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APPARATUS FOR COATING RESISTOR BODIES

Filed March 29, 1952

2 Sheets-Sheet 1

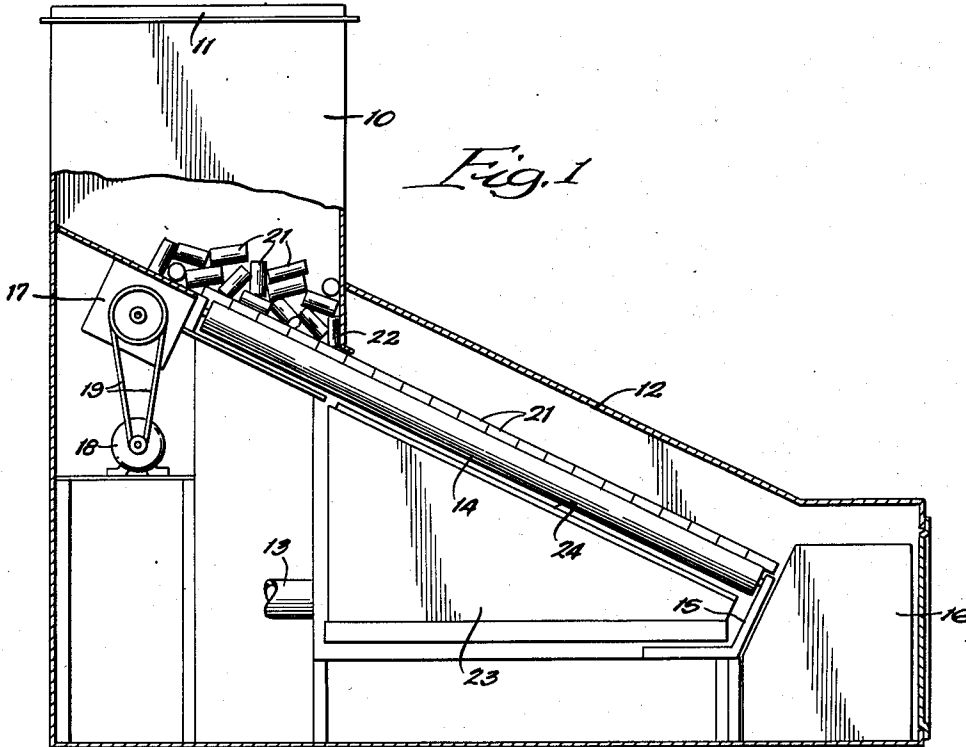


Fig. 1

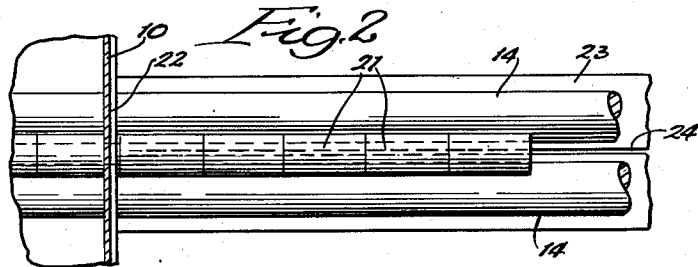


Fig. 2

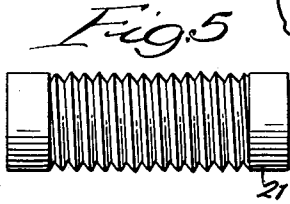


Fig. 5

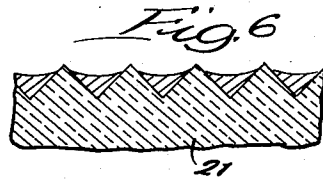


Fig. 6

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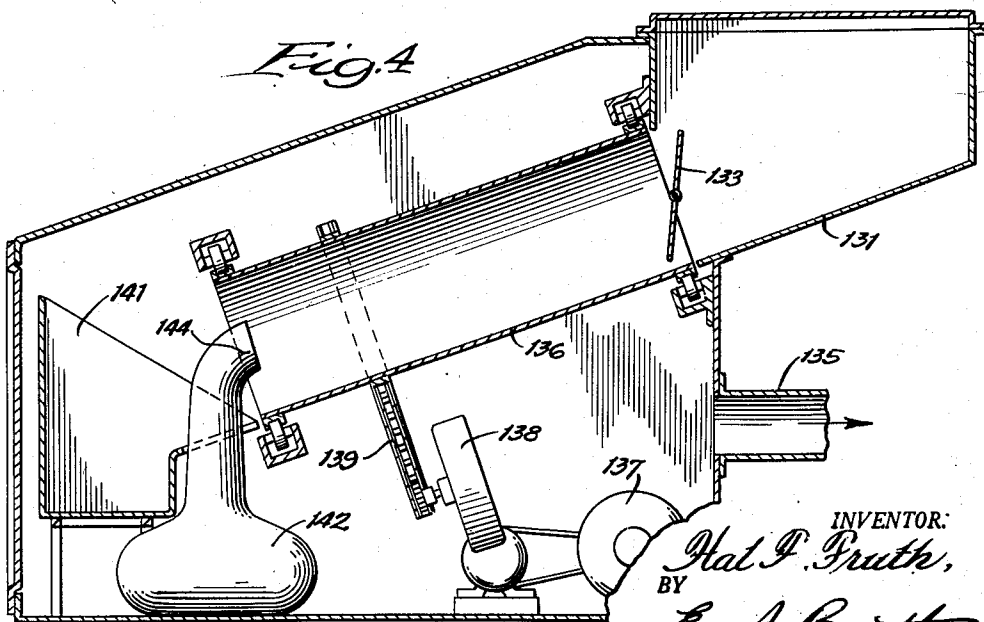
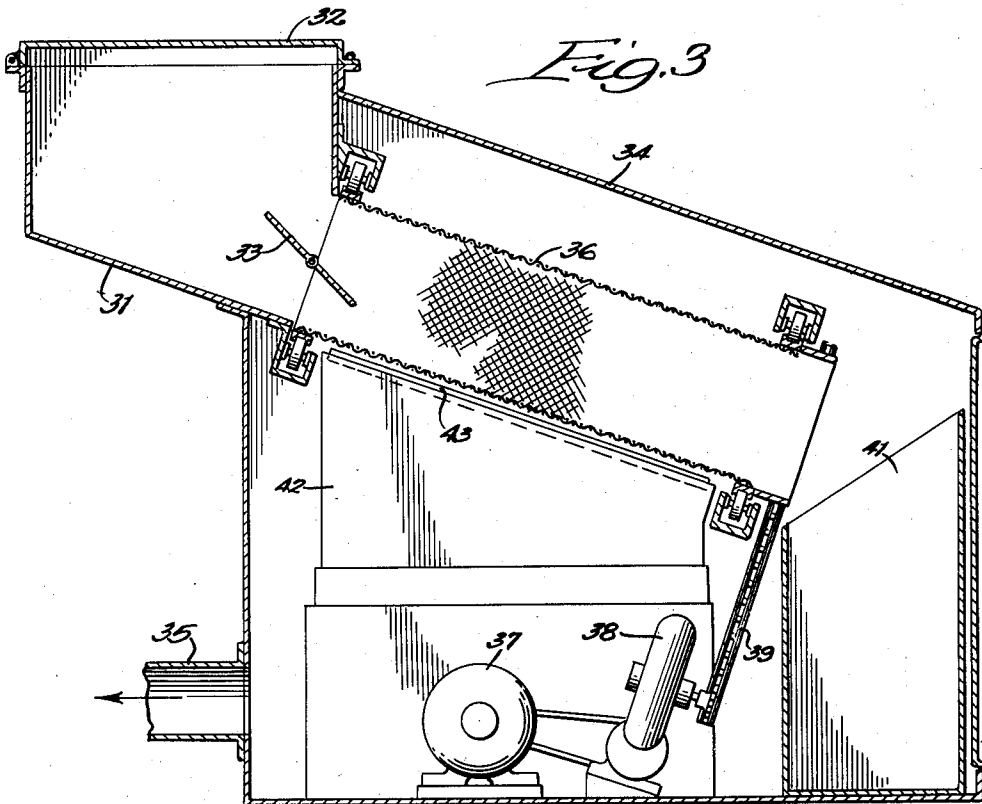
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APPARATUS FOR COATING RESISTOR BODIES

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2 Sheets-Sheet 2



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APPARATUS FOR COATING RESISTOR BODIES

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17 Claims. (Cl. 118-49)

This invention relates to an apparatus for coating resistor bodies, and more particularly to an apparatus for forming on bodies of insulating material such as ceramic material, a metallic resistor coating.

In forming metal film resistors by depositing a metal film on an insulating body it has heretofore been necessary to handle the bodies individually to obtain uniform coating and uniform resistance values. Since most resistors of this type are quite small, individual handling of the bodies makes the manufacture thereof both tedious and expensive.

It is one of the objects of the present invention to provide an apparatus for coating resistor bodies in which individual handling of the bodies is eliminated and a uniform coating is formed thereon.

Another object is to provide an apparatus in which the bodies are haphazardly tumbled while being exposed to a metal vapor which condenses thereon to form a film.

According to one feature of the invention, threaded bodies may be employed and are tumbled not only to insure uniform exposure to vapor but also to break off or prevent the deposition of a film on the peaks of the threads so that a spiral film is formed without requiring any further operations.

A further object is to provide an apparatus in which resistor bodies are tumbled in a foraminous container and vapor is discharged through the container wall onto the bodies to condense thereon.

According to a feature of the invention, the container wall is heated prior to exposure thereof to the vapor so that the vapor will not condense thereon. Preferably a radiant heater is employed to direct radiant heat onto the container wall and also onto the peaks of the threads on threaded bodies so that the vapor will condense preferentially in the valleys of the threads.

A still further object is to provide an apparatus in which the bodies travel continuously through a container while being exposed to metal vapor. Preferably the container rotates on an axis at an acute angle to horizontal and the bodies are fed into the upper end thereof to flow downward therethrough and to be tumbled thereby as the container rotates.

The above and other objects and features of the invention will be more readily apparent from the following description when read in connection with the accompanying drawings, in which

Figure 1 is a vertical section through an apparatus embodying the invention;

Figure 2 is a partial enlarged plan view of the apparatus;

Figures 3 and 4 are vertical sectional views of alternative forms of apparatus embodying the invention;

Figure 5 is a side elevation of a threaded resistor body, and

Figure 6 is an enlarged partial section illustrating the manner of coating the threaded body of Figure 5.

The apparatus of Figure 1 comprises a hopper 10 adapted to hold a plurality of bodies to be coated and which may be closed by a cover 11 having a sealing fit with the hopper. The hopper is connected at its lower part to a housing 12 which seals against the hopper and may be evacuated through a vacuum connection 13. The housing 12 carries a pair of elongated parallel rollers 14 which extend into the hopper through an opening in the bottom thereof and which slope downward from the hopper at an acute angle to the horizontal. At their lower ends the rollers 14 are rotatably supported by a

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bracket 15 which overlies the open top of a receiver 16. The rollers are adapted to be driven for rotation in the same direction as indicated by the arrows by a gear box 17 driven by a motor 18 through a belt 19. As the rollers rotate ceramic bodies to be coated as indicated at 21 will fall onto the upper surfaces thereof within the hopper and will be supported in the space between the rollers. The hopper opening preferably terminates in a lip 22 spaced above the rollers sufficiently far to pass a single body 21 so that the bodies will be supported in a row on the rollers as shown. Preferably cylindrical bodies as shown in Figures 5 and 6 are employed and will lie with their axes parallel to their rollers and supported on the upper surfaces of the rollers to be turned thereby as the rollers rotate and to slide down the rollers from the hopper into the receiver 16.

A metal vaporizing unit 23 is mounted beneath and between the rollers and contains a heating element to heat metal therein to a temperature such that it will vaporize under the pressure existing in the casing. The metal vapor will pass up between the rollers 14 and will flow over the bodies 21 supported on the rollers to condense thereon. To prevent condensation of the vapor on the rollers a heating element 24 is preferably mounted beneath and between the rollers to radiate heat onto their surfaces so that the vapor will not condense readily thereon.

According to one feature of the invention, pre-threaded bodies as shown in Figures 5 and 6, are employed. The body as illustrated at 26 in Figure 5 is generally cylindrical and is formed throughout the major portion of its length with screw threads 27 generally of V-section. When bodies of this type are employed rotation of the bodies on the thread peaks and heating of the thread peaks by the element 24 tends to prevent deposition of metal so that the metal vapor will condense preferentially in the valley portions and will tend to leave the threads bare. Therefore in the completed articles the metal will be deposited in the valleys of the threads only as indicated at 28 in Figure 6. Thus when the bodies are removed from the apparatus an elongated spiral conducting film is formed thereon requiring no grinding or cutting operations to form a spiral as in conventional practices.

Figure 3 illustrates an alternative form of apparatus designed for more or less continuous operation. This apparatus as shown, comprises a hopper 31 adapted to be sealed by a cover 32 and having a discharge opening controlled by a valve 33. The discharge opening of the hopper discharges into a sealed casing 34 which may be evacuated through a vacuum connection 35 and in which the remainder of the mechanism is contained.

As shown, a foraminous tubular container 36 which may be formed of screen wire or the like, is rotatably supported with its axis at an acute angle to the horizontal and with its upper open end registering with the hopper discharge opening. The container is rotated by a motor 37 through a gear reducer 38 and a sprocket 39. A receptacle 41 is mounted adjacent the lower end of the container 36 to receive articles discharged therefrom.

A metal vaporizing unit 42 is mounted in the casing 34 beneath the container 36 and has an elongated discharge opening lying beneath and closely adjacent to the container wall. Preferably a radiant heating unit 43 is mounted adjacent to the vaporizing unit to heat the container wall and to reflect heat onto the thread peaks of threaded bodies in the container.

In use of this apparatus with the hopper and casing closed and sealed and with the space therein evacuated the vaporizing unit is heated and the motor 37 is started. The valve 33 is adjusted to control the rate of discharge of bodies from the hopper into the container and as the container turns the resistor bodies will be tumbled therein and will pass slowly by gravity therethrough from the upper to the lower end. As the bodies pass through the container they will be subjected to vaporized metal from the vaporizing unit 42 which will condense thereon to form a uniform film. In the case of threaded bodies as shown in Figures 5 and 6, the peaks of the threads will be heated by the heating unit 43 to cause a preferential

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deposition of vaporized metal in the valleys of the bodies to result in a final product such as that shown in Figure 6.

When the hopper is emptied the apparatus can be stopped for refilling it or additional bodies to be coated could, if desired, be added thereto through a pressure lock. The completed coated bodies will be collected in the receptacle 41 and can be removed as desired.

Figure 4 shows an apparatus generally similar to that of Figure 3 and parts therein corresponding to like parts in Figure 3 are indicated by the same reference numerals plus 100. In this construction, the container 136 is formed of imperforated metal or the like, but is otherwise generally similar to the container 36 of Figure 3. The vaporizing unit 142 is in the form of a flask having its discharge end 144 directed substantially axially into the lower end of the container 136.

In operation of this apparatus, the vaporized metal discharged through the discharge opening 144 will flow into the lower end of the container and over the bodies being tumbled in the container due to rotation thereof. The bodies will therefore be uniformly exposed to the vapor to be uniformly and evenly coated as they pass from the hopper through the container into the receptacle 141.

While several embodiments of the invention have been shown and described in detail, it will be understood that they are illustrative only and that the invention is applicable to the coating of bodies for purposes other than to form resistors. For example, the apparatus of the invention could be used equally well to coat bodies to form coils or condensers or merely to ornament the bodies. It is, therefore, intended that the coating of bodies for purposes other than the formation of electrical resistors shall be included in the scope of the invention and that the invention shall not be limited to the precise apparatus shown nor otherwise than by the limitations of the appended claims.

What is claimed is:

1. Apparatus for coating resistor bodies and the like comprising a tubular container to hold bodies to be coated, means to rotate the container about its axis to tumble the bodies therein, an evacuated housing enclosing the container, and a vaporizer unit for conducting material mounted in the housing adjacent to the container to discharge vaporized conducting material into the container to condense on the bodies therein.

2. Apparatus for coating resistor bodies and the like comprising a tubular container to hold bodies to be coated, means to rotate the container about its axis to tumble the bodies therein, an evacuated housing enclosing the container, and a metal vaporizing unit containing a heating device in the housing adjacent to the container to vaporize metal and discharge the vapor into the container to condense on the bodies therein.

3. Apparatus for coating threaded resistor bodies comprising a tubular container to hold a plurality of generally cylindrical resistor bodies having externally threaded surfaces, means to rotate the container about its axis to tumble the threaded bodies therein, an evacuated housing enclosing the container, and a metal vaporizing unit including a heating device in the housing adjacent to the container to discharge vaporized metal into the container to condense on the bodies therein, tumbling of the bodies in the container exposing the surfaces thereof uniformly to the metal vapor and breaking off deposits of metal on the peaks of the threads on the bodies.

4. Apparatus for coating resistor bodies comprising a tubular container having its side walls formed of foraminous material and adapted to hold a plurality of bodies to be coated, means to rotate the container about its axis to tumble the bodies therein, an evacuated housing enclosing the container, and a vaporizing unit for conducting material mounted in the housing and having a discharge opening adjacent to the side wall of the container to direct vapor through the container wall and onto the bodies in the container.

5. Apparatus for coating resistor bodies comprising a tubular container having its side walls formed of foraminous material and adapted to hold a plurality of bodies to be coated, means to rotate the container about its axis to tumble the bodies therein, an evacuated housing enclosing the container, a vaporizing unit for conducting material mounted in the housing and having a discharge opening adjacent to the side wall of the container to direct vapor through the container wall and onto the bodies in the container, and a heating unit in the hous-

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ing adjacent to the container wall ahead of the vaporizing unit with respect to the direction or rotation of the container to heat the container wall so that the vapor from the vaporizing unit will not condense thereon.

6. Apparatus for coating resistor bodies comprising an elongated rotatable holding means lying at an acute angle to horizontal, means to rotate the holding means to turn resistor bodies thereon and to cause the resistor bodies to move down the holding means, means at the upper end of the holding means to supply loose resistor bodies to the holding means to move therefrom, and a vaporizing unit for conducting material mounted adjacent to the holding means to discharge vaporized conducting material onto the bodies carried by the holding means.

7. Apparatus for coating resistor bodies comprising an elongated rotatable holding means lying at an acute angle to horizontal, means to rotate the holding means to turn resistor bodies thereon and to cause the resistor bodies to move down the holding means, means at the upper end of the holding means to supply loose resistor bodies to the holding means to move therefrom, a vaporizing unit for conducting material mounted adjacent to the holding means to discharge vaporized conducting material onto the bodies carried by the holding means, and a heating unit mounted adjacent to the holding means to heat the holding means so that the vapor will not condense thereon.

8. Apparatus for coating resistor bodies comprising a rotatable tubular container mounted with its axis at an acute angle to horizontal, means to rotate the container, means to feed bodies to be coated into the upper end of the container to flow downward therethrough and to be tumbled thereby as the container rotates, and a vaporizing unit for conducting material mounted adjacent to the container to discharge vaporized conducting material into the container to condense on the bodies therein.

9. Apparatus for coating resistor bodies comprising a rotatable tubular container mounted with its axis at an acute angle to horizontal, means to rotate the container, means to feed bodies to be coated into the upper end of the container to flow downward therethrough and to be tumbled thereby as the container rotates, the container wall being foraminous, and a vaporizing unit for conducting material mounted adjacent to the container to discharge vapor through the foraminous container wall and onto the bodies in the container.

10. Apparatus for coating resistor bodies comprising a rotatable tubular container mounted with its axis at an acute angle to horizontal, means to rotate the container, means to feed bodies to be coated into the upper end of the container to flow downward therethrough and to be tumbled thereby as the container rotates, the container wall being foraminous, and a vaporizing unit for conducting material mounted adjacent to the container to discharge vapor through the foraminous container wall and onto the bodies in the container, and a heating unit adjacent to the container wall ahead of the vaporizing unit with respect to the direction of rotation of the container to heat the container wall so that vapor from the vaporizing unit will not condense thereon.

11. Apparatus for coating resistor bodies comprising a rotatable tubular container mounted with its axis at an acute angle to horizontal, means to rotate the container, means to feed bodies to be coated into the upper end of the container to flow downward therethrough and to be tumbled thereby as the container rotates, and a vaporizing unit for conducting material having a discharge opening directed into the lower end of the container to discharge vaporized conducting material onto bodies in the container.

12. Apparatus for coating resistor bodies comprising a rotatable tubular container mounted with its axis at an acute angle to horizontal, a hopper communicating with the upper end of the container to feed bodies to the upper end of the container to flow downward therethrough as the container rotates, a vaporizing unit adjacent to the container to vaporize conducting material and discharge the vapor onto bodies in the container, a housing enclosing the container and the vaporizing unit and forming a closed space with the hopper, and a vacuum connection to the housing to evacuate it.

13. Apparatus for coating threaded resistor bodies comprising a rotatable tubular container having a perforate wall and adapted to hold a plurality of generally cylindrical resistor bodies having externally threaded sur-

faces, means to rotate the container to tumble the threaded bodies therein, an evacuated housing enclosing the container, a metal vaporizing unit adjacent to the container wall to direct vaporized metal through the container wall and onto the threaded bodies in the container, and a radiant heating unit adjacent to the container wall to direct radiant heat onto the container wall and onto the tips of the threads on the bodies whereby the vaporized metal will tend to condense to a lesser extent on the container wall and the peaks of the threads than in the valleys of the threads.

14. Apparatus for coating resistor bodies comprising a pair of spaced parallel rotatable rollers mounted with their axes in a plane at an acute angle to horizontal, means for rotating the rollers, means to feed bodies to be coated onto the upper ends of the rollers and to be turned thereby and move downward therealong as the rollers turn, and a vaporizing unit for conducting material having a discharge opening below and between the rollers to discharge vapor upward between the rollers onto the bodies.

15. Apparatus for coating resistor bodies comprising a pair of spaced parallel rotatable rollers mounted with their axes in a plane at an acute angle to horizontal, means for rotating the rollers, means to feed bodies to be coated onto the upper ends of the rollers to be supported between the rollers and to be turned thereby and move downward therealong as the rollers turn, a vaporizing unit for conducting material having a discharge opening below and between the rollers to discharge vapor upward between the rollers onto the bodies, a housing enclosing the rollers, the feed means and the vaporizing unit, and a vacuum connection to the housing to evacuate it.

16. Apparatus for coating resistor bodies comprising a pair of spaced parallel rotatable rollers mounted with their axes in a plane at an acute angle to horizontal, means for rotating the rollers, means to feed bodies to be coated onto the upper ends of the rollers to be supported

ported between the rollers and to be turned thereby and move downward therealong as the rollers turn, a vaporizing unit for conducting material having a discharge opening below and between the rollers to discharge vapor upward between the rollers onto the bodies, and a heating element mounted adjacent to the rollers to heat the surfaces thereof so that the vapor will not condense thereon.

17. Apparatus for coating resistor bodies comprising a pair of spaced parallel rotatable rollers mounted with their axes in a plane at an acute angle to horizontal, means for rotating the rollers, means to feed bodies to be coated onto the upper ends of the rollers to be supported between the rollers and to be turned thereby and move downward therealong as the rollers turn, a vaporizing unit for conducting material having a discharge opening below and between the rollers to discharge vapor upward between the rollers onto the bodies, a hopper to contain bodies to be coated and into which the upper ends of the rollers extend, the rollers supporting the bodies between them and turning the bodies and causing them to move downward along the rollers, and a vaporizing unit for conducting material having a discharge opening below and between the rollers to discharge vapor upward between the rollers onto the bodies.

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