

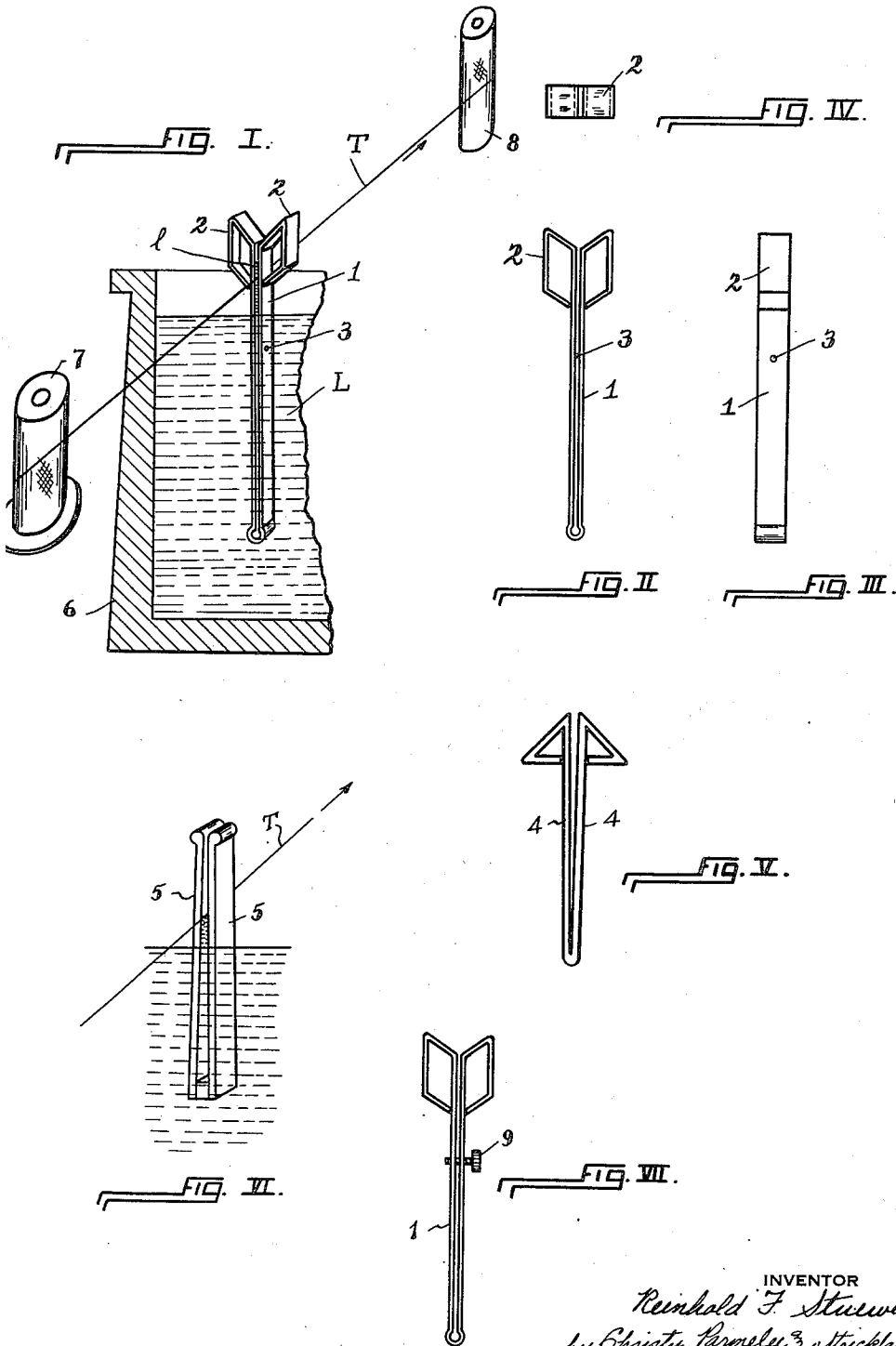
Dec. 21, 1943.

R. F. STUEWER

2,337,357

TREATMENT OF FILAMENTS WITH LIQUIDS

Filed Oct. 1, 1941



INVENTOR
Reinhold F. Stuewer
by Christy, Parmelee & Strickland
his attorneys

UNITED STATES PATENT OFFICE

2,337,357

TREATMENT OF FILAMENTS WITH LIQUIDS

Reinhold F. Stuewer, Scranton, Pa., assignor to
Grove Silk Company, a corporation of Penn-
sylvania

Application October 1, 1941, Serial No. 413,152

3 Claims. (Cl. 68—200)

This invention relates to the treatment of filaments with liquids; and, while applicable throughout a wide field of particular uses, finds practical utility in the treatment of threads, both those formed of natural fibres, such as cotton, linen, and wool, and those artificially produced, such as threads of rayon and of nylon; and the treatment may be merely a wetting, in preparation for ensuing operations, or it may be an application to the thread of oil, of a solution of oil, of an emulsion, or of a solution, suspension, or dispersion in water of a textile assistant.

It is conventional, in such operations as those just alluded to, to cause the filament or thread, advancing in continuous course, to plunge into a bath of the treating liquid; and, in order to accomplish this, it has heretofore been necessary to deflect the filament or thread from straight-away course, and to cause it to pass beneath some submerged guide or abutment, such, for example, as a glass rod. This conventional procedure makes it necessary, first, that the filament or thread be subjected to augmented tension, sufficient to draw it beneath the abutment and through the bath; second, the procedure involves replacement of the abutment as in continued service it becomes worn; and, third, guiding surfaces that must ordinarily intervene between the bath and the bobbin upon which the treated material is wound are liable to become fouled and must be kept clean. The practice of my invention is free of all such limitations.

In the accompanying drawing Fig. I is a view in perspective of a mechanical appliance in which and in the use of which my invention is realized; and in Fig. I this appliance is diagrammatically shown in operative assembly with a pool of the liquid of the treatment and with a filament in course of treatment. Figs. II, III, and IV are views in front and side elevation and in plan from above of the appliance of Fig. I. Fig. V is a view in front elevation of the appliance formed of material of specifically different sort, and it illustrates a minor modification in shape. Fig. VI is a view corresponding to Fig. I and shows the appliance of the invention, formed of material of yet another sort, and illustrates yet further modification in shape and refinement in operation. Fig. VII is a view corresponding to Fig. II and in it an elaboration of structure is illustrated.

Referring first to Figs. I-IV, a pool of the treating liquid L is maintained; and, by known means, such a pool may be maintained at constant level within a suitable container 6. Parti-

ally submerged in and rising from the surface of the pool is the mechanical element 1. The element as it here is shown is made of a narrow strip of metal, such as steel, bent medially and doubled upon itself to bifurcated form, with the two furcations facing one another and spaced apart at a narrow interval. The ends of the strip are bent to form reinforcing terminal loops 2 that give to the article greater rigidity. By such loops also the element may be supported, and in its support adapted to turn on a vertical axis, so as to offer least resistance to the thread T advanced through it. In a specific instance the strip so shaped is 0.25 of an inch wide; the overall length of the shaped article is 2.5 inches; and the space at which the two furcations stand apart is 0.015 of an inch. A small and carefully proportioned projection 3 may preliminarily be formed in the strip that is bent to form the element 1, so that in the bending the width of the space between the furcations may be exactly predetermined. The element 1 is placed in vertical position, so that the furcations defining the narrow space are partially submerged, but rise above the surface. In consequence a column 4 of the liquid rises under capillary attraction in the space between the furcations and above the general level of the pool L. Conveniently the element 1 is arranged as shown in Fig. I, the bend in the strip downward, and the free ends upward. In the specific installation shown in Fig. I, and employing the liquid presently to be specified, the height of the capillary column is about 0.5 of an inch; and, accordingly, the element 1 is so particularly adjusted that the parallel space-defining portions of the strip rise to a height of somewhat more than half an inch above the surface of the pool. Through the space defined by the furcations of the body 1, and through the body of liquid elevated within that space the thread T to be treated is caused to advance. And it will be manifest that the thread T may so be advanced without deflection from its straight-away course from one instrumentality to another, as, for instance, from a source 7 to a bobbin 8.

In a test run, here described by way of illustration and example, the thread under treatment was thirty denier nylon yarn and the liquid was a 6.5% aqueous solution of a water-soluble resin, to act as a sizing agent and a tint. The run was of 50 hours duration, and the yarn was caused to advance at a speed of 45 feet per minute. The product of this test run was of uniform color throughout, indicating a uniform

application of liquid throughout the run; and a size content of 4.5% was found to have been added to the yarn.

In this test run the capillary element was capable of supplying much more than the required quantity of solution, and the quantity of size taken up by the yarn was determined by the concentration and viscosity of the solution, as shown by the values given. Actual immersion of identical yarn by passing it through a guide beneath the surface of a pool of the solution gave the same quantitative result.

Variation in the concentration of the resin solution was found to have effect, as follows:

Solution		Yarn, size concentration in percentage
Size concentration in percentage	Viscosity at 78° F. in seconds	
4.6	40	2.2
5.5	50	3.4

In another test run a forty denier nylon yarn was passed in straight-away course through the capillary column as described, from a bobbin to a reel. The liquid was oil, and in such manner an oil content of 20% by weight was added to the yarn.

In like procedure rayon threads were successfully and satisfactorily treated with an emulsion of what the industry terms soluble oil, with a wax-like water-soluble yarn conditioner and a wetting agent, and with tint dissolved in distilled water.

The exact dimensions of the capillary space required for the application of a given liquid depend upon the physical properties of the liquid; and in this connection the surface tension, the density, the viscosity, and the ability of the liquid to wet the material that bounds the capillary space, are the controlling considerations.

Control of the quantity of material added to the yarn may be effected in various ways. In some cases the viscosity of the liquid may be adjusted to give the desired rate of flow to the path in which the yarn advances; in others, the concentration of the solution or suspension will be adjusted. The dimensions of the capillary space and the distance at which the path of the yarn is spaced above the surface of the liquid in the pool may be varied, to change the quantity of material taken up by the yarn. In the application of sizing material to nylon yarn it has been found desirable to make these dimensions such that an amount of solution is supplied greater than that which the advancing yarn is capable of absorbing. The viscosity of the solution and the size of the yarn and the speed at which it advances then determine the quantity of the solution that will be taken up. In effect the procedure last particularly specified is one of immersion; and comparative tests with a procedure in which the yarn was actually immersed in the pool of the solution gave the same result, so far as concerned the quantity of sizing material actually added to the yarn.

The invention is particularly well adapted for use with fine yarns (of which nylon yarns are exemplary), and may be used to advantage when the yarn is advancing at relatively low speed.

The surfaces that define the capillary space may extend in parallelism or they may diverge or converge at small angles. The material may be of steel, as has been said, or of other suitable

substance, whether metal, or glass, ceramic material, or plastic. It should obviously be such as not to be corroded or otherwise attacked by the liquid employed. Metal is ordinarily to be preferred, because of its durability and the ease of fabrication. For aqueous solutions or dispersions unpolished metal surfaces are desirable because of the fact that they are the more easily and uniformly wetted. The metal surfaces may be plate, to afford resistance to corrosion and wear, as, for example, with chromium.

When small amounts of liquid are to be applied the capillary element may be formed by bending cylindrical wire, as is illustrated in Fig. V. In this case the capillary-defining furcations 4 of the wire are shown to spread slightly from the medial bend upward. Employing a capillary element such as that illustrated in Fig. V in which the upper ends were spaced 0.008 of an inch apart, a thread of forty denier nylon was passed from bobbin to reel through the capillary column of liquid, and in such manner oil was added to the yarn in an amount of 4.5% by weight.

In the oiling of yarn which is being run upon a cone or bobbin at a speed that varies as the diameter of the accumulated wrapping increases, the increase in speed may be compensated for by raising or lowering the container for the liquid and the capillary element with it, so that the oil in smaller or larger quantity is supplied to the yarn; and in this case an element whose capillary defining surfaces diverge upwardly will be found to be peculiarly advantageous.

The capillary element may, as has been said, be made of glass. In a particular instance the element was made of two plates of glass three inches long and 0.25 of an inch wide, sealed together at one end, and at the opposite end spaced apart at an interval of 0.02 of an inch. Test runs with this element gave results of like kind with those afforded by the use of an element of steel, and already described.

In Fig. VI of the drawing a capillary element formed of glass plates such as those last specified is shown, and in this case the capillary space is by the convergence of the plates made upwardly tapering. In some cases it is desirable that the advancing thread shall take up all of the liquid supplied to it, and to make provision that the liquid shall rise to the path of the thread with the same rapidity that the thread takes up the liquid. This condition is particularly illustrated in Fig. VI, where it will be seen that the capillary column 1 of the liquid rises to, but does not rise above the strand T of thread advancing in its course.

Explanation has been given, that the quantity of liquid supplied to the advancing filament may be varied by varying the space interval between the general level of the liquid within its container and the path in which the filament advances. Alternatively, the capillary element may be so refined in structure as to afford like effect. An element so refined is illustrated in Fig. VII. The substantially parallel furcations of the element, that form between their surfaces the capillary space, may by means of a thumb-screw 9 be rendered minutely adjustable in their spacing; and, manifestly, as the space is widened and narrowed, the height of the capillary column is lowered and raised.

In every case it will be seen that a capillary column of liquid is raised above the surface of a supplying pool; that this column is accessible to a filament advancing in a straightaway course

transverse to the vertical (though not, of course, necessarily horizontal course); and that, while the advancing filament takes up and carries away liquid with which it so makes contact, capillary attraction is effective to replace the liquid so consumed and to maintain the column for continuous operation.

I claim as my invention:

1. In apparatus for treating with liquid a filament advancing in straight-away course, an element formed of a length of metal bent medially and doubled upon itself to bifurcated form, with the two furcations facing one another and spaced apart at a narrow interval, the ends of the length of metal being bent to form terminal loops, whereby the element may be supported, with

adaptability to turn on a vertical axis, in partial submergence in a pool of liquid with a column of the liquid rising under capillary attraction above the general level of the pool and between the furcations of the element.

2. The structure of claim 1, one of the furcations of the element being provided with a space-defining projection positioned intermediate said furcations to determine the width of said interval.

3. The structure of claim 1, one of the furcations of the element being provided with a space-defining projection of adjustable effective magnitude positioned intermediate said furcations to determine the width of said interval.

REINHOLD F. STUEWER.