UNITED STATES PATENT OFFICE.

LEO DAFT, OF RUTHERFORD, NEW JERSEY, ASSIGNOR TO ELECTRO-CHEMICAL RUBBER & MANUFACTURING COMPANY, A CORPORATION OF NEW JERSEY.

ATTACHING RUBBER TO METALS.

1,036,576. Specification of Letters Patent. Patented Aug. 27, 1912.

No Drawing. Application filed January 28, 1911. Serial No. 605,170.

To all whom it may concern:

Be it known that I, LEO DAFT, a subject of the King of Great Britain, and a resident of Rutherford, in the county of Bergen and State of New Jersey, have invented a new and Improved Method of Attaching Rubber to Metals, of which the following is a specification.

My invention relates to a method of attaching rubber to metals by direct vulcanization of the rubber upon the metal so as to produce a chemical combination between constituents of the rubber and of the metal to which it is attached.

My invention is more particularly directed to improvements upon the method of electroplating the surface to which the rubber is to be attached with an alloy of antimony and other metals, disclosed in my application Serial Number 564,840, filed June 3, 1910.

In the method of electroplating disclosed in my said prior application, I used an electrolyte made up by using the salts of antimony, copper and zinc, together with the necessary solvents.

Owing to the extremely refractory nature of the antimony salts when combined with salts of other metals, in the presence of such solvents as are necessary to make up the electrolyte, and the tendency of the antimony to separate and precipitate out of the solution, which precipitates are frequently so nearly insoluble that a considerable variation of the antimony content of the solution is experienced, the process of my said prior application requires considerable care in its practice.

The object of my present invention is to produce an electrolyte in such a way that there is little or no tendency on the part of the antimony to precipitate out of the solution; consequently the process may be practised by ordinary workmen or other unskilled persons and is better adapted for use upon a large scale.

By my present improved method I do not produce the electrolyte by the direct combination of the salts of the metals it is desired the electrolyte shall contain, but from the metals themselves by a series of steps such as the following: I first cast an alloy containing approximately 60 parts of copper, 38 parts of zinc and 2 parts of antimony. These proportions may be slightly varied except that the antimony should never exceed 3% of the total, as when more antimony than that is contained in the alloy, it is difficult if not impossible to obtain a homogeneous metal. I then dissolve this alloy in nitric acid, using approximately one ounce of alloy to 5 ounces of nitric acid at 36 Baumé. This solution is then diluted with water so that the resulting solution contains 2 oz. of alloy to ½ a gallon, and is neutralized with ammonia. When the solution is neutralized it will have assumed a clear sapphire blue color. I then add a sufficient quantity of a solution of potassium cyanid at a specific gravity of 1200, to cause the solution to assume a clear light straw-color. I then dilute this until 1 gallon of the solution contains 1 oz. of the alloy. This completes one of the solutions used in the preparation of the electrolyte, which I shall call solution No. 1.

Another solution, which I shall call solution No. 2, is prepared in the following manner: I first cast an alloy containing 60 parts of copper and 40 parts of zinc, which I dissolve in nitric acid and dilute so that one ounce of the alloy is contained in one-half a gallon. I then add ammonia to neutralize the solution in the same manner as in solution No. 1, and add about 12 ounces of potassium cyanid solution at a specific gravity of 1200. I then dilute until 1 oz. of the alloy is contained in 1 gallon of the solution. I then have two solutions—No. 1, which will have a specific gravity of approximately 1032 to 1035 and contains the antimony, and No. 2, which will have a specific gravity of 1030 to 1035 and is used as a diluent. During the making of these solutions some loss will occur due to evaporation of water and nitric acid, so that the quantities given above are not exact. I find it preferable to keep the solutions at a temperature of approximately 200° Fahrenheit during the dissolution of the alloys. Solutions Nos. 1 and 2 are then mixed together in variable proportions depending upon the antimony content of the rubber intended to be vulcanized to the metal. If the antimony content of the rubber (usually found in the form of antimony pentasulfid) is relatively high, a greater proportion of solution No. 2, which contains no antimony, will be used. If the antimony content of the rubber is relatively low, a greater proportion of solution

No. 1 should be used. It is thus apparent that I have formed an electrolyte by dissolving the antimony in the presence of copper and zinc, which are almost at the extremes of the electro-chemical scale, in a powerful oxidizing agent, and have formed my electrolyte from the solution thus obtained. This method entirely eliminates the tendency of the antimony to precipitate, and the antimony content of the electroplating bath will therefore remain constant at all ordinary temperatures. The electrolyte is then put in the plating tank and maintained at a temperature of approximately 70° F. The article to be plated forms the cathode, and an anode consisting of the same ingredients as the alloy used to make solution No. 1, viz: 30 parts copper, 38 parts zinc and 2 parts antimony, is used. I find that a potential of about 3.75 volts is preferable for this electroplating and that the distance between the anode and cathode should be approximately 10 centimeters.

I have found that the amount of antimony deposited upon the cathode may be varied in one of two ways. If it is desired to reduce the amount of antimony deposited, this may be done by reducing the potential of the current used for electroplating. Conversely, if it is desired to increase the amount of antimony deposited, the potential of the current should be raised. I find, however, that an increase of potential above the limits specified above is undesirable as it produces too rapid a deposition of the zinc. The other method of varying the amount of antimony deposited is by a variation in the constituents of the anodes, the electrolyte remaining practically constant in composition. The amount of antimony deposited may be reduced by reducing the antimony content of the anode and increased by increasing it. A convenient method of doing this is to have a number of anodes of various compositions at hand and use the ones appropriate to the result desired.

The electrolyte above described begins to plate immediately, without previously working through, and a sufficient quantity of alloy will be deposited upon the cathode after a very short period of time. When sufficient antimony has been deposited on the cathode, the article is removed, placed in boiling water and scratch-brushed, and while still clean is brought into contact with the rubber it is intended to attach to it, and vulcanized at a temperature of 245 to 300° F. This produces a chemical combination between constituents of the alloy and those of the rubber, causing a perfect adhesion of the rubber to the metal.

As it is evident that the steps I have described above and the proportions of the ingredients of the various solutions may be varied without departing from the spirit of my invention, I do not desire to be limited to the precise steps and proportions set forth above.

What I claim and desire to secure by Letters Patent of the United States is:

1. The method of attaching rubber to metals which consists in making a solution of a plurality of metals, to one of which rubber may be chemically united, electroplating the article to which it is desired to attach the rubber in said solution obtaining a deposit containing said metal and attaching the rubber to the surface, thus formed by vulcanization.

2. The method of attaching rubber to metals which consists in making an electrolyte from a plurality of metals, one of which is antimony, electroplating the article to which it is desired to attach the rubber in said solution obtaining a deposit containing antimony and attaching the rubber to the surface thus formed by vulcanization.

3. The method of attaching rubber to metals which consists in making an electrolyte from a plurality of metals, two of which are antimony and zinc, electroplating the article to which it is desired to attach the rubber in said solution obtaining a deposit containing antimony and zinc and attaching the rubber to the surface thus formed by vulcanization.

4. The method of attaching rubber to metals which consists in making an electrolyte from a plurality of metals, three of which are antimony, zinc and copper, electroplating the article to which it is desired to attach the rubber in said solution obtaining a deposit containing antimony, zinc and copper and attaching the rubber to the surface thus formed by vulcanization.

5. The method of attaching rubber to metals which consists in casting an alloy of metals to which rubber may be chemically united, making a solution of said alloy, electroplating the article to which it is desired to attach the rubber in said solution obtaining a deposit containing said metals, and attaching the rubber to the surface thus formed by vulcanization.

6. The method of attaching rubber to metals which consists in casting an alloy containing antimony, making an electrolyte from the same, electroplating the article to which it is desired to attach the rubber in said electrolyte obtaining a deposit of said alloy, and vulcanizing the rubber directly upon the surface thus produced.

7. The method of attaching rubber to metals which consists in casting an alloy containing zinc and antimony, making an electrolyte from the same, electroplating the article to which it is desired to attach the rubber in said electrolyte obtaining a deposit of said alloy, and vulcanizing the rubber directly upon the surface thus produced.

8. The method of attaching rubber to metals which consists in casting an alloy containing copper, zinc and antimony, making an electrolyte from the same, electroplating the article to which it is desired to attach the rubber in said electrolyte obtaining a deposit of said alloy, and vulcanizing the rubber directly upon the surface thus produced.

9. The method of attaching rubber to metals which consists in dissolving an alloy of metals to which rubber will chemically adhere, in acid, making an electrolyte from said solution, electroplating the article to which it is desired to attach the rubber in said electrolyte obtaining a deposit of said alloy and attaching the rubber to the surface thus produced by vulcanization.

10. The method of attaching rubber to metals which consists in producing two alloys, one of which contains antimony and the other of which does not, making an electrolyte from said alloys, electroplating the article to which it is desired to attach the rubber obtaining a deposit containing antimony, and attaching the rubber to the surface thus produced by vulcanization.

11. The method of attaching rubber to metals which consists in casting two alloys, one of which contains all of the elements contained in the other, together with antimony, making an electrolyte from said alloys, electroplating the article to which it is desired to attach the rubber, and attaching the rubber obtaining a deposit containing all of the elements of the said two alloys to the surface thus produced by vulcanization.

12. The method of attaching rubber to metals which consists in producing two alloys, one of which contains copper, zinc and antimony, and the other of which contains copper and zinc, making an electrolyte from said alloys, electroplating the article to which it is desired to attach the rubber obtaining a deposit containing copper, zinc and antimony, and attaching the rubber to the surface thus produced by vulcanization.

13. The method of attaching rubber to metals which consists in casting an alloy of copper, zinc and antimony and an alloy of copper and zinc, dissolving each of said alloys in acid, neutralizing said solutions, adding potassium cyanid to said solutions, diluting said solutions, mixing said diluted solutions together to form an electrolyte, electroplating the article to which it is desired to attach the rubber obtaining a deposit containing copper, zinc and antimony, and attaching the rubber to the surface thus produced by vulcanization.

14. The method of electroplating with a plurality of metals, one of which is antimony, which consists in dissolving the antimony in a powerful oxidizing agent in the presence of copper and zinc, making an electrolyte from said solution, immersing the article to be plated therein, and passing an electric current therethrough.

In witness whereof I have hereunto set my hand in the presence of two witnesses this 27th day of January, 1911.

LEO DAFT.

Witnesses:
CHARLES A. VAN WINKLE,
RAMSAY HOGART.