May 18, 1926.

1,585,622

J. A. HEANY

YARN AND PROCESS OF MAKING SAME

Original Filed July 27, 1923 3 Sheets-Sheet 1

Fig. 1.

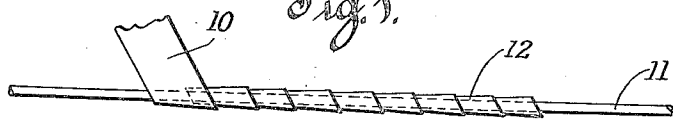


Fig. 2.

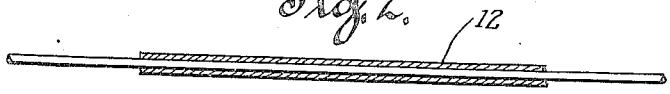


Fig. 3.

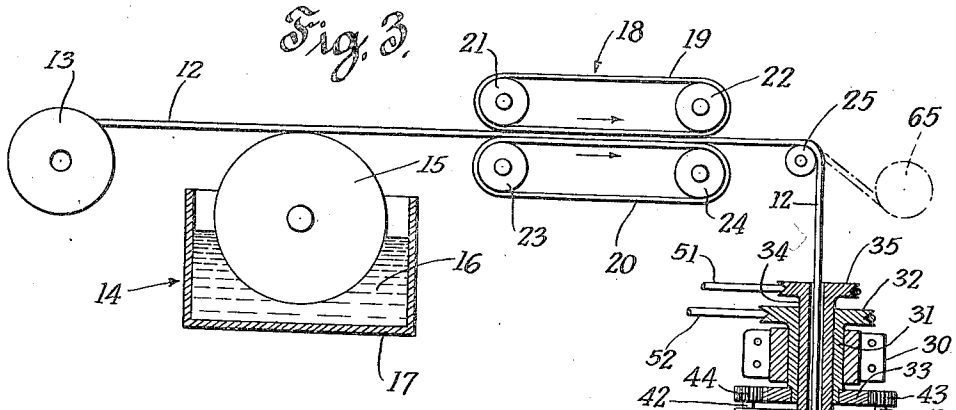
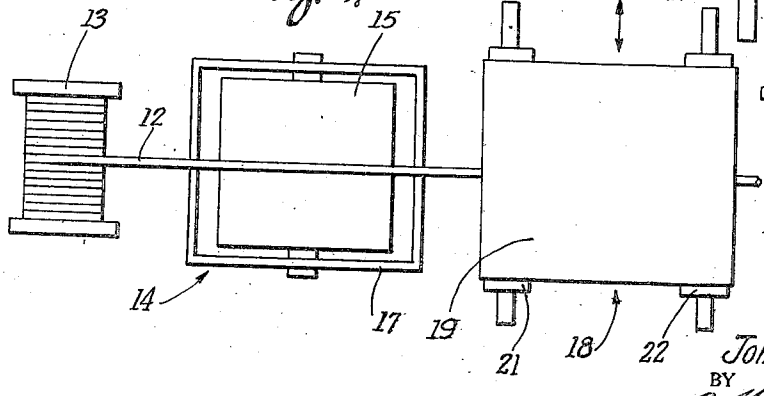


Fig. 4.



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YARN AND PROCESS OF MAKING SAME

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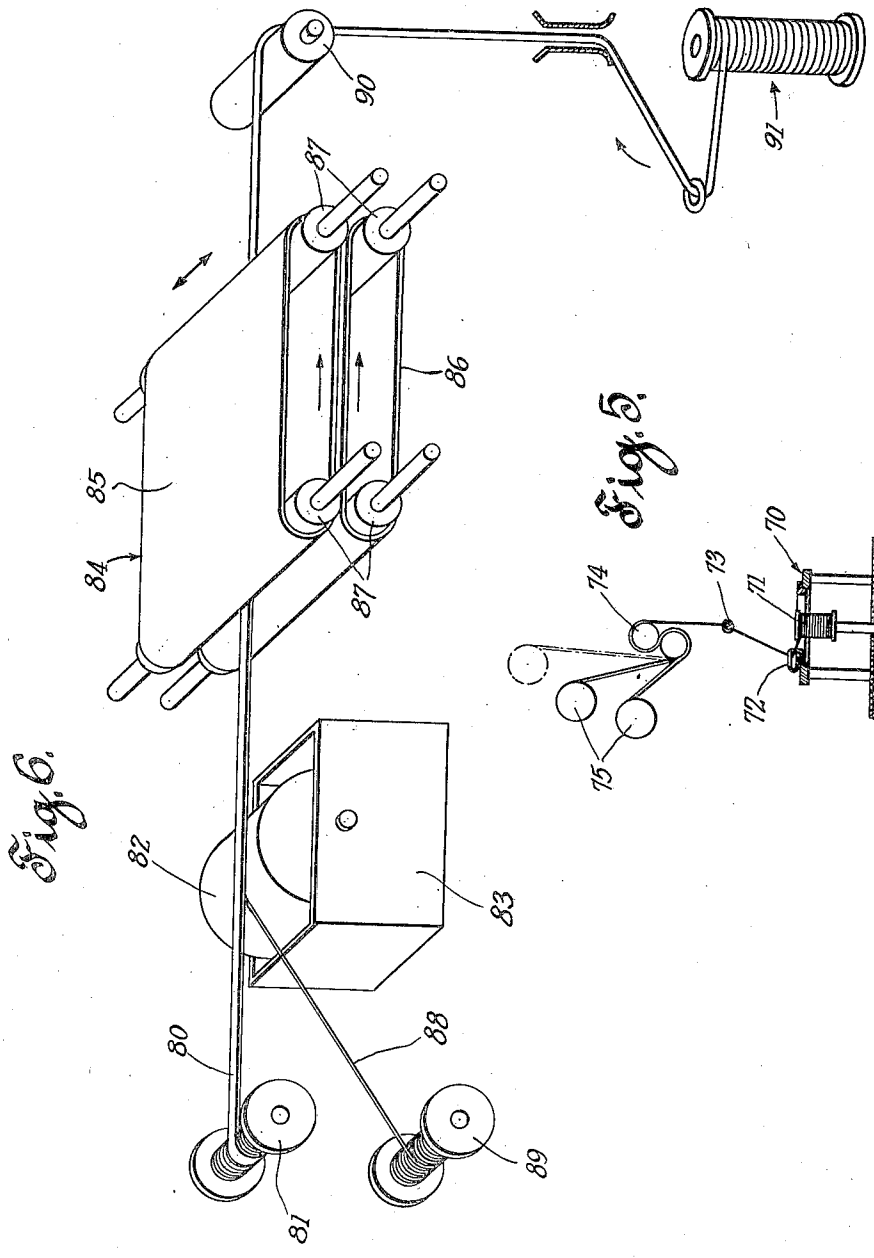


Fig. 6.

Fig. 5.

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YARN AND PROCESS OF MAKING SAME

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Fig. 7.

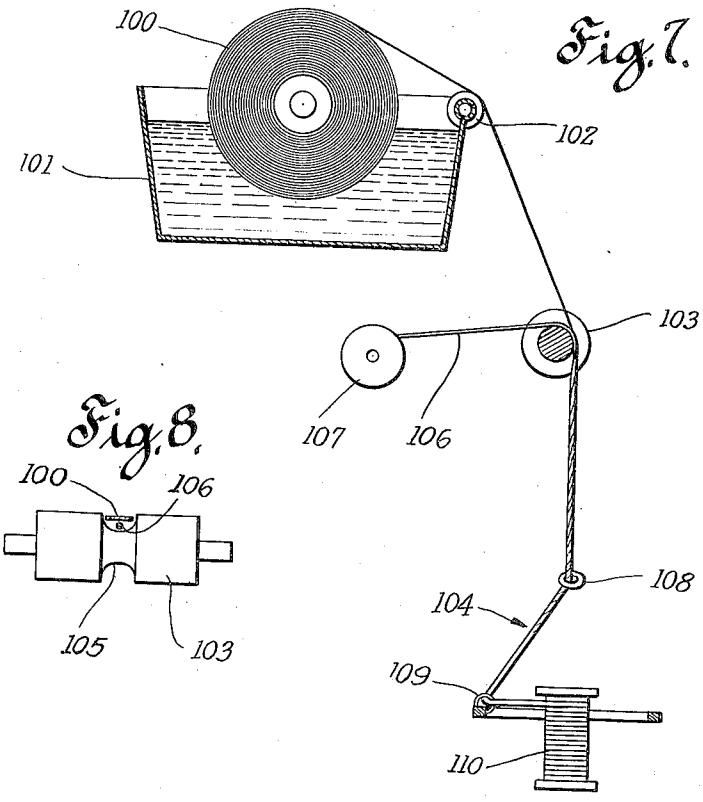


Fig. 11.

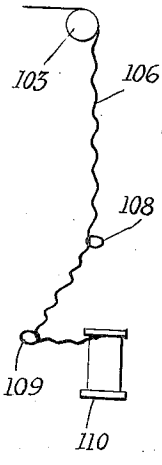


Fig. 8.

Fig. 9.

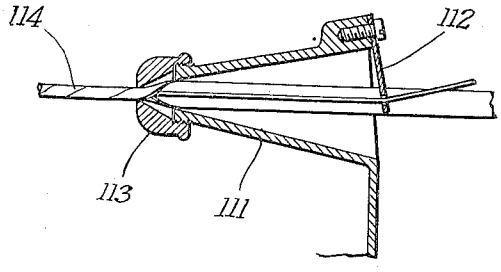
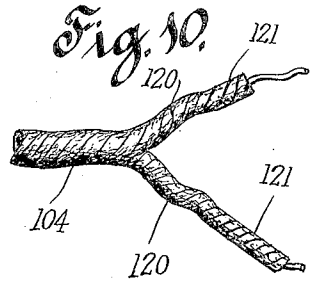


Fig. 10.



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Patented May 18, 1926. 1,585,622

UNITED STATES PATENT OFFICE.

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YARN AND PROCESS OF MAKING SAME.

Application filed July 27, 1923, Serial No. 654,118. Renewed January 28, 1926.

This invention relates to a new process for making yarn having high tensile and coherent properties from base material which is naturally non-coherent, such as asbestos material and the like.

The various methods heretofore attempted in the manufacture of yarns from such material have been along two general lines. On the one hand, the material has been mixed in pulp form with material including a binder or cement, such as starch or albumen, and moulded on a holding core which may be a filament, such as a wire or a thread; or, on the other hand, long-fibred material, such as jute, hemp, or a plurality of continuous threads of cotton or the like have been so mixed and interwoven with the fibrous material that a coherent yarn structure is obtained.

Applicant avoids certain difficulties encountered inherent in the above processes by a method which in general consists in wrapping a suitable core with thin paper strip formed of material, such as asbestos, and binding material including a soluble binder such as starch; compacting the material on the core to a smooth strand, and, where desirable, twisting the strand either on itself or with other strands to form a final yarn in which the material is tenaciously and intimately secured to the core. Preferably, in forming the asbestos material into such a strip or band, use is made of binding material which may include a soluble or substantially soluble binder, such as starch. In modifications of the invention, it is proposed further to limit and simplify the general method indicated by elimiating certain steps and apparatus without modifying the utility and value of the completed yarn.

An object of the invention, therefore, is to provide a yarn with high tensile strength and resistance to frictional wear. Another important object of the invention is to fabricate a superior yarn from a strip of asbestos paper of a given cohesiveness and tenacity, or to make an equal grade of yarn from asbestos paper of an inferior grade. The asbestos paper-like material or the asbestos paper-like strip is, however, bound with sufficient cohesiveness and tenacity for and adapted for yarn manufacture. Another important object is the provision of means for loosely covering a retaining core with asbestos paper material and subsequently intimately associating this material with the core so that a coherent and strong yarn is made possible. Another important object of the invention is the provision of a process which includes relatively loosely placing or positioning asbestos paper-like material while substantially dry on a filament and further uniting said paper-like material and said filament to form a strand of yarn. A further object is the provision of a process of manufacture which will permit the utilization of material initially secured to a reinforcing or supporting core or filament, which may be obtained separately as a completed article and utilized in the manufacture of the final perfected yarn.

An object also contemplated is the provision of a yarn making process whereby asbestos material in the shape of paper strip is wound about a holding core, subsequently moistened to render the strip pliable and soften the material thereof, rubbed in a condensing mechanism to amalgamate and solidify the material and finally twisted to form a final yarn characterized by smoothness of texture, retention of form, coherence of material and tensile strength. A primary object also is to provide means whereby a substantial yarn may be formed of paper wrapped and manipulated about a metal core or filament.

It is an object also to treat the paper strip so as to prevent tearing or undue breakage thereof, specifically by a process of lubrication.

Further objects, and objects relating to a specific mode of manufacture and details of the process will become apparent in connection with the description of the process, hereinbelow indicated and illustrated in the accompanying drawings, in which

Figure 1 shows a primary core or filament wrapped with paper forming a casing therefor;

Figure 2 is a view partly in section showing the casing material secured to the core.

Figure 3 is a diagrammatic showing in elevation of the various principal elements of the apparatus utilized in the process; and

Figure 4 is a plan view of the apparatus shown in Figure 3.

Figure 5 is a view of a plural twister;

Figure 6 shows apparatus used in the yarn making process;

Figure 7 illustrates a method for making

yarn without utilizing a condensing or rubbing step;

Figure 8 is a detail sectional view of a guide roller; and

Figure 9 shows an alternative wrapping means.

Figure 10 is a view of the completed yarn showing the elementary portions thereof; and

Figure 11 is a diagrammatic showing of a twisting operation of the modification of Figure 7.

In accordance with the present invention use is made both of short-fibred or other non-coherent material and also of coherent long-fibred stock, but the same is first bound by material including starch or some similar cohesive substance in the form of a tape or paper strip as described for example in my co-pending application, Serial No. 516,129, filed November 18, 1921. It is possible, however, according to the process of the present invention, to use even such a fibre felt strip as purported to be made by the process of the British patent to Kellner, No. 20,225 of 1891. When such a paper strip is used, this binder is softened, thus securing a resulting yarn similar to that obtained by the process disclosed in said application, Serial No. 516,129 but by steps having notable advantages and improvements under certain conditions of manufacture.

In accordance with the present invention, a central core or filament 11 is completely encased by a paper-like strip or band 10 of asbestos material, preferably by wrapping the strip about the core by any suitable mechanism or by hand. The casing, when formed in this way from comparatively weak paper is weak, easily torn and easily removable, and the strand thus formed would not be suitable for the manufacture of fabrics.

In order to place this article, which will hereinafter be referred to as a primary or elementary yarn 12 in a final substantial form in which the substance does not exist in separate layers, or, loosely wound on the core, the following operations are carried out.

The elementary yarn 12 wound on a removable bobbin 13 is led over a moistening device 14 which consists of a horizontal roller 15 rotatable in a water bath 16 in the vat 17. Thence, the strand is led through a condenser or rubber 18, of well known construction, consisting of two super-imposed belt structures 19 and 20, the belt 19 being revolvable upon rollers 21 and 22 and the belt 20 upon rollers 23 and 24. Not only are these belts freely revolvable about the horizontal axis of the rollers 21, 22, 23 and 24, but they are also transversely movable parallel to the axes of the rollers so that the yarn, in passing through the condenser 18 is subject to a transverse as well as a forward movement in accordance with the well known operation of this type of apparatus resulting in a compacting, condensing manipulation of the material. Emerging from the farther end of the condenser 18, the strand of yarn material is led over a guide roller 25 and thence into a twisting mechanism 60. The twisting mechanism, as illustrated in Figure 3, consists of twisting apparatus and winding mechanism. As shown, within a housing 30, there is positioned a rotatable cylinder 31 having at its top a drive pulley 32 and at its base a gear 33. Within this cylinder is a stub shaft 34, which is rotatable therein and which at its top is fixed on drive pulley 35 and at its base on cross bar 36, adapted to support the specific twisting elements. There is positioned beneath the cross bar 36 a second cross bar 37 through connecting plate 38 and at the ends of the bar 47 are positioned the fliers 39 and 40. The flier 39 is hollow and serves to feed the yarn to the receiving spool. Extending through the ends of cross bar 36 are pinion shafts 41 and 42, carrying pinions 43 and 44, adapted to contact with the driving pinion 33 secured to the base of the cylinder 31. Mounted on the pinion shafts 41 and 42 are also the plural pulley elements or feed rolls 45 and 46, adapted to carry the yarn in the manner hereinafter described.

The spool 47 upon which the yarn is wound is slidably mounted on the center shaft 48, positioned in the axis of the twisting mechanism, a cam operated device (not shown) reciprocating the base plate 49, upon which the spool 47 is mounted, upon the rod 48, this operation being simultaneous with the twisting operation of the twisting mechanism.

In the operation of the twisting mechanism, the yarn 12 is fed through the hollow center of the central shaft 31 to a point below the cross bar 36, then over the guide pulley 50, feed rolls 45 and 46 and thence through the hollow flier element 39 to the spool 47. The power belts 51 and 52, connected respectively to the twist pulley 35 and feed pulley 32, operate the gear elements at different speeds, the speed of the flier or twisting apparatus being sufficiently in excess of the speed of the feeding gear 33, so that a different speed in a single direction is obtained for the feed rolls 45 and 46. In consequence of the rotation imparted to the mechanism as above indicated, the yarn is wound in even layers on the spool 47 as the same is constantly reciprocated by mechanism not illustrated.

Considering now the process as a whole and with the specific apparatus in mind, the following sequential steps are taken in producing the finished yarn of the invention.

Asbestos paper strip formed from pulp of

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asbestos material mixed with a soluble binder and dried is wound, rubbed or otherwise secured to a metallic core or filament by mechanism of common type such as a condenser, a tube twister or a rotary twister. This primary yarn or strand is then fed from a bobbin 13 over the moistening roller 15. The object of moistening the primary strand 12 is twofold. In the process of manufacture, paper strip is mixed with a small proportion of soluble binder, such as starch, albumen, sodium silicate, or the like, and in order to render the fabric pliable, it is desirable that this binder be dissolved to an extent dependent upon the specific requisites of the completed yarn. Then also, through the absorption of water or other liquid, the asbestos fibres become even less coherent than usual through a diminution of the frictional coefficient. The moistening step thus serves to disorganize the fibrous coating on the primary strand and make it readily workable.

After the moistening step, the strand is led into the condenser 18 where it is subjected to a lateral rubbing and working which compacts the material about the core and gives smoothness and uniformity thereto. Then the strand is led into the twister 60 where the core and the casing material are both subjected to a torsional stress, causing a uniform twist in the strand. The completed yarn is then wound on suitable spools subject to various suitable uses.

Note has been hereinabove made to the holding effect secured upon the yarn fibre or material by reason of the twist to which it is subjected as a final operation. If this final step were omitted, the core or filament in the completed yarn would lie in the axis of the yarn as a straight smooth core generally equidistant at all points from the outer yarn surface. The twisting operation, however, transforms the straight core into a coiled, twisted or corrugated element, generally off-set from the core axis, or passing through said axis in angular relation thereto. The effect of this distortion is to enclose and compact the yarn stock between adjacent co-extending sections of the filament, thus securing, especially in the case of semi-rigid metallic cores, an added binding and retaining agent for the yarn material tending to maintain the rigidity and coherence of the fabric to a marked and important degree. As above intimated, the distortion of the core induced by the twisting operation may be in the form of a regular progressing coil or in a series of undulations lying in a single plane. The shape of the core distortion is, however, secondary to the main effect of imparting to the yarn core a non-coaxial relationship relative to the yarn envelope.

It is important to note also that not only the core but also the casing is subjected to a continuous twist which compacts and wedges the material in position about the core.

In some instances it is desirable to employ a yarn having maximum durability and tensile and surface strength and in order to produce a yarn of this type, the single yarn made in accordance with the process above outlined is twisted, wound or in various ways incorporated with one or more additional yarns utilizing such mechanism for example, as is indicated in Fig. 5. In this figure is shown an ordinary ring twister 70 comprising a power driven spool 71, a rotatable and reciprocatable guide ring 72, a stationary guide ring 73, pressure and guide rollers 74, and spools 75 on which the single yarns 76 is wound. The plural winding mechanism as illustrated may be used in several ways. A yarn may be formed by winding two strands together as they emerge from the coating or rubbing mechanism before receiving an individual twist. In this modified process, the strand in being twisted with one or more similar untwisted strands receives a marked reinforcement and binding effect from the contiguous yarns and in addition the tensile strength is multiplied in so far as the number of strands are increased.

It is, of course, apparent that in the twisting operation the individual strands are subjected to distortion so that aside from the holding and binding effect of coextensive strands the individual strands possess retaining properties for the casing material similar to that described in reference to the single strand yarn.

A modified process involves twisting one or more of the strands and then twisting these strands together into a single yarn of great compactness and durability.

It is of interest to note that the plural strand yarn by reason of the loosening of the binder and the use of non-coherent stock has a flexibility limited only by the properties of the core and even where a metal filament is used, the yarn has a pliability approaching that of coreless yarn which can also be made by apparatus such as disclosed in Fig. 6 of this patent.

A further modification of the process consists in omitting the solvent bath 14 in Fig. 3, whereby the paper strip binder is loosened and modifying the condenser or rubber 18 by increasing its operating surface or reaction speed or pressure so that the binder is broken and removed by purely mechanical means. This rubbing action also serves to form the coat on the core so that at the completion of this operation a pliable compacted strand is produced. The strand thus made is wound over a reel 65 as a final yarn or subjected to a twisting operation as described with ref-

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erence to the preferred form, either as a single twisted strand or as a yarn formed of two or more strands intertwisted.

An important modification of the process is illustrated in Fig. 6 of the drawing. In some instances it has been found desirable from the manufacturing view point to obtain both the paper strip and filament separately as raw material to be assembled and manipulated to produce a final yarn. As a part of the invention, therefore, there is disclosed means for feeding both of these stocks into a single machine simultaneously and operating thereon to cover the filament, loosen the binder of the strip, and condense the strip over the filament, this operation being continuous, where desirable, with the twisting operations previously described.

Referring to Fig. 6, the paper strip 80 is fed from a bobbin 81 over a moistener roll 82, rotatable in a liquid vat 83 and passed into the condenser 84 between rub-belts 85 and 86, movable progressively and laterally on rollers 87, as indicated by the arrows. Simultaneously the core filament 88 is fed from bobbin 89 over moistener roll 82 in juxtaposition with the strip 80 and in the rub belts these two elements are operated upon to produce a closely and completely covered strand. Subsequently, the strand is passed over roller 90 and, if desirable, into the twister 91 to produce a final twisted yarn.

Fig. 7 illustrates a further modified arrangement, whereby the rubbing or condensing mechanism is entirely dispensed with. In this modification the coiled strip 100 is preferably mounted directly in the moistener vat 101, although alternatively the coil may be placed without the vat and the strip passed over a moistener roll as indicated in Fig. 3. The moistened fabric is led out of the vat 101 over guide roller 102 and from roller 103 into the usual twisting mechanism 104. The roller 103 is formed as shown in Fig. 8, with a curved groove 105 on its periphery, the same being adapted to retain and center the filament core 106, fed from bobbin 107, and also to form or condense the moistened strip about the core. Other forms of rollers such as a flat roller over which the tape is guided by a wire loop may also be used.

Intermediate the roller 103 and stationary guide ring 108, the initial twist of the strand takes place, this operation serving to bind the moistened strip about the core and produce striation and stresses in the same. Moreover, the core itself, especially where a metallic non-elastic filament is used, is modified to include a series of projecting undulations or coils between which the casing material is bound and thus the whole structure is consolidated and compacted and the material closely united to the retaining core.

It is evident, of course, that the twist begun between roller 103 and stationary guide ring 108 is continued and amplified between the rings 108 and 109 and reel 110, so that the final yarn is a smoothly and uniformly twisted product. It will be seen that the twisting of the strand and filament is effected along the substantial length thereof, thus tending to make the product more uniform. Fig. 11 shows the wire in the process of being twisted with the strip casing removed therefrom. The yarn may be also intertwisted with one or more twisted or non-twisted strands to form a highly tenacious, flexible and durable yarn.

In carrying out the above process in order to accelerate the action, prevent tearing of the paper strip, and in general lubricate the strip and strand, it has been found highly advantageous to employ such a lubricant as oil soap, the same being dissolved in the moistener tank and forming therein a soapy solution transmissible to the travelling strip. Any other type of lubricant may also be used which may be applied directly to the strip or incorporated with the paper during manufacture.

Fig. 10 illustrates the final yarn as made up of single strands or yarns twisted together,—the single yarns being indicated at 120, the sections 121 showing the wire core and strand after the individual twist, and the sections 104 showing the strand after being twisted with a second strand. The yarn 104 is unwound to show the nature of the section 120.

It is worthy of comment that the condensor unit employed in the process of Fig. 3 and various modifications thereof is subject to considerable modification to produce results desirable for a given type of yarn. For example instead of a single set of rub-belts, where a considerable rub action is desirable, several sets may be used, progressively operating on the raw stock to condense and smooth out the same. Similarly, the belts may be extended materially or the rate or amplitude of lateral displacement may be considerably modified to produce important modifications on the product.

In other instances, however, as exemplified in Fig. 7, the rub belts may be dispensed with and dependence placed wholly on forming run-ways or wrappers combined with twisters. As illustrating a modified former, there is shown in Fig. 9 a conical tube structure 111 through which the strip and core are fed simultaneously the contracting conical terminal 113 of the tube condensing the fabric over the core so that on emergence a covered elementary yarn 114 is obtained. The core is fed over the guide plate 112. Such a yarn may then be rubbed to condense the casing or merely twisted as in the process of Fig. 7 according to the uses to be made of the final product. However,

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such means (as exemplified in Fig. 7) for placing the asbestos paper-like material on a core are not specifically claimed herein, and it should be distinctly understood that such subject matter is expressly reserved to be claimed in a later application.

Attention should be directed to certain important aspects of the process by which valuable results are obtained. While reference has been made to the presence of binding or cementing substances in the paper used, it is not held to be an essential part of the invention that only such be employed, inasmuch as body material in which coherence is maintained merely by frictional coaction of the fibrous or elemental structure may be utilized with marked success.

Moreover, in some instances as already intimated, the material may be naturally entirely non-coherent and to form paper strip with the aid of a binder is the appropriate and necessary step in yarn building process with such material.

In cases, as exemplified, where a paper strip is employed, the process contemplates merely a wetting of the binder and a partial removal or a complete removal of the binding substances. In ordinary processes, the binder is softened only so as to give pliability to the fibrous structure, the binder remaining almost in its entirety in the fabric. On drying, the binder assists in maintaining coherence in the yarn, acts as a filler and tends to prevent undue absorption of atmospheric moisture. The binder serves also to give smoothness to the yarn exterior and functions as a carrier for dyes or other substances. Where a partial solution of the binder occurs the general result is similar to that secured from a non-removal of the cementing agent. In the case where the binder is completely removed, the completed yarn obtains coherence solely from the binding effect of individual fibres and the holding effect of the twisted core as will be hereinafter detailed. Where the yarn is to be subjected to usage in the presence of liquids and in consequence waterproofing operations are desirable, the entire removal of the soluble binder may be a requisite step and hence, such an operation is an appropriate part of the invention.

Certain pulps, such as are formed by chemical processes or which have been subjected to straining processes have little or no fibrous constituents and it is notable that such pulps lend themselves readily to the uses of this invention. With these substances it is desirable that the paper strip binder be loosened by a wet process and retained, at least in part, in the completed yarn. Moreover, the complete twisting operation and the intertwisting with additional strands serves to give added rigidity and coherence to the final yarn.

It is a notable feature of the invention, moreover, that manufacture of yarn in accordance with the process does not necessitate expensive carding machinery or even pulp or paper apparatus. The manufacturer may, on the contrary, have the paper made by a paper maker and then manufacture yarn with no other equipment than a moistener, condenser and twister. Moreover, in accordance with this process, the finished yarn may contain only the yarn stock and the core. In the case of asbestos yarn adapted for use in brake lining, fireproof curtains, steam pipe casings and insulations for electric wire circuits, this feature is of highest importance, since the completed yarn would contain only pure asbestos fibre secured to a metal filament with such combustible material, as long cotton fibres now commonly used, entirely eliminated.

The use of a metal filament in the yarns as above described while not requisite in all cases is very desirable where a twist is imparted to the final product inasmuch as the metal maintains the set produced by the twisting stress and thus assists in holding the case material thereto. Preferably a non-resilient, non-fragile and plastic material core as copper is used in preference to a resilient core which requires increased stresses to surpass the elastic limit.

It should be understood that as a result of the first step of wrapping the asbestos paper strip around a core, use may be made of asbestos paper of less cohesiveness and tenacity than is required by methods heretofore in use, to withstand subsequent operations such as condensing and twisting. Or stated in another way, applicant is enabled to make an equal grade of yarn with an inferior grade of asbestos paper. This is possible because the paper-like asbestos material is initially wrapped around its core in a substantially dry condition, with the result that there is more uniformity, in fact, exact uniformity of distribution of the paper-like material upon the core. In so wrapping the paper the strength and quality of the paper utilized need not be so great, and the extreme care in binding the asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations need not be resorted to. It may also be pointed out that by the initial wrapping of the paper strip about its core, it has been found that the strip itself is subjected to less strains in the strand and yarn operations of the process. That a very strong, smooth, even, uniform and durable asbestos yarn is produced cannot be gainsaid.

It should be understood that the term "asbestos material", wherever it appears in the specification and claims, is intended to refer

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to material having a substantial percentage of asbestos fibres, such as to give more or less the characteristics of asbestos as far as working and handling are concerned, and the term "asbestos material" where used in the specification and claims shall be considered as thus defined.

Various other advantages and uses and results leading from the specific process disclosed, and modifications based thereupon, will be evident to those skilled in the art, and, therefore, it is intended that the invention be covered broadly as well as specifically within the scope of the claims hereto appended.

It should be understood that although there has been described herein the combination of a reinforced strand with a binding filament by means of the apparatus shown in Fig. 5, that such subject matter is not claimed herein but is claimed in my co-pending application, Serial No. 685,300, filed January 10th, 1924, and that claims to the yarn formed in that manner are included in my co-pending application, said Serial No. 685,300 and my co-pending application Serial No. 287,218, filed January 19th, 1924. It should also be understood that a yarn formed by twisting together two or more strands, such as shown in Fig. 1, is claimed in my co-pending application, Serial No. 654,511, filed July 30th, 1923.

What I claim and desire to secure by Letters Patent is:

1. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises the steps of binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand forming operations, wrapping said strip or band while substantially dry around a core, and of further uniting said strip or band and said core to form a strand.

2. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band while substantially dry around a core, further uniting said strip or band and core to form a strand, and thereafter twisting the strand to form a yarn.

3. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, positioning said strip or band around a core, softening said strip or band after being positioned on the core, further uniting said softened strip or band and said core to form a strand, and thereafter twisting the strand to form a yarn.

4. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band while substantially dry around a core, and further uniting the strip or band and the core in twisted arrangement to form a yarn.

5. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material united with workable binding material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band about a core, moistening said strip or band after being wrapped on the core, and further uniting the moistened strip or band and the core in twisted arrangement to form a yarn.

6. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into thin uniform paper-like strips or bands of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping each of said strips or bands while substantially dry about a core, further uniting each of said strips or bands with its core to form strands or yarns, and thereafter twisting a plurality of strands or yarns together to form a final yarn.

7. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band around a core, moistening said strip or band after being wrapped on the core, further uniting said moistened strip or band with said core to form a moistened strand, and thereafter twisting the strand while in moistened condition to form a yarn.

8. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into thin uniform paper-like strips or bands of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping each of said strips or bands around a core, moistening said strips or bands on said cores after being wrapped, further uniting each of said moistened strips or bands with

its core to form moistened strands, and thereafter twisting a plurality of moistened strands together to form a yarn.

9. A process of making asbestos yarn, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band around a core, advancing said strip or band and said core, moistening the strip or band as it advances with its core, and thereafter further uniting the moist-advancing strip or band with its core into a twisted yarn.

10. A process of making asbestos yarn, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band around a core, advancing said strip or band and said core, moistening the strip or band as it advances with its core, further uniting the moist advancing strip or band with its core into a strand, and thereafter twisting said strand in a yarn.

11. In a method of making asbestos yarn for the manufacture of fabrics and other purposes, the steps which comprise binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand forming operations, wrapping said strip or band around a core, advancing the strip or band and core, moistening said strip or band as it advances with its core, and thereafter further uniting said moistened strip or band with its core to form a strand.

12. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises the steps of binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand forming operations, wrapping said strip or band while substantially dry around a core, and of condensing said strip or band on its core to form a strand.

13. In a method of making asbestos yarn for the manufacture of fabrics and other purposes, the steps which comprise binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band while substantially dry around a core, condensing said strip or band on said core to form a strand, and thereafter twisting the strand to form a yarn.

14. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band around a core, softening said strip or band after being wrapped on its core, and further uniting the moistened strip or band to its core by condensing and twisting to form a yarn.

15. A process of making asbestos yarn, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band about a core, advancing said strip or band and said core, moistening said strip or band as it advances with its core, and further uniting the strip or band to its core by condensing and twisting to form a yarn.

16. A process of making asbestos yarn, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band around a core, advancing said strip or band and said core, moistening the strip or band as it advances with its core, condensing the strip or band on the core to form a rounded strand, and twisting the rounded strand to form a yarn.

17. In a method of making asbestos yarn for the manufacture of fabrics and other purposes, the steps which comprise binding and forming asbestos material into a thin paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand forming operations, wrapping said strip or band around a core, advancing said strip or band and said core, moistening said strip or band as it advances with its core, and thereafter condensing said strip or band on its core to form a strand.

18. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises the steps of binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand forming operations, wrapping said strip or band while substantially dry around a core with successive convolutions overlapping, and of further uniting said strip or band and said core to form a strand.

19. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming opera-

tions, wrapping said strip or band while substantially dry around a core with successive convolutions overlapping, further uniting said strip or band and core to form a strand, and thereafter twisting the strand to form a yarn.

20. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band around a core with successive convolutions overlapping, softening said strip or band after being wrapped on the core, further uniting said softened strip or band and said core to form a strand, and thereafter twisting the strand to form a yarn.

21. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band while substantially dry around a core with successive convolutions overlapping, and further uniting the strip or band and the core in twisted arrangement to form a yarn.

22. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material united with workable binding material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band about a core with successive convolutions overlapping, moistening said strip or band after being wrapped on the core, and further uniting the moistened strip or band and the core in twisted arrangement to form a yarn.

23. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into thin uniform paper-like strips or bands of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping each of said strips or bands while substantially dry about a core with successive convolutions overlapping, further uniting each of said strips or bands with its core to form strands or yarns, and thereafter twisting a plurality of strands or yarns together to form a final yarn.

24. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band around a core with successive convolutions overlapping, moistening said strip or band after being so wrapped, further uniting said moistened strip or band with said core to form a moistened strand, and thereafter twisting the strand while in moistened condition to form a yarn.

25. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into thin uniform paper-like strips or bands of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping each of said strips or bands around a core with successive convolutions overlapping, moistening said strips or bands on said cores after being wrapped thereon, combining each of said moistened strips or bands with its core to form moistened strands, and thereafter twisting a plurality of moistened strands together to form a yarn.

26. A method of making yarn for the manufacture of fabrics and other purposes, which comprises the steps of wrapping a paper-like strip or band around a core, softening said strip or band after being wrapped on the core, further uniting said softened strip or band and said core to form a strand, and thereafter twisting the strand to form a yarn.

27. A method of making yarn for the manufacture of fabrics and other purposes, which comprises wrapping a paper-like strip or band about a core, moistening said strip or band after being wrapped on the core, and further uniting the moistened strip or band and the core in twisted arrangement to form a yarn.

28. A method of making yarn for the manufacture of fabrics and other purposes, which comprises forming paper-like strips or bands, wrapping each of said strips or bands around a core, moistening said strips or bands after being wrapped on said cores, further uniting each of said moistened strips or bands with its core to form moistened strands, and thereafter twisting a plurality of moistened strands together to form a yarn.

29. A process of making yarn, which comprises wrapping a paper-like strip or band around a core, advancing said strip or band and said core, moistening the strip or band as it advances with its core, further uniting the moist advancing strip or band with its core into a strand, and thereafter twisting said strand into a yarn.

30. A process of making yarn, which comprises wrapping a paper-like strip or band around a core, advancing said strip or band

and said core, moistening the strip or band as it advances with its core, further uniting said moistened strip or band with its core as they advance into a loosely twisted moistened strand, and thereafter twisting said moistened strand to form a yarn.

31. In a method of making yarn for the manufacture of fabrics and other purposes, the steps which comprise wrapping a paper-like strip or band around a core, advancing the strip or band and core, moistening said strip or band as it advances with its core, and thereafter further uniting said moistened strip or band with its core to form a strand.

32. A method of making yarn for the manufacture of fabrics and other purposes, which comprises wrapping a paper-like strip or band around a core, softening said strip or band after being wrapped on its core, and further uniting the moistened strip or band to its core by condensing and twisting to form a yarn.

33. A process of making yarn, which comprises wrapping a paper-like strip or band about a core, advancing said strip or band and said core, moistening said strip or band as it advances with its core, and further uniting the strip or band to its core by condensing and twisting to form a yarn.

34. A process of making yarn, which comprises wrapping a paper-like strip or band around a core, advancing said strip or band and said core, moistening the strip or band as it advances with its core, condensing the strip or band on the core to form a rounded strand, and twisting the rounded strand to form a yarn.

35. In a method of making yarn for the manufacture of fabrics and other purposes, the steps which comprise wrapping a paper-like strip or band around a core, advancing said strip or band and said core, moistening said strip or band as it advances with its core, and thereafter condensing said strip or band on its core to form a strand.

36. A process of making yarn, which comprises wrapping a paper-like strip or band around a core with successive convolutions overlapping, advancing said strip or band and said core, moistening the strip or band as it advances with its core, and thereafter further uniting the moist advancing strip or band with its core into a twisted yarn.

37. A process of making yarn, which comprises wrapping a paper-like strip or band around a core with successive convolutions overlapping, advancing said strip or band and said core, moistening the strip or band as it advances with its core, further uniting the moist advancing strip or band with its core into a strand, and thereafter twisting said strand into a yarn.

38. A process of making yarn, which comprises wrapping a paper-like strip or band around a core with successive convolutions overlapping, advancing said strip or band and said core, moistening the strip or band as it advances with its core, further uniting said moistened strip or band with its core as they advance into a loosely twisted moistened strand, and thereafter twisting said moistened strand to form a yarn.

39. In a method of making yarn for the manufacture of fabrics and other purposes, the steps which comprise wrapping a paper-like strip or band around a core with successive convolutions overlapping, advancing the strip or band and core, moistening said strip or band as it advances with its core, and thereafter further uniting said moistened strip or band with its core to form a yarn.

40. A method of making yarn for the manufacture of fabrics and other purposes, which comprises the steps of wrapping a paper-like dry strip or band around a core with successive convolutions overlapping, and of condensing said strip or band on its core by transverse rubbing to form a strand.

41. In a method of making yarn for the manufacture of fabrics and other purposes, the steps which comprise wrapping a paper-like dry strip or band around a core with successive convolutions overlapping, condensing said strip or band on said core to form a strand, and thereafter twisting the strand to form a yarn.

42. A method of making yarn for the manufacture of fabrics and other purposes, which comprises wrapping a paper-like strip or band around a core with successive convolutions overlapping, softening said strip or band after being wrapped on its core, and further uniting the moistened strip or band to its core by condensing and twisting to form a yarn.

43. A process of making yarn, which comprises wrapping a paper-like strip or band about a core with successive convolutions overlapping, advancing said strip or band and said core, moistening said strip or band as it advances with its core, and further uniting the strip or band to its core by condensing and twisting to form a yarn.

44. A process of making yarn, which comprises wrapping a paper-like strip or band around a core with successive convolutions overlapping, advancing said strip or band and said core, moistening the strip or band as it advances with its core, condensing the strip or band on the core to form a rounded strand, and twisting the rounded strand to form a yarn.

45. In a method of making yarn for the manufacture of fabrics and other purposes, the steps which comprise wrapping a paper-like strip or band around a core with successive convolutions overlapping, advancing

said strip or band and said core, moistening said strip or band as it advances with its core, and thereafter condensing said strip or band on its core to form a strand.

46. A method of making yarn for the manufacture of fabrics and other purposes, which comprises the steps of wrapping a paper-like strip or band while substantially dry around a core with successive convolutions overlapping, and of subsequently further uniting said strip or band and said core by transverse rubbing to form a strand.

47. A method of making yarn for the manufacture of fabrics and other purposes, which comprises wrapping a paper-like strip or band while substantially dry around a core with successive convolutions overlapping, further uniting said strip or band and core to form a strand, and thereafter twisting the strand to form a yarn.

48. A method of making yarn for the manufacture of fabrics and other purposes, which comprises wrapping a paper-like strip or band while substantially dry around a core with successive convolutions overlapping, and subsequently further uniting the strip or band and the core in twisted arrangement to form a yarn.

49. A method of making yarn for the manufacture of fabrics and other purposes, which comprises forming paper-like strips or bands, wrapping each of said strips or bands while substantially dry about a core with successive convolutions overlapping, further uniting each of said strips or bands with its core to form strands or yarns, and thereafter twisting a plurality of strands or yarns together to form a final yarn.

50. A method of making yarn for the manufacture of fabrics and other purposes, which comprises the steps of wrapping a paper-like strip or band while substantially dry around a core, moistening said strip or band after being wrapped on the core, and of combining said moistened strip or band on its core to form a yarn.

51. An asbestos yarn formed of a core and a strip of asbestos material bound into finished paper of sufficient cohesiveness and tenacity to undergo strand and yarn forming operations wrapped while substantially dry about said core and further united therewith.

52. An asbestos yarn formed of a core encased in a substantially dry strip of asbestos material bound into finished paper of sufficient cohesiveness and tenacity to undergo strand and yarn forming operations and further united therewith.

53. An asbestos yarn formed of a core and a strip of asbestos material bound into finished paper of sufficient cohesiveness and tenacity to undergo strand and yarn forming operations wrapped while substantially dry about the core and further united therewith in intertwisted relation.

54. An asbestos yarn formed of a core and a strip of asbestos material bound into finished paper of sufficient cohesiveness and tenacity to undergo strand and yarn forming operations wrapped while substantially dry about the core and subsequently moulded thereon.

55. An asbestos yarn formed of a core and a strip of asbestos material bound into finished paper of sufficient cohesiveness and tenacity to undergo strand and yarn forming operations wrapped while substantially dry about the core and subsequently moulded thereon and twisted therewith.

56. An asbestos yarn formed of a twisted core and a strip of asbestos material bound into finished paper of sufficient cohesiveness and tenacity to undergo strand and yarn forming operations wrapped while substantially dry upon the core and subsequently moulded thereon.

57. An asbestos yarn formed of a metal core and a strip of asbestos material bound into finished paper of sufficient cohesiveness and tenacity to undergo strand and yarn forming operations wrapped while substantially dry about the core and further united by twists in the core.

58. An asbestos yarn formed of a core and a strip of asbestos material bound into finished paper of sufficient cohesiveness and tenacity to undergo strand and yarn forming operations wrapped while substantially dry about a core in a helix with overlapping convolutions and further united therewith.

59. An asbestos yarn formed of a core and a strip of asbestos material bound into finished paper of sufficient cohesiveness and tenacity to undergo strand and yarn forming operations wrapped while substantially dry about the core in a helix with overlapping convolutions and moulded about the core.

60. An asbestos yarn formed of a core and a strip of asbestos material bound into finished paper of sufficient cohesiveness and tenacity to undergo strand and yarn forming operations wrapped while substantially dry about the core in a helix and moulded into an envelope for said core, and further united with said core in intertwisted relation.

61. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band while substantially dry around the core, and thereafter twisting said strip or band and said core to form a yarn.

62. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises forming asbestos

material united with workable binding material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, wrapping said strip or band while substantially dry around a core with successive convolutions overlapping, and thereafter twisting said strip or band on said core to form a yarn.

63. A method of making yarn for the manufacture of fabrics and other purposes, which comprises the steps of wrapping a paper-like strip or band around a core, softening said strip or band after being wrapped on the core, and thereafter twisting said strip band and said core to form a yarn.

64. A method of making yarn for the manufacture of fabrics and other purposes, which comprises the steps of wrapping a paper-like strip around a core with successive convolutions overlapping, advancing said strip or band with its core, moistening said strip or band as it advances with its core, and thereafter twisting said strip or band and said core to form a yarn.

65. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises the steps of binding and forming asbestos material into a thin uniform paper-like-strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, of wrapping said strip or band about a core to form an article of separate manufacture, and of subsequently and further uniting said strip or band and said core to form a strand or a yarn.

66. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises the steps of binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness to undergo subsequent strand and yarn forming operations, of wrapping said strip or band about a core without change in the condition of the core as to twist, and of further uniting said strip or band and said core to form a strand or yarn.

67. A process of making asbestos yarn, which comprises wrapping a paper-like strip or band of asbestos material around a core, advancing said strip or band and said core, moistening said strip or band as it advances with its core, and then further uniting said moist advancing strip or band with its core to form a yarn.

68. A method of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes mechanically positioning said paper-like material while substantially dry on a filament, and further mechanically uniting said paper-like material and said filament to form a strand or yarn.

69. A method of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes mechanically placing said paper-like material while substantially dry on a core, further mechanically uniting said paper-like material and core to form a strand, and thereafter mechanically twisting the strand.

70. A method of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes mechanically placing said paper-like material on a core, moistening said paper-like material after being placed on the core, and further mechanically uniting the moistened paper-like material and the core to form a strand or yarn.

71. A method of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes applying said paper-like material while substantially dry to a core, mechanically associating said paper-like material with the core to form a strand, and thereafter mechanically twisting a plurality of strands together to form a final yarn.

72. A method of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes mechanically placing said paper-like material while substantially dry on a metallic core, and further mechanically uniting said paper-like material with the metallic core in helical arrangement to form a strand or yarn.

In testimony whereof, I affix my signature.

JOHN ALLEN HEANY.

Process of making yarn from asbestos paper (US Patent 1,585,622, 1926)
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