E. J. GUAY.

GEAR, BLANK FOR GEARS, ROLLS, &c., AND METHOD FOR MANUFACTURING THE SAME.

APPLICATION FILED NOV. 9, 1917.

1,275,906. Patented Aug. 13, 1918.

Fig. 1.

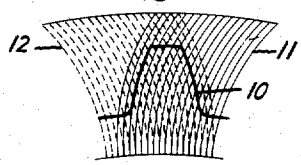


Fig. 5.

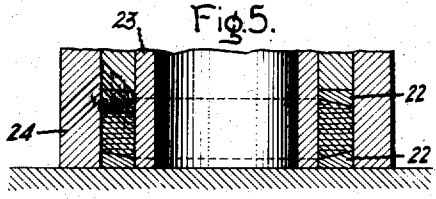


Fig. 2.

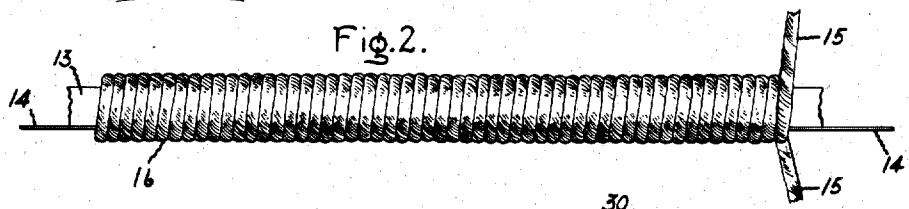


Fig. 3.

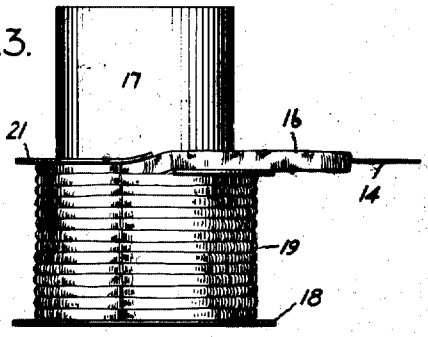


Fig. 6.

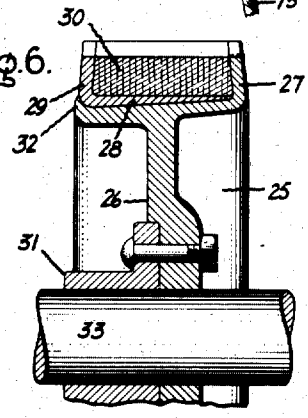


Fig. 4.

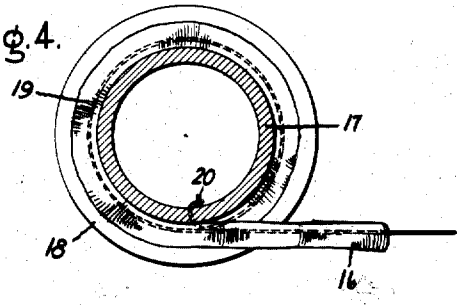


Fig. 8.



Fig. 9.



Fig. 7.

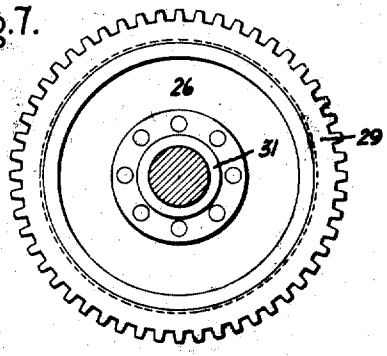
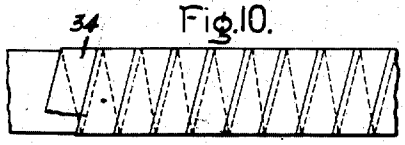


Fig. 10.



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His Attorney.

UNITED STATES PATENT OFFICE.

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GEAR, BLANK FOR GEARS, ROLLS, &c., AND METHOD OF MANUFACTURING THE SAME.

1,275,906. Specification of Letters Patent. Patented Aug. 13, 1918.

Application filed November 9, 1917. Serial No. 201,015.

To all whom it may concern:

Be it known that I, EMILE J. GUAY, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Gears, Blanks for Gears, Rolls, &c., and Methods of Manufacturing the Same, of which the following is a specification.

This application is a continuation in part of my application, Serial No. 123,993, filed October 5, 1916.

The present invention relates to gears and blanks for gears, rolls, etc., which are made of that class of material generally known as spinnable textile fibers.

Gear blanks constructed of such fibers are now manufactured in two principal ways, as follows:

In one case, the fibers are woven into cloth from which rings or disks are cut, after which they are piled one on the other in a metal holder until the desired thickness is obtained. The body thus formed is then subjected to heavy compression, which compression is retained by said holder. Instead of mounting the woven cloth rings or disks in a holder in the manner described, it is possible for some classes of work to impregnate the cloth with a binder and depend solely or partially on it to hold the laminations in a compressed state. Instead of first cutting the cloth to shape, said cloth may also be assembled into a laminated structure from which the disks or rings are thereafter cut.

In the second case, the blanks are made from what is commonly termed "bats", meaning thereby sheets or bodies of textile fibers in a more or less soft and fluffy state. These bats are compressed into sheets from which rings or disks are cut by means of dies as in the first case. The disks are then piled one on the other in a holder until the desired thickness is obtained to form the finished blank. The material thus formed is then subjected to heavy pressure, which pressure is retained by suitable means.

Due to the fact that the disks or rings are cut out of sheet stock by dies, or other means, it follows that a considerable amount of stock in the form of trimmings is wasted in the manufacture. It is evident that it costs money in the first instance to form the cloth or compressed bats of which these trimmings are composed, and while in both cases, and more especially in the case of bats the material may be used over again after being suitably treated, it can only be done at a further expense.

In the old cloth type of gear the fibers extend at right angles to each other. In the bat type of gear some of the fibers run in the same direction and in parallel planes, and the remainder at different angles, the said fibers frequently passing through one plane to another. In neither case is it possible to definitely locate the positions of the individual fibers with respect to the teeth of the finished gear.

One of the objects of my invention is to improve the method of manufacturing such blanks whereby loss of stock in the form of trimmings is avoided. I have discovered that a simple and satisfactory way to do this is to form the material of which the blank is composed into a thin flat element, strip or strand and subsequently to wind said element, strip or strand edgewise on a drum to form a helix which is afterward compressed to the desired degree and held in said compressed state.

Another object of my invention is to improve the construction of gears and blanks therefor, whereby their strength will be greatly increased. I have discovered that if the fibers in a finished gear are definitely positioned or arranged so that they extend in the same general direction as the finished teeth, and preferably as the sides of the finished teeth, the strength of the individual teeth will be very greatly increased. Owing to the fact that each tooth has two sides I prefer to so arrange the fibers that substantially one-half of them extend in the same general direction as one side and the remainder in the same general direction as the other side. This results in making both sides of each tooth alike as regards the relation of the fibers. To attain the best results the body should be composed of a large number of thin layers, preferably arranged in helical form, so that the interlocking or crossing of the fibers in adjacent layers will serve to mutually support them. This feature is very important in gears designed to transmit substantial powers, particularly at high speeds where the stresses are large. Having defined the construction required, it will be evident that the blank can be

manufactured in a variety of ways. A simple and satisfactory way to carry out the invention is to form the stock into a hollow flattened tube in which the fibers form a fine pitch spiral, and subsequently to wind the tube edgewise on a suitable form or drum. Such a method permits of positioning the fibers to give the maximum strength to the teeth of the finished gears. To enable the tube to be easily wound on the drum and also to hold it in place thereon, a small cord or core is located within the tube which serves as a binding means. This is an important feature since it greatly adds to the ease of manufacture.

In the manufacture of these blanks many different kinds of textile fibers may be used which are capable of being spun; for example, cotton, flax, hemp, ramie, wool and silk. As cotton is relatively cheap and has been found satisfactory for the purpose, it will be described as the material used, but it is understood that reference is made thereto as an illustration and not as a limitation of the invention. By experiment and practical use I have ascertained that sliver, *i. e.* textile fibers formed into a fleecy strand, and preferably made from what is ordinarily known as a poor grade of cotton can advantageously be employed; for example, that which in the textile arts is known as "waste from the picker." Such material has relatively short fibers, generally less than an inch in length. It is spinnable, but is commonly used only in the cheapest kinds of garments. When such sliver is used it is preferable to have its fibers at least twice as long as the finished gear teeth, if the best results are to be obtained.

In the accompanying drawing which is illustrative of my invention, Figure 1 is a diagrammatic view showing the general and preferred relation of the fibers to the finished gear teeth; Fig. 2 shows the means employed in forming the fibrous material into a flattened tube; Figs. 3 and 4 show the means for winding the flattened tube into a helix; Fig. 5 shows a part of the press for compressing the helix; Fig. 6 is a partial sectional view of a finished gear; Fig. 7 shows a gear in elevation; Fig. 8 shows a modification in which a ribbon of woven material with the fibers extend substantially at right angles to each other is employed instead of sliver; Fig. 9 shows another form of ribbon or tube in which the threads extend at acute angles to the sides thereof, and Fig. 10 shows a ribbon or tape wound on a former preparatory to winding it into a helix.

Referring first to Fig. 1 which illustrates in a diagrammatic manner the general relation of the fibers to the gear teeth, the heavy line 10 indicates an involute or single curve gear tooth of the Brown & Sharpe type. The invention is also applicable to other shapes of teeth, for example to the double curved gear teeth. The sides of these gear teeth form an angle of $14\frac{1}{2}$ degrees which is the standard. That is to say, a plane tangential to the face of the tooth at the pitch line and perpendicular to the plane of pressure makes an angle of $14\frac{1}{2}$ degrees with a plane passing diametrically through the axis of the gear and coinciding with said face of the tooth at the pitch line. In some special cases this angle may vary from the standard. The lines 11 indicate the fibers in one of the thin elementary layers which it will be noted extend in the same general direction as one side of the tooth, and the dotted lines 12 indicate the fibers in the next thin elementary layer which follow the same general direction as the opposite side of the tooth. The fibers in the third thin layer will correspond in angular position to the fibers in the first layer, and the fourth to the second and so on.

It will be noted that the fibers in this figure are somewhat curved from end to end. This is due to the edgewise winding of the flattened tube on the drum in one of the steps of the process, as will appear later. In defining the relation of the fibers to the angle of the finished gear teeth, I do not mean that this is mathematically accurate, because owing to the nature of the material it would hardly be possible to get this exact relation, but for all practical purposes the angles of the fibers correspond to the angles of the teeth.

It is also to be noted that in each tooth there is a very large number of relatively long fibers which are not only securely anchored in the tooth itself by other relatively long fibers but are also securely anchored in the body below the root of the tooth in a similar manner. As a result of this each tooth is very strong and is therefore capable of withstanding heavy stresses and shocks in a tangential direction without breaking or deflecting which is of the utmost importance.

In Fig. 2 is shown means for carrying out the first step in the process. 13 indicates a metal former for making the tube. Since the tube is flattened it is desirable to make the former approximate the shape and size of the finished tube. On this account the former is made relatively wide and thin. The width of the former should be chosen with regard to the desired radial depth of fibrous material on the finished blank. In general it may be stated that the radial depth of said material should be substantially greater than the height of the finished gear teeth. The thickness of the former is determined by mechanical considerations. Extending lengthwise of the former is a core 14 which can advantageously be made of silk because of its strength for a given small cross-sec-

tional area. Small wire may also be used. The sliver or strand 15 is wound around the former and the core. One or more strands or slivers may be wound at a time, two being shown in said figure.

As the flattened tube 16 is made it is progressively pushed off of the former and is then wound edgewise on the drum 17 to form a helix, said drum being rotated by any suitable means. The drum has a flange 18 at its lower end which supports the first turn of the helix 19. In this operation the core 14 is first attached to the drum, as at 20, Fig. 4, and the drum started into motion. The speed of the drum should be such as to receive the tube as fast as it is made. The core being attached at one end and being fed forward under suitable tension binds each turn of the helix to the face of the drum, thereby holding it in position. This operation can be facilitated by exerting a slight endwise pressure on the upper turn by means of the plate or plates 21 which also act as a guide to maintain the sides of the turns perpendicular to the axis of the drum, said plate or plates being held against rotation, but being capable of moving longitudinally of the drum. Since the plates act on the flattened tube after it leaves the former they also serve as a means for further flattening and consolidating the material by exerting a certain amount of pressure thereon. After a helix of sufficient length to form a finished blank has been wound on the drum, it is removed by pushing the same endwise off of the drum, after which the helix, which for convenience may be called an element, is mounted on a steel cylinder of substantially the same diameter for further treatment. The drum 17 may be made of thin sheet metal since the stresses on it are small, but it can be made of steel or other strong material in which case the element may not have to be removed for further treatment.

After the element is formed the next step is to compress it. This may be done in a hydraulic or other press. Owing to the presence of the same amount of fiber in the region of the inner diameter or bore as at the periphery, it follows that the axial length at the bore will be somewhat greater than that of the periphery, assuming a uniform compression which is highly desirable. This necessitates the use in the press of oppositely beveled rings 22 upon which pressure is exerted. 23 indicates a cylinder which may be the drum 17 if strong enough and properly constructed, if not another cylinder is employed. This has to withstand a heavy pressure tending to collapse it when the opposing parts of the press move toward each other. To prevent the element from bulging outwardly a ring 24 is provided which closely surrounds the peripheral faces of the element and the beveled rings 22. To state the matter another way, the ring and cylindrical member confine the element against change of shape in planes perpendicular to the axis during the compressing or consolidating operation.

In the press the element is subjected to a sufficient preliminary pressure to materially compress or consolidate it. In a blank composed of cotton sliver about eight inches in diameter a pressure of about five tons per square inch of surface of the element will be sufficient. Such a pressure will reduce the length of a helix from fourteen inches to about one and one-quarter inches. After the pressure is removed the elasticity of the fibers will cause the helix to expand to an axial length of about three inches.

The next step is to put one or more elements in a holder or clamp, in which they are retained under a moderate pressure, after which the elements are subjected to the action of a softening agent, such as water for example. The purpose of this is to soften the fibers so that they can be consolidated to a greater degree without causing injury to the individual fibers, particularly at the points where said fibers cross each other. To decrease the amount of time required in this operation it is best done in an ordinary vacuum tank where about one-half hour will suffice. I find it desirable to compress the fibrous material to a greater or less extent before subjecting it to the action of the softening agent, but in some cases it may be found desirable to reverse these operations.

In some cases it will be found advantageous to add a small amount of binder to the water, the purpose being to cause the fibers to have a slight adhesion which is useful in handling the elements. This binder has no effect as a binding agent on the finished product, because the final pressure is such as to substantially drive it all out of the material. My experience has demonstrated that the less binder used the better. Ammonia shellac will form a suitable binder if used in the proportion of three one-hundredths of one per cent. by weight to that of the water used as the softening agent.

When the material is immersed in the softening agent it is under a moderate pressure, the amount of which is not material. It is desirable, however, to limit it to such a pressure as will permit the necessary amount of liquid to freely penetrate the fibers to soften them without there being any substantial excess which would have to be removed later.

The next step is to remove the elements and subject them to sufficient pressure which may be approximately the final pressure to drive out substantially all of the softening agent and the binder, and then to subject

them to a drying temperature. This drying may be done in a hot oven after the retaining clamp has been removed. It is also desirable to keep the elements in a hot dry place until used to prevent them from absorbing moisture from the atmosphere.

After the elements have been thoroughly dried each is placed in its final holder, as shown in Fig. 6. This comprises a member 25 which has a web 26 and an integral flange or shroud 27. A second member is provided which has a tapered cylindrical portion 28 that makes a good fit with the periphery of the member 25. It also has a flange or shroud 29 between which and the flange 27 the element 30 is clamped. To complete the hub a flanged member 31 is provided which is bolted or otherwise secured to the web 26. In assembling, the member 25 is mounted in a horizontal position in a press and the element placed in position thereon. Above this is placed the second member and the final pressure is applied in the ordinary manner. In practice I find that a pressure of ten tons per square inch of face is satisfactory for the purpose, but the amount can be varied to suit the requirements. By the various pressure steps in the process herein outlined, a cotton sliver helix fourteen inches long and about eight inches in diameter is reduced to one inch in the finished gear. While the members of the holder and the gear are under the final pressure the end face 32 of the member 25 is rolled over the corner of the flange 29 of the second member to unite the parts of the holder. This rolling can be done by a suitable tool in the same press in which the gear is assembled. After the parts of the holder have been united the pressure on the cotton will be somewhat decreased for the reason that the parts of the metal holder which before were neutral are now under tension and hence have stretched a little. Also because the fibers have taken more or less of a "set" during the manufacturing operations.

It is to be noted that the flanges 27 and 29 are inclined toward each other, *i. e.*, are slightly cored. This inclination will vary with different sizes of gears and bears a definite relation to the difference between the inner and outer diameters of the element. This arrangement has two purposes, first to provide the necessary space for the fibrous material, so that the pressure will be uniform throughout, and second to anchor it against the effects of centrifugal force. The additional space between the sides of the inner edges over that between the sides at the outer or peripheral edges is made necessary by reason of the fact that the same amount of fibrous material is present at both points which differ in diameter. Theoretically some slight allowance should be made for the presence of the core 14, but since it is very small, and since the turns of the core in the finished gear do not all fall in the same cylindrical plane, its presence may be disregarded. However, if a heavier core or one less compressible is employed, some slight allowance should be made, as it is important to have as nearly uniform pressure as possible over the entire sides of the gear. It is also important to have smooth faces on the flanges since any substantial increase of pressure at any local point is liable to injure the gear at this particular point. By making the shrouds slightly conical they are able to withstand heavy axial pressure because the metal is placed in tension.

It is to be particularly noted that the textile material is held under such compression by the end flanges or shrouds 27 and 29 and the cylindrical portion 28 that the use of auxiliary retaining devices, such as keys, screw-threaded studs, and rivets, is avoided. In other words, the combined arrangement is such that the torque or power exerted by or on the teeth is transmitted directly to the gear carrying shaft 33, thereby greatly simplifying and reducing the cost of construction.

When, for any reason, it is desirable to make up a gear from a number of elements, the inclined faces thereof will be cut away leaving both sides parallel to each other except the outside faces on the end elements which are left inclined for the purpose of anchoring the material in the holder.

After the material is mounted in the holder as above described, it may be machined the same as any metal gear. Figs. 6 and 7 show a gear, the teeth of which are cut in the flanges or shrouds 27 and 29, as well as in the fibrous material, but it is not intended that the metal shrouds shall engage the companion gear. The teeth in some cases will be cut straight and in other cases on a spiral, depending upon the use to which the gear is to be put.

It will be noted, owing to the formation of the element from a flattened tube wound into a helix, that the fibers in the finished product are arranged in turns or layers, each turn or layer being composed of two elementary layers. Of the fibers in these elementary layers, one-half are slightly inclined in one direction to a diametral plane and the remainder in the opposite direction at the same angle, said angles substantially coinciding with the angles and sides of the finished gear teeth. It will also be noted that the fibers extend at acute angles to each other as well as to diametral planes. Each half of a turn, or elementary layer, in the particular element described and composed of cotton sliver is approximately eight one-thousandths of an inch in thickness, there being about sixty layers or

complete turns in the helix in a completed gear or blank one inch thick. These figures, as well as those regarding pressures, are given as illustrations and not as limitations of my invention, since different sizes of the finished product may require somewhat different treatment.

By careful test I have found that a gear constructed as herein described is not only very much stronger than a gear made according to the old methods, but shows less wear. As a matter of fact the gears are fully as strong as the best grades of cast iron and withstand shocks much better. Moreover they are quiet in operation. In a given test my improved sliver gear and one made of spinnable textile fiber by an old process were tested under similar conditions of load and speed. The old type gear at the time it broke in service showed a wear of .024" on the teeth, while my improved gear showed a wear on the teeth of only .006" and was apparently as good as before, except for the slight wear. Another test showed that the teeth in a gear made by the old process having a one inch face broke under a pressure of 1000 lbs., while with my improved gear having teeth of the same size they withstood a pressure of 1600 lbs.

In some cases the presence of the core 14 in the finished blank may be undesirable. Where this is so, the blank may be held in a suitable clamp and the core and the fibers immediately surrounding it removed by a suitable cutting operation.

In the description thus far is disclosed the construction of a blank made from unwoven material as it represents the most highly developed form of the invention. In its broader aspect, however, my invention is not limited to the use of sliver or other unwoven material since certain substantial advantages, due to avoidance of loss in trimmings and increased strength, may be had by using woven material in the form of tape or ribbon or hollow flattened tubing. The tape or ribbon may be formed in any suitable manner, as, for example, is shown in Figs. 8 and 9. In Fig. 8 certain of the threads extend longitudinally and the remainder at right angles thereto. In Fig. 9 the material is so woven or braided that the threads are inclined to the edges of the body. In carrying out this form of the invention the tape, if suitably formed, may be directly wound edgewise on the drum 17, or it may first be wound on a former into a flattened tube, as in the case of the sliver blank and described in connection with Fig. 2 and then wound on the drum.

There is, however, one difference in the tube thus formed over that previously described. In Fig. 2 the turns are, practically speaking, side by side with only such overlap as occurs due to the soft nature of the material used. In the case of the tape or ribbon 34 there is a substantial overlap, as shown in Fig. 10, and for a particular purpose. As the flattened tube is wound edgewise on the drum the outer portions, or edges, of the turns move slightly on each other to compensate for the difference in length between the circumference of the drum and that of the wound body. The material also stretches more or less in this operation and if it is loosely woven the stretch may of itself be sufficient to effect this compensation. When tape of the character shown in Fig. 8 is employed, it is evident that the longitudinal threads in adjacent elementary layers will cross each other at acute angles and thus interlock; also that said threads are interlocked by the cross-threads which in turn cross and interlock with other cross threads in adjacent layers. It will also be evident that the threads on the outside of each turn of the helix will cross and interlock with those in adjacent turns, and in this manner the teeth of the finished gear will be strongly supported. With the material formed as shown in Fig. 9 there is also interlocking of the fibers as above described but the relative position of the fibers is different. Irrespective of the way the helix is formed the subsequent treatment of it may advantageously be the same as those outlined for the sliver blank.

In the beginning of this specification, reference was made to a type of gear made of layers or laminations of cloth in which the several layers are held together solely by the action of a binder. My improved method of manufacture, in so far as it relates to the formation of the several layers or laminations, is also applicable to gears, rolls, etc., of this character. Owing to the presence of the relatively large amount of binder necessary in a blank of this character, it will generally be preferable to avoid the intermediate pressure step and to subject the helix to its final pressure after being impregnated. In this manner all danger from injury to the fibers due to pressure when the binder is in a more or less hardened state will be avoided.

My invention has been described more particularly in connection with gears having peripheral teeth, but it is evident that it is also applicable to gears having internal teeth. The only essential difference in the manufacture is that the holder will have to be different shape and will surround the fibrous body. In machining the blank the inner ends of the fibers and the core 14 will be removed instead of being retained, as in the peripheral tooth type of gear.

As has been previously pointed out my improved blanks are particularly intended for gears in which at times the tangential

stresses and strains are very great. It is evident that if the blank will stand up for such purposes it will also stand up for other purposes, especially where the strains and stresses are less. For example the blanks may advantageously be used as friction rollers for various purposes, in which case the pressure is substantially all in a radial direction. Where the surface which coöperates with the roller or blank is wider than the textile fiber filler face, the end shrouds or flanges should be cut away slightly so that their diameter will be slightly less than that of the filler face to prevent the shrouds from engaging said surface. Owing to the fact that the ends of the fibers are presented to the periphery of the finished roll, the coefficient of friction of the roll will be high which is of course a desirable characteristic for such devices.

I am able to get a greater amount of spinnable fibers into a given space with the same compression pressure than was possible with the prior constructions with the result that the gear teeth are substantially stronger and more durable. This is due to the improved arrangement of the fibers with respect to each other. I may also use higher pressures than with the prior constructions without injury to the fibers. I am also able to greatly decrease the amount of stock required over prior constructions without, however, sacrificing any of the necessary and desirable qualities of the gear. Specifically, it requires about three times as much stock to make a cotton bat gear as it does one of my improved spirally wound gears of the same diameter and working face.

I believe it is broadly new with me in the manufacture of blanks of the character described from spinnable textile fibers to form said fibers into a relatively thin body either in an unwoven or woven state and to wind said body edgewise into a helix; to definitely locate or position the individual fibers in the layers and to wind the layers in such manner that the fibers in layers approximately follow the shape of the finished gear teeth, and at the same time cross or interlock with those in the adjacent layers, and also to wind the material into a flattened tube, which tube is subsequently wound into a helix, said layers, however formed, being subsequently compressed and retained in said state by any suitable means.

What I claim as new and desire to secure by Letters Patent of the United States is—

1. The method of manufacturing blanks which comprises winding a cylindrical body from loose textile fibers, said fibers being arranged to extend generally in a radial direction from the center to the outside of said body, and subjecting the body thus formed to pressure to consolidate it.

2. The method of manufacturing blanks which comprises winding a cylindrical body from loose unwoven textile fibers, said fibers being arranged to extend generally in a radial direction from the center to the outside of said body and in predetermined definite positions with respect to each other, and subjecting the body thus formed to pressure to consolidate it.

3. The method of manufacturing blanks which comprises forming textile fibers into a sliver, winding said sliver into a narrow strip with fibers extending crosswise thereof, assembling the material into cylindrical form with the fibers occupying definite positions with respect to each other, and subjecting the body to and confining it under pressure.

4. The method of manufacturing blanks for gears, rolls, etc., which comprises forming textile fibers into a long, narrow strip, winding said strip into a cylindrical body, said fibers being arranged to extend outwardly from the axis of said body and at different angles so that the fibers cross each other, and mounting the body in a holder under compression.

5. The method of manufacturing blanks for gears, rolls, etc., which comprises forming a cylindrical body of loose textile fibers, said fibers being arranged to extend outwardly from the axis of the body and at different angles so that the fibers cross each other, subjecting the body thus formed to the action of a softening agent, driving out the agent by the application of pressure, and mounting the body in a holder under its final compression.

6. The method of manufacturing blanks for gears, rolls, etc., which comprises winding a cylindrical body of thin narrow layers of textile fibers, said fibers in each layer extending crosswise of each layer and also outwardly from the axis of the body, those in certain layers extending at different angles from those in the remaining layers so that the fibers in different layers cross, and mounting the body in a holder under compression.

7. The method of manufacturing blanks for gears, rolls, etc., which comprises forming a relatively narrow strip of loose textile fibers, arranging the strip in layers to form a cylindrical body, the fibers in successive layers extending at acute angles to each other and to planes passing diametrically through the axis of the body whereby the fibers in the different layers overlap, and subjecting the body thus formed to pressure.

8. The method of manufacturing blanks for gears, rolls, etc., which comprises forming a cylindrical body of loose textile fibers arranged in thin layers, the fibers in successive layers extending at acute angles to each other and the planes passing diametrically through the axis of the body whereby the

fibers forming the different layers overlap, subjecting the body to the effects of a softening agent and then to pressure to consolidate the fibers and drive out said agent, and mounting the body in a holder under compression.

9. The method of manufacturing blanks for gears, rolls, etc., which comprises winding spinnable textile fibers into an elongated element in which said fibers form a fine pitch spiral, winding the element into the form of a helix, and mounting the helix in a holder under compression.

10. The method of manufacturing blanks for gears, rolls, etc., which comprises winding spinnable textile fibers into an elongated element in which said fibers form a fine pitch spiral, winding the element into the form of a helix, subjecting the helix to the action of a softening agent, driving out said agent by the application of pressure and heat, and mounting the helix in a holder under compression.

11. The method of manufacturing blanks for gears, rolls, etc., which comprises winding textile fibers around a core, mounting said fibers on a holder and temporarily confining them in place by the core, and finally subjecting the fibers to and confining them under pressure.

12. The method of manufacturing blanks for gears, rolls, etc., which comprises loosely winding spinnable textile fibers around a core in a manner to form a flattened fine pitch spiral, winding it edgewise on an annular form with the core under tension to retain the fibers, subjecting the body to pressure to consolidate it, and confining the body in a compressed state.

13. The method of manufacturing blanks for gears, rolls, etc., which comprises loosely winding textile fibers about a core to form a tube, winding it on a drum to form a helix with the core under tension to hold the turns in place, subjecting the helix to the action of a softening agent, consolidating the helix to drive out said agent, mounting the helix in a holder under compression, and finishing the blank.

14. The method of manufacturing blanks for gears, rolls, etc., which comprises forming a cylindrical body of loose textile fibers around a temporary support, said fibers arranged to extend outwardly from the axis of the body and at different angles so that the fibers cross each other, subjecting the body to the action of a softening agent, removing the body from its temporary support and subjecting it to the action of pressure and heat to drive out said agent, and mounting the body in a permanent support under compression.

15. The method of manufacturing blanks for gears, rolls, etc., which comprises winding loose textile fibers around a former and core and then winding the fibers and core to form a cylindrical body, said fibers being arranged to extend outwardly from the axis of the body and at different angles so that the fibers cross each other, confining the body against change of shape in a plane perpendicular to its axis, subjecting the same to axial pressure to consolidate the fibers, and confining the same in a compressed state.

16. The method of manufacturing blanks for gears, rolls, etc., which comprises forming a cylindrical body of loose unwoven textile fibers, all of said fibers being arranged to extend outwardly from the axis of the body and at different angles so that the fibers cross each other, impregnating the body with a binder, confining the body against change of shape in a plane perpendicular to its axis and subjecting the body to heavy axial pressure to consolidate it and drive out the excess binder.

17. The method of manufacturing blanks for gears, rolls, etc., which comprises loosely winding textile fibers around a core, winding the fibers and core around a temporary support to form a helix, subjecting the helix to end pressure to consolidate the fibers, subjecting the helix to the action of a softening agent, and then to the action of pressure and heat to further consolidate it and drive out said agent, removing its temporary support, and mounting the body in a permanent holder under compression.

18. As an article of manufacture, a blank for gears, rolls, etc., comprising a consolidated body formed from narrow, edgewise wound ribbon of unwoven textile fibers, the trend of said fibers being in general outwardly from the axis of the body.

19. As an article of manufacture, a blank for gears, rolls, etc., comprising a consolidated body formed of thin, edgewise wound layers of unwoven textile fibers, said fibers being arranged to extend outwardly, those in one layer crossing those in the adjacent layers.

20. As an article of manufacture, a blank for gears, rolls, etc., comprising a consolidated body formed from an edgewise, helically wound ribbon of textile material, the fibers in the different turns of the helix extending outwardly from the axis of the body, those in one side of each turn of the helix crossing those in the other side of another turn.

21. As an article of manufacture, a gear, comprising a wound body of loose textile fibers, which are arranged in layers, said fibers extending outwardly from the axis of the body and at different angles so that the fibers cross each other in the teeth and are securely anchored in the body below the teeth, and a metallic holder in which said body is retained under compression.

22. A gear having its body portion com-

posed of wound compressed spinnable textile fibers which cross each other in the teeth and in the body below the teeth, the trend of said fibers being generally in a radial direction.

23. A gear comprising a toothed body composed of a consolidated mass of unwoven spinnable textile fibers in which said fibers are definitely positioned with respect to the teeth.

24. A gear comprising a toothed body composed of a consolidated mass of unwoven spinnable textile fibers in which said fibers are arranged in thin interlocking layers, said fibers being definitely positioned with respect to the teeth.

25. A gear comprising a toothed body composed of layers of unwoven spinnable textile fibers consolidated into a dense mass with the fibers in adjacent layers interlocking, those in certain of the layers approximately following the shape of one side of the teeth and in other layers that of the opposite side of the teeth.

26. A gear having a toothed body comprising unwoven spinnable textile fibers which are definitely positioned with respect to the teeth, and a metallic holder in which said fibers are held under pressure in a compact mass.

27. A gear having a toothed body comprising unwoven spinnable textile fibers in thin interlocking layers, the fibers in said layers being positioned to correspond generally to the side faces of the gear teeth.

28. A gear having a toothed body comprising unwoven spinnable textile fibers in thin interlocking spirally arranged layers, the fibers in said layers being positioned to correspond generally to the side faces of the gear teeth, and a metallic holder in which the layers are held under heavy end pressure.

29. A gear comprising a toothed body of compressed textile fibers, said fibers being arranged in thin layers and extending outwardly from the axis of the gear and at different angles so that the fibers in adjacent layers cross each other, and a metallic holder which forms a hub and has end flanges that hold the body of the gear under compression.

30. A gear comprising a toothed body formed of a helix of textile fibers, the turns of said helix being flattened, the individual fibers in certain of the turns of the helix crossing those in the other turns both in the teeth and in the body below the teeth, and a holder that retains the helix in a compressed state.

31. A blank comprising textile fibers arranged in the form of a helix having substantially the same amount of fiber in the region of its bore as at the periphery, and a metallic holder which engages the wall of the bore and also the side faces of the blank and retains the fibers under substantially uniform compression.

32. The method of manufacturing blanks for the purpose described, which comprises forming a thin element of spinnable textile fibers, winding the element thus formed into a helix, and compressing the helix and holding it under compression.

33. The method of manufacturing blanks for the purpose described from a flat strand of spinnable textile fibers, which comprises winding the strand edgewise to form a helix, and compressing the helix and holding it under compression.

34. The method of manufacturing blanks for the purpose described, which comprises forming spinnable textile fibers into a thin flat element, winding the element thus formed into a helix, compressing the helix, and mounting the helix in a holder and retaining it under heavy compression.

35. The method of manufacturing blanks for the purpose described, which comprises winding textile fibers into a thin flat element, winding the element thus formed edgewise into a helix, and compressing the helix and holding it under compression.

36. The method of manufacturing blanks for the purpose described, which comprises winding textile fibers into a thin flat element, the fibers on one side of the element interlocking with those on the other side, winding the element thus formed into a helix, and mounting the helix in a holder under compression.

37. A gear comprising spinnable textile fibers arranged in thin interlocking layers and forming a helix, and a holder therefor constructed and arranged to hold said fibers under heavy compression and to directly transmit pressure between the gear teeth and its supporting shaft.

In witness whereof, I have hereunto set my hand this 5th day of November, 1917.

EMILE J. GUAY.