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METHODS FOR SEVERING A PROTECTIVE COATING ON COATED MEMBERS

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Fig. 1

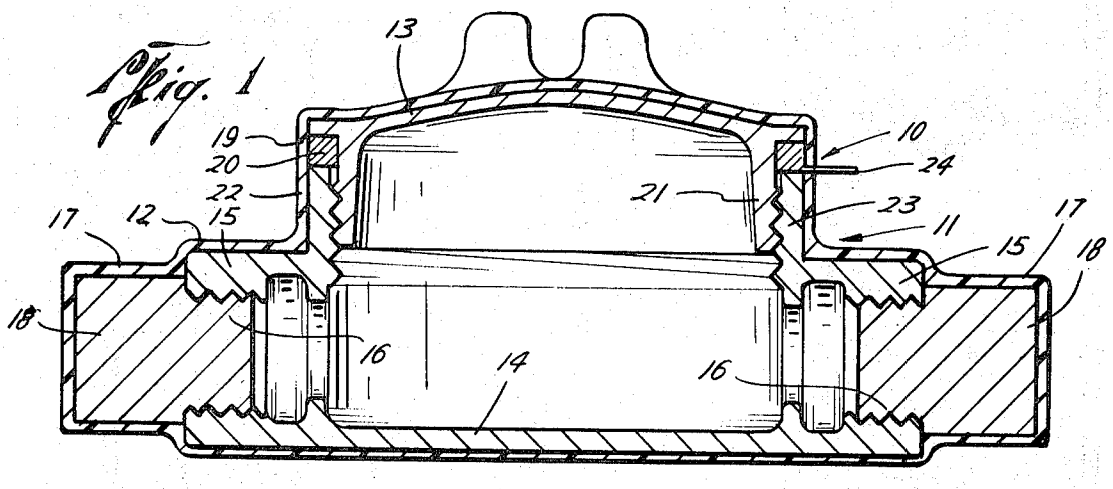


Fig. 3

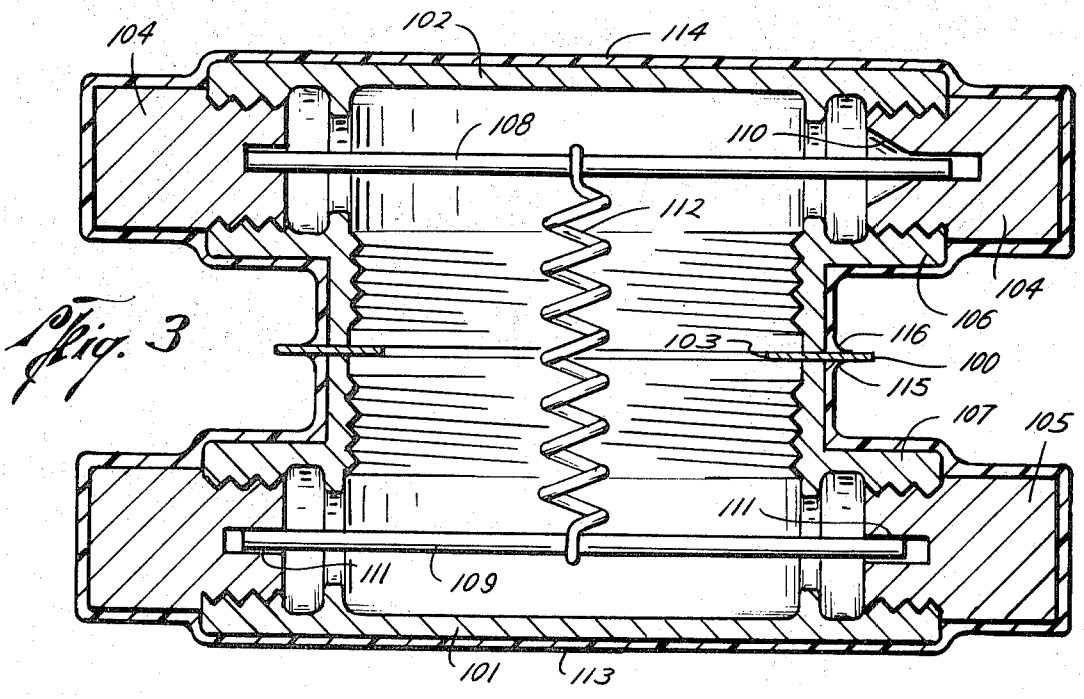


Fig. 2

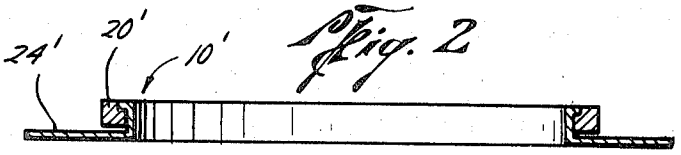
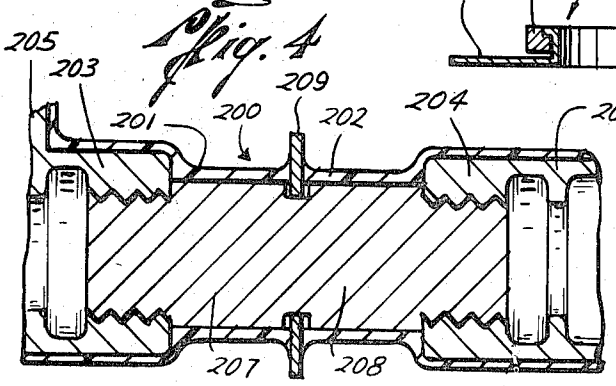


Fig. 4



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ABSTRACT OF THE DISCLOSURE

The particular embodiments described herein as illustrative of the present invention relate to the selective severing of protective coatings on members that have been coated. More particularly, the present invention as disclosed herein is directed to methods for severing a protective coating that has been applied continuously over interfitted members by one of the several fusion-coating techniques using pulverulent particles of a fusible thermoplastic or thermosetting coating material. After the members have been coated and the coating has at least firmed, a severing member movably disposed therebetween is moved in such a manner as to leave a well-defined termination of the coating on each coated member, with these terminations in some instances preferably being raised in relation to the adjacent portions of the coating to provide a mating sealing surface for similar terminations extending from the other or another coated member when the two members are ultimately connected.

It is, of course, quite common to coat metal articles by heating the article to an elevated temperature and, by one of the powder-coating techniques, applying a suitable pulverulent coating composition to those surfaces of the article that are to be coated. As the coating particles approach or contact these heat-releasing surfaces, the particles absorb heat from the article and are melted to form a continuous fused coating on the substrate surfaces. Where necessary, the coated articles are again heated to complete the fusion process and leave an effective protective coating on the substrate surfaces. There are, of course, many well-known techniques for applying such powdered coatings and subsequently conditioning the fused particles to obtain a desired coating; and those skilled in the art are fully cognizant of the various ramifications involved to achieve a desired result.

It is, of course, recognized that a mask must be used to prevent such powdered coatings from being accepted by those portions of an article which are heated but which are not to be coated. Where, however, an article to be coated is comprised of two or more interfitted elements, it is often much simpler to coat the article with its various elements fitted together to prevent the coating from contacting the interfitting surfaces raher than masking the critical surfaces and coating the elements separately. This poses somewhat of a problem since the coating will cover both elements and make it necessary, therefore, to carefully cut the coating along the junction of the interfitted coated elements with one another. It will be appreciated that this usually requires a tedious manual operation that generally leaves an irregular edge at the termination of the coating on each element. A similar problem will also exist where a number of articles to be coated are temporarily connected so that they may be coated in a single operation. Thus, irrespective of the application technique used or the particular fusion-coating composition involved, no suitable procedure has yet been devised for severing such fused coatings to leave a smooth and uniform edge after the elements have been separated.

Accordingly, it is an object of the present invention to provide new and improved methods for severing a continuous powder-coating over separable elements in such a manner that a smooth and uniform termination will be formed along the severed edges of the coating.

This and other objects of the present invention are attained by interposing a severing member of a heat-conductive material and having a minimum mass between adjacent elements to be coated, with the severing member being adapted for movement relative to the elements. Thus, after the elements have been coated and the coating has at least firmed, by moving the severing member, the band of coating joining the elements to one another will be severed to leave smooth and uniformly terminated edges on the finished coating.

The novel features of the present invention are set forth with particularity in the appended claims. The operation, together with further objects and advantages thereof, may best be understood by way of illustration and example of certain embodiments when taken in conjunction with the accompanying drawings, in which:

FIG. 1 depicts one embodiment of apparatus arranged in accordance with the principles of the present invention for severing a coating on an article having complementally fitting elements;

FIGS. 2 and 3 show alternate embodiments of severing apparatus for use in the practice of the present invention to sever a coating on an article such as shown in FIG. 1; and

FIG. 4 shows still another embodiment of severing apparatus incorporating the principles of the present invention.

Turning now to FIG. 1, a severing device **10** arranged in accordance with the principles of the present invention is shown mounted on a typical electrical junction box **11** that has been powder-coated, as at **12**. It will be appreciated, of course, that the severing device **10** was positioned before the closure **13** and body **14** of the junction box **11** were connected. Once the severing device **10** and junction box **11** were coupled, they were heated in some convenient manner to a selected temperature above the sintering or melting temperature of whatever thermoplastic or thermosetting pulverulent composition is to be applied to achieve the coating **12**. The range of preheating temperatures practical for the methods of this invention has a lower limit set by the melting or sintering point of the coating material adequate to cause adherence to the substrate surfaces, and an upper limit determined by the melting, softening, or deterioration temperature of the article being coated as well as by the transient decomposition temperature of the pulverulent coating substance.

It will also be appreciated that the external surfaces of the junction box **11** that were to be coated were previously prepared as required to obtain adherence thereto of the coating **12** developed as the pulverulent coating particles are coalesced by the heat given up by the heat-releasing surfaces of the closure **13** and body **14**. Inasmuch as the particular techniques required to obtain a satisfactory coating **12** and its adequate bonding are well understood by those skilled in the art of powder-coatings and powder-coating techniques and these details are only incidental to an understanding of the present invention, it is believed sufficient to say only that the coating **12** is a powder-coating that has been applied to the properly prepared surfaces by any one of the typical powder-coating techniques.

The open ends of the coupling bosses **15** on the junction box **11** must, of course, be covered to prevent entrance of the pulverulent coating composition into the interior of the box during the coating operation. Since it has

been customary in some instances to coat tubular members, such as a pipe or a conduit, that are to be connected to a junction box, as at **11**, the plugs **16** used to close the bosses **15** are arranged to provide somewhat of a seal between such coated tubular members and the junction box. To obtain such a seal, it has been found desirable to form an outwardly-projecting pliable sleeve, as at **17**, around each of the sockets on the bosses **15**, with these sleeves being adapted to snugly receive a coated tubular member (not shown) when it is connected to the junction box **11**. The pliable sleeves **17** extending from the bosses **15** will be respectively formed to have an internal diameter that is only slightly larger than the anticipated external diameter of the coated tubular member (not shown) that is to be ultimately received by the socket.

In one typical manner of forming such pliable sleeves **17**, the end plugs **16** are respectively provided with a cylindrical extension **18** of suitable dimensions and the outer exposed surfaces of these extensions are previously prepared (as by either coating them with a non-sticking compound or—depending upon the powder composition used—by not priming their exposed surfaces) so that the powder-coating will not adhere to the extensions when they and the junction box **11** are powder-coated. Thus, when the junction box **11** and the various temporary members connected thereto are preheated and the pulverulent coating powders brought into contact therewith, the coating **12** will extend without interruption over the temporary members as well. It will be appreciated, therefore, that the coating **12** will be bonded to the junction box **11** but that the extended sleeve portions **17** thereof over the cylindrical extensions **18** will not be adhered to the extensions so that pliable sleeves will be formed after their ends are cut and the extensions are removed. This technique is familiar to those skilled in the powder-coating art and further elaboration is believed unnecessary.

The severing device **10** shown in FIG. 1 serves two functions. In addition to its severing function, the severing device **10** is arranged to form a depending pliable skirt, as at **19**, of the coating **12** around the lip of the closure **13** when the coating is ultimately severed. To accomplish this, the severing device **10** includes an annular body **20** of a heat-conductive material that is formed to fit loosely around the depending threaded extension **21** of the closure **13**. The outer diameter of the annular body **20** is sized to form the internal diameter of the pliable skirt **19** to subsequently fit snugly over that portion (as at **22**) of the coating **12** around the circuilar access opening **23** of the body **14** when the junction box **11** is coated and assembled. The thickness of the annular body **20** will, of course, determine the height of the pliable skirt **19**. It will, therefore, be appreciated that the external surface of the annular body **20** is previously treated in a similar or the same manner as the cylindrical extensions **18** so that although the skirt **19** will be formed over the annular body during the coating process, the skirt will not be adhered thereto.

Accordingly, once the exposed surfaces of the severing device **10** and end plugs **16** are properly prepared to not adhere to a powder-coating deposited thereon, the plugs are inserted into their respective sockets on the bosses **15** and the severing device **10** is mounted on the threaded extension **21** of the closure **13**. The closure **13** is then loosely connected to the body **14** as shown in FIG. 1 with the annular body **20** being free to rotate in relation to the junction box **11**. The assembled members **10**, **11** and **16** are then heated to an elevated temperature in a typical manner.

By using one of the typical powder-coating techniques, a selected pulverulent coating composition having a fusion or sintering temperature less than the elevated temperature of the assembled members **10**, **11** and **16** is then contacted with the assembled members for a sufficient

time to form the coating **12** on the box **11** of a desired thickness. Once the assembled members **10**, **11** and **16** are removed from contact with the pulverulent coating composition, it will be appreciated that the coating **12** will be extended continuously over all exposed surfaces of the assembled members. The coating **12** will, of course, not be bonded to the exterior surfaces of either the cylindrical extensions **18** or the annular body **20**.

Then, while the coating **12** is preferably still relatively soft, a lateral cutting member **24** extending outwardly from the annular body **20** is rotated for at least a full circle about the threaded cover extension **21**. In this manner, the coating **12** is parted or severed along a plane transcending the pliable skirt **19** and the adjacent portion **22** of the coating around the access opening **23**. The coating **12** is, of course, treated further—if required—in the usual manner to achieve the desired final condition of the coating. Then, once the coating **12** has become at least firmed sufficiently to allow handling, the closure **13** is removed to withdraw the severing device **10**. The coating **12** is also cut around the distal ends of the end plugs **16** and the plugs removed from the bosses **15**. Thus, as already pointed out, the closure **13** will be coated with its portion of the coating **12** bonded thereto and defining the pliable skirt **19**. Similarly, the body **14** will be coated with the other portion of the coating **12** bonded thereto and defining the pliable sleeves **17**.

The lateral cutting member **24** of the severing device **10** is appropriately sized to be capable of cutting through the warm coating **12** but to not be coated during the coating process. In one manner of accomplishing this, the cutting member **24** is formed as a relatively-thin pin with either a flat, ovaloid, or cylindrical transverse cross-section and lying generally in the plane of rotation of the severing device **10**. Thus, as the severing device **10** is rotated in relation to the junction box **11**, the relatively-thin leading edge of the lateral pin **24** will easily cut through the warm coating **12**. Moreover, by arranging the pin **24** to have a minimal mass with respect to the annular body **20**, it has been found that the pin **24** itself will quickly cool below the sintering temperature once the assembled members **10**, **11** and **16** are removed from the source of heat and before any large proportion of the coating composition is applied thereto so that little or no coating will be coalesced on the body of the pin itself. The annular body **20** and the other members **11** and **16**, of course, have such a relatively larger mass that they will retain sufficient heat to remain at a temperature adequately above the sintering temperature to coalesce the pulverulent particles contacting these members.

Accordingly, it will be appreciated that the severing device **10** needs only to have a lateral projection, as at **24**, with a relatively-thin leading edge and of a minimal heat-absorption mass. In this manner, the heat-retention capacity of the lateral projection **24** is held to a minimum and the time typically spent in transferring the assembled members **10**, **11** and **16** from their heating source (not shown) to the coating-application apparatus (not shown) will usually be adequate for the projection to cool to a reduced temperature that is not sufficient to coalesce the powdered coating composition being employed. Then, while the coating **12** is still soft, the movement of the severing device **10** around the access opening **23** will readily divide the coating **12** and leave the portions **19** and **22** thereof with smooth and uniform terminations opposing one another.

Turning now to FIG. 2, an alternate embodiment is shown of a severing device **10'** that is also suited for applications such as already described with respect to FIG. 1. As seen in FIG. 2, the annular body **20'** is provided with a flat, outwardly-projecting, annular disc **24'** that is journalled thereto in a convenient manner so as to be free to rotate with respect thereto. The disc **24'** has such a reduced mass in relation to the annular body

20' that the disc will quickly cool in the same manner as the lateral pin **24** so that little or no coating will be formed thereon. The opposed edges of the coating portions (corresponding to the coating portions **19** and **22** in FIG. 1) will terminate on opposite faces of the disc **24'** and (by virtue of the proximity of the adjacent heat-releasing surfaces of the body **20'** and member being coated), in some instances, be bonded thereto. Rotation of the disc **24'** about the closure member will, however, clearly sever any bonded edge.

Although it may be preferred to coat a multi-element article as a unit in the manner described with respect to FIG. 1, there may be situations where it is desired to coat the various elements separately. Accordingly, in another manner of practicing the present invention, a masking device **100** is shown in FIG. 3 releasably mounted between two opposed bodies **101** and **102** of typical electrical conduit junction boxes. Although the bodies **101** and **102** could just as well be elongated or generally rectangular in cross-section the bodies are illustrated as being similar to or identical to the body **14** previously described. Since it is not necessary to form an outstanding skirt on the bodies **101** and **102**, the cutting device **100** is simply a thin, flat sheet of a heat-conductive material, such as a metal, a ceramic, or other glass-like materials, with a central opening **103** therein. End plugs **104** and **105** arranged in the same manner as the end plugs **16** are disposed in the open sockets of the bosses **106** and **107** of the bodies **102** and **101** respectively.

Although satisfactory means can, of course, be provided exteriorally of the bodies **101** and **102** for clamping them on opposite sides of the severing device **100**, the opposite ends of relatively-stiff rods **108** and **109** are arranged to be inserted into sockets **110** and **111** in the end plugs **104** and **105** and span the length of the bodies. A spring **112** is passed through the opening **103** in the plate **100** and its opposite ends are respectively connected to the rods **108** and **109**. Once the bodies **101** and **102** are clamped together on opposite sides of the plate **100**, the assembly is heated and then powder-coated in the same manner as already described.

It will be appreciated that since at least the protruding portions of the plate **100** are of a relatively minimal mass, these protruding portions will quickly cool so that by the time the coating composition is contacted therewith, little or no coating will be formed thereon. Thus, once a fused coating **113** and **114** is respectively formed on the bodies **101** and **102** and the assembly is removed from further contact with the pulverulent coating particles, the plate **100** needs only to be moved relative to the bodies to sever the edges of the coatings. It will be appreciated that this relative movement can be either a rotative movement or a sliding movement. Similarly, if desired, the bodies **101** and **102** can also be moved in relation to the stationary plate **100** to accomplish the desired severing of the coatings **113** and **114** from the plate. In any event, the coatings **113** and **114** will be terminated with uniform and smooth edges.

It will be noted from FIG. 3 that the terminal edges of the coatings **113** and **114** are respectively protruding outwardly, as at **115** and **116**, in the immediate proximity of the plate **100**. These protrusions **115** and **116** are possibly formed by a slight release of heat from the portions of the plate **100** in contact with the bodies **101** and **102**. In any event and irrespective of either the coating composition used or the type of edge termination provided for the coating on the closures (not shown) subsequently mounted on the bodies **101** and **102**, these peripheral protrusions or beads **115** and **116** will be of benefit.

Assuming that a coated closure as at **13** in FIG. 1 and having a pliable skirt, as at **19**, therearound is subsequently fitted onto the body **101**, the distension of the pliable skirt as it slips over the bead **115** will provide a better seal therebetween. A better seal will also be provided by the bead **115** even where the coating on the closure member (not shown) is terminated substantially flush with the edges of the closure. For example, where the coating on the closure member is also terminated in a peripheral bead similar to the bead **115**, the two beads will be abutted against one another when the closure is placed on the body **101**. This arrangement will, of course, be usually found where the plastic coatings are not pliable and cannot, therefore, be formed into pliable skirts.

The preceding descriptions have not disclosed how the present invention can be employed to clearly sever the free ends of the pliant sleeves as at **17** in FIG. 1. Accordingly, as seen in FIG. 4, severing means **200** arranged in accordance with the present invention are shown for smoothly terminating the free ends of pliant sleeves **201** and **202** formed around and extended from bosses **203** and **204** on typical conduit fittings **205** and **206**.

In general, the severing means **200** are comprised of oppositely directed end plugs **207** and **208** that are similar to those already disclosed. In this manner, the end plugs **207** and **208** can be used to hold the fittings **205** and **206** together during the coating process and form the pliant sleeves **201** and **202**. The end plugs **207** and **208** are either made as an integral body or of releasably joined members. In either case, however, an annular disc **209** of a relatively-thin heat-conductive material is rotatably mounted around the mid-portion of the joined plugs **207** and **208**. Thus, as will now be realized from the foregoing descriptions, rotation of the flat disc **209** in relation to the end plugs **207** and **208** will cleanly terminate the free ends of the pliant sleeves **201** and **202**. It will be realized that the desired severing action is obtained by achieving relative rotation of the disc **209** with respect to the pliant sleeves **201** and **202**. Thus, a similar result will be accomplished by fixing the disc **209** to the end plugs **207** and **208**. With this arrangement, rotation of one or both bodies **205** and **206** relative to the end plugs **207** and **208** will cause the pliant sleeves **201** and **202** to be rotated in relation to the disc **209** since the sleeves are not bonded to the end plugs.

Accordingly, it will be appreciated that the various exemplary embodiments of the present invention described above will now permit a powdered coating to be quickly severed along a well-defined plane so that all exposed edges of the coating will be uniform and smooth. In each instance, a thin or small member of a relatively minimal mass is arranged to project outwardly beyond the surface to be coated. Thus, since the heat-retention capability of the projecting member is substantially negligible, the projecting member will quickly cool although the articles adjacent thereto that are to be coated will not. This will prevent pulverulent coating particles from coalescing on the projecting member as a fused coating is being formed on the adjacent heat-releasing surfaces. Thus, once the coating process is discontinued, by moving the projecting member in relation to the now-coated heat-releasing surfaces, these coatings will be quickly and reliably severed along a predetermined plane to leave well-defined, uniform and smooth terminating edges thereon.

While particular embodiments of the present invention have been shown and described, it is apparent that changes and modifications may be made without departing from this invention in its broader aspects; and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

What is claimed is:

1. A method for powder-coating selected first and second surfaces of heat-conductive materials and comprising the steps of: interposing between said selected surfaces a member of a heat-conductive material and having a portion of a reduced mass protruding outwardly from said selected surfaces; heating said interposed member and said selected surfaces to an elevated temperature greater than the sintering temperature of a selected pulverulent coating

composition; before said selected surfaces have cooled below said sintering temperature, applying a pulverulent coating composition having a sintering temperature lower than said elevated temperature to said selected surfaces and at least the adjacent surfaces of said protruding reduced-mass portion of said interposed member to form a continuous fused coating thereon; and, after said fused coating has at least firmed, moving said interposed member in relation to said selected surfaces to sever said fused coating and form a smooth termination along the resulting severed edges thereof.

2. The method of claim 1 wherein said protruding portion of said interposed member has a thin edge extending away from said selected surfaces along a plane transcending said selected surfaces.

3. The method of claim 2 wherein said protruding portion of said interposed member is a lateral projection thereof extending away from only a portion of said selected surfaces and adapted for movement along said plane for severing said coating between the remaining portions of said selected surfaces.

4. The method of claim 2 wherein said protruding portion of said interposed member is a lateral projection thereof extending away from all of said selected surfaces and adapted for movement along said plane for severing said coating between said protruding portion and said selected surfaces.

5. The method of claim 1 wherein said selected surfaces define an enclosure having an opening therein and said interposed member is disposed across said opening and adapted for transverse movement in a plane transcending said selected surfaces.

6. The method of claim 1 wherein said selected surfaces are cylindrical and said interposed member is a thin plate adapted for rotational movement in relation to said selected surfaces and having a peripheral edge spatially disposed from and circumscribing said selected surfaces.

7. The method of claim 1 wherein said selected surfaces are cylindrical and said protruding portion of said interposed member is a lateral projection thereof extending away from a portion of said selected surfaces and rotatable about the axis of revolution thereof for severing said coating between the remaining portions of said selected surfaces.

8. A method for powder-coating a selected surface of a member of a heat-conductive material and comprising: mounting a plate of a reduced mass and of a heat-conductive material transversely across one end of said selected surface with a portion of said plate protruding outwardly

from said surface; heating said member and said plate to an elevated temperature greater than the sintering temperature of a selected pulverulent coating composition; before said member has cooled below said sintering temperature, contacting said selected coating composition with said selected surface and at least the adjacent surface of said plate to form a continuous fused coating thereon; and, after said fused coating has at least firmed, moving said plate and said member in relation to one another to sever that portion of said fused coating over the junction of said contacted surfaces and form a smooth termination along the resulting severed edge thereof.

9. A method for powder-coating a selected surface of a member of a heat-conductive material and having coupling means thereon, and comprising: connecting to said coupling means a cylindrical member of a heat-conductive material and having an annular disc of a heat-conductive material and a reduced mass mounted thereon; heating said members to an elevated temperature greater than the sintering temperature of a selected pulverulent coating composition; before said members have cooled below said sintering temperature, contacting said selected coating composition with said selected surface and at least the adjacent surface of said disc to form a fused coating of said coating composition over said contacted surfaces; and, after said fused coating has at least firmed, relatively rotating said disc in relation to one of said members to sever that portion of said coating over the junction of said contacted surfaces and form a smooth termination along the resulting severed edge of said coating.

10. The method of claim 9 further including the step of preparing the exterior surface of said cylindrical member to not adhere to said fused coating so that, after said cylindrical member has been removed, said fused coating will define a tubular extension projecting away from said selected member and around said coupling means.

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