

UNITED STATES PATENT OFFICE

2,154,834

RUBBER COATED OBJECTS AND METHOD OF PRODUCTION

William W. De Lamatter, Cleveland Heights, Ohio

No Drawing. Application October 8, 1936,
Serial No. 104,735

4 Claims. (Cl. 91—68.2)

This invention relates to an improved article of manufacture comprising an object having a strongly adherent coating of rubber disposed upon it, and, more particularly, relates to rubber-coated metal articles and the method of producing the same.

It is frequently desirable to incorporate strips or wires into rubber manufactures for the purpose of reinforcing the same, or to dispose a coating of rubber, as a covering, upon semi-finished articles. In the cases where iron or steel articles form the reinforcements, or the base metal, upon which rubber is coated, it is well known that some difficulty is had in obtaining good adherence between the rubber and such base metal.

Another difficulty has been the rate at which such reinforcing elements rust; soon corroding to a point of great weakness, and usually resulting in the early failure thereof. This rusting takes place at a relatively rapid rate, notwithstanding the fact that the reinforcements are embedded in rubber, and is believed to arise from moisture penetrating the rubber, which causes corrosion (in the form of rusting) to attack the reinforcements.

It is an object of the present invention to prepare articles for incorporation into rubber, or for receiving a coating thereof, which will afford stronger adherence with the rubber, and which will satisfactorily resist the corrosive influences of the environment of its application far better than any similar articles heretofore employed. Other objects and advantages will become apparent hereinafter as the description proceeds.

In practicing my invention, I have found that iron and steel articles; more specifically, steel wires, such as are employed in the reinforcement of automobile tire beads, can be satisfactorily prepared for being imbedded in rubber by placing upon such articles a coating of corrosion resisting metal; e. g., zinc, and, thereafter, disposing a plating of copper upon such coating, with a subsequent coating of nickel upon the copper plate. A wire, or other metallic article, prepared in this manner can be readily vulcanized within a rubber matrix, and exhibits superior properties of adherence and of protection to the base metal against rusting and corrosion.

In carrying out the invention, any suitable protective coating may be disposed upon the base metal, which, for the sake of economy and convenience, can be an ordinary hot-galvanized zinc-coat. A zinc-coat thus obtained is preferably wiped thoroughly upon being withdrawn from the bath so as to eliminate any surplusage of zinc, and

so as to provide the lightest covering of zinc that is practicable. In a case where the wipe is employed, that amount of zinc remaining upon the base metal is found to consist of a ferrous-zinc alloy substantially in its entirety.

The zinc-coated base metal is thereafter introduced in an electro-plating bath, wherein a thin film of copper is deposited on top of the zinc coating. This copper coating is preferably kept within certain limits as to thickness for reasons to appear hereinafter. Upon emerging from the copper plating bath, the base metal is introduced into a nickel plating bath wherein a small amount of nickel is superposed upon the copper-plate. Thereafter, the article is ready to be introduced into a matrix of rubber, or to receive a coating of rubber upon the nickel-plate, and will, upon application of the usual vulcanizing temperature, become firmly affixed to the rubber, and will successfully resist the corrosive attacks of water and other media.

The theory upon which this invention is based is that the zinc or any other suitable protective coating protects the steel against the corrosive action of water, etc.; that the copper acts to form a stronger bond between the rubber and the underlying metal, while the nickel on top of the copper supplements the bonding action of the latter, and augments the resistance to corrosion of the underlying metals. The adhesion obtained between rubber and base metal by the practice of this invention is found to be comparable to the bond attained between copper and rubber, while affording resistance to corrosion far in excess of that obtained when copper and zinc alone are used.

The exact amount of zinc or other protective coating to be applied is not a critical factor, whereas, the amounts of nickel and copper present can be confined advantageously within certain limits. The precise amounts of nickel and copper to be applied in the electroplating baths are best obtained by empirical determination. It has been found, and the cause for the good adherence has been ascribed to the fact, that the sulphur prevalent in rubber compounds tends readily to corrode both nickel and copper to form the sulphides of each. In the event that there is an excess amount of nickel, copper, or both, applied to the base metal, the chemical corrosive action in forming the sulphide compounds of these metals is carried on indefinitely, which progressive-action tends, after a certain time, to weaken the bond formed therebetween. It is, therefore, desirable that the nickel and copper be applied in

such slight amounts that the chemical action, provoked by the surrounding rubber, will be completed within a reasonable time, leaving a thin stratum of nickel and copper sulphide interposed as a strong bond between the rubber and the zinc.

It has been suggested that the nickel and copper tend to alloy with each other at vulcanizing temperatures, and that the copper, and perhaps the nickel, form an alloy, or a solid solution, with the surface of the zinc or other underlying metal. Whether or not these metals alloy, or go into solution, has not been definitely ascertained, although it is supposed that after the lapse of a sufficient period of time, a gradual combining action ensues, which is probably hastened by the temperatures of vulcanization.

As a specific example of this invention, a steel wire has been prepared having the desired characteristics, as set forth above, by acquiring a zinc coating thereupon by hot-dipping and wiping the same to obtain from .14 to .18 ounce of zinc per square foot of surface thereon. This zinc-coated wire was then immersed in a copper electroplating bath, wherein .2 to .5 gram per kilogram of wire was deposited thereon. Thereafter, a coating of nickel was electroplated upon the copper coating in an amount approximately equal to one-half of the amount of copper applied; i. e., .12 to .18 gram per kilogram of wire. The wire was then imbedded in the rubber matrix and vulcanized in the usual manner.

Similar advantages may be obtained by plating the copper and the nickel upon a zinc-coated wire simultaneously. This may be accomplished, by employing as the electrolyte, a double salt solution into which both copper and nickel electrodes are introduced. Alternatively, instead of employing separate copper and nickel electrodes, composite electrodes embodying both copper and nickel; such as Monel metal, may be employed.

I do not wish to be limited to any specific amounts of nickel and copper, since the results obtained have indicated that a considerable range in the amounts of these metals applied is permissible. Something has been said of the danger of applying too much nickel and copper due to the progressive reaction in the presence of rubber, but it should also be noted that an unsatisfactory bond is had wherein inadequate amounts of these metals are employed. Therefore, it seems desirable to rely upon an empirical deter-

mination of the exact amounts of nickel and copper utilized in any specific case.

Furthermore, the present invention is not limited to an initial coating of any particular metal, such as zinc, for it is believed that any metal that will protect steel, or other base metal, from rusting or corrosion will serve equally well. Though the invention has been illustrated as applied to iron or steel base metals, it is obvious that it is equally applicable to any other metals to which application of the invention is desired.

While I have described specific embodiments of the present invention, it is to be understood that I do not wish to be limited exactly thereto, since various modifications may be made without departing from the scope of the invention as defined by the following claims.

I claim:

1. The method of manufacturing rubber adherent ferrous wire, which includes providing a wire with a coating of zinc in the order of .18 ounce of zinc per square foot of surface, thereafter electroplating copper and nickel upon said coating of zinc so that the amount of copper present is in the order of .2 to .5 gram per kilogram of wire and so that the amount of nickel present is approximately one-half of the amount of copper aforesaid.

2. A rubber adherent article comprising a ferrous metal object, a covering of zinc disposed upon the surface of said object, a covering of copper disposed upon said zinc and a covering of nickel upon said copper.

3. A rubber adherent article comprising a ferrous body having a zinc coating disposed thereon, a coating of copper disposed upon said zinc coating and a nickel coating deposited upon said copper coating, said nickel coating being in thickness approximately one-half of said copper coating.

4. A rubber adherent article comprising a ferrous body having a coating of zinc thereon in the order of .18 ounce of zinc per square foot of surface and a coating of copper and nickel upon said zinc coating, said copper being present in amounts ranging from .2 to .5 gram per kilogram of wire and said nickel being present in an amount equal approximately to one-half of the amount of copper aforesaid.

WILLIAM W. DE LAMATTER.