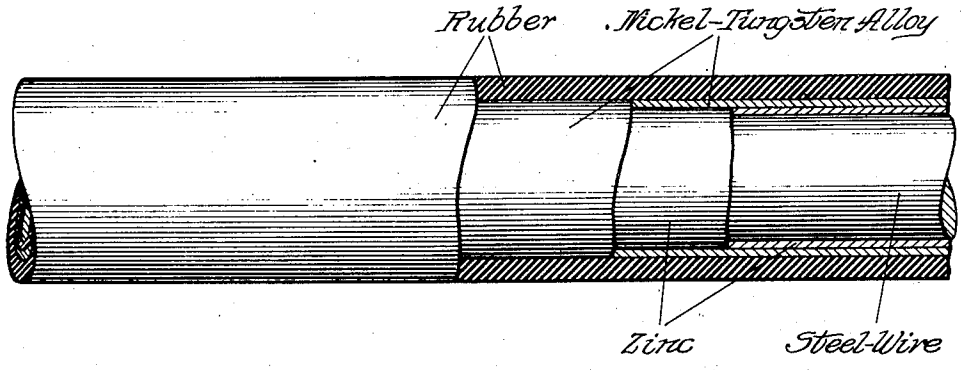
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RUBBER COATED STEEL OBJECT

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RUBBER COATED STEEL OBJECT

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This invention relates to a coated ferrous base object and a method of making the same and particularly to ferrous base wire adapted for rubber coating.

Steel wires and other ferrous base materials have a large use in providing strength to rubber articles. For example, they are frequently employed in tire beads. In Domm Patent 2,002,261 a method of coating ferrous base wires with copper and zinc is described which makes the wires adherent to rubber. The present process is an improvement upon that described in Domm in that the coating applied to the wire is more adherent to rubber of certain types and at the same time the corrosion resistance of the wire is considerably improved.

The invention will be described in connection with tire bead wires but it is to be understood that it is applicable to other ferrous base metals whether in wire or other form. It will also be described particularly in connection with ferrous wire which has been coated with zinc, but the new coating may be applied either on the zinc or on the bare ferrous base.

The invention is illustrated diagrammatically in the drawing in which the figure shows a broken view of a wire cut away to illustrate the various coatings. As there shown, the base is a steel wire provided with a zinc coating upon which is a layer of nickel-tungsten alloy, and upon the latter is a rubber coating. The drawing is of course not to scale.

The invention will be described in connection with steel tire bead wire. This wire may be coated with zinc either as described in said Domm Patent 2,002,261 or as set forth in my Patent 2,323,890, but preferably in accordance with the latter patent. In that process wires having a diameter of .060 to .070 inch are thoroughly cleaned, drawn through a flux such as a saturated solution of zinc ammonium chloride, the excess solution removed, and the wires drawn through a bath of molten zinc.

The temperature of the zinc bath is preferably in the range of 820° to 840° F. The wire is wiped after the zinc plating operation by what is known as the "tight wipe" method. In this process, the amount of zinc added is approximately 6 to 15 grams per kilogram of wire or approximately .00013 to .00033 inch in thickness. The zinc coated wire may then be drawn to reduce its thickness to the necessary diameter, usually about .025 inch. The zinc coating may, however, be applied directly to wire of this thickness.

The wires, after thoroughly cleaned, are then

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coated with an alloy of tungsten and a metal of the group consisting of nickel, cobalt and iron.

For the purpose of producing a nickel-tungsten alloy, the following bath may be employed:

	Grams per liter
$NiSO_4.7H_2O$	250
$NiCl_2.6H_2O$	21
H_3BO_3	30

Sodium tungstate is added to the above bath after dissolving it in water. The sodium tungstate solution is added slowly to the bath while agitating. The preferred amount is sufficient to give 2 to 10 grams per liter of tungsten.

Continuous plating is carried out preferably at a current density of about 50 amperes per square foot and at a temperature of 110° F.

Conditions are preferably controlled as to temperature, current density and concentration to give a jet black finish. The concentration, temperature and density may be varied but the variation should be correlated to produce the black finish.

The deposit of black alloy on analysis is found to have between 4% and 12% tungsten, the balance being nickel. It is quite possible that the tungsten and the nickel may each be present at least partially as salts rather than as the metal.

The bath is preferably operated at a pH of about 5.4 but this likewise is one of the conditions which may be varied. The thickness of the coating may be varied within wide limits. A coating produced by the use of 50 amperes per square foot current density for 5 minutes is not too thick. The minimum plate necessary at 50 amperes current density per square foot is produced in about 2 seconds.

In coating a galvanized wire there is a tendency of the zinc to react with the solution. This tendency may be inhibited by the use of buffers. For example, sodium sulfate may be added substantially to saturation, as, for example, 160 grams per liter. Sodium citrate may be employed, for example, at the rate of 7½ grams per liter.

The nickel-tungsten alloy has particularly good adherence with rubber. For example, in one test, wire so coated gave an adherence of 180 lbs. per inch on .037 wire, as compared with 160–170 lbs. to the wire of Domm Patent 2,002,261, 90 for nickel, and 30 for bare steel.

The nickel-tungsten alloy when applied over zinc has a vastly improved corrosion resistance as measured by salt spray, as compared with copper over zinc. For example, comparable

coatings of brass, nickel-tungsten and nickel, had the following comparative salt spray lives:

	Hours
Brass	45 to 50
Nickel	80 to 120
Nickel-tungsten	170
Bare galvanized	80 to 120

The corrosion resistance is not dependent upon the jet black character of the coating, although the black coating is most desirable for rubber adherence.

Instead of nickel, cobalt or iron may be employed. Improved adhesion and corrosion resistance have been obtained with cobalt-tungsten and iron-tungsten alloys.

A suitable solution for cobalt is as follows:

$CoSO_4.7H_2O$	grams per liter	504
NaCl	do	17
Boric acid	do	45
Sodium tungstate	do	2
pH		4.5

Plating may be carried out at 50 amperes per square foot for 20 seconds at 120° F. The resulting coating is gray.

A suitable solution for iron tungsten is as follows:

	Grams per liter
Ferrous ammonium sulfate	360
Tungsten (as sodium tungstate)	4

This is suitably operated at 20 amperes per square foot current density at a pH of 2 at 120° F. It is preferably operated long enough to secure a jet black coating.

The various tungsten alloys may also be applied over any intermediate coating or coatings. For example, zinc may be replaced by cadmium, tin, lead, or alloys thereof, and the tungsten alloy may be the final coating on a series of intermediate coats. In usual practice, however, the alloy will be applied either to the bare wire or to a zinc coated wire.

The foregoing detailed description has been given for clearness of understanding only, and

no unnecessary limitations should be understood therefrom.

What I claim as new, and desire to secure by Letters Patent, is:

1. A rubber coated article comprising a ferrous base having firmly adherent to a surface thereof an electrolytically deposited layer of a rubber adherent alloy of 4% to 12% by weight of tungsten and a metal of the class consisting of nickel, cobalt and iron, and a coating of rubber adherently vulcanized thereon.

2. An article as set forth in claim 1, in which a layer of zinc is interposed between the ferrous base and the tungsten alloy.

3. A rubber coated article comprising a ferrous base having firmly adherent to a surface thereof an electrolytically deposited layer of rubber-adherent nickel-tungsten alloy containing from 4% to 12% by weight of tungsten and a coating of rubber adherently vulcanized thereon.

4. An article as set forth in claim 3, in which a layer of zinc is interposed between the ferrous base and the tungsten alloy.

5. An article as set forth in claim 3, in which the nickel-tungsten coating is jet black.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,154,834	De Lamatter	Apr. 18, 1939
2,160,321	Armstrong et al.	May 30, 1939
2,320,998	Beebe	June 8, 1943
2,296,838	Domm	Sept. 29, 1942

FOREIGN PATENTS

Number	Country	Date
460,931	Great Britain	Feb. 1, 1937
674,430	Germany	Apr. 14, 1939

OTHER REFERENCES

Transactions of the American Electrochemical Society, vol. 82 (1942), pages 193–215.