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CORROSION RESISTANT COATED STEEL

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1

The present invention relates, in general, to a method of improving the corrosion resistance of metallic articles, and, in particular, steel ammunition components and contemplates a novel coating on steel cartridge cases and shot shell heads comprising the combination of a phosphate coating and a furan resin with or without a suitable wax.

The art of forming protective coatings on steel cartridge cases and similar steel ammunition components is well developed. The so-called Parkerite or Bonderite processes of rendering steel surfaces corrosion resistant are characterized by the use of a phosphate coating which in conjunction with a suitable wax overcoat protects the steel surfaces from corrosion when exposed to moisture, and, in particular, salt water or salt spray, and from the electrolytic action set up between adjacent dissimilar metals, as, for example, between the gilding metal of a cartridge primer and the steel of the cases or the copper coating of a bullet and the steel of the case.

The Parkerite and Bonderite processes are described in greater detail in United States patents, Nos. 1,167,966, 1,842,085 and 2,303,242.

It has been discovered, however, that the corrosion resistance of steel surfaces, and, in particular, steel cartridge cases having a Parkerite or Bonderite undercoating can be advantageously enhanced by the application of a film or overcoat of a furan resin. The term "furan resin" as hereinafter used will be understood to include the resins of furfural (furfuryl aldehyde) and furfuryl alcohol. The resins of furfural and furfuryl alcohol are widely used in industry, and, in general, are manufactured by the admixture of the furfuryl aldehyde or alcohol and a catalyst, such as a small amount of an acid, with or without heat. The resins, and, in particular, the resin of furfuryl alcohol are attractive from a cost standpoint, possess appreciable heat resistance and form a hard, relatively non-brittle, infusible, water repellent coating, and have been found especially suited for enhancing the corrosion resistance of steel cartridge cases. The patents of Trickey et al., No. 1,665,235, April 10, 1928, Richardson, No. 1,682,934, September 4, 1928, and Meiler, No. 2,243,481, May 27, 1941, describe specifically several methods of forming furan resins which are particularly adapted to the purposes of this invention.

Solutions of the furans having relative high acid concentrations resinify with a vigorous reaction of almost explosive violence, whereas solutions of low acid concentrations provide spontaneous resinification at room temperature. For coating steel cartridge cases in quantity production lots, a solution which is relatively stable at room temperature is preferred, setting being effected by the subsequent application of heat.

2

Moreover, it is necessary that a suitable acid be used which will not react adversely with the Parkerized coating. An acid which has been especially suitable for the purposes of the present invention is phosphoric acid.

An example of a resinous composition which is fairly stable at room temperature and which has proven successful in coating Parkerized steel cartridge cases of small caliber, such as .22, .30 and .45 caliber cases, is the admixture of a dilute solution of phosphoric acid (phosphoric acid and acetone in the ratio of 1.1) and furfuryl alcohol in the ratio of one part of the dilute acid to fifteen parts of furfuryl alcohol.

Various methods of applying the resinous composition to the Parkerized steel cases may be used, for example, the cases may be dipped into a bath of the resinous solution and then withdrawn and thereafter heated to set the resinous coating. However, for small caliber relatively light weight cases, the bulk or tumbling barrel method has proven successful. Thus, a small quantity of the resinous solution is put into a tumbling barrel into which a lot of steel cases are dumped. After being thoroughly coated the cases are removed from the barrel and, thereafter, a blast of air at approximately 250° F. is directed onto the cases for substantially five minutes. Each cartridge case is thereby provided with a resinous coating which, when set up by the heat of the air blast, is smooth, water repellent, non-brittle and adherent.

For the larger and heavier caliber cases, such as Parkerized .50 caliber steel cases, the preferred method of coating is by dipping the cases into a bath of the resinous solution, and then withdrawing and heating the cases for substantially ten minutes at approximately 350° F. Due to the greater weight and relatively large surface area of the .50 caliber cases, a resinous coating formed by the bulk or tumbling barrel method is more apt to be cracked or scraped off at the corners of the cases, and hence is less satisfactory than coatings formed by dipping.

Suitable resinous coatings may also be applied to larger caliber cases by spraying the resinous solution onto hot Parkerized cases and thereafter providing additional heat to completely set the resin.

As mentioned above the resinous solutions may have different physical characteristics such as viscosity and specific gravity depending upon such factors as the type of catalyst used and the acid concentration of the solution. In this connection, it has been found advantageous to provide a relatively non-viscous resinous solution for coating the larger caliber cases in order that the excess coating fluid will quickly drain off of the larger surface areas, and, in particular, from the inside of the cases.

To this end, a solution having substantially the viscosity of water is used and is prepared by adding a dilute solution of phosphoric acid and acetone in the ratio of 1.1 to furfuryl alcohol in the ratio by volume of 6% of the dilute acid to 94% of alcohol. This mixture is then diluted in an equal amount of water and heated whereupon the solution separates into an upper layer of water and a lower layer comprising a water insoluble resinification product of furfuryl alcohol and phosphoric acid. This product is readily separable from the water and thereafter dissolved in three parts furfuryl alcohol. The resulting product is relatively non-viscous and stable at room temperatures. A similar method of forming a partial resinification product as well as an alternative method in which no acetone is used are described more fully in the Trickey et al. and Richardson patents identified above. This relatively non-viscous resinification solution drains quickly from Parkerized .50 caliber steel cases which have been dipped therein. The coated cases are then heated for substantially ten minutes at 350° F. to set the resin. The resulting resinous coating is smooth, uniform, water impervious and relatively non-brittle.

Although the so-called "straight" furan resins mentioned above have provided excellent corrosion inhibiting resinous coatings for Parkerized steel cases, the use of other furan resins is contemplated such as the lignin-sulphonic acid, furfuryl alcohol, and furfuryl aldehyde resins described in greater detail in the aforementioned Meiler patent.

Moreover, the good corrosion inhibiting characteristics of furan resin coatings on Parkerized steel can, it has been discovered, be further enhanced by a subsequent coating of a hydrophobic material, such as a microcrystalline petrolatum wax or a rust inhibiting oil. Cartridges so coated exhibit a corrosion resistance which is highly superior to waxed Parkerized steel cartridges and other known corosion inhibiting coatings.

It will be understood that, in order to obviate gumming up the barrel chamber and more especially the feed mechanisms of automatic firearms, the maximum thickness of a coating of wax on a Parkerized steel case is limited, and hence it is impracticable to enhance the corosion resistance of a waxed case by multiple coatings of wax.

However, it has been discovered that by coating a Parkerized steel case with a furan resin and then applying an overcoating of wax to the resin, a superior corrosion inhibiting surface is obtained. The coating of resin is of itself water impervious and is characterized by a less porous structure than a microcrystalline wax. The resin thus provides a corrosion resisting coating over the phosphate coating of the steel case which is less porous than either the phosphate coating or the overcoating of wax. Further, a wax coating is considerably softer than the furan resin coating and when used alone on Parkerized cases its surface is more susceptible to scratches and indentations by abrasion and handling than are the harder resinous surfaces. It has also been found that the resin coating provides a better bond between the Parkerized coating of the steel case than wax.

The wax over the resin tends primarily to offset any brittleness of the resin and provides a buffer for protecting the resinous coating from the force of an inadvertent blow incurred during the handling of the resinous coated cases. The

wax overcoating is also used as a lubricant for the resin coated case. Moreover, by combining a corrosion inhibiting coat of resin with an overcoat of wax, the wax coating may be relatively thin thereby avoiding gumming up the barrel chamber and feed mechanism of a firearm.

For the purposes of this invention, a suitable wax for coating furan resin coated steel cases comprises the compound known to the trade as Socony 2300, the characteristics of which are described in the United States patent, No. 2,298,844.

The wax coating is applied, in general, to the completed or loaded cartridge to provide an unbroken corrosion resisting buffer and lubricating coating on both the bullet and the resin coated case. To this end, a bath of the wax is provided comprising Socony 2300 dissolved in a suitable solvent such as carbon tetrachloride. The cartridges are first immersed in the bath and then withdrawn, the wax taking the form of a substantially solid coating covering the entire cartridge.

Although the foregoing description has related to a method of coating Parkerized steel cases with a furan resin and wax, it will be understood that by selecting a resinous solution having a relatively non-vigorous reaction and one adapted to set up at relatively low temperatures loaded cartridges as well as empty cases may be successfully coated with a corrosion resisting furan resin coating and an overcoating of wax.

What is claimed is:

1. A steel cartridge case having thereon a corrosion resisting coating comprising an undercoat of a phosphate, a coat of furfuryl alcohol resinified with phosphoric acid superimposed on said phosphate coat, and a thin exterior coat of wax, said wax coat being of a thickness procurable by deposition from a solution of wax in a solvent.

2. A steel cartridge case having thereon a corrosion resisting coating comprising a phosphate coat directly upon said steel, a coat of furfuryl alcohol resinified with a solution of acetone and phosphoric acid, and a thin exterior coat of microcrystalline petrolatum wax, said wax coat being of a thickness procurable by deposition from a solution of wax in a solvent.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,665,235	Trickey et al.	Apr. 10, 1928
1,781,507	Gravell	Nov. 11, 1930
2,037,710	Ellis	Apr. 21, 1936
2,047,957	Fletcher	July 21, 1936
2,120,212	Curtin	June 7, 1938
2,170,658	Hucks	Aug. 22, 1939
2,209,530	Mason	July 30, 1940
2,323,333	Kauth	July 6, 1943
2,337,939	Sermattei	Dec. 28, 1943
2,339,242	Abrams et al.	Jan. 18, 1944
2,383,790	Harvey	Aug. 28, 1945
2,418,935	Hutchinson	Apr. 25, 1947
2,423,872	Clipper	July 15, 1947

FOREIGN PATENTS

Number	Country	Date
9,926	Great Britain	Feb. 18, 1915