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E. J. GUAY ET AL

NONMETALLIC GEAR

Filed Jan. 9, 1926

Fig. 1.

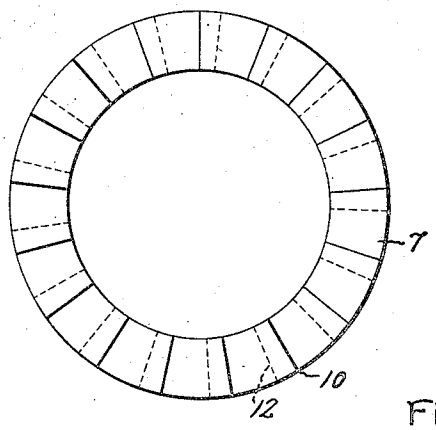


Fig. 2.

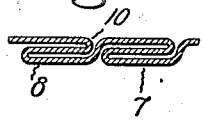


Fig. 3.

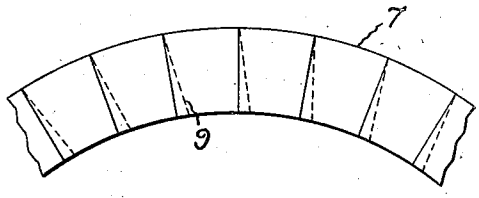


Fig. 4.



Fig. 5.

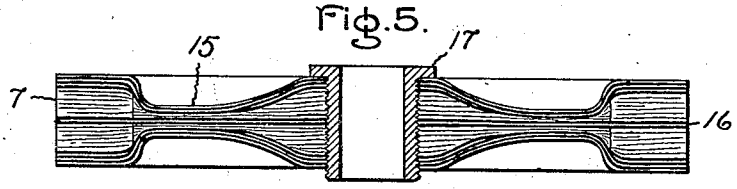
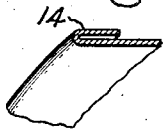


Fig. 6.



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UNITED STATES PATENT OFFICE.

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NONMETALLIC GEAR.

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The present invention relates to the manufacture of non-metallic gears from textile fabric and a binder such as synthetic resins. In the manufacture of such gears as ordinarily constructed there is considerable waste of binder-treated fabric which obviously increases the cost of the finished product.

Our invention has for its object to improve the construction of gears and gear material of the above-mentioned type and also to reduce the losses due to wastage of valuable materials.

For a consideration of what we believe to be novel and our invention, attention is directed to the accompanying description and the claims appended thereto.

In the drawing which is illustrative of our invention, Fig. 1 is a side view of a rim or a rim member of a gear blank; Fig. 2 is a sectional view showing how the fabric ribbon is pleated in a plane perpendicular to the axis of the blank; Fig. 3 is a side view on a somewhat enlarged scale also showing the arrangement of the pleats; Fig. 4 is a cross section of a rim member; Fig. 5 is a sectional view of a portion of a finished gear, and Fig. 6 shows a folded over ribbon to compensate for variations in thickness of the inner and outer edges of the rim members.

In carrying out our invention, we employ a relatively narrow ribbon 7 for forming a large portion of the rim. The ribbon may be woven as such, or it may be made by cutting a wide sheet into strips. The latter method has some advantages over the former due to the fact that it is more nearly uniform in thickness due to the absence of the threads which form the selvage edge. If such a ribbon is wound on edge to form an annulus it will be found that the inner edge will be crimped while the outer edge is tight. This is due to the fact that whereas the diameters of the inner and outer edges are different the amount of fabric or numbers of threads at said edges is the same. To compensate for this difference of diameter we closely pleat the ribbon, the depth of the pleats being governed by the diameter of the blank and the width of the ribbon. To attain the best results the pleats are deeper at the inner edge than at the outer, the amount being governed by the difference of diameter of the two edges. If the pleats are made uniform the desired result may be obtained by having the pleats overlap at the inner edge. The ribbon may be coated with a binder such as a phenolic condensation product, either before or after pleating, but as a general thing it is preferable to first coat the ribbon and then pleat it, since by so doing an excess of binder is avoided, it being remembered that the strength and elasticity of the finished product is due to the woven fabric and not to the binder. The ribbon after being coated with the binder and dried in any suitable way, is closely pleated, as indicated at 8 in Fig. 2. In this figure the portions of the pleats are purposely separated so that the arrangement can be clearly seen. It will be noted that by this pleating each layer of the ribbon as applied to the rim member comprises three thicknesses of fabric. The ribbon should be closely pleated so as to avoid the formation of pockets containing binder alone as distinguished from fibers and a binder in the finished product. After the ribbon is pleated it is wound edgewise around a drum or equivalent support to form a helix such as indicated in Fig. 1, the plane of each turn of the helix and hence of the pleats themselves being perpendicular to the axis thereof. This perpendicular arrangement is important because when the teeth are cut in the blank the edges of the numerous layers, as distinguished from the side face of the fabric, will be presented to the teeth of the companion meshing gear. For gears intended for relatively heavy duty, it is preferable to make the pleats slightly deeper at the inner edge than at the outer edge, as indicated by the dotted lines 9 in Fig. 3, or if the pleats be uniform to overlap them at the inner edge. The purpose of this is to avoid as far as possible open spaces or pockets between adjacent pleats in the same turn of the helix. If there are such spaces or pockets they will be filled with binder in the heating and pressing operations and for some classes of gears this is not particularly objectionable but for heavy duty gears it is desirable to have fibers of the fabric as uniformly arranged as possible and to avoid even very small pockets containing binder alone. Even if the helix shows some small spaces or pockets in the preliminary stages of manufacture they will be wholly or largely filled

due to the spreading of the fibers of which the fabric is composed when subjected to the heavy pressure used in the final operation. The helix should be so wound that the bends of the pleats in the different layers, turns, or laminations do not register, i. e., appear in the same axial plane, but should be in staggered or overlapping relation. In other words, the bends 10 in one turn of the helix should be opposite the first surface of the adjacent turns of pleated ribbon. To accomplish this, the pitch of the pleats should be such that a given number of pleats will cover a little more or a little less than the complete circumference of the drum used in the forming operation. The non-registering arrangement of the pleats is indicated in Fig. 1 where the full lines 10 indicate the bends in the pleats of one layer or turn, and the dotted lines 12 the bends in another layer.

It will be evident in using a ribbon of uniform width and thickness that when wound into a helix the same number of fibers will be present at the inner as well as the outer diameter of the ring or turn of the helix and because the diameter at the periphery is greater than at the inner surface or bore of the ring or turn the material in the region of the bore will be slightly thicker, measured axially, than in the region of the periphery. In some gears this does not make any difference but in others it does. Where it is desired to make a rim of uniform thickness and density of fibers, inserts may be employed and preferably made from woven fabric, although other materials having suitable characteristics may be used. In Fig. 4 inserts 13 are shown by heavy black lines. They may be of the same or different radial depths, and the number of such inserts will be determined by the difference in thickness to be compensated. In Fig. 6 is shown another way for making these inserts. In this case ribbon is used either pleated or plain and one edge is turned over as at 14 to provide the additional thickness desired. The inserts however made may be located between rim members, between parts of a member, or they may be applied to the sides of the members.

The helically wound rim member may be applied directly to a metal center or to a center composed of textile binder-treated material. The latter may be composed of pieces of woven fabric, or moldable materials, or a combination of both. In Fig. 5 is shown a center or web 15 composed of binder-treated woven fabric made in the form of disks, segments or other forms. Preferably, some of the disks 16 will extend from between the rings or rim members to the hub thus tying them to the hub elements while others will serve to cover the side faces of the rim members and also to tie them to the web and hub. The web may be keyed directly to the supporting shaft or a metal hub such as 17 may be employed.

We have found that bodies made of pleated fabric and held under compression by a suitable binder are much harder to split in the plane of the laminations than when made of plain flat pieces piled flatwise. We attribute this chiefly to the fact that the adjacent surfaces considered as a whole are not so smooth and uniform as is the case with plain, flat pieces, and hence the binder more securely unites or bonds the laminations. There is also a certain interlocking of the laminations which further resists the tendency to split. A blank constructed as described has the great advantage that the threads or fibers, either the warp or woof in the rim are substantially parallel to each other and in planes perpendicular to the axis and hence a large percentage of them extend radially of the finished teeth from the root to the point thereof.

It will be evident by utilizing ribbons as distinguished from disks, segments or other cut forms, that a very great saving is effected in the high-grade, expensive materials employed. When woven fabric disks or pieces are used for anchoring purposes or as fillers, any trimmings or scraps resulting from the cutting operations may be utilized in the web or hub portion of the blank.

After the parts have been prepared as previously described, they are subjected to heat to soften the binder and then to pressure to compress the fibers, the final action of heat and pressure causing the binder to harden and retain the fibers in their compressed state thereby forming a uniformly rigid structure. In this particular we may follow the established practice. In forming gear blanks it is preferable to employ molds shaped to conform to the finished blanks. Preferably each rim member or unit is made of a single piece of ribbon but in some cases it will be satisfactory to use several such pieces, especially when the gear is of large diameter.

Instead of making the center portion, i. e. the hub and web of woven fabric we may make it of a moldable composition comprising textile material fibers and a binder or of any other composition in fact which will afford a firm support for the rim and which will readily unite therewith when subjected to the temperatures and pressures used in forming said rim. Where such a composition center is provided it may be covered on both sides with sheets of fabric which not only increases the strength of the blank but improves its appearance.

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

1. A blank of the character described hav-

ing at least a portion of its rim comprising woven fabric arranged in layers, said fabric being pleated, the pleats increasing in depth from the periphery inwardly, inserts which compensate for difference in thickness of different parts of the rim due to the form of the pleats, and a binder which holds the fabric in a compressed state.

2. A blank of the character described comprising a hub portion, fabric disks which extend from the hub portion to the periphery of the blank, bodies of fabric located between the disks and forming with them the rim, each of said bodies comprising layers of fabric which are pleated over their entire surface, the pleats contacting with one another, the side pleats also contacting with the disks, and a binder which holds the disks and bodies in a rigid structure.

3. A blank of the character described comprising rings which form the major portion of the rim and which are composed of relatively narrow strips of woven and pleated fabric, said strips standing edgewise with respect to the web of the blank with the pleats perpendicular to the axis and in firm contact with one another, a woven fabric disk located between the rings and extending into the web to form an anchor, other anchoring disks which form the side faces of the blank including the web, and extend to the hub thereof, a fabric filling for the space defined by the outside disks, rim and hub, and a binder which unites the various parts over their entire surface and holds the fibers thereof in a compressed state to form a rigid structure.

In witness whereof, we have hereunto set our hands this 7th day of January, 1926.

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CLARENCE W. MANSUR.