

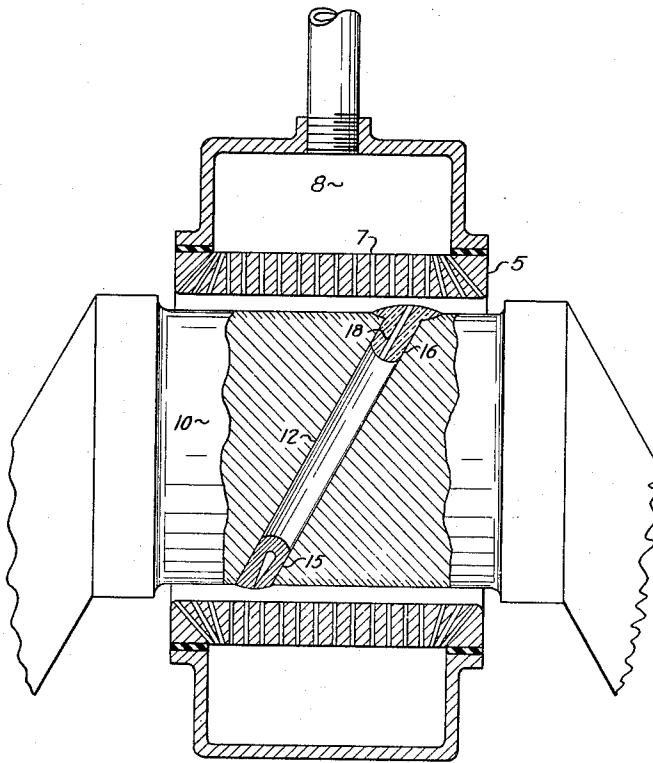
May 6, 1941.

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2,240,494

METHOD OF HEAT TREATING

Original Filed March 29, 1934



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UNITED STATES PATENT OFFICE

2,240,494

METHOD OF HEAT TREATING

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Original applications March 29, 1934, Serial No. 718,002 and Serial No. 718,003. Divided and this application November 10, 1938, Serial No. 239,810

3 Claims. (Cl. 148—21)

This application is a division of our co-pending cases Serial Nos. 718,002 and 718,003, filed March 29, 1934, and is directed to the art of electrically heating metals for surface hardening and particularly to the surface hardening of metals with holes and recesses therein, as oil holes and keyways.

The invention relates to the surface hardening by inductive or other heating followed by quenching, of metal articles having in their surface various types of recesses or openings, such as oil holes, keyways or the like. By the term "surface hardening" is meant the formation of a hardened surface zone only, of limited depth, by rapidly heating said surface zone to hardening temperature and quenching the heated surface before any substantial amount of heat has passed into the interior or core of the article.

The normal distribution of induced current and quenching fluid, when said articles are being surface hardened, is such as to cause extreme local hardness and a tendency of the metal to crack at the edges of their recesses or openings, and the object of the present invention is to prevent or retard the penetration at these edges of both the heat and the quenching action, so that the surface structure around the recess or opening will not differ appreciably from that at other parts of the hardened surface.

According to the invention, in the surface hardening, by inductive or other heating and quenching, of a metal article having a recess or opening in its surface, said recess or opening is partially or completely closed by a plug or filling during the heating and quenching periods. The recess or opening may be so closed either by a solid plug or by a filling with a plastic or semi-plastic material. For inductive heating the plug or filling is preferably of a magnetic and current-conducting character, and it is desirable that such magnetic property and current-carrying ability should closely approximate that of the metal in the article being hardened.

The nature of the material of the plug or filling may be such that after heating and quenching it will remain softer than the hardened surface so as to permit easy removal. It may, for example, consist of finely divided low carbon steel mixed with asbestos, clay or other material and a suitable binder. If it is a solid plug, it may consist of low carbon non-hardening steel. Vent passages may be provided in the plug or filling or the latter may be made of a porous character.

The accompanying drawing is a sectional view

through an inductor and a crankshaft pin having the oil passage therein plugged or filled in accordance with the invention.

Referring now to the drawing, an inductor 5 is provided to encircle the shaft undergoing heating for hardening. This inductor lies in closely spaced relation with the shaft and by means of a periodically varying current passed through the inductor there is induced in the underlying surface zone of the shaft a magnetic flux by which the said zone is heated to the desired temperature. A plurality of quench orifices 7 provide outlets from a hollow chamber 8 on the interior of the inductor and are adapted to direct quench against that portion of the shaft heated by the inductor. The quench is supplied with sufficient rapidity and in sufficient volume to effectively quench the zone and retain the desired metallurgical characteristics sought after. Such apparatus and method by which the same is employed are best shown in the parent cases, of which this is a division.

The pin or shaft 10 is provided with an oil hole 12 opening into the cylindrical surface to be hardened. In order to prevent the penetration of heat and retard the penetration of quenching fluid to the edges of the hole 12 adjacent said surface, and thereby prevent extreme local hardness and tendency for the metal to crack at the said edges, one or both ends of the said oil hole 12 are closed by a plug or filling during the heating and quenching periods. A solid plug 15, as shown at the lower end of the hole, may be employed, preferably made of a low-carbon non-hardening steel; or a plastic or semi-plastic filling 16, as shown in the upper end of the hole, may be employed. It is desirable, however, that the plug or filling should possess magnetic properties and current-carrying ability as closely approximating that of the metal in the shaft as is possible. Further, it is desirable that the nature of the material be such that, after heating and quenching, it will remain softer than the hardened surface so as to permit of easy removal. In the case of a plastic or semi-plastic filling, finely divided low-carbon steel mixed with asbestos, clay or some other material and a suitable binder may be used to advantage. This mixture may be molded to shape, baked or dried, and then inserted in the recess; or it may be pressed in the recess in plastic condition.

Since the gas in the plugged recess expands with heat and tends to force the plug out of place, it is desirable that a sufficient vent be provided in the plug, such as by the provision

of a vent passage 18 shown in the plug or filling 16; or the plug or filling may be a loose fit at some point; or the plug itself may be made sufficiently porous to permit the gas to escape.

The application of the invention to other articles having any form of recess in its surface, such as a keyway or other recess, differs in no essential respect from its application to a shaft having an oil hole through it as hereinbefore described.

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

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

1. In a method of inductively heat treating a surface zone of an article with a recess in the surface thereof, the steps of filling such recess only to the outer edge thereof without covering said surface with a current conducting pliable plug comprising a current conducting medium having a low carbon content and a binder, said plug being of such viscosity that it will not freely flow, causing the inductive heating current to flow through said surface zone

and said plug, thereafter quenching said surface zone and then removing said plug from said recess.

2. In a method of inductively heat-treating a surface zone of an article with a recess in the surface thereof, the step of filling said recess with a plug comprising finely divided low-carbon steel and a plastic binder so that said plug terminates at the recessed side walls and leaves the surface zone uncovered, placing an inductor heating element in heating relation with said surface zone to inductively heat the same, quenching said zone and thereafter removing said plug.

3. In a method of inductively heat treating a surface zone of an article with a recess in the surface thereof, the steps of filling said recess with a plug characterized by low carbon content and permeability and electrical conductivity approximately that of the article, causing heating current to flow through said surface zone and through the plug, thereafter quenching said surface zone and then removing said plug from said recess.

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