**[0006]** In the method described in Patent Document 2, the surface layer is prevented from being excessively melted by setting the wavelength of the laser beam to not less than 9 μm. However, since a depth capable of being densified is only a slight part of the surface layer, the densified layer does not extend to a deeper part, and hence a sufficient effect of densification may not be obtained. In order to extend the densified layer to the deeper part, it is sufficient to lower the scanning speed of the laser beam. However, because of the surface treatment, the treating time is significantly prolonged, resulting in the increase of the cost or the generation of excessively large cracks passing through the spray coating.

**[0007]** Accordingly, in view of the problems of the conventional techniques described above, ~~it is an object~~embodiments of the present invention seek to provide a method of forming a densified layer in a spray coating wherein the densified layer of a sufficient effect is formed while preventing generation of excessively large cracks without causing the increase of the cost as well as a spray coating covering member.

MEANS FOR SOLVING THE PROBLEMS

**[0008]** ~~The following technical means are taken for achieving the above-described object.~~

——————An aspect of the present invention provides a method of forming a densified layer in a spray coating by forming a spray coating on a base member and irradiating a surface of the spray coating with a high-energy beam to remelt and resolidify a coating composition of a surface layer of the spray coating to thereby densify the surface layer, characterized in that when the high-energy beam is scanned over the surface of the spray coating, it is constituted with a plurality of laser beams forming a plurality of beam spots with the same width arranged side by side in a direction perpendicular to a scanning direction on the surface and sequentially shifted rearward in the scanning

direction, and the plural laser beams are irradiated onto the surface of the spray coating while scanning at such a state that an precedent beam spot anteceding toward the scanning direction and a follow-up beam spot followed thereto in the two adjacent beam spots among the plural beam spots are overlapped over a half or more of a spot region to each other in the perpendicular direction and the precedent beam spot and the subsequent follow-up beam spot are superimposedly passed through substantially a full region irradiated by the plural laser beams to densify a surface layer of the irradiation region. ~~The formation method of the densified layer in the spray coating according to the present invention is a method of forming a densified layer in a spray coating by forming a spray coating on a base member and irradiating a surface of the spray coating with a high-energy beam to remelt and resolidify a coating composition of a surface layer of the spray coating to thereby densify the surface layer, characterized in that when the high-energy beam is scanned over the surface of the spray coating, it is constituted with a precedent laser beam being precedently scanned in a scanning direction and a follow-up laser beam being subserviently scanned on the same trajectory~~

~~as in the precedent laser beam, and the precedent laser beam is irradiated to the surface of the spray coating while scanning and the follow-up laser beam is superimposedly irradiated on an irradiation region scanned with the precedent laser beam while scanning to thereby densify a surface layer of the irradiation region.~~

**[0009]** In the method of forming a densified layer in a spray coating according to the present invention, the high-energy beam irradiated to the spray coating is constituted with the precedent being precedently scanned in the scanning direction and the follow-up laser beam being superimposedly scanned on the same trajectory as in the precedent laser beam, and the precedent laser beam is irradiated to the surface of the spray coating while scanning and the follow-up laser beam is superimposedly irradiated on the irradiation region scanned with the precedent laser beam while scanning to thereby densify the surface layer of the irradiation region. Accordingly, the densified layer is easily extended to the deeper part and sufficient effect of densification is obtained. It is not necessary to lower the scanning speed of the laser beam, and there is caused no increase of costs due to the prolongation of the treating time. Since the irradiation region is superimposedly irradiated with the precedent laser beam and the follow-up laser beam to remelt and resolidify the coating composition of the irradiation region, the morphological change of the coating composition becomes gentle. Consequently, the generation of excessively large cracks can be prevented.

**[0010]** It is preferable that each of the precedent laser beam and the follow-up laser beam has an energy density appropriate to one or more of plural steps in the process of remelting and resolidifying the coating composition. In this case, the morphological change in each step in the process of remelting and resolidifying the coating composition can be made optimum.

**[0011]** The formation method of the densified layer in the spray coating according to

CLAIMS

1. method of forming a densified layer in a spray coating by forming a spray coating on a base member and irradiating a surface of the spray coating with a high-energy beam to remelt and resolidify a coating composition of a surface layer of the spray coating to thereby densify the surface layer, characterized in that when the high-energy beam is scanned over the surface of the spray coating, it is constituted with an precedent laser beam being precedently scanned in a scanning direction and a follow-up laser beam being subserviently scanned on the same trajectory as in the precedent laser beam, and the precedent laser beam is irradiated to the surface of the spray coating while scanning and the follow-up laser beam is superimposedly irradiated on an irradiation region scanned with the precedent laser beam while scanning to thereby densify a surface layer of the irradiation region.

2. The method of forming a densified layer in a spray coating according to claim 1, wherein each of the precedent laser beam and the follow-up laser beam has an energy density appropriate to one or more steps among plural steps in the process of remelting and resolidifying the coating composition.

3. A method of forming a densified layer in a spray coating by forming a spray coating on a base member and irradiating a surface of the spray coating with a high-energy beam to remelt and resolidify a coating composition of a surface layer of the spray coating to thereby densify the surface layer, characterized in that when the high-energy beam is scanned over the surface of the spray coating, it is constituted with a plurality of laser beams forming a plurality of beam spots in tandem on the surface in a scanning direction, and the plural laser beams are irradiated on the surface of the spray coating while scanning so as to sequentially pass the plural beam spots through the same irradiation region on the surface of the spray coating to thereby densify a surface

layer of the irradiation region.

4. The method of forming a densified layer in a spray coating according to claim 3, wherein each of the plural laser beams has an energy density appropriate to one or more steps among plural steps in the process of remelting and resolidifying the coating composition.

5. The method of forming a densified layer in a spray coating according to claim 3 or 4, wherein two adjoining beam spots among the plurality of beam spots in the scanning direction are partially overlapped with each other.

6. A method of forming a densified layer in a spray coating by forming a spray coating on a base member and irradiating a surface of the spray coating with a high-energy beam to remelt and resolidify a coating composition of a surface layer of the spray coating to thereby densify the surface layer, characterized in that when the high-energy beam is scanned over the surface of the spray coating, it is constituted with a plurality of laser beams forming a plurality of beam spots with the same width arranged side by side in a direction perpendicular to a scanning direction on the surface and sequentially shifted rearward in the scanning direction, and the plural laser beams are irradiated onto the surface of the spray coating while scanning at such a state that an precedent beam spot anteceding toward the scanning direction and a follow-up beam spot followed thereto in the two adjacent beam spots among the plural beam spots are overlapped over a half or more of a spot region to each other in the perpendicular direction and the precedent beam spot and the subsequent follow-up beam spot are superimposedly passed through substantially a full region irradiated by the plural laser beams to densify a surface layer of the irradiation region.

7. A spray coating covering member comprising a base member and a spray coating covering a surface of the base member, characterized in that a surface layer of

the spray coating is provided with a densified layer formed by remelting and resolidifying a coating composition, and the densified layer is formed by irradiating the surface of the coating sprayed on the base member with an precedent laser beam anteceding toward a scanning direction and superimposedly irradiating a follow-up laser beam following to the precedent laser beam while scanning on an irradiation region scanned with the precedent laser beam.

8. The spray coating covering member according to claim 7, wherein the spray coating is made of an oxide-based ceramic material.

## CLAIMS

1. A method of forming a densified layer in a spray coating by forming a spray coating on a base member and irradiating a surface of the spray coating with a high-energy beam to remelt and resolidify a coating composition of a surface layer of the spray coating to thereby densify the surface layer, characterized in that when the high-energy beam is scanned over the surface of the spray coating, it is constituted with a plurality of laser beams forming a plurality of beam spots with the same width arranged side by side in a direction perpendicular to a scanning direction on the surface and sequentially shifted rearward in the scanning direction, and the plural laser beams are irradiated onto the surface of the spray coating while scanning at such a state that an precedent beam spot anteceding toward the scanning direction and a follow-up beam spot followed thereto in the two adjacent beam spots among the plural beam spots are overlapped over a half or more of a spot region to each other in the perpendicular direction and the precedent beam spot and the subsequent follow-up beam spot are superimposedly passed through substantially a full region irradiated by the plural laser beams to densify a surface layer of the irradiation region.