May 18, 1926. 1,585,613

J. A. HEANY

YARN AND MECHANISM FOR AND PROCESS OF MAKING THE SAME

Original Filed Jan. 10. 1924 2 Sheets-Sheet 1

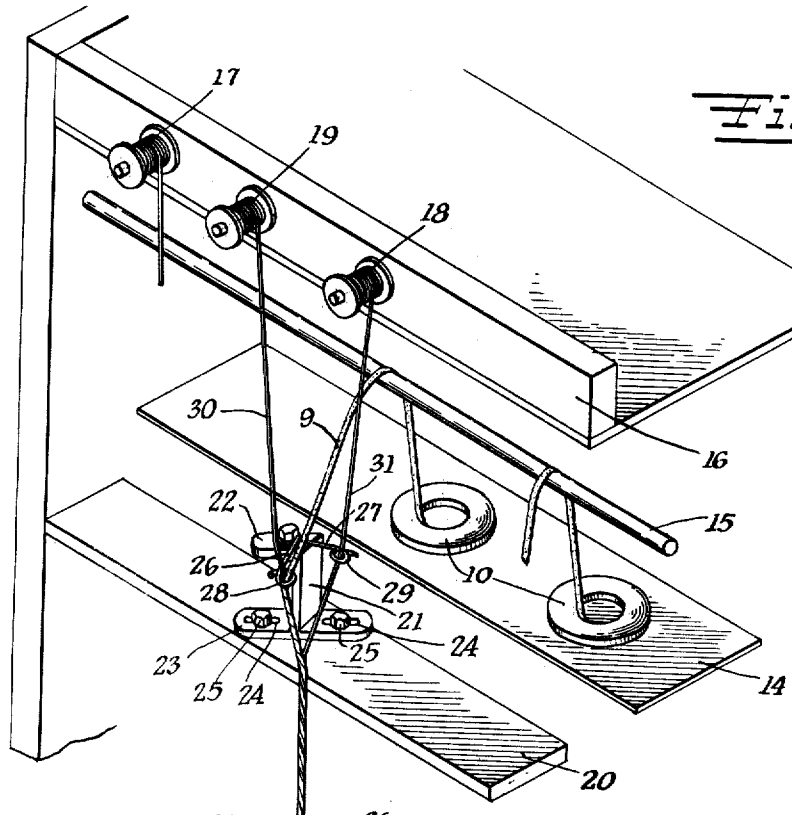


Fig. 1.

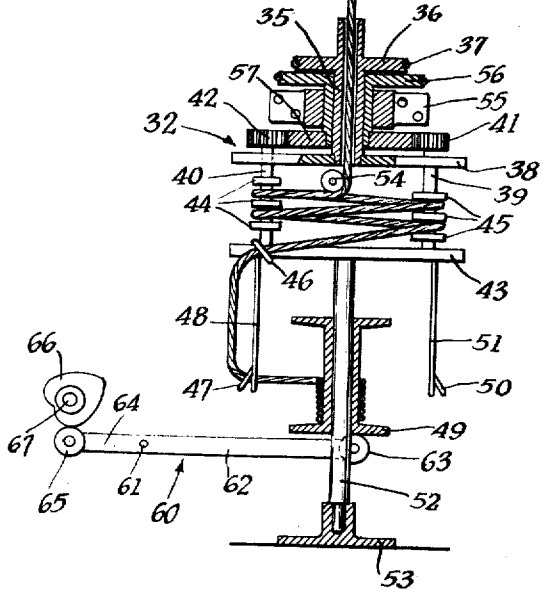


Fig. 2.

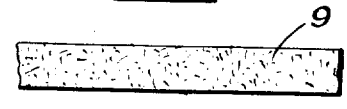
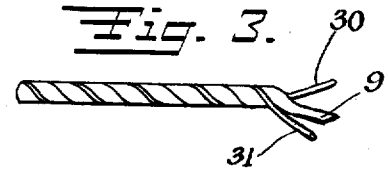


Fig. 3.



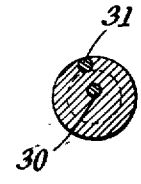


Fig. 4.

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Fig. 5.

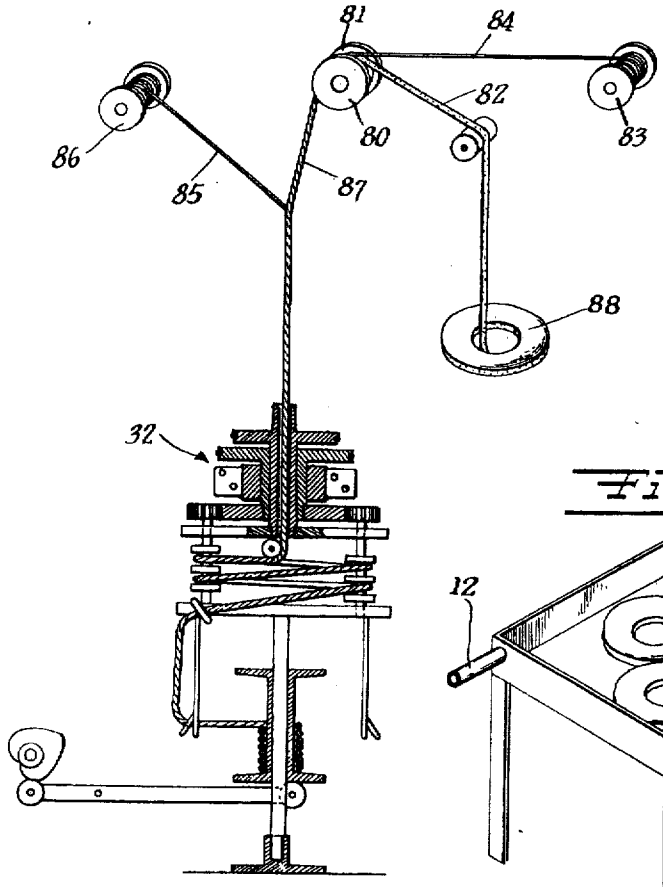
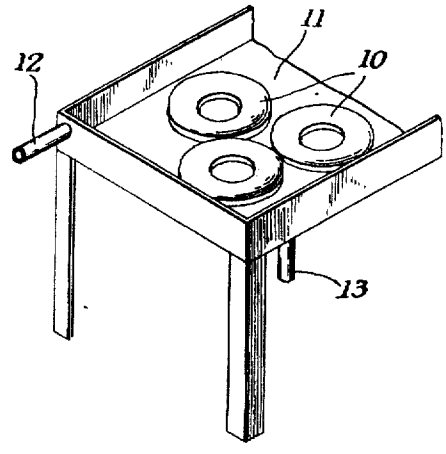


Fig. 6.



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YARN AND MECHANISM FOR AND PROCESS OF MAKING THE SAME.

Application filed January 10, 1924, Serial No. 685,300. Renewed January 25, 1926.

This invention relates to the manufacture of yarn from mineral or vegetable fibre. Broadly considered, the invention is comprehended in improved means for treating fibre stock and manipulating and processing the same, including as steps, the formation of the fibre into paper strip and the combining of the strip with a reinforcing filament, such as thread or wire as by a twisting operation to form the final yarn.

Various methods have heretofore been employed in yarn manufacture such as agglomerating the loose fibre on a core through the use of an adhesive or by carding the fibre and twisting it with long-fibred stock to give coherence to the product. Aside from the expense and manufacturing difficulties involve in these methods, certain important dificiencies in the resulting yarn have become apparent such as the lack of resistance to high temperatures when employed for purposes demanding heat resistance.

One of the important objects of the invention, therefore, is the provision of means whereby a yarn having a greater proportion of mineral matter may be easily and cheaply manufactured. Another important object is the provision of a method of manufacture for yarns which is applicable to short-fibred stock without the use of adhesives to bind the fibres on a holding core. A further object contemplated is the utilization of a manufacturing process which binds the loose fibres of yarn stock closely to the strand to form a yarn having strong resistance to stripping or frictional impact and wear.

An object also is the provision of means whereby a flexible yarn formed of normally loose and non-coherent fibred stock is manufactured without the necessity of using bulky holding sheathes or intermixed long fibres.

It is an object of the invention also to provide a highly simplified method of yarn manufacture which is applicable to both short and long-fibred stock; which is usable with equal facility with vegetable and mineral fibre; which may be readily varied to meet demands for different products; and which involves structural details of notable simplicity and efficiency.

Another object of the invention is to provide a process of making yarn from paper-like strips or bands of asbestos material bound with sufficient cohesiveness and tenacity to undergo subsequent mechanical strand and yarn forming operations in which one or more of said strips or bands are combined, as by mechanical means, with a plurality of filaments to form a yarn, or in which asbestos paper-like material of the character referred to is combined with a plurality of filaments to form a yarn.

Another object of the invention is to provide a process of making yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes associating, as by mechanical means, the asbestos paper-like material with one or more tension or supporting filaments, and of applying, as by mechanical means, one or more binding filaments, preferably helically, to the paper-like material and said tension filament or filaments to bind them together.

Another object of the invention is to provide a process of making yarn from paper-like strips or bands of asbestos material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture in which a plurality of said strips or bands are combined or united with one or more filaments to form a strand or a yarn.

Another object of the invention is to provide a process for making yarn from asbestos paper-like material of the character previously referred to in which said paper-like material is combined with a plurality of reinforcing filaments to form a yarn with the filaments separated by said paper-like material.

Another object of the invention is to provide a process of making yarn from a strip or band of asbestos material or from asbestos paper-like material of the character previously referred to and a filament or filaments in which the paper-like strip or the paper-like material is associated with or arranged about one or more tension filaments and in which undulations or distortions are produced in such tension filament or filaments by applying a binding filament or filaments helically around said tension filament or filaments.

Another object of the invention to to pro-

vide a process of making yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes moistening said paper-like material, binding the paper-like material while moist with a plurality of filaments to form a yarn; or which includes associating the moist paper-like material with one or more tension or supporting filaments, and applying one or more binding filaments, preferably helically, to the moist paper-like material and said tension filament or filaments to bind them together.

Another object of the invention is to provide a process of making yarn from asbestos material of the character previously referred to in which a plurality of filaments are employed, one or more of which may be metallic, to form a yarn; or in which one or more of the tension filaments and/or one or more of the binding filaments may be metallic.

Another object of the invention is to provide a process of making yarn from asbestos paper-like material of the character previously referred to in which the paper-like material and the reinforcing filaments are twisted with each other or are arranged helically with respect to one another.

Another object of the invention is to provide a process for making asbestos yarn from asbestos paper-like material of the character previously referred to in which the paper-like material is associated, combined, helically arranged or twisted with a filament to form a strand and in which the strand thus formed is associated, combined, helically arranged or twisted with a second filament to form a yarn, with or without including the step of moistening the paper-like material previously and hereinafter referred to.

Another object of the invention is to provide an asbestos yarn comprising asbestos paper-like material associated with one or more tension or supporting filaments and secured thereto by one or more binding filaments.

A further object of the invention is to provide a yarn comprising a core, asbestos materal present in the yarn in paper-like formation, and one or more filaments binding said material and core together.

Another object of the invention is to provide a yarn comprising one or more paper-like strips of fibrous asbestos material associated with a tension filament and secured thereto by a binding filament.

Another object of the invention is to provide an asbestos yarn comprising a paper-like strip of asbestos material placed about a filament or core and bound thereto by a helically arranged filament such as a wire.

Another object of the invention is to provide an asbestos yarn of the character previously referred to in which the paper-like strip of asbestos material contains binding material.

Another object of the invention is to provide an asbestos yarn comprising a core having undulations along the longitudinal length thereof, asbestos paper-like material positioned or placed about the core, and filamentary means for holding the asbestos paper-like material in the depressions of the undulations of said core to prevent the stripping of the asbestos material from the core, said filamentary means being helically, twisted or otherwise combined with the paper-like material and the core.

Another object of the invention is to provide a yarn which includes a strand comprising asbestos paper-like material with a filament helically arranged around said strand.

Various other objects will be apparent on consideration of the description of an embodiment of the invention which may be preferred, hereinafter described and illustrated in the accompanying drawings, in which

Fig. 1 is a diagrammatic view in perspective showing the various essential units used in the manufacturing process;

Fig. 2 is a detail view of the paper strip employed in the process;

Fig. 3 is a view of the segment of the completed yarn;

Fig. 4 is a cross-section of the completed yarn; and

Fig. 5 is a view of a modified form of mechanism.

Fig. 6 is a perspective view of a portion of the vat for moistening the rolls of paper to loosen the binder.

An important step in the manufacture of the yarn consists in binding and forming material, such as asbestos material, into a thin paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations. In a co-pending application of the present invention, Serial Number 516,129, filed November 18, 1924, (now replaced by the continuing application, Serial No. 82,249, filed January 19, 1926), a process is described by which non-coherent fibre stock is formed into pulp from which is made a web of sufficient strength or coherence to permit the same to be slitted by passing it through a slitting machine and to permit the strips thus formed to be handled satisfactorily in the subsequent steps of yarn manufacture. It should be understood that the strength of the final web depends on the strength of the surface material thereof. For example, asbestos material may be formed into paper strip by mixing the fibre in a beater with binding material, which may include a binder such as starch, depositing the

resulting pulp on carrier belts and subsequently calendering, drying and reeling the resulting paper sheet.

For the purposes of the present application, the paper in rolls of suitable diameter is slitted in cutting machines and formed into a plurality of rolls, of tape or strip 10, having a thickness of about three eighths of an inch and a diameter of about ten inches, the paper strip appearing as indicated in Fig. 2. The paper is now in form for direct application to the yarn making mechanism.

The first step involved in the process of manufacture is to moisten the tape in a vat 11, having appropriate water connections 12 and 13, in order to loosen the binder in the paper. Water alone may be used as the solvent, but in certain conditions, additional materials may be added to increase the frictional characteristics of the loosened fibres. Such moistening of the strip rolls in a vat before placing them in the twisting machines has been found to give particularly advantageous results.

The moistened strip is then placed on the plate 14 of the yarn machine below a roller or rounded guide 15 over which the tape 9 is fed from the center of the tape roll. Above the guide roll 15 is a support 16 to which are attached pins 17 adapted to receive spools 18 and 19 of wire, thread or similar filamentary material.

Positioned on a supporting base 20 below the guide roll 15 is a bracket 21 having an out-turned arm 22. The base 23 of the bracket is preferably slotted as at 24 to receive the holding bolts 25, the slotted connection facilitating ajustment of the bracket on the base. To the arm 22 is attached two outwardly extending fingers 26 and 27, terminating in pig tail loops 28 and 29. The loop 28 constitutes a guide ring for the filament 30 derived from spool 19 and also for the tape 9 fed from roll 10, and the loop 29 forms a guide ring for wire 31 derived from spool 18. These three elements, the wires 30 and 31 and the tape 9 are united in a manner as will presently be described and led together into the twister 32, the details of which will now be described.

The twister 32 is of a well known type, embodying a twisting mechanism and a feeding mechanism and is placed directly beneath the guide loops 28 and 29.

The twisting mechanism includes a cylinder 35, carrying on its top a drive pulley 36 adapted to receive power from a pulley cord 37. To the base of the cylinder 35 is secured a cross bar 38 at the end of which are mounted stub shafts 39 and 40, the same extending below and above the cross bar 38. The stub shafts 39 and 40 carry on their upper ends pinions 41 and 42, and at their bases contact with and are journaled in a cross bar 43. The stub shafts carry also guide pulleys 44 and 45 intermediate the cross bars 38 and 43, by means of which and in conjunction with guide roll 45 fixed to the cross bar 38, guide loop 46 fixed adjacent one end of the cross bar 43, and guide loop 47 secured to the end of a support 48 depending from the end of the cross bar 43, the yarn strand is led into a twisting mechanism and guided into contact and engagement with the spool 49. An auxiliary guide loop 50 suspended from a support 51 at the other end of the cross bar 43 may also be used when the circumstances make its use desirable.

The feed mechanism of the twister is embodied in a sleeve 55 carrying a drive pulley 56 at its top and a gear 57 at its base. The gear 57 is adapted to mesh with and drive the pinions 42 and thus regulate the feed of the yarn elements through the twister.

The spool 49 is mounted upon a supporting rod 52 and is adapted to have vertical sliding movement thereupon, between the cross bar 43 attached to the top of said rod 52 and the base plate 53 upon which the twisting mechanism is mounted. Reciprocation of the spool 49 to obtain the deposition of the yarn upon the spool in successive layers is secured by any suitable mechanism. A diagrammatic form of reciprocating mechanism is indicated in Fig. 1, consisting of a lever 60 pivoted at 61, having a longer arm 62 to the end of which is attached a roller contact 65. The roller 63 is adapted to contact with the lower flange of the spool 49 and the roller 65 is adapted to make contact with a heart shaped cam 66 mounted for rotation at 67. It is apparent that rotation of the cam 66 will cause reciprocation of the spool 49 upon the rod 52 thereby permitting proper placing of the yarn upon the spool.

The consecutive operative steps of the process should be apparent from the description as above indicated. Beginning with the roll of tape as secured from a slitting machine, the various steps involve: first, a moistening of the paper to loosen the binder, second, a feeding of the moistened tape through the guide loop 28 with a filament 30 to secure an initial combination of the two elements and a subsequent union of the strand thus formed with another filament 31, and third, a passage of the combined wires and tape into the twisting mechanism proper to obtain the yarn as indicated in Fig. 3. The yarn as secured by this process, is a firm and flexible one which has high power of resistance to disintegration from friction or contact with foreign bodies, due to the fact that the added filament wrapped around the exterior of the fibre stock tends to hold all the loose fibres firmly relative to the strand. It is evident

that the use of this auxiliary wrapping filament permits the use in the yarn stock of fibres of relatively short length, such for example, as would of necessity, be used in the mineral yarns made of asbestos. The structure of the yarn in perspective and cross section is brought out in Figs. 3 and 4.

Attention is directed to certain specific features of the method and apparatus as indicated in Fig. 1. It is pointed out that the operation is continuous from the tape 10 and spools 18 and 19 to the spool 49, the various elements in their passage from these points, being always under various stresses and the final yarn being secured only upon being wound upon the spool 49. Particularly above the twister proper 32 to the spools 18 and 19, the wires 30 and 31 are subjected to a twist throughout their length and consequently as the tape 9 enters the guide loop 28, it is subjected to the action of the twisting and is immediately wrapped about the wire. The twist intermediate the loop 28 and the twister 32 is not, however, close, the twisting mechanism 32 giving the torsion requisite to produce the solid compact twist as appears in the final yarn. It is desirable that not too great twisting stress be applied in the preliminary steps, inasmuch as the tape being moist and formed of a non-coherent agglomeration of the fibres, is subject to breakage. Further, in order to have a smooth product without the necessity of passing the strand through a rubbing mechanism, there is a limit to the rate of movement and the degree of twist which is readily obtainable by the apparatus employed.

It has been found that the use of a loop as shown in Fig. 1 causes the tape to be wrapped about the wire in a manner which eliminates lumps in the final yarn, the result being a smooth strand of uniform dimension which can be readily employed for weaving into various fabrics. The loop 28 is constructed so that its diameter is somewhat less than that of the width of the tape, the tape upon entering this loop being thereby crowded together and directed into proper alignment with the core or filament 31.

While the apparatus as indicated in the drawing and described above relate to a specific embodiment of the invention, it is obvious that the showing is diagrammatic and that variations may be made within the spirit of the invention. For example, instead of the loop guide means shown in Fig. 1, it may be expedient to employ a roller guide arrangement as indicated in Fig. 5 of the drawing. In this figure there is shown a guide pulley 80 having peripheral flanges 81 forming guide way for the tape 82 unwinding from the roll of tape 83. Adjacent the infeed side of the pulley 80 is a spool 83 of wire 84 which is adapted to be fed with the tape 82 on to the pulley 80 and thence into the twister 32. In this mechanism the twisting effect is carried from the top of the twister to the pulley 80, so that the tape is wrapped about the wire 83 at a point relatively near the pulley 80, and below this point a second wire 85 adapted to be unwound from a spool 86, is fed into union with and wrapped about the strand 87, and the whole unit is fed into the twister 32, emerging as a yarn similar to that obtained by the modification of Fig. 1. It is to be, however, expressly understood, so far as the method is concerned, that I do not limit myself to the construction illustrated and described herein, as the method is not dependent in any wise upon said apparatus but may be obviously carried out in practice by apparatus other than that covered by the apparatus claims herein without departing from the true spirit and scope of my invention. It is also to be expressly understood that I do not limit myself to the exact steps of the process herein described as many changes may be made and even modifications resorted to without deviating from the true spirit and scope of my invention as defined by the annexed claims. It will be seen that in the resulting yarn, the strip or band and the two filaments are combined, with the tension filament or wire located substantially along the axis preferably in a coiled, twisted or undulated form, and another filament or wire located at or near the surface of the yarn. The distortions or undulations of the core may be increased by using the arrangement shown in Fig. 5 in which the filament 85 exerts a considerable side pull on the strand 87.

In the modification of Fig. 1, while the process has been described as referring specifically to the employment of two wires 30 and 31 on a single tape 9, it is evident that variation in the number of these units may be made as demands of the final products make expedient. For example, instead of one wire 30 being used as a core of tension reinforcement for the strand, two or more such wires may be utilized and two or more paper strips may also be employed to give greater body to the yarn. Use may also be made of two or more wires or filaments entering the loop 29 to be wrapped about the preliminary strand for binding reinforcement, and further variations in the type of filament used may be made such as the employment of wire for the core of the yarn and various long fibred threads for the exterior, or vice versa. Such employment of wire for the core is disclosed in my copending application, Serial No. 654,118, filed July 27, 1923.

The apparatus and process described has been found particularly useful in connection with the manufacture of yarn from asbestos. The normal asbestos fibre is short

and as compared with a vegetable fibre, is relatively smooth, lacking the coherence of cotton, jute, hemp and the like, and consequently it has been found extremely difficult to form a smooth yarn of sufficiently small dimensions and sufficient coherence for use in weaving operations without the use of some auxiliary holding means for preventing disintegration of the fibrous structure. By the present method it is possible not only to make a yarn of small cross section out of asbestos fibre, but also make a yarn which resists unravelling and disintegration, due to wear and tear. Advantageous results may be obtained by the employment of an external filamentary wire or thread about the exterior of the strand.

In asbestos yarns formed principally of asbestos paper-like material or strips or bands thereof, there is in many cases a tendency of the paper-like material to become relatively hard and stiff in the finished yarn and also in the fabric. Under these conditions there is a tendency to breakage in the hard surface of such yarns. Such hardness and stiffness and consequent tendency to cracking at the surface of the yarn is under many conditions decidedly undesirable. Such disadvantages are avoided to a great extent in the yarn of the present invention due to the breaking up of the hard surface by the binding filament 31 which, as shown in Fig. 4, is embedded in the asbestos paper-like material at the surface of the yarn. I have found that if the filaments employed are made of vegetable fibre, such as cotton, a superior yarn results; that is to say a yarn that is soft, flexible, of more uniform strength and easier to weave. This species of the invention forms, in part, the subject matter of my copending application Serial No. 712,970, filed May 13, 1924.

Means for loosening the binder of the paper strip have been referred to as including moistening of the same, but other means may be employed successfully such as mechanical manipulation or working of the strip. The loosening of the binder, while assisting in the process is not essential, as yarn may be made without disturbing the binder of the paper, but breakage is more apt to occur when the binder is not loosened. In some yarns, moreover, it may be desirable to remove the binder partially or completely, and this may be accomplished by permitting the liquid to dissolve out the binder or the binder may be worked or burned out of the strip.

Note should be made that the plate 14 may be formed as a tray adapted to receive liquid so that the tape rolls 10 may be saturated immediately before use on the machine.

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

From the foregoing it will be seen that I have devised a new method of manufacturing asbestos yarn from asbestos paper-like material, or from one or more paper-like strips or bands of asbestos material, bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture which, in its broad aspect, comprises associating said paper-like material with a plurality of metallic or non-metallic reinforcing filaments to form a yarn; or which comprises associating a plurality of paper-like strips or bands of asbestos material with one or more metallic or non-metallic filaments to form a yarn; or which includes forming a reinforced or unreinforced strand comprising asbestos paper-like material and arranging a reinforcing filament helically around said strand. In the specific method described and claimed it will be noted that one of the filaments, specifically referred to herein as the tension or supporting filament, supports and carries the asbestos material in subsequent steps of yarn making. The asbestos material immediately becomes loosely associated with the tension filament after which a second filament, specifically referred to herein as the binding filament, is combined with the asbestos material and the first filament to securely bind and hold the former to the latter. In the embodiment of the invention illustrated this is accomplished by a twisting of the asbestos material and the filaments. The association of the paper-like material with the first or tension filament may be done in a variety of ways and by different kinds of contrivances so far as the broad features of my invention are concerned, as by encasing, wrapping or twisting these two elements together. And the combining with the paper-like material and the first or tension filament of a second filament also may be performed in a variety of ways and by different contrivances so far as the broad features of my invention are concerned, as by wrapping, winding or twisting with the paper-like material and the first or tension filament of the second or binding filament. For economical reasons, however, I prefer to combine the asbestos material with the first or tension filament by twisting these elements to form a strand, and, during a later stage of the strand forming, combining said strand and the second or binding filament by means of the same twisting mechanism

to form a yarn, thus helically arranging the component parts of the yarn. It will also be apparent, so far as specific features of my invention are concerned, that the method comprises the association of the asbestos material about the first or tension filaments and thereafter producing in the first or tension filament undulations or distortions by applying a second or binding filament helically around the asbestos material and the first or tension filament. Referring further to specific features of my invention, still having reference to the method, special mention is hereby made of the softening or moistening step of the process which enables the asbestos paper-like material to readily conform to, combine with and to be bound by the respective filaments, the better enabling the asbestos material to be combined with the undulations or distortions of the core and also enabling the binding filament or filaments to be embedded, helically or otherwise, in said material and thus producing a yarn the fibrous material of which cannot be stripped from the filamentary means. And in this connection it is to be observed that my invention contemplates the use also of a plurality of what I have termed "tension" filaments as well as a plurality of "binding" filaments. In carrying out my process, however, it will be noted that an important feature resides in the fact that the asbestos material is located between the respective filaments, thus enabling a yarn to be manufactured of even texture and strength and the surface of which is exceedingly uniform and therefore well adapted for weaving. The filaments may be of any suitable material depending upon the specific uses to which the yarn is put, but I have found that by employing metallic filaments in the process of manufacture certain alvantageous results are achieved.

It will also be noted from the foregoing that I have produced a new yarn having several new and marked properties, qualities and characteristics chief of which have been pointed out above in the statement of the objects of the invention in view of which and in view of the statement of invention in the preceding paragraph concerning the new method a detailed statement of this part of my invention is believed to be unnecessary, and, with a view to avoid prolixity of description, is omitted herefrom.

There is also illustrated, described and claimed herein a machine for practicing the new method and for producing the new yarn but I do not limit myself thereto so far as the apparatus claims are concerned, much less in the practicing of the method illustrated thereby, as many changes may be made in points of detail and other embodiments resorted to without departing from the true spirit and scope of my invention as defined by the apparatus claims appended hereto.

Various other modifications of the invention will be apparent to those skilled in the art, the scope of the invention being determined only by the claims hereto appended.

What is claimed is:

1. A process of making yarn from paper strip held together by binding material, which includes softening the binding material of the strip, twisting the strip with a filament to form a strand, and introducing, at an intermediate stage of the twisting, a reinforcing element to be twisted with the strand.

2. A process of making yarn, which includes forming paper strip of asbestos material and binding material to hold together the fibres thereof, softening the binding material, twisting the strip with a core to form a strand, and twisting together the strand and a filament.

3. A process of making yarn from paper strip formed with a suitable binder, which includes combining the strip and a core in twisted relation to form a strand, and, during a later stage of such strand forming, combining the strand and a reinforcing element in twisted relation.

4. In apparatus for making yarn, a twisting device, means cooperating with said device for forming a loosely and smoothly twisted strand from a paper strip and a reinforcing element, and other means cooperating with the twisting device for forming a yarn with a tighter twist from said loosely twisted strand and a second reinforcing element.

5. In apparatus for making yarn, twisting means, means for so supporting a strip roll as to permit the strip to be drawn freely therefrom in a direction transverse to the plane thereof, means including a guide to determine the direction of presentation of the strip to the twisting means, means for bringing a reinforcing element into engagement with said guide in juxtaposition with said strip to be twisted therewith into a strand, and means for applying a second reinforcing element to said strand at a point spaced from said guide to be twisted with said strand to form a yarn.

6. In apparatus for making yarn, twisting means, means for so supporting a strip roll as to permit the strip to be drawn freely therefrom in a direction transverse to the plane thereof, means including a guide to determine the direction of withdrawal of the strip from the roll, a second guide for determining the direction of presentation of the strip to the twisting

means, means for bringing a reinforcing element into engagement with the second guide in juxtaposition with said strip for twisting therewith into a strand, and means for applying a second reinforcing element to said strand at a point spaced from said second guide to be twisted with said strand to form a yarn.

7. In apparatus for making yarn, twisting means, means for so supporting a strip roll as to permit the strip to be drawn freely therefrom in a direction transverse to the plane thereof, means including a guide to determine the direction of presentation of the strip to the twisting means, means for bringing a reinforcing element into engagement with said guide in juxtaposition with said strip to be twisted therewith into a strand, and means for applying a second reinforcing element to said strand at a point spaced from said guide to be twisted with said strand to form a yarn, said applying means including a guide spaced from the strip guide and positioned at about the same distance from the twisting means as the strip guide.

8. A process of making yarn, which includes feeding a plurality of yarn elements simultaneously through a common guide loop, feeding another element into juxtaposition with the first mentioned elements at a uniting point spaced from said loop, and twisting said elements together to form a preliminary yarn between the loop and the uniting point, and a final yarn beyond said uniting point.

9. A process of making yarn, which includes feeding a plurality of yarn elements to a uniting point, feeding at least one other element into juxtaposition with the first mentioned elements at a second uniting point spaced from the first, and twisting said elements together to form a preliminary yarn between said uniting points and a final yarn beyond the second uniting point.

10. A process of making yarn, which includes feeding two spaced filamentary elements to a uniting point, applying another yarn element to one of said filamentary elements at a uniting point spaced from the first mentioned uniting point, and twisting all of said elements together after passing the first mentioned uniting point.

11. A yarn formed of a thin paper-like strip of fibrous asbestos material having a tension reinforcement about which said strip is twisted and a binding reinforcement.

12. A yarn formed of asbestos paper strip wrapped about a holding core to form a strand and reinforced by a filament in twisted relationship with the strand.

13. A yarn formed of asbestos material in a paper-like strip with a starch binder, a wire tension reinforcement for said strip and a wire binding reinforcement for said strip.

14. An asbestos yarn formed of asbestos paper strip material having a central core filament and an external binding filament, the external filament being embedded in the paper strip material.

15. A yarn formed of a strip of asbestos material and binding material for holding the fibres together, a core with which said strip is twisted to form a strand, and a filament twisted with said strand and embedded in the asbestos material.

16. A continuous process of making asbestos yarn, which consists in twisting together a strip and a filament to form a strand and applying to the strand thus formed a second filament twisted therewith.

17. A process of making yarn which includes forming a paper strip of asbestos material, of which the fibres are held together by a workable binder, twisting the strip with a core of at least one filament to form a strand, and twisting the strand with at least one filament to form a final yarn.

18. A process of making yarn which includes forming a pulp containing asbestos material, forming said pulp into a web of sufficient strength to withstand slitting, slitting the web into strips of suitable width, twisting one of said strips with a reinforcing element to form a strand, and twisting said strand with a second reinforcing element to form a yarn.

19. A process of making yarn which includes forming a pulp containing asbestos material and binding material, forming a web from such pulp rendered sufficiently strong by said binding material to withstand slitting, slitting said web into strips of suitable width, twisting one of said strips with a reinforcing element to form a strand, and twisting said strand with a second reinforcing element to form a yarn.

20. A process of making yarn from fibrous material which includes forming the fibre into paper strip made coherent by a binder, softening the binder and twisting the strip with a plurality of filamentary elements positioned on opposite sides of the strip.

21. A process of making yarn from asbestos paper strip which consists in feeding a paper strip and a reinforcing element simultaneously through a common guide loop, subsequently combining a second reinforcing element with said strip beyond said loop, and finally twisting said strip with the reinforcing elements.

22. A process of making yarn from fibrous material which includes forming the fibre into paper strip, softening the binding material of said strip, passing the strip and

a filamentary element together through a guide loop, and uniting a second filamentary element to the strip at a point without the loop, the first element being on one side, and the second element on the other side of the strip.

23. A process of making yarn from fibrous material which includes forming the fibre into paper strip, softening the binding material of said strip, passing the strip and a filamentary element together through a guide loop, uniting a second filamentary element to the strip at a point without the loop, the first element being on one side, and the second element on the other side of the strip, and finally twisting together the strip and filamentary elements.

24. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which includes 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, twisting the strip or band with a filament to form a strand, and introducing a reinforcing element at an intermediate stage of the twisting to be twisted with the strand to form a yarn.

25. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which includes 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, combining the strip about a reinforcing core to form a strand, and finally twisting the strand with a reinforcing filament to form a yarn.

26. 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, moistening the materials in said strip or band, twisting the moistened strip or band about a reinforcing core to form a strand, and at a later stage twisting said strand in moistened condition with a filament to form a yarn.

27. 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, softening said strip or band, combining said softened strip or band with a filament to form a strand, and thereafter twisting the strand in moistened condition with a second filament to form a yarn.

28. 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, and twisting the strip or band with a plurality of reinforcing filaments to form a yarn.

29. 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, and twisting the strip or band with a plurality of reinforcing filaments with the strip located between said filaments to form a yarn.

30. 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, moistening said strip or band, and twisting the moistened strip or band with a plurality of reinforcing filaments to form a yarn.

31. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises forming asbestos material united with binding material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, moistening said strip or band, and twisting the moistened strip or band with a plurality of reinforcing filaments to form a yarn.

32. 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, moistening said strip or band, and twisting the moistened strip or band between a plurality of reinforcing filaments.

33. An asbestos yarn comprising one or more paper-like strips of fibrous asbestos material associated with a wire tension filament and secured thereto by a binding filament.

34. An asbestos yarn comprising asbestos paper-like material associated with one or more wire tension filaments and secured thereto by one or more binding filaments.

35. An asbestos yarn comprising a metallic core, asbestos paper-like material positioned about the core, and one or more metallic filaments binding said material and core together.

36. An asbestos yarn comprising a metal-

lic core, asbestos material present in the yarn in paper-like formation, and a metallic filament binding said material and core together.

37. An asbestos yarn comprising a paper-like strip of asbestos material placed about a core and bound thereto by a helically arranged wire.

38. An asbestos yarn comprising asbestos paper-like material associated with one or more tension filaments and secured thereto by one or more binding filaments.

39. An asbestos yarn comprising asbestos material in a paper-like strip containing binding material, a tension reinforcement for said strip, and a binding reinforcement for said strip.

40. An asbestos yarn comprising a paper-like strip of asbestos material bound together with sufficient cohesiveness and tenacity for yarn manufacture, a metallic tension filament for said strip having undulations, and a metallic binding filament.

41. An asbestos yarn comprising a core having undulations along the longitudinal length thereof, asbestos paper-like material positioned about the core, and filamentary means for holding the asbestos material in the depressions of the undulations of said core to prevent the stripping of the asbestos material from the core.

42. An asbestos yarn comprising a core having undulations along the longitudinal length thereof, asbestos paper-like material bound with sufficient cohesiveness and tenacity for yarn manufacture and positioned about the core, and filamentary means for holding the asbestos paper-like material in the depressions of the undulations of said core to prevent the stripping of the asbestos material from the core.

43. An asbestos yarn comprising a metallic core having undulations or distortions along the longitudinal length thereof, and paper-like asbestos material bound with sufficient cohesiveness and tenacity to undergo strand and yarn forming operations intimately combined with said undulations or distortions by means of a binding filament to prevent the stripping from the core of the asbestos material.

44. An asbestos yarn comprising a metallic core having undulations or distortions along its longitudinal length, and asbestos material present in the yarn in flexible paper-like formation and intimately combined with said undulations or distortions by means of a metallic binding filament to prevent the stripping from the core of the asbestos material.

45. An asbestos yarn comprising a twisted metallic core having undulations or distortions along its longitudinal length, and asbestos material present in the yarn in flexible paper-like formation and intimately combined with and united to said undulations or distortions by means of a twisted binding filament to prevent the stripping from the twisted metallic core of the asbestos material.

46. An asbestos yarn comprising a plurality of wire helices and, combined therewith, asbestos paper-like material bound with sufficient cohesiveness and tenacity to undergo strand and yarn forming operations.

47. An asbestos yarn comprising a plurality of wire helices and, combined therewith in helical arrangement, asbestos paper-like material bound with sufficient cohesiveness and tenacity for yarn manufacture.

48. An asbestos yarn comprising a plurality of wire helices and, associated therewith, one or more strips or bands of asbestos paper-like material bound with sufficient cohesiveness and tenacity to undergo strand and yarn forming operations.

49. An asbestos yarn comprising a plurality of wire helices and, bound thereby, one or more helically arranged strips or bands of asbestos paper-like material bound together with sufficient cohesiveness and tenacity for yarn manufacture.

50. A process of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which comprises mechanically associating said paper-like material with a tension filament, and mechanically binding said paper-like material and tension filament together by means of a second filament.

51. A process of making asbestos yarn which comprises binding and forming asbestos material into a paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, mechanically associating the strip or band with a tension filament, and mechanically binding said strip or band and filament together by means of a second filament.

52. A continuous process of making asbestos yarn from a paper-like strip or band of asbestos material bound with sufficient cohesiveness and tenacity to undergo subsequent mechanical strand and yarn forming operations, which comprises the steps of mechanically associating said strip or band with a tension filament, and of mechanically arranging a binding filament helically around the strip and the tension filament.

53. A process of making asbestos yarn which consists in forming paper-like strips of asbestos material united with binding material, mechanically associating one or more of the strips with a core of at least one filament, and mechanically binding such parts together by at least one other filament.

54. A method of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes the steps of moistening said paper-like material, mechanically associating the moistened paper-like material with a core, and mechanically arranging a filament helically around such parts to bind them together.

55. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent mechanical strand and yarn forming operations, and mechanically associating said strip or band with a tension filament and a binding filament to form a yarn with the tension filament having undulations therein.

56. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent mechanical strand and yarn forming operations, and mechanically associating said strip or band in moist condition with a tension filament and a binding filament to form a yarn with the tension filament having undulations and with the binding filament arranged helically.

57. A process of making asbestos yarn, which consists in binding and forming asbestos material into a paper-like strip or band, mechanically associating the strip with one reinforcing filament to form a strand, and mechanically twisting together the strand and a second reinforcing filament.

58. A process of making asbestos yarn, which consists in binding and forming asbestos material into a paper-like strip or band, mechanically twisting the strip with a core to form a strand, and mechanically arranging a binding filament helically around said strand.

59. A process of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity to undergo subsequent mechanical strand and yarn forming operations, which comprises the step of uniting by mechanical means the paper-like material and a plurality of reinforcing filaments to form a yarn with the filaments separated by said strip.

60. A process of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises binding and forming asbestos material into a paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent mechanical strand and yarn forming operations, mechanically arranging the strip or band about a filament to form a strand, and mechanically binding said strand together by a helically arranged binding filament.

61. A method of making asbestos yarn from asbestos material formed into a paper-like strip or band bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which comprises moistening said strip or band, mechanically arranging the moistened strip or band about a filament to form a strand, and mechanically combining said strand and a binding filament to form a yarn with the binding filament arranged helically.

62. A process of making asbestos yarn which comprises binding and forming asbestos paper-like material, mechanically associating said paper-like material about a tension filament, and producing in said tension filament undulations or distortions by mechanically applying a binding filament helically around the paper-like material and tension filament.

63. A process of making asbestos yarn which comprises binding and forming asbestos paper-like material, mechanically associating said paper-like material about a metallic core, and producing in said core undulations or distortions by mechanically applying a metallic binding filament helically around the paper-like material and core.

64. A method of making asbestos yarn from uniform paper-like strips or bands of asbestos material bound with sufficient cohesiveness and tenacity to undergo subsequent mechanical strand and yarn forming operations, which comprises mechanically uniting one or more of said strips or bands with a plurality of filaments in helical arrangement to form a yarn.

65. The process of making yarn from asbestos material including forming the material into strips, the fibres of which are held together by binding material, moistening the binding material in said strips, mechanically uniting a plurality of strips with a core which takes a set when deformed, and mechanically twisting the core and strips into a strand in which the core is deformed along its longitudinal length.

66. In a process of making asbestos yarn the following steps: forming finished paper of asbestos material and workable binding material securing together the fibres of said asbestos material, slitting the finished paper into strips, and incorporating into a yarn by mechanical means a plurality of strips of the finished paper and one or more reinforcing filaments in twisted relation.

67. A method of making asbestos yarn from paper-like strips or bands of asbestos material bound with sufficient cohesiveness and tenacity to undergo subsequent mechanical strand forming operations, which com-

prises the steps of softening said strips or bands, and of mechanically combining one or more of said softened strips or bands with a plurality of filaments to form a yarn.

68. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises the steps of forming uniform paper-like strips or bands of asbestos material bound with sufficient cohesiveness and tenacity to undergo subsequent mechanical strand forming operations, and of combining by mechanical means one or more of said strips or bands with a plurality of filaments to form a yarn.

69. A method of making asbestos yarn from paper-like strips or bands of asbestos material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which comprises moistening a plurality of said strips or bands, mechanically advancing said strips or bands, and mechanically combining the moist advancing strips or bands with one or more filaments to form a yarn.

70. A process of making asbestos yarn which comprises binding and forming asbestos paper-like material of sufficient cohesiveness and tenacity to undergo subsequent mechanical strand and yarn forming operations, and of mechanically combining said paper-like material with a plurality of filaments to form a yarn.

71. 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 mechanical strand and yarn forming operations, and mechanically uniting one or more of said strips or bands with a plurality of filaments in helical arrangement to form a yarn, at least one of said filaments being a wire.

72. A method of making asbestos yarn for the manufacture of fabrics including forming strips of asbestos material, the fibres of which are held together by binding material which permits the strips to be worked, and combining by mechanical means one or more strips with a plurality of metallic reinforcing filaments to form a yarn.

73. The process of making yarn from asbestos material including forming the material into strips, the fibres of which are held together by binding material, moistening the binding material in said strips, mechanically uniting a plurality of strips with a metallic core which takes a set when deformed, and mechanically twisting the metallic core and strips into a yarn in which the metallic core is deformed along its longitudinal length.

74. In a process of making asbestos yarn the following steps: forming dry finished paper of asbestos material and workable binding material securing together the fibres of said asbestos material, slitting the finished paper into strips, and incorporating into a yarn by mechanical means a plurality of strips of the finished paper in twisted relation with one or more metallic reinforcing elements.

75. 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 thin uniform paper-like strips or bands of sufficient cohesiveness and tenacity to undergo subsequent mechanical strand forming operations, of softening said strips or bands, and of mechanically combining one or more of said softened strips or bands with a plurality of metallic reinforcing filaments to form a strand.

76. 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 thin uniform paper-like strips or bands of sufficient cohesiveness and tenacity to undergo subsequent mechanical strand forming operations, and of mechanically combining one or more of said strips or bands with a plurality of metallic reinforcing filaments to form a strand.

77. 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 mechanical strand and yarn forming operations, moistening a plurality of said strips or bands, mechanically advancing said strips or bands, and mechanically combining the moist advancing strips or bands with one or more metallic reinforcing filaments to form a yarn.

78. A process of making asbestos yarn which comprises binding and forming asbestos paper-like material of sufficient cohesiveness and tenacity to undergo subsequent mechanical strand and yarn forming operations, and of mechanically combining said paper-like material with a plurality of reinforcing filaments to form a yarn, at least one of said filaments being a wire.

79. A process of making asbestos yarn which comprises binding and forming asbestos material into thin uniform paper-like strips or bands of sufficient cohesiveness and tenacity to undergo subsequent mechanical strand and yarn forming operations, and mechanically uniting a plurality of said strips or bands with one or more filaments to form a strand or a yarn.

80. A method of making asbestos yarn from asbestos paper-like material bound

with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which comprises mechanically advancing said paper-like material and a plurality of reinforcing filaments, and mechanically twisting said paper-like material with said reinforcing filaments to form a yarn.

81. A method of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which comprises moistening said paper-like material, mechanically advancing said moist paper-like material and a plurality of reinforcing filaments, and mechanically twisting said moist paper-like material with said reinforcing filaments to form a yarn.

82. A method of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes forming a strand comprising said asbestos paper-like material, and arranging a filament helically around said strand to form a yarn.

83. An asbestos yarn formed of a strand comprising asbestos paper-like material and a filament helically arranged around said strand, said paper-like material being bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture.

In testimony whereof, I affix my signature.

JOHN ALLEN HEANY.

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with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which comprises mechanically advancing said paper-like material and a plurality of reinforcing filaments, and mechanically twisting said paper-like material with said reinforcing filaments to form a yarn.

81. A method of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which comprises moistening said paper-like material, mechanically advancing said moist paper-like material and a plurality of reinforcing filaments, and mechanically twisting said moist paper-like material with said reinforcing filaments to form a yarn.

82. A method of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes forming a strand comprising said asbestos paper-like material, and arranging a filament helically around said strand to form a yarn.

83. An asbestos yarn formed of a strand comprising asbestos paper-like material and a filament helically arranged around said strand, said paper-like material being bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture.

In testimony whereof, I affix my signature.

JOHN ALLEN HEANY.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,585,613, granted May 18, 1926, upon the application of John Allen Heany, of New Haven, Connecticut, for an improvement in "Yarn and Mechanism for and Processes of Making the Same," an error appears in the printed specification requiring correction as follows: Page 8, line 115, claim 32, after the word "filaments" and before the period insert the words *to form a yarn;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of August, A. D. 1926.

[SEAL.]

M. J. MOORE,
Acting Commissioner of Patents.

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M. J. MOORE,
Acting Commissioner of Patents.

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