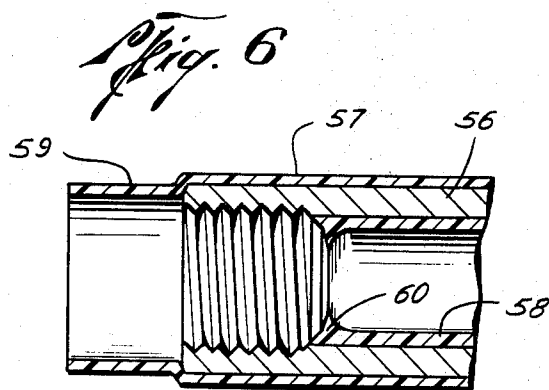
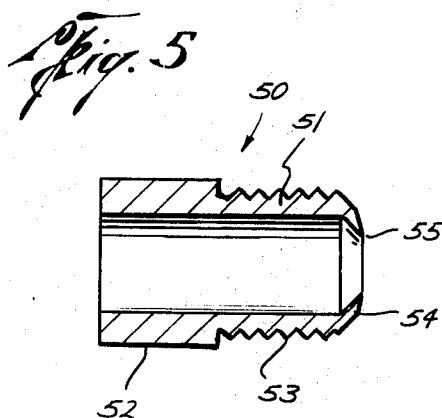
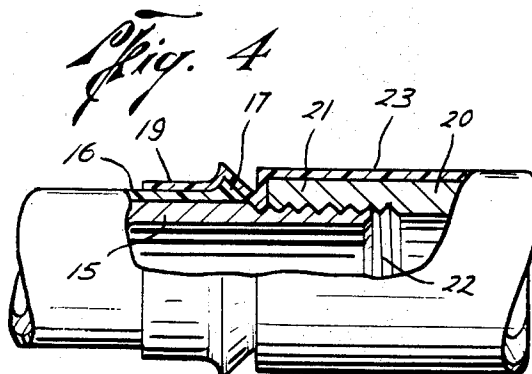
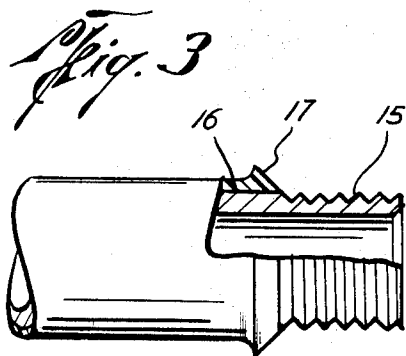
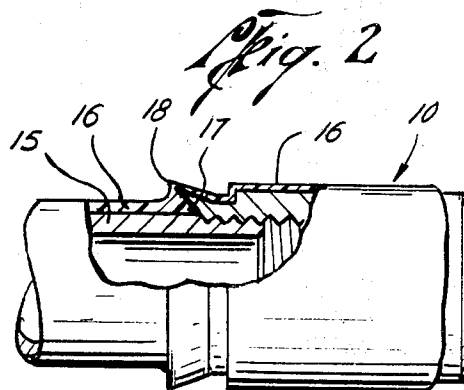
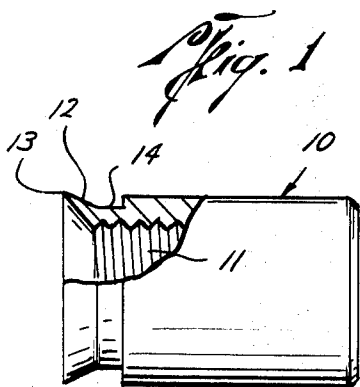


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METHODS AND APPARATUS FOR TERMINATING A PROTECTIVE
COATING ON A CYLINDRICAL MEMBER
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METHODS FOR TERMINATING A PROTECTIVE COATING ON A CYLINDRICAL MEMBER

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ABSTRACT OF THE DISCLOSURE

The particular embodiments described herein as illustrative of the present invention relate to the selective masking of particular portions of a member to be coated. More particularly, the present invention as disclosed herein is directed to methods for masking selected cylindrical surfaces of a heat-conductive member that is to be heated and then fusion-coated by application thereto of pulverulent particles of a fusible thermoplastic or thermosetting coating material. After the member has been coated and the coating has at least firmed, the mask is removed in such a manner as to leave a well-defined termination of the coating, with this termination in some instances preferably being raised in relation to the surface of the adjacent portions of the coating to provide sealing engagement with a pliable sleeve extending from another coated article.

It is, of course, quite common to coat metal articles by heating the article to an elevated temperature and, by one of the fluidized coating techniques, applying a suitable pulverulent coating composition to those surfaces of the article that are to be coated. As the fluidized coating particles approach or contact these 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 fluidized powdered coatings and 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 must be heated but which are not to be coated. This poses somewhat of a problem where the mask is first engaged with the article to be coated and the mask and the article are then pre-heated together since the coating will cover both the article and the mask. This will make it necessary, therefore, to carefully cut the coating along the junction of the mask with the article to remove the mask. It will be appreciated that this usually requires a tedious manual operation that generally leaves an irregular surface at the termination of the coating on the finished article.

Irrespective of the application technique used or the particular fusion-coating composition involved, no suitable procedure has yet been devised for masking the end portions of cylindrical or tubular members, such as pipe, conduit, and the like, so as to terminate the fused coating with a smooth and uniform surface after the mask has been removed. The problem is particularly evident where the masked portion of the cylindrical member is threaded. Moreover, where a cylindrical member with male threads is adapted for subsequent threaded engagement into another coated member having a projecting plastic sleeve that is arranged to snugly fit over the cylindrical member

behind the male threads, the manner in which the coating on the cylindrical member is terminated becomes even more significant in determining whether a sealing engagement is effected between the interior of the pliable sleeve and the exterior of the coating.

Accordingly, it is an object of the present invention to provide new and improved methods for masking the ends of either a cylindrical or a tubular member to be powder-coated in such a manner that, by simply removing the mask, a smooth and uniform surface will be formed along the terminal edge of the coating. It is also an object of the present invention to provide new and improved methods for forming a smooth peripheral bead around such a coated cylindrical member that will allow a tubular pliable sleeve projecting from an article that is attached to the tubular member to be distended slightly by the peripheral bead so as to more tightly seal the sleeve around the cylindrical member.

These and other objects of the present invention are attained by providing a tubular mask of a heat-conductive material and having a marginal severing edge, with this mask being adapted for complementary engagement with an end portion of a cylindrical or tubular member that is to be powder-coated. Thus, after the cylindrical member has been coated and the coating has at least firmed, as the mask is removed, the marginal severing edge thereon will part the circumferential band of coating joining the mask to the cylindrical member to leave a smooth and uniform termination along the edge of the finished coating.

By shaping the marginal severing edge in a particular manner, where the coating is on the exterior of the cylindrical member, the termination of the coating will be in the form of a peripheral projection or bead encircling the cylindrical member. Thus, when the cylindrical member is coupled to another member having a resilient tubular sleeve projecting outwardly therefrom, the sleeve will be snugly fitted over the cylindrical member and the peripheral bead.

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 a mask arranged in accordance with the principles of the present invention;

FIG. 2 shows the mask of FIG. 1 being used in the practice of the present invention to coat the external surfaces of a tubular member;

FIG. 3 shows the tubular member of FIG. 2 after the mask of FIG. 1 has been removed;

FIG. 4 illustrates a typical fitting or the like coupled to the coated tubular member of FIG. 3;

FIG. 5 shows an alternative embodiment of a mask incorporating the principles of the present invention; and

FIG. 6 illustrates an internally-coated tubular member prepared by the method of the present invention with the mask of FIG. 5.

Turning now to FIG. 1, a tubular mask 10 is shown there as a preferred embodiment of the present invention for use in protecting the exterior end portions of a cylindrical or tubular member (not shown in FIG. 1) that is to be coated by one of the typical fluidized or powder-coated techniques. In general, the tubular mask 10 is formed of a rigid, heat-conductive material, such as a metal, a ceramic, or a glass-like material, that is capable of being heated to elevated temperatures. The tubular mask 10 has an internal bore sized to complementarily receive the end portion of the cylindrical or tubular member. Thus, where the cylindrical or tubular

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member to be coated has an externally threaded end, the mask 10 is preferably provided with complemental internal threads 11 adapted to threadingly engage those on the member to be coated.

Severing means, such as a separate or an integral outwardly-converging peripheral projection 12, are provided on the end of mask 10 that is to be fitted over a cylindrical or tubular member to be coated. It will be noted that the peripheral projection 12 is appropriately tapered so as to terminate in a thin, if not somewhat sharp, circumferential edge as at 13. Although the peripheral projection could be extended outwardly in more or less a directly radial direction, it is preferred to incline the projection 12 as shown in FIG. 1 so that the circumferential edge 13 will encircle a cylindrical or tubular member coupled to the mask 10 and be spatially disposed therearound.

For reasons that will subsequently become apparent, the peripheral projection 12 is formed so as to have a minimal mass in relation to the remainder of the mask 10. To accomplish this, the projection 12 is formed with the tapered cross-section as illustrated and a portion of the mask 10 adjacent thereto is cut-away as by forming an external circumferential groove 14 around the body of the mask. In this manner, the mass of the material comprising the peripheral projection 12—whether the projection is integral or is a separate member of the same or different material as the body of the mask 10—is substantially less than the mass of the body or major portion of the mask.

It will be realized, of course, that means must be provided to close the end of the mask 10 on the opposite end thereof from the peripheral projection 12 in some convenient manner so as to block entrance of the powdered-coating composition. Similarly, means may also be included to facilitate handling of the cylindrical or tubular member once the mask 10 is secured thereon. Since the arrangement of such closure means and handling means will depend upon the particular circumstances and such arrangements are readily apparent to those skilled in the art, FIG. 1 does not illustrate any particular arrangement. Thus, the opposite end of the body of the mask 10 may be blocked with either an integral or a removable closure and a suitable hook or the like may also be provided as desired where, for example, the tubular member to be coated is to be immersed in a so-called fluidized bed of powdered-coating material. Such closure or handling means are, of course, of not particular significance to the present invention.

Turning now to FIG. 2, the mask 10 is shown threadingly engaged onto one end of a tubular member 15 that has been powder-coated, as at 16. It will be appreciated, of course, that the mask 10 was coupled to the tubular member 15 before the members were coated. Once the mask 10 and tubular member 15 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 16. Similarly, it will be appreciated that the surfaces of the tubular member 15 to be coated were previously prepared as required to obtain an adequate bonding of the coating 16 as the pulverulent coating particles are coalesced by the heat given up by the mask 10 and tubular member. Inasmuch as the particular techniques required to obtain a satisfactory coating 16 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 16 is a powder-coating that has been applied to the properly prepared surfaces by any one of the typical powder-coating techniques.

It will be noted in FIG. 2 that the coating 16 has a substantially uniform thickness except in the proximity

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of the peripheral projection 12. In one instance of such non-uniformity, the portion of the coating 16 partially received, as at 17, within the annulus defined between the inner face of the peripheral projection 12 and the exterior of the tubular member 15 has been built-up to a greater thickness than the other portions of the coating. In the other instance, the portion of the coating 16 immediately overlaying the thin or sharpened edge 13 of the peripheral projection 12 is substantially thinner, as at 18, than any other portion of the coating. It is the essence of the invention, therefore, to obtain at least the thin portion 18 and, preferably, the enlarged-diameter portion 17 as well.

It will be recognized, therefore, that it is the particular configuration of the peripheral projection 12 on the mask 10 of the present invention that is responsible for the two discrepant coating portions 17 and 18. Those skilled in the art will, of course, recognize that, all else being equal, the thickness of a given powder-coating that will be built-up on a heated member will be significantly controlled by the amount of heat released at a given point on the article being coated. Thus, in the first instance, the enlarged-diameter coating portion 17 is attributed to the release of heat from the adjacent surfaces of both the peripheral projection 12 and the tubular member that will coalesce the pulverulent coating particles in this annular but well-opened recess during the coating process. By facing two heat-releasing surfaces such as these on opposite sides of the annular recess defined therebetween, a coating will be built-up on each surface that will quickly approach and then merge with the other. Thus, by the time that the coating application is discontinued (whether by cooling of the members 10 and 15 or by removal of the members from further contact with the still-pulverulent particles of the coating composition), the coatings on each of these facing surfaces will have built-up and come together to form the integral enlarged-diameter coating portion 17.

The action described above in regard to forming the enlarged-diameter coating portion 17 is, at least in part, responsible for formation of the fairly thin coating portion 18 since this will reduce the quantity of transferable heat that is available for forming a coating right along the sharp edge 13 of the projection 12. Moreover, in any event as, for example, where a projection is directed radially outwardly, the tapered cross-section of the projection will so reduce the mass of heat-retaining material immediately adjacent to the outer edge that only a relatively-thin layer of coating can be formed before insufficient heat is left in the projection to coalesce additional pulverulent particles of the coating composition. Thus, the tapered projection 12 will also assure that the coating portion 18 is relatively thinner than any other portion of the coating 16.

Once the coating 16 has cooled sufficiently to be at least firm, the mask 10 is simply rotatably disengaged from the tubular member 15. As it is removed, the mask 10 is twisted or rotated so that the sharp edge 13 will be effective to part the coating along the thin encircling portion 18 and leave the enlarged-diameter projection portion 17 undisturbed as shown in FIG. 3.

The significance of the enlarged-diameter coating bead 17 remaining after the mask 10 is removed is best understood when FIG. 4 is considered. It has been customary in some instances to coat tubular fittings and other articles to which a coated tubular member, such as a pipe or conduit, is to be connected. Accordingly, as shown in FIG. 4, to provide somewhat of a seal between such coated tubular members and their associated fittings or other articles, it has previously been found desirable to form an outwardly-projecting pliable sleeve 19 around each of the sockets and the like on a fixture, fitting or such, as at 20, with these sleeves supposedly being adapted to snugly receive a coated member when it is connected to the fitting.

For example, where the fitting 20 is a typical coupling, elbow, T, connection box, or an electrical fixture having a socket 21 with female threads 22 therein, the pliable sleeve 19 extending therefrom will be formed to have an internal diameter that is only slightly larger than the anticipated external diameter of the coated tubular member, as at 15, that is to be ultimately received by the socket. In one typical manner of forming such a pliable sleeve 19, a metallic cylindrical extension (not shown in FIG. 4) of suitable dimensions is temporarily disposed in each of the sockets 21 and the outer exposed surfaces of these extensions are prepared (as by either coating them with a non-sticking compound or—depending upon the power composition used—by not priming their exposed surfaces) so that the powder-coating will not adhere to the extensions when they and the fitting 20 are power-coated. Thus, when the fitting 20 and the various extensions thereon are preheated and the pulverulent coating powders brought into contact therewith, a coating 23 will be developed on the fitting that will also extend without interruption over the temporary extensions. It will be appreciated, therefore, that the coating 23 will be bonded to the fitting 20 but that the extended portions thereof on the temporary extensions will not be adhered to the extensions so that pliable sleeves, as at 19, will be formed after the extensions are removed. This technique is familiar to those skilled in the powder-coating art and further elaboration is believed unnecessary.

It has, however, been a problem heretofore to obtain a snug sealing engagement between the inner surfaces of such pliable sleeves, as at 19, and the external surfaces of the coating on those tubular members that have been powder-coated in the usual manner. For example, before the present invention, if the coating on the tubular member was either too thick or too thin, the pliable sleeves, as at 19, would either not slip easily over the coated tubular member being inserted or else would be so loose that little or no seal was effected.

The present invention will, however, insure that a tight seal is effected by the pliable sleeves as at 19. As shown in FIG. 4, the enlarged-diameter termination 17 of the coating 16 will serve two functions in providing a tight seal between the pliable sleeve 19 and the coating on the tubular member 15. First of all, as the tubular member 15 of the present invention is being coupled to the fitting 20, the tapered forward face of the peripheral bead 17 will be effective to slightly expand the mouth of the pliable sleeve 19 and allow it to slip easily on over the coating 16. Then, once the tubular member 15 is fully coupled to the socket 21, the peripheral bead 17 will be snugly fitted within the pliable sleeve 19 to effect a sealing engagement irrespective of the fit between the forward portion of the sleeve and the coating 16.

It will be appreciated that, within the range of practical limits of typical quality control techniques that may be used in large-scale production, the dimensions of the tapered projection 12 of the mask 10 will establish a substantially constant height for the enlarged-diameter bead 17 even though the thickness of the coating 16 may vary considerably from one tubular member 15 to another. This close dimensional control is, of course, assured since both the outer diameter of the peripheral bead 17 and the internal diameter of the pliable sleeve 19 are respectively determined by the corresponding dimension of the heat-releasing surfaces used to form the bead and sleeve. Since these corresponding dimensions are relatively unvarying, the degree of fit between the sleeves 19 and the peripheral beads 17 will be fairly uniform. Thus, it will no longer be necessary as heretofore to hand-pick matching fixtures and conduits to achieve a reasonable seal. It will be recognized that the only other practical alternate heretofore has been to use an adhesive to bond a loose-fitting sleeve to a coated member therein. This, of course, makes it necessary to destroy the coating and sleeve if the coated member is subsequently removed.

It will be appreciated, therefore, that the present invention has now for the first time made mass-production of coated tubular members and their associated fixtures and fittings practically feasible. Moreover, the present invention now permits such members to be removed as needed without damage to either the coating or the pliable sleeve.

Although tubular members, fittings, fixtures, and the like, are not coated internally by powder-coated techniques as often as they are coated externally, there are situations, however, where such articles must also be internally coated. This, of course, has presented a significant problem heretofore of how to mask internal surfaces, such as threads and the like and still obtain a smooth termination of the coating when the mask is removed.

Accordingly, FIG. 5 shows a mask 50 arranged in accordance with the principles of the present invention and adapted for forming a pliable sleeve on an externally-coated fitting as well as smoothly terminating an internal powder-coating. As shown there, the mask 50 is a tubular member having a reduced-diameter portion 51 adapted for reception in a socket on a fitting, fixture, or the like (not shown in FIG. 5) that is to be internally and externally coated by one of the aforementioned typical powder-coating techniques and an enlarged-diameter portion 52 that, if desired, is suitably sized to form a pliable sleeve extension (not shown in FIG. 5) from the fitting. External threads 53 are of course, provided on the reduced-diameter portion 51 of the mask 50 where the fitting to be coated has mating internal threads. It will be realized, of course, that the length and outside diameter of the enlarged-diameter portion 52 will determine the length and internal diameter of those pliable sleeve extensions subsequently formed thereon.

In accordance with the previously described criteria of the present invention, the outer end of the reduced-diameter portion 51 is also provided with severing means such as an inwardly-directed annular projection 54 that may either be a separate member of the same or different material as other portions of the mask 50 or be an integral extension thereof as shown in FIG. 5. In either event, the mask 50 is formed of one or more rigid heat-conductive materials as previously discussed with respect to FIG. 1. It will be noted as well that the annular projection 54 is tapered to a thin, if not sharp, peripheral edge 55 for the same reasons previously discussed in regard to the mask 10.

To utilize the mask 50, it is coupled to a fixture or fitting, as at 56 (FIG. 6), that is to be powder-coated. The enlarged-diameter portion 52 is either coated with a suitable nonsticking compound or its surface is not prepared to accept a powder-coating composition. In any event, once the coupled mask 50 and fitting 56 are properly heated and a pulverulent coating composition applied thereto, an external coating 57 and an internal coating 58 will be formed on both the mask and fitting. Then, as shown in FIG. 6, after the coatings 57 and 58 have at least firmed, the mask 50 is rotatably removed to leave a pliable sleeve 59 extending outwardly from the fitting 56 as a continuation of the external coating. In a manner similar to that already explained in relation to the mask 10, removal of the mask 50 will be effective to sever the thin layer of the internal coating 58 immediately covering the peripheral edge 55 of the mask 50. Similarly, an enlarged, inwardly-projecting bead 60 will be formed as a smooth termination of the internal coating 58. Thus, the mask 50 is specially adapted for forming a smooth and uniform terminal surface for the edge of an internal coating.

Accordingly, by employing the principles of the present invention, powder-coatings can now be formed on the internal and external surfaces of cylindrical members in such a manner that the coating is smoothly and uniformly terminated along its exposed edges. By employing the new and improved methods of the present invention for

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masking portions of the external surfaces of cylindrical members to be powder-coated, a smoothly terminated projection or bead of the coating material is formed around the coated member which, if desired, will insure a snug fit of an enveloping pliable sleeve projecting from another coated member that is to be disposed over the first coated member when the two members are coupled. Similarly, when the present invention is employed for masking a portion of the internal surfaces of an article to be powder-coated, a smooth termination surface will be formed along the edge of the internal coating. It will be appreciated, therefore, that the present invention provides new and improved methods suited for masking selected areas of cylindrical or tubular members as well as providing cooperatively arranged sealing surfaces adapted to effect snug seals with complementally-fitting pliable extensions.

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 surfaces of a cylindrical article made from a heat-conductive material and comprising the steps of: complementally fitting an end portion of a tubular mask of a heat-conductive material over a first surface of such a cylindrical article to isolate said first surface from a second surface immediately adjacent thereto that is to be powder-coated, said end portion of said mask having a reduced mass extending away from said cylindrical article and terminating in a thin annular edge spatially disposed in relation to said second surface; heating said mask and cylindrical article to an elevated temperature greater than the sintering temperature of a selected pulverulent coating composition; before said mask and said cylindrical article have cooled below said sintering temperature, applying a pulverulent coating composition having a sintering temperature lower than said elevated temperature to said second surface of said cylindrical article and at least said end portion of said mask to coat said second surface and said end portion with a continuous fused coating of said coating composition; after said fused coating has at least firmed, rotating said mask in relation to said cylindrical article for said thin annular edge of said mask to sever that portion of said fused coating on said second surface from that portion of said fused coating on said end portion of said mask and form a smooth termination along the resulting severed edge of said fused coating; and removing said mask from said cylindrical article.

2. The method of claim 1 wherein said reduced-mass end portion of said mask is inclined in relation to the longitudinal axis of said mask.

3. The method of claim 1 wherein said surfaces of said cylindrical article are external surfaces thereon.

4. The method of claim 3 wherein said first surface is at one end of said cylindrical article.

5. The method of claim 1 wherein said cylindrical article is tubular and said surfaces thereof are internal surfaces therein.

6. The method of claim 5 wherein said first surface is at one end of said cylindrical tubular article.

7. A method for powder-coating an unthreaded exterior surface of a tubular member of a heat-conductive material and having external threads on one end thereof and comprising: threading a tubular masking member of a heat-conductive material onto said one threaded end of said tubular member to isolate said external threads from said unthreaded surface thereof, said masking member having a tapered projection extending from said masking member and terminating in a thin annular edge en-

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circling and spatially disposed around said unthreaded surfaces of said tubular member when said masking member is threadingly coupled thereto; heating said masking member and said tubular member to an elevated temperature greater than the sintering temperature of a selected pulverulent plastic-coating composition; before said masking member and said tubular member have cooled below said sintering temperature, contacting said selected plastic-coating composition with said unthreaded surface and at least the adjacent external surface of said tapered projection of said masking member to form a continuous fused coating of said coating composition over the surfaces of said members contacted thereby; after said fused coating has at least firmed, rotating said members relative to one another for said thin annular edge to sever that portion of said fused coating extending over the junction of said contacted surfaces and form a smooth termination along the resulting severed edge of said fused coating on said unthreaded surface; and unthreading said members to remove said masking member from said tubular member.

8. The method of claim 7 wherein said severed portion of said fused coating is thicker than other portions of said fused coating whereby a peripheral bead is left at said termination on said tubular member after said masking member is removed therefrom.

9. A method for powder-coating the external and internal surfaces of a selected member of a heat-conductive material and having internal threads on one end thereof and comprising: threading an end portion of a tubular masking member of a heat-conductive material into said one threaded end of said selected member to isolate said internal threads from said internal surface thereof, said end portion of said masking member having a reduced mass extending inwardly from said internal surface and terminating in a thin annular edge spatially disposed therefrom; heating said masking member and said selected member to an elevated temperature greater than the sintering temperature of a selected pulverulent plastic-coating composition; before said masking member and said selected member have cooled below said sintering temperature, contacting said selected plastic-coating composition with said external and internal surfaces and at least the adjacent internal surface of said masking member to form a first fused coating of said coating composition over said external surface and a continuous second fused coating of said coating composition over the internal surfaces of said members contacted thereby; after said fused coatings have at least firmed, rotating said members relative to one another for said thin annular edge to sever that portion of said second coating extending over the junction of said contacted internal surfaces and form a smooth termination along the resulting severed edge of said second coating on said unthreaded internal surface; and unthreading said members to remove said masking member from said tubular member.

10. The method of claim 9 further including the step of preparing the exterior surface of said masking member to not become bonded to said first fused coating so that, after said masking member has been removed, said first fused coating will define a tubular extension projecting away from said selected member and around said threaded end thereof.

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