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HEAT TREATING GEARS AND THE LIKE

Original Filed Nov. 15, 1937

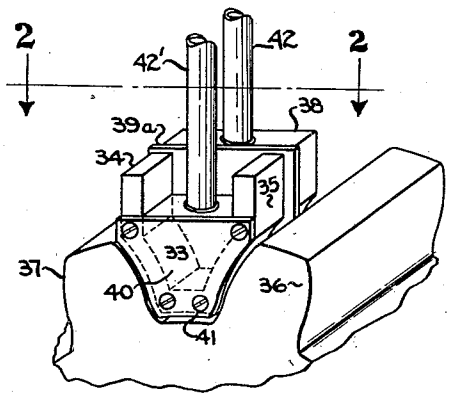


Fig 1.

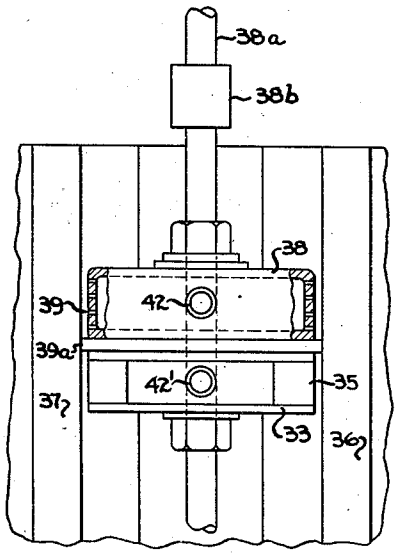


Fig. 2

INVENTORS.

Francis S. Denneen

William C. Denneen

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HEAT TREATING GEARS AND THE LIKE

Francis S. Denneen, Cleveland, and William C. Dunn, Shaker Heights, Ohio, assignors to The Ohio Crankshaft Company, Cleveland, Ohio, a corporation of Ohio

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1 Claim. (Cl. 219—13)

The present application as a division of our co-pending application Serial No. 174,610 filed November 15, 1937, is directed to mechanism and method for the heat treatment of gear teeth and numerous other projections on surfaces of metallic articles.

The invention herein disclosed is particularly advantageous in cases where large projections must be heat treated with a limited amount of power. With our apparatus and method it is possible to provide the article with a preliminary heat treatment to produce a core having the desired physical properties as to strength and ductility and then to provide a surface zone of such depth and of such hardness and localized in such parts as will provide high resistance to wear and abrasion and simultaneously prevent warping or other distortions which would cause noisy operation or which would set up local strains of a harmful nature in parts of the article.

In general, the object of the invention has been to provide a method and apparatus for hardening internal or external projections on a member of the class mentioned above.

A further object of this invention has been to provide a gear or other article of the general character of a gear having hard surface zones to resist wear on contacting surfaces. Another object has been to provide a metal tooth or rib having a tough and ductile core and root section adapted to resist heavy bending or other stresses caused by shock or impact in the section in which such high stresses occur. An additional object has been to provide a tooth having a hard surface zone so bonded to the core or underlying metal as to resist cleavage of this hard zone. A still further object has been to provide a method of procedure in the formation of such hard surface zone on a tooth previously formed and heat treated for the desired core characteristics. A further object has been to provide apparatus adapted to be used in the practice of the process, which apparatus is easily constructed and which does not require a high degree of skill for its operation.

Numerous other objects will become apparent from the following description in which details of forms of apparatus with which to achieve the results of our invention will be pointed out and novel and advantageous steps in the procedure for obtaining the desired results will be described.

It is to be understood that while our description and drawing relate to gears we do not confine ourselves to hardening gears alone but apply the invention to the various objects heretofore outlined.

While in most of the accompanying illustrations the preferred method of heating is by high frequency induced current set up in the zones to be hardened, the heating may be accomplished in part by the direct flow of current into the article by contacts established between the article and parts of the apparatus as hereafter illustrated.

When it is necessary to harden large areas, frequently the power available is not sufficient to heat all the desired parts of that area simultaneously. Therefore this area must be heated in sections. Small parts may be hardened progressively by causing the inductor to pass over the area from one portion to the other and quenching back of the inductor as fast as the inductor advances past part of the area heated. Alternatively, small teeth or other projections may be heated and quenched without relative movement of the inductor and such teeth or projections and surface zones of two such teeth or projections can readily be hardened simultaneously.

The manner in which we accomplish our invention is illustrated by the following description and the appended drawing. The novel features of the invention are summarized in the claim.

In said annexed drawing:

Fig. 1 illustrates the preferred form of our apparatus for progressively hardening oppositely placed faces of two adjacent teeth or projections.

Fig. 2 is a view, partly in section, as indicated by line 2—2 of Fig. 1.

Referring now to Figs. 1 and 2, it will be observed that the inductor element is moved lengthwise of the tooth surface and at substantially right angles to the radius of gear. With this construction, the width of the tooth becomes immaterial and determines only the distance the inductor block must be moved.

The inductor block employed is shaped to substantially fill the cross-sectional region between the two adjacent gear teeth. Current is brought to the block by terminals 34 and 35 which, as shown, are at the top of the block. The current thus enters at terminal 34 and passes downwardly adjacent the tooth 37 across the root between the teeth, upwardly adjacent the tooth 36 and out through the terminal 35. As the current passes in close proximity to the adjacent tooth faces eddy currents of heating density are induced in the adjacent tooth surface.

After the critical or hardening temperature has been reached the surface heated is rapidly quenched. This is accomplished by the quench block 38, which is hollow and receives fluid through a pipe 42. A plurality of quench orifices 39 open from the interior of the block 38 to permit discharge of the quenching fluid onto the tooth surfaces just treated. The entire unit comprising the inductor block and the quench block 13 carried on a suitable support 38[a] guided in a bracket 38[b] and progressively moved across the gear faces at a predetermined rate of speed. The direction of movement is such that the quench block follows the inductor block.

The conductor 33 is closed by a jacket 40 secured thereto by screws 41 and supplied with cooling fluid through the pipe 42'. A shield 39[a] prevents passage of the quench fluid on to the surfaces of the teeth not yet sufficiently heated and thus prevents prematurely cooling them. It will be obvious that various portions of the tooth faces may be heated, depending on the dimensions given the inductor block 33, the duration of the heating interval and the power applied.

It will be observed that numerous modifications in the relative size and proportion of the parts shown in the above figures may be made to provide a suitable heating and quenching rate for almost any arbitrary size of gear tooth without resorting the excessively large generator capacity. In manufacturing a gear tooth by our process and by the use of the above described apparatus the gear is usually completely formed and machined either before or after a preliminary heat treatment which is usually desired to provide the maximum strength and ductility. The surface of the teeth which come in contact with adjacent teeth of a driving or driven member are then hardened to the desired depth and to the desired depth contour to give the desired hardness at the points of maximum wear and abrasion without detracting from the toughness and ductility acquired by the previous heat treatment. It is to be understood that where the term "tooth" and/or "teeth" have been used in this specification any part or parts projecting from an article are meant, and by "face" or "faces" is understood any lateral surface of such projection.

Other modes of applying the principle of our invention may be employed instead of the one explained, change being made as regards the structure herein disclosed, provided the means stated by the following claim or the equivalent of such stated means be employed.

We therefore particularly point out and distinctly claim as our invention:

An inductor comprising a conductor having two spaced branches forming sides of a generally U-shaped loop, each branch having an external surface adapted to lie adjacent to a surface of an article to be heated, enclosure members extending across the space between the branches and engaging the branches to provide a cooling fluid chamber between said branches, means for supplying cooling fluid to the chamber, and means for supplying periodically varying current to the inductor of sufficient frequency to induce heating current in the aforesaid article when the article lies in closely spaced relation with the aforesaid external surface of a branch of the loop.

FRANCIS S. DENNEEN.
WILLIAM C. DUNN.