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G. SEIBT

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COATING APPARATUS

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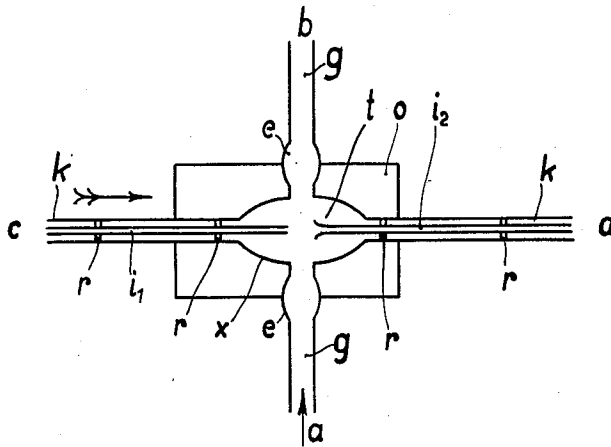


Fig. 1

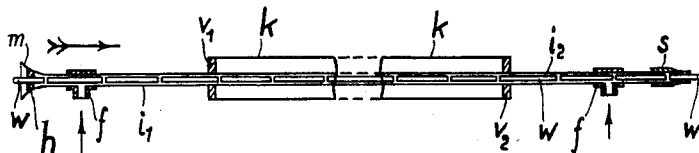


Fig. 2

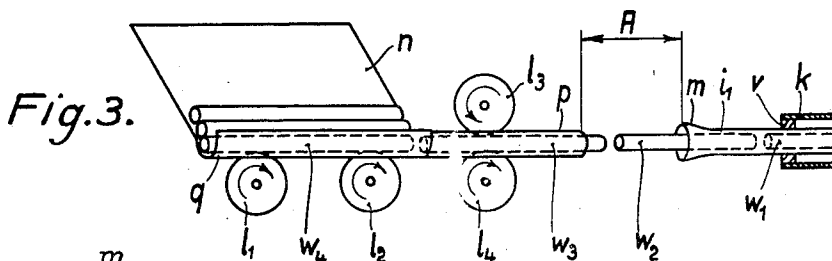


Fig. 3.

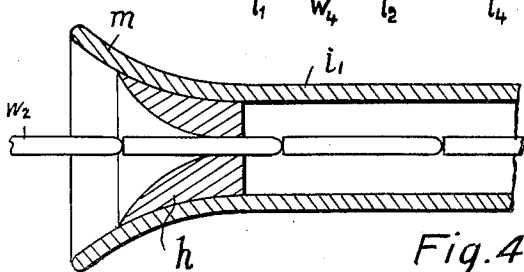


Fig. 4.

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COATING APPARATUS

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It is known that in a vessel which is heated to about 900° and which is traversed by a neutral gas to which carbon has been added, carbon with metallic lustre is deposited on the walls of the vessel or on bodies contained therein, for instance, pieces of porcelain. A suitable neutral gas is, for instance, nitrogen or carbonic acid. The collection of carbon may be effected by passing the gas, before it enters the vessel, through a bottle filled with benzine (a so-called washing bottle). It has also been proposed to use this method for the manufacture of so-called high ohmic resistances. For this purpose porcelain bars are introduced into the heated chamber on which bars there is deposited a fine layer of carbon with metallic lustre. Owing to the great hardness of the carbon with metallic lustre, of its comparatively high resistance, of its practical independence of temperature, and of the fineness of the layer to be obtained, this kind of manufacture of resistances is especially advantageous.

Although the principle is known per se, there has been no investigation of the working conditions required for the most economical manufacture of such high ohmic resistances. The simplest form of carrying out the principle in practice is as follows:—

A furnace which is lined with a ceramic material and which is closed in an airtight manner is filled with small bars of porcelain, being then closed up against the penetration of the outer air and heated to about 900° C. Thereupon the current of gas which has been enriched with carbon is passed through the furnace for a certain period of time which is best determined by experiment. Thereupon the furnace has to be cooled down slowly, until a temperature of about 100° C. is reached, when the porcelain bars are taken out. We thus have an intermittent operation, during which the furnace must necessarily be continuously heated and allowed again to cool down. If the furnace were opened too early before it cooled down, fresh air would reach the bars and the deposit formed thereon would immediately be lost by oxidation. A further fact to be borne in mind is that the deposition shall take place at the temperature at which carbon with a metallic lustre is actually deposited, since, at a lower temperature, such as 400°, it is not carbon with a metallic lustre that is deposited on the surface of the porcelain bars, but soot. This soot, however, does not possess the good property of the carbon with metallic lustre, since it can be easily wiped away by hand so that it is useless for the manufacture of high ohmic re-

sistances. Moreover, there is also the drawback that when the bars are placed on one another in the furnace, for instance on a grate or the like, the portions lying on the grate remain uncoated and that eddies or the like may be produced in the current of gas, thereby causing a non-uniform deposition of carbon with metallic lustre on the porcelain bars.

The invention relates to an apparatus and method by which the disadvantages above referred to are avoided, and which allow the manufacture of high ohmic resistances to be carried out in continuous operation with the greatest precision and uniformity. The porcelain bars are introduced continuously, one after the other, into the reaction chamber and continuously removed therefrom, after the deposition. At the same time the current of gas is also continuously passed through the reaction chamber and brought there in contact with the bodies to be coated. Care has to be taken that soot shall not be deposited anywhere and further that the deposition of carbon with the metallic lustre shall take place perfectly uniformly on the whole surface of the porcelain bars.

The accompanying drawing illustrates diagrammatically and by way of example the most essential parts of the invention in which

Figure 1 is a diagrammatic showing of the reaction vessel as a whole, two crossed tubes being employed;

Fig. 2 is a longitudinal section of the two outer ends only of the conveyor tubes with their sealing means and the supply apertures for neutral gas, the middle portion with the heating chamber being left out.

In Figure 1 *g* and *k* are two quartz tubes crossing one another, the tubes being enlarged spherically or ellipsoidally at the crossing point. The current of gas is introduced at *a* into the chamber *x*, in the direction of the arrow and is let out at *b*, the gas having previously been caused to pass through a so-called washing bottle, filled approximately one-third to one-half with benzine, in order to enrich the nitrogen or oxygen with carbon. Two narrower tubes *i*₁ and *i*₂, preferably also made of quartz are provided in the tubes *k*, wherein they are kept in a central position by rings *r*. The small porcelain bars *W*₁, *W*₂, *W*₃, *W*₄ are caused to pass through the tubes *i*₁, *i*₂ from *c* to *d* in the direction of the feathered arrow. The deposition of the carbon with metallic lustre takes place in the reaction space *x* where the tubes *g* and *k* meet and where they are enlarged ellipsoidally. It will be seen that the tubes *i*₁ and *i*₂ do not

abut against one another with their ends in the ellipsoidal chamber, a distance of about 10 cm. being left free at that place. Now when the porcelain bars pass this point, they are surrounded by the current of gas, and carbon with a metallic lustre is deposited on them in a perfectly uniform manner.

In order that the bars which are caused to pass through the inner tube i_1 shall be moved on merely by the feeding pressure and reach the right hand tube i_2 , the end of the tube i_2 projecting into the reaction chamber is slightly widened in a funnel-like manner, as is shown at t . The length of the interruption between i_1 and i_2 in the reaction chamber x must not be greater than the length of a single bar, preferably 10 cm., as compared with about 15 cm., the length of the porcelain bars which have to be coated. As the latter lengths would be too great in practice, the bars are subdivided by means of grooves into separate sections, each about 3 cm. long, corresponding to the length of the resistance to be used in practice. On the other hand the length of the interruption between i_1 and i_2 is preferably made greater than the length of such an individual section in order to ensure that each one of these sections, that is to say, each one of the final resistances, will be impinged upon at the same time, and consequently uniformly, by the reaction gas. It is further to be pointed out that the tube g which conveys the gas is provided with enlargements e , at the points where it enters into the furnace o , with the object of preventing the soot which is formed there (at this point the temperature in the gas tube g is about 400°) from choking this tube. The enlargements e are of such dimensions that during one period of operation, for instance, a whole working day, the soot which is formed cannot cause the tube g to be choked. Further, care has to be taken that that part of the tube k which contains the uncoated bars shall be surrounded by the furnace o over a longer distance than the part of the tube k through which the bars which have already been coated are led away. This too is for the purpose of preventing any detrimental formation of soot during the heating of the bars to the reaction temperature.

The whole of the arrangement is made as airtight as possible as regards the individual gas conveying parts with respect to the outer atmosphere. In Figure 2 these parts have been shown separately; of the conveying tube k , only the two outer parts have been shown, whilst the central part which contains the reaction chamber has been left out. The tube k is carefully made airtight at its two ends with respect to the inner tubes i_1 and i_2 , by means of seals v_1 and v_2 , which may, for instance, consist of cemented discs. Especially difficult is the closing up of the inner conveying tubes i_1 and i_2 against the outer atmosphere, so that the feeding of the resistance bars from the outside shall in no way be affected. This problem is best solved by providing at the funnel-shaped inlet end m of the tube i_1 , that is to say there where the bars to be coated are introduced by means of the mechanical feed, a rubber ring h which is also preferably funnel-shaped prevents as much as possible the dragging along of air. At the other end of i_2 , where the completely coated bars come out, there is preferably provided a short piece of rubber tubing s which surrounds as tightly as possible at its outer end the bars which pass through. The bars which are fed through have been indicated by the reference letter w . It is

also to be pointed out that the tubes i_1 , i_2 project considerably at both sides over the ends of the tube k , so as to enable a gradual heating as well as a gradual and complete cooling of the bars to be coated, to take place. If the bars came in contact with the outer air whilst in a heated condition the deposited layers of carbon or the like would in most cases immediately oxidize.

As already pointed out it is also necessary to take care that no soot will be deposited on the bodies to be coated. In order to avoid this, care must be taken that at the points at which the porcelain bars or the like reach a temperature of about 400° C. there is no gas which has already been enriched with carbon. For this purpose, a neutral gas which does not contain carbon is introduced into the tubes i_1 , i_2 , by means of short pipes f , f (see Figure 2). This neutral gas, which is free of carbon, flows partly into the reaction chamber and partly into the outer atmosphere and effects that the porcelain bars while passing through the tubes i_1 , i_2 nowhere come into contact with gas containing carbon. If these precautions were not taken, soot would be deposited in the tubes i_1 and i_2 , namely, at those points where a temperature suitable for such soot deposition, for instance, 400° C., occurs in these tubes. It is advisable to control the pressure in the tubes i_1 and i_2 of the gas containing carbon by means of a manometer, for instance, an oil manometer which is provided outside.

Figure 3 illustrates the essential parts of the automatic feeding apparatus of the supports to be coated, more particularly of the small bars of porcelain. It consists of an inclined surface n on which the bars to be coated are arranged next to one another, a larger container (not shown) being preferably provided in which the bars are placed parallel to one another and from which a new bar passes on to the surface n as soon as a bar has been moved away from the front part of the apparatus. The removal is effected by the frontmost bar, which lies in a trough q closing the surface n , being pushed to the right by one or more conveying rollers l_1 , l_2 , the upper part of which projects through corresponding slots in the lower part of the trough q . After the said bar has been moved forward over a distance of a few centimetres, it is gripped by conveying rollers l_3 , l_4 which grip it, preferably from above and below, and which take over the actual feeding of this resistance and of all those which lie in front of it. The row of bars w_1 , w_2 , w_3 , w_4 , then reach into the conveying tube i_1 which, as shown more in detail in Figures 1 and 2, is continued by the tube k . The conveying rollers l_3 , l_4 engage in slots provided in a tube p which thus acts as the first guide of the bars. Between the end of the tube p and the left end of the inner conveying tube i_1 a distance A is left free which is about 30 to 50% smaller than the length of an individual bar, and which is provided for the purpose of allowing bars which have been broken in the preceding part of the feeding or for other reasons, to be automatically removed, the bars simply dropping in the free place A , since they no longer have the required lengths for bridging over this distance. This prevents the broken bars from reaching through the conveying tube i_1 to the reaction chamber x and dropping out there, which would constitute a very great danger, since the quartz walls of the reaction chamber x or one of the tubes connected thereto might become damaged. In order to ensure that the bars which have passed through the free space A will easily be

introduced into the tube i_1 , the latter is enlarged at its left-hand end m , in a funnel-like manner and to which is attached the similarly shaped rubber ring h .

The automatic working of the arrangement is completed by a striking device (not shown) which is provided, preferably at the outer end of the conveying tube i_2 , and which strikes against, and removes, each bar section which comes out, that is to say, the portion lying between each two grooves of each complete bar, the striking operation being made dependent upon the moving speed of the bars. The resistances now having their proper length, viz., of about 3 cm., drop in a container which is provided underneath.

The thickness, and if desired, also the hardness of the carbon layer is best regulated by a suitable adjustment of the feeding speed. A further possible regulation may be obtained by suitably adjusting the dimensions of the current of gas passing through the tube g and its composition.

It is to be understood that the individual parts of the arrangement illustrated in the drawing may be modified in various respects.

The apparatus described may be used also for the manufacture of layers other than carbon and for the manufacture of articles other than resistances.

What I claim is:

1. An apparatus for coating bodies with a layer of hard carbon, which comprises a body conveying device and means surrounding the same and sealed from the atmosphere, other means for conducting carbonaceous gas intercepting said device and said first means, whereby said bodies will be exposed to said carbonaceous gas, means for heating the juncture of said device and said second named means, whereby a layer of hard carbon will be formed on said bodies as they are conveyed by said conveying device, said conveying device serving as a container for inert gas in order to prevent soot from forming on said bodies.

2. An apparatus for coating bodies in the form of short bars with a layer of hard carbon, which comprises a body conveying device and a reaction chamber surrounding the same and sealed from the atmosphere, means for conducting carbonaceous gas intercepting said device and said reaction chamber, whereby said bodies will be exposed to said carbonaceous gas in said reaction chamber, a furnace for heating said reaction chamber in order to form a layer of hard carbon on said bodies as they are conveyed by said conveying device, said conveying device serving as a container for inert gas in order to prevent soot from forming on said bodies.

3. In an apparatus as described in claim 2, said conveying device including a tubular member providing a path for said bodies across said reaction chamber, said tubular member being interrupted within said chamber in order to expose said bodies to the carbonaceous gas, the interruption being less than the length of one of said bodies.

4. An apparatus for continuous coating of rod-like individual bodies with a layer of hard carbon, by passing over these bodies a hydrocarbon from which carbon is separated out by heating, said apparatus comprising a tube through which the hydrocarbon gas is adapted to be conducted and a second tube, through which said bodies are adapted to be conducted, passing through said first tube and being interrupted at one point for bringing said bodies in contact with said

gas, an automatic feeding device at one end of said second tube conveying said bodies through this tube in a continuous sequence, an oven surrounding said first tube at the point of interruption of the second tube, said oven producing at the said point of interruption the temperature required for depositing the carbon on said bodies.

5. An apparatus for continuous coating of rod-like individual bodies with a layer of hard carbon, by passing over these bodies a hydrocarbon from which carbon is separated out by heating, said apparatus comprising a tube through which the hydrocarbon gas is adapted to be conducted and a second tube, through which said bodies are adapted to be conducted, passing through said first tube and being interrupted at one point for bringing said bodies in contact with said gas, the axis of the second tube being in the same plane as the axis of said first tube, an automatic feeding device at one end of said second tube conveying said bodies through this tube in a continuous sequence, an oven surrounding said first tube at the point of interruption of the second tube, said oven producing at the said point of interruption the temperature required for depositing the carbon on said bodies.

6. An apparatus for continuous coating of rod-like individual bodies with a layer of hard carbon, by passing over these bodies a hydrocarbon from which carbon is separated out by heating, said apparatus comprising a tube through which the hydrocarbon gas is adapted to be conducted, and a second tube through which said bodies are adapted to be conducted passing through said first tube and being interrupted at one point for bringing said bodies in contact with said gas, the axis of the second tube being in the same plane and at substantially right angles to the axis of said first tube, an automatic feeding device at one end of said second tube conveying said bodies through this tube in a continuous sequence, an oven surrounding said first tube at the point of interruption of the second tube, said oven producing at the said point of interruption the temperature required for depositing the carbon on said bodies, the portion of said inner tube beyond the interruption having a funnel-like enlargement.

7. An apparatus according to claim 4, in which said first tube has an enlargement surrounding said interrupting space and forming a reaction chamber in which the decomposing of the carbon layer takes place.

8. An apparatus according to claim 4, in which the part of the tube which is surrounded by the oven and which contains the bodies not yet coated is longer than the part of the tube which is surrounded by the oven and through which the completely coated bodies are moved away.

9. An apparatus according to claim 4, in which said gas conducting tube has enlargements at the points of its entry into said heating oven.

10. An apparatus according to claim 4, in which said second tube conveying said bodies has two apertures, each near one of its ends, through which a current of an inert gas is introduced in order to prevent soot from forming on said bodies.

11. An apparatus according to claim 4, in which said space interrupting said second tube is shorter than the length of an individual body.

12. An apparatus according to claim 4, in which a distance is left free between the outlet opening of said feeding device and the inlet opening of said second tube, the length of said distance being

slightly less than the length of one of said individual bodies.

13. An apparatus according to claim 4, in which said tubes are made of quartz.

- 5 14. An apparatus for continuous coating of rod-like individual bodies with a layer of hard carbon, by passing over these bodies a hydrocarbon from which carbon is separated out by heating, each rod-like body being subdivided by
10 annular grooves into a plurality of sections intended to form resistance bars of equal length when finally separated, said apparatus comprising a tube through which the hydrocarbon gas is adapted to be conducted and a second tube,

through which said bodies are adapted to be conducted, passing through said first tube and being interrupted at one point for bringing said bodies in contact with said gas, an automatic feeding device at one end of said second tube conveying said bodies through this tube in a continuous sequence, an oven surrounding said first tube at the point of interruption of the second tube, the length of said interruption being less than the length of said resistance bars, said oven producing at the said point of interruption the temperature required for depositing the carbon on said bodies. 5 10

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