(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 059 023 A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 82300025.2

(22) Date of filing: 05.01.82

(51) Int. Cl.³: C 23 D 3/00

(30) Priority: 16.01.81 GB 8101306

(43) Date of publication of application: 01.09.82 Bulletin 82/35

(84) Designated Contracting States: DE FR IT

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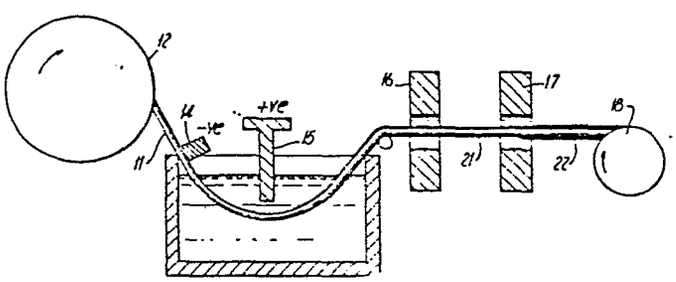
(54) Process for improving the corrosion resistance of a ferrous metal body.

(57) Ferrous metal surfaces are protected against corrosion by providing the metal (11) with a flash coating (12) of copper followed by coating the structure with a corrosion inhibiting layer wholly or partially comprising a water soluble glass. A plant for providing the coating treatment is also described.



EP 0 059 023 A1

C.F.Drake 76

CORROSION INHIBITION

This invention relates to corrosion inhibition and in particular to the prevention or inhibition of the corrosion of ferrous metals. The invention also relates to ferrous metal piece parts provided with such corrosion protection.

Ferrous metals are employed in the construction of reinforcing member in a variety of building and constructional operations. Typically the metal is used in the form of rods or wires which are embedded in concrete to form a structure having both tensile and compressive strength. Such reinforced concrete structures are employed e.g. in the construction of roadways, bridges, tunnels and buildings. In applications where a high load is to be applied to the reinforced structure it is often prestressed by applying tension to the reinforcing metal 'skeleton' thus enhancing the load bearing properties of the structure.

A problem associated with all ferrous metal structures is that of corrosion and consequent deterioration of the load bearing properties of the structure. This problem is particularly acute when the metal is in contact with or embedded in a building material such as cement or concrete. The commonly used building cements and concretes are strongly alkaline when freshly mixed with water and are highly corrosive in nature. A ferrous material is immediately attacked during the setting process and, as small traces

of water remain in contact with the metal, this attack continues throughout the life of the composite structure. In some cases this can lead to the ultimate failure of the reinforcement.

Whereas composite structures of this type are used in low stress application this failure of the reinforcement can lead to fracture of the structure necessitating eventual replacement which can be difficult and costly. Where the composite structure is used in a high stress application sudden failure of one or more reinforcing members can lead to catastrophic failure with the partial or complete collapse of the structure.

Various techniques for preventing ferrous metal corrosion have been investigated. One of the best known techniques is that of dip coating the metal with a layer of zinc, the process being known as galvanising. This process provides an effective degree of corrosion inhibition but, as the zinc coating is relatively thick, the process is too costly for many applications. Furthermore the period during which the corrosion inhibition is effective is limited in a corrosive environment by dissolution of the zinc which acts as a sacrificial anode. In an attempt to overcome the disadvantages of galvanised ferrous metal it has been proposed to protect the metal surface with a layer of electroplated copper which layer is chemically inert in many corrosive environments. However it has been found necessary to employ a relatively thick, and therefore expensive, copper layer to avoid the risk of pinholes through which accelerated electrolytic corrosion of the ferrous metal can occur. Also abrasion damage to the copper layer exposes the underlying metal and again leads to electrolytic corrosion.

The object of the invention is to minimise or to overcome these disadvantages.

According to the invention there is provided a ferrous metal body having a corrosion inhibiting surface coating, characterised in that said coating includes a layer of copper in contact with the metal surface and an external layer wholly or partially comprising a material having corrosion inhibiting properties.

According to another aspect of the invention there is provided a method of inhibiting corrosion of a ferrous metal surface, including applying a coating of copper to the surface, and covering the copper with a corrosion inhibiting coating.

Preferably the corrosion inhibiting material comprises a water soluble glass.

Embodiments of the invention will now be described with reference to the accompanying drawings in which:-

Figure 1 is a schematic diagram of a plant for producing corrosion inhibited ferrous metals;

and Figure 2 is a cross-section of a ferrous metal body produced by the plant of Figure 1.

Referring to the drawings, the coating plant shown in Figure 1 is intended for the treatment of e.g. steel rod or wire, or wire products, in continuous lengths. It will however be clear to those skilled in the art that the process can be readily adjusted to the treatment of ferrous metals in other forms such as tube and sheet.

The wire or wire product 11 to be treated is fed from a storage reel 12 through an electroplating bath 13 where a flash coating 21 (Fig. 2) of copper is deposited on the metal surface. To effect this coating an electric current is fed to the wire product 11 via one or more brush contacts 14, the current being fed via the wire through the electrolytic solution in the bath 13 to a copper anode 15. The thickness of the electrodeposited

copper coating 21 can be determined by controlling both the site at which the wire product is fed through the plating bath 13 and the electroplating current. Typically this thickness will be in the range 0.01 to 1 micron although the thickness of the copper layer is not critical.

After the electrodeposition stage the wire 11 passes, preferably via a washing and drying station 16 where electrolyte residues are removed, to a coating station 17 where the copper coated wire is provided with an outer corrosion inhibiting coating 22 (Fig. 2) comprising wholly or partially a water soluble glass housing corrosion inhibiting properties. Typically the glass is of the phosphorus pentoxide type and may comprise phosphorus pentoxide/zinc oxide/alumina glass or phosphorus pentoxide/calcium oxide/alumina glass, such glasses being described in our published United Kingdom specification No. 23790/77 (C.F.Drake 58) and our copending applications No. 7939544 (C.F.Drake-A.Maries-P.F.Bateson 73-2-1) and No. 8011297 (A.Maries-P.F.Bateson 3-2). Advantageously the glass is applied as a powder dispersed in a paint resin, but other coating techniques may also be employed. Thus, for example, the glass may be applied as a fine powder from a fluidized bed followed by fusion of the glass to provide a uniform surface layer. Other coating methods will be apparent to those skilled in the art. Finally the coated wire 11 is wound on to a storage reel 18.

The corrosion inhibited ferrous metal products manufactured by the plant of Figure 1 may be employed in a variety of applications in hostile environments where unprotected ferrous metals would be subject to rapid corrosion. Advantageously the corrosion inhibited metal product is in the form of rods or wires

which are employed as the reinforcing elements in cement and concrete structures; the corrosion inhibiting glass prevents attack of the ferrous metal during the concrete setting process and continues this protection for an extended period while the structure is in service.

Other applications include the corrosion inhibition of steel tube that is to be employed in the construction of underground or submarine pipelines e.g. for gas or oil.

CLAIMS:

1. A ferrous metal body having a corrosion inhibiting surface coating, characterised in that said coating includes a layer of copper in contact with the metal surface and an external layer wholly or partially comprising a material having corrosion inhibiting properties.

2. A metal body as claimed in claim 1, characterised in that said corrosion inhibiting material comprises a water soluble glass.

3. A metal body as claimed in claim 2, characterised in that the glass is in the form of a powder dispersed in a paint resin.

4. A metal body as claimed in claim 2 or 3, characterised in that said glass is a phosphorous pentoxide/zinc oxide/alumina glass.

5. A metal body as claimed in claim 1, 2, 3 or 4, characterised in that said copper layer is an electrodeposited layer.

6. A metal body as claimed in any one of claims 1 to 5, characterised in that said copper layer is from 0.01 to 1 micron thick.

7. A metal body as claimed in any one of claims 1 to 6 and in the form of a wire or a wire product.

8. A cement or concrete structure reinforced with a wire or wire product as claimed in claim 6.

9. A method of inhibiting corrosion of a ferrous metal surface, including applying a coating of copper to the surface, and covering the copper with a corrosion inhibiting coating.

10. A method as claimed in claim 9, characterised in that said coating wholly or partially comprises a water soluble glass.

11. A method as claimed in claim 9 or 10, characterised in that said copper coating is electro-deposited.

12. A method as claimed in claim 9, 10 or 11, characterised in that the copper coating is from 0.01 to 1 micron thick.

13. A method as claimed in claim 9, 10, 11 or 12, characterised in that said glass is applied in the form of a powder dispersed in a paint resin.

14. A corrosion inhibited ferrous metal product made by the method of any one of claims 9 to 13.

Fig.1.

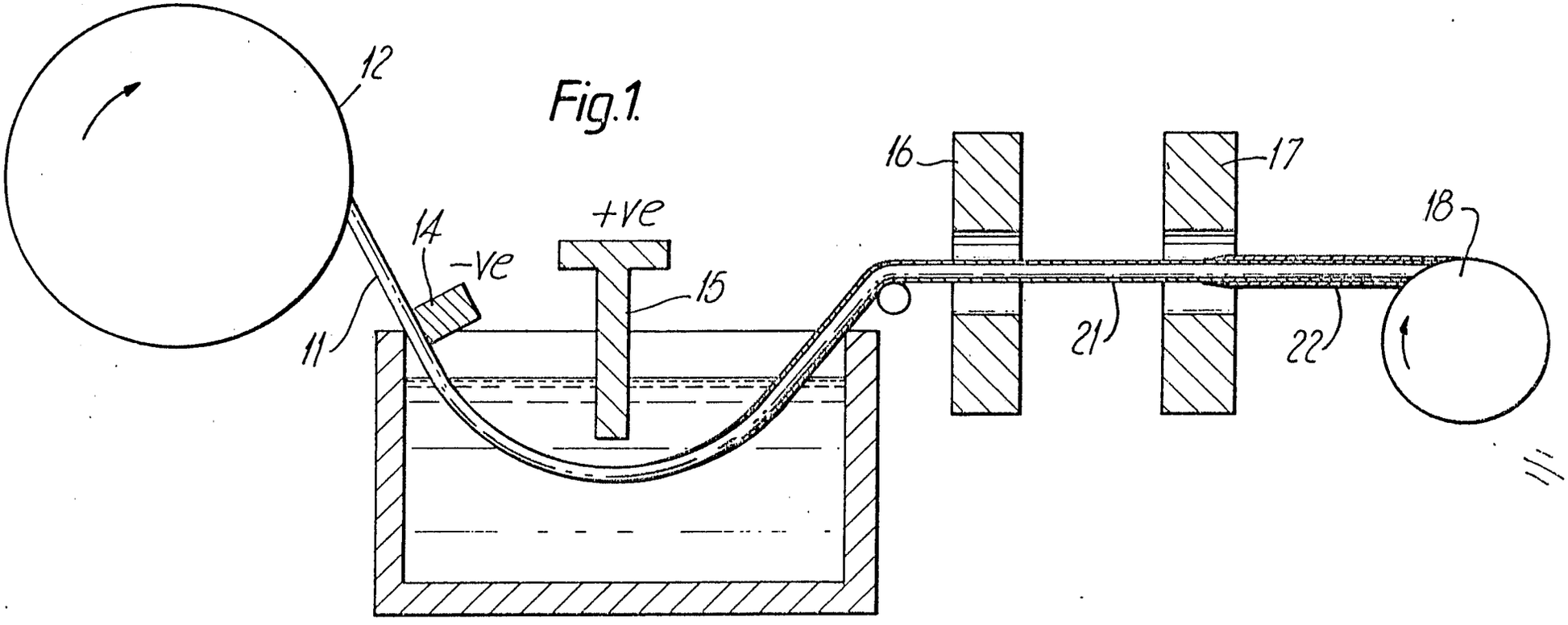
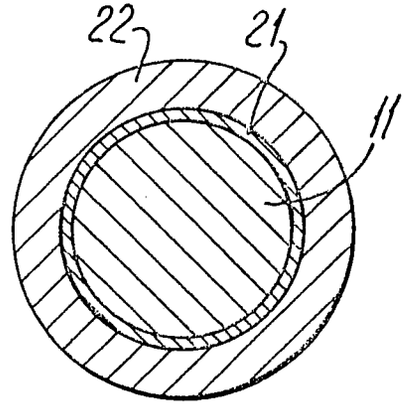


Fig.2.



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European Patent Office

EUROPEAN SEARCH REPORT

Application number
0059023
EP 82 30 002

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	FR - A - 2 225 545 (CENTRE DE RECHERCHES METALLURGIQUES) * Claims 1,4; page 4 *	1,2,5 6,9, 10,11 12
X	FR - A - 1 469 571 (AMAND) * Page 1, right-hand column, lines 19-25 *	1,2,5 6,9, 10,11 12
X	US - A - 2 417 885 (POWELL) * Column 4, example 2 *	1,5,6 9,11 12

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

C 23 D 3/00

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

C 23 D 3/00
13/20
B 05 D 7/16
C 22 C 22/63

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23-03-1982	NGUYEN THE NGHIEP

EPO Form 1503.1 08.78