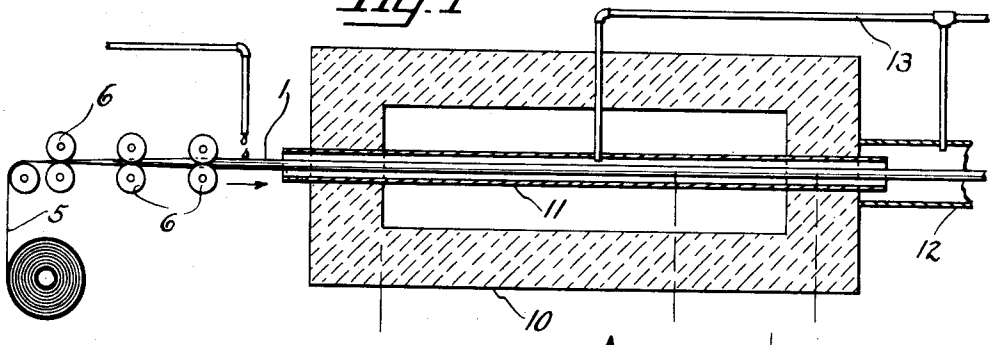
Sept. 7, 1937. B. L. QUARNSTROM 2,092,557

COPPER COATING AND WELDING PROCESS

Original Filed June 21, 1934 2 Sheets-Sheet 1

Fig. 1



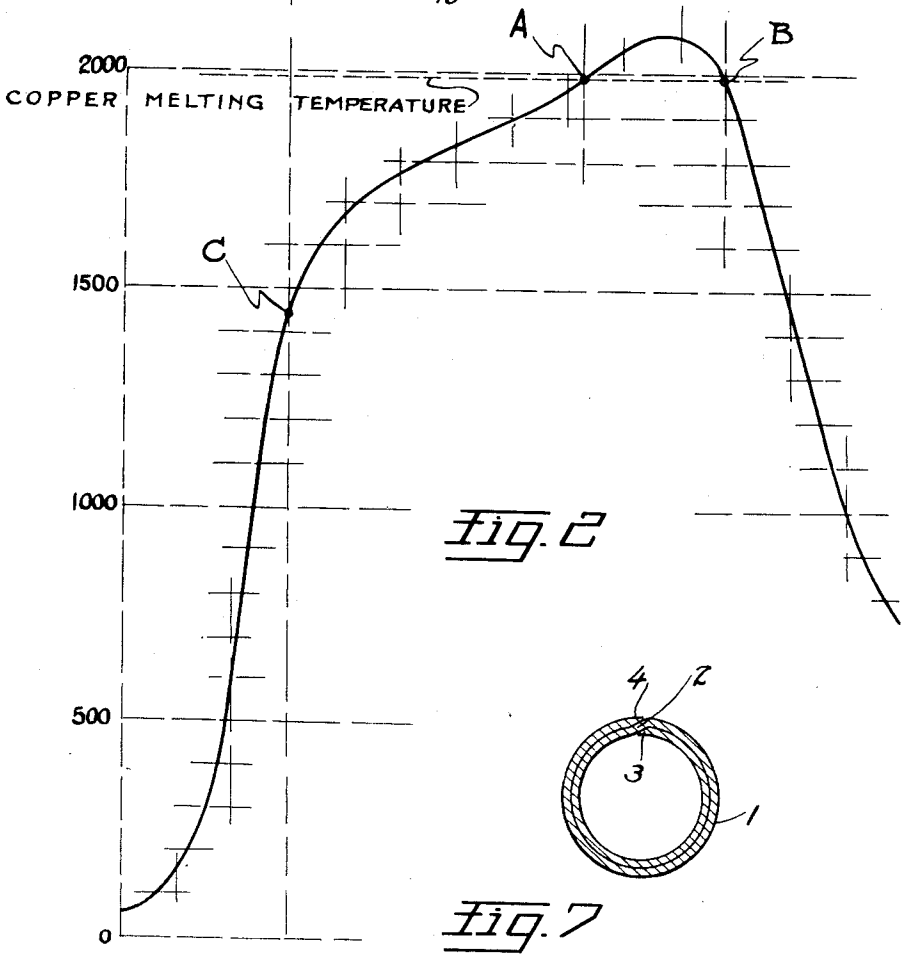


Fig. 2

Fig. 7

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Sept. 7, 1937. B. L. QUARNSTROM 2,092,557

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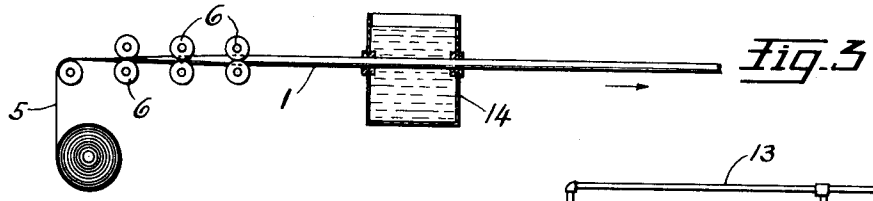


Fig. 3

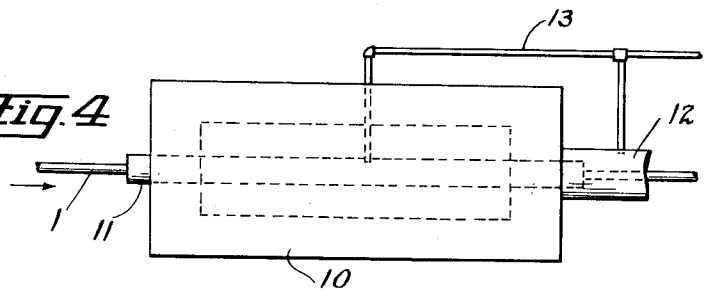


Fig. 4

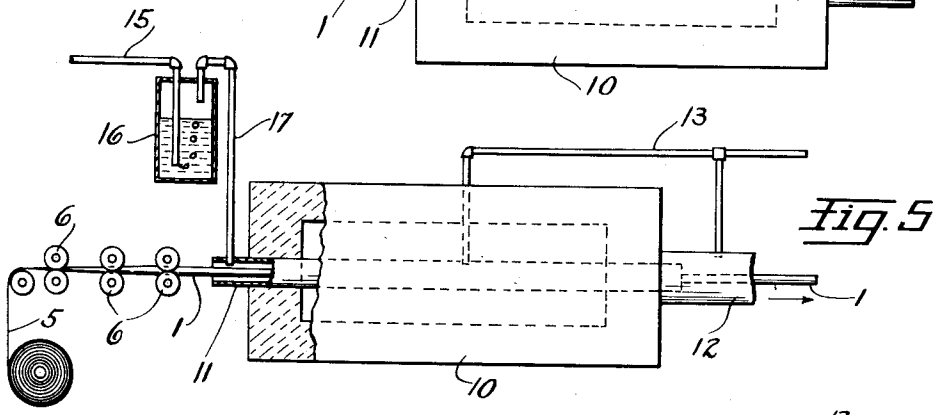


Fig. 5

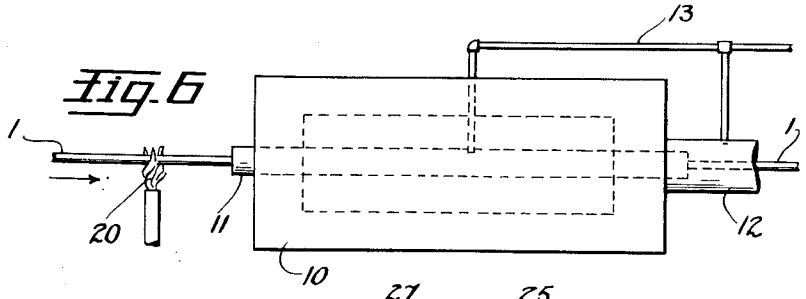


Fig. 6

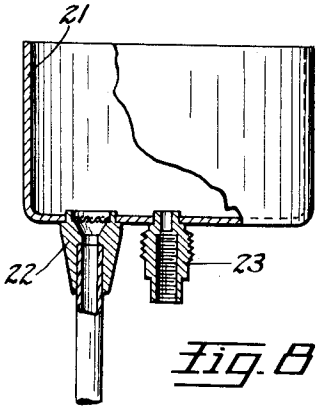


Fig. 8

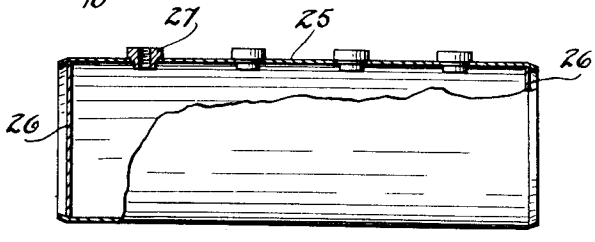


Fig. 9

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Patented Sept. 7, 1937 2,092,557

UNITED STATES PATENT OFFICE

2,092,557

COPPER COATING AND WELDING PROCESS

Bert L. Quarnstrom, Detroit, Mich., assignor to Bundy Tubing Company, Detroit, Mich., a corporation of Michigan

Application June 21, 1934, Serial No. 731,722
Renewed January 16, 1937

25 Claims. (Cl. 113—112)

This invention relates to the art of coating ferrous metal with copper, and it also relates to the art of uniting two or more ferrous metal objects or elements with copper which has been rendered molten. Where two or more of such objects or elements or different portions of one article are united by copper which has been rendered molten, the term "copper-welding" is sometimes employed and the term "copper-brazing" is sometimes employed.

The invention is concerned particularly with a process for fixing and/or retaining a copper coating on ferrous metal wherein a previously copper-coated or copper-plated ferrous object is subjected to copper melting temperature. The invention is concerned also with the production of copper coated articles fabricated from properly fashioned ferrous stock or from separate ferrous metal pieces interfitted together, where portions of the stock or the separate pieces are to be copper-welded together and a copper coating on some or all of the surfaces obtained.

For the purpose of more fully disclosing the invention, reference will be made to the making of tubing which is fashioned from strip steel stock, the stock preferably being copper-coated previous to being formed into tube. The stock is fashioned so as to provide over-lapping parts or a plural ply structure, and then the tube is subjected to copper melting temperature in a non-oxidizing or reducing atmosphere. The molten copper unites the overlapping or interfitting parts. Such a process is disclosed in the Harry W. Bundy Patent No. 1,892,607 of December 27, 1932. The copper coating may be applied to the strip stock in any suitable manner, preferably, so far as the present invention is concerned, by electro-plating.

The present invention involves new steps designed to preserve with great facility the copper coating on outside or inside exposed surfaces, to the end that upon the completion of the tube a bright copper coating is provided substantially free of oxides, smooth and of uniform characteristics. Such a coating may be obtained by the process set forth in the above mentioned Harry W. Bundy patent, but the process must be rather delicately controlled.

The present invention provides a process which facilitates the making of such a tube or other articles under production methods and on a commercial scale. To this end various factors in the process, such as the heat to which the article is subjected and the time period of the heat treatment, and other factors, need not be so delicately controlled; and as a result workmen of fairly unskilled nature may be employed for commercially producing the tube or articles, while at the same time tubing produced from day to day or from hour to hour remains substantially uniform. Also the tubing may be passed more rapidly through the heating zone.

Before going further into the disclosure, reference may be made to the accompanying drawings wherein:

Fig. 1 is a diagrammatical illustration of a furnace and associated parts for the making of tubing in accordance with the present process.

Fig. 2 illustrates a curve showing the temperature in the furnace, this figure being laid out in correct relation as regards Fig. 1.

Fig. 3 is a view illustrating the making and treating of a tube with a substance prior to subjecting the tube to the heat treatment.

Fig. 4 diagrammatically illustrates the passing of a tube made in Fig. 3 through a furnace for the heat treatment.

Fig. 5 is a view similar to Fig. 1 illustrating a modification of the method.

Fig. 6 is a view illustrating another modification of the method.

Fig. 7 is a cross-sectional view of a tube which may be made by the process.

Fig. 8 illustrates an assembled article which may be made in accordance with the process.

Fig. 9 illustrates another article which may be made by the process.

The invention is directed particularly to the obtaining of a good smooth copper coating on a copper-plated article which has been subjected to copper melting temperature. Now, it will be at once appreciated that an article of ferrous metal having an electro-plated copper coating may be subjected to copper melting temperature to cause the copper to alloy with the underlying ferrous metal for the sole purpose of fixedly uniting the coating to the article by reason of the copper alloying with the ferrous metal; and it will also be apparent that at the time the copper is rendered molten different parts or portions of the article may be copper-welded together. The tube, as shown herein in Fig. 7, is what has now become known in the trade as "Bundy" tube, which consists of a single piece of strip stock fashioned into a tube with plural ply walls. This tube is generally shown at 1, and the center portion of the stock has an off-set 2 against which the edges 3 and 4 substantially abut. This is but one form of tube which may be made in accordance with the process. Copper coated

strip stock 5 may be run through a suitable tube-forming machine having tube-forming rollers 6. Such machines are well known to those versed in the art and need not be gone into in detail herein. The tube so made may be like that as shown in Fig. 7, and may be fed directly into a furnace or other apparatus for subjecting the tube to a copper melting temperature. So far as the present invention is concerned, various kinds of furnaces or heating devices may be used, the essential thing being to subject the article to heat sufficiently high to melt the copper. One of such devices is illustrated herein as being a muffle furnace 10 equipped with a muffle pipe 11. The tube may pass into the furnace in the direction illustrated by the arrow, and upon leaving the furnace may pass through a cooler 12. Preferably, a reducing or non-oxidizing gas is supplied to the furnace and cooler, advantageously through piping 13.

It will be observed by reference to Fig. 2 that the tube is brought up to copper melting temperature through a zone substantially between points A and B, which zone is in proximity to the outlet end of the furnace, the curve in Fig. 2 substantially showing the temperature of the tube in the furnace. The zone, from points A to B represents a temperature above 1983° F., the melting point of copper.

When the copper coating is melted, it will be understood, of course, that the same fills in between the plies of the tube, and upon cooling the plies are copper-welded together. It will be appreciated that when the copper coating is melted the coating on exposed surfaces—either inside or outside of the tube or inside or outside of any other article—may flow or migrate, and may result in a spotty or uneven coating. Some parts may be more or less bare.

I have discovered that the depositing of carbon directly upon these exposed surfaces, or the decomposing or vaporizing of an organic substance on or around the tube, serves to hold the copper coating in position on such surfaces. There are a number of ways by which such carbon deposits may be applied to the tube. One way is to coat the tube with a substance prior to entrance into the heating zone, which substance decomposes into some of its various constituents or vaporizes by the heat to thus deposit or to leave upon the tube a film of carbon. One satisfactory substance is lacquer. Advantageously, in the case of lacquer, the same may be applied to the outside of the tube by running the same through a pot of lacquer, as illustrated at 14 (Fig. 3). In this case lengths of tubing may be made and the lacquer allowed to dry before the same is fed through the furnace, or as is illustrated in Fig. 1, the tubing may be fed directly into the furnace. Other substances may be used, such as for example mineral oil, or vegetable or animal fats combined with carbonaceous matter and having such consistency or viscosity as to adhere to the tube and form a fairly uniform coating or covering for the tube.

Where mineral oil, or other liquids such as vegetable oil or animal fats mixed with carbonaceous matter are utilized, the same may be applied to the tube just before the same enters the furnace, as illustrated in Fig. 1. Obviously, it is not essential that the tube-forming machine and the furnace be so associated that the tube passes directly from the forming machine into the furnace, although this arrangement may be advantageously employed.

A still further variation is illustrated in Fig. 5 where a carbon producing gas is fed into the muffle pipe in immediate proximity to the tube. There are a number of ways of obtaining such a gas. As shown in Fig. 5, ordinary illuminating gas may be fed through pipe 15 and bubbled through a tank 16 containing a fluid, some of which is evaporated or absorbed by the gas and carried out of the tank with the gas through a pipe 17, which may lead directly into the muffle pipe 11. The substance through which the gas is bubbled adds to the carbon producing tendency of the gas when it decomposes into some of its various constituents. For example, the gas may be bubbled through alcohol or a commercial grade of lacquer thinner that may contain chamel alcohol or other suitable substance. However, the illuminating gas may be charged directly into the muffle pipe without being bubbled through such a carbon producing liquid.

The reducing or non-oxidizing gas fed to the furnace through the piping 13 is preferably under a pressure exceeding somewhat atmospheric pressure, so that the gas may fill the muffle pipe. The same may escape at either end of the muffle pipe, although due to the movement of the tube most of this gas will probably escape at the outlet end. Accordingly, oxygen is excluded in the heating treatment.

As the tube moves through the furnace, the lacquer coating, or the mineral oil coating, or the substance such as vegetable oil or animal fat containing carbon producing matter, or the gas which is fed into the furnace through the pipe 17, depending upon the variation of the process used, decomposes into some of its various constituents, including carbon, and a film of carbon is deposited on the surfaces of the tube. The substance employed preferably is such that it decomposes into some of its various constituents to deposit carbon on the tube at a temperature below the melting temperature of copper. Accordingly, the decomposing zone may be anywhere from the point C, or thereabouts, on the curve (Fig. 2) to the point A.

This deposition of carbon upon the copper coated surfaces before the copper is melted or the decomposing of the organic substance performs the function of holding the copper coating in place after it has become molten. In other words, it prevents the copper coating, while in molten condition, from shifting, migrating or flowing, and thus maintains more perfect uniformity of the coating, obviates the necessity for great accuracy in the general procedure, and prevents the same from becoming spotty or collecting in pools and from leaving some spots bare of copper. I do not feel prepared at the present time to advance a definite theory as to why this peculiar and novel result takes place. One possible explanation is that the presence of the carbon film breaks down or minimizes the surface tension of the molten copper, so that the molten coating is held in position over all the surfaces of the tube. However, it may be possible that when an organic material is used which decomposes or vaporizes, the decomposition process or the products of the decomposition goes far towards producing these results, and that under these conditions the actual depositing of the carbon may be incidental. Whether lacquer, oil, or a mixture of oil and carbon producing matter, or gas is used, they all decompose and deposit carbon on the tube before the copper becomes molten. It appears, also that the carbon is most effective in its

nascent form, which, of course, is the result of the decomposing of any one of the substances, as the carbon is most active at such time and quickly and thoroughly deoxidizes the surfaces. Not alone does this preserve the exterior coating, but it likewise aids in the preservation of the interior coating, although it may be pointed out that most of the difficulty is in preserving the exterior coating. Where the process is used, the speed of the tube passing through the furnace may be increased, thus increasing production and making it possible to more cheaply produce the tube. In the above mentioned Bundy Patent No. 1,892,607 carbon monoxide is mentioned as a gas which may be used in the furnace to provide a non-oxidizing or reducing environment. Carbon monoxide gas thus used in the making of copper welded tube at the temperatures mentioned in the Bundy patent and in this application, will not decompose or break down into carbon and oxygen and will not result in a deposit of carbon on the surface of the tube.

I have found that good results may be obtained by applying carbon to the tube in manners other than the above mentioned variations where the substance decomposes and deposits carbon on the tube in the heating zone. For instance, carbon may be deposited directly upon the tube by carbon producing flame **20**, as illustrated in Fig. 6. Another manner resides in mixing a carbon, such as lampblack, with a carrier. Such a carrier may be varnish, shellac or the like, with which a suitable quantity of lampblack is mixed and which may be applied to the tube in the manner illustrated in Fig. 3. The varnish or shellac dries and then the tube is subjected to the heat treatment and the varnish or shellac decomposes and vaporizes and the lampblack deposits upon the tube. The carrier, such as the varnish or shellac, may in itself deposit some carbon when it decomposes, and in this event the lampblack provides the required additional carbon.

The finished tube, as it comes out of the furnace, has a fine layer of dust-like carbon over its surface, which may be readily brushed off the tube. The copper coating is clean, bright, smooth and uniform. In carrying out the method, the non-oxidizing or reducing gas which is supplied around the tube in the heating zone, speaking now of the gas in the piping **13**, may have varying reducing properties. Good results have been obtained with the use of hydrogen, which is highly reducing, although good results may be obtained by the use of a gas having lower reducing properties, as for example from a gas having a range of 2% to 31% reducing. Such a gas may be that generally known as electrolene or the like, which is cracked illuminating gas. Accordingly, the invention makes feasible the use of a cheaper or more readily available gas, which is fed into the furnace, having relatively low reducing properties, which serves to exclude oxygen but which preferably has some reducing characteristics.

As has been before mentioned, various means may be used to provide the heat to which the tube is subjected, and the muffle furnace herein shown is illustrative of one of such means. The furnace may be heated in any suitable manner, as by gas, electricity or the like.

In Fig. 8 an article is shown which may be in the nature of a container including a chamber **21** equipped with fittings **22** and **23**. A suitable quantity of copper may be deposited adjacent the joints where the fittings **22** and **23** are associated with the shell, and the same may be subjected to copper melting temperature in the presence of a non-oxidizing or reducing gas to copper-weld the joints. Where a copper coating is desired upon the shell the same may be coated, as for example by the electroplating process, or by a heat treatment, and then the surfaces of the shell may be coated with lacquer, oil, or a carbon carrying substance, such as varnish or shellac, or a deposit of carbon may be applied as by means of a gas flame, or a gas may be injected into the heating zone for decomposing and depositing carbon upon the shell to fix the copper coating.

In Fig. 9 an accumulator tank for a refrigerator is shown having a shell **25**, end pieces **26**, and equipped with various fittings **27**. Where a copper coating is desired either on the inside or outside of this tank, the same may be electroplated with copper and then treated by any one of the before-mentioned forms of the invention and subjected to copper melting temperature to unite the fittings to the shell and to unite the ends of the tank to the shell, and the copper coating fixed. These two articles, as shown in Figs. 8 and 9, are selected as being merely illustrative of assembled devices which may be made. Any suitable furnace structure may be employed for subjecting articles of this kind to the copper melting heat.

It may be pointed out that the use of a liquid such as oil, or a substance which may be applied in liquid form and later hardens into a solid, such as lacquer or carbon carrying vehicle, is particularly advantageous inasmuch as the liquid rather uniformly covers the surfaces, with the result that carbon deposits upon the surface in a substantially uniform manner. The use of a gas which decomposes and deposits carbon upon the surfaces produces uniform carbon deposits but appears to require a more delicate control than is the case with the use of liquids.

It may be pointed out that the carbon deposit has an effect upon the color of the copper coating. If an excess of carbon is deposited upon the copper surfaces, the finished copper coating tends to lack color and has a rather whitish appearance. However, the amount of the carbon deposit may be regulated or controlled, so that the finished copper coating has the desired copper color and at the same time is held from running, shifting or collecting into pools or globules while mounting.

While the invention attains its maximum advantages in the coating of exteriors, whether of tubing or other articles or shapes, it is likewise applicable to interiors of the various articles; and the procedure above described may be followed in treating such interiors, and the claims appended are to be so interpreted.

Where reference is made herein to overlapping parts of the tube, it is to be understood that I mean parts which abut or contact with each other, and the language is to be so construed. In the claims appended hereto, some have language to the effect that a step in the method is that of applying a deposit of carbon to the surfaces, and some have language to the effect that a substance decomposes and deposits a film of carbon upon the surfaces. These claims are to be construed to cover a process where these things or their equivalents take place and which process obtains the results of this invention, or substantially the results of this invention, or the equivalent thereof, all within the meaning of the patent law, even though a different scientific ex-

planation be found or be alleged. The use of the term "decomposes" is to be construed to cover a situation, as for example, where it is only necessary for a carrier to vaporize to leave carbon deposits. Furthermore while copper is referred to in the specification and claims as the coating and welding or brazing medium, it will be understood that the method of manufacture of such coated articles and coated and welded or brazed articles is not restricted to the use of pure copper, as pointed out in the Bundy Patent No. 1,892,607, referred to above.

I claim:

1. The method of affixing a copper coating to a ferrous metal object which comprises, subjecting a copper coated article to heat in a non-oxidizing atmosphere to melt the copper coating, and applying a deposit of carbon upon the copper surfaces to hold the copper in place on the ferrous metal in the form of a coating when the copper is molten, and then cooling the object with the copper coating intact.

2. The method of affixing a copper coating to a ferrous metal object which comprises, subjecting a copper coated object to heat in a non-oxidizing atmosphere to melt the copper coat, and applying a deposit of carbon upon the copper surfaces prior to the melting of the copper, whereby to hold the copper in place on the ferrous metal in the form of a coating when the copper is melted, and then cooling the object with the copper coating intact.

3. The method of affixing a copper coating to a ferrous metal object which comprises, electrodepositing a coating of copper upon the object, subjecting the copper coated object to heat in a non-oxidizing atmosphere to melt the copper coating, applying a deposit of carbon upon the copper surface whereby to hold the copper in place on the ferrous metal in the form of a substantially uniform coating when the copper is melted, and then cooling the object with the copper coating intact.

4. The method of affixing a copper coating to a ferrous metal object which comprises, electrodepositing a coating of copper upon the object, subjecting the copper coated object to heat in a non-oxidizing atmosphere to melt the copper coating, applying a deposit of carbon upon the copper surface prior to the melting of the copper whereby to hold the copper in place on the ferrous metal in the form of a substantially uniform coating when the copper is melted, and then cooling the object with the copper coating intact.

5. The method of affixing a copper coating to a ferrous metal object which comprises, coating the object with copper, covering the coated object with a fluid substance which will decompose into some of its various constituents at a heat lower than that of copper melting temperature, subjecting the thus prepared object to copper melting temperature in the presence of a non-oxidizing atmosphere whereby the substance decomposes and deposits a film of carbon upon the copper surfaces to hold the copper in place on the ferrous object in the form of a substantially uniform coating when the copper is molten, and then cooling the object with the copper coating intact.

6. The method of affixing a copper coating to a ferrous metal object which comprises, coating the object with copper, covering the coated object with a mineral oil which will decompose into some of its various constituents at a heat lower than that of copper melting temperature, subjecting the thus prepared object to copper melting temperature in the presence of a non-oxidizing atmosphere whereby the mineral oil decomposes and deposits a film of carbon upon the copper surfaces to hold the copper in place on the ferrous object in the form of a substantially uniform coating when the copper is molten, and then cooling the object with the copper coating intact.

7. The method of affixing a copper coating to a ferrous metal object which comprises coating the object with copper, covering the coated object with lacquer which will decompose into some of its various constituents at a heat lower than that of copper melting temperature, subjecting the thus prepared object to copper melting temperature in the presence of a non-oxidizing atmosphere whereby the lacquer decomposes and deposits a film of carbon upon the copper surfaces to hold the copper in place on the ferrous object in the form of a substantially uniform coating when the copper is molten, and then cooling the object with the copper coating intact.

8. The method of affixing a copper coating to a ferrous metal object which comprises applying a copper coating to the object, subjecting the object to heat in a non-oxidizing atmosphere to melt the copper, and introducing a gas directly around the object while the same is being subjected to heat in the non-oxidizing atmosphere whereby the gas decomposes into some of its various constituents and deposits a film of carbon upon the copper surfaces to hold the copper in place and prevent flowing thereof when molten, and then cooling the object with the coating intact.

9. The method of affixing a copper coating to a ferrous metal object which comprises, coating the object with copper, depositing a film of carbon upon the copper surfaces, subjecting the object to copper melting temperature in a non-oxidizing atmosphere, the carbon film serving to hold the copper coating in place in the form of a substantially uniform coating while the copper is molten, and then cooling the object with the copper coating intact.

10. The method of affixing a copper coating to a ferrous metal object which comprises, coating the object with copper, applying a carbon-carrying vehicle to the surfaces and allowing the same to dry, subjecting the object to copper melting temperature in a non-oxidizing atmosphere, whereby the vehicle decomposes and leaves the carbon deposited upon the copper surfaces to hold the copper on the ferrous metal in the form of a substantially uniform coating while the copper is molten, and then cooling the object with the copper coating intact.

11. The method of making tubing fabricated from copper coated ferrous stock with over-lapping parts which comprises, subjecting the tubing to heat in a non-oxidizing atmosphere to melt the copper, applying a film of carbon to the exposed copper coated surfaces to hold the copper coating in place upon the ferrous metal while molten, and then cooling the tube to copper weld over-lapping parts together and with the exposed coating intact.

12. The method of making tubing from copper coated strip ferrous stock fashioned in tubular form with over-lapping parts which comprises, applying a coating of substance while in fluid form over the exposed surfaces of the tubing, such

substance being such as to decompose into some of its various constituents at a temperature below the melting point of copper, subjecting the tube to copper melting temperature in a non-oxidizing atmosphere whereby the substance decomposes and leaves a film of carbon over the surfaces of the tube to hold the exposed copper coating in place on the ferrous metal while molten and then cooling the tube to solidify the copper to copper weld the over-lapping parts together and with the exposed copper coating intact.

13. The method of making tubing from copper coated strip ferrous stock fashioned into hollow cross-sectional form with over-lapping parts which comprises, applying a film of oil over the exposed surfaces of the tube, subjecting the tube to copper melting temperature in a non-oxidizing atmosphere whereby the oil decomposes into some of its various constituents and leaves a deposit of carbon upon the exposed surfaces of the tube to hold the copper of the coating in place upon the ferrous metal while molten, and then cooling the tube to copper weld the over-lapping parts together and with the copper coating on the exposed surfaces intact.

14. The method of making tubing from copper coated strip ferrous stock fashioned in a hollow cross-sectional form with over-lapping parts which comprises, applying a coating of lacquer over the surfaces of the tube, subjecting the tube to copper melting temperature in a non-oxidizing atmosphere whereby the lacquer decomposes into some of its various constituents and leaves a deposit of carbon upon said exposed surfaces to hold the copper coating in place on the ferrous metal when molten, and then cooling the tube to copper-weld the over-lapping parts together and with the coating on the exposed surfaces intact.

15. The method of making tubing from copper coated ferrous strip stock fashioned in a hollow cross-sectional form with over-lapping parts which comprises, subjecting the tube to copper melting temperature in a non-oxidizing atmosphere, introducing a gas immediately around the tube which decomposes into some of its various constituents and leaves a deposit of carbon upon the exposed copper surfaces to hold the copper in place upon the ferrous metal while molten and then cooling the tube to copper-weld the over-lapping parts together and with the copper coating on the exposed surfaces intact.

16. The method of making tubing from copper coated ferrous strip stock fashioned in a hollow cross-sectional form with over-lapping parts which comprises, depositing a film of carbon upon the exposed copper surfaces, subjecting the tube to copper melting temperature in a non-oxidizing atmosphere whereby the carbon film holds the copper on the exposed surfaces in place upon the ferrous metal while molten, and then cooling the tube to copper-weld the over-lapping parts together and with the coating intact.

17. The method of making tubing from copper coated ferrous strip stock fashioned in a hollow cross-sectional form with over-lapping parts which comprises, applying a carbon-carrying vehicle over the exposed surfaces of the tube, subjecting the tube to copper melting temperature in a non-oxidizing atmosphere whereby the vehicle decomposes and leaves a film of carbon upon said exposed surfaces with said carbon serving to hold the copper on said exposed surfaces in place while molten, and then cooling the tube to copper-weld the over-lapping parts together and with the copper coating on the exposed surfaces intact.

18. The method of making tubing from copper coated strip ferrous stock fashioned in a hollow cross-sectional form with over-lapping parts which comprises, subjecting the same to copper melting temperature in a non-oxidizing atmosphere and introducing in the immediate proximity of the tube while being heated a substance which decomposes into some of its various constituents due to the heat and deposits a film of carbon upon the exposed surfaces of the tube to thus hold the copper coating in place upon the ferrous metal while molten and then cooling the tube to copper-weld the over-lapping parts together and with the coating on the exposed surfaces intact.

19. The method of affixing a copper coating to a ferrous metal object which comprises, subjecting a copper coated article to heat to melt the copper, bringing an organic substance into proximity to the object and there decomposing said substance whereby the copper is held in place on the ferrous metal in the form of a coating when the copper is molten, and then cooling the object with the copper coating intact.

20. The method of affixing a copper coating to a ferrous metal object which comprises, subjecting a copper coated article to heat in a non-oxidizing atmosphere to melt the copper coating, bringing an organic material into proximity to the article while the article is in the process of heating and there decomposing said material whereby the copper is held in place on the ferrous metal in the form of a coating when the copper is molten, and then cooling the object with the copper coating intact.

21. The method of affixing a copper coating to a ferrous metal object which comprises, applying a covering of oil to the surfaces of a copper coated object, subjecting the object to copper melting temperature, at or below which temperature the oil decomposes, whereby the copper is held in place on the ferrous object in the form of a coating when the copper is molten, and then cooling the object with the copper coating intact.

22. The method of affixing a copper coating to a ferrous metal object which comprises, applying a covering of oil on the surfaces of a copper coated article, subjecting the object to copper melting temperature in the presence of a non-oxidizing atmosphere, at or below which temperature the oil decomposes in proximity to the object whereby the copper is held in place on the ferrous object in the form of a coating when the copper is molten, and then cooling the object with the copper coating intact.

23. The method of making tubing fabricated from copper coated ferrous stock which comprises, subjecting the tubing to heat to melt the copper, bringing an organic material into proximity to the tubing during the heating thereof and there decomposing said material whereby the copper coating is held in place as a coating on the ferrous metal while the copper is molten, and then cooling the tube to unite adjacent parts of the stock together with a copper joint and with the coating intact.

24. The method of making tubing from copper coated strip ferrous stock fashioned into hollow cross sectional form which comprises, applying a covering of organic substance when in liquid form over the surfaces of the tube, subjecting the tube to heat in a non-oxidizing environment to melt the copper and to decompose the organic

substance whereby the copper is held in place on the ferrous metal in the form of a coating while molten, and then cooling the tube to unite adjacent parts of the ferrous stock together with a copper joint and with the copper coating on the surfaces intact.

25. The method of making tubing from copper coated strip ferrous stock fashioned into hollow cross sectional form which comprises, applying a covering of oil over the surfaces of the tube, subjecting the tube to heat in a non-oxidizing environment to melt the copper and to decompose the oil whereby the copper is held in place on the ferrous metal in the form of a coating while molten, and then cooling the tubing to unite adjacent parts of the ferrous stock together with a copper joint and with the copper coating on the surfaces intact.

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