Oct. 31, 1939. G. I. FINCH 2,178,251

COATING OF METAL SURFACES

Filed June 22, 1937

Fig. 1.

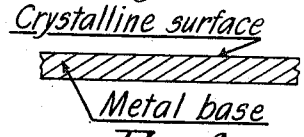



Fig. 2.

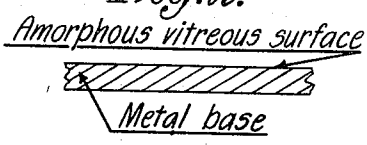



Fig. 3.

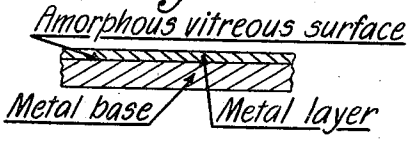



Fig. 4.

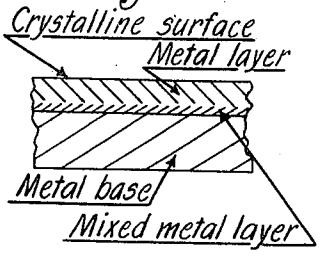



Fig. 5.

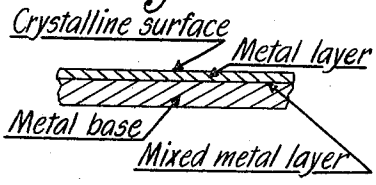



Fig. 6.

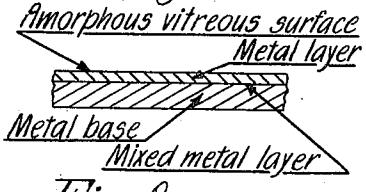



Fig. 7.

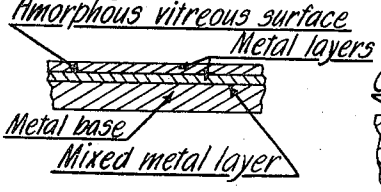



Fig. 8.

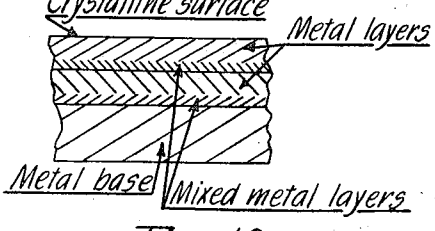



Fig. 9.

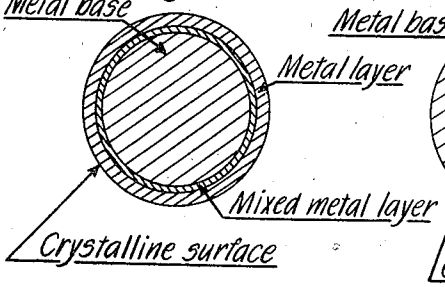
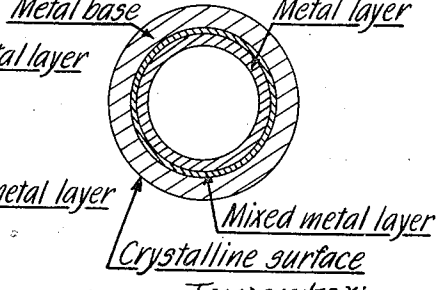



Fig. 10.




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Patented Oct. 31, 1939 2,178,251

# UNITED STATES PATENT OFFICE

2,178,251

## COATING OF METAL SURFACES

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Application June 22, 1937, Serial No. 149,783
In Great Britain June 24, 1936

5 Claims. (Cl. 29—149.5)

This invention relates to a process for the coating of metal surfaces.

It has been found that when metal surfaces are polished, burnished, or hammered, the normal crystalline structure of the surface is destroyed and the atoms are displaced from the positions which they normally occupy in the crystal lattice and become packed to form a hard dense, amorphous, vitreous glass-like layer on the surface of the metal. The term "hammered" is used herein to include the process of rumbling, either by means of rollers or balls; either the "continual contact" or the "impact" type of rumbling treatment is suitable to disrupt the crystal lattices of the metal of the surface being treated. It has also been found that subjecting the surface of metal to a shearing stress in a direction along the surface is sufficient to rupture the crystal lattice and to disarrange the atoms so that they form the hard, dense, amorphous layer referred to above. The burnished surfaces possess the peculiar property, not possessed by the normal crystalline surface of the metal, of being able to dissolve crystals of the same or of a foreign metal very readily at ordinary room temperature provided that the foreign metal is not such as to be insoluble in or incapable of alloying with the metal of the burnished surface.

According to this invention a process for the preparation of metal surfaces consists in coating the surface of a metal base with the same metal, or with a metal soluble in, or alloyable with, the metal of the base, and treating the crystalline surfaces of the base and of the coating to transform them into amorphous vitreous layers in the manner herein described by disrupting the crystal lattices of the metal of the surface. Preferably the surface of the metal base is treated so as to form the aforesaid amorphous vitreous layer and the metal coating is subsequently applied and treated to form an amorphous vitreous layer thereon.

A feature of the invention consists in that a number of metal coatings are successively applied, the surfaces of each coating being treated in the manner above referred to.

In certain cases it will be desirable to provide a coating of a metal which is not soluble in, or is not alloyable with, the metal of the base and under such circumstances a further feature of the invention consists in that an intermediate coating of a metal is applied to the base, which metal coating is soluble in, or alloyable with, both the metal of the base and the first said metal. In this way it will be appreciated that it is possible to apply a coating of such a metal which will be intimately bonded to the metal of the base by means of an intermediate bonding coating which coating is, at each interface, alloyed with the metals on either side thereof.

A further important feature of the invention consists in treating metal bearing surfaces in the manner above described, applying a metal coating thereto and treating the surface of the coating to form the aforesaid dense amorphous vitreous layer. It will be appreciated that bearing surfaces thus treated will have a prepared surface which will not require to be "run-in" to provide the necessary smooth working surfaces.

A still further feature of the invention consists in providing a journal with a coating of a suitable metal, as herein described, whereby an artificially "run-in" surface is formed. In one method of carrying this process into effect, a metal bearing surface is formed by treating a ferrous metal journal, for example, by burnishing, to destroy the crystalline structure of the surface and to transform that surface into the aforesaid amorphous vitreous layer, applying a coating of a non-corrodible metal, for example, chromium or nickel, and converting the said coating into the amorphous vitreous layer referred to above. It will be appreciated that in this way it is possible to provide a journal with a dense, hardened surface of a non-corrodible metal of the class consisting of chromium, nickel, cobalt, beryllium, manganese and vanadium on a base of a suitable metal which, although possessing properties (e. g. tensile strength) which render it desirable for use as the main part of the article, is liable to corrosion and thus, not suited for use in certain circumstances.

It will be appreciated that the process of this invention may be applied to the treatment of bearing members other than journals of crank shafts and the like; for example the sleeve-valves of sleeve-valve engines may be provided with a non-corrodible surface in the manner just described, whilst it will also be appreciated that the cylinder bores or cylinder liners may thus also be similarly treated.

In the accompanying drawing, Figures 1 to 8 are diagrammatic drawings showing the steps in the process of applying a coating to a metal base herein described.

Figure 1 shows the metal base with the normal crystalline surface.

Figure 2 shows the metal base with the amor-

phous vitreous surface produced by polishing, burnishing, hammering or rumbling.

Figure 3 shows the base of Figure 2 with the layer of metal (which may be the same as the base-metal or different but which must be soluble in or alloyable with the metal of the base) applied to the amorphous vitreous surface.

Figure 4 is an enlarged view to show the solution or alloy of the two layers at the interface designated as "mixed metal layer".

Figure 5 is the same as Figure 4 but on a reduced scale.

Figure 6 shows the metal layer with the amorphous vitreous layer formed on the surface thereof.

Figures 7 and 8 are similar to Figures 3 and 4 showing two layers of metal (which may be the same or different) on the metal base.

Figure 9 is a diagrammatic section of a shaft or rod having the metal layer or layers on the metal of the base as in Figures 4 and 8.

Figure 10 is a diagrammatic section through a tube or hollow cylinder (such as a cylinder barrel or cylinder liner) the inner surface of which is provided with a metal layer or layers similar to Figures 4 and 8.

The coating of metal may be deposited on the base in any suitable manner for example, the metal coating may be formed by electro-deposition, by flashing or by dipping.

I claim:

1. A process of forming a thick amorphous hardened surface on a metal bearing member of ferrous metal and of the required shape and finish which consists in forming an amorphous, vitreous layer on the surface of the said bearing member by mechanically disrupting the crystal lattices of the surface without attrition thereof, and without substantially altering the configuration thereof, subsequently applying a coating of the same metal and forming an amorphous, vitreous layer of the surface of said coating by mechanically disrupting the crystal lattices of the surface thereof without attrition also without substantially altering the configuration thereof.

2. A process of forming an artificially "run-in" bearing member of ferrous metal which consists in forming an amorphous, vitreous layer on the surface of the said bearing member by mechanically disrupting the crystal lattices of the surface without attrition thereof, and without substantially altering the configuration thereof, subsequently applying a coating of the same metal and forming an amorphous, vitreous layer on the surface of said coating by mechanically disrupting the crystal lattices of the surface thereof also without attrition thereof and without substantially altering the configuration thereof.

3. A process for forming an artificially "run-in" surface on a metal bearing member of ferrous metal and of the required shape and finish which consists in forming an amorphous, vitreous layer on the surface of the said bearing member by mechanically disrupting the crystal lattices of the surface without attrition thereof and without substantially altering the configuration thereof, subsequently applying a thin coating of a hard metal, and forming an amorphous, vitreous layer on the surface of said coating by mechanically disrupting the crystal lattices of the surface thereof also without attrition thereof and without substantially altering the configuration thereof.

4. A process of preparing an artificially run-in bearing member of ferrous metal which consists in forming an amorphous layer on a bearing member of the required shape and finish by disrupting the crystal lattices of the surface layers of metal without attrition thereof and without substantially altering the configuration thereof by the application of a shear stress, applying a thin coating of a hard metal and substantially wholly converting the said coating into amorphous metal by disrupting the crystal lattices of the metal therein without attrition thereof by the application of a shear stress to the surface of the coating also without substantially altering the configuration thereof.

5. A process of preparing an artificially run-in bearing member of ferrous metal which consists in forming an amorphous layer on a bearing member of the required shape and finish by disrupting the crystal lattices of the surface layers of metal without attrition thereof and without substantially altering the configuration of the surface by the application of a shear stress, applying a plurality of thin coatings of hard metal and substantially wholly converting each coating into amorphous metal without attrition thereof before the application of a succeeding coating.

GEORGE INGLE FINCH.