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METHOD OF TREATING CUTTER TEETH

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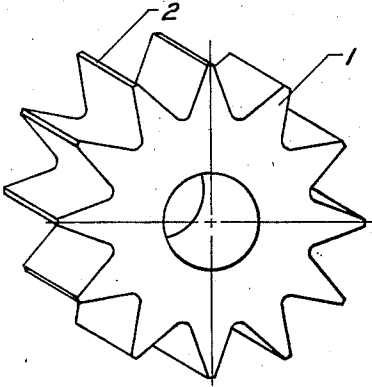


Fig. 1

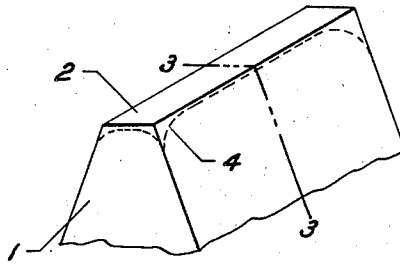


Fig. 2

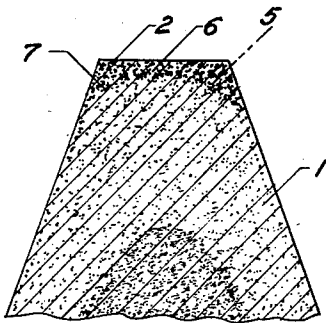


Fig. 3

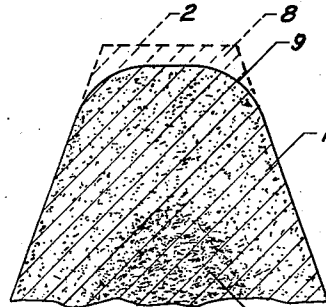


Fig. 4



Fig. 5

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METHOD OF TREATING CUTTER TEETH

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6 Claims. (Cl. 76—108)

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This invention relates to the method of treating the teeth of cutters such as are employed in well drilling, or for other similar purposes.

The present application is a continuation in part of my prior application Serial No. 519,321, filed January 22, 1944, for a Method of treating cutter teeth, which application is being abandoned.

In forming the teeth upon cutters of this character it is found that when the teeth have been cut to their desired shape and size and thereafter carburized, internal stresses and strains are set up, particularly along the corners and sharp edges of the teeth. These strains tend to assist the development of cracks in the metal which may cause the cutter teeth to break down where they otherwise would not.

Furthermore, when cutters of this character have been carburized to develop a strong case on the portions of the cutters which are subject to wear and abrasion, there is a tendency of the carbon to concentrate in irregular forms along the corners and sharp edges of the teeth. These massive carbides which are thus developed in the metal along the edges of the teeth are brittle and thus support the development of the cracks in the metal.

It is an object of the invention to subject the teeth of the cutters to abrasion and wear in such manner as to relieve the strains and stresses set up in the metal of the teeth by the carburizing step and also the heat treatment.

It is an object of the invention to remove as far as possible the metal of the teeth wherein these strains may be set up and in which the carbon is concentrated, and by so doing to eliminate the tendency of the metal to crack or fracture, along the crests and ends of the cutting teeth. I aim to provide a tooth which is hard and wear-resisting and yet which will not crack or splinter when used upon hard formations.

It has also been found that after the cutters are carburized, abraded and then heated further development in the service rendered by the cutters may be obtained by subjecting the cutters to a second abrasive operation. Such second operation seems to affect the surface resulting from the heat treatment by work hardening or peening of the surface, and particularly where the surface may have acquired a skin decarburizing or skin softening due to such heat treating.

In explaining the invention, reference is made to the drawing herewith wherein Fig. 1 is a perspective view showing one type of cutter to which the invention may be applied.

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Fig. 2 is a broken enlarged view of the crest of one of the teeth illustrating somewhat diagrammatically the extent of the carbon concentration along the sharp edges of the teeth.

Fig. 3 is a transverse section along the line 3—3 of Fig. 2.

Fig. 4 is a view similar to Fig. 3 but showing the crest of the tooth worn away by abrasion.

Fig. 5 is a much enlarged view showing a microphotograph of a corner of one of the teeth, indicated by the dotted line 5 in Fig. 3, and illustrating the concentration of massive carbides in groups as shown.

The invention is adapted for use particularly on the teeth of the cutters employed in well drilling but it will be obvious that such cutters may be used for other purposes, such as stone dressing and the like, and the invention is not limited entirely to cutters for well drills.

In Fig. 1 is a view showing a disc shaped cutter with an approximately cylindrical periphery which has been machined to provide teeth 1 thereon adapted to engage the formation in drilling. Such teeth are normally provided with a cutting crest 2, which is a narrow flat area at the end of the tooth, which is adapted to penetrate the formation and disintegrate the same. The flat crest is preferable to a sharp crest because of its greater strength and is thus adapted to wear more efficiently.

When a cutter has been formed into the shape shown in Fig. 1, it is to be noted that the teeth have sharp corners at the ends and along the sides of the crest thereof, so that the said teeth are adapted to be more easily penetrated by carbon along these edges and angles than in the other parts of the teeth.

After the teeth are thus formed they are subjected to a carburizing treatment which develops a carbon penetration along the surface exposed to the treatment. The carbon penetrates into the steel and it is found that said treatment tends to form an excess of carbon along the sharp corners and edges of the teeth. Thus, as seen in Fig. 2, the dotted line 4 shows the approximate depth of penetration of massive carbides in the steel. Said carbides tend to make it more brittle and subject to fracture than the rest of the tooth. A microphotograph of the metal taken through the corner of a tooth in which the carbides are thus concentrated is shown in Fig. 5. This view shows the carbon lying in small particles in the tooth itself, as shown along the area 7. However, there are massive carbides 6, which, concentrated in larger particles in the metal,

would tend to furnish lines along which cracks may develop.

Thus, as seen in Fig. 3, there is excess of carbon deposited within the metal along the crest and sides of the teeth. This portion is thus more brittle than the remainder of the tooth and is thus subject to fracture when the tooth engages upon hard formation under high pressures. Thus cracks may develop in this portion of the tooth. Such a crack may extend along this surface area and penetrate into the hard material of the interior of the tooth, following the lines of the massive carbides. Chips and large particles of the steel of the tooth are broken off from the tooth during use, thus causing it to break down far sooner than it otherwise would.

To remove the excess carbon in the tooth along the more exposed portion thereof I next submit the cutter to wear and abrasion to remove the sharp corners and the massive carbides contained therein. This metal may be removed by tools, if desired, but a much easier and more satisfactory method has been found. Said method consists in tumbling the cutters in a ball mill until the sharper edges and corners of the teeth have been worn away. Fig. 4 illustrates in dotted lines at 8 the original crest of the tooth. By wear this crest has been reduced and rounded, as shown at 9 in full line. Thus the corners have not only been rounded to reduce the strains which develop in heat treating but the larger portion of the massive carbides have also been worn away. When teeth thus rounded are employed in the drilling operation, it has been found that fractures do not tend to develop as in the original form of the tooth. Very few chips or splinters are broken off of the tooth when it has been thus treated.

After the corners of the teeth have been thus rounded off the cutter is subjected to the usual heat treatment. The particular type of heat treatment is not material in the use of this invention and it may be understood that any preferred form of heat treatment may be used in hardening the teeth for use in drilling.

From reference to Fig. 4, it will be seen that after the cutter tooth has been tumbled in the ball mill to remove the sharp corners thereon the tooth has a carburized case extending inwardly from the surface to a material extent and the interior of the tooth indicated at 10 is a soft and tough material which is not so liable to fracture. The rounded corners tend to prevent the setting up of strains in the material which would tend to cause cracks in said metal. The tooth is thus supported by tough and strong interior and has along its surfaces a hard case due to the case hardening treatment. Such a cutter has been found to wear much better than a tooth not so treated. The teeth will not break down when subjected to heavy pressures upon hard formations but will wear for comparatively long periods of time before the teeth are dulled so that the cutter must be discarded. A cutter so treated is therefore of longer life and will drill more hole and be more economical for use by the driller.

It has also been found in some instances that the heat treating of the cutters affects the surface to some extent, depending of course upon the type of heat treatment applied. In some instances such heat treatment may cause a skin

softening of the surface or a decarburization thereof to some extent, and when the cutter is then put in use such a softening or decarburized surface may not produce a maximum of service. It has been found therefore that if the cutters are now subjected to another tumbling action the above condition of the surface can be eliminated. It is believed that this second tumbling action serves to work harden or peen the surface. This action prepares the surface for severe shocks and abrasion and may substantially extend the service to be obtained from the cutter.

The present invention therefore contemplates a procedure where the cutter will be carburized, tumbled, and heat treated in preparing it for use and it may also embody a procedure for carburizing, tumbling, heat treating and then a final action of peening or tumbling so as to complete the preparation of the surface for final use.

What is claimed is:

1. In the forming of teeth upon a drill cutter the steps of machining the teeth to produce narrow crests thereon, carburizing said teeth whereby massive carbides are concentrated along the sharp corners thereon, rounding off the crests and corners of said teeth to remove some of said massive carbides from said corners and resist the development of strains in heat treatment, and heat treating to harden said cutter in the usual manner.

2. In forming teeth upon a cutter having corners and narrow crests thereon, the steps of carburizing said teeth, removing the sharp corners and a portion of metal from said crests and sharp edges, and then submitting said cutter to customary heat treatment to harden the same.

3. In treating the teeth of cutters, the steps of carburizing said teeth, then abrading the corners and cutting edges of said teeth to remove therefrom some of the brittle massive carbides and thus resisting the development of strains therein, and then heat treating to harden said cutters.

4. In the forming of teeth upon a drill cutter the steps of machining the teeth to produce narrow crests thereon, carburizing said teeth whereby massive carbides are concentrated along the sharp corners thereon, rounding off the crests and corners of said teeth to remove some of said massive carbides from said corners and resist the development of strains in heat treatment, heat treating to harden said cutter in the usual manner, and thereafter tumbling the cutter to work harden the surface thereof.

5. In forming teeth upon a cutter having corners and narrow crests thereon, the steps of carburizing said teeth, removing the sharp corners and a portion of metal from said crests and sharp edges, then submitting said cutter to customary heat treatment to harden the same, and thereafter peening the surface.

6. In treating the teeth of cutters, the steps of carburizing said teeth, then abrading the corners and cutting edges of said teeth to remove therefrom some of the brittle massive carbides and thus resisting the development of strains therein, then heat treating to harden said cutters, and thereafter subjecting the cutter to tumbling to work harden the surface.

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