of the pumps 26 et al. While the arrangement shown provides for recirculation of the several liquids, this may be omitted as to the liquids supplied to any one or more, or even to all of the treatment zones.

While the axis of the treating member 2 of Figures 1 to 4 is illustrated as being substantially horizontal, it is apparent that such axis could be arranged at any inclination to the horizontal and even substantially vertical, such inclination being made in a clockwise direction as viewed in Figure 1. Figures 5 and 6 illustrate a somewhat modified form that is useful when a substantially vertical arrangement is desired. As shown in those figures, the interior stationary partitioning means within the cylindrical member 2' comprises an uppermost closed partition 15' and cone shaped partitions 13' therebelow, each having a central opening communicating with an individual of a plurality of concentric pipes 14'. The septa 18' may be arranged as in the embodiment of Figures 1 to 4, but there is no need for their being tangent to the pipes associated with the given chamber within the member 2'. The plates 13' are sloped to direct the flow of any liquid into the associated pipes 14'. The septa 18' do however serve the purpose, as in the embodiment of Figures 1 to 4, of cutting off the vacuum from that portion of the periphery of the cylindrical member 2' which is opposed to the associated cylindrical wrap-displacing member 3' of the thread-advancing device. The fluid-conveying conduits 27' preferably terminate in heads 28' disposed toward the upper portion of the respective fluid-treating zones.

The cylindrical member 2 or 2' may be provided with a liquid- or fluid-permeable fabric 30, such as of felt or woven fabric, though this is not essential in all cases, particularly when the thread-advancing action is so controlled that adjacent convolutions of thread in the helix are extremely close together. The circulation of the fluids or liquids may be performed so that the flow follows the direction of the arrows shown in Figure 1. However, this action may be reversed so that a fluid or liquid may be directed from the inside of the cylindrical member 2 or 2' outwardly to suitable fluid-conveying conduits arranged opposite the zones for receiving the fluid or liquid coming therethrough. In such a case, the thread-advancing device shown in Figure 1 should preferably be inverted and the liquid-conveying conduits placed beneath the cylindrical member 2 to receive the liquid discharged therefrom.

If desired, heat may be supplied by any suitable means internally of the end compartment 31 or 31' respectively to effect drying of the threads as they pass thereabout. The cylindrical member 2 or 2' may have a gradually decreasing diameter in the direction of travel of the helix (as shown) to compensate for any shrinkage that may occur during drying of the particular threads handled, such as regenerated cellulose from viscose. Alternatively hot air or other gas having a controlled humidity may be passed through one of the fluid-treatment sections of the treatment device.

In operation of the device, the strand to be treated is passed over the inner end of the thread-advancing device (that is, toward the end carrying gears 8 and 9), and the helix thereof passes in succession through the several fluid-treating zones and is finally removed, whether or not it has been dried about the end compartment 31 or 31', to proceed to the next stage of operation, which may be a collecting, a drying, a twisting, or any other stage of operation. The strand proceeding to the treatment device of the present invention may be received directly from the thread-coagulating or thread-stretching stage of any conventional artificial filament spinning machine, and in such embodiment the strand may be subjected to such after-treatments as may be suitable for the particular material of which it is formed. For example, in the case of regenerated cellulose from viscose which proceeds to the device immediately after stretching, the conventional treatment with desulfurizing, washing, bleaching, sizing and other liquids may be performed in rapid succession on a single treatment device.

The device of the present invention may also be supplied with strands, yarns, filaments and the like of natural origin as well as artificial, and it may be used to perform a wide variety of operations, such as mercerization, saponification of cellulose ester strands, softening, conditioning, steaming, sizing, coating, lubricating, drying, and the like. The device is useful for treating filaments, threads, yarns, cords, and other strands of any material whatsoever, whether intended for a strictly textile or an industrial use, such as cellulose, cellulose derivatives, synthetic resins, e. g. nylon, vinyl resins, proteins, e. g. casein, and strands consisting of or comprising metallic filaments or siliceous filaments, e. g. of glass asbestos or other related spinnable minerals.

The invention has numerous advantages over devices which have heretofore been used for similar purposes. In the first place, it comprises relatively few moving parts. By providing sta-

tionary partitioning means within the rotating cylindrical member, it is possible to accomplish a great number of liquid treatment steps on a single thread-advancing device and still maintain the several liquids separate. In addition, the septa within the cylindrical member block off the effect of the vacuum from a portion of the periphery of the cylindrical member 2 which faces the wrap-displacing member 3, thereby increasing the efficiency and preventing any possibility of undue tension on the strands as a result of the vacuum pulling them against the cylindrical member 2 at those intervals of time when they must be removed therefrom to proceed about the member 3. Besides preventing intermingling of adjacent treating fluids or liquids, the present invention is accompanied with the advantage that there is no possibility of any dripping of liquids or splashing thereof in the vicinity of the thread-treating apparatus.

In the claims, the term "strand" is intended to be generic to the various strips of indefinite length to which the invention is applicable, whether such strip is a single continuous filament, a multiple-filament bundle twisted or untwisted, a spun yarn composed of staple fibers twisted together, a plied yarn, such as a cord, and the like.

It is to be understood that variations and modifications of my invention may be made without departing from the spirit and scope thereof, as defined in the appended claims.

I claim:

1. In a device for the treatment of strands with fluids, a thread-advancing device comprising a rotatable hollow cylindrical member for passing the strands thereabout in a generally helical path, said cylindrical member having a plurality of separate annular fluid-permeable zones, stationary partitioning means within the member dividing the space therein into a plurality of separate chambers communicating with corresponding zones of the member, and a plurality of fluid-conveying conduits disposed outside the member and having discharge openings arranged opposite a plurality of the chambers provided therein by the partitioning means.

2. In a device for the treatment of strands with fluids, a thread-advancing device comprising a rotatable hollow cylindrical member for passing the strands thereabout in a generally helical path, said cylindrical member having a plurality of separate annular fluid-permeable zones, stationary partitioning means within the member dividing the space therein into a plurality of separate liquid-receiving chambers communicating with corresponding zones of the member, a plurality of fluid-conveying conduits disposed outside the member and having discharge openings arranged in close proximity to the fluid-permeable zones thereof and opposite a plurality of the chambers provided therein by the partitioning means, and means for reducing the pressure in said chambers.

3. In a device for the treatment of strands with fluids, a thread-advancing device comprising a rotatable hollow cylindrical member for passing the strands thereabout in a generally helical path, said cylindrical member having a plurality of separate annular fluid-permeable zones, stationary partitioning means within the member dividing the space therein into a plurality of separate generally axially spaced liquid-receiving chambers communicating with corresponding zones of the member, a plurality of



fluid-conveying conduits disposed outside the member and having discharge openings arranged in close proximity to the fluid-permeable zones thereof and opposite a plurality of the chambers provided therein by the partitioning means, means for reducing the pressure in said chambers, and a septum associated with each of the chambers having its ends substantially in contact with the internal surface of the cylindrical member along two lines spaced circumferentially of the member, said septum extending entirely across the chamber between the adjacent walls of the partitioning means bounding the chamber, to restrict the application of reduced pressure to a predetermined portion of the respective permeable zones at least a part of which portion is opposite to the discharge openings of the conduit outside the chamber.

4. In a device for the treatment of strands with fluids, a thread-advancing device comprising a rotatable hollow cylindrical member for passing the strands thereabout in a generally helical path, said cylindrical member having a plurality of separate annular fluid-permeable zones, stationary partitioning means within the member dividing the space therein into a plurality of separate liquid-receiving chambers communicating with corresponding zones of the member, a plurality of fluid-conveying conduits disposed outside the member and having discharge openings arranged in close proximity to the fluid-permeable zones opposite a plurality of the chambers provided therein by the partitioning means, means for reducing the pressure in said chambers comprising a plurality of concentric pipes each communicating with a single one of said chambers, and a septum associated with each of the chambers having its ends substantially in contact with the internal surface of the cylindrical member along two lines spaced circumferentially of the member, said septum extending entirely across the chamber between the adjacent walls of the partitioning means bounding the chamber, to restrict the application of reduced pressure to a predetermined portion of the respective permeable zones at least a part of which portion is opposite to the discharge openings of the conduit outside the chamber.

5. In a device for the treatment of strands with fluids, a thread-advancing device comprising a rotatable hollow cylindrical member for passing the strands thereabout in a generally helical path, said cylindrical member having a plurality of separate annular fluid-permeable zones, stationary partitioning means within the member dividing the space therein into a plurality of separate liquid-receiving chambers communicating with corresponding zones of the member, a plurality of fluid-conveying conduits disposed outside the member and having discharge openings arranged in close proximity to the fluid-permeable zones opposite a plurality of the chambers provided therein by the partitioning means, means for reducing the pressure in said chambers comprising a plurality of concentric pipes each communicating with a single one of said chambers, and a septum associated with each of the chambers having its ends substantially in contact with the internal surface of the cylindrical member along two lines spaced circumferentially of the member, said septum extending entirely across the chamber between the adjacent walls of the partitioning means bounding the chamber, to restrict the application of reduced pressure to a predetermined portion of the respective per-

meable zones at least a part of which portion is opposite to the discharge openings of the conduit outside the chamber, each of said septa being arranged approximately tangent to a corresponding one of said pipes.

6. In a device for the treatment of strands with fluids, a thread-advancing device comprising a rotatable hollow cylindrical member for passing the strands thereabout in a generally helical path, said cylindrical member having a plurality of annular fluid-permeable zones separated by intervening impermeable bands, stationary partitioning means within the member dividing the space therein into a plurality of separate chambers communicating with corresponding zones of the members, said means comprising a plurality of axially spaced partitions aligned with the impermeable bands of the member and a plurality of concentric pipes each communicating with a distinct chamber, a plurality of fluid-conveying means disposed outside the member and having discharge openings arranged in close proximity to the fluid-permeable zones thereof and opposite a plurality of the chambers provided therein by the partitioning means, and means for reducing the pressure in the chambers.

7. In a device for the treatment of strands with fluids, a thread-advancing device comprising a rotatable hollow cylindrical member and means laterally spaced from the cylindrical member for axially displacing succeeding wraps of the strand to cause it to travel thereabout in a generally helical path, said cylindrical member having a plurality of annular fluid-permeable zones separated by intervening impermeable bands, stationary partitioning means within the member dividing the space therein into a plurality of separate chambers communicating with corresponding zones of the member, a plurality of fluid-conveying means disposed outside the member and having discharge openings arranged in close proximity to the fluid-permeable zones thereof and opposite a plurality of the chambers provided therein by the partitioning means, means for reducing the pressure in said chambers, and a septum associated with each of the chambers having its ends substantially in contact with the internal surface of the cylindrical member along two lines spaced circumferentially of the member, said septum extending entirely across the chamber between the adjacent walls of the partitioning means bounding the chamber, to prevent the application of reduced pressure to a predetermined portion of the arcuate path taken by the cylindrical member facing the wrap-displacing means.

8. In a device for the treatment of strands with fluids, a thread-advancing device comprising a rotatable hollow cylindrical member and means laterally spaced from the cylindrical member for axially displacing succeeding wraps of the strand to cause it to travel thereabout in a generally helical path, said cylindrical member having a plurality of annular fluid-permeable zones separated by intervening impermeable bands, stationary partition means within the member dividing the space therein into a plurality of separate chambers communicating with corresponding zones of the member, said means comprising a plurality of axially spaced partitions aligned with the impermeable bands of the member and a plurality of concentric pipes each communicating with a distinct chamber, means for reducing the pressure in said chambers, a septum associated with each of the chambers having its ends substantially in contact with the internal surface of the cylindrical member along two lines spaced circumferentially of the member, said septum extending entirely across the chamber between the adjacent walls of the partitioning means bounding the chamber, to prevent the application of reduced pressure to a predetermined portion of the arcuate path taken by the cylindrical member facing the wrap-displacing means, a plurality of fluid-conveying means disposed outside the member and having discharge openings arranged in close proximity to the fluid-permeable zones thereof and opposite those portions of said plurality of chambers which communicate the reduced pressure to the permeable zones of the cylindrical member.



9. In a device for the treatment of strands with fluids, a thread-advancing device comprising a rotatable hollow cylindrical member for passing the strands thereabout in a generally helical path, supporting means for the member arranged to extend from one end only of the member, said cylindrical member having a plurality of separate annular fluid-permeable zones, partitioning means within the member dividing the space therein into a plurality of separate liquid-receiving chambers communicating with corresponding zones of the member, separate conduits within the member communicating with the several chambers and extending through that end only of the member from which the supporting means extends, a plurality of fluid-conveying conduits disposed outside the member and having discharge openings arranged in close proximity to the fluid-permeable zones thereof and opposite a plurality of the chambers provided therein by the partitioning means, means for reducing the pressure in said chambers, and a septum associated with each of the chambers having its ends substantially in contact with the internal surface of the cylindrical member along two lines spaced circumferentially of the member, said septum extending entirely across the chamber between the adjacent walls of the partitioning means bounding the chamber, to restrict the application of reduced pressure to a predetermined portion of the respective permeable zones at least a part of which portion is opposite to the discharge openings of the conduit outside the chamber.

10. In a device for the treatment of strands with fluids, a thread-advancing device comprising a rotatable hollow cylindrical member and means laterally spaced from the cylindrical member for axially displacing succeeding wraps of the strand to cause it to travel thereabout in a generally helical path, supporting means for the member arranged to extend from one end only of the member, said cylindrical member having a plurality of annular fluid-permeable zones separated by intervening impermeable bands, partitioning means within the member dividing the space therein into a plurality of separate chambers communicating with corresponding zones of the member, separate conduits within the member communicating with the several chambers and extending through that end only of the member from which the supporting means extends, a plurality of fluid-conveying means disposed outside the member and having discharge openings arranged in close proximity to the fluid-permeable zones thereof and opposite a plurality of the chambers provided therein by the partitioning means, means for reducing the pressure in said chambers, and a septum associated with

each of the chambers having its ends substantially in contact with the internal surface of the cylindrical member along two lines spaced circumferentially of the member, said septum extending entirely across the chamber between the adjacent walls of the partitioning means bounding the chamber, to prevent the application of reduced pressure to a predetermined portion of the arcuate path taken by the cylindrical member facing the wrap-displacing means.

11. In a device for the treatment of strands with fluids, a thread-advancing device comprising a rotatable hollow cylindrical member and means laterally spaced from the cylindrical member for axially displacing succeeding wraps of the strand to cause it to travel thereabout in a generally helical path, supporting means for the member arranged to extend from one end only of the member, said cylindrical member having a plurality of annular fluid-permeable zones separated by intervening impermeable bands, partitioning means within the member dividing the space therein into a plurality of separate chambers communicating with corresponding zones of the member, said means comprising a plurality of axially spaced partitions aligned with the impermeable bands of the member and a plurality of concentric pipes each communicating with a distinct chamber and extending through that end only of the member from which the supporting means extends, means for reducing the pressure in said chambers, a septum associated with each of the chambers having its ends substantially in contact with the internal surface of the cylindrical member along two lines spaced circumferentially of the member, said septum extending entirely across the chamber between the adjacent walls of the partitioning means bounding the chamber, to prevent the application of reduced pressure to a predetermined portion of the arcuate path taken by the cylindrical member facing the wrap-displacing means, a plurality of fluid-conveying means disposed outside the member and having discharge openings arranged in close proximity to the fluid-permeable zones thereof and opposite those portions of said plurality of chambers which communicate the reduced pressure to the permeable zones of the cylindrical member.



12. In a device for the treatment of strands with fluids, a thread-advancing device comprising a rotatable hollow cylindrical member for passing the strands thereabout in a generally helical path, said cylindrical member having a plurality of separate annular fluid-permeable zones, partitioning means within the member dividing the space therein into a plurality of separate generally axially-spaced liquid-receiving chambers communicating with corresponding zones of the member, a plurality of fluid-conveying conduits disposed outside the member and having discharge openings arranged in close proximity to the fluid-permeable zones thereof and opposite a plurality of the chambers provided therein by the partitioning means, means for reducing the pressure in said chambers, and a septum associated with each of the chambers having its ends substantially in contact with the internal surface of the cylindrical member along two lines spaced circumferentially of the member, said septum extending entirely across the chamber between the adjacent walls of the partitioning means bounding the chamber, to restrict the application of reduced pressure to a predetermined portion of the respective permeable zones at least a part of which portion is opposite to the discharge openings of the conduit outside the chamber.

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