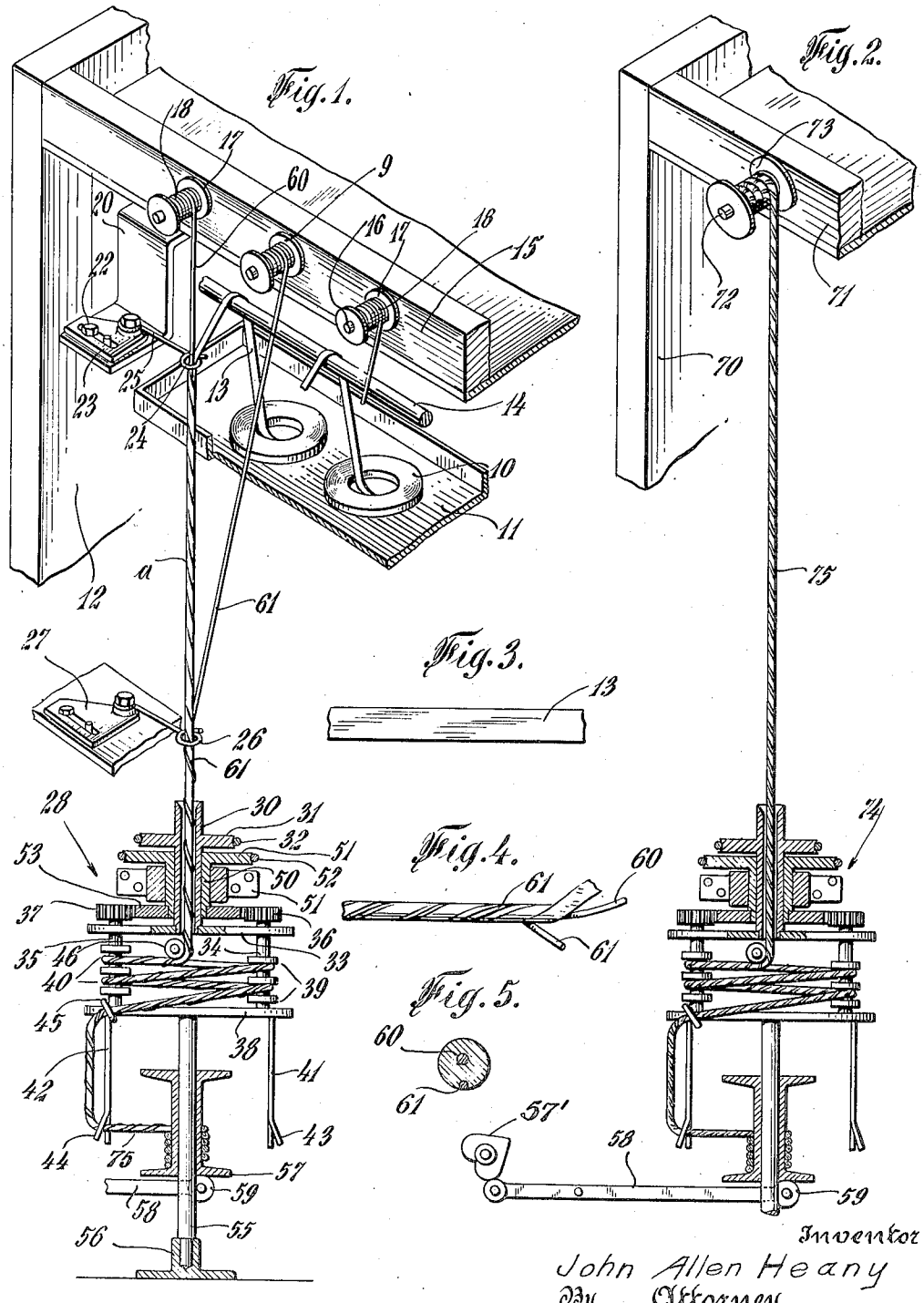
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PROCESS AND APPARATUS FOR MAKING YARN

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PROCESS AND APPARATUS FOR MAKING YARN.

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This invention relates to a process for an apparatus for making asbestos yarns. The invention has particular utility in connection with the manufacture of yarns from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture. My invention relates particularly to the manufacture of such a yarn which is markedly strong, compact and flexible; it also relates to the reinforcing of such a yarn by one or more suitable reinforcing filaments.

In my copending applications, Serial No. 654,117, filed July 27, 1923, Serial No. 654,118, filed July 27, 1923, Serial No. 684,325, filed January 4, 1924, and Serial No. 685,300, filed January 10, 1924, I have described various processes of making yarn utilizing paper strip in conjunction with a reinforcing filament. In my co-pending case 685,300, filed January 10, 1924, for example, I have described a yarn making process in which paper strip is moistened to loosen the binding material, is then wrapped about a core, and is finally twisted with a reinforcing filament. In the present invention, the processes of the co-pending application are, in certain features, improved upon, resulting in a more uniform product having improved qualities of strength, flexibility and uniformity.

It is accordingly one of the important objects of the invention to provide a process of making yarn in which the bunching of the material in the yarn is eliminated, the product having a pronounced smoothness and uniformity. Another object is the provision of an improved process in which rupture of the paper strip during the movement of the same through the mechanism is practically eliminated. An important object also is the provision of means in a yarn making process by which a yarn structure may be built up from fibrous material having considerable variation in length and other physical characteristics.

An object also contemplated is the provision of means whereby a non-coherent substance such as asbestos fibre may be formed into a strong and flexible yarn usable in fabrics requiring great resistance to wear as in friction fabrics for use in brake and transmission linings.

In my co-pending applications referred to above and also Serial No. 654,510, filed July 30, 1923, Serial No. 685,091, filed January 9, 1924, and Serial No. 685,092, filed January 9, 1924, I have described certain yarns in which a constituent element included paper material such as asbestos material. An important step in the process of manufacture of the yarn consists in binding and forming such material into a thin paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations. In the present invention, I have provided an improved yarn having increased flexibility and uniformity of diameter and also improved characteristics as regards tensile strength.

Additional objects, therefore, are contemplated in the provision of yarn which is uniform of diameter, which is markedly flexible and which possesses improved tensile strength. A further object is the provision of a yarn made of paper stock in which the metallic reinforcing filament is so embedded in the material that the external surface of the yarn is practically non-metallic.

Among the important features of the invention are the use of asbestos paper-like material or paper-like strips or bands of asbestos material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, the association of the paper-like asbestos material relatively loosely with a core or a filament, the securing of the paper-like material on the core by one or more helically arranged binding filaments, and the further uniting of the paper-like material and filaments as by twisting. It will be evident that in the final yarn the paper-like material and the filaments will be combined in a generally helical arrangement.

Generally stated, my invention involves a series of steps in which paper strip is first moistened in a liquid, such as water, and is then wrapped or twisted loosely on a filamentary support and along a sufficient length thereof to avoid bunching and to assure a uniform wrapping. Subsequently, a binding filament is twisted with the strand previously formed to effect a loose wrapping of the binding filament or element around the strand to hold the paper strip in position on the filamentary support or element and finally the strand, while moist, although this is not essential, is twisted on itself under tension to compact the yarn

material and embed the binding filament on the yarn surface. A feature of the invention is the employment of an initial loose twist of the paper with the core filament which serves to place the strip smoothly about the filamentary core of the yarn, and thus preventing binding of the material. Another feature of my invention is the utilization of a final binding twist on the yarn while under tension and preferably while the material is moist which serves to force the binding filament on the exterior of the yarn into the body thereof so that a smooth and uniformly dimensioned exterior surface is obtained. This latter characteristic of the yarn also eliminates wear of the binding filament, the wearing surface consisting entirely of the body material of the yarn.

Referring to the drawings:

Fig. 1 is a view partly in perspective of the preliminary twisting mechanism;

Fig. 2 is a view of the final twisting mechanism;

Fig. 3 is a view of a paper strip utilized in the process;

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

Fig. 5 is a cross section of the completed yarn.

The invention contemplates the use of paper strip in the manufacture of the yarn. This strip may be manufactured in accordance with the method disclosed in my copending application, Serial No. 516,129, filed November 18, 1921, in which the material, for example asbestos material, is formed into a pulp and passed through an ordinary paper making machine to form a web which is rolled up in the usual manner. This web, which in the paper making operation has been rendered sufficiently dry and compact, particularly at the surfaces thereof, to have the necessary strength, is separated by a slitting machine into narrow strips to be utilized in the manufacture of yarn. Satisfactory results are obtained by combining with the asbestos material in the pulp suitable binding material which serves to increase the strength of the finished web or paper, thus rendering it suitable for manipulation in the yarn making operations. Thin rolls 10 are placed in a liquid bath in order to loosen the binding material with which the asbestos material is combined in the manufacturing process. There is used for this purpose a tray 11, supported on appropriate standards 12, and a strip 13 is led from the center of each roll over a guide rod 14 similarly attached to the standards 12. Positioned above the guide rod 14 is a support block 15 also attached to the standards 12 and from the side of this block projecting over the rod and tray 11 are a plurality of spool pins 16 upon which spools 17 wound with filamentary material as wire or thread 18 are adapted to be positioned.

Depending from the block 15 is a bracket 20 having an outwardly extending arm 21 adapted to hold adjustably by means of a slot-bolt connection 22 a plate 23, and to the plate 23 is attached a pig tail guide loop 24 by means of a connecting rod 25. A second guide loop 26 similar to the loop 24 is mounted on an adjustable base 27 connected with the standard 12. The guide loop 26 is directly below the loop 24 at an appreciable distance therefrom varying in accordance with the general dimensions of the apparatus from one to two feet, although lesser and greater distances may be employed with good results, the requirements of the final yarn determining in some degree the exact distances desirable between the loops 24 and 26.

The twister 28 is positioned directly beneath the guide loop 26 and includes feed drive mechanism and twisting mechanism. The twisting mechanism is indicated as including a sleeve 30 adjacent the top of which is a drive pulley 31 on the periphery of which a drive cord 32 is positioned. At the base of the sleeve 30 a cross bar 33 is fixed, the same carrying at its respective ends the stub shafts 34 and 35. The stub shafts have affixed thereto at their upper ends the pinions 36 and 37 and their lower ends are adapted to have rotatable connection with a second cross bar 38. The shafts 34 and 35 carry also intermediate the cross bars 33 and 38 the guide rollers 39 and 40. Depending from either end of the cross bar 38 are rods 41 and 42, the ends of which are formed into pig tail guide loops 43 and 44. In addition to the guide mentioned, there is indicated also the guide loop 45 adjacent one end of the cross bar 38 and a guide roller 46 attached to and suspended from the cross bar 33 beneath the sleeve 30.

The feed mechanism of the twister is embodied in a sleeve 50 supported by a bracket 51 and surrounding the sleeve 30. The upper end of the sleeve 50 terminates in a drive pulley 51′ grooved at its periphery to receive the drive cord 52 and at its base terminates in a gear 53 which meshes with the pinions 36 and 37, hereinabove indicated.

The twister is supported on a rod 55 which contacts with the cross bar 38 at its middle point and rests upon a base plate 56. The rod 55 is adapted to receive the spool 57 upon which the strand of yarn is adapted to be wound as it comes from the twister. Reciprocating movement is given to the spool 57 in order to facilitate the winding of the yarn in layers thereupon, the mechanism for this action consisting in an appropriate rotating cam 57′ operating a lever 58 with a contact roller 59 at the

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end thereof and on which the spool 57 rests.

In utilizing the mechanism as described to this point and confining the operation to a single yarn, the tape 13 is led over the rod 14 and into the guide loop 24. A filament 60, led from the roll 18 on the spool 17 is similarly led through the guide loop 26 and into the twisting mechanism. The filament 61 fed from the spools 9 is led to the guide loop 26 and then into the twister. With the filaments 60 and 61 passed into the twister and secured to the spool 57, the drive mechanism is energized and the twist imparted to the filament, this twist extending from a point within the twister upwardly to the spools 9 and 17. Simultaneously, the tape or strip 13 which is flexible by reason of the prior saturation of the same to loosen the binder, is fed through the guide loop 24 and loop 26, the twisting of the filament 60 imparting a twist to the strip which is relatively loose, approximating about three twists to the inch. The strand *a* intermediate the loop 24 and loop 26 is free of any external holding means, but beneath the loop 26 the filament 61 is added to the strand and the three combined elements are passed together into the twister 26 and receive therein a further and increased twisting effect which causes a loose winding or wrapping of the filament or element 61 around the strand *a* to rest on the surface of the paper strip 13 and hold it in position on the element 60, thus forming a preliminary yarn 75 in satisfactory form for winding on the spool 57. It will be seen that the loop 26 acts to hold the strand *a* in a straight line and that the filament or element 61, as applied to the strand below the loop 26, lies entirely on the surface of the yarn and therefore must be supplied at a relatively lower tension than the element 60. In practice, tensioning is obtained by including the spool pins and where further increase of tension is required, by placing a device, such as a washer, on the outer end of the proper spool pin. The preliminary yarn as it emerges from the twister 26 is wound upon the spool 57 according to the operation previously indicated, and when the spool is full, it is removed and while the yarn thereupon is still moist, subjected to the second twisting operation, the details of which will now be indicated.

In Fig. 2 of the drawing, there is shown a standard 70 to which is attached a support 71 and a plurality of pins 72 extend outwardly from the support 71 and are adapted to receive spools 73 of yarn from the twister 26. A second twister 74 similar to the twister 26 is positioned beneath the pin 72 and is adapted to receive the preliminary yarn 75 unwound from the spool 73. Inasmuch as the twister 74 is similar in all details to those of twister 26, a description thereof will be omitted.

In continuation of the description of the operation, the yarn 75 as it comes from the twister 26 in preliminary form and while still moist is applied to the twister 74. In the second phase of the process, the yarn is subjected to a preliminary twist intermediate the spools 73 and second twister 74 and a final twist within the twister itself. The function of the second twister is to draw the preliminary yarn down to a smaller size and to compact the fibrous material and bind it into closer relationship with the central core and the external reinforcing filament. As hereinbefore stated, the twisting on spool 75 is effected under tension. In practice, the required tensioning is obtained by inclining the pins 72 to cause suitable frictional contact between one head of each spool and the support in which the spool pin is mounted. The operation of the twister 74 is such as to increase the number of twists per inch to two or three times that which the strand receives in the first twisting operation. In addition, the action of the second twister operating as it does upon the moist body material of the yarn, forces the external filament into the surface of the yarn, thereby giving the same a relatively smooth exterior, and since the number of twists per inch is considerably multiplied over that existing in the preliminary yarn, a much greater uniformity of product is secured.

The yarn as finally produced is illustrated in Figs. 4 and 5, Fig. 4 showing the filament 61 embedded in the surface of the yarn, and Fig. 5 showing the cross section of the same with the filament 60 in the center and 61 at the surface thereof.

It is important to note several features of the invention. One of the great difficulties encountered in manufacturing yarn from short-fibred stock is in the production of the same without lumps or bunching of material. This defect is largely obviated by employing the fibrous material in the form of a paper strip, the process of manufacturing the paper tending to smooth out the fibres and even the distribution of the same. The use of paper strip, however, does not wholly remove the tendency of the material to bunch when the paper strip is twisted with a filament. I have found, however, by passing the filament and the strip together through a single loop and then allowing a considerable distance between the initial loop and the twister, an initial twist is obtained which is exceedingly smooth. This is made possible by the extent of movement between the loop and the twister in which free adjustment of the strip and the filament relative to each other may be made. In

order to accomplish this result, it is advantageous to give the strip a preliminary twisting, winding the same on a spool and subsequently with the yarn elements in position, subjecting the same to a final close twist which will draw the material into proper dimensions and compact and bind the same in position.

For certain uses, however, the yarn is in usable form after coming from the first twister and I desire it to be understood that the process may include only this first twisting operation.

It is obvious that by means of the processes as above indicated, yarn material of great variety may be employed successfully in yarn manufacture. The process is independent of the length of fibres utilized, short-fibred stock being manipulated as readily and as successfully as long-fibred stock. Moreover, there is no limitation to the composition of the fibre, the process being equally applicable to mineral fibres and vegetable fibres. In view, however, of difficulties encountered in prior processes in the manipulation of short-fibred asbestos stock, the process has particular utility in connection with the manufacture of asbestos yarns, it being noted that where the filaments are employed are metallic in nature such as brass wire, for example, the yarn formed is entirely heat resisting and may be used for any purpose in which resistance to heat is essential and requisite. In case there is a wire core as just specified, the twisting operation will, as brought out more fully in said co-pending application, Serial No. 654,118, transform the straight core into a coiled, twisted or undulated form. It will be evident that the application of an external binding filament tends to increase the distortion of a metallic core due to the twisting operation and that an external binding filament would produce such distortion in a core even if the core were of thread.

A feature of the asbestos yarn made in accordance with my process is that the thickness of the yarn may be varied within wide limits, the external binding filament 61 holding the material successfully irrespective of the dimensions of the yarn. Consequently, where a fine asbestos yarn is desired which may be usable in weaving fabrics such as curtains, heat-resisting sheaths, electric wire conduits, garments, and the like, this process has very high utility.

In the description of the process hereinabove made, the yarn has been referred to as composed of a single paper strip uniting with a centering filament 60 and with the binding external filament 61. It is obvious, however, that instead of a single unit of each of these constituent parts, there may be employed two or more of these units, each combining with two or more units of the other constituent parts. For example, I may employ a core formed of two or more filaments, a single tape or strip 13 and two or more external filaments 61, or I may use a single external binding filament and two or more strips 13, the same being fed through the guide loop 24 and subjected to a process identical to that heretofore described in connection with the single combining elements.

It should be observed further that while I have indicated moistening of the roll 10 in the liquid as a means of loosening the binder of the paper strip, other means may be employed with equal facility such, for example, as mechanical bending or working of the paper. Mechanical manipulation may be employed not only to loosen the binder within the paper strip, but also to entirely remove the binder therefrom and this end may also be obtained in the case of mineral fibre by burning the strip. I have found, however, that while in some instances and in order to secure yarns having very high flexibility, it may be desirable to remove the binder of the paper entirely, ordinarily it is desirable to merely loosen the binder and not remove the same, the binder at the end of the yarn making process hardening and serving to give additional rigidity to the yarn sturcture. In this connection, it may be stated further that it is possible to form a yarn without loosening the binder in the paper strip, the initial twisting operation being sufficient to permit a proper working of the paper fabric. There is a tendency, however, in yarn made without an initial loosening of the binder for the strand to break in the twisting operation and unless the strand is relatively thick and unless the final yarn is required for certain specific uses in which the removal or loosening of the binder in the paper is disadvantageous, a prior moistening or mechanical loosening of the paper binder is found desirable.

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 precentage 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.

While I have shown in detail a specific method for manufacturing a yarn and apparatus for producing the same, it is apparent that various changes may be made in the structure and process which will be readily apparent to any one skilled in the art and which come within the spirit of

the invention, and therefore it is desired to cover the invention broadly as well as specifically as indicated in the appended claims.

I do not claim herein broadly the method of bringing together asbestos paper-like material and a plurality of filaments and then associating them into a yarn, or the yarn produced thereby, as such subject matter is covered in my co-pending application, Serial No. 685,300, filed January 10, 1924.

Having thus described the invention, what is claimed is:

1. A process for making yarn out of paper strip having a binder therein, which includes softening the binder of the strip, loosely twisting the strip with a filament to form a strand, twisting the strand with a second filament, and finally closely twisting the yarn.

2. A process for making yarn out of asbestos paper strip having a binder therein, which includes softening of the binder of the strip, twisting the strip loosely with a filament, subsequently twisting the strip and filament with a second reinforcing filament to form a preliminary yarn, and finally twisting the preliminary yarn to form a final yarn.

3. A process of making yarn from paper strip having a binder therein, which comprises softening the binder in the strip, combining the strip with a filament at one point, subjecting the strip and the filament to a loose twist between said point and a second point at a distance therefrom to form a smooth loosely twisted strand, and loosely twisting a second filament around the strand beyond the second point to form a preliminary yarn.

4. A process of making yarn from asbestos strip which includes forming a strand by loosely twisting the strip with a plurality of filaments displaced therealong, and subsequently closely twisting the strand to form a final yarn.

5. A process of making yarn from paper strip which includes loosely twisting the strip with a plurality of displaced filaments to form a strand, and subsequently twisting the strand upon itself in at least one stage to increase the closeness of the twist to form a final yarn.

6. A process of making yarn of asbestos paper strip which includes twisting the strip loosely with a filament to form a strand, subsequently twisting the strand with a second filament to form a preliminary yarn, and then twisting the preliminary yarn upon itself to form a final yarn.

7. A process of making yarn from an asbestos strip which comprises the steps of uniting the strip with a filament to form a strand, subjecting the strand to a loose twist over an extended length of the strand, and loosely twisting the strand with an additional filament supplied at a fixed point at such a distance from the point of application of the first filament as to permit the formation of a comparatively smooth twisted preliminary yarn.

8. A process of making yarn from paper strip which includes uniting the strip with a filament to form a strand, subjecting the strand to a loose twist over an extended length of the strand, then twisting the strand with an additional filament applied at a fixed point, and subsequently twisting the strand upon itself to form a final yarn.

9. A process of making yarn from asbestos paper strip which includes in combining the strip and a filament in loosely twisted relation over an extended length thereof to form a strand, twisting the strand with a second filament to form a preliminary yarn, and subsequently twisting the preliminary yarn upon itself to form a final yarn.

10. A process of making yarn of paper strip which includes passing the strip with a reinforcing element through a guide loop, twisting the strip and element together to form a strand, subsequently loosely twisting the strand with a second reinforcing element, and finally closely twisting the strand and second element together to form a final yarn.

11. The process of making yarn from an asbestos paper strip which includes initially twisting the strip loosely around a reinforcing filament and continuing such initial twisting action until the bunching of the material in the strip is eliminated to form a strand, wrapping a second filament around said strand to hold the strip thereon to form a preliminary yarn, and then closely twisting said strand and second filament to form a final yarn.

12. The process of making yarn from an asbestos paper strip which includes initially twisting the strip loosely around a reinforcing filament to form a strand, wrapping a second filament loosely around said strand to hold the strip thereon to form a preliminary yarn, and then closely twisting said preliminary yarn to form a final yarn.

13. The process of making yarn from a moistened asbestos paper strip which includes initially twisting the strip loosely around a reinforcing filament to form a strand, twisting a second filament loosely around said strand to hold the moistened strip thereon to form a preliminary yarn, and closely twisting said preliminary yarn while the strip is in its moistened condition to form a final yarn.

14. The process of making yarn from an asbestos paper strip which includes initially wrapping the strip loosely and uniformly around a continuously moving reinforcing

filament and continuing such initial wrapping action until the bunching of the material in the strip is eliminated to form a strand, continuously moving said strand, wrapping a second filament around said moving strand to hold the strip thereon to form a preliminary yarn, and then twisting said strand and second filament to form a final yarn.

15. The process of making yarn from a moistened asbestos paper strip which includes initially wrapping the strip loosely and uniformly around a continuously moving reinforcing filament to form a strand, continuously moving said strand, wrapping a second filament loosely around said moving strand to hold the moistened strip thereon to form a preliminary yarn, and then twisting said preliminary yarn while the strip is in its moistened condition to form a final yarn.

16. The process of making yarn from a moistened asbestos paper strip which includes initially wrapping the strip loosely around a longitudinally moving reinforcing core to form a strand, continuously moving said strand, wrapping a filament loosely around said moving strand to hold the moistened strip thereon to form a preliminary yarn, and closely twisting said preliminary yarn while the strip is in its moistened condition to form a final yarn.

17. The process of making yarn from a moistened asbestos paper strip which includes continuously rotating and advancing a reinforcing core, initially twisting the strip loosely around said core and continuing such initial twisting action until the bunching of the material in the strip is eliminated to form a continuously rotating and advancing strand, wrapping a filament loosely around said strand to hold the moistened strip thereon to form a preliminary yarn, and then closely twisting said strand and filament while the strip is in its moistened condition to form a final yarn.

18. A method of making yarn from an asbestos paper strip, which includes advancing a strip and a reinforcing element longitudinally, twisting the element to wrap the strip uniformly about the same with a gradually decreasing pitch to form a strand, wrapping a reinforcing element loosely around the strand to retain such uniformity and form a preliminary yarn, and subjecting the preliminary yarn to a tight twist to embed the second element in the strip material.

19. A method of making yarn from a moistened asbestos paper strip which includes advancing a strip and a reinforcing element longitudinally, twisting the element to wrap the moistened strip uniformly about the same with a gradually decreasing pitch to form a strand, wrapping a reinforcing element loosely around the strand to retain the uniformity of the moistened strip to form a preliminary yarn, and subjecting the preliminary yarn to a tight twist to embed the second element in the moistened strip material.

20. A method of making yarn, including supplying a paper strip at low tension and two reinforcing filaments at greater tension, bringing the strip and one of said filaments together at a predetermined uniting point to form a strand, bringing such strand and the second filament together at a predetermined second uniting point, and twisting and advancing the strip and filaments after passing the second uniting point to twist them together and to twist the strip and first filament together before reaching the second uniting point.

21. A process of making yarn which includes twisting a yarn element with a reinforcing element to form a strand, twisting the strand with a second reinforcing element to form a preliminary yarn, and finally closely twisting the preliminary yarn to form a final yarn.

22. A process of making yarn which includes making a strand from pulp containing asbestos material and binding material, twisting the asbestos strand with a reinforcing element to form a composite strand, twisting the composite strand with a second reinforcing element to form a preliminary yarn, and finally twisting the preliminary yarn to form a final yarn.

23. A process of making yarn which includes making a strand from pulp containing asbestos material and binding material, treating the strand to render the binding material more workable, twisting the asbestos strand with a reinforcing element to form a composite strand, twisting the composite strand with a second reinforcing element to form a preliminary yarn, and finally twisting the preliminary yarn to form a final yarn.

24. A process of making yarn which includes forming a web from a pulp containing suitable fibrous material, separating the web into strips, twisting one of said strips with a reinforcing element to form a composite strand, twisting the composite strand with a second reinforcing element to form a preliminary yarn, and finally twisting the preliminary yarn to form a final yarn.

25. The process of making yarn out of a strip of finished asbestos paper in which the fibres are held together by workable binding material, which includes treating the strip to render the binding material more workable, loosely twisting the strip with a reinforcing element to form a strand, loosely twisting the strand with the second reinforcing element, and finally closely twisting the yarn.

26. An apparatus for making yarn from a paper strip and two reinforcing filaments, comprising a twister acting upon the strip and filaments, means cooperating with the twister for wrapping said strip around one of said filaments to form a strand, means cooperating with the twister for wrapping the other filament around the strand, and means adjacent the twister for controlling the point at which the second filament is applied to said strand.

27. An apparatus for making yarn, comprising a twisting device, means cooperating with said device for wrapping an asbestos strip around a reinforcing element to form a strand, means also cooperating with the twisting device for loosely wrapping a second filament around said strand to form a preliminary yarn, and means for determining the point between the twisting device and the first mentioned means at which the wrapping of the second filament around said strand begins.

28. An apparatus for making yarn, comprising a twisting device, means for supporting a paper strip, means for supporting a reinforcing element, guide means cooperating with said device and said supporting means for wrapping said asbestos strip around said element to form a strand, and a supporting means for a second reinforcing element also cooperating with the twisting device for loosely wrapping the second element under relatively low tension around said strand to form a preliminary yarn.

29. An apparatus for making yarn, comprising a twister, guide means distant from said twister to bring together a strip and a filament for twisting into a loose strand, and means located adjacent the twister to effect an application of a second reinforcing filament to the strand at a certain minimum distance from the guide means.

30. In apparatus for making yarn, a twister, means for supporting a strip roll to permit the strip to be drawn freely therefrom in a direction transverse to the plane thereof, means including a guide distant from the twister to bring together the strip and a reinforcing filament for twisting into a loose strand, and means adjacent the twister to prevent a second reinforcing filament acted on by the twister from being prematurely applied to the strand.

31. An apparatus for making yarn from a paper strip and two reinforcing filaments comprising a twister acting upon the strip and filaments, means cooperating with said twister for wrapping said strip around one of said filaments to form a strand, means located adjacent the twister to effect an application of a second reinforcing filament to the strand at a certain minimum distance from the guide means and tensioning means for said filaments, said second filament being under a relatively low tension to enable the same to be loosely wrapped around the strand.

32. An apparatus for making yarn from a paper strip and two reinforcing filaments, comprising a twister acting upon the strip and filaments, guide means cooperating with the twister for wrapping said strip around one of said filaments to form a strand, the other filament being fed from a source so located as to enable it to be wrapped around the strand at a point between the guide means and the twister, and tensioning means for said filaments, said second filament being under a relatively low tension to enable it to be loosely wrapped around the strand.

33. 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, loosely twisting the strip or band with a filament to form a strand, and loosely introducing a reinforcing element at an intermediate stage of the twisting to be twisted with the strand to form a preliminary yarn, and closely twisting said preliminary yarn to form a final yarn.

34. 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, combining the strip about a reinforcing core to form a strand, twisting the strand with a reinforcing filament to form a preliminary yarn, and finally closely twisting the preliminary yarn to form a final yarn.

35. 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, loosely uniting the moistened strip or band about a reinforcing core to form a strand, and at a later stage loosely twisting a second filament with said strand in moistened condition to form a moistened preliminary yarn, and closely twisting said moistened preliminary yarn to form a final yarn.

36. 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

Process of making yarn from asbestos paper (US Patent 1,585,615, 1926)
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forming operations, loosely combining the strip with a core to form a strand, and, during a later stage of such strand forming, loosely combining the strand with a reinforcing element to form a preliminary yarn, and finally closely twisting said preliminary yarn to form a final yarn.

37. 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, loosely combining said softened strip or band with a filament to form a strand, loosely twisting a second filament with the strand in moistened condition to form a moistened preliminary yarn, and closely twisting said moistened preliminary yarn to form a final yarn.

38. 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, loosely twisting the strip or band with a plurality of reinforcing filaments to form a preliminary yarn, and finally closely twisting the preliminary yarn to form a final yarn.

39. 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, loosely combining the strip or band with a plurality of reinforcing filaments with said reinforcing filaments located on opposite sides of the strip to form a preliminary yarn, and finally closely twisting the preliminary yarn to form a final yarn.

40. 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, loosely combining the moistened strip or band with a plurality of reinforcing filaments to form a moistened preliminary yarn, and finally closely twisting the moistened preliminary yarn to form a final yarn.

41. 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, loosely combining the moistened strip or band with a plurality of reinforcing filaments to form a moistened preliminary yarn, and finally closely twisting the moistened preliminary yarn to form a final yarn.

42. 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, loosely combining the moistened strip or band with a plurality of reinforcing filaments with said reinforcing filaments located on opposite sides of the strip to form a moistened preliminary yarn, and finally closely twisting the moistened preliminary yarn to form a final yarn.

43. 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 the strip or band loosely about a reinforcing core to form a strand, wrapping a filament about said strand to hold the strip or band thereon to form a preliminary yarn, and closely twisting said preliminary yarn to form a final yarn.

44. A process 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 associating one or more strips or bands with one or more filaments, binding said associated strip or band or strips or bands and said filament or filaments together by means of one or more additional filaments, and further uniting said strip or strips and said filaments.

45. A process of making asbestos yarn, which comprises binding and forming asbestos material into paper-like strips or bands, associating one or more of said strips or bands with one or more tension filaments over such a distance as to enable a free adjustment of said strip or band and the filament relative to each other, and after such adjustment helically arranging one or more binding filaments around the associated strip or band or strips or bands and the tension filament or filaments, to form a strand or preliminary yarn.

46. A process of making yarn, which consists in forming paper-like strips or bands of asbestos material united with binding material, associating at least one of said strips or bands with a core of at least one filament,

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binding such parts together by at least one other filament, and further uniting said strip or band or strips or bands and said filaments.

47. A method of making asbestos yarn from paper-like strips or bands of asbestos material bound with sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, which comprises associating one or more of said strips or bands with a core over such a distance as to enable a free adjustment of the strip or band or strips or bands and the core relative to each other to form a strand, and arranging one or more binding filaments around said strand to form a yarn.

48. A method of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations, which comprises moistening the paper-like material, associating the moistened paper-like material with a core, arranging a filament helically around such parts to bind them together, and further uniting said paper-like material, said core, and said filament.

49. 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, associating the strip or band with a filament, binding said strip or band and said filament together by means of a second filament to form a preliminary yarn, and twisting said preliminary yarn to form a final yarn.

50. A process of making asbestos yarn, which comprises binding and forming asbestos material into a paper-like strip or band, associating said strip or band with a tension filament, arranging a binding filament helically around the strip or band and the tension filament to form a preliminary yarn, and twisting said preliminary yarn in a direction to draw the binding filament tighter.

51. 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 strand and yarn forming operations, associating said strip or band with a tension filament and a binding filament to form a yarn with the tension filament having undulations, and further uniting said strip or band, said tension filament, and said binding filament.

52. A process of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which comprises associating the paper-like material with one or more filaments, binding said paper-like material and said filament or filaments together by means of one or more additional filaments, and further uniting said paper-like material and said filaments.

53. A process of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which comprises associating said paper-like material with one or more tension filaments, helically arranging one or more binding filaments around the paper-like material and the tension filament or filaments, and further uniting the paper-like material and said filaments.

54. A process of making yarn, which consists in forming asbestos paper-like material, associating the paper-like material with a core of at least one filament, binding such parts together by at least one other filament, and further uniting said paper-like material and said filaments.

55. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises forming asbestos paper-like material, moistening said paper-like material, helically associating said paper-like material with a core over such a distance as to enable a free adjustment of the paper-like material and the core relative to each other to form a strand, and arranging one or more binding filaments around said strand to form a yarn.

56. 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 the material, associating the moistened material with a core, arranging one or more filaments helically around such parts to bind them together, and further uniting said material, said core, and said filament or filaments.

57. A process 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 associating the paper-like material with one or more filaments over such a distance as to enable a free adjustment of the paper-like material and the filament or filaments relative to each other, and after such adjustment mechanically binding said paper-like material and said filament or filaments together by means of one or more additional filaments to form a preliminary yarn.

58. A process of making asbestos yarn, which comprises forming asbestos paper-like material, mechanically associating said paper-like material with one or more tension filaments, mechanically aranging one or more binding filaments helically around the paper-like material and the tension filament

or filaments to form a preliminary yarn, and mechanically twisting said preliminary yarn in a direction to draw the binding filament or filaments tighter.

59. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises forming asbestos paper-like material, mechanically associating said paper-like material with one or more tension filaments and with one or more binding filaments to form a yarn with the tension filament or filaments having undulations, and further mechanically uniting said paper-like material, said tension filament or filaments, and said binding filament or filaments.

60. A method 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 mechanically associating said paper-like material with a tension filament and a binding filament to form a yarn with the tension filament having undulations, and further mechanically uniting said paper-like material, said tension filament, and said binding filament.

61. 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 associating the paper-like material with one or more filaments over such a distance as to enable a free adjustment of the paper-like material and the filament or filaments relative to each other, mechanically binding said paper-like material and said filament or filaments together after such adjustment by means of one or more additional filaments to form a preliminary yarn, and further uniting said paper-like material and said filaments to form a final yarn.

62. 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 associating the moist paper-like material with one or more filaments over such a distance as to enable a free adjustment of the paper-like material and the filament or filaments relative to each other, mechanically binding said paper-like material and said filament or filaments together after such adjustment by means of one or more additional filaments to form a preliminary yarn, and further uniting, as by twisting, said paper-like material and said filaments to form a final yarn.

63. A method of making asbestos yarn from asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which comprises helically associating the paper-like material with one or more filaments over such a distance as to enable a free adjustment of the paper-like material and the filament or filaments relative to each other, binding said paper-like material and said filament or filaments together after such adjustment by helically arranging around the same one or more additional filaments to form a preliminary yarn, and further uniting, as by twisting, said paper-like material and filaments to form a final yarn.

In testimony whereof, I affix my signature.

JOHN ALLEN HEANY.