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STAINLESS STEEL POLISHING

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3 Claims. (Cl. 204—140)

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My application for patent is a continuation in part of my copending application, Serial No. 523,572, filed February 23, 1944, and entitled Stainless steel polishing and the invention relates to stainless steel articles and products, and more particularly to a method of electrolytically polishing the same, and to the resultant articles themselves.

An object of my invention is the provision of an efficient and wholly reliable method for the rapid production of electrolytically polished stainless steel articles and products.

A further object of my invention is the provision of a method for the continuous, mass production of bright-polished, high-carbon stainless steel articles and products.

A still further object of my invention is the provision of bright, electrolytically polished stainless steel articles and products including those of high-carbon quality.

Other objects in part will be obvious and in part pointed out hereinafter.

The invention accordingly consists in the art or process as described herein, as well as the resultant product, the scope of the application of which is indicated in the following claims.

As conducive to a clearer understanding of certain features of my invention, it may be noted at this point that stainless steel is defined as an alloy comprising small amounts of carbon, from about 10% to 35% or more chromium, with or without separate percentages of nickel, and with or without supplemental additions of manganese, silicon, cobalt, copper, molybdenum, tungsten, vanadium, columbium, titanium, sulphur, or the like, for special purposes, and a remainder which is substantially all iron except for incidental impurities.

It is well known in the art that stainless steel in unpolished condition has a characteristic dull gray appearance, and that with proper polishing treatment the steel is finished to possess a brilliant, mirror-like surface. There are, in this connection, certain polishing methods which involve mechanical treatment such as abrading, buffing, rubbing and the like. These methods, apart from yielding products which are prohibitively expensive, are tedious and time-consuming, require skilled labor, and frequent replacement of polishing equipment. They fall short of giving uniformly polished products, and are unsatisfactory where peculiar or intricate metal surfaces are encountered, or where polished surfaces are desired which are substantially free of scratches and blemishes.

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A more recent expedient for effecting a polish on stainless steel, namely, electrolytic-polishing, shows great promise from a commercial standpoint as compared with the still widely used grinding, buffing, and like mechanical polishing methods. It has been demonstrated that electrolytic polishing methods are far more simple, and are more rapid and economical of performance. The resulting electrolytically polished products are marketable at lower prices, yet possess greater brilliance and beauty than mechanically finished products, and are more even and uniform of finish.

While the art of electrolytic polishing does represent an exceptionally great advancement in the field of stainless steel finishing, the art still is relatively new and as such leaves much to be sought in way of improvement. One difficulty of the art has been that of providing a uniform electro-polish on stainless steels having a carbon content of 0.25% or more. The steels which come within this classification are very erratic in their response to conventional electrolytic treatment; the quality of finish obtainable being anywhere from flat gray to bright in appearance depending upon the specific high-carbon quality of the steel and the condition of heat treatment thereof.

There are electrolytic polishing processes which are objectionable in that the bath employed has poor electrical conductivity and evaporates. Evaporation of essential ingredients causes a dilution of the bath with respect to these ingredients, thus requiring frequent replenishing. In such cases the operating conditions for obtaining best polish are difficult to maintain with the result that finished products are likely to exhibit surfaces with etching or lack of polish.

Certain heretofore known electrolytic polishing processes are insufficiently rapid in effect to permit their practical use for continuous polishing treatment as distinguished from batch operation. At best, in adapting the process for such uses, long vats are necessary to give prolonged electrolytic polishing action, large quantities of solution are required to fill the vats, and other complications, such as the need for numerous anodic contacts for obtaining effective feeding along the length of vat, together with the problems of heating and maintenance of proper temperatures of solution, all enter. Even with elongated vats, continuous feeding of products through the bath essentially is kept slow in order to achieve proper polishing treatment.

An outstanding object of my invention ac-

cordingly is the provision of a process for the continuous electrolytic polishing of a wide variety of stainless steels including those of 0.25% minimum carbon content quality in hardened or unhardened condition, which method ensures the rapid obtainment of a bright polish while employing a bath and related operating conditions that are practical, reliable, and simple to maintain.

Referring now more particularly to the practice of my invention, I bright-polish stainless steel articles and products electrolytically, as for example wire, rods, sheet, strip, and the like by moving the same lineally thru an acid bath consisting approximately, by weight, of 50% to 70% concentrated ortho-phosphoric acid (specific gravity 1.7), 10% to 30% concentrated sulphuric acid (specific gravity 1.84), 1% to 20% butyl carbitol (diethylene glycol mono-butyl ether), and water, this latter ranging from amounts which are incidental to the acids and butyl carbitol up to a remainder not exceeding approximately 39% total weight of solution. While so moving the products anodic contact is preserved as by way of a stationary anode contact maintained beneath the surface of the bath. During the polishing treatment, I maintain a temperature of treating bath within the approximate range of 125° F. to 165° F., and a current density of about 5 to 12 or more amperes per square inch of product surface immersed in the bath.

The process is suited for the continuous bright-polishing of stainless steel including either the high-carbon or low-carbon steels in various conditions of heat treatment or hardness beginning in soft and extending through hard as incident to annealing, quench hardening or precipitation hadening. A wide variety of straight-chromium or chromium nickel stainless steels including the 18—8 chromium-nickel grades are rapidly polished using my treatment. In general, a bright, lustrous polish is achieved on the steel in a period of time as short as one-half minute, depending somewhat upon the initial surface condition and the grade or quality of steel.

As illustrative of the practice of my invention, I treat bright-annealed, low-carbon 18—8 chromium-nickel stainless steel wire by feeding or reeling the same directly and continuously from an annealing furnace through an electrolytic polishing unit where the wire is subjected to polishing treatment. The polishing unit comprises a suitable container such as an open tank, having a lead or other acid resistant lining in which is provided an electrolyte solution containing by weight, for example: approximately 56% ortho-phosphoric acid (85% concentrated quality having a specific gravity of 1.7), about 27% sulphuric acid (98% concentrated quality having a specific gravity of 1.84), about 7% butyl carbitol, and the remainder substantially all water. The wire is fed or reeled through the solution over spaced anodic contacts or rolls at a rate, for example, of six feet per minute while maintaining a current density of about 5 amperes per square inch of immersed wire surface, and a bath temperature of about 140° F. Preferably the contact between the moving work and the anodic contacts is had beneath the surface of the bath. The anodic contacts as well as the cathodes employed illustratively are of copper. Under such conditions a thoroughly bright, lustrous polish is obtained on the wire in about one-half minute, which means that the effective length of solution tank need not be over 2 to 4 feet. For greater

speeds of reeling, of course, the length of tank should be increased—unless higher current densities or temperatures are employed, either of which alternatives would be wholly permissible within the broad limits mentioned hereinbefore. It will also be understood that the composition of bath may be varied with good results within the broad composition limits specified hereinbefore.

From the electrolytic bath the polished wire preferably is fed or reeled through a washing fluid such as clean water and thence onto reels, after which the product is ready for use or sale. The wire possesses a mirror-like surface which is free of scale, is evenly polished, and highly attractive.

My electrolytic polishing process is successfully practiced on stainless steel wire, rod, sheet, strip and the like of widely differing quality and consistently gives uniformly polished stainless steel surfaces. The electrolytic polishing process which I provide is, moreover, rapid and economical of performance and is quite adaptable to continuous mass production of polished high-carbon or low-carbon stainless steel products of outstanding quality. Polishing is had as a part of a continuous wire-drawing or sheet-reeling or strip-reeling operation without delay or other sacrifice in the speed and efficiency of those operations.

In my electro-polishing process as described above the electrolyte solution employed is reliably stable over a wide range of effective temperatures which are convenient to maintain, and will support current densities which are admirably suited for rapid polishing treatment without requiring frequent replenishing due to excessive evaporation. It is also important, in way of advantage, that the polishing equipment necessary in my continuous process is cheap and readily available, is compact requiring a minimum of space for installation, and after installation is easily operated and maintained.

Thus it will be seen that there is provided in this invention, a continuous process of electrolytically polishing stainless steels of various qualities in which the various objects hereinbefore noted together with many thoroughly practical advantages are successfully achieved. It will be noted that the process gives in a simple and economical manner, evenly polished stainless steel products which are free of pits and other surface blemishes and which possess outstanding, lustrous beauty. It will be noted further that the process is instrumental to the rapid achievement of an electrolytic polish of high quality through the use of an electrolyte of maximum stability, which electrolyte permits the use of high current densities and a wide range of operating temperatures.

As many possible embodiments may be made of my invention and as many changes may be made in the embodiments hereinbefore set forth, it is to be understood that all matter described herein is to be interpreted as illustrative and not as a limitation.

I claim:

1. In the rapid and continuous production of polished stainless steel wire, rods, sheet and strip having about 10% to 35% chromium, at least about 0.25% carbon and the remainder essentially iron, the art which comprises, establishing anodic connection to the said wire, rods, sheet or strip, and lineally moving the same through an acid bath consisting, by weight, of about 50% to 70% concentrated ortho-phosphoric acid (sp. gr. 1.7), about 10% to 30% concentrated sulphuric

acid (sp. gr. 1.84), about 1% to 20% diethylene glycol mono-butyl ether, and any remainder substantially all water, while maintaining a current density of at least about 5 amperes per square inch of product surface and a bath temperature between about 125° F. and 165° F.

2. In rapidly and continuously polishing to a mirror-like surface a stainless steel product having about 10% to 35% chromium, a minimum carbon content of about 0.25% and the remainder essentially iron, the art which comprises, axially moving the product through an acid bath consisting, by weight, of 50% to 70% concentrated ortho-phosphoric acid (sp. gr. 1.7), 10% to 35% concentrated sulphuric acid (sp. gr. 1.84), 1% to 20% diethylene glycol mono-butyl ether, and any remainder substantially all water, and while moving the same through said bath preserving electrical contact to the product by way of a stationary anodic contact and maintaining a current density of at least about 5 amperes per square inch of product surface and a bath temperature between about 125° F. and 165° F.

3. In the rapid and continuous production of polished stainless steel wire, rods, sheet and strip having about 10% to 35% chromium, about 0.25% minimum carbon content, and the remainder essentially iron, the art which includes moving the same lineally through an acid bath consisting, by weight, of about 56% concentrated ortho-phosphoric acid (sp. gr. 1.7), approximately 27% concentrated sulphuric acid (sp. gr. 1.84), about 7% diethylene glycol mono-butyl ether, and the remainder substantially all water, while maintaining anodic contact with the said wire, rods, sheet or strip giving a current density of 5 to 12 amperes per square inch of product surface and while preserving a bath temperature of 125° F. to 165° F., a mirror-like surface being achieved in about .5 to 1.5 minute immersion in the bath.

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