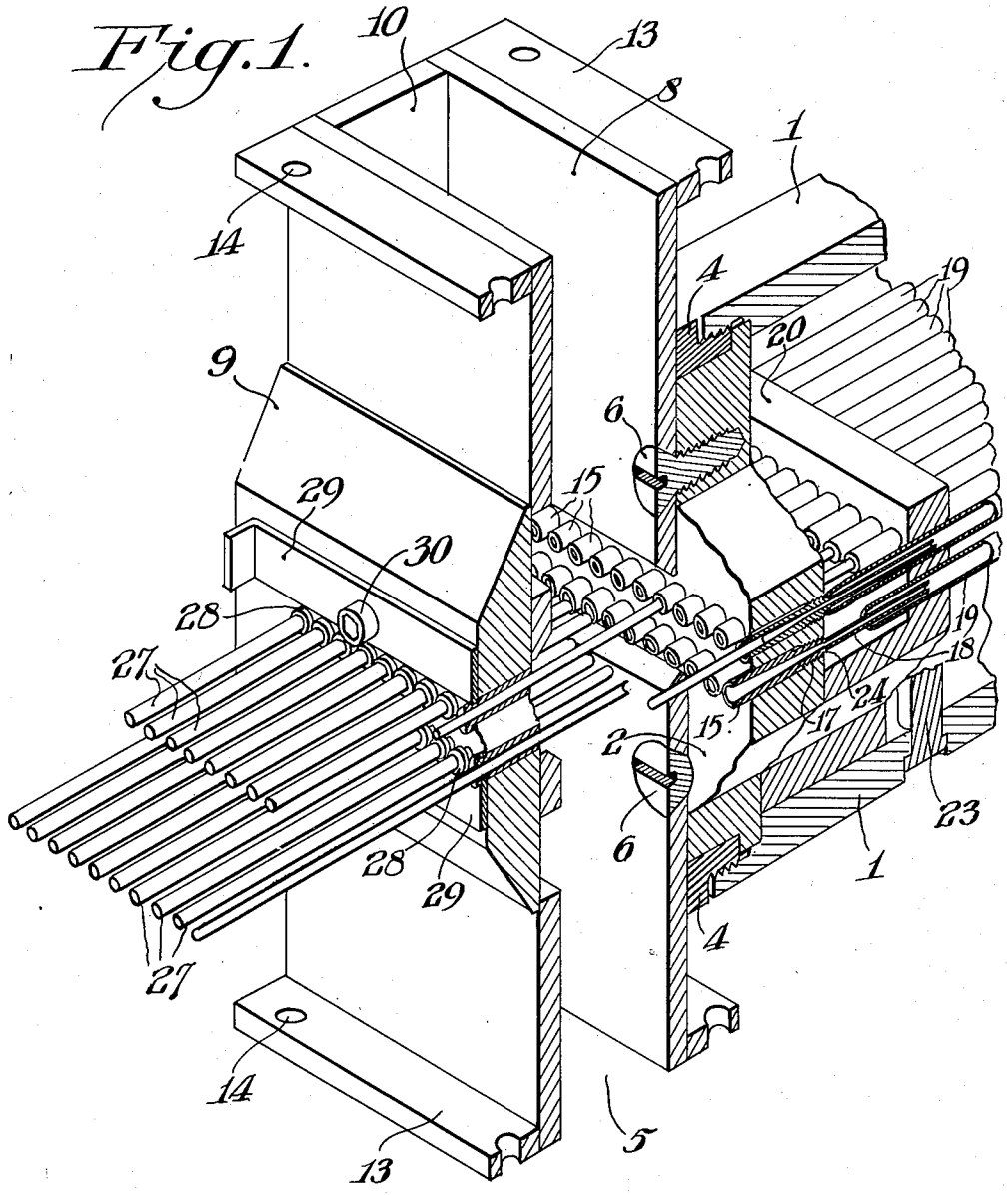
Sept. 25, 1951 W. T. R. KINRAIDE 2,568,920

APPARATUS FOR TREATING SHAPED ARTICLES WITH FLUIDS

Filed April 21, 1949 3 Sheets-Sheet 1

Fig. 1.



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Filed April 21, 1949 3 Sheets-Sheet 2

Fig. 2.

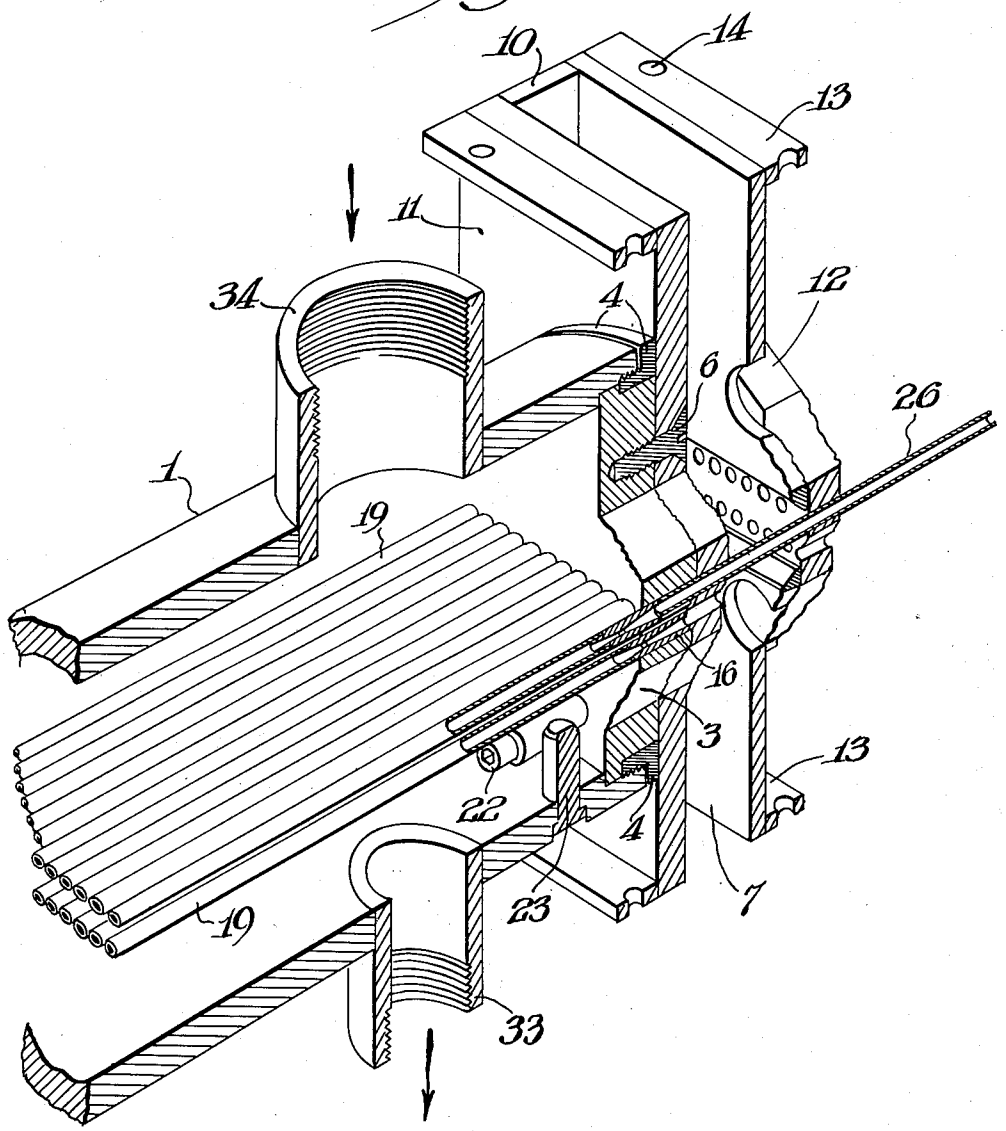

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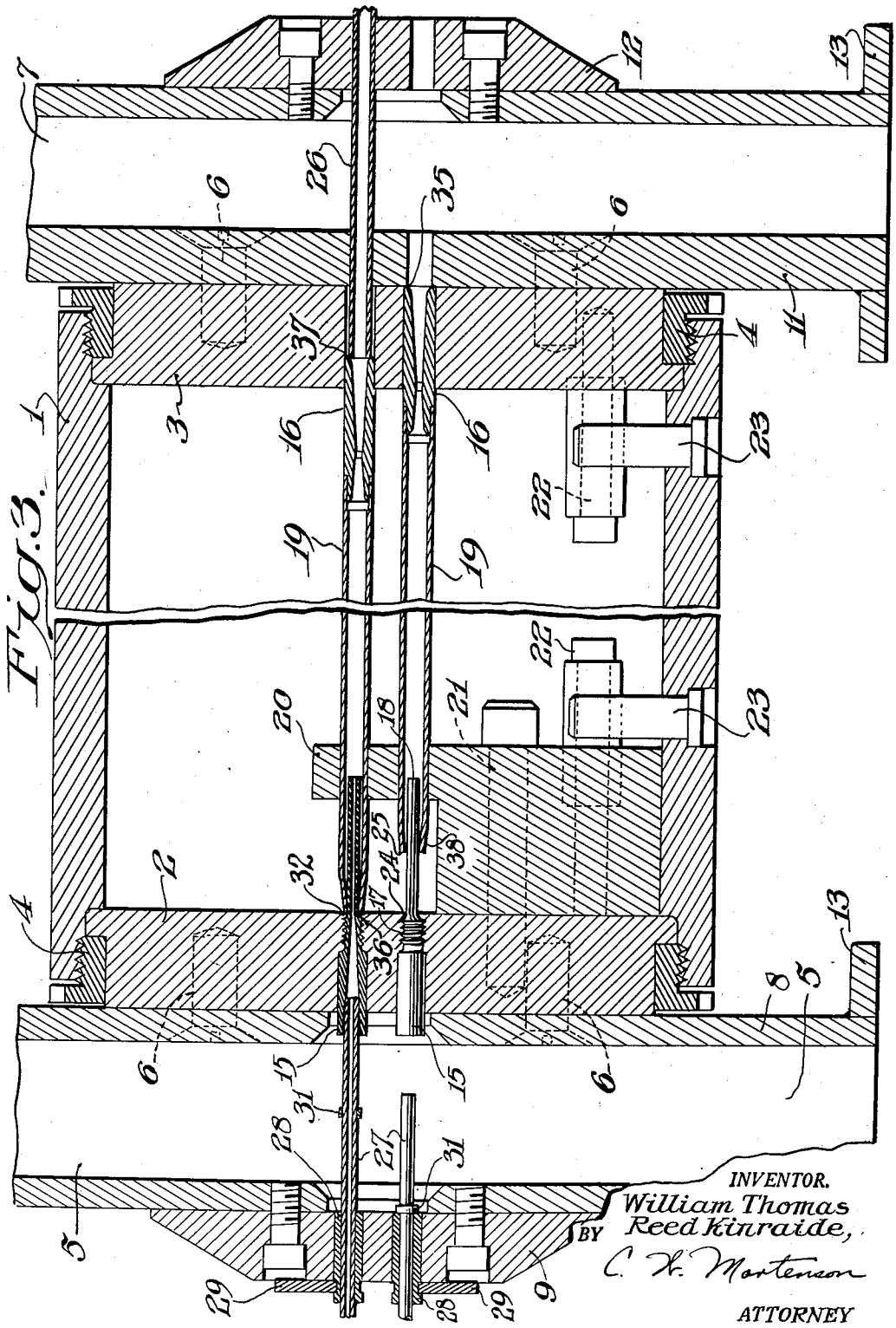
Fig. 3.



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UNITED STATES PATENT OFFICE

2,568,920

APPARATUS FOR TREATING SHAPED ARTICLES WITH FLUIDS

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Application April 21, 1949, Serial No. 88,789

8 Claims. (Cl. 68—5)

1

This invention relates to equipment used in the textile field. In particular, it relates to a machine which permits the exposure of running lengths of shaped articles such as yarn to fluid.

To obtain useful synthetic yarns prepared by the extrusion of solutions of polymeric materials through shaped orifices into evaporative or coagulative media the yarns must, in general, be stretched to avoid low tenacity and extremely high elongation. These high elongations, of course, make it possible to stretch the yarns many times their original lengths without excess breaking. The drawn yarns, particularly if set in the stretched condition by the application of a short heat treatment, possess much higher tenacities than the original yarns. In some instances better physical properties and better all around drawing performance are obtained if the synthetic yarn is drawn in the presence of a hot plasticizer, such as steam. In the case of freshly spun polyacrylonitrile yarn, the tenacity and elongation are both low and the drawing operation must be carried out at temperatures of at least 80° C. and preferably at 100° C. and higher in order to prevent excessive breaking of the yarn.

Heretofore many devices have been designed to accomplish the fluid treatment of running lengths of yarn. The majority of these devices are subject to many objections. Since such devices must operate with running lengths of yarn on close centers, it has been very difficult to incorporate valves which permit stringing up one end while the adjacent ends are still running. Further, the pressures are variable due to different distances between the valve and the cell. Still further, the introduction of fluid into the cell must be carried out so as to avoid too much turbulence. When the fluid is introduced radially through a port at one or more points around the cell, the fluid tends to spiral through the cell even when a baffle in the form of a tube is provided for the yarns. This is especially true if the fluid enters not radially but slightly off center.

The fluid treating apparatus must have a means for disposing of exhaust fluid which is emitted from each end. This feature is important from the standpoint of quality of performance as well as safety. This is especially so if a toxic fluid or vapor or one which need be recovered is used.

In previous designs for vapor treatment, entrained condensates have not been entirely avoided. Such condensates may form on any surface below the saturation temperature of the

2

vapor. As short a passage as possible is desirable from the vapor header take-off to the inner part of the cell. Also, as little exposure as possible to surfaces below the dew-point temperature is desirable. Furthermore, since it is difficult to separate condensate from the vapor in the presence of turbulence, the separation must be made in a large volume part of the system. In some cases where the vapor is brought into a prechamber and then introduced into the cell the inevitable result is that condensate collects in the prechamber and is discharged into the cell in slugs.

Another important feature the fluid treating apparatus must have is a means for avoiding or clearing plugged cells. Specifically, provision has to be made to remove any orifice for either cleaning or replacement while the adjacent positions are in operation.

Probably the most serious problem heretofore has been a satisfactory method for stringing up the cells and in particular, a method for stringing up one end of yarn while adjacent ends are running. In the majority of cases in the past this has been accomplished by means of wires either to pull the yarn through or push it through the cell. The use of such a device is very unsatisfactory, especially with cells of considerable length. Several attempts have been made to use sliding plugs to carry the yarn through the cell, but they were too cumbersome to place on close centers and were too difficult to operate. The use of jets to string up a cell has also been tested. In this case, it was found that a relatively large outlet orifice was required to permit sufficient flow of vapor to carry the yarn through the cell.

It is an object of this invention to provide an apparatus for treating running lengths of yarn with fluid. It is a further object of this invention to provide such an apparatus which is capable of operation at pressures of at least 60 lbs./sq. in. gauge. It is a particular object of this invention to provide an apparatus for the fluid treatment of a plurality of running lengths of yarn which will permit safe and easy stringing-up of a yarn end without interfering with adjacent running ends of yarn. It is still a further object of this invention to provide a fluid treating apparatus designed so that individual orifices and tubes may be shut down, cleaned or replaced while adjacent positions are in operation. It is a further object of this invention to provide separate valving of fluid to each cell for treating individual running lengths of yarn. It is still a

further object of this invention to provide an apparatus for the treatment of a plurality of running lengths of yarn with vapor under pressure, which apparatus is free from passages and pockets capable of producing and collecting condensate. Furthermore, it is a particular object of this invention to provide an apparatus for the individual, yet uniform, treatment of a plurality of running lengths of yarn with fluid under pressure. Other objects will become obvious from the description of the invention which follows.

The objects of this invention are accomplished by an apparatus for fluid treatment of running lengths of yarn which comprises a vessel in which or through which a fluid may be passed preferably under elevated pressures and which contains a passageway which spans the vessel, directs the yarn through the vessel and exposes the yarn to the action of the fluid and, at any desired moment, protects the yarn from the fluid. The passageway comprises an inlet mounted in one end of the vessel and extending into the vessel and into a cell passage called a cell tube, which is slidably mounted within the vessel. The superimposed relation between the extension and the cell tube permits control of the fluid along the edges of the tube extension into the cell tube. The extension smooths out the flow of fluid and the cell tube may be moved forward to shut off the supply entirely. Aligned with the cell tube and inlet tube is an outlet through which the yarn passes to a wind-up device. Since fluid is flowing through the vessel usually under pressure, there are means to keep the inlet and cell tubes stationed within the vessel and means to dispose of fluid coming out of the vessel through the inlet tube and the outlet. The disposal means may be aspiration chambers and tubular inserts are provided to span these chambers. The tubular insert at the outlet end cooperates with or is a suction device designed to draw the yarn through the passageway. Insertion of the suction device pushes the cell tube forward to closed position.

In more detail the apparatus comprises a pressure vessel fitted with inlet and outlet end plates, said inlet end plate containing a plurality of inlet tubes extending a short distance inside the pressure vessel, said outlet end plate containing a plurality of holes which hold, by sliding fit, outlet tubes which are joined at one end of a plurality of cell tubes, said cell tubes and outlet tubes combined being capable of spanning the entire length of the vessel between the end plates and being capable of slight longitudinal movement whereby contact with the inlet tube is broken and fluid from the pressure vessel can enter the cell tubes and flow through these tubes. A portion will exit through the outlet tubes into an aspiration chamber at the outlet end and a portion will pass from the cell tube into the inlet tube and then to an aspiration chamber at the inlet end of the device.

Better understanding of this invention can be obtained by reference to the drawings which illustrate a specific embodiment of the invention and in which like numbers refer to like parts.

Figure 1 is a perspective view partly in section of the inlet end of the device;

Figure 2 is a perspective view partly in section of the outlet end of the device and

Figure 3 is a sectional elevation showing the valving arrangement more clearly.

The pressure vessel called the cell body 1 is closed at each end by plates, the inlet end plate 2 and the outlet end plate 3. The end plates are secured to the cell body 1 by means of the threaded bushings 4. The inlet end plate 2 is attached to an aspiration chamber 5 by means of bolts 6. Similarly, the outlet end plate 3 is attached to an outlet aspiration chamber 7 by bolts 6. The inlet aspiration chamber 5 comprises plate 8 to which the inlet plate 2 is attached, the inlet guide block 9 and side plates 10. The outlet aspiration chamber 7 is composed of plate 11 to which outlet end plate 3 is attached, outlet guide block 12 and side plates 10. Either the inlet or outlet guide blocks may be made in one piece or in section as shown in Figure 3. Both aspiration chambers are equipped with flanges 13 which may be bolted at 14 to a frame (not shown) to secure the entire apparatus. Both aspiration chambers are open at one end and suction is applied at the other by any means, for example, a blower.

The inlet end and outlet end plates are carefully drilled on the same spacings and contain the inlet tubes 15 and outlet tubes 16, respectively. The inlet tubes 15 are held in place by threading 17 in inlet plate 2 although other fastening means can be used. The inlet tubes taper (7° included angle) down to a small tube 18 which extends into the interior of the cell body. The outlet tubes 16 are mounted in holes in end plate 3 so that they may slide back and forth. The tubes 16 are secured to the individual cell tubes 19. Actually, tubes 16 and 19 may be constructed in one piece. However, construction of the inward taper from both ends shown in tube 16 in Figure 3 is more conveniently done on a separate small tube. Each cell tube 19 is externally tapered at the entrance end, the end fitting over extension 18 of the inlet tube 15.

The cell tubes 19 are supported at the inlet end on guide plate 20 so that they are free to slide. The cell tube support 20 is fastened to the inlet end plate 2 by means of bolts 21. The centering pins 22 and 23, shown in Figure 3, serve to position the end plates 2 and 3 with respect to the cell body 1 and to assure perfect alignment with one another. The cell tubes 19 and the attached tubes 16 slide and are restrained from sliding out the outlet end by a shoulder formed by the smaller holes in the inner wall 11 of the outlet aspiration chamber 7. This shoulder may be seen at 35 in Figure 3. The walls 8 and 9 of the inlet aspiration chambers and the walls 11 and 12 of the outlet aspiration chamber are drilled on the same spacing as the end plates to provide access to the orifices.

The inlet tube 15 is so formed that it provides a seat 24 with the inlet end of cell tube 19 shown in Figure 3. When the cell tube 19 is moved toward the inlet end, the cell tube valve seat 25 contacts the inlet tube valve seat 24 and closes off the vapor passage into cell tube 19 by forming joint 36. Upon release of the pressure holding cell tube 19 against valve seat 24, the pressure of the fluid exerted on the tapered end forces tube 19 back, thereby permitting fluid to flow through the tubes. It is not essential that cell tube 19 be tapered or that the tube be forced back to open position by pressure. The tubes may be mounted on a slight angle downward toward the outlet. Upon removal of the tubular insert or suction device, the cell tube falls by its own weight to open position. The method of closing this vapor port and accomplishing string-up of the drawing apparatus is shown in Figure 3 in which the lower cell tube shown is in operating position and the upper is in shut-down or string-up posi-

tion. When inlet tube 15 is removed, tube 19 moves up to and into plate 2 and a joint is formed between wall edges 32 of plate 2 and the tapered sides of 19, designated as valve seat 38. This double valve arrangement is not essential; a single valve system may be used. The wall edges 32 of inlet plate 2 may be recessed to receive the cell tube 19 and thereby form a seal in the presence or absence of inlet tube 15. However, the double valve arrangement is preferred, since a worn valve seat on an inlet tube is easier to replace than a worn valve seat on the plate 2.

The string-up tool which may be used in stringing up the apparatus of this invention is equipped with a slender suction tube 26 which fits into the outlet aspiration chamber 7 and extends up against the outlet tube 16 as shown in Figure 3 at 37. When this suction device is in place, the fluid port is closed and a strong suction is produced at the inlet tubes 15 and yarn may be drawn through the cell. Any string-up tool which will draw the yarn through the device may be used.

Since there is continually maintained a suction in each aspiration chamber produced by blowers to carry away exhaust fluid it is necessary to provide protection for the slack yarn during string-up. It will be seen that the suction tubes 26 of the string-up device provide this protection at the outlet end. The problem at the inlet end is solved and string-up is facilitated by tubular inserts 27 which may be moved to span the aspiration chamber 5 and enter the inlet tubes 15. The tubular inserts 27 are positioned by bushings 28 in which they may slide, spanning the aspiration chamber 5 and extending into tubes 15 as far as the taper in tubes 15 will permit. The movement of inserts 27 out of block 9 is restricted by collars 31. The bushings 28 are contained by inlet guide block 9 which also acts as the outer wall of the aspiration chamber 5. The bushings 28 are held in place by any convenient means such as locking plate 29. When the nut 30 is loosened, the locking plate 29 can be moved to disengage the bushings 28. When bushings 28 are removed, the tubular inserts 27 may be taken out and as described below inlet tubes 15 may be removed. When a tubular insert 27 is moved so as to enter an inlet tube 15, the yarn has a continuous path during string-up all the way through the entire cell and is subject to the drag of the air flowing through the cell into the suction device. After the yarn is running into the suction device and during vapor treatment, the tubular insert 27 is drawn out to its normal position set by the collar 31 to permit exhaust vapor to be carried away by the inlet aspiration chamber.

By means of the tubular inserts spanning the aspiration chambers and by means of the valve system a yarn end may be passed through the device without being exposed to the fluid. This is advantageous since for the most part, the fluids are hot and any softening of the yarn which would hamper string-up is avoided. The extension of the inlet tubes into the cell tubes affords another advantage in that the flow of fluid to the yarn is smoothed out and turbulence is avoided.

To provide for clean out of the inlet tubes and cell tubes an auxiliary seat is provided on the face of the inlet end plate 2 by the wall edges or unthreaded recess 32. The inlet end of cell tube 19 is shaped at point 38 so as to form the mate to the auxiliary valve seat 32. Thus, even when the inlet tube 15 is removed, a valve still exists. The double valve permits easy replacement of a plugged tube or a worn inlet tube valve seat. If it is necessary to remove a cell tube 19, outlet end plate end wall 11 may be removed and the tube may be withdrawn. In actual practice it is seldom necessary to remove a cell tube.

When it is necessary to remove an inlet tube 15 while the adjacent ends are running, the following procedure may be employed. The tubular insert 27 and bushing 28 are removed. The resulting hole in the inlet guide block 9 is then large enough to allow the inlet tube 15 to be removed. A special wrench tapered on the end to match the inner taper of the inlet tube 15 is inserted into the tube, tapped lightly causing the tapers to lock, and the tube is unscrewed and removed. In the meantime, cell tube 19 is moved by means of an appropriate tool toward the inlet end of the chamber so that cell tube side edges or auxiliary valve seat 38 makes contact with the auxiliary valve seat 32 situated on inlet end plate 2. The closing of this valve prevents the flow of fluid through the dismantled position. Pressure is thereby maintained and more economical use of the fluid is insured. In putting in a new inlet tube 15, the above procedure is reversed. Needless to say, an inlet tube 15 not seriously plugged may be cleaned out by blowing compressed air through the cell tube 19. In actual practice the cell tubes 19 and inlet tubes 15 are cleaned in this manner and removal of the inlet tubes 15 is necessary only infrequently.

In order to string-up a single position while adjacent ones are running, the following procedure is used. The tube 26 of the suction device is inserted through outlet aspiration chamber 7 and against the outlet tube 16 so as to slide cell tube 19 until cell tube valve seat 25 makes contact with the inlet tube valve seat 24. This closes off the flow of vapor through the individual cell tube. Then with the tubular insert 27 pushed in so as to span the inlet aspiration chamber 5, the end of yarn to be treated is inserted by hand into the tubular insert 27 where it becomes subject to the drag of the air flowing concurrent with the yarn into the suction device 26. The yarn then runs into the suction device and the tubular insert 27 is drawn out to its normal position and the yarn is carried while traveling into the suction device over the output metering rolls and eventually to a suitable take-up device (not shown). When the suction tube 26 is withdrawn from the outlet end of the apparatus, the pressure of the fluid or vapor within the cell body 1 pushes the cell tube tube 19 toward the outlet end, thereby opening the valve at the inlet end and allowing fluid or vapor to enter the cell tube.

The string-up of the device and changing of tubes can be performed by an operator with ease and safety. An important element of safety is provided by the inlet and outlet aspiration chambers 5 and 7. Sufficient suction is maintained in these aspiration chambers by means of blowers that substantially all of the fluid from the pressure vessel is carried away without issuing into the room or surrounding area. This is highly advantageous particularly if the treating material is toxic. The possibility of an operator receiving burns from the hot materials becomes very remote. In addition, the treating fluids may be recovered if desired.

Continuously running lengths of yarn of acrylonitrile polymers have been subjected to vapor

treatment in the apparatus of this invention at pressures as high as 60 lbs./sq. in. gauge. Many other yarns may be used similarly, as for example, polyamides, cellulosic yarns and synthetic yarns of other vinyl polymers. The size and number of the tubes determine to a great extent the upper limits of operating pressure. In general, a plurality or warp of any yarn may be treated in the device of this invention. If it is desired to treat shaped articles of different form, such as a ribbon or film, only minor changes are required, for example, a change in the shape of the orifice to conform to the article treated.

The apparatus is not limited in use to any particular fluid. While steam is probably most commonly employed in commercial yarn processing, the treatment of yarns with more expensive materials is carried out advantageously in the apparatus of this invention. In addition to steam or water there may be mentioned air and other gases, formaldehyde vapor, bleaching solutions, dyeing solutions, finishing solutions and such substances as alcohols, ketones, etc. in liquid or vapor form. In addition to the safety of operation, the treating fluid can be recovered without substantial loss. Further, the design is such that in the treatment of synthetic yarn at relatively high temperatures, if air has some degrading influence on the yarn at those high temperatures, it may be easily excluded.

As pointed out above, the apparatus may also be used for the treatment of running lengths of yarn with liquids, particularly hot liquids. The valving arrangement will operate equally well and the string-up can be accomplished in similar fashion to that described above. After the small amount of liquid in the cell tube is removed, the suction string-up device produces a flow of air through the cell tube which will carry the length of yarn through the tube. In the case of liquid treatment the aspiration chambers at each end of the pressure chamber are used to carry away the treating liquid for purification and recycling.

In using the apparatus of this invention it is customary to use an individual cell tube for each running length of yarn to be treated, although this is not necessary. While the pressure chamber may contain only one cell tube, it is generally advantageous to treat a plurality of running lengths of yarn, in warp form or otherwise, simultaneously. In this way uniformity and economy are effected. This apparatus is particularly adapted to the handling of a plurality of running lengths of yarn on close centers. An arrangement comprising two parallel rows of cell tubes, those of one row being staggered with respect to those of the other has been found most efficient for the handling of a plurality of running lengths of yarn. With the orifices arranged in this fashion, the number of running lengths of yarn that can be handled simultaneously is restricted principally by the distance between adjacent tubes. The design of this apparatus is such that when adjacent orifices are as little as ⅛" apart, the running lengths of yarn can be conveniently handled.

The length of the cell tubes and the corresponding size of the pressure chamber is not restricted in any manner. The size is determined merely by the desired yarn treatment conditions. From the standpoint of economy and space conservation, the size of the apparatus will, of course, be kept to the minimum required by the processing conditions.

Although each running length of yarn receives individual treatment in its cell tube, the treatment of adjacent ends is uniform. This is made possible in the apparatus of this invention by the valving design. Each valve is equidistant from the fluid source and variable pressures in adjacent cell tubes cannot exist. In addition, the valve design is such that fluid turbulence in the cell tube is minimized. The fluid is admitted to the cell tube through one end so that the flow is parallel to the wall of the tube and the tendency to spiral through the tube is eliminated.

The possibility for the formation and admittance of condensate in the individual cell tube is substantially eliminated by the design of the yarn treating apparatus of this invention. The separation of condensate from vapor is made in the large volume part of the system, namely, the pressure chamber, by means of outlet **33**. Practically all of the condensate formed by steam or vapor entering inlet **34** is removed at **33**. The valves of the individual cell tubes are located such that condensate cannot be discharged into the tubes in slugs or large amounts. In addition, the cell tubes are surrounded and heated by the hot treating vapor. This minimizes the tendency for formation of condensate inside the cell tubes.

The apparatus of this invention overcomes the objections inherent in devices described in the prior art for fluid treatment of running lengths of yarn. An apparatus has been provided which allows uniform treatment of a multiple number of running yarn ends on an individual basis so that string-up of one position while adjacent ends are running is devoid of danger and difficulty.

Any departure from the procedure described herein which conforms to the principles of the invention is intended to be included within the scope of the claims below.

I claim:

1. Apparatus for directing a shaped article through a fluid containing vessel comprising a tubular inlet mounted in one end of said vessel and having an extension within said vessel; a tubular cell passage mounted within said vessel to be slideably superimposed over said extension with a small space between said cell passage and said extension; an outlet at the other end of said vessel cooperating with said inlet and said cell passage to exhaust fluid passing therethrough; means for keeping said cell passage in said vessel and means for controlling the flow of said fluid into said cell passage.

2. Apparatus for directing a shaped article through a fluid containing vessel comprising a tubular inlet mounted in one end of said vessel and having an extension within said vessel; a tubular cell passage mounted within said vessel to be slideably superimposed over said extension with a small space between said cell passage and said extension; an outlet at the other end of said vessel cooperating with said inlet and said cell passage to exhaust fluid passing therethrough; means for keeping said cell passage in said vessel and means for controlling the flow of said fluid to said article as it passes through said cell passage.

3. Apparatus for directing a yarn through a fluid containing vessel comprising an inlet tube mounted in one end of said vessel and having an extension within said vessel; a cell tube mounted within said vessel to be slideably superimposed over said extension with a small space between said cell tube and said extension; an outlet at the other end of said vessel cooperating with said

inlet tube and said cell tube to exhaust fluid passing therethrough; means for keeping said cell tube in said vessel; means for controlling the flow of said fluid to said yarn as it passes through said vessel through said tubes and outlet; and means for removing said fluid passing out of said vessel through said inlet tube and said outlet.

4. Apparatus for directing a yarn through a fluid containing vessel comprising an inlet tube mounted in one end of said vessel and having an extension within said vessel; a cell tube mounted within said vessel to be slideably superimposed over said extension with a small space between said cell tube and said extension; an outlet at the other end of said vessel cooperating with said inlet tube and said cell tube to exhaust fluid passing therethrough; means for keeping said cell tube in said vessel; means for controlling the flow of said fluid to said yarn as it passes through said vessel through said tubes and outlet; and means for removing said fluid passing out of said vessel through said inlet tube and said outlet; and tubular inserts slideably mounted in said removal means to span said removal means and extend into said inlet tube and said outlet.

5. Apparatus for directing yarn through a fluid containing vessel comprising an inlet tube mounted in one end of said vessel and having an extension within said vessel; a cell tube externally tapered at the entrance end and mounted thereat within said vessel to be slideably superimposed over said extension with a small space between said cell tube and said extension; an outlet at the other end of said vessel cooperating with said inlet tube and said cell tube to exhaust fluid passing therethrough; a valve comprising a valve seat at the inlet end of said vessel and a valve seat at the tapered end of said cell tube; an aspiration chamber at the inlet end; an aspiration chamber at the outlet end of said vessel; and in the outside wall of said aspiration chamber at said inlet end a tubular insert slideably mounted to span said chamber and extend into said inlet tube.

6. Apparatus for directing yarn through a fluid containing vessel comprising an inlet tube mounted in one end of said vessel and having an extension within said vessel; a cell tube externally tapered at the entrance end and mounted thereat within said vessel to be slideably superimposed over said extension with a small space between said cell tube and said extension; an outlet at the other end of said vessel cooperating with said inlet tube and said cell tube to exhaust fluid passing therethrough; a valve comprising a valve seat at the inlet end of said vessel and a valve seat at the tapered end of said cell tube; an aspiration chamber at the inlet end; an aspiration chamber at the outlet end of said vessel; and in the outside wall of said aspiration chamber at said inlet end a tubular insert slideably mounted to span said chamber and extend into said inlet tube; and in the outside wall of said aspiration chamber at said outlet end a tubular insert slideably mounted to span said chamber and extend into said outlet.

7. Apparatus for treating yarn with a fluid comprising a pressure vessel containing an inlet end plate, a cell tube support, and an outlet end plate; a cell tube externally tapered at one end and slideably supported at that end in said cell tube support and at the other end in said outlet end plate; an inlet tube removably mounted in said inlet end plate, said inlet tube having a tapered extension fitting into the tapered end of said cell tube with a small space between said cell tube and said extension; an aspiration chamber at the inlet end; an aspiration chamber at the outlet end; a tubular insert slideably mounted in the aspiration chamber at the inlet end to span said chamber and extend into said inlet tube; an orifice in the inside wall of said aspiration chamber at the outlet end having a smaller diameter than said cell tube; and an orifice in the outside wall of said aspiration chamber at the outlet end, said orifice being aligned with said cell tube and said inlet tube.

8. Apparatus for directing yarn through a fluid containing vessel comprising a pressure vessel containing an inlet end plate and an outlet end plate; an internally tapered inlet tube mounted in the inlet plate of said vessel and having an extension within said vessel; a cell tube externally tapered at the entrance end and mounted thereat within said vessel to be slideably superimposed over said extension with a small space between said cell tube and said extension; an internally tapered outlet mounted in the outlet plate of said vessel, said outlet cooperating with said inlet tube and said cell tube to exhaust fluid passing therethrough; a valve seat on said extension cooperating with a valve seat at the end of said tapered cell tube; a valve seat on said inlet plate cooperating with a valve seat on the external taper of said cell tube; an aspiration chamber at the inlet end; an aspiration chamber at the outlet end; in the outside wall of said aspiration chamber at said inlet end a tubular insert slideably mounted to span said chamber and extend into said inlet tube; an orifice in the inside wall of said aspiration chamber at the outlet end aligned with and having a smaller diameter than said cell tube; and in the outside wall of said aspiration chamber at said outlet end a tubular insert slideably mounted to span said chamber and extend into said outlet.

WILLIAM THOMAS REED KINRAIDE.

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