

July 7, 1942.

L. S. FRYER ET AL

2,288,618

METHOD OF AND APPARATUS FOR DRYING THREAD

Filed June 10, 1940

4 Sheets-Sheet 1

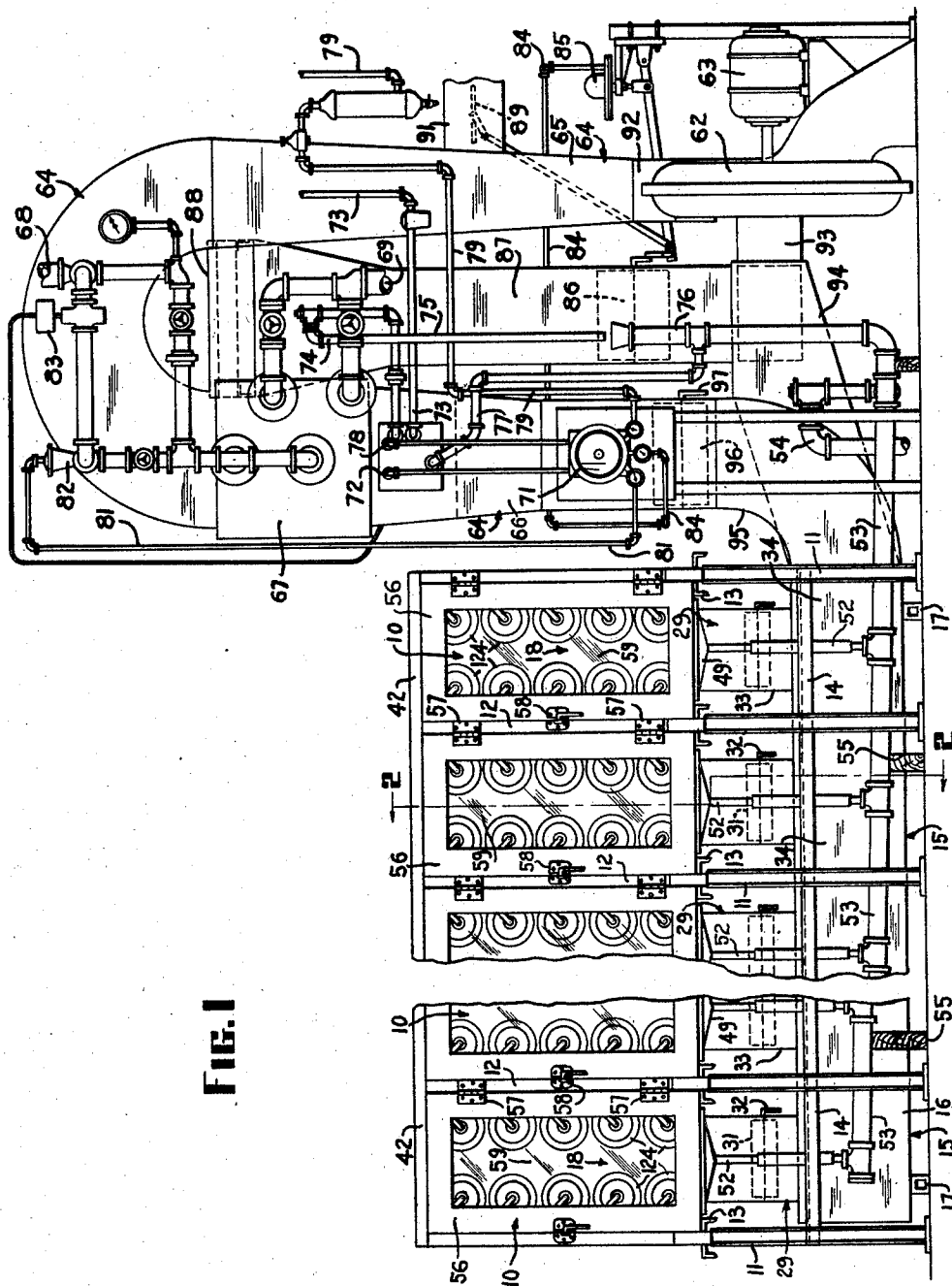


FIG. 1

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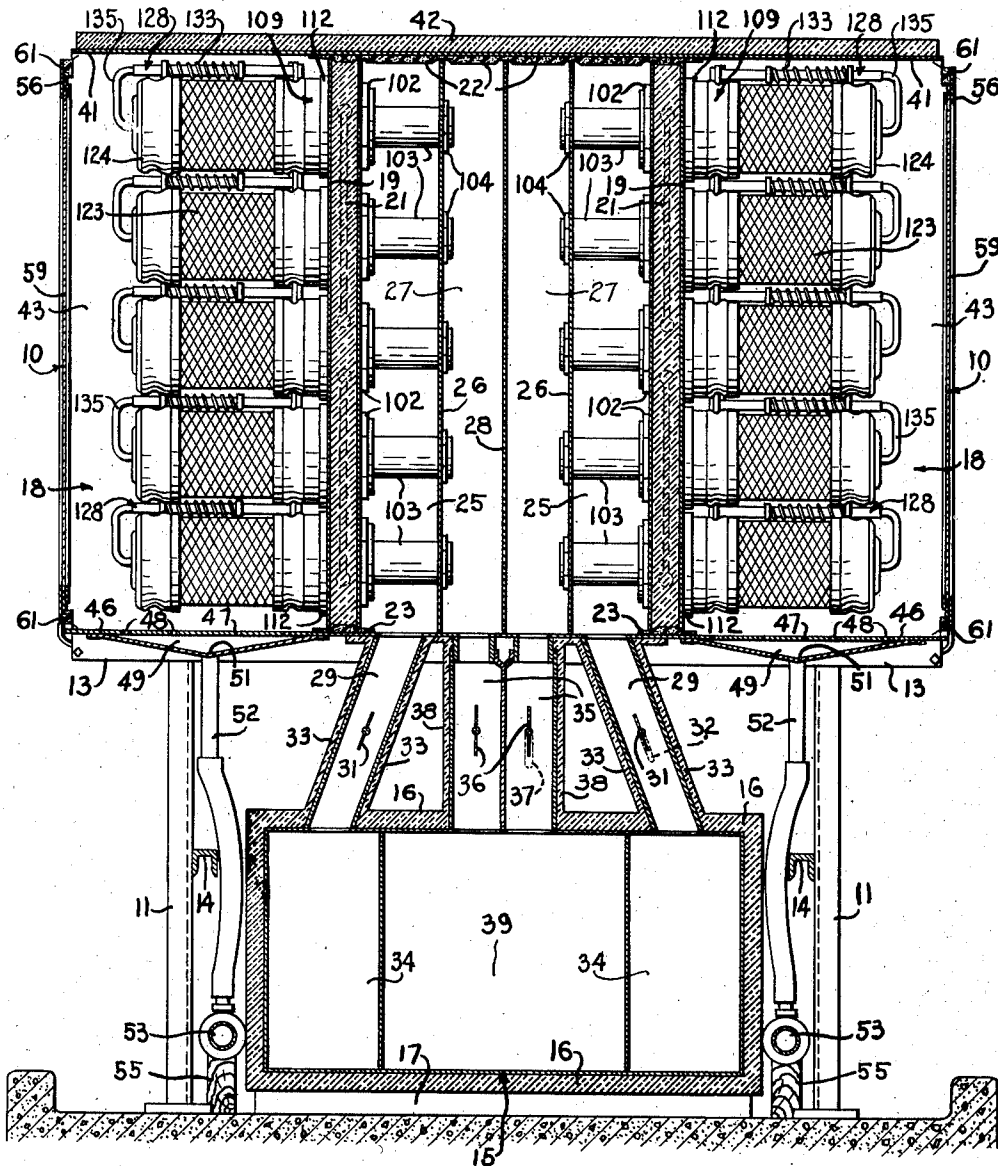
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METHOD OF AND APPARATUS FOR DRYING THREAD

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4 Sheets-Sheet 2

FIG. 2



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4 Sheets-Sheet 3

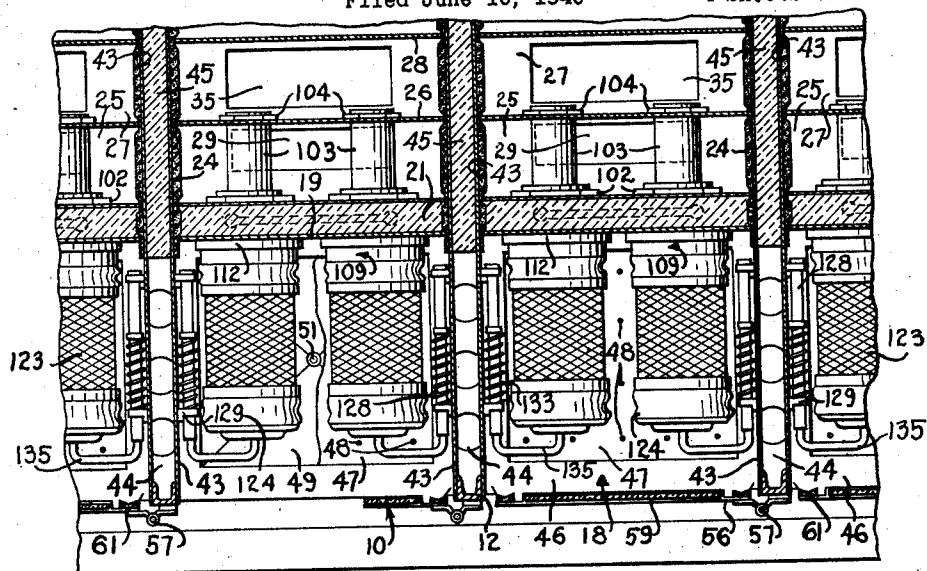


FIG. 4

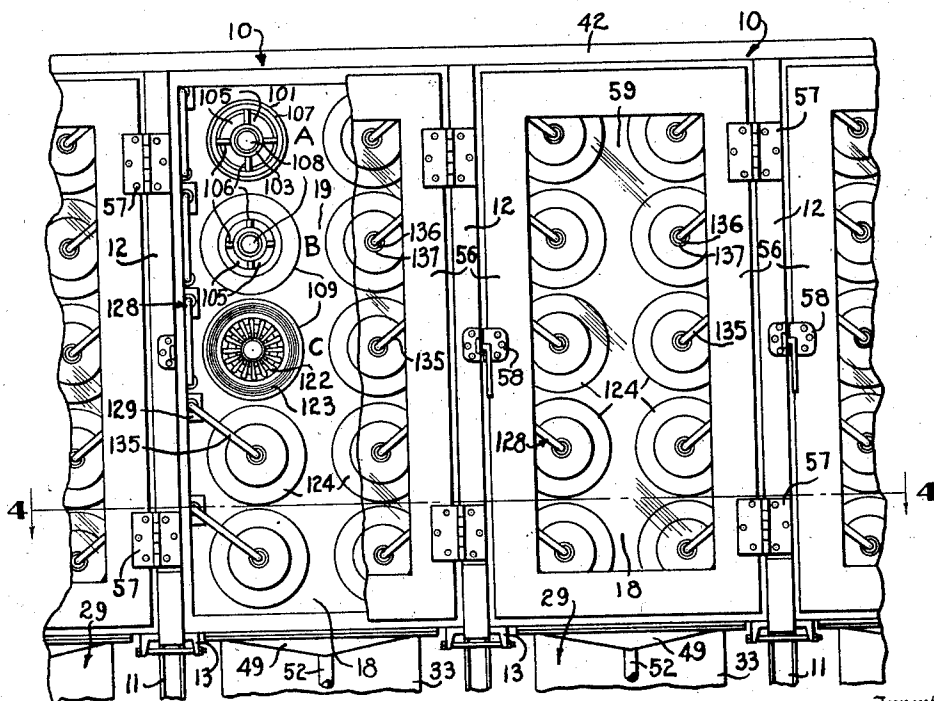


FIG. 3

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4 Sheets-Sheet 4

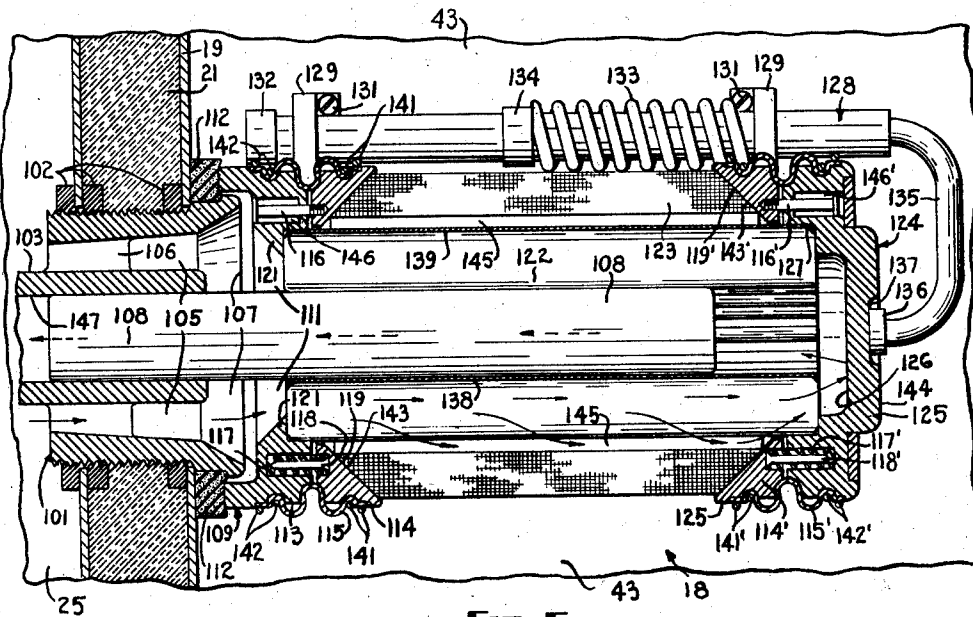


FIG. 5

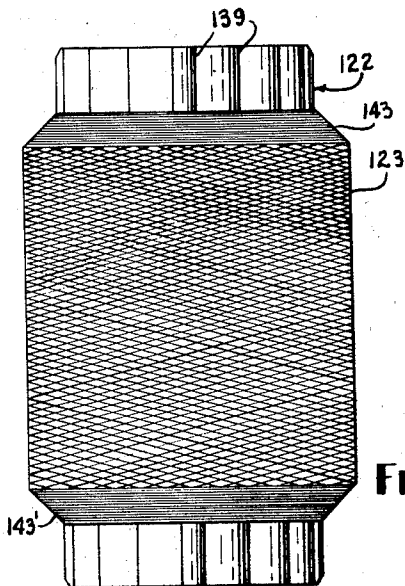


FIG. 6

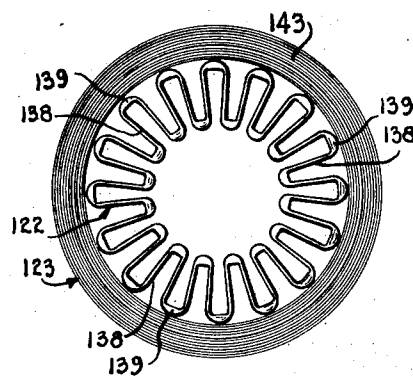


FIG. 7

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2,288,618

METHOD OF AND APPARATUS FOR DRYING
THREAD

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Application June 10, 1940, Serial No. 339,668

9 Claims. (Cl. 34—24)

This invention relates to methods of and means for drying thread or the like in package form. More particularly, the invention is concerned with the drying procedure and apparatus employed in the production of thread-like articles, especially those of synthetic origin such, for example, as single- or multiple-filament threads, tapes, bands, cords and the like, notably those adapted for weaving. Such products will be referred to hereinafter in a generic sense as "thread."

Thread in package form dried according to conventional practice upon a rigid, perforated spool exhibits a very wide variation in its physical and physico-chemical characteristics which renders it less valuable. Perhaps the most troublesome of these factors is the non-uniform shrinkage displayed throughout its length by the finished product. Such thread is unsuitable for employment in the production of woven material: cloth woven from it shrinks so irregularly that it is frequently torn or otherwise damaged when dried in the usual tentering frames in the course of its manufacture.

The usual procedure employed in drying such thread packages involves subjecting the thread to the action of a drying medium simultaneously from the exterior and interior of the thread package. In such operations, the innermost layers of thread attempt to shrink as they are dried but are prevented from so doing by the rigid core upon which they are wound; consequently, they are in effect stretched. The outermost layers, on the other hand, which dry simultaneously with the innermost layers, shrink slightly, but the presence of the wet intermediate layers tends to restrict their freedom, thus introducing a certain amount of tension into them. The intermediate layers, the last to dry, are cushioned upon the previously dried innermost layers and thus shrink without any appreciable restraint.

In an effort to eliminate these difficulties, thread manufacturers have devised numerous processes by which the thread is permitted to shrink more freely in order that subsequent shrinkage may be eliminated.

One of these methods involves drying the thread in the usual way on a rigid spool, twisting the dried thread, unwinding the thread from the twist bobbin, skeining the thread, and drying the thread for a second time in the form of skeins. While this procedure permits substantially free shrinkage of the thread during the second drying operation, the process has other objectionable aspects. For instance, although a somewhat

more satisfactory product is produced, the cost of the additional handling tends to put the product at a disadvantage in a competitive market.

Other processes have been developed among which is a group which have in common the fact that they employ a highly flexible winding spool made from wire or the like. The principle involved is that the spool is compressed as the package shrinks, so that little or no tension is exerted on the thread while it is being dried. In practice, however, the flexible wire core, if flexible enough to permit unrestrained shrinkage of the thread, soon loses its shape and has to be replaced. Also, difficulties are frequently experienced in removing the thread from such wire spools for twisting and coning operations.

The present invention contemplates the use of a highly flexible core possessing the ability to withstand innumerable flexings but adapted to be retracted within the inner surface of the thread package by mechanical means, leaving the package suspended in what may be termed a "floating" position. By virtue of the fact that the responsibility for compressing the spool is removed from the thread, the stress normally imparted to the thread is eliminated. The drying medium is applied exclusively to the interior of the package, thus permitting the layers of thread forming the package to dry and shrink successively from the interior toward the exterior thereof wholly without the introduction of tension into the thread. Thread produced according to the teachings of the invention is uniform from one end thereof to the other, which renders it adaptable to virtually every ordinary use.

In the accompanying drawings, which represent the preferred embodiment of the invention, Figure 1 is an elevation of the drying apparatus and its associated equipment. Figure 2 is a sectional elevation on an enlarged scale as seen from line 2—2 of Figure 1. Figure 3 is an elevation on the same enlarged scale of the upper portion of the apparatus shown in Figure 1. Figure 4 is a sectional plan from line 4—4 of Figure 3. Figure 5 represents a considerably enlarged section, with parts in elevation, of one of the spool mountings. Figure 6 is an elevation of a flexible corrugated spool carrying the thread package. Figure 7 is an end elevation of a spool and package showing the manner of supporting the package on the spool.

As shown in Figures 1, 2 and 3, the preferred embodiment of the invention comprises a plurality of fully enclosed insulated cabinets 10 ar-

ranged in a double row, back to back, extending longitudinally of and at some distance above a multiple unit supply duct 15. Vertically extending frame members 11 spaced longitudinally of horizontal frame members 14 carry spacer members 12 and lateral frame members 13 which support cabinets 10 in the desired relation to supply duct 15. The latter is supported just above floor level by blocks 17.

Each cabinet 10 preferably comprises a spool compartment 18, an intake chamber 25, and an exhaust chamber 27. Spool compartment 18 is separated from intake chamber 25 by a rear panel 19 containing insulating material 21. To prevent leakage of the drying medium into the spool compartment 18, rear panel 19 is completely sealed at the top, bottom and sides thereof by means of sponge rubber gaskets 22, 23 and 24, respectively. Intake chamber 25 is separated from exhaust chamber 27 by division wall 26. Wall 26 serves as a common division between exhaust chamber 27 of one cabinet 10 and the corresponding exhaust chamber on the other side of the apparatus.

Supply duct 15, which serves to direct drying medium to intake chambers 25 and remove the moisture laden drying medium from exhaust chambers 27 of the several cabinets 10 arranged therealong, is divided longitudinally thereof into a central return duct 30 flanked by two inlet ducts 34. An insulation jacket 16 is preferably provided to enclose supply duct 15 for the purpose of preventing the dissipation of heat from the heated drying medium carried by inlet ducts 34.

Each inlet duct 34 is connected with intake chambers 25 on the same side of the apparatus by means of inlet branch ducts 29 each of which is provided with an insulation jacket 33. For the purpose of controlling the flow of drying medium entering intake chamber 25, inlet branch duct 29 is provided with a control damper 31 manually adjustable by means of lever 32. It is desirable to regulate the dampers in each of the several inlet branch ducts 29 in such manner that a uniform supply of drying medium is furnished to the intake chamber 25 of each of the several cabinets 10, whence it proceeds as hereinafter explained to the interior of each thread package.

For the return of the drying medium, exhaust branch ducts 35 connect exhaust chambers 27 with the central return duct 30. As in the case of the inlet branch ducts 29, exhaust branch ducts 35 are provided with control dampers 36 manually adjustable by means of levers 37. The exterior of each exhaust branch duct 35 is surrounded by insulating material 38.

Transversely of the apparatus, each pair of cabinets 10 is provided with a common top 41 and floor 46, top 41 being preferably covered with a suitable insulating material 42. As shown in Figure 4, side walls 43 secured to spacer members 12 enclose each pair of cabinets. Separating said side walls is an insulating panel 45 extending over the central portion of the side walls directly above supply duct 15. Between the portions of side walls 43 adjacent spool compartments 18 is an air space 44 permitting circulation of the air between cabinets 10 in order to aid in the dissipation of heat in the interior of each of the spool compartments 18.

Floor 46 of cabinet 10 is provided within each spool compartment 18 with a base plate 47 in which are drilled a number of drain holes 48. Directly below base plate 47 is disposed a gen-

erally funnel-shaped pan 49 provided with a drain outlet 51 connected by means of a drain pipe 52 to a drain conduit 53 mounted on a series of supports 55. Any moisture present in the packages upon the spools when the latter are introduced into spool compartment 18 drips therefrom and is collected in drain conduit 53, which is inclined to facilitate drainage to one end of the machine, at which is located a suitable stand-pipe 54. Stand-pipe 54 is employed for the purpose of trapping a certain portion of the liquid in the system in order to prevent the introduction of air into the interior of spool compartments 18.

Each cabinet 10 is provided with a door 56 supported by hinges 57 from spacer member 12 of the frame of the apparatus through which door access may be had to spool compartment 18 for the introduction and removal of the spools. Door 56 is provided with rubber insulation 61 surrounding its entire outer edge to insure a substantially air-tight closure when locked in place, as by means of latch 58. A transparent window 59 is provided in each of the doors 56 to facilitate inspection of the packages in the course of the drying operation.

To insure best results in the operation of the apparatus, it is desirable that the atmosphere within each spool compartment 18 be maintained as nearly static as possible. The drying medium is introduced into the interior of each thread package in order that drying may proceed from the interior to the exterior thereof. By doing so, variations in shrinkage which result under ordinary conditions when a drying medium is applied simultaneously to the inside and the outside of the package are minimized. In such circumstances, however, accurate control of the drying medium is necessary.

To that end, a constant flow of the drying medium is provided by the use in the apparatus of a blower 62 driven by motor 63. To the exhaust port 62 of blower 62 is connected an inverted U-shaped supply duct 64. Air is passed through the blower to the exhaust port 62, through the upwardly extending leg 65 of supply duct 64, through steam coil heater 67, and thence to the downwardly extending leg 66 of said supply duct. Leg 66 is connected to inlet ducts 34 which supply cabinets 10 with heated air in the manner previously described.

Various types of humidity and temperature control mechanisms may be employed to maintain the drying medium at the desired moisture content and at a uniform temperature during the operation of the device. In the illustrated embodiment of the invention, this is accomplished by means of temperature-humidity control means 71. Control means 71 is provided with both a wet bulb thermometer connection 72 and a dry bulb thermometer connection 73 located at a point just below heater bank 67 in the downwardly extending leg 66 of supply duct 64. A water line 74 and an outlet 77 connected by means of drain pipe 76 to longitudinal conduit 53 provide a constant flow of water to wet bulb thermometer connection 72. Stand-pipe 74 operates to maintain a proper liquid level for the wet bulb thermometer connection 72 with an overflow outlet 75 to the aforementioned drain pipe 76.

A compressed air line 78 supplies control means 71 with compressed air to operate the temperature regulator 82, located in incoming steam line

68, and damper control regulator 85. Temperature regulator 82, which is connected to control means 71 by pipe line 81, controls the flow of the steam entering heater 67 by incoming steam line 68 and leaving by outgoing steam line 69. A temperature control 83 operated by any suitable thermometric means is employed to balance the temperature of the steam against that of the drying medium.

Damper control regulator 85, which serves to operate damper 86 in air supply duct 87 and damper 89 in exhaust duct 91 located in the upwardly extending leg 65 of supply duct 64, is connected to control means 71 by a suitable connection 84. The purpose of this installation is to discharge a portion of the moisture-laden drying medium from the system at regular intervals and to introduce a like quantity of fresh drying medium. The latter is drawn in through opening 88 of duct 87 through a filtering means such, for example, as a spun-glass filter.

Connection 95 serves to direct the drying medium from the downwardly extending leg 66 of supply duct 64 to inlet ducts 34. The entrance to each of the latter is provided with a damper 96 which may be manually operated by lever 97 to control the flow of the drying medium entering said inlet ducts. A similar connection 94 is provided to connect central return duct 39 with the suction port 93 of blower 62, to which incoming air supply duct 87 is likewise connected.

As shown in Figure 5, the rear panel 19 of each spool compartment 18 mounts a plurality of spool mounting bases 101. Each base 101 is secured to said rear panel 19 by suitable nuts 102 threaded thereon. Shank portion 103 of base 101 extends through intake chamber 25 and division wall 26 into exhaust chamber 27 as indicated in Figures 2 and 4, being held in place by a nut 104. Base 101 is provided with a plurality of ports 105 which are separated by an equal number of webs 106 which serve to support shank 103 axially of said base and to communicate with intake chamber 25.

Supported in shank 103 is an exhaust tube 108 which extends outwardly from the center of face 107 of base 101 and assists in locating the thread package upon its insertion in the apparatus. Circumferentially of the face 107 of base 101 is a sponge rubber gasket 112 against which is seated base collar 109 which, together with cap 124, supports the thread package when the spool is placed in the apparatus preparatory to proceeding with the drying operation.

A spool 122 of the type illustrated in Figure 6 is preferably employed. Such spool forms the subject matter of copending application Serial No. 339,666. Spool 122 is characterized by a plurality of longitudinally extending grooves 138 and ridges 139 which insure flexibility and permit it to be compressed radially. Many other convenient forms of flexible spools may, however, be substituted for that above described without in any way departing from the spirit or scope of the invention.

Base collar 109 is applied to one end of spool 122 prior to its mounting on base 101, while cap 124 is mounted on the other end thereof. Base collar 109 comprises floating ring 114 and compression ring 113 provided with a central opening 111 and shoulder 121 in which one end of said spool 122 may be compressed in such manner that its inside diameter will conform substantially to the outside diameter of exhaust tube 108. Floating ring 114 is connected to com-

pression ring 113 by means of flexible tubing 115 held in place by wire clamps 141 and 142 and is so mounted with respect thereto; for example, by means of a plurality of guide pins 116 spaced alternately with an equal number of compression springs 117 disposed about fingers 118, as to be continually forced apart. On one face of floating ring 114 opposite to that adjacent compression ring 113 is formed a tapered portion 119 which contacts a similarly tapered shoulder 143 formed on thread package 123 in the winding operation.

Cap 124 is generally similar in construction to base collar 109 with the exception that its compression ring 125 is provided with a blank outer face 144 and a substantially cup-shaped inner deflecting surface 126. A shoulder 127 in cap 124 operates to compress the other end of spool 122 to a diameter equal to that imposed thereon by the corresponding shoulder 121 of base collar 109. Floating ring 114' of cap 124 is identical in its construction and method of connection with that associated with base collar 109. By virtue of the compression of the spool 122 away from the interior of thread package 123, the package itself is completely supported away from the outer surface of said spool by means of tapered portions 119 and 119' of floating rings 114 and 114' forming part of base collar 109 and cap 124, respectively.

The base collar and cap above described are claimed in copending application Serial No. 339,669.

In view of the flexible mounting of floating rings 114 and 114' with respect to compression rings 113 and 125 of base collar 109 and cap 124, respectively, and by virtue of the force exerted by springs 117 and 117' forming a part of said mounting, contact is constantly maintained between shoulders 143 and 143' of thread package 123 and tapered portions 119 and 119' of said floating rings 114 and 114', respectively. Since floating rings 114 and 114' are capable of movement under the influence of springs 117 and 117' within the limits imposed by guide pins 116 and 116' and holes 146 and 146' in which said pins slide, said rings are permitted to follow the thread package 123 as it shrinks during the drying operation. As a result, package 123 is suspended about spool 122 so as to leave a generally cylindrically shaped air space 145 enveloping said spool and is thus free at all times from restraining forces likely to introduce tension into the thread.

Mounted on the side walls 43 of each spool compartment 18, as by means of brackets 129 and bolts 131, are a number of compression clamping means 128 one of which is illustrated in detail in Figure 5. One such clamping means 128 is provided for each spool mounting and is so disposed with respect thereto that its butt portion 136 is adapted to seat in depression 137 in the blank face 144 of cap 124 to provide support for the spool and package during the drying operation. Handle 135 is provided in order that the operator when inserting a thread package in the apparatus may swing clamping means 128 into place and slide it axially so as to compress spring 133 between collar 134 and the forward bracket 129. End collar 132 serves to limit the extent to which clamping means 128 may be drawn through brackets 129.

In the operation of the device, flexible spools of some sort; for example, spools of the type illustrated in Figures 6 and 7, are transported to

the drying apparatus from the processing apparatus in which they have been subjected to liquid processing treatment. Spool mounting A in Figure 3 exhibiting face 107 of spool mounting base 101 and exhaust tube 108 protruding from shank 103 supported by webs 106 shows the apparatus as it appears at such time; i. e., preparatory to the insertion of spool 122. Reference character B indicates a similar mounting with base collar 109 in place, while C represents a corresponding mounting with the spool and thread package inserted but with cap 124 not yet in place.

It is preferable when placing the spools in the apparatus to insert one end of spool 122 in base collar 109 and to apply cap 124 to the other end before positioning the unit as a whole on the spool mounting base 101 in spool compartment 18. In this fashion, proper positioning of thread package 123 with respect to shoulder portions 119 and 119' of floating rings 114 and 114' of base collar 109 and cap 124, respectively, will be insured. When thus assembled, spool 122 is slipped over the end of exhaust tube 108 so that base collar 109 is seated firmly against rubber gasket 112, after which clamping means 128 can be applied to cap 124.

Spools 122 bearing thread packages 123 are similarly inserted in each of the several positions in spool compartment 18 and when all are in place door 56 is closed and locked by means of latch 58. In every instance package 123 is supported solely by tapered portions 119 and 119' of floating rings 114 and 114' of base collar 109 and cap 124, respectively, so as to form air space 145 as hereinbefore explained. Spool 122, as shown in Figure 5, remains in fixed position, being held by shoulders 121 and 127, but thread package 123 is free to move radially as well as longitudinally.

Drying medium enters the space 145 from intake chamber 25 by passing through ports 145 in spool mounting base 101, through opening 111 in base collar 109 and along grooves 138 of spool 122. Blower 62, by reason of its connection to the system, drives the drying medium into the several intake chambers 25 and simultaneously induces a slight suction in exhaust chambers 27 of the apparatus, thus serving to keep the drying medium in motion. By virtue of the constant circulation of the drying medium, it is caused to pass along the innermost layers of package 123 toward cap 124, the inner deflecting surface 126 of which directs the drying medium as indicated by the arrows toward the exhaust tube 108 which communicates by means of bore 147 of shank 103 with exhaust chamber 27.

Although thread package 123 is normally porous, when it is wet the drying medium fails, due to moisture trapped therein, to penetrate the interstices in the windings. Thus practically none of the drying medium passes through the package so as to cause currents in or to raise the temperature of the atmosphere contained within spool compartment 18 until after the thread packages enclosed therein are substantially completely dried. As a result, the external layers of each package remain moist and the drying operation proceeds layer by layer from the interior toward the exterior of the package.

Upon completion of the drying operation, the spools and thread packages may be removed by releasing clamping means 128 and removing as a unit spool 122 bearing dried package 123, base collar 109 and cap 124. After the removal of the spool and thread package from base collar

109 and cap 124, the equipment is ready for the next series of spools. The thread on the spool may be packaged in any suitable way by unwinding it from the spool onto a twister, a coning machine, skeining device or the like or it may be otherwise handled as desired before packaging.

Numerous modifications may be made in the apparatus of the invention without departing from the spirit thereof, as will readily appear to those skilled in the art. For example, various types of flexible spools may be employed; the spool mountings may be arranged in vertical relation rather than horizontally, as in the illustrated embodiment of the invention; and a greater or lesser number of packages may be housed within a single spool compartment. Many other changes of a similar nature may be made.

It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty reside in the invention.

What is claimed is:

1. The process of drying thread in the form of a package made up of a plurality of layers wound upon a flexible core comprising the steps of compressing the core; supporting the package wholly out of contact with the outer periphery of said core so as to permit unrestrained shrinkage of the thread; sealing the ends of said core and package to prevent the escape of drying medium from the interior thereof; introducing a drying medium between the outer periphery of the core and the innermost layers of the thread package; passing said drying medium axially of the interior of said thread package; directing the spent drying medium around one end of said core; and exhausting said spent drying medium through the inner periphery of said core.

2. The process of drying thread in the form of a package made up of a plurality of layers wound upon a flexible core comprising the steps of compressing the core; supporting the package wholly out of contact with the outer periphery of said core so as to permit unrestrained shrinkage of the thread; sealing the ends of said core and package to prevent the escape of drying medium from the interior thereof; introducing a drying medium from one end of said core between the outer periphery of the core and the innermost layers of the thread package; passing said drying medium axially of the interior of said thread package; directing the spent drying medium around the opposite end of the core from that at which it was introduced; and exhausting said spent drying medium through the inner periphery of said core.

3. The process of drying thread in the form of a package made up of a plurality of layers wound upon a flexible spin spool characterized by a plurality of axially extending corrugations comprising the steps of compressing the spool; supporting the package from the ends thereof wholly independently of said spool so as to permit unrestrained shrinkage of the thread; sealing the ends of said spool and package so as to prevent the escape of drying medium from the interior of the thread package; introducing a drying medium from one end of the spool between the outer periphery of said spool and the innermost layers of the thread package; directing the drying medium axially of the corrugations of the spin spool along the interior of the thread package; and exhausting the spent drying medium by passing it around the end of the spool ap-

site that at which it was introduced and withdrawing it through the inner periphery of the spool.

4. Apparatus for the free shrinkage drying of thread wound in package form upon a flexible core comprising means for supplying a drying medium; distributing means cooperating with said supply means serving to distribute said drying medium to each of a plurality of enclosures arranged along said distributing means, said enclosures individually embracing one or more units each of which accommodates a single thread package and includes means for supporting said thread package wholly out of contact with the outer periphery of the flexible core; means for introducing drying medium from said distributing means between the outer periphery of the flexible core and the innermost layers of the thread package; and means for withdrawing said drying medium through the interior of the flexible core to exhaust means associated with said withdrawing means.

5. Apparatus for the free shrinkage drying of thread wound in package form upon a flexible core comprising means for supplying a heated drying medium; distributing means extending longitudinally of the apparatus serving to distribute said drying medium to each of a plurality of enclosures which are arranged in series lengthwise of said distributing means, said enclosures individually embracing one or more units each of which accommodates a single thread package and includes means for supporting said thread package wholly out of contact with the outer periphery of the flexible core; means for introducing drying medium from said distributing means between the outer periphery of the flexible core and the innermost layers of the thread package; and means for withdrawing said drying medium through the interior of the flexible core to exhaust means associated with said withdrawing means.

6. Apparatus for the free shrinkage drying of thread in package form upon a flexible core comprising means for supporting the thread package wholly out of contact with the surface of said flexible core; means for introducing drying medium between the outer surface of the flexible core and the innermost layers of the thread

package; and means for removing said drying medium without contacting the exterior of said thread package.

7. Apparatus for the free shrinkage drying of thread in package form upon a flexible core comprising means for uniformly compressing the flexible core; means for supporting the thread package from the ends thereof wholly out of contact with the flexible core; means for introducing drying medium between the outer surface of the flexible core and the innermost layers of the thread package; means for directing the drying medium around one end of the flexible core to the interior thereof; and means for removing the drying medium from the interior of the flexible core.

8. Apparatus for the free shrinkage drying of thread in package form upon a flexible core comprising means for uniformly compressing the flexible core and supporting the thread package wholly independently of said core; means disposed at one end of said core for introducing a drying medium into the space between the outer surface of the flexible core and the innermost layers of the thread package; means for directing said drying medium around the opposite end of the core from that at which it is introduced into the interior of said core; and means for removing the drying medium from the interior of the core.

9. Apparatus for the free shrinkage drying of thread wound in package form upon a flexible spin spool having a plurality of axially extending corrugations comprising means for uniformly compressing the spool and supporting the thread package wholly independently of said spool; means for introducing a drying medium at one end of the spool between the outer surface of said spool and the innermost layers of the thread package so as to follow the corrugations longitudinally of the package; means for directing said drying medium around the end of the spool opposite that at which it is introduced into the interior thereof; and means for removing said drying medium from the interior of said spool.

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