

May 3, 1955

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2,707,368

TWINE AND PROCESS OF PREPARING THE SAME

Filed May 23, 1951

2 Sheets-Sheet 1

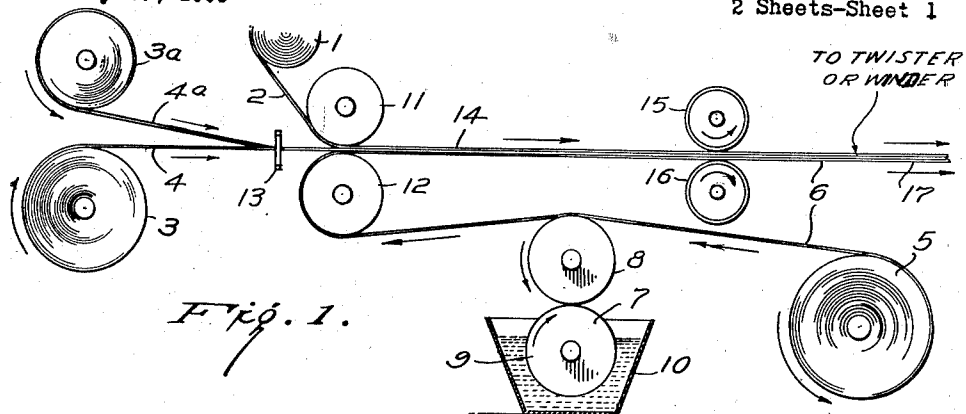


Fig. 1.

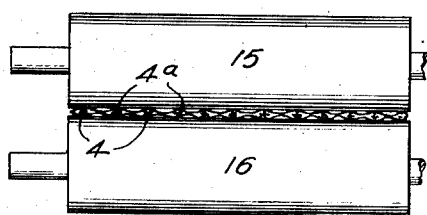


Fig. 3.

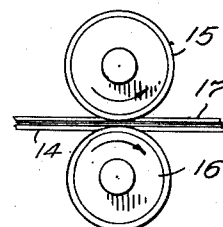


Fig. 4.

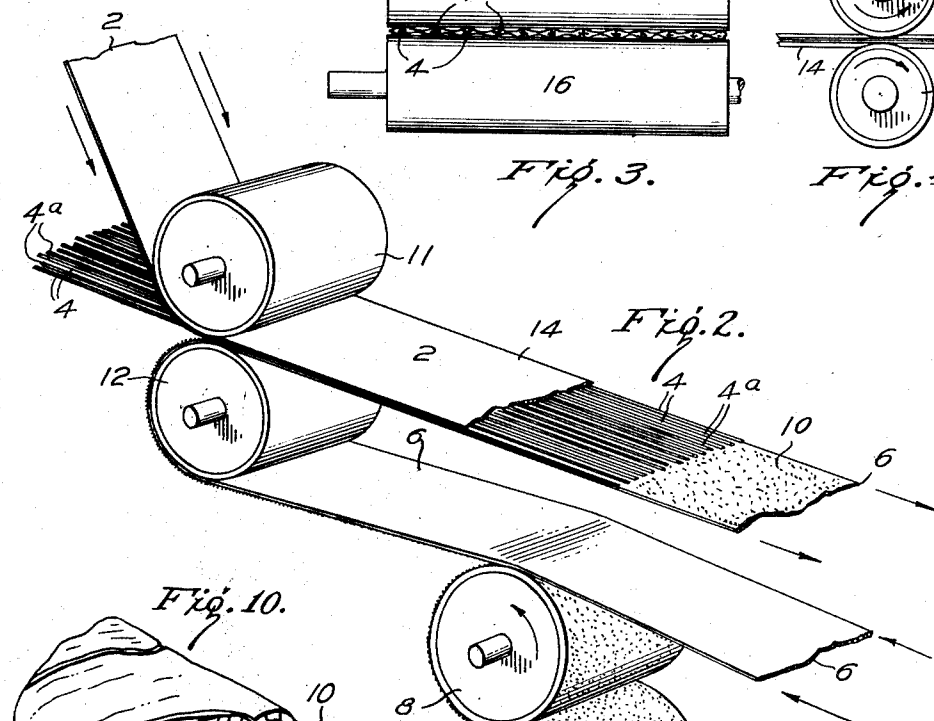


Fig. 2.

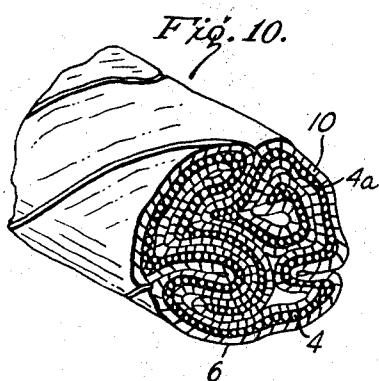


Fig. 10.

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Fig. 6.

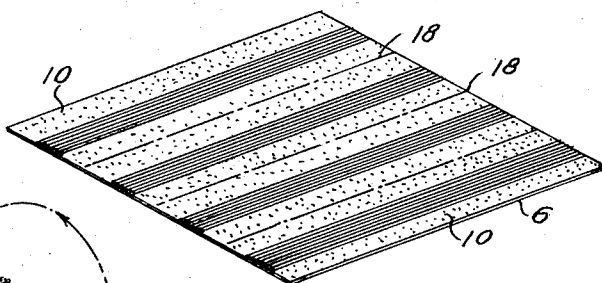
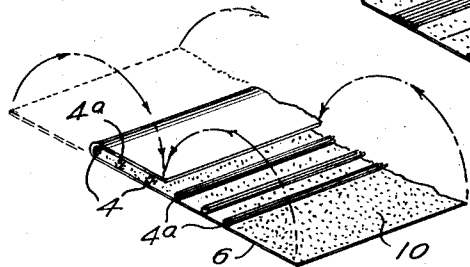


Fig. 5.

Fig. 7.

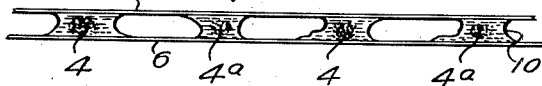


Fig. 8.

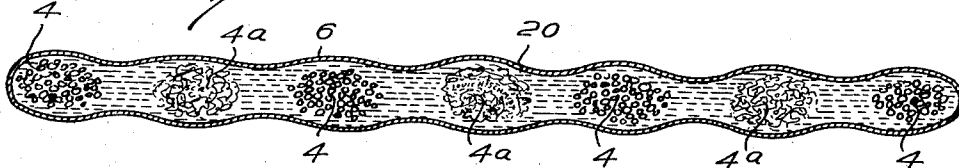
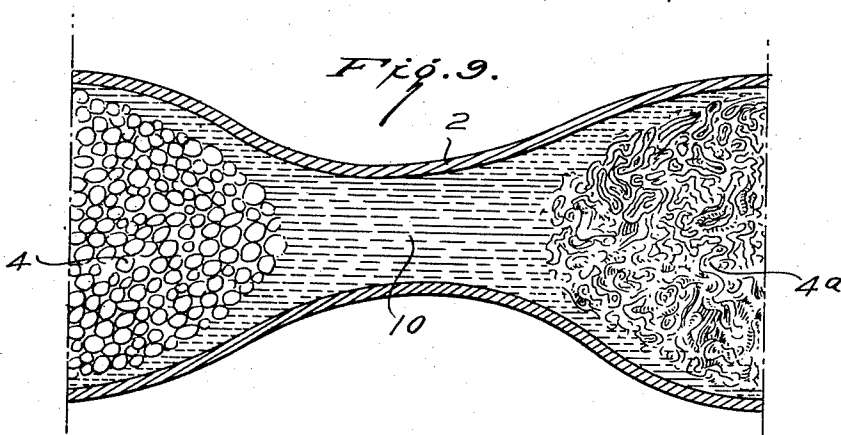


Fig. 9.



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TWINE AND PROCESS OF PREPARING THE SAME

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Application May 23, 1951, Serial No. 227,768

11 Claims. (Cl. 57—154)

This invention relates to a process for producing twine and, more particularly, to a process for producing glass fibrous strand and organic fibrous strand twine in which the strands are imbedded in an adhesive material coated on a paper web, covered with another layer of paper to form a flat assembly and twisting said assembly into a twine. Still further, this invention relates to a process for preparing twine in which the glass strands and the organic fibrous strands are superimposed upon an adhesive coated paper web in parallel alignment and in alternate traverse arrangement wherein the coated web thus imbedded with strands is covered with a second layer of paper to form a flat assembly and twisting said assembly into a twine. Still further, this invention relates to a process of preparing twine wherein the strand-paper assembly defined hereinabove is pressed, so that the paper webs form corrugations with the strands prior to the twisting of the paper web assembly to form the twine.

One of the objects of the present invention is to produce a twine which will have general utility as a twine but will be particularly useful as a binder twine and baler twine. A further object of the present invention is to produce a twine which can be readily substituted for natural twine, such as those generally referred to as sisal twine. A still further object of the present invention is to produce twine by superimposing a plurality of glass fibrous strands and organic fibrous strands in parallel alignment and in alternate traverse arrangement, on a paper web coated with an adhesive material imbedding the strands in the adhesive coating on the paper web and covering said strands with another paper web, uniting the strands, paper and adhesive into a flat assembly, thereafter twisting said assembly into a twine. A still further object of the present invention is to apply pressure to the aforementioned flat assembly in the course of the web assembly production so as to form corrugations with the strands in the paper web prior to the twisting of the paper strand into a twine. These and other objects of the present invention will be discussed more fully hereinbelow.

Natural twine, generally referred to as sisal twine, is becoming increasingly short in supply and the price of said natural twine is increasing steadily, so that it has become a virtual necessity to find a synthetic twine which will be satisfactory for all of the general applications to which the natural twine is put.

This application is a continuation-in-part of my previously filed application bearing the Serial No. 212,065 and the filing date February 1, 1951, for "Twine and a Process of Preparing the Same." In that application, I have pointed out that glass strand paper twine can be prepared by superimposing glass strands on an adhesive coated paper web and that the strand imbedded web may then be covered with a paper web to form a flat assembly and twisting that assembly into a twine. I have since discovered that by substituting for some of the glass strands, organic fibers strands, I can produce a twine which has unexpectedly higher load strength and knot strength. I

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have pointed out in my above-mentioned application that the process for the preparation of these glass fibrous filaments and strands is well known in the art, as represented by U. S. Patents 2,133,236, 2,133,238 and 2,175,225, amongst others. I have indicated that these filaments are generally of extremely small diameter in the order of magnitude of about 0.0002-0.0004" and are combined to form a strand having a diameter of about 0.01", since there are generally about 200 or more filaments used to form a single strand. These glass strands have exceedingly high tensile strength and, in fact, have greater tensile strength than steel wire per unit weight. These strands, on the other hand, cannot be used directly for twine because they do not have the flexibility which steel wire has nor do they have the flexibility which natural fibrous twine has. A further shortcoming of the glass fibrous strands resides in the fact that if the twine were to be made from glass strands without any protective coating surrounding the strands, the continuous rubbing of one strand against the other would result in a breakdown of the individual strands and eventually a breakdown of the entire twine. A still further shortcoming of the ordinary glass strand twine resides in the fact that the flexibility in small arcs is so low and the attrition is so great that it is nearly impossible to produce knots having adequate knot strength with such twine without experiencing continuous breaks in the twine. This is due to the sharp sudden curve through which the twine is bent in knot tying. The tensile strength of most organic fibrous strands, such as cotton, rayon and nylon strands, and the like, is appreciably lower than the tensile strength of the glass fibrous strands and one would expect that if one were to substitute these organic fibrous strands for part of the glass strands in a given twine, that the total strength would necessarily be diminished. I was surprised to discover that when I substituted organic fibrous strands for some of the glass strands, I was able to increase the tensile strength and knot strength of the twine produced in keeping with the broad concept of my invention. It was, however, necessary that these strands, both glass strands and organic fiber strands, be placed in parallel alignment and arranged in an alternate traverse order. By alternate traverse order, I mean that the glass strands and the organic fibrous strands are laid down across the width of a paper web in alternating order. The strands are, of course, maintained in a substantially parallel alignment.

The twines of the present invention will be prepared substantially in a manner comparable to that disclosed in my earlier application, except for this novel departure of placing the glass strands and the organic fibrous strands in parallel alignment and in alternate traverse arrangement, which departure produces such novel and unexpected results. There are a plurality of ways in which this twine may be fabricated. Each of these minor departures from the essential concept of the applicant are mere modifications, a few of which are set forth hereinbelow. Fundamentally, the adhesive material may be applied directly to the paper web before the glass strands and organic fibrous strands are applied to the paper. But, if one so desires, the adhesive material could be applied after the strands are superimposed on the paper web or the adhesive material could be applied to the web simultaneously with the strands; or, still further, the strands may be coated with the adhesive composition and thereafter the resin coated strands could be applied to the paper web, thereby coating the web. This latter approach is actually preferred. A still further embodiment of this invention resides in the modification wherein the glass fibrous strands and the organic fibrous strands are placed in parallel position and in alternate traverse arrangement on approximately one-half of the width of

the resin-coated web, whereupon the web can be folded by means of a plow-like device, so as to cover the strands and to form a flat unitary assembly of paper, adhesive and strands. Still further, one could superimpose a great plurality of the fibrous strands on a wide paper web, coated with the adhesive, and thereafter superimposing a second sheet of paper on the strand imbedded lower web. By slitting this wide web assembly into a plurality of narrower webs of desired width, one could proceed to twist each of the narrower webs into the desired twine. Still further and, as a preferred embodiment of the present invention, one could make use of a pressing device in the nature of a pair of rollers covered with a resilient material which would force the upper and lower papers together to form corrugations with the strands. Care must be taken in the selection of the pressure rollers to insure that the fibrous strands and, more particularly, the glass strands are not damaged while the unitary assembly is being pressed into a corrugated form. For this reason, it is advisable to use a combing wheel which is firm and resilient and yet pliable so as to avoid damaging the glass strands. Still other embodiments of this invention will be obvious to anyone skilled in the art and, for this reason, further specific enumeration of detail is considered unnecessary. Each of these embodiments are, however, intended to be included with the scope of the appended claims. Reference is made to the accompanying drawings which serve to illustrate further the concepts of the present invention.

Fig. 1 is a side elevational view of a suitable arrangement for the preparation of the tapes to be used in the twine fabrication.

Fig. 2 is a perspective view of a part of Fig. 1 showing in greater detail the fabrication of the tape to be used ultimately in the twine manufacture.

Fig. 3 is a front elevational view of the rubber covered rollers used to press the upper and lower webs together with the glass and organic fibrous strands with the adhesive therebetween.

Fig. 4 is a side elevational view of Fig. 3.

Fig. 5 is a perspective view of a resin coated web upon which the strands have been superimposed in readiness for the subsequent steps in the twine fabrication.

Fig. 6 is a perspective view of one portion of Fig. 5 in which the lower web is folded over the strands which are imbedded in the adhesive on the web.

Fig. 7 is a cross sectional view of a section of the tape illustrated in Figs. 6 or 2.

Fig. 8 is an enlarged cross sectional view of Fig. 6 after the tape has been passed through the companion rubber covered rollers to form the corrugations.

Fig. 9 is a substantially enlarged cross sectional view of a portion of Fig. 8.

Fig. 10 is a front elevational view of the twine fabricated according to the process of the present invention tied in one embodiment of a baler's knot.

In Fig. 1 the symbols are used to identify the following components illustrated: 1 is the roll of paper tissue used as the upper web. 5 is the roll of paper tissue used to form the lower web. 3 is the spool or creel providing the plurality of glass strands. 3a is the spool or creel providing the plurality of the organic fibrous strands. 10 is the adhesive material in a suitable container into which the conveyor roller 7 dips and carries adhesive to the applicator roll 8 which in turn applies the adhesive material to one face of the lower web 6, which passes around the combining roller 12. At the same time, the glass strands 4 and the organic fibrous strands 4a are drawn from the spools 3 and 3a through the reed 13 and are united in alternate traverse arrangement with the lower web 6 and the upper web 2 as they pass through the combining rollers 11 and 12. The resultant tape 14 is drawn through the rubber-covered rollers 15 and 16 which applies sufficient pressure to tape 14 so as to produce a series of corrugations in the tape 17. The tape may then be

wound onto a reel or may be led directly to a conventional twisting machine. The reed 13 contains a great plurality of dents through which the individual glass strands and organic fibrous strands are fed, so that the strands are kept in parallel alignment as they are being positioned between the upper and lower webs 6 and 2. In Fig. 2, the symbol 7 represents the adhesive conveyor roller carrying the adhesive 10 to the adhesive application roll 8. The adhesive is applied to the face of the web 6 which is carried up and around the roller 12 and is combined with the glass strands 4, organic fibrous strands 4a in alternate traverse arrangement and the upper web 2 as the components are passed between the combining rolls 11 and 12. The resultant tape 14 is illustrated in partial section to show the individual strands 4 and 4a imbedded in parallel relationship to the adhesive 10 on the lower web 6 and covered with the upper web 2. In Fig. 3, the rubber covered rolls 15 and 16 apply sufficient pressure to the tape 14 made up of the lower web 6 and the glass strands 4 and the organic fibrous strands 4a and the adhesive 10 and the upper web 2 so as to unite the individual components into a unitary structure which has a plurality of corrugations in parallel alignment produced by the presence of the strands between the upper and lower webs.

Fig. 4 shows a side elevational view of Fig. 3 in which the tape 14 passes through the rubber covered rolls 15 and 16 to produce the desired corrugated effect.

Fig. 5 represents one of the modifications of the process illustrated in Fig. 1 in which the lower web 6 is used as the sole web and upon which the adhesive is applied and the strands are imbedded in a series of disconnected parallel groups, each of which can be separated into individual tapes at the lines 18 by some suitable cutting device, such as a cutting wheel. In mass production of the twine, one could apply the adhesive 10 to the web 6, superimpose thereupon the strands in a plurality of groups in parallel alignment. The web may be cut along the lines 18 and the web 6 may be folded over the top of the strands in either a butting or overlapping arrangement. This is more completely illustrated in Fig. 6. Therein, one section of Fig. 5, which has been cut from the rest of the web along at least one of the lines 18 illustrates the resin 10 coated on the web 6 folded over in part and superimposed upon the resin covered strands 4 and 4a. If one were to practice the process of the present invention by adapting the modification illustrated in Figs. 5 and 6, one could dispense with the need for roller 11 and the upper web 2 but would need some conventional plow-like device to force the web 6 to fold up and over the top of the strands imbedded in the resin before passing through the rollers 15 and 16 to produce the corrugated effect. Still further, the concept illustrated in Fig. 5 could be further modified by applying the strands along the web 6 in parallel alignment without any appreciable discontinuity between the groups of strands by practicing the process as illustrated in Fig. 1, an upper web 2 could be applied to the assembly and the individual tapes cut along lines such as those indicated by the symbol 18 prior to or subsequent to the passing of the complete assembly through the rubber covered rollers 15 and 16. Fig. 7 illustrates a sectional view in part of the combined assembly of upper web 2, lower web 6, strands 4 and 4a and adhesive 10 prior to the passage of this combined assembly through the pressure rollers 15 and 16. It is to be noted that each group of filaments making up an individual strand of glass is completely surrounded by the adhesive material and each glass strand is kept separate from each other glass strand not only by adhesive material but also by an organic fibrous strand. It is to be further noted that since this tape has not been passed through the rollers 15 and 16, the corrugations have not, as yet, been produced. Fig. 8 illustrates the corrugated tape in an enlarged view, partially in section, which would be produced by passing a flat composite tape comparable

to that illustrated in Fig. 6 through the rollers 15 and 16. Again, it is to be noted that individual strands 4 made up of the individual filaments are isolated from one another by the organic fibrous strands 4a and by the adhesive 10, which in turn protects the strands from direct contact with the web 6. The point 20 shows the butting of the edges of the web 6. Fig. 9 illustrates a substantially enlarged sectional view of one portion of Fig. 8, in which the filaments 19 making up the glass strand 4 are very numerous. But it is to be noted that the filaments in one glass strand are isolated from the filaments in the next glass strand, because of the presence of the intervening organic fibrous strands. The adhesive 10 not only separates the individual strands from one another, but also substantially protects the strands from direct contact with the paper webs 2 and 6. The organic fibrous strands, on the other hand, serve further to provide a barrier, which prevents the individual glass strands from making any attritional contact with one another.

In the practice of the process of the present invention, any adhesive material may be used to bond the paper web and the strands together, such as natural adhesives and synthetic resinous adhesives, both thermosetting and thermoplastic. Still further, one may use as the adhesive material, rubber adhesives, both natural and synthetic. Amongst the synthetic rubber adhesives are such materials as the polymers of butadiene or copolymers of butadiene and styrene and the like.

Among the thermosetting resinous adhesives which may be used in the practice of the process of the present invention are the aminoplast resins, such as those produced when an aldehyde is reacted with an amino compound such as urea, dicyandiamide and aminotriazines, such as melamine, benzoguanamine, formoguanamine, acetoguanamine, halo-substituted triazines, such as 2-chloro-4,6-diamino-1,3,5-triazine, mono-, di- or tri-alkyl melamine, for instance, 2,4,6-triethyl triamino, 1,3,5-triazine, the mono-, di- or tri-aryl or mono-, di- or tri-aryl melamines, such as 2,4,6-triphenyl triamino-1,3,5-triazine and the like. Other thermosetting resins which may be used are those produced by the coreaction of an aldehyde with phenol such as hydroxy benzene, resorcinol, bis-phenol and the like; or aldehydes reacted with ketones, such as acetone, methylethyl ketone, diethyl ketone, ethyl propyl ketone, cyclohexanol and the like. Amongst the aldehydes which may be used in co-reaction with any of the resin forming materials set forth hereinabove are acetaldehyde, propionaldehyde, crotonic aldehyde, acrolein and aromatic or heterocyclic aldehydes, such as benzaldehyde, furfural and the like. Formaldehyde is generally the most commonly used aldehyde in co-reaction with these resin forming materials and is actually generally preferred.

Amongst the thermoplastic resin adhesives which may be used are polyvinyl acetate, the alkyl esters of alpha-beta unsaturated carboxylic acids, such as polymethyl acrylate, polymethyl methacrylate, polybutyl acrylate, polybutyl fumarate, alkyd resins of the unsaturated or saturated type, either oil-free or oil-containing, modified with styrene or other vinylidene compounds, polyesters such as glycol succinates or glycol sebacates, amide esters and the like.

Amongst the natural adhesives which may be used are casein, soya protein, and other proteins, starch, animal glue, gelatin, blood, asphalt, pitch and the like.

When these tapes are prepared in keeping with the concept of the present invention and are desired to be converted into twine form, they may be twisted in a plurality of different ways, for instance, tape may be passed through a water bath, from then on directly to the twisting machine, or the tapes may be merely passed between heated rollers and directly twisted, or as a further modification, tapes may be passed between a pair of parallel hot plates and twisted directly. A still further modification can be accomplished by applying heat, such as in

the manner indicated hereinabove, passed through a water bath and then twisted to form the twine. Or the tapes may be passed through a water bath, twisted to form the twine and then heated. If one so desired, one could pass the tapes through a steam box wherein both heat and moisture would be applied to the tapes and then upon removal therefrom, the tape could be twisted in its moist warm condition. A still further modification resides in the embodiment in which a water bath is used wherein a sizing material, such as glue, flour, wax emulsions, metallic soaps, resin dispersions and the like is incorporated into the water bath. These sizing materials may be added to improve water and/or scuff resistance. Still further, one could apply to the paper web a softener in the nature of an oil, such as mineral oil, vegetable oil, animal oils and the like.

A still further modification of the general process resides in the use of a third web of paper wherein a lower web coated with the adhesive material is embedded with the parallel glass strands and organic fibrous strands in an alternate transverse arrangement, a second web, coated with adhesive on both sides is superimposed thereupon, a second layer of parallel glass strands and organic fibrous strands in alternate transverse arrangement may be imbedded thereon and a top web is positioned to form a sandwich-like structure of paper, adhesive, strands, paper, adhesive, strands and paper. The number of strands used across a given web is in no way critical. It is possible to vary the number of strands rather substantially, depending on the width of the tape or the thickness of the twine desired and depending further on the strength of the twine desired. It is important, however, to remember that the strands, in being positioned on the web, must alternate between the two types selected, namely glass strands, organic fibrous strands, glass strands, etc.

In the manufacture of the glass filaments, molten glass, maintained at a temperature of about 2500° F. is allowed to pass through about 204 dies to form glass threads which are drawn downward at about 6,000-10,000 feet per minute. A size coating is applied to the individual filaments. This coating serves to protect each individual filament from its companions in the strand, whereby loss due to attrition is reduced to a negligible factor.

Amongst the organic fibrous strands which may be used in the practice of the process of the present invention are both the natural organic fibrous strands, such as cotton, linen, silk, wool and the like, and synthetic organic fibrous strands, such as rayon, nylon, i. e., synthetic linear superpolyamides, polyacrylonitrile fibrous strands or any of the conventional organic synthetic fibrous strands which are commercially available on the market today. Obviously, a plurality of these types of organic fibrous strands may be used in the production of the twine in keeping with the present invention, provided that the same concept of alternate transverse arrangement is maintained between the glass strands and the organic fibrous strands. These organic fibrous strands may, in some instances, be monofilamentary or polyfilamentary.

I claim:

1. A process for producing twine comprising the steps of coating one face of a tissue paper web with an adhesive material, superimposing and imbedding on said adhesive coated web a plurality of glass fibrous strands and organic fibrous strands, in parallel alignment, and in alternate transverse arrangement, covering the strand imbedded adhesive coated web with a tissue paper web and uniting these components into a flat assembly, thereafter twisting said assembly into a twine.

2. A process for producing twine comprising coating one face of a tissue paper web with an adhesive material, superimposing on approximately one-half of the width of said adhesive coated web, a plurality of glass fibrous strands and organic fibrous strands, in parallel alignment, and in alternate transverse arrangement, folding the paper

so as to cover the strands to form a flat assembly, thereafter twisting said assembly into a twine.

3. A process for producing twine comprising coating one face of a tissue paper web with an adhesive material, superimposing on approximately one-half the width of said adhesive coated web, a plurality of glass fibrous strands and organic fibrous strands, in parallel alignment, and in alternate traverse arrangement, folding the paper so as to cover the strands to form a flat assembly, pressing the folds of the paper web together so as to form corrugations with said strands and paper, twisting the paper-strand assembly into a twine.

4. A process for producing twine comprising coating one face of a tissue paper web with a thermosetting synthetic resinous adhesive, superimposing on approximately one-half of the width of said resin coated web, a plurality of glass fibrous strands and organic fibrous strands, in parallel alignment and in alternate traverse arrangement, folding the paper web so as to cover the strands to form a flat assembly, thereafter twisting said assembly into a twine and heating said twine so as to cure the resin.

5. A process for producing twine comprising coating one face of a tissue paper web with a thermoplastic synthetic resinous adhesive, superimposing on approximately one-half of the width of said resin coated web, a plurality of glass fibrous strands and organic fibrous strands, in parallel alignment, and in alternate traverse arrangement, folding the paper so as to cover the strands to form a flat assembly, thereafter twisting said assembly into a twine.

6. A process for producing a glass strand, organic fibrous strands and paper twine comprising the steps of coating one face of a tissue paper web with an adhesive material, superimposing and imbedding on approximately one-fourth of the paper web on each side of the center of said web, a plurality of glass fibrous strands and organic fibrous strands, in parallel alignment and in alternate traverse arrangement, folding over both sides of the web not covered with strands onto the center portion of the web covered with strands, uniting into a flat assembly, thereafter twisting said assembly into a twine.

7. A process for producing twine comprising coating one face of a tissue paper web with an adhesive material, superimposing and imbedding on said adhesive coated web a plurality of glass fibrous strands and organic fibrous

strands, in parallel alignment and in alternate traverse arrangement, covering the strand imbedded adhesive coated web with a second tissue paper web and uniting these components into a substantially flat assembly, thereafter twisting said assembly into a twine.

8. An adhesive coated paper, glass fibrous strand, organic fibrous strand twine comprising a plurality of spirally parallel glass fibrous strands and organic fibrous strands positioned between at least two layers of twisted tissue paper and imbedded in an adhesive material coated on said paper web, wherein said glass strands and said organic fibrous strands are in alternate traverse arrangement.

9. A thermosetting resin coated paper, glass strand, organic fibrous strand twine comprising a plurality of spirally parallel glass strands and organic fibrous strands positioned between at least two layers of twisted tissue paper and imbedded in a thermosetting synthetic resin, wherein said glass strands and said organic fibrous strands are in alternate traverse arrangement.

10. A thermoplastic resin coated paper, glass strand, organic fibrous strand twine comprising a plurality of spirally parallel glass strands and organic fibrous strands positioned between at least two layers of twisted tissue paper and imbedded in a thermoplastic synthetic resin, wherein said glass strands and organic fibrous strands are in an alternate traverse arrangement.

11. A process for producing twine comprising the steps of coating one face of a tissue paper web with an adhesive material, by superimposing and imbedding on said web a plurality of adhesive coated glass fibrous strands and organic fibrous strands, in parallel alignment and in alternate traverse arrangement, covering the strand imbedded, adhesive coated web with a tissue paper web and uniting these components into a flat assembly, thereafter twisting said assembly into a twine.

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