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METHOD OF POLISHING STAMPED STEEL ARTICLES

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This invention relates to improvements in processes for smoothing and polishing metal articles, and more particularly to processes such as those utilized for imparting to articles of relatively low carbon steel a smooth and highly polished surface.

It has previously been proposed to polish metal articles in tumbling barrels in contact with various abrasive and polishing compounds, but it has been found difficult to impart a satisfactory finish to articles such as those made of low carbon steel, for example, without resorting to buffing after tumbling, and it is accordingly one of the objects of the present invention to provide a finishing process which eliminates the necessity for buffing such articles.

Another object is to provide a process for finishing steel parts by tumbling without resorting to excessive tumbling periods.

Yet another object is to provide a process for preparing the surfaces of parts made of relatively low carbon steel for tumbling in such a manner as to prevent or minimize damage thereto during the tumbling operation.

A still further object of the invention is to provide a process for preparing metal and more particularly low carbon steel articles for tumbling in such a manner as to permit large loads in the tumbling barrels without resultant damage to articles in the lower portions of the barrel which are subjected to the weight of the load thereabove.

A further object of the invention is to provide an efficient and economical process for imparting a high finish to articles made of soft metal such as low carbon cold rolled steel.

Another object of the invention is to provide a process for imparting to articles made of metal such as cold rolled low carbon steel, a smooth surface finish that can be electroplated without resorting to buffing before or after plating.

These and other objects of the invention will be more readily apparent when taken in connection with the following detailed description. It is to be expressly understood however, that the latter is not intended as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

The finishing of parts made of relatively soft metal and particularly small parts made of soft low carbon steel having relatively large unbroken surfaces, has always presented a problem, and the methods resorted to have included tumbling in barrels in the presence of abrasive and polishing compounds, hand buffing, as well as a combination of the two. The expense of hand buffing has been found prohibitive in the case of many articles, while in the case of such articles finished by tumbling alone, difficulty has been experienced in obtaining a satisfactory finish, due to the fact that the articles striking together in the barrels form dents or other marks in the soft surfaces thereof which render the articles unsatisfactory for subsequent plating.

In accordance with the present invention, it has been

found that a highly satisfactory finish can be imparted to articles of normally soft case-hardenable steel, such as S. A. E. 1010 steel, for example, by carburizing the articles, quenching, drawing or tempering to reduce the hardness produced by carburizing and quenching to a value intermediate the original hardness and that produced by carburizing and quenching, and thereafter tumbling the articles in tumbling barrels in the presence of an abrasive. The above treatment of the steel articles prior to tumbling is so controlled as to provide an article having a relatively soft core and a harder outer surface layer of sufficient hardness and thickness to resist and substantially prevent damage to the surface during the tumbling operation. At the same time, however, the surface is softer than that produced by the carburizing and quenching steps alone, as it has been found that tumbling produces a better finish on this type of surface than is the case on unhardened articles, or on hardened articles case-hardened in the above manner which have not been tempered. The articles are subjected to severe shocks in the tumbling barrels, and it has also been found that articles which have been hardened but not tempered are too brittle and tend to crack in the tumbling barrels, while untreated articles are so soft as to become dented or gouged in the barrels. In addition, the tumbling period required for tempered articles is materially less than that required for hardened but untempered articles.

In the preferred form of the invention as applied to articles formed of S. A. E. 1010 steel, for example, the articles are case hardened by carburizing and quenching, gas carburizing preferably being used. The articles are quenched immediately after carburizing, and are thereafter drawn or tempered in a furnace to reduce the hardness of the case to a value intermediate between that of the untreated steel and that imparted thereto by the carburizing and quenching operation.

As an example of the present process, brackets stamped from cold rolled S. A. E. 1010 strip steel having a thickness of .043" and having relatively large plane surfaces requiring a high polish, were carburized by heating in a belt furnace in a carburizing gaseous atmosphere for seventeen minutes with the furnace entrance temperature at 1575° F. and the exit temperature at 1600° F., and were thereafter quenched in oil, cleaned to remove the quenching oil, and thereafter drawn or tempered at 600° F. for thirty minutes to reduce the hardness of the case produced by carburizing and quenching. These articles, which had a case thickness of the order of .005" to .006", were then placed in a tumbling barrel with an abrasive compound and zinc slugs, and tumbled for 24 hours, after which they were removed from the barrel and cleaned, and then tumbled for another 24 hours in a barrel with zinc slugs and a finer polishing compound. The articles were then cleaned and electroplated, and the resulting finish was substantially equal to a highly buffed finish. Although gas carburizing in a belt type furnace was used in the above example, pot carburizing, also called liquid carburizing, has been resorted to with equally satisfactory results, the articles so carburized also being quenched after carburizing and thereafter tempered to reduce the hardness. Either method of carburizing may be used, but gas carburizing is preferred as being more adaptable to production requirements.

Although the exact hardness and thickness of case required for optimum results in connection with an article varies with the design, thickness of material, weight, and grade of steel, it has been found that in the case of the brackets referred to by way of example above, a case thickness of .005" to .006" produced very satisfactory results, while a thickness of .0045" or less resulted in a tendency for gouges or dents to be formed in the surface during tumbling. On another article having a stock

thickness of .040 and made of S. A. E. 1010 steel, a case thickness on the order of .009" tended to result in cracking of the articles during tumbling. It has also been found that the thickness of case required varies with case-hardenable steels of different carbon content, the higher carbon steels requiring less case thickness than the lower carbon steels.

Control of the hardness resulting from the drawing operation is also essential, it having been found that the finish produced by tumbling articles case hardened as in the above example and then drawn to obtain the proper hardness was much superior to that obtained in the case of articles similarly case hardened but not drawn. Drawing of the articles to further reduce the hardness of the case also resulted in the production of an inferior finish, the quality of the finish decreasing as the hardness was further reduced, and being entirely unsatisfactory in the case of articles which were not given any case hardening and subsequent drawing treatment. It is therefore important that the articles be so treated as to produce a surface layer portion having a hardness intermediate between that of the untreated material forming the article and that obtainable by case hardening in the manner set forth in the example given.

In further explanation of the process and its adaptability to the finishing of low carbon steel articles made of case-hardenable steel, it is pointed out that furnaces of the gas carburizing conveyor belt type provide an extremely efficient and economical means for case hardening steel articles of the above type, but that the case resulting from such carburizing after quenching is too hard for satisfactory tumbling. The hard case formed by the above type of case-hardening may be tempered to reduce its hardness, and the tempering or drawing of such case-hardened articles can be efficiently and economically carried out by equipment now available. By combining the steps of case-hardening by carburizing and quenching, tempering to control and reduce the hardness of the case to a value below that normally produced by such case-hardening, and tumbling in barrels with an abrasive to polish the entire article, a finish is produced on low carbon steel articles which can otherwise be produced only by buffing, the expense of which is often prohibitive. These steps all contribute to the production of an article having a high polish, which cannot be obtained either by tumbling unhardened articles of low carbon steel, or by tumbling untempered articles which have been case hardened by carburizing and quenching in the manner heretofore described. Articles processed in the above manner can be electroplated to provide a finish which does not require buffing after plating.

In the description, the term S. A. E. 1010 steel refers to steel so designated in standards set up by the Society of Automotive Engineers, Inc. Case-hardenable steel refers to steel which can be carburized and subsequently quenched to form a hardened surface layer on the steel, it being noted that S. A. E. 1010 steel and other low carbon steels used in the practice of the invention can,

after carburizing and quenching, be tempered by reheating to soften the hardened surface layer resulting from the carburizing and quenching operation.

While the invention has been described herein with considerable particularity, it will be understood by those skilled in the art that the invention may be embodied in other forms within the scope of the appended claims without departing from the spirit of the invention.

This application is a continuation-in-part of application Serial No. 142,717, filed February 6, 1950, now abandoned.

What is claimed is:

1. The method of polishing articles stamped from relatively low carbon steel which consists in carburizing the articles for a period sufficient to produce a continuous carburized layer thereon having a thickness of approximately .005" to .006", quenching said articles to harden said continuous carburized layer, tampering the articles to reduce the hardness of said continuous layer to a value less than that obtaining following the quenching step and greater than that of the articles prior to carburizing, and thereafter tumbling said articles together in a tumbling barrel with an abrasive.

2. The method of treating articles stamped from relatively low carbon steel which consists in carburizing the articles for a period sufficient to provide a continuous carburized layer thereon having a thickness of approximately .005" to .006", quenching the articles to harden said continuous layer, tempering the articles to reduce the hardness of said continuous layer, tumbling the articles together in a tumbling barrel with an abrasive, and thereafter electroplating said articles.

3. The method of polishing articles stamped from relatively low carbon steel which consists in carburizing the articles for a period sufficient to produce a thin continuous carburized layer thereon, quenching said articles to harden said continuous carburized layer, tempering the articles to reduce the hardness of said continuous layer to a value less than that obtaining following the quenching step and greater than that of the articles prior to carburizing, and thereafter tumbling said articles together in a tumbling barrel with an abrasive, the thickness of the hardened carburized layer on the articles being sufficient to resist denting of the articles during tumbling.

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