METHOD OF TREATING GEARS AND SIMILAR ARTICLES

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My invention relates to a method of treating metal articles having openings therein by a heat treatment to enable the operator to form the opening to the proper dimensions.

My invention is particularly applicable to the treatment of gears and like articles wherein it is desirable that the opening extending through the gear shall be formed with an extremely small tolerance as to the dimension of the opening.

The invention is particularly applicable to the treatment of splined gears. In one method of forming splined gears the gear is formed from a suitable blank, the teeth being cut thereon and the splines being formed thereon with sufficient metal left to permit the removal thereof as by broaching to the proper dimension. This gear is heat-treated in the usual manner and then subjected to a quenching bath for hardening purposes.

In the production of gears in large quantities some of the gears fail to pass inspection because of the fact that the splined opening formed thereon is oversized. This may be caused by the removal, by the workmen, of too much material during the finishing process. These gears heretofore have been rejected with the consequent loss of the gear and the consequent loss of the time and labor spent in producing the gear. My method of treatment provides a means for eliminating the opening, without affecting the gear, to permit of the obtaining of the correct diameter or configuration of the opening in the gear, thereby preventing the loss of the gear.

For the purpose of illustrating my invention I have shown in the accompanying drawing, diagrammatically, one means of carrying out my method.

In the drawing Fig. 1 is a plan view partly in section, diagrammatically illustrating an apparatus carrying out my invention:

Fig. 2 is a side elevation thereof, and

Fig. 3 is a side elevation of a gear showing a plug, of the character used by me, in position.

In the apparatus illustrated I provide a pair of clamping jaws 1 and 2, one of which (2) is movable relatively to the other and may be moved by the manipulation of a suitable cam lever 3. These two jaws are electrically connected together by the conductor 4. A similar pair of jaws 5 and 6 is provided, the jaw 6 being manipulated by a cam lever 7, and these jaws are electrically connected by the conductor 8. The conductor 4 is connected by a conductor 9 through a suitable control switch 10 with one terminal of a generator 11. The conductor 8 is connected by the conductor 12 with the other terminal of the generator 11.

The gear 13 to be treated is mounted on a plug 14 which plug may be splined to coincide with the splines of the gear 13, or even may be an ordinary round plug. In any event, the dimensions of the plug 14 are such that expansion of the walls of the opening of the gear will be unrestricted under the influence of the application of heat to the gear. The plug, with its gear mounted thereon, is secured in position between the two sets of clamping jaws and upon the application of electric current thereto, the resistance set up by the plug will cause the plug to heat. In actual practice the plug becomes red hot. The heat radiated from the plug heats the gear 13 locally about the opening in the gear, and this heating of the gear is continued until the metal in a zone approximately bounded by the dotted line 15 reached about 1400°F, at which temperature the metal becomes plastic. However, the heat is not maintained sufficiently long to heat the entire gear so that the periphery of the gear remains relatively cool, not reaching at the outside periphery much over 500°F. As the result of this heat treatment, due to the fact that the gear, has a cold band area, the metal surrounding the opening of the gear expands towards the axis of the gear and due to the fact that this metal will expand only in one direction, the metal of the gear becomes sufficiently distorted to enable the gear to be reformed by the operation of the force out of the band, or in other words, the metal is relieved of the strain set up due to the distortion of the metal.

While I have specifically described my invention in connection with the treatment of steel gears, it will be understood that my method is capable of application to other articles and to articles of other metals.

I claim as my invention:

1. The process of treating a hardened steel gear having a splined opening therein which consists in mounting said gear on a mandrel, constituting a resistance element of an electric circuit and heating said mandrel by the passage of an electric current therethrough to such
an extent as to heat the metal adjacent the opening of said gear sufficiently to distort said metal and so rapidly as to obtain such distortion before sufficient heat is conducted to the peripheral area of the gear to substantially affect the hardness of the gear and so as to leave a relatively cool band of metal around said heated area, the diameter of said mandrel being smaller than the diameter of the opening by an extent greater than the expansion limits of said heated metal.

2. The process of treating a hardened steel gear having an opening therein which consists in mounting said gear on a mandrel and heating said mandrel to such an extent as to heat the metal adjacent the opening of the gear sufficiently to render said metal plastic and so rapidly as to obtain such plasticity before sufficient heat is conducted to the peripheral area of the gear to substantially affect the hardness of the teeth of the gear so as to leave a relatively cool band of metal around said heated area, the diameter of said mandrel being smaller than the diameter of the opening by an extent greater than the expansion limits of said heated metal.

3. The process of treating a hardened steel gear having a splined opening therein which consists in mounting said gear on a splined mandrel and heating said mandrel to such an extent as to heat the metal adjacent the opening of the gear sufficiently to render said metal plastic and so rapidly as to obtain such plasticity before sufficient heat is conducted to the peripheral area of the gear to substantially affect the hardness of the teeth and so as to leave a relatively cool band of metal around said heated area, the diameter of said mandrel being smaller than the diameter of the opening by an extent at least as great as the expansion limits of the heated metal.

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