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TORQUE TRANSMITTING MEMBER AND METHOD FOR PRODUCING THE SAME

Original Filed Feb. 18, 1931 2 Sheets-Sheet 1

Fig. 1



Fig. 2.

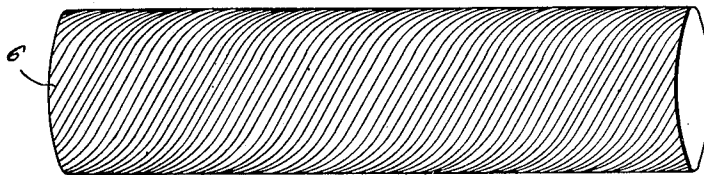
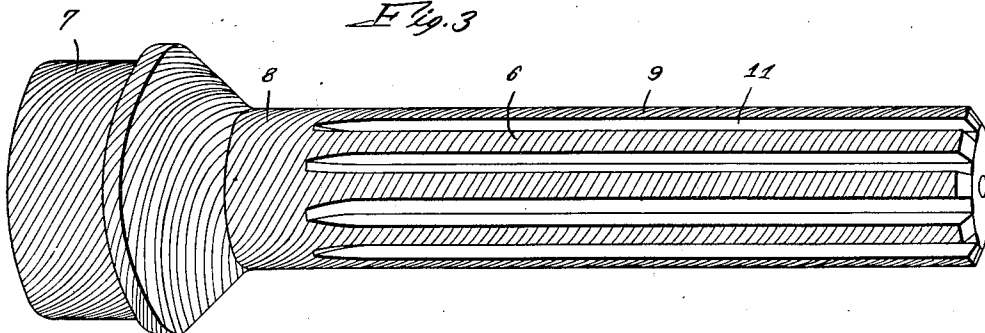


Fig. 3



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Fig. 4

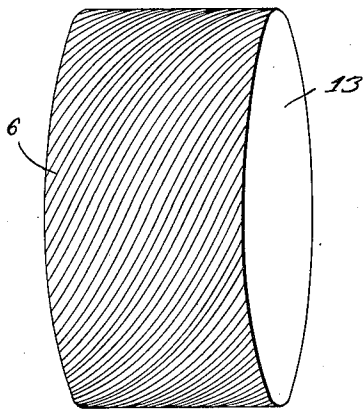


Fig. 5

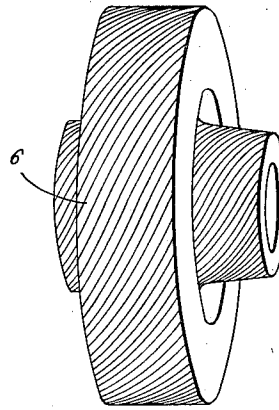
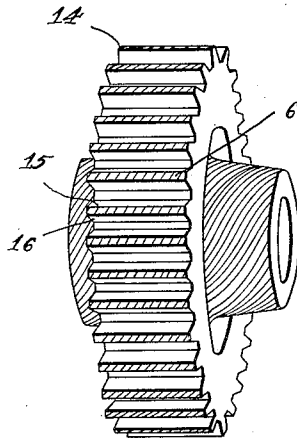


Fig. 6



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UNITED STATES PATENT OFFICE

1,998,108

TORQUE TRANSMITTING MEMBER AND
METHOD FOR PRODUCING THE SAME

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Application February 13, 1931, Serial No. 516,565
Renewed January 15, 1934

3 Claims. (Cl. 29—159.2)

This invention relates to the manufacture and treatment of metals and has particular reference to the manufacture of bar stock of ferrous metals having improved characteristics.

The usual and customary methods for manufacturing bar stock of steel, alloy steels, and similar materials are such that the direction of the fiber flow is parallel to the longitudinal axis of the bar. In the manufacture of various types of articles, it is customary to cut the metal either lengthwise or cross-wise of the bar. Because of this the cuts will normally lie either parallel with the fiber or cross-wise thereof.

It is a well known fact that the resistance to abrasion and the ultimate strength of the metal differ depending upon whether the force is applied in the direction of, or at right angles to, the fiber flow. In the former case, the strain is borne by the ends of the fibers of the metal while in the latter the strain must be borne by the weaker flow lines. In the former case the metal exhibits its greatest strength while in the latter it exhibits its minimum strength.

In making torque transmitting members it is convenient and economical to cut the splines, teeth and the like, lengthwise of the bar, whereby the faces thereof must necessarily lie parallel to the fiber flow. Under these circumstances the force directed against these portions of the member is at right angles to the fiber flow of the metal and as a result the metal exhibits its minimum strength whereby the portions are relatively easily broken off. In the case of torque transmitting members such as gears and the like, it becomes necessary, in order to develop sufficient strength, and resistance to wear in the teeth, to form the blanks through a forging operation to rearrange the fiber flow. However, the use of forging operations results in a member in which the metal is of variable density whereby satisfactory heat treatment of the member becomes difficult.

There is also a considerable difference in the machining characteristics of the metal depending upon the relation between the direction of the cut and the direction of the fiber flow, this difference being a maximum when cross-wise and lengthwise cuts are made on the usual type of bar stock.

One of the principal objects of my invention is the provision of torque transmitting members from bar stock wherein the fiber flow is helically directed within the bar thereby to produce an object of improved torsional strength, machinability and wear resisting properties, par-

ticularly in the teeth or transmitting projections.

Another object of the invention is the provision of torque transmitting members having materially less susceptibility to distortion during the heat treatment thereof.

I have also aimed to provide a torque transmitting member wherein the fiber flow thereof is helically directed within the member to increase the torsional strength and impact value thereof.

Another object of the invention is the provision of a torque transmitting member having longitudinal faces wherein the fiber flow lies at an angle with respect to the faces.

A still further object of the invention is the provision of a method for manufacturing toothed torque transmitting members wherein the cost of manufacture is materially reduced.

Other objects and attendant advantages will become apparent to those skilled in the art from the following description and the accompanying drawings in which—

Figure 1 shows a conventional bar stock section wherein the fiber flow lies parallel to the longitudinal axis;

Fig. 2 shows a bar stock section in which the fiber flow lies helically about the longitudinal axis, representing one step in my improved method;

Fig. 3 is a wide elevation of a propeller shaft splined stud end made from bar stock in which the fiber flow is helically arranged;

Fig. 4 is a side view of a blank from which a gear is to be cut;

Fig. 5 is a side view of the gear before the teeth have been cut therein; and

Fig. 6 is a side view of the finished gear.

The invention contemplates, the twisting of bar stock of steel or similar material in order to helically dispose the fiber flow about the longitudinal center of the bar. This permits the forming of longitudinal or transverse slots or projections on the bar in the usual manner without having the fiber flow parallel with the longitudinal surfaces thus formed. Because of the helical direction of the fiber flow, the transverse slots or projections are cut across the fiber flow so that such formations will have greater strength and greater wearing properties. The amount of this twist may vary considerably depending upon the purpose for which the material is to be used. I have in some instances twisted the stock through an angle of 75° per inch and in other cases I have succeeded in imparting a twist of as much as 375° per inch.

Referring to the drawings, Fig. 1 shows a por-

tion of conventional steel bar stock, the shading designated by the numeral 5 representing the fiber flow of the metal. In this figure the fiber flow will be seen to lie parallel with the longitudinal axis of the bar. In Fig. 2, the lines designated collectively by the numeral 6 indicate the position of the fiber flow after a bar such as that shown in Fig. 1 has been progressively twisted. Fig. 3 shows a stub end made from twisted bar stock similar to that shown in Fig. 2. The numeral 7 designates an upset head on the end of a bar 8 and indicates the manner in which the usual metal working methods may be employed without disturbing the helical position of the fiber flow. Splines 11 are formed in the bar through which rotary motion is transmitted to the stub end. It will be seen from the lines 6 that the fiber flow lies at an angle with respect to the faces 11 of the splines thereby imparting materially greater torsional strength and higher impact value than would be the case were stock of the nature shown in Fig. 1 used.

Figs. 4, 5, and 6 show the various steps in the formation of a gear. In this instance a blank 13 of suitable length is cut from bar stock of substantially the same diameter as the gear to be formed; the bar having previously been twisted to dispose the grain flow 6 helically about the longitudinal center of the bar. The structure shown in Fig. 5 is then formed from the blank 13 by the usual well known machining operations, after which the teeth 14 are cut on the outer surface of the gear as shown in Fig. 6 to provide faces 15 and 16. It will be seen that the grain flow 6 within the teeth 14 lies at an angle with respect to the faces 15 and 16, and that when the faces 15 and 16 are brought against the faces of a cooperating gear the force exerted upon these faces will be directed against the ends of the metal fiber, that is, at an angle with respect to the grain flow rather than parallel therewith. In forming a gear in this manner from twisted bar stock the forging operations are completely eliminated and a gear having uniform strength results. It will furthermore be seen that by eliminating the forging operation and cutting the gear directly from a twisted blank, a member results in which the metal is of uniform density and which may be heat treated without the difficulties attendant upon variable metal density.

The orientation of the fiber flow may be accomplished by any desired method. In one particular instance I have employed a bar of commercial steel in which the fiber flow lies parallel to the longitudinal axis. I have heated this bar to a temperature near the rolling temperature of the metal and have then imparted rotation to one end of the bar, the other end being held stationary. I believe it advisable to impart the twist to the bar at a temperature near the rolling temperature in order to avoid any possible rupture. This exact temperature will, of course, vary somewhat depending upon the composition of the metal. If desired, the twisting of the bar stock may be accomplished during the rolling process. At this time the metal is at a temperature suitable for the twisting process and such a step may be interposed between various steps of the rolling operation. I have then normalized and annealed the metal and found that the orientation of the fiber flow has not been altered by this treatment. A feature of this invention is, however, the fact that these operations are normally eliminated, thereby reducing the cost of manufacture. Upon machining the bars so treated I have observed

that the machinability of the metal has been materially improved.

In order to compare the characteristics of bars in which the fiber flow is parallel to the geometric axis and bars in which the fiber flow was helically disposed, I have conducted a number of tests in which stub ends made of both types of bars were employed. The treatment of each was identical except for the twisting step, the twisted bar being given a twist of 75° per inch. Both pieces were made from the same bar; were normalized together in the same furnace; were annealed together in the same furnace, and were hardened, and drawn in the same manner and by the same operator. Upon test both articles showed the same Rockwell hardness (R. C. S.). The article made from the metal in which the fiber flow was helically disposed showed noticeably less dimensional changes during the heat treatment, while the torque strength for the twisted article was 1075 foot pounds and the torque strength for the article in which the fiber flow was parallel to the geometric axis was 975 foot pounds. These tests conclusively show that the article made from the steel in which the fiber flow was helically disposed had a greater torque strength, were less susceptible to distortion and displayed improved machinability.

The use of my invention permits the use of cheaper grades of material in torque members and like articles wherein torsional strength is a material factor. The use of the process materially improves the machinability of the metal and thereby reduces the machining costs.

The cost of producing articles in quantity is reduced because of the fact that fewer of the finished articles are rejected upon inspection because of distortion during the heat treatment thereof. This is probably due to the fact that the twisting operation brings the metal to a more uniform density, increases the density of the metal and brings the fibers thereof in closer proximity.

The invention also serves as an inspection step as any glaring defects in the metal will be apparent during the twisting operation and rejection may be made at this time. Minor defects of the metal will be cured by twisting the metal as described. Thus the use of the twisting operation avoids the possibility of such defects going unnoticed until final inspection of the bar stock or even until the finished articles have been manufactured. In this manner the number of rejected finished articles is still further reduced whereby the cost of production is also reduced.

A further result of the use of my invention is the fact that when longitudinal forms or shapes are produced the fiber flow will not lie in a plane parallel to the longitudinal faces but rather at an angle with respect thereto, thereby materially increasing the strength of the article to forces directed at right angles to these longitudinal faces.

The invention is, however, by no means limited to the particular applications herein set forth but will be of value in innumerable other and different uses. For example, my invention may be advantageously employed in the manufacture of line shafts, coiled spring axles, sucker rods, journals, and innumerable other articles of commerce in which desirable characteristics will be imparted to the finished article by helically disposing the grain flow in the bar stock from which they are manufactured.

While I have thus described and illustrated a specific embodiment of my invention I am aware that numerous alterations and changes may be

made therein without materially departing from the spirit of the invention and the scope of the appended claims in which—

I claim:

5 1. An article of manufacture comprising a solid torque transmitting member formed from a single piece of metal and wherein a substantial amount of the metal fiber flow is helically directed to a substantial degree throughout the length of
10 said member.

2. An article of manufacture comprising a torque transmitting member of improved torque strength and wearing properties formed from a solid bar and having at least one working face
15 parallel to the longitudinal axis of the bar, the grain flow being helically arranged in said member and at an angle with respect to said working face.

3. The method of manufacturing a toothed
20 torque transmitting member of metal bar stock which includes forming a solid bar of said metal, helically directing the fiber flow of said metal while substantially at its rolling temperature, and circumferentially and longitudinally cutting the resultant bar to the desired shape, and to form
25 torque transmitting teeth.

4. The method of forming a toothed torque transmitting member which includes forming a

solid bar of desired diameter in which the grain flow is helically directed, machining the bar to size and shape, and heat treating the same.

5. The method of manufacturing splined stub
5 ends which includes the steps of forming a solid bar of metal, twisting said bar to helically direct the grain flow of said metal, and cutting longitudinal slots in said bar to form teeth therein.

6. The method of forming gears which consists
10 in the steps of forming a solid bar of metal, twisting the bar to helically direct the grain flow, machining the resultant bar to form the gear, and heat treating the same.

7. The method of forming gears which includes
15 machining a solid bar in which the grain flow is helically directed to shape the gear and form teeth therein, and heat treating said gear.

8. The method of forming toothed torque transmitting members without forging which includes
20 the steps of forming a solid bar of metal in which the grain flow is helically directed and machining the same to shape the member and form teeth therein, and heat treating the same for the purpose of causing the ends of the metal grain to face
25 the working faces of the teeth and to produce a member of uniform density.

HORACE L. WAISNER.