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MECHANICALLY WORKING METAL ARTICLE

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Tubus A. G., Zurich, SwitzerlandNo Drawing. Application May 14, 1936, Serial
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1 Claim. (Cl. 148—4)

This invention relates to improved methods of mechanically working metal articles for the purpose of extensive plastic deformation by drawing, rolling and the like, and has for an important object the reduction or elimination of difficulties heretofore encountered through contact of the metal article and the working tool.

In mechanically working both ferrous and non-ferrous metal articles difficulties result, in the event that high speed or substantial reduction is attempted, from the contact between the article being worked and the working element. This is particularly true in the ferrous field, more specifically with respect to steel, where drawing dies or other working tools tend to bite into or seize the metal, thereby interfering with the proper drawing or reducing operation. In an effort to reduce these difficulties it is customary to apply a lubricant to the article or the working element, or both. Various forms of lubrication have been proposed, of which oil is perhaps the most commonly employed. It has been found, however, that ordinary lubrication methods, while helpful, are insufficient under many circumstances, as for example, where high drawing speeds or high deformation rates are being employed, to overcome the difficulties resulting from metal-to-metal contact. Other more unusual methods of lubrication have been devised, many of them patented, but none of them, it is believed, serves the needs of the present invention to a degree commensurate with the efficiency of the latter.

Turning to the prior art, efforts have heretofore been made to improve the working conditions by applying a lime or oil-color coating to tubes or bars that are to be drawn. While this may afford some improvement it is not entirely satisfactory because of the fact that the coating is readily dislodged from the article being worked. Again it has been proposed to coat the article with a soft metal such as lead or copper which may be applied in various ways, as for example, by dipping the article in molten metal, or by electrodeposition. Here also disadvantages are encountered. The application of the coating is relatively expensive and where it is objectionable in the finished article it is necessary to remove it, thus further increasing the expense of the process.

In addition to the liming or soft metal coatings above mentioned, it has been proposed to rust the surface of the article to be drawn, which process is commonly termed "sul-coating". Rusting results, however, in the formation of

iron hydroxide, which is powdery, amorphous, only lightly adherent to the article, and does not prevent biting of the article by the die when high moulding speeds, or what may be termed severe or deep reductions, are employed, with the consequence that it is inefficient in providing the beneficial results which flow from the invention now to be described.

The present invention is predicated upon the discovery that the difficulties and disadvantages herein mentioned as a result of metal-to-tool contact in mechanically working metal articles, as for example, by drawing, rolling and similar procedures, can be materially reduced or overcome by providing the surface of the article with a thin crystalline coherent coating of a metallic oxide or salt, the crystals of which are in heterogeneous crystalline joint with the metal base and are tightly grown together with the latter, and thereafter subjecting the coated article to the working operation.

Although the coating thus formed may properly be considered a lubricant, as contrasted with a coating applied for some other purpose, as for example, increasing the rust or corrosion resisting properties of the metal, it should be fully understood that it is not a lubricant in the customary or ordinary sense, for the reason that the well known, present day methods of lubrication may also be used in conjunction with the practice of the present process, and in many instances will be an essential factor in obtaining proper results.

Not all oxide or salt coatings are suitable for the purposes of the present invention. Thus, where metal is heat treated without excluding atmospheric oxygen it is well known that the ordinary oxide scale so formed must be removed by pickling operations in order to condition the metal for subsequent plastic deformation. Similarly, other coatings are unsuited because they are readily dislodged, or otherwise unsatisfactory.

Coatings fulfilling the requirements of the instant invention are preferably produced by treating the article with aqueous solutions of reagents capable of producing coatings of oxides or salts of the same metal as that of the metal article, or of metal different from that of the metal article, or of mixtures of the base metal and other metals. If the working of iron and steel is contemplated coatings of iron or complex iron phosphates or oxalates may preferably be used. Satisfactory processes for applying such coatings are well known in the art, such for example as the so-

called Parkerizing process. They comprise treatment of the article with a heated dilute aqueous solution of phosphoric or oxalic acid which may or may not contain phosphates or oxalates of iron, manganese, zinc or other metals in solution. Thereby there is formed on the article a dense thin crystalline coherent and tightly adherent coating of salts of phosphoric or oxalic acid which combines both chemically and physically with the metal of the base. Such a coating adapts the article admirably to mechanically working and reduces or eliminates the troubles arising from the contact of the article with the working element.

Oxide coatings may be produced by known procedures of blackening the surfaces of iron or steel articles to produce the desired finish. One such method consists in dipping them into a solution of 70 grs. crystalline protochloride of iron (FeCl_2), 10 grs. perchloride of iron (FeCl_3) and 2 grs. sublimate (HgCl_2) in 1 liter water to which solution are added several drops of hydrochloric acid. The thus dipped articles are first heated at 100°C . for half an hour, then treated with steam and finally boiled in water whereby the original rusty-brown layer is transformed into jet black oxide of iron. This process has lately been greatly simplified. Such a simplified blackening process is described in the paper "Finishing Steel Jet Black in Five Minutes", published in the Iron Age, Volume 135, No. 4, of January 24, 1935, page 26.

So much of the description as has already been given applies to the processing of ferrous articles, although as already pointed out the invention is applicable to any metal, including those of the non-ferrous group on which an oxide or a salt of the character herein described can be formed on the surface of the article. If, for instance, the working of aluminum and aluminum alloys is contemplated, suitable coatings may be produced by known anodic electrolytical oxydation methods, and in the event brass is being worked various known metal coloring methods may be employed, so long as they result in the formation of a coating which is strongly coherent and tightly adherent to the base and not sufficiently hard to injure the tool. Such processes result in the formation of a coating of oxide or salt-containing oxygen so that the coatings may be said to comprise an oxygen-containing compound of a metal.

The use of coatings of the kind herein described

permits what might be termed deep, severe or even almost excessive reduction rates, as well as a series of normal reductions without the customary intermediate annealing operations.

In the practice of the invention at least those surfaces of the article which are to be in contact with the working element are provided with a coating of the type described, and the article is then worked in the customary manner, no change in procedure or tools being necessary. Such coatings are considerably cheaper than the coatings of soft metals heretofore applied, and if not already removed during the working operation they can be removed completely much more readily than the metallic coatings, as for example, by simple pickling operations. In many instances no further removal of the coating is necessary after working, either because it has been substantially removed during the working operation or that portion which remains does not interfere with the use to which the article is subsequently applied.

In closing it must be pointed out that although the invention is primarily intended for cold working it can be employed up to working temperatures at which no alteration of the chemical and physical properties of the metal takes place. This limit will ordinarily lie between 700° and 800°F . because above these the coating will generally be transformed into common scale.

Insofar as any and all common subject matter is concerned, this application is a continuation of my co-pending application Serial No. 42,306, filed September 26, 1935.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent of the United States is:

That improvement in methods of mechanically working metal articles at temperatures below 800°F ., for the purpose of extensive plastic deformation, which consists in coating the metal by treating it with a chemical solution which reacts with the metal to produce thereon a lubricant coating of an iron salt of the group consisting of phosphates and oxalates, the crystals of which coating are in heterogeneous crystalline joint with the metallic base and tightly grown together with the latter, and subsequently working the thus coated article to the extent that the coating is substantially removed.

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