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G. SEIBT

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APPARATUS FOR PRODUCING HIGH OHMIC RESISTANCES OR THE LIKE

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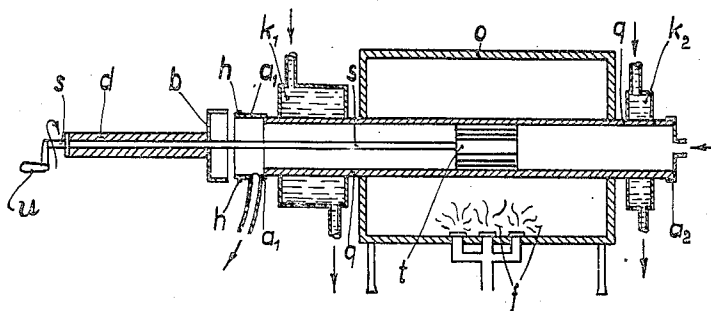


Fig. 1

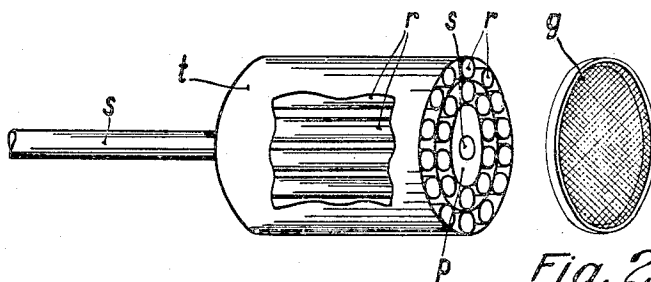


Fig. 2

Fig. 2.^a

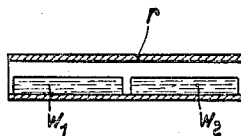


Fig. 3

Georg Seibt
By
Marks & Clem
Attorneys

UNITED STATES PATENT OFFICE

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APPARATUS FOR PRODUCING HIGH OHMIC RESISTANCES OR THE LIKE

Georg Seibt, Berlin-Schöneberg, Germany

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4 Claims. (Cl. 91—18)

This invention relates to an apparatus for and to a method of producing high ohmic resistances, which consists of a support of insulating material on which a thin conducting layer is deposited.

The object of the invention is to provide an improvement in the known method in which the resistance bars to be coated are subjected under heat to a current of gas containing carbon, which current of gas is diluted by a gas which does not take part in the process of production. The advantages of the method according to the present invention consist in the first instance in this that perfectly uniform conducting coatings are obtained, that these coatings are not affected by oxidation or the like after they have been applied, and that it is possible easily to regulate the resistance of the said coatings within certain limits by a corresponding regulation in the current of gas. Moreover, the new apparatus makes it possible to manufacture the high ohmic resistances advantageously on a large scale by which the cost of production is substantially reduced.

The invention will now be more particularly described with reference to the accompanying drawing, which illustrates, by way of example, one form of construction.

Figure 1 is a diagrammatic view, partly in section and partly in elevation, of the general arrangement.

Figure 2 is a perspective view of the heating drum partly in section and showing the supporting tubes for the resistances.

Figure 2—*a* is a perspective view of a grid to close the end of the heating drum.

Figure 3 is a cross-section of one of the supporting tubes in the heating drum, and showing two resistances positioned therein.

The apparatus shown in Figure 1 mainly consists of a long quartz tube *q* which is about 60–100 cms. long and has a diameter of about 10 cms. The tube *q* is provided at its two ends with a preferably metallic closing cap *a*₂ and a ring *a*₁. The current of gas passes into the quartz tube through the cap *a*₂, being composed of a neutral gas such as nitrogen and the gas containing the coating material; the gas leaves the tube laterally through the closing ring or member *a*₁. The metal ring *a*₁ is provided on its outer surface with a few projecting pins *h* and *h*, which are intended to co-operate with slots provided in a cap *b*, which forms a bayonet joint with the ring *a*₁. The cap *b* has a central opening which is in communication with a tube *d* connected with the said

cap. The cap *b* and the tube *d* preferably consist of metal. A long rod *s* passes through the tube *d* as well as through the opening in the cap *b*, which rod is provided at its outer end with a small crank *u* which may for instance be driven by hand, whilst the support, preferably a drum *t*, is provided at its other end, the said drum being intended to receive the resistance bars to be coated, the process for producing the resistance thus being carried out in the said drum. The inner diameter of the tube *d* is such that the rod *s* can be just slightly forced through it or be rotated therein. The length of the tube *d* ensures that the gas shall not escape through it. This arrangement thus permits the drum containing the resistance bars to be coated to be displaced from the outside during the passage of the gas in a rotary direction as well as axially. The central part of the quartz tube *q* is surrounded by an oven *o*, which may be heated in any known manner. In the example shown on the drawing, the heating is effected by means of gas flames *f*. It is, however, to be understood that electrical heating or the like may be used instead. The length of the rod *s* is such that the drum containing the resistance rods to be coated can be pushed into the position where the heating is greatest in the tube *q*. The two ends of the quartz tube *q* are further surrounded by cooling jackets *k*₁ and *k*₂ respectively. The cooling is preferably effected in a known manner by the passing of a current of water. The cooling at *k*₁ has for its object to cool the resistances after the conducting layer has been provided on the rods, whilst the cooling *k*₂ has for its main object to protect the connection between the quartz tube *q* and the inlet cap *a*₂ against too strong heating.

The manufacture of the articles to be coated, more particularly resistances, is effected as follows:—The oven *o* is first of all heated and the temperature brought up to about 800° which is preferably ascertained by means of a thermoelement and a galvanometer. Thereupon the current of the neutral gas, that is to say of the gas which does not take part in the process of manufacture, is introduced into the quartz tube *q* at *a*₂. Then the support of the resistances, that is to say in the present case the drum *t*, after it has been filled up by the resistance rods to be covered and after opening the bayonet joint *a*₁, *b*, is introduced into the quartz tube *q* up to the point where the temperature is greatest, whereupon the bayonet joint is again closed. One or two minutes are then allowed to lapse, during which

time the neutral gas traverses the quartz tube *q*. At the same time the bars or the like to be covered, as well as the drum itself, are heated up and brought up to the temperature of the oven.

At the same time the air which was previously present in the quartz tube, as well as other gases, are driven out. The heating as well as the cooling having sufficiently progressed, that is to say after about 1-2 minutes, the current of neutral gas is then enriched with the gas containing the coating material. For the production of carbon resistances use is preferably made of benzine vapour which is passed through the quartz tube during about 5-30 seconds together with the further neutral gas in sufficient quantity. The deposition takes place during this time. The short duration of the flow of the benzine vapour has the main advantage that the resistance bars are uniformly coated along their whole length. If the current of carbon gas were allowed to pass slowly through the quartz tube, its carbon constituent would be deposited to a large extent already on the right-hand side of the resistances present in the drum, whilst the left-hand side would not be coated, or coated only to a small extent. In contradistinction thereto, if the periods of reaction are short, the carbon is deposited practically uniformly at all points along the length of the resistance bars. The enrichment of the neutral gas with benzine vapour is preferably effected by passing gas through a benzine flask. After the benzine vapour has flowed through, the tube is again filled with neutral gas for about 1-2 minutes. This is effected in order that all the benzine vapours should be removed, since they become detrimental if the temperature of the resistances should drop to a temperature of about 400° owing to the incipient cooling. In this case soot would be formed which would affect the carbon coatings.

During the passage of the benzine vapour and the heating of it, the drum is rotated several times round its own axis by means of the outer crank handle *u*, whereby the individual resistance bars are caused to be continuously displaced and change the surfaces on which they rest, being thus continuously swept over by the stream of benzine vapour at all points. In addition thereto, each individual bar is subjected again and again at another point of the tube to the current of gas which sweeps over it. It is also an advantage to rotate the drum also before the benzine vapour is caused to pass through the drum in order to ensure that all the bars shall be uniformly heated.

If, after the benzine vapour has been allowed to act, the neutral gas is passed again for one to two minutes in order to remove the traces of benzine vapour, the rod *s* is pulled out to a certain extent by means of the crank lever *u*, viz. until the support *t* is brought within the range of the cooling jacket *k*₁. The cooling is necessary because the layers of the resistances, if brought in contact with the atmosphere while still in the freshly coated and heated state, would immediately oxidize. On the other hand, the manufacture would be greatly retarded if it was necessary to wait until the whole of the tube *q* had itself cooled down. Generally the cooling has advanced after a few minutes, for instance two minutes, to such an extent that the front end of the quartz tube *q* which is closed by the bayonet joint can be opened. The drum is then completely pulled out of the quartz tube and is emptied of the coated bars or the like. After the drum is refilled the manufacture can again proceed.

Figure 2 shows a perspective view of the drum *t* containing the resistances. The drum mainly consists of a sheet metal cylinder which is provided in its interior with a series of tubes *r* which run parallel to the axis of the drum. The resistance rods *w*₁ and *w*₂ to be coated are pushed into the said tubes, as can be seen in Figure 3. In order to carry out the manufacture on a large scale, the tubes *r* are made so long that it is always possible, as shown in Figure 3, to place for instance two rods one beyond the other. In order that the rods should not overlap one another when they are inserted, it is necessary to ensure that the diameter of the tubes *r* should be smaller than double the diameter of the individual resistance rods *w*₁, *w*₂. The two end surfaces of the drum *t* are covered by grids *g* (see Figure 2—*a*) which allow the current of gas to pass through unobstructedly. The grid *g* lying at the end opposite the rod *s* is removably attached in order to allow the resistance rods to be inserted into and removed from the tubes.

When choosing the material for the drum it is necessary to see that the same will not disturb the manufacturing process. Such disturbance is for instance effected if use is made of metals of low vaporization point, for instance copper; also iron causes difficulties. Nickel has been found to be especially suitable. However, also in this case precautions must be taken that the temperature at which the deposition takes place should not be so high that the nickel should vaporize even in small quantities. If vaporization takes place, the nickel vapour is permeated by the carbon, and is also deposited on the body to be coated.

It is to be understood that the apparatus hereinbefore described as well as the method of manufacture associated therewith, may be varied without in any way departing from the scope of the invention claimed. For instance, the support of the resistances may be ensured by other means than the drum hereinbefore described. Further, if desired, the rotary movement of the drum or the like may be dispensed with if the arrangement of the drum or the like and the passage of the current is such that a uniform coating of the bodies placed therein can be effected without the rotation. Further, if desired, the second cooling jacket (*k*₂) may be dispensed with.

It is also to be understood that the application of the present invention is not limited to high ohmic resistances and that the invention may also be applied to other articles in which a coating has to be deposited on a support under the action of high temperatures by the separation of a gas containing the substance to be deposited.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. An apparatus for manufacturing high ohmic resistances comprising a closed container for covering ceramic rods with carbon by separation of a gas containing carbon under the action of high temperature, a support within the said container for carrying the said rods, said support comprising a drum and a bar on which said drum is mounted and means for rotating the said support from the outside during the passage of the said gas through the said container, and for moving the said support axially from the hot part of the said container to a colder part, the said container remaining closed.

2. Apparatus as claimed in claim 1, and in which said container consists of a tube having at

one of its ends a long tubular extension surrounding the said rotatable and axially displaceable bar so closely that the gas led through the said tube cannot escape and a bayonet joint connecting the said tube with the said tubular extension.

3. An apparatus as claimed in claim 1 and in which the said container consists of a quartz tube in combination with an oven heating the said tube in its centre and with cooling jackets near its end for cooling the said ceramic rods while remaining in the said tube when they have been coated with carbon and removed from the hot zone by the rotatable and axially displaceable bar.

4. An apparatus for manufacturing high ohmic

resistances comprising a closed container for covering ceramic rods with carbon by separation of a gas containing carbon under the action of high temperature, a support within the said container for carrying the said rods, said support consisting of a drum and means for moving the said drum from the outside during the passage of the said gas through the said container, said means including a rotatable and axially displaceable bar on which the said drum is mounted, the said drum containing a plurality of tubes arranged to run parallel to the axis of the drum and intended to be filled with the said ceramic rods and removable grids closing the drum at its ends.

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