

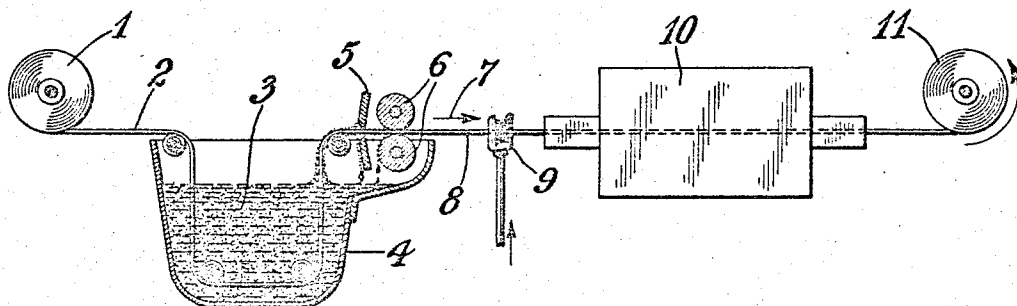
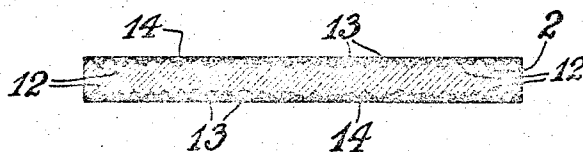
Oct. 1, 1935.

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2,016,139

COATING IRON WITH CARBON

Filed Aug. 16, 1933

Fig. 1.Fig. 2.INVENTOR  
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## UNITED STATES PATENT OFFICE

2,016,139

## COATING IRON WITH CARBON

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Application August 16, 1933, Serial No. 685,351

4 Claims. (Cl. 148—19)

My invention relates to a method and means for carbonizing metals, and more particularly to carbonizing iron to make a product particularly suitable for use in the manufacture of radio tube parts.

In the radio tube art carbonized grid and plate electrodes have many advantages. For example, a carbonized electrode radiates heat more efficiently and therefore operates at a substantially lower temperature than a clean metal electrode for the same wattage input, and its secondary electron emission is much lower, as a carbonized electrode is inherently a poor emitter of electrons.

In one method of carbonizing metals, such as nickel, for use in electron discharge tubes the metal parts are heated for one or two hours to approximately 900° C. in an atmosphere of a carbon bearing gas free from air, whereby the metal parts are carbonized, probably by some reaction between the metal and the carbon vapors. This method of carbonizing is more satisfactory for nickel than for iron as iron when carbonized by this method becomes brittle and the carbon coating on the iron may not be black as it should be for best results and may blister and peel off.

One object of my invention is to provide an improved method and means for carbonizing iron and similar metals.

Another object of my invention is to provide a mixture of carbonaceous compounds particularly suitable for use in carbonizing metals.

In accordance with my invention the surface of the metal is carbonized by finely divided carbon kept in intimate contact with the metal while the metal is maintained at a temperature above 350° C. and below the formation temperature of carbides of the metal. A convenient way of keeping the carbon in contact with the metal is to prepare a paste of finely divided carbon mixed with one or more oleaginous binders which upon heating to decomposition yield carbon as an end product, applying a coat of the mixture to the metal, and heating the coated metal in a reducing or inert atmosphere to decompose these binders into their elements, thus expelling the volatile constituents and leaving pure residual carbon. In this way there is formed on the metal a uniform coating of pure carbon which is more adherent than the carbon coating produced by the usual methods of the prior art. Previous to the application of the carbon, the metal may to advantage have its surface roughened, for example, by etching until the surface is

rough, or by sand blasting or steel blasting. The carbon mixture adheres better to the roughened surface thus produced than to a smooth surface.

While various oleaginous binders may be used, one mixture which has been found to be particularly useful consists of finely divided carbon, palmitic acid, and lard oil. When these constituents are thoroughly mixed into a paste and applied to the roughened surface of a metal such as iron and the metal heated sufficiently a very fine closely adhering uniform coat of exceedingly black carbon is produced. Other oleaginous compounds which may be used instead of the palmitic acid are oleic acid and stearic acid. These compounds are sufficiently unctuous to wet the carbon and the metal, and decompose below visible red heat and below the formation temperature of the carbide of the metal being used. These oleaginous compounds may be mixed directly with the lamp black to form a paste or they may be dissolved in a suitable solvent such as alcohol, benzene, acetone or chloroform and the resulting solution mixed with lamp black or carbon black to form a paint. This paint may be applied to the metal by means of spraying with a gun or by painting it on with a brush.

The invention will now be explained more in detail with reference to the accompanying drawing in which,

Figure 1 is a diagrammatic representation of one way of practicing the process and

Figure 2 is a cross-section of a strip of the coated metal before carbonization.

Referring now to Figure 1 of the drawing a supply roll 1 furnishes a strip of uncoated metal 2 which has previously had its surface roughened either by sand blasting, steel blasting, or by etching. The strip of uncoated metal is unwound from the roll 1 and moves in the direction of the arrow 7 passing through a paste-like carbonaceous mixture 3, such as is described above, held in the container 4. The mixture 3 sticks to and coats the metal, the excess being scraped off by the knife edges 5 and rollers 6 between which the metal strip 2 passes after it has been through the container 4. The coated metal strip 8, with a thin coating, preferably only a few mils in thickness, of the carbon mixture, passes through a small gas flame 9, and then through the furnace 10 which is preferably maintained at a temperature which maintains the metal strip slight below visible red heat and at a temperature between 300° C. and 650° C. An indifferent atmosphere, of hydrogen or of some inert gas such as

nitrogen or forming gas, is maintained in the furnace. The coated metal strip 8 is fed through the furnace at a rate such that complete decomposition of the palmitic acid and lard oil in the carbonaceous coating occurs in the furnace. The speed, of course, depends upon the temperature and length of the furnace. For example, the metal may be fed at the rate of one to two inches per second through a furnace approximately twenty-four inches in length and heated to 600° C. which is below visible red heat and above the decomposition temperature of the oleaginous binder. After the coated metal strip passes through the furnace it is wound upon the take-up roll 11. The carbon coating left upon the metal strip which is wound on the roll 11 is hard and dry since the palmitic acid and lard oil have been decomposed in the furnace 10. The residual carbon of the palmitic acid and lard oil, which remains after the decomposition of these materials, and the lamp black form the carbon coating on the metal strip. In this specification, and in the claims I mean by decomposition a resolution of the oleaginous compounds into their elements; for example, the hydrocarbons are decomposed into hydrogen which is expelled, and carbon which remains on the metal.

In one modification of my process a strip of iron after being etched or sand blasted and before being coated with the carbon mixture is oxidized to a dark oxide. This may be done by passing the strip 2 directly through the furnace 10 heated to approximately 650° C. and containing air. In this way the strip may be oxidized sufficiently in 30 to 60 seconds time. The palmitic acid, instead of being used as paste, may be dissolved in some suitable solvent, and then mixed with the lamp black, the resultant mixture being either sprayed on the metal with a spray gun or painted on with a brush. When the carbon is applied in this manner the coated strip is allowed to dry in air sufficiently to evaporate the solvent in the coating. After the coating is dry the strip is passed through the furnace 10, which is now heated to approximately 100° C., to cause the coating to flow evenly over the surface of the metal strip. The evenly coated strip is again passed through the furnace, which now has an inert atmosphere and is heated to about 600° C. to 650° C., whereby the carbonaceous compounds are decomposed and the iron carbonized.

Figure 2 is a cross-section of the metal strip after being coated and before being carbonized. The roughened surface produced by etching or sand blasting is illustrated by the numerous indentations 12 which as shown have been filled in with the carbon mixture 13 so that there is a smooth carbon coating 14 on the surface of the metal.

While a number of carbonaceous compounds may be used and the proportions of the different constituents varied over wide ranges the following materials and proportions have been found to make a particularly satisfactory coating mixture:

|                           | Gms. |
|---------------------------|------|
| Carbon (lamp black) ..... | 88   |
| Palmitic acid .....       | 215  |
| Lard oil .....            | 120  |

The lard oil, which is principally oleic acid, acts mainly to wet the lamp black so that it will

mix easily with the palmitic acid to form a paste.

It has been found that my carbonizing method is adaptable to various metals, such as iron, copper, nickel and tungsten.

The carbon coating produced by this invention is exceptionally black and uniform, does not blister or peel, but adheres firmly to the metal surface and therefore may be handled easily, and will withstand, in vacuum, temperatures up to those at which the carbide of the metal begins to form. Since my process is carried out at temperatures slightly below visible red heat and below the formation temperature of the carbide of the metal being treated, the deleterious effects of metal carbides are avoided, as carbides are not present in the finished product.

While a number of specific embodiments have been described, this invention admits of various changes and modifications the scope of which is limited only by the appended claims.

What is claimed as new is,—

1. The process of carbonizing a metal comprising roughening the surface of the metal, applying to said roughened surface an adhesive coating comprising finely divided free carbon and an oleaginous binder which wets said carbon and said metal and decomposes into gas and a residue of pure carbon above room temperature and below visible red heat of the metal, and heating said coated metal to decompose said binder and vaporize its volatile constituents whereby a black uniform adherent layer containing the residual carbon of said binder is deposited on the metal.

2. A continuous process of carbonizing metal comprising sand blasting a long strip of metal to produce on it a roughened surface, passing said roughened metal strip through a suspension of carbon in an oleaginous binder decomposable by heat at temperatures slightly below visible red heat of said metal to form a carbon containing coating on the roughened surface of said metal, removing the excess coating from said strip, and heating said coated metal strip in an indifferent atmosphere to slightly below visible red heat of said metal strip to decompose said oleaginous binder and leave a black adherent uniform layer of carbon deposited on said strip.

3. The process of producing on a metal body a uniform adherent coating of carbon which comprises producing on said body a roughened surface of clean metal, coating the clean roughened metal with a mixture of finely divided carbon and an unctuous oleaginous binder which wets said metal and said carbon and which is completely decomposable by heat at a temperature slightly below visible redness of said metal, and heating the coated metal to a temperature above 300° C. and below visible red heat to decompose said binder completely and leave an adherent uniform layer of carbon on said metal.

4. The process of carbonizing a metal of the iron class which comprises etching the surface of the metal, coating the etched metal surface with an adhesive carbonaceous compound consisting of a pasty mixture of finely divided carbon and a binder of palmitic acid and lard oil, and heating the coated metal to within a temperature range of 300° C. to 675° C. to decompose completely said binder and leave an adherent coating of carbon on said metal.

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