Sept. 26, 1944. A. R. UPTON 2,358,892

METHODS FOR PRODUCING TIN-COATED COPPER TUBES

Filed Dec. 9, 1942

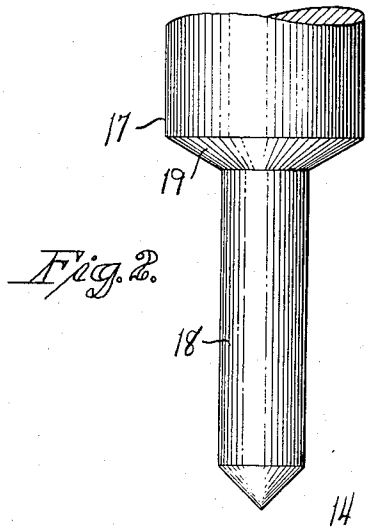


Fig. 2.

Fig. 1.

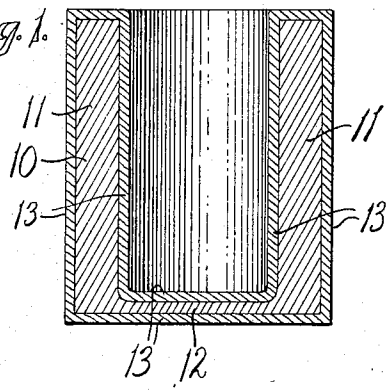
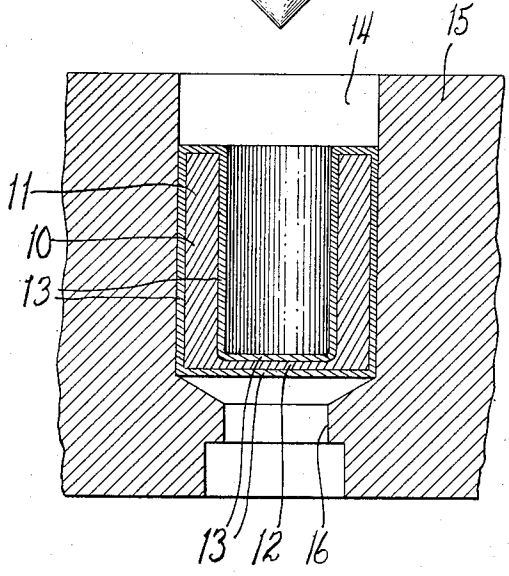


Fig. 3.



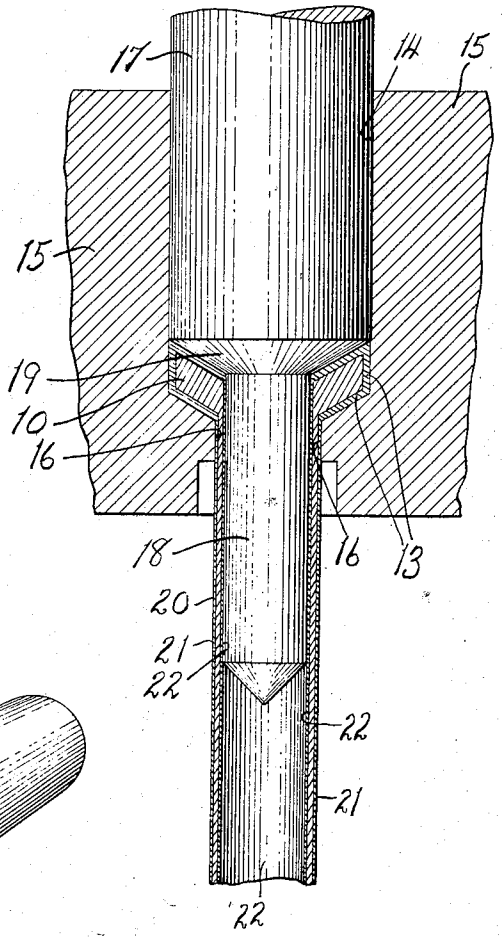
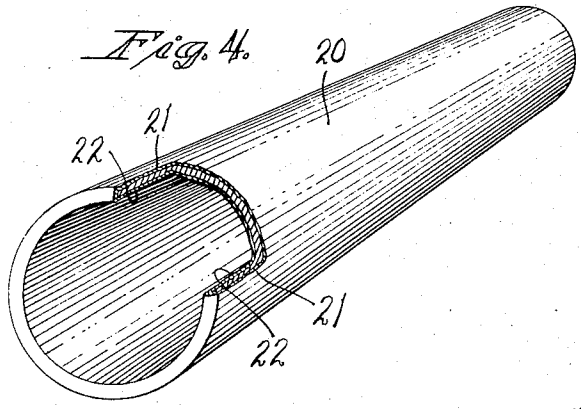


Fig. 4.



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METHOD FOR PRODUCING TIN-COATED COPPER TUBES

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4 Claims. (Cl. 207—10)

The present invention relates to improvements in methods whereby tubes of copper may be produced with coatings of tin.

One of the objects of the present invention is to provide a superior low-cost method for producing tin-coated copper tubes.

Another object of the present invention is to provide a superior method whereby a copper tube may be provided with a consolidated coating of tin for purposes of improving the corrosion resistance or for imparting other desirable properties to the resultant tin-coated copper tube.

A further object of the present invention is to provide a superior method whereby copper tubes may be produced which are provided with extremely-thin but adherent, continuous and consolidated tin coatings.

With the above and other objects in view, as will appear to those skilled in the art from the present disclosure, this invention includes all features in the said disclosure which are novel over the prior art.

In the accompanying drawing, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a view in central-longitudinal section of a billet or blank of copper provided with a coating of tin preparatory to being extruded;

Fig. 2 is a broken schematic view partly in section and partly in side elevation of one form of an impact-extrusion punch-and-die apparatus suitable for carrying out the present invention, and showing the tin-coated copper billet or blank in place in the die preparatory to the impact-extrusion operation;

Fig. 3 is a view corresponding to Fig. 2 but showing the elements in the positions which they assume during the impact-extrusion operation; and

Fig. 4 is a broken perspective view partly in section of a tin-coated copper tube produced in accordance with the present invention.

In the preferred mode of carrying out the present invention, a cylindrically-contoured cup-shaped blank or billet 10 is provided which has a relatively-thick annular side-wall 11 and a relatively-thin bottom- or end-wall 12. The said billet 10 may be formed of commercially-pure copper or a high-copper alloy responsive to impact-extrusion, and is preferably so formed that its grain structure is oriented in the direction of its longitudinal axis. The billet or blank 10 is provided with a coating of tin 13 which preferably covers both the interior and exterior of the said blank and which may be applied thereto by dipping the blank in a molten bath of tin in a manner as will presently be described.

In order to properly bond the tin-coating to the copper blank or billet so that the said coating will be properly jointly extrudable with the copper of the blank itself, the said blank, after proper cleaning and fluxing, is immersed in a bath of molten tin. By thus coating the copper-base billet or blank not only is an adequately-thick coating provided for later thinning, but the said coating is made in effect an integral part of the copper-base material. It appears that by the hot-coating step just referred to, the inner part of the tin-coating alloys or amalgamates with the copper of the billet in contradistinction to a mere surface contact. The alloying or amalgamation referred to, virtually creates a minutely-thin bronze (copper and tin) bonding layer between the inner surfaces of the tin-coating and the outer surfaces of the billet or blank. The thickness of the tin-coating 13 is somewhat exaggerated from normal in the accompanying drawing for purposes of clarity of illustration, but the thickness may be regulated in manners well understood in the art, to provide a thickness of coating which will eventuate into the desired thickness of coating on the finished tube when the blank is subjected to impact-extrusion in a manner as will more fully hereinafter appear.

Following its being provided with a coating of tin such as 13, the billet or blank 10 is placed in a suitable cavity, such as the cavity 14 formed in an extrusion-die 15 and provided at its lower portion with an extrusion-passage or orifice 16 of circular form in cross section and corresponding in diameter to the desired outside diameter of the tube to be produced. In conjunction with the die 15, a suitable extrusion-punch such as 17 is employed, which is provided at its lower end with an integral coaxial extrusion-mandrel 18 having a diameter corresponding to the desired interior diameter of the tube to be produced and also substantially corresponding to the interior diameter of billet 10 and its coating 13.

By means of any suitable impact-extrusion press, the extrusion-punch 17 is caused to descend with a hammer-like blow to cause its extrusion-mandrel 18 to enter the open upper end of the cup-shaped billet or blank 10 and its tin coating 13 so as to punch through the thin bottom-wall 12 and to extend through the extrusion-passage or orifice 16 in the extrusion-die 15. The diameter of the extrusion-mandrel 18 of the extrusion-punch 17 is preferably such as to substantially correspond to the interior diameter of the coated billet 10, and when the said mandrel enters the extrusion-passage 16 in the extrusion-die 15, it will occupy a central position therein.

After the lower portion of the extrusion-mandrel 18 has penetrated the end-wall 12 of the billet or blank 10 and has entered the extrusion-passage 16 in the extrusion-die 15, the extrusion-shoulder 19 of the extrusion-punch 17 will engage with the upper portion of the billet 10 and will compress or extrude the billet 10 and its al-

loyed tin-coating 13 in such manner that the metal of both the said billet 10 and coating 13 has but one channel escape, namely, that through the annular ring-like space now existing between the periphery of the extrusion-mandrel 18 and the surface of the extrusion-passage 16. As the punch 17 continues to descend, the copper-base metal of the billet 10 will be extruded through the extrusion-passage 16 and around the extrusion-mandrel 18 into the form of a thin-walled copper-base tube 20 schematically shown in Figs. 3 and 4. At the same time that the copper of the billet 10 is extruded, the tin of the coating 13 will also be extruded in situ while bonded on the said copper-base metal and proportionately thinned to provide the copper-base tube 20 with an outer tin-coating 21 and an inner tin-coating 22. The stroke of the punch 17 may be continued until its extrusion-shoulder 19 engages with the bottom of the cavity 14 in the extrusion-die 15, and normally the extruded metals will have such impetus, due to the rapidity of the stroke of the said punch 17, that the said extruded metals will "strip" themselves, so to speak, out of the extrusion-passage 16 and off from the extrusion-mandrel 18.

The extrusion-punch 17 may now be withdrawn and restored to substantially the position in which it is shown in Fig. 2, preparatory to the insertion of another tin-coated billet into the cavity 14 and preparatory to another cycle of operations.

During the process of impact-extrusion as above described, the relatively-thick tin-coating 13 on the billet or blank 10, even though relatively-porous and lacking in desired density, will be consolidated and densified as it is converted into the respective outer and inner coatings 21 and 22 without, however, rupturing the bond between themselves and the copper-base metal.

By means of the present invention, copper-base metals may be economically converted into thin-walled tubes having one or more coatings of tin, by the simple expedient of first providing the billet or blank with a relatively-heavy alloyed or amalgamated coating of tin and then simultaneously thinning the metal of the blank itself, together with its coating. The resultant product possesses a hard, dense and substantially-nonporous coating which is free of breaks and interruptions. The impact-extrusion operation above described is carried on while the billet, the coating and the extrusion apparatus are at room temperature, with the result that though considerable heat is momentarily developed during the extrusion operation, the time factor is of such short duration that the resultant thin-walled tube (which may have a wall-thickness of the order of .005") is adequately work-hardened to enable it to withstand collapse and distortion stresses to a marked degree.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. The improvement in methods for producing tin-coated copper tubes comprising: providing a tube-like billet of copper; providing the interior peripheral portion of the said tube-like billet with a relatively-thick tubular coating of tin partially amalgamated with the copper of the interior peripheral portion of the said billet; placing the said tube-like billet with its said previously-applied tubular interior coating in an apertured extrusion-die; and simultaneously subjecting the said tube-like copper billet and its interior tubular tin-coating to the action of an impact-extrusion punch to simultaneously extrude the said tube-like billet and its said interior tubular coating through the said apertured die and into tubular form and thinning and consolidating the said interior tubular coating of tin while the same is bonded to the copper of the interior of the said tube-like billet as the latter is extruded.

2. The improvement in methods for producing tin-coated copper tubes comprising: providing a tube-like billet of copper; providing both the interior and exterior peripheries of the said tube-like billet respectively with a relatively-thick tubular coating of tin partially amalgamated with the copper of the said billet; placing the said billet with its said previously-applied tubular coatings in an apertured extrusion-die; and simultaneously subjecting the said copper billet and both its interior and exterior tubular tin-coatings to the action of an impact-punch to simultaneously extrude the said tube-like copper billet and its two said tubular coatings of tin through the said apertured die and into tubular form and thinning and consolidating both the said exterior and interior tubular coatings of tin while the same are bonded to the copper of the said billet as the latter is extruded.

3. The improvement in methods for producing tin-coated copper tubes comprising: providing a cup-shaped billet of copper; providing the interior peripheral portion of the said cup-shaped billet with a relatively-thick tubular coating of tin partially amalgamated with the copper of the interior peripheral portion of the said billet; placing the said cup-shaped billet with its said previously-applied tubular interior coating in an apertured extrusion-die; and simultaneously subjecting the said cup-shaped copper billet and its interior tubular tin-coating to the action of an impact-extrusion punch to simultaneously extrude the said cup-shaped copper billet and its said interior tubular tin-coating through the said apertured die and into tubular form and thinning and consolidating the said interior tubular tin-coating while the same is bonded to the copper of the interior of the said cup-shaped billet as the latter is extruded.

4. The improvement in methods for producing tin-coated metal tubes comprising: providing a cup-shaped billet of copper; providing both the interior and exterior peripheries of the said cup-shaped billet respectively with a relatively-thick tubular coating of tin partially amalgamated with the copper of the said billet; placing the said billet with its said previously-applied tubular coatings in an apertured extrusion-die; and simultaneously subjecting the said copper billet and both of its said tubular tin-coatings to the action of an impact-extrusion punch to simultaneously extrude the said cup-shaped copper billet and both its said inner and outer tubular tin-coatings through the said apertured die and into tubular form and thinning and consolidating both the said interior and exterior tubular tin-coatings while the same are bonded to the copper of the said cup-shaped billet as the latter is extruded.

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