Sept. 15, 1936. C. F. DULKEN 2,054,155

METHOD AND APPARATUS FOR TREATING YARN

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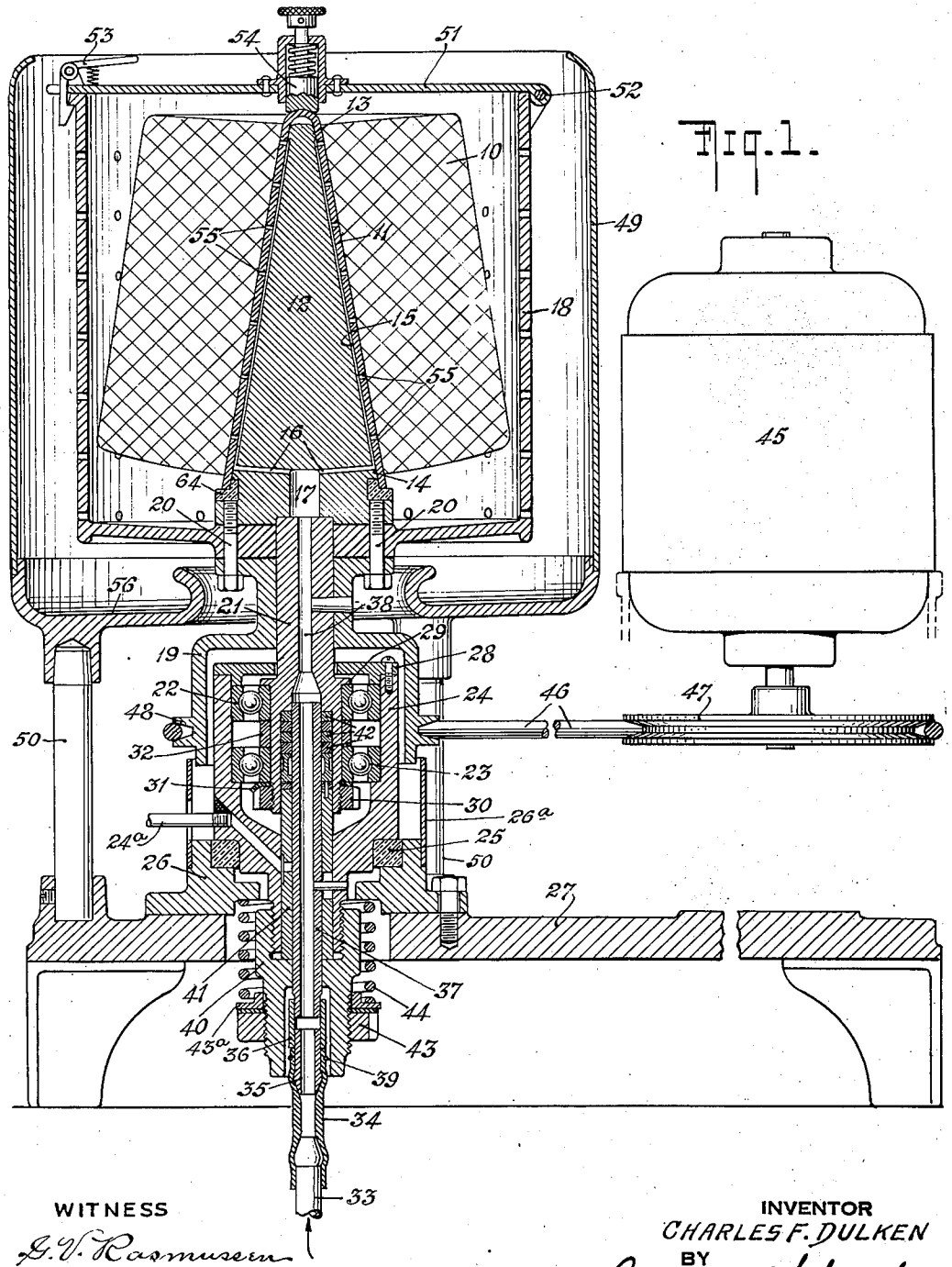
Fig. 1.



WITNESS

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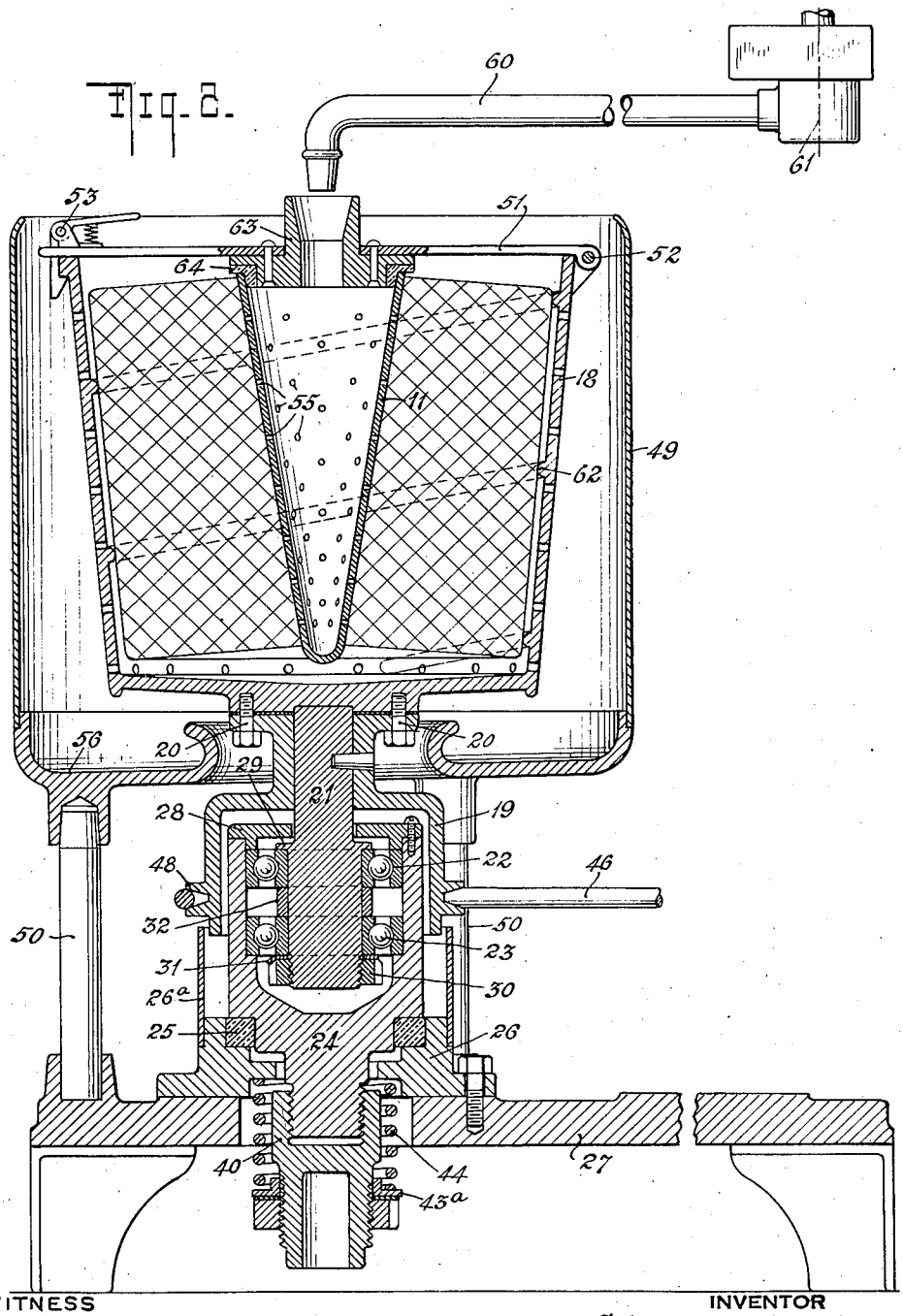
Fig. 2.



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METHOD AND APPARATUS FOR TREATING YARN

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Application November 29, 1933, Serial No. 700,214

7 Claims. (Cl. 28—58)

The present invention relates to the treatment of yarn and has for its object to provide an improved process and apparatus for introducing into and distributing substantially uniformly in a body of yarn wound upon a cone, cylinder, or other form, a quantity of liquid which is less than the amount required completely to saturate such body of yarn.

In the textile industry it is the common practice to treat yarn to impart thereto a more or less predetermined degree of moisture for a variety of purposes. Depending on the nature of the moistening liquid, the object of the treatment may be to protect the yarn against deterioration, as by moistening the same with a preservative liquid or solution, or to improve its qualities for the subsequent operations to which it is to be subjected, or to restore it to its original weight where it has lost moisture during previous operations. In each of these treatments, it is required that a comparatively small amount of liquid, much less than the amount necessary to saturate the yarn, be uniformly distributed throughout the whole body of yarn. The amount of moisture to be contained in the yarn is somewhat above that which the yarn will normally retain when in equilibrium with the atmosphere under normal conditions. Thus in the case of cotton yarn, a body of yarn exposed to the atmosphere will retain about 6% of its weight in moisture, while for the various weaving and other processes which such yarn is to undergo, or for the purpose of conditioning the yarn for storage, it is desirable that it contain moisture to the amount of about 8½%, or slightly more, of its weight. This amount will vary for different types of yarns and for different types of use, being higher, for example, for yarn which is to be employed for making knitted articles.

It is highly desirable, and in most cases, if not all cases, even essential, that the moisture introduced into a given body of yarn be distributed substantially uniformly throughout the body thereof. Such even distribution of a limited amount of moisture in a body of yarn wound to a considerable depth upon a cone, cylinder, or other device has proved to be extremely difficult, and prior to the present invention, results obtained have not been entirely satisfactory.

The problem underlying the present invention is to be distinguished from various known dyeing processes, wherein, indeed, a body of yarn is substantially uniformly moistened with a dyeing liquid. In such processes, however, the yarn is completely saturated with the dyeing liquid and an amount of liquid far in excess of that required for saturation is employed, the liquid being usually circulated back and forth through the yarn to insure the thorough saturation of the latter.

According to the present invention, a predetermined degree of moistness, considerably less than that required for saturation, is imparted to a wound body of yarn under such conditions that local over-moistening or under-moistening is practically avoided and a predetermined, limited quantity of liquid having the necessary penetrating qualities, as determined by the nature of the yarn, the density of the winding, and the size of the yarn package or wound body of yarn, is caused to be distributed quite uniformly throughout the whole body of yarn.

The present invention is an improvement over the process described in my copending application Serial No. 422,273 and my United States Patent No. 1,935,261, dated November 14, 1933, wherein there is introduced into a body of yarn only that quantity of liquid which it is desired to distribute within the yarn. According to the present invention there is employed a quantity of liquid which, while it is considerably less than the amount required to saturate the mass of yarn under treatment, is nevertheless larger than the amount which it is desired that the yarn retain. According to the invention, therefore, this excessive quantity of liquid is introduced into the yarn under such conditions and in such manner that the excess amount is expelled from the yarn to such an extent that the desired quantity remains in the yarn and is uniformly distributed therein.

In the preferred embodiment of the present invention, a measured quantity of liquid insufficient to saturate the yarn, but nevertheless in excess of the amount required to bring the moisture content of the yarn to a desired value, is caused to be distributed uniformly within the body of yarn with the aid of centrifugal force, the body of yarn being rotated at such high speed that the excess amount of liquid is expelled before it is able to seep into the interior of the yarn fibres. Thus a measured amount of liquid is introduced into the interior of, for example, a cone of yarn, either while the body of yarn is being rotated or shortly before the rotation is begun, and the speed of rotation is so controlled that the liquid is forced to travel rapidly through the body of yarn before it has had time to soak into and be retained by the innermost layers of yarn. The speed at which the yarn is to be rotated will depend upon a number of variables, such as the

nature of the yarn itself, the thickness of the yarn package, the density of the winding, the viscosity of the treating liquid, the duration of the rotation, and the number and size of the holes in the cone, etc., and for every type and condition of yarn the optimum speeds can readily be determined empirically. I have found that speeds of from about 2000 to 6000 R. P. M. will suffice for yarn cones of the types generally met in practice. The speed range of 4500–5000 R. P. M. has been found to give the best results in most cases.

The treating liquid is introduced into the interior of the body of yarn either with the aid of pneumatic or hydraulic pressure or by gravity, and is preferably introduced within the hollow, perforated core upon which the yarn is wound.

Suitable apparatus for carrying out the invention is illustrated by way of example on the accompanying drawings, wherein Fig. 1 represents a vertical section through a centrifugal apparatus in which the liquid is introduced into the interior of the body of yarn under pressure; while Fig. 2 shows a similar apparatus wherein the liquid is poured by gravity into the interior of the body of yarn.

Referring to Fig. 1, the numeral 10 represents a body or mass of yarn wound upon a cone 11 which is adapted to be mounted upon a holder 12 arranged to be rotated at high speed, as explained more fully hereinafter. The holder 12 is provided with shoulders 13 and 14 so arranged that a narrow conical space 15 separates the holder from the cone 11 when the latter is in position upon the holder. The space 15 communicates with a series of passages 16 leading from a central bore 17 in the holder. The holder is located within a perforated basket 18 which is clamped to a rotating sleeve 19 by means of bolts 20 which simultaneously fix the holder 12 to the basket.

The sleeve 19 is keyed to a vertical shaft 21 which is supported through the medium of antifriction bearings 22 and 23 upon a support 24 which is seated upon a rubber ring 25 resting upon a ring 26 fixed to the frame 27 of the machine. A cover plate 28 serves to protect the bearings against foreign matter. The inner bearing raceways are clamped between a shoulder 29 on the shaft 21 and a lock nut 30, with which cooperates the lock washer 31, a spacer ring 32 being interposed between the two bearings.

The treating liquid is introduced into the interior of the body of yarn by means of a fitting 33 which is connected through a flexible hose 34 with a nozzle 35 extending from a sleeve 36. From the sleeve 36 there leads a tube 37 which communicates through a central passage 38 in the shaft 21 with the bore 17. The rubber connection 34 may be securely clamped upon the nozzle 35 by means of a wire ring 39. The support 24 terminates at its lower end in a threaded reduced section which receives a nut 40, the latter engaging a sleeve 41 serving to compress a series of packing elements 42 which prevent leakage of fluid from within the tube 37 to the space about the shaft 21 and within the bearings. The lower end of the nut 40 is threaded to receive a nut 43 which supports a ring 43a serving as an abutment for a compression spring 44 surrounding the nut 40 and engaging the under side of the ring 26. This spring operates to exert a downward pull upon the support 24 and tends to hold such support securely upon its seat 25, and thus aids in steadying the whole structure. The purpose of the resilient mounting 25 for the support 24 is to permit limited lateral movement of the support without strain upon the various parts.

The tube 37 is keyed to the support 24 to prevent rotation of such tube; while a pipe 24a may be provided to supply lubricant to the packing rings 42. A shield 26a may be arranged to protect the mechanism against foreign matter.

The sleeve 19 and hence the shaft 21 are driven by an electric motor 45 by means of a belt or cable 46 passing around a pulley 47 upon the motor shaft and about a pulley 48 integral with the sleeve 19. It will be understood that any suitable regulating device may be associated with the motor for controlling the speed thereof.

The rotatable basket 18 is arranged within a fixed housing 49 which is supported from the frame 27 of the machine by three or more posts 50. The basket is provided with a holding plate 51 hinged at 52 to the cylindrical body thereof and equipped with a latch device 53 for locking the same in its operative position. The plate may be provided with a spring pressed plunger 54 which yieldingly engages the upper rounded end of the cone 11 and serves to center and steady the cone. The latter may be provided with a number of substantially radial ports 55 leading from the space 15 into the body of yarn. The number, size and distribution of the ports 55 will depend upon various factors, such as the type of yarn, the pressure at which the liquid is supplied, etc., and can best be determined experimentally for any given set of conditions. The housing 49 is provided with a trough 56 for collecting the excess treating liquid, such excess liquid being drawn off in any suitable manner. It will be understood that the perforations in the basket 18 permit the escape of liquid expelled under centrifugal force from the body of yarn 10. To prevent leakage of liquid from within the cone, a resilient packing ring 64 may be arranged to be engaged by the lower edge of the cone.

The apparatus just described operates as follows: Upon starting the motor 45, the sleeve 19 and with it the shaft 21, basket 18, holder 12, and yarn body 10, are set into rapid rotation. Either during this rotation, or shortly before the motor is started, a measured quantity of liquid under pressure, in excess of the amount which is to be retained by the yarn, is introduced through the pipe 33, the liquid travelling through connection 34, nozzle 35, tube 37, shaft 21, and bore 17, into the radial passages 16, from which it is forced upwardly into the space 15, and thence through ports 55 in a plurality of streams into the body of yarn 10. The speed of the motor 45 is so determined with relation to the rapidity with which the yarn will take up and absorb the moisture that the excess quantity of liquid is expelled by centrifugal force through the outer layer of yarn and collected in the trough 56 before enough time has elapsed for the yarn to absorb more than the predetermined amount of moisture. The treating liquid is thus driven at high speed in a large number of streams through the body of yarn and by virtue also of the penetrating and diffusing qualities of the treating liquid, substantially all parts of the mass of yarn are contacted by such liquid, so that all the layers of the yarn are subjected to substantially the same moisture absorbing conditions for substantially the same period of time. As a result, all parts of the mass absorb practically the same unit amounts of moisture, and by the time that the predetermined excess of liquid is expelled from the cone of yarn, the remainder has become uniformly distributed

through the yarn. It will be understood that the time of treatment for any particular cone or other package of yarn must be determined empirically to insure the expulsion of the correct excess of liquid by the time that the motor is stopped.

A number of the above described treating units can be arranged along an arc of a circle and attended to by a single operative who replaces a treated cone while one or more other cones are being rotated and moistened with the liquid.

In the embodiment of the invention illustrated in Fig. 2, the cone is inverted in order to receive a measured, excess quantity of liquid by gravity through a spout 60 which is rotatable on a vertical axis 61 and receives the liquid from any suitable measuring device (not shown). The cone of yarn is supported directly within the basket 18, a spiral rib 62 being provided to space the yarn from the basket and permit escape of liquid radially of the basket. Any other suitable spacing means may be provided, such as inwardly projecting pins or lugs, and such spacing means may also be provided on cylindrical baskets designed to receive cylindrical yarn packages. As in the construction shown in Fig. 1, the basket 18 is clamped to a sleeve 19 which is provided with a grooved pulley 48 through which it is driven by a belt or cable 46 in the manner shown more fully in Fig. 1. The sleeve 19 is fixed to a shaft 21 which in the present instance may be solid and is supported, as in Fig. 1, upon a support 24 through the medium of anti-friction bearings 22, 23. The support 24, however, is solid at its lower end and receives the nut 40 about which is coiled the spring 44 which serves to pull the support 24 toward its rubber seat 25. The other parts of the driving and supporting structure shown in Fig. 2 are similar to the corresponding parts shown in Fig. 1.

The plate 51 of the basket 18 in Fig. 2 may be provided with a fitting or plug 63 which upon the interior thereof is designed to fit within the base of the cone 11 and is provided with a lining 64 of yielding material, such as rubber, which engages the edge of the cone and forms a water-tight seal therewith. The inner portion of the fitting 63 serves as a stop for liquid tending to rise along the inner wall of the cone during the rotation of the same and forces such liquid back into the cone. The operation of the mechanism shown in Fig. 2 is similar to that shown in Fig. 1, except that the liquid is introduced into the interior of the cone by gravity instead of under pneumatic or hydraulic pressure. As already indicated, the liquid may be introduced shortly before the rotation of the cone of yarn has begun or during the rotation of the cone.

I claim:

1. The method of moistening the whole of a body of yarn substantially uniformly with an amount of liquid insufficient to saturate the yarn, which comprises forcing throughout substantially the whole extent of the body of yarn a measured amount of liquid which is less than that required to saturate the body of yarn but is in excess of the amount to be retained by the yarn, from the interior of the body of yarn outwardly while rotating the latter about its axis at a speed greater than that at which the yarn can absorb all of the liquid until the excess of liquid has been forced out of the body of yarn and there remains distributed in the yarn an amount of liquid which is less than the maximum amount which can be retained by the yarn at such speed of rotation.

2. The method of moistening the whole of a body of yarn substantially uniformly with an amount of liquid insufficient to saturate the yarn, which comprises distributing substantially uniformly along the length of a body of yarn an amount of liquid which is less than that required to saturate the yarn but is in excess of the amount to be retained by the yarn throughout the whole body of yarn, and forcing the liquid through the yarn at such speed that the liquid cannot be entirely absorbed by the layers of yarn initially contacted by it, and for so long a time interval that the excess amount of liquid is forced through and out of the body of yarn before it can be absorbed by the yarn and there remains distributed in the yarn an amount of liquid which is less than the maximum amount which can be retained by the yarn at such speed of rotation.

3. The method of distributing substantially uniformly within the whole of a body of yarn a quantity of liquid insufficient to saturate the yarn, which comprises introducing within the interior of the body of yarn an amount of liquid less than that required to saturate the yarn but greater than the amount to be retained in the yarn and distributing the liquid substantially uniformly along the length of the body of yarn, and rotating the body of yarn at high speed about its axis to cause the liquid to pass through the mass of yarn and reach the outer layers of yarn where it is expelled centrifugally, and continuing the rotation until the excess of liquid over the predetermined amount to be retained is expelled from the yarn, the amount of liquid charged into the body of yarn and the speed of rotation being so related that the amount retained is less than the maximum amount which can be retained by the yarn at such speed of rotation.

4. Apparatus for moistening yarn comprising, in combination, a rotatable support for a body of yarn, means for distributing substantially uniformly along the interior of the body of yarn a quantity of liquid less than the amount required to saturate the whole body of yarn but greater than the predetermined amount to be retained by the yarn, means for rotating said support at such speed that the liquid flows through the body of yarn faster than it can be absorbed by the yarn and is thus expelled in part from the outer layers of yarn, means for collecting the excess of liquid, said support including a tapered basket adapted to receive an inverted cone, and ribs upon the inner wall of said basket for spacing the whole of the cone from the wall of such basket.

5. Apparatus for moistening yarn comprising, in combination, a rotatable support for a body of yarn, means for distributing substantially uniformly along the interior of the body of yarn a quantity of liquid less than the amount required to saturate the whole body of yarn but greater than the predetermined amount to be retained by the yarn, means for rotating said support at such speed that the liquid flows through the body of yarn faster than it can be absorbed by the yarn and is thus expelled in part from the outer layers of yarn, means for collecting the excess of liquid, said support including a basket adapted to receive a yarn package, and spacing elements upon the inner wall of sad backet for separating the whole of the package from the basket wall.

6. Apparatus for moistening yarn comprising, in combination, a rotatable conical basket adapted to receive a perforated cone of yarn with the cone in inverted position, a pivoted retaining member having an apertured plug at the center thereof and movable into position to lock the cone within the basket, the plug then fitting over the

upper edge of the cone, mechanism for delivering into the interior of the body of yarn and through the opening in the plug a quantity of liquid less than the amount required to saturate the whole body of yarn but greater than a predetermined amount to be retained by the body of yarn, and mechanism for rotating the basket at such speed that the liquid is distributed by centrifugal action along the length of the cone and is forced through the body of yarn and the excess thereof is expelled at the exterior surface of the body of yarn.

7. Apparatus for moistening yarn comprising, in combination, a rotatable basket for supporting in inverted position a body of yarn wound upon a perforated cone, the upper wider end of the cone being open, means for delivering into the interior of the cone through its open end a measured quantity of liquid less than the amount required to saturate the whole body of yarn but greater than a predetermined amount to be retained by the yarn, and mechanism for rotating said support, the measured quantity of liquid being distributed by centrifugal force along the periphery of the cone and along the whole length thereof, said rotating means operating at such speed that the liquid is forced through the whole body of yarn at a rate faster than the rate of absorption of the liquid by the yarn so that a predetermined excess is expelled at the exterior surface of the body of yarn while the remainder is substantially uniformly distributed throughout the yarn, the inner surface of the cone being unobstructed and the liquid being thus free to pass along the inclined sides of the cone, and a hinged cover for the basket and a plug fitting within only the upper portion of the cone and attached to the cover, said plug being moved against the upper edge of the cone, when the cover is closed, to close the cone and prevent upward escape of liquid and being provided with an aperture leading into the interior of the cone and through which the liquid to be distributed is introduced.

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