May 18, 1926. 1,585,614

J. A. HEANY

YARN AND APPARATUS AND PROCESS FOR MAKING YARN

Original Filed Jan. 4, 1924 2 Sheets-Sheet 1

Fig. 1.

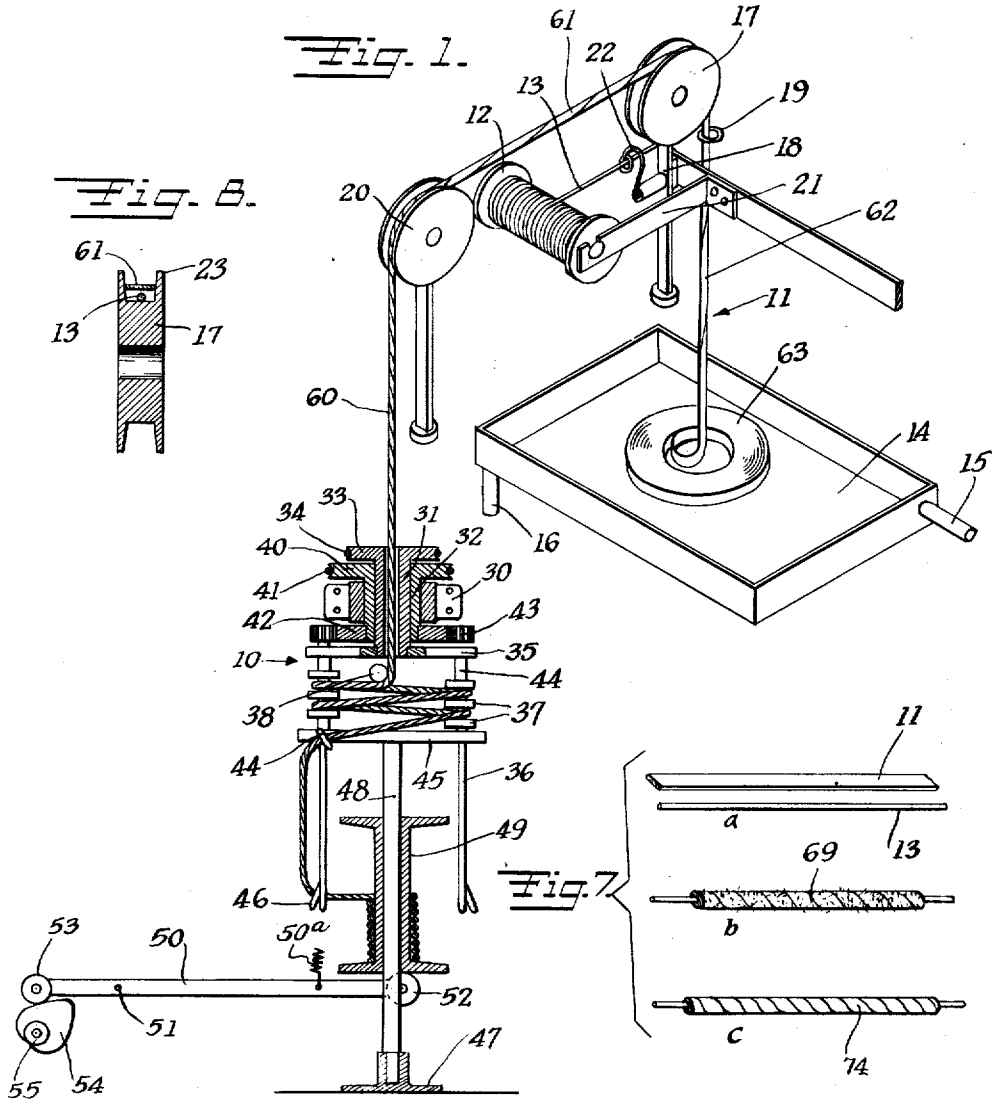


Fig. 8.

Fig. 7.

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Fig. 2.

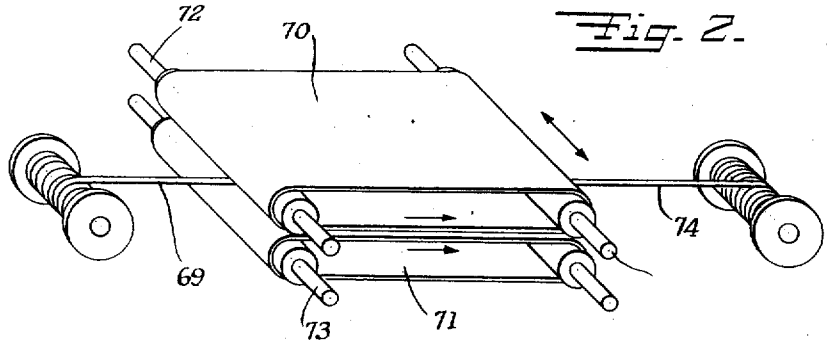


Fig. 3

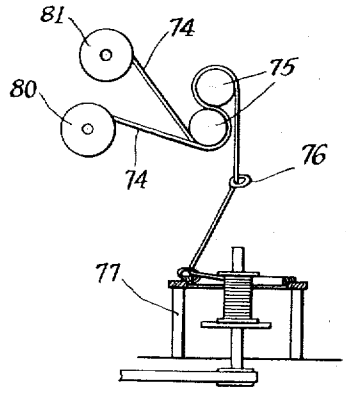


Fig. 4.

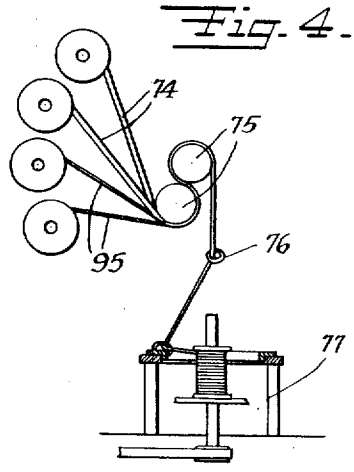


Fig. 5.

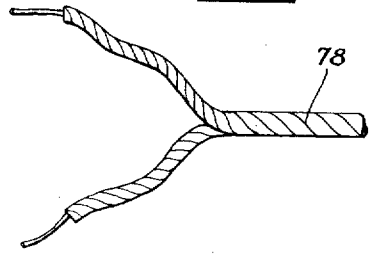
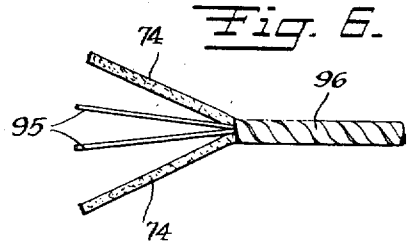


Fig. 6.



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UNITED STATES PATENT OFFICE.

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YARN AND APPARATUS AND PROCESS FOR MAKING YARN.

Application filed January 4, 1924, Serial No. 684,325. Renewed January 28, 1926.

This invention relates to a process for manufacturing yarn out of paper strip and more particularly of asbestos paper or similar materials and to apparatus requisite for carrying out the process.

In the method of yarn manufacture heretofore employed, it has been usual to form the yarn fibres into loose rovings which were subsequently built about a thread or metal core to form a yarn. Disadvantages of this method lie in the fact that it becomes in general essential to use fibres of appreciable length in order to give coherence to the roving and also in that a carding step is generally requisite to align the fibres.

Among the objects of the invention, therefore, is contemplated the provision of a simple process whereby yarns may be manufactured from either long or short fibred asbestos material, which may be bound and formed into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand and yarn forming operations.

Another object is the provision of means for the manufacture of yarn from a paper strip in which the binding material has been loosened by moistening.

An important object is the provision of means for the manufacture of yarn from asbestos material irrespective of the length, texture or strength of the individual fibres.

Another object contemplated is the utilization of means for manipulating and processing a non-coherent element and a relatively stronger supporting material so that the two form together a closely compacted and tenacious yarn structure.

An object also is the provision of a step in the yarn manufacturing process which includes shaping the yarn by a rubbing manipulation adapted to smooth out the corrugations and unevenness of the yarn and give uniformity to the product. Still another object is the provision of apparatus by means of which paper strip may be utilized in the manufacture of yarn without the necesity of placing tension on the strip which would result in breakage of the material.

Further objects are contemplated in the provision of apparatus permitting the use of a varied number of paper strips or reinforcing cores dependent upon the requirements of the finished product; the utilization of highly simplified mechanism readily permitting multiple unit manufacture; the employment of asbestos fibre of either short or greater lengths in the manufacture of yarns, the fibres by incorporation with the binder being independent of frictional contact with each other; and other objects intimately associated with the processes involved and the mechanism and apparatus utilized as will become evident from examination of the description of the indicated method hereinafter detailed and from inspection of the accompanying drawings illustrative of the arrangement which may be preferred, fulfilling the contemplated objects of the invention.

One of the more important features of the present invention comprises the method of making an asbestos yarn from asbestos paper-like material, or, more specifically, from a strip or band of asbestos material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes the step of helically arranging said asbestos paper-like material or said strip or band in flat form directly with a reinforcing filament or core. Another of the more important features of the invention comprises the method of making yarn from an asbestos paper-like strip or band, which comprises associating said strip or band about a reinforcing filament or core, shaping or condensing said strip or band on the filament or core to form a strand, and thereafter combining said strand with one or more reinforcing filaments to form a yarn.

Referring to the drawings:

Fig. 1 is a view in perspective showing the twisting mechanism employed in the initial stage of manufacture;

Fig. 2 is a perspective view of the rubbing mechanism for compacting the fabric upon the yarn;

Fig. 3 is a diagrammatic view of a twister operating upon two yarn strands to form a final intertwisted yarn;

Fig. 4 is a diagrammatic view of a twister operating on a plurality of strands and a plurality of reinforcing filaments;

Fig. 5 is a view of a portion of the com-

pleted yarn and of the strands and cores forming the same;

Fig. 6 shows a portion of the yarn with separated elements manufactured according to the process of Fig. 4;

Fig. 7 is a view illustrative of the various steps in the manufacture of the completed yarn from paper fabric and the reinforcing core; and

Fig. 8 is a view of the roller runway.

In carrying out the present invention by the apparatus illustrated in the drawings, a roll of asbestos paper strip or a paper strip of similar characteristics is moistened sufficiently to render it flexible and is then drawn with little or no tension applied to it into juxtaposition or light contact with a reinforcing filament. The roll of paper strip is preferably placed horizontally and the paper taken from the inner end and drawn upwardly to and over a roller around which said filament is supplied, the only tension being that of the weight of the short strip as the paper strip comes into contact with the reinforcing filament. The strip is then given a slight twist which serves to wrap it about the filament and thus gives it sufficient support for the following twisting operation. In this initial twisting step the asbestos paper is wound uniformly about the reinforcing filament so that upon subsequent twisting it forms a substantially uniform strand. The filament and lightly twisted paper strip are then passed over a guide roller and are given a second, tight twist which draws the strip tightly and compactly about the filament and shapes it thereon so that it forms a unitary strand therewith and may be subjected to compacting and finishing operations or to twisting with other reinforcing strands or yarns. It should be understood that the slight twist of the paper strip about the portion of the filament between the two rollers is effected as a result of the slipping of the strand on the roller from which the strand passes to the twisting apparatus. The tightly twisted reinforced yarn may then be finished or smoothed by rubbing or other suitable means or may be twisted with another reinforcing filament or yarn. Any suitable reinforcing filament may be employed such as a metallic wire or a strand of cotton jute.

In order to more clearly describe the invention, the view in Fig. 1 of the twisting mechanism has been limited to a single element, although in practice use is made of a battery of units driven by elements common thereto. There is shown in this figure a twister 10 adapted to receive from a roll 63 of tape 11 and a spool 12 the elements requisite to the formation of the yarn. Although the tape referred to may be of other material, it is as applied to a more specific form of the invention, composed of asbestos fibre held together by suitable binding material.

A mode of manufacturing the paper and the strip cut therefrom is described in my co-pending application, Serial Number 516,129, filed Nov. 18, 1924.

As described in said co-pending application, Serial No. 516,129, the 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 in the surface portions thereof, to have the necessary strength, is separated by a slitting machine into narrow strips to be utilized in yarn manufacture. 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.

The core or reinforcement element 13 is for the purposes of this disclosure a slender wire of brass or metal having similar characteristics, the tensile properties of which, together with its susceptibility to bending, make it desirable as a reinforcing element of the fabric. It is understood, however, that any other core element may be employed such as vegetable fibre in the shape of cotton.

In the apparatus of Fig. 1, the roll of tape 63 is placed on its flat side within a tray 14 which is adapted to receive water through an inlet 15 in order to moisten the tape. An outlet 16 for the liquid within the tray is also provided. Above the tray and positioned so as to be above the tape is a roller 17 supported by a bracket 18. The tape is adapted to be fed over this roller, there being a circular guide loop 19, through which the tape is adapted to have passage, intermediate the roller and the tray and adjacent the roller. The bracket 18 is adapted to support also a second roller 20 the axis of which lies approximately in the plane horizontal with the axis of the roller 17 and over this roller, coming from the roller 17, the tape is adapted to have movement.

The spool 12 is supported from the bracket 18 through side plates 21 intermediate and below the rollers 17 and 20 and the wire is adapted to feed through a small guide loop 22 around the lower side of the roller 17 and over the same and over the second roller 20 beside the strip of asbestos tape. Since the wire feeds from the under side of the roller 17, it is evident that the tape covers the core as indicated in Fig. 8, thus permitting free movement of the tape and preventing binding and grooving of the fabric. Both rollers 17 and 20 are provided with approximately

radial flanges 23 which channel the tape and core, although permitting a certain degree of movement of the same. (See Fig. 8.)

From the roller 20, the wire and tape are together fed into the twister 10. Preferably, this part of the mechanism is positioned immediately below the roller 20 so that the tension of twisting tends to maintain the strand properly upon the roller 20. The twister is of a usual type, including a twist drive which determines the number of twists put in in a given time, and a feed drive which, in connection with the twist drive, determines the rate of feed of the strand through the twister and consequently the number of twists per unit of length of the twister strand or yarn. As illustrated, the drive elements include a central twist sleeve 31 and an outer feed sleeve 32, the latter being supported by a bracket 30. The twist sleeve 31 is hollowed axially to receive the strand and carries at its upper end a pulley wheel 33 adapted to be driven by the pulley belt 34. The lower end of the sleeve 31 carries a cross plate 35 to which are attached depending legs 36, the latter carrying a plurality of rollers 37 adapted to receive the yarn strands. A guide roller 38 is positioned near the axis of the twister.

The feed mechanism includes the feed sleeve 32 positioned about the twist sleeve 31, there being a drive pulley 40 at the top of the sleeve connected to a pulley belt 41. At the base of the feed sleeve is attached a gear 42, adapted to mesh with pinions 43, these latter pinions being connected by shafts 44 to the guide rollers 37. It is apparent, therefore, that the speed at which the strand is fed to the twister is dependent upon the speed of the pulley wheel 40 and by varying the speed of this pulley, the number of twists per inch, for example, may be varied.

A guide loop 85 is fastened to a cross bar 45 on the legs 36 of the twist mechanism and also at the base of the legs 36 additional guide loops 46 are constructed.

The cross bar 45 is adapted to be supported from base 47 by means of a rod 48 upon which the spool 49 is adapted to have slidable movement. For purposes of illustration, means for moving the spool in the reeling operation is diagrammatically indicated, the same comprising a lever arm 50 pivoted at 51 having end contact bearings 52 and 53, the bearing 52 being adapted to have frictional engagement with the base of the spool 49 and the bearing 53 being adapted to have operative contact with the heart-shaped cam 54, pivotally mounted as at 55. The right hand end (Fig. 1) of the lever is urged upwardly by suitable means such as a spring 50a attached at its lower end to the lever to move the spool upwardly and hold the contact bearing 53 against the cam 54. It is clear from this illustration that the rotation of the cam 54 will cause a reciprocation of the spool 49 on the rod 48 and if this reciprocation is properly timed, the yarn will be wound in layers around the spindle of the spool.

It is now possible to describe consecutively the initial twisting operation by which the primary strand of a yarn is formed from the elementary tape and core.

The tape and core 13 as illustrated in Figs. 1 and 7a are placed in the mechanism of Fig. 1, the tape 11 in the form of the roll 13 lying flat in the tray 14 and the core 13 on the spool 12. The free ends of these elements are now threaded through the various guide loops and over the rollers 17 and 20 into the twister 10 and power applied to the twisting mechanism. The effect of the twist of the twister 10 on the wire and tape immediately above the pulley 33 and intermediate the tape in the tray 14 is as follows.

The section 60 intermediate the roller 20 and twister is twisted to a limited extent, the tape being wrapped or arranged helically about the core, the section 61 intermediate the rollers 17 and 20 is twisted only a few times while the section 62 is practically free of twist except for such twist as arises from the origin of the tape from the roll. As illustrated, the tape leaves from the roll 63 at its center and there are two or three twists in the tape, the number depending on the length of the section 62, between the roll 63 and the roller 17. The twisting of the tape in section 61 is due primarily to the slipping of the strand as it moves about the roller 20. If the tension between the roller 20 and twister 10 were sufficiently high, there would be no slippage, the point of contact with the roller 20 acting as a fixed point of support and the tape in the section 61 being free of twist except for that which arises from the unrolling of the tape from the roll 63. The tension, however, is adjusted so that the twist of the strand effective at the roller 20 occasionally slips and transmits the portion of the twisting action onto the section 61 so that in operation, the tape in the section 61 is wrapped a number of times about the core.

From the description of the operation as given to this point, it is apparent that there are three stages of twisting prior to the entry of the strand into the twister proper, the twists occurring in the sections 62, 61 and 60 and that in these three stages the twist is increased progressively. That this initial twisting of the tape is desirable, arises from the fact that the tape is moist and that the binder of the paper is dissolved, the paper having very little strength. Consequently, if in traveling from roller 17 to roller 20, there be no means of support for

the moist tape, it would tend to sag and break. Inasmuch, however, as the tape is wrapped around the wire, this sagging is prevented and the tape is carried in proper relation over to the pulley 20 where the full twisting force of the wire is transmitted to the tape. Attention is directed to the fact that the roll of tape 63 is placed in the tray so that its convolutions have a direction in unwinding similar to that of the twister so that the preliminary twist due to the unwinding of the tape is in the same direction and adds to the twisting imparted by the twisting operation.

The distance intermediate the tray and roller 17 is relatively small so that the weight of upstanding portion of free tape is insufficient to cause breakage, even though the paper is thoroughly saturated and beyond the roller 17 the union of the tape with the wire prevents any rupture of the fabric.

The strand 69, as it comes from the twisting mechanism, is wound on the reel or spool 49, is somewhat rough due to minor irregularities in the laying of the strip as suggested in Fig. 7[b]. The next step, therefore, is to pass the strand through a rubbing or condensing machine such as is indicated in Fig. 2, there being shown in this Fig. 2, overlying belt structures 70 and 71, the belt structure 70 being mounted on the rollers 72 and the belt 71 on the rollers 73. These belts have a laterally reciprocating as well as forward movement so that the strand 69 in passing between the belt is subjected to a lateral or transverse reciprocation while moving forwardly in the direction as indicated by the arrows in Fig. 2. This combined forward and lateral movement smoothes the material and works or shapes the pulp about the core so that on emergence, it is a closely compacted and rounded strand as indicated by 74 in Fig. 7[c]. In actual manufacture of the yarn, a number of separate strands are simultaneously manipulated by the condenser, forming a plurality of separate spools of smoothed strands.

After the condensing operation, the strand is ready for the final twisting step. This operation consists in a simple twisting movement utilizing the form of mechanism shown in Fig. 1 and diagrammatically indicated in Fig. 3. Referring to Fig. 3, there are shown two spools 80 and 81 of preliminary yarn strands 74 and these strands are fed simultaneously over guide rollers 75 through guide loops 76 into the twister 77, the material emerging as a final twisted yarn 78 indicated as in Fig. 5 with the two strands uniformly and closely wrapped about each other, forming a compact and strong yarn suitable for any use, requiring great strength and wearing properties and resistance to heat. It is pointed out that the paper or paper-like strip or band which is wrapped about the wire cores is retained in place not only by the twist of the core element itself, but also by the interengagement of the two adjacent strands, one aiding the other in maintaining the material in position in the yarn. The number of twists per unit of length is such that under all ordinary circumstances and in all ordinary uses, the paper material is held closely in position in the yarn structure, there being little, if any, tendency for fraying or separation from the holding core element.

In summary of the various steps above indicated, the general process is as follows:

Paper in the form of a narrow strip, preferably composed of asbestos held together by a binding material including starch, is subjected to moisture, to loosen the binder and then fed with a filament such as brass wire over a carrier including a plurality of rollers where a preliminary twist is imparted to the strip and the filament sufficient to loosely unite the two elements together. The combined strip and filament is then fed into a twisting mechanism to produce a preliminary yarn which subsequently is passed through a condenser machine to round out and smooth the strand and then finally twisted with another similar strand or another reinforcing filament.

When desired, marked flexibility of the yarn may be obtained by eliminating the binder from the paper by means of mechanical vibration or heat. In cases where a somewhat stiffer type of yarn is preferred, such yarn may be obtained by eliminating part only of the binder in the manufacturing process and retaining a sufficient amount to give the desired stiffness. To obtain such difference in stiffness, the amount of moisture applied to the type may be varied by the amount of water supplied in the tray, such amount being readily controlled by the operator.

The general process as outlined above is applicable to the use of the single tape in connection with a single core but variations from this simple combination may readily be made. In certain cases two wires may be supplied for twisting with the single tape 11, such wires being supplied in any suitable manner, as, for example, from a single spool 12. If desired, the number of wires may be multiplied in any other way and also the number of tapes or strips used may be increased with or without increasing the number of wires, thus producing a final yarn, the strength and characteristics of which may be varied within wide limits.

In Fig. 4, there is illustrated diagrammatically a modification of the apparatus and process in which the final twisting step includes as an addition to the strands 74, one or more wires 95, these wires being adapted to be led along the guide rolls 75

and guide loop 76 into the twister 77 as a single unit, the twisting operation wrapping the free wire filaments closely about the strand 74. This modified procedure produces a finished yarn having exceptionally high tensile and wearing properties, the additional bare wire filament 95 wrapping itself about the exterior of the preliminary yarns and tending to bind the loose fibres in position and preventing the same from being combed out of the final yarn by friction or contact with foreign bodies. In Fig. 6, a portion 96 of the completed yarn produced according to the modification of Fig. 4, is illustrated.

I make no claim or claims herein broadly to a multi-strand asbestos yarn, as that is covered in my co-pending application, Serial No. 82,250, filed January 19, 1926; nor do I claim broadly herein the process of manufacturing a multi-strand asbestos yarn, as that is embraced in my co-pending application, Serial No. 82,249, filed January 19, 1926. Mention is also made herein that a plurality of wires may be combined with one or more tapes or strips 11 or a plurality of strips may be combined with one or more filaments, but I make no claim or claims herein to such subject matter broadly as the same is claimed in my co-pending application, Serial No. 685,300, filed January 10, 1924, renewed January 25, 1926.

For convenience in illustration, there is shown one independent mechanism for carrying out each step of the process. It should be understood, however, that the embodiments of such mechanisms here shown are merely illustrative and that the other suitable forms of mechanism may be substituted therefor. It will readily be seen, however, that, instead of using mechanism in which winding the article on a spool after each operation is necessary, use may be made of mechanism in which certain successive steps may be carried out continuously. It is to be expressly understood, however, that, in so far as the method is concerned, I do not limit myself to the apparatus illustrated and described herein, as the method is not dependent in any wise upon said apparatus but may obviously be 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 inasmuch 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 method or process claims. It should also be expressly understood that the mechanism disclosed is merely illustrative and that the same may be changed or modified in various respects without departing from the true spirit of the invention as defined in the apparatus claims.

Note should be made also of the fact that while it is not essential that the enclosing paper pulp be moist in the rubbing operation and in the final twist operation, it is desirable that a certain amount of moisture be present in order to facilitate the smoothing and condensing process and more readily permit an intimate interengagement of the various strands. It has been found possible also to omit moisture entirely from the initial twisting operation and though dry material is not so readily worked as wet, and, moreover, is more subject to breakage in some conditions and where certain types of raw material is employed, as in long-fibred stock, a dry working may be 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 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.

While the invention has been described with reference to a single specific disclosure, it is apparent that modifications of the inventive idea may be readily made by those skilled in the art to which the invention pertains. It is not desired, therefore, to limit the invention except as defined in the claims hereunto appended.

Having thus described the invention, what is claimed is:

1. A process of making yarn from paper strip which comprises twisting the strip around a reinforcing core, condensing the strip on the core to form a strand, and finally twisting the strand with a reinforcing element.

2. A process of making yarn from paper strip which comprises moistening the strip, twisting the strip while wet with a reinforcing core, condensing the strip around said core to form a strand, and finally twisting the strand with a reinforcing element.

3. The process of making yarn including forming a strip of asbestos material held together by workable binding material, twisting the strip about a reinforcing core, and shaping the strip about said core.

4. The process of making yarn including forming a strip of asbestos material held together by binding material, treating the strip to render it more workable, twisting the strip about a reinforcing core, and shaping the strip about said core.

5. The process of making yarn from asbestos paper strip containing binding material, which comprises softening the binding material by which the fibres of the strip are held together, and immediately thereafter twisting the strip about a supporting core which is being simultaneously twisted.

6. The process of making yarn from asbestos paper strip containing binding material, which comprises loosening the binding material by which the fibres of the strip are held together, twisting the strip about a supporting core which is being simultaneously twisted, and subsequently shaping the strip about the core to form a strand.

7. The process of making yarn from asbestos paper strip having binding material incorporated therewith, which comprises softening the binding material by which the fibres of the strip are held together, and twisting the strip in successive stages of increasing twist about a supporting element.

8. The process of making yarn from paper strip having binding material incorporated therewith, which comprises loosening the binding material by which the fibres of the strip are held together, twisting the strip about a supporting core in successive stages, including a primary stage where the twists are relatively few, and a subsequent stage where the twists are relatively numerous.

9. The process of making yarn from paper strip having binding material incorporated therewith, which comprises loosening the binding material by which the fibres of the strip are held together, twisting the strip about a supporting core in successive stages, including a primary stage where the twists are relatively few, and a subsequent stage where the twists are relatively numerous, and subsequently shaping the strip about said core.

10. A process of making yarn from asbestos paper strip, which comprises placing a roll of strip in a moistening device, moistening the strip, and feeding the moistened strip through a twisting mechanism with a strip supporting element.

11. A process of making yarn from asbestos paper strip, which comprises placing a roll of strip in a moistening receptacle, moistening the strip, feeding the moistened strip through a twisting mechanism with a strip supporting element, and subsequently shaping the strip on the supporting element to form a strand.

12. A process of making yarn from asbestos paper strip, which comprises placing a roll of strip in a moistening receptacle, moistening the strip, feeding the moistened strip through a twisting mechanism with a strip supporting element, subsequently shaping the strip on the supporting element to form a strand, and finally twisting the strand with another supporting element.

13. In apparatus for making yarn, the combination of a moistening receptacle, adapted to receive paper strip rolls, a twisting device, and means including a plurality of rollers for guiding said paper strip from the receptacle to said twisting device.

14. In apparatus for making yarn, the combination of a moistening receptacle, adapted to receive paper strip rolls, a twisting device, a support for a reinforcing element, means including a plurality of rollers for guiding said paper strip from the receptacle and said reinforcing element from its support to said twisting device.

15. A method of making reinforced yarn of fibrous asbestos material, comprising forming a relatively weak strip of fibres of such material, twisting said strip under low tension with a reinforcing element to form a strand, and twisting with a tight twist the composite strand so formed.

16. A method of forming a reinforced yarn, comprising supplying a reinforcing element, applying a strip of comparatively low strength freely from a source of supply to said element, winding the strip loosely on the element, and twisting the strip and element.

17. 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 such withdrawal for guiding the strip from the roll to the twisting means, and means for bringing a reinforcing element into engagement with the guide in juxtaposition with the strip for twisting therewith.

18. In apparatus for making yarn, a support adapted to receive a paper strip mass from which a paper strip may be drawn substantially without drag and without moving said mass, a twisting device, means for guiding the strip from the strip mass to the twisting device including a guide having a groove over which the strip passes on its way to the twisting device, and a second guide to receive the strip from the first guide and direct it to the twisting device, and means for supplying a reinforcing element to said groove beneath the strip to enable the element to be fed with the strip to the second guide and to the twisting device.

19. In apparatus for making yarn, a support adapted to receive a paper strip mass from which a paper strip may be drawn substantially without drag and without moving said mass, a twisting device, means for guiding said strip in the proper direction from the mass on said support and to the twisting device, and means for supplying

a reinforcing element to the strip at the guiding means to be twisted with the strip as they pass to the twisting device.

20. In apparatus for making yarn, means to support a roll of strip material lying flat thereagainst to permit the strip to be drawn off transversely of the roll, a twisting device, a guide roller to receive the strip from the roll and having in its periphery a groove over which the strip passes, means for supplying a reinforcing element to the groove of said roller to permit the strip to wind loosely around the element as it is drawn from the strip roll, and additional guiding means to receive the strand formed of the element and loosely wound strip and guide it to the twisting device.

21. In apparatus for making yarn, a twister, means for receiving a paper strip roll to permit the strip to be fed transversely therefrom, a device to bring together the strip and a reinforcing element, and a second device to direct the strip and element to the twister and to resist the twisting to cause a loose twist on the side thereof opposite the twister, and a comparatively tight twist on the side toward the twister.

22. In an apparatus for making yarn, a twister, a support for a paper strip, a support for a reinforcing element, means for bringing together the strip and the reinforcing element, and a second means to direct the strip and element from the first means to the twister and to resist the twisting to cause a loose twist between the first and second means and a comparatively tight twist between the second means and the twister.

23. In an apparatus for making yarn, a twister, a support for a paper strip, a support for a reinforcing element, means for guiding said strip and element from said supports to the twister, said means also serving to impart an increasing twist to said strip and element as they approach the twister.

24. In an apparatus for making yarn, a twister, a support for a paper strip, a support for a reinforcing element, and means contacting with the yarn which serves to resist the twist back of said means and to effect an increasing twist to said strip and element as they approach the twister.

25. A method of making yarn comprising forming a paper strip of asbestos material of which the fibres are held together by suitable binding material, supplying the paper strip at low tension, twisting and advancing the strip, and resisting at a predetermined point the twisting of the strip to effect a greater twist of the strip after passing said point while permitting the twist to extend rearwardly beyond said point.

26. A method of making yarn comprising supplying a paper strip and a reinforcing element, bringing the strip and element together at a uniting point, advancing the strip and element and twisting the same together, and subjecting the strip and element to a resistance to twist at a predetermined point after leaving the uniting point to cause a loose twist before reaching the resistance point, and a tighter twist after leaving the same.

27. A method of making reinforced yarn including the steps of bringing a comparatively weak strip into juxtaposition with a generally horizontal portion of a reinforcing element, twisting the strip loosely around such generally horizontal portion to form a strand, and subsequently twisting with a tight twist the strand so formed.

28. A method of making reinforced yarn including the steps of bringing a comparatively weak strip into juxtaposition with a generally horizontal portion of a reinforcing element, twisting the strip loosely around such generally horizontal portion to be supported thereby, subsequently twisting with a tight twist the strand so formed, and combining in twisted relation such tightly twisted strand and at least one other strand.

29. A process of making yarn which comprises forming a flat strip of asbestos material of which the fibres are held together by workable binding material and twisting the strip in flat form directly with a reinforcing element to form a strand.

30. A process of making yarn which comprises forming a thin dry strip of asbestos material of which the fibres are held together by binding material, treating the strip to render it more workable and twisting the treated strip in flat form directly with a reinforcing element to form a strand.

31. A process of making yarn which comprises forming a pulp containing asbestos material and binding material, forming a dry finished web from said pulp, separating the web into flat strips of suitable width, treating each of said strips to render it more workable, and twisting one or more of said strips in flat form directly with a reinforcing element to form a strand.

32. A process of making yarn which comprises forming pulp containing asbestos material and binding material, forming a web from said pulp, treating the web to dry the same and to compact and strengthen the surfaces thereof, separating the dry web into strips of suitable width, treating one of said strips to render it more workable, and twisting said strip in flat form directly with a reinforcing element to form a strand.

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

twisting the strip or band about a reinforcing core, and shaping said strip or band on the core to form a strand.

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, twisting the strip about a reinforcing core, shaping said strip or band to form a strand, and finally twisting the strand with a reinforcing element to form a yarn.

35. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises the steps of 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 forming operations, twisting the strip or band about a reinforcing core, and shaping said strip or band on said core to form a strand.

36. A method of making asbestos yarn for the manufacture of fabrics and other purposes, which comprises the steps of binding and forming asbestos material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand forming operations, moistening said strip or band, twisting the moistened strip or band about a reinforcing core, and shaping said strip or band on the core while in a moist condition to form a strand.

37. A method of making yarn for the manufacture of fabrics and other purposes, which comprises the steps of binding and forming fibrous material into a thin uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand forming operations, twisting the strip or band about a reinforcing core, and shaping said strip or band on the core to form a strand.

38. 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 flat uniform paper-like strip or band of sufficient cohesiveness and tenacity to undergo subsequent strand forming operations, and of twisting said strip or band in flat form directly with a reinforcing filament to form a strand.

39. The 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 includes mechanically uniting a strip or band in flat form directly with a filament with the strip or band arranged helically about the filament, and further mechanically uniting the strip or band and said filament to form a yarn.

40. A process of making asbestos yarn, which includes 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 uniting the strip or band in flat form directly with a filament to form a strand having the strip or band arranged helically about the filament.

41. A process of making asbestos yarn from a paper-like strip or band of sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes mechanically uniting the strip or band in flat form directly with a filament having the strip or band arranged helically about the filament, and mechanically shaping said strip or band about the filament to form a strand.

42. The process of making asbestos yarn which includes forming a flat strip of asbestos material of which the fibres are held together by workable binding material, and helically arranging the strip in flat form by mechanical means directly with a reinforcing element to form a strand.

43. The process of making asbestos yarn which includes forming a flat strip of asbestos material of which the fibres are held together by binding material, treating the strip to render it more workable, and directly arranging by mechanical means the treated strip in flat form helically with a reinforcing element to form a strand.

44. The process of making asbestos yarn from a paper-like strip of asbestos material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes mechanically uniting the strip or band in flat form directly with a metallic reinforcing core with the strip or band arranged helically about the metallic core, and further mechanically uniting said strip or band and said metallic core to form a yarn.

45. A process of making asbestos yarn, which includes forming asbestos paper-like material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, and mechanically uniting the paper-like material in flat form directly with a metallic reinforcing core to form a strand having the paper-like material arranged helically about the metallic core.

46. 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 mechanical strand and yarn forming operations, and mechanically twisting the strip or band in flat form directly with a metallic reinforcing core to

form a strand having the strip or band arranged helically about the metallic core.

47. The process of making asbestos yarn from a flat asbestos strip held together by binding material, which includes moistening the strip to render it more workable, and subsequently helically arranging the moist strip while flat by mechanical means about a metallic reinforcing core.

48. The process of making asbestos yarn which comprises forming a flat strip of asbestos material of which the fibres are held together by workable binding material, and helically arranging the strip in flat form by mechanical means directly with a metallic reinforcing element to form a strand.

49. The process of making asbestos yarn which comprises forming a flat strip of asbestos material of which the fibres are held together by binding material, treating the strip to render it more workable, and helically arranging the treated strip in flat form by mechanical means directly with a metallic reinforcing element to form a strand.

50. The 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 includes associating a strip or band with a reinforcing filament, shaping said strip or band on said filament to form a strand, and thereafter combining said strand with one or more additional filaments to form a yarn.

51. A process of making asbestos yarn from a paper-like strip or band of sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes mechanically associating the strip or band helically with a reinforcing filament, mechanically shaping said strip or band on said filament, to form a strand, and thereafter mechanically associating said strand with one or more additional filaments in helical arrangement to form a yarn.

52. The process of making asbestos yarn from a paper-like strip or band of asbestos material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes, moistening said strip or band, mechanically associating the strip or band with a reinforcing filament, mechanically shaping said strip or band on said filament to form a strand, and thereafter mechanically combining said strand with one or more additional reinforcing filaments to form a yarn.

53. The process of making asbestos yarn from a paper-like strip or band of asbestos material, which includes moistening the strip or band, helically arranging said strip or band about a reinforcing filament, shaping said strip or band on said filament to form a strand, and thereafter combining said strand with one or more additional reinforcing filaments in helical arrangement to form a yarn.

54. The process of making asbestos yarn from a paper-like strip or band of asbestos material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes moistening said strip or band, mechanically associating the strip or band with a reinforcing filament, shaping said strip or band on said filament to form a strand, and thereafter mechanically combining, with or without one or more additional filaments, said strand and one or more additional strands to form a yarn.

55. An asbestos yarn formed of a plurality of strands and one or more filaments combined therewith, at least one of said strands comprising a reinforcing filament and asbestos material bound with sufficient cohesiveness and tenacity to undergo strand and yarn forming operations.

56. An asbestos yarn formed of a plurality of strands and one or more filaments twisted therewith, at least one of said strands comprising a core combined with asbestos material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture.

57. An asbestos yarn formed of a plurality of strands and one or more filaments combined therewith, at least one of said strands comprising asbestos material bound with sufficient cohesiveness and tenacity to undergo strand and yarn forming operations.

58. An asbestos yarn formed of a plurality of strands and one or more filaments twisted therewith, at least one of said strands comprising asbestos material 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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51. A process of making asbestos yarn from a paper-like strip or band of sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes mechanically associating the strip or band helically with a reinforcing filament, mechanically shaping said strip or band on said filament, to form a strand, and thereafter mechanically associating said strand with one or more additional filaments in helical arrangement to form a yarn.

52. The process of making asbestos yarn from a paper-like strip or band of asbestos material bound with sufficient cohesiveness and tenacity and adapted for yarn manufacture, which includes, moistening said strip or band, mechanically associating the strip or band with a reinforcing filament, mechanically shaping said strip or band on said filament to form a strand, and thereafter mechanically combining said strand with one or more additional reinforcing filaments to form a yarn.

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58. An asbestos yarn formed of a plurality of strands and one or more filaments twisted therewith, at least one of said strands comprising asbestos material 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. 1,585,614, granted May 18, 1926, upon the application of John Allen Heany, of New Haven, Connecticut, for an improvement in "Yarn and Apparatus and Processes for Making Yarn," an error appears in the printed specification requiring correction as follows: Page 4, line 106, for the word "type" read *tape;* 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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