(57) La présente invention a trait à un pistolet électrostatique pour projection de la poudre. Le pistolet produit un rideau d'air cylindrique vers la partie avant principale du corps du pistolet en fournissant de l'air comprimé à une chambre à air située entre la périphérie extérieure d'un couvercle et un cylindre extérieur, afin que de l'air soit éjecté au moyen d'un soufflet. Grâce au rideau d'air, les particules de poudre se déplacent en direction d'un objet à enduire, sans risque d'être dispersées vers une électrode de piège à ions.

(57) According to an electrostatic powder spray gun of the present invention, a cylindrical air curtain toward the front side of a gun main body is formed by supplying the compressed air to an air chamber formed between the outer periphery surface of a cover member and an outer cylinder so as to eject the air from an air blowing opening. Owing to the air curtain, powder particles move toward an object to be coated without the risk of scattering to an ion trap electrode.
ABSTRACT OF THE DISCLOSURE

According to an electrostatic powder spray gun of the present invention, a cylindrical air curtain toward the front side of a gun main body is formed by supplying the compressed air to an air chamber formed between the outer periphery surface of a cover member and an outer cylinder so as to eject the air from an air blowing opening. Owing to the air curtain, powder particles move toward an object to be coated without the risk of scattering to an ion trap electrode.
ELECTROSTATIC POWDER SPRAY GUN

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION:

The present invention relates to an electrostatic powder spray gun for applying charge to powder particles and blowing the same onto an object to be coated, utilizing the electrostatic electricity.

DESCRIPTION OF THE RELATED ART:

From the viewpoint of the environmental conservation, an electrostatic powder spray gun attracts attention as an environment-friendly, non-polluting coating method without the need of using a solvent. In the electrostatic powder coating, powder particles are supplied from a powder hopper to a spray gun via an injector so that the powder particles are sprayed with a conveying air flow to an object to be coated from a nozzle opening formed at the tip portion of the spray gun. At the time, the object to be coated is grounded as well as a high voltage is applied to a pin type electrode(s) for charging provided at the tip portion of the spray gun so that corona discharge is generated from the charging electrode to the object to be coated. Therefore, the powder particles discharged from the nozzle opening collides with ions generated by the corona discharge so as to be charged at the time of passing by the vicinity of the electrode. The powder particles accordingly charged are coated on the surface of the object to be coated by the conveying air flow and the electric force along the line of electric force.

However, it is known that, in general, in the powder coating, powder particles discharged from the tip of the spray gun and charged can partially adhere to the periphery of the spray gun without contributing to the coating film formation. If the powder particles continue to partially adhere to the
spray gun, the adhered powder particles gradually aggregate in the periphery of the spray gun to generate the risk of the so-called spit where the aggregated particles are flipped onto the object to be coated and adheres to the coated surface. Besides, since a part of the powder particles does not contribute to the film formation, a problem is involved in that the transfer efficiency of the powder particles is deteriorated.

Further, with a smaller size powder particle, a powder particle becomes lighter so that the particle adherence ratio to the periphery of the spray gun increases and the transfer efficiency further deteriorates.

Moreover, by providing an electrically-grounded ion trap electrode(s) to the rear side with respect to the charging electrode of the spray gun for trapping free ions generated by the corona discharge, since an electric field is formed between the charging electrode and the ion trap electrode, a part of the powder particles is drawn to the rear side of the spray gun by the electrostatic attracting force from the electric field so as to be easily adhered to the outer periphery portion of the spray gun.

SUMMARY OF THE INVENTION

In order to solve the above-mentioned problems, an object of the present invention is to provide an electrostatic powder spray gun capable of preventing the spit generation by restraining the adherence of the powder particles to the spray gun and improving the transfer efficiency to the object to be coated.

An electrostatic powder spray gun according to the present invention for electrostatically coating charged powder particles on the surface of an electrically-grounded object to be coated comprises a gun main body for spraying forward powder particles and charging the powder particles and an air curtain forming means for forming an air curtain by ejecting air to the
front side of the gun main body along the outer surface of the
gun main body for preventing the powder particles from
scattering.

As an air curtain forming means, an outer cylinder
covering the gun main body may be provided such that an air
chamber is formed around the outer surface of the gun main body,
a ring-like air blowing opening being formed between the outer
surface of the gun main body and the front end portion of the
outer cylinder. Furthermore, a free ion trap device may be
provided for trapping free ions.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a cross-sectional view showing the
configuration of an electrostatic powder spray gun according to
an embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter an embodiment of the present invention
will be described with reference to the accompanied drawing.

FIG. 1 shows a configuration of an electrostatic
powder spray gun according to an embodiment of the present
invention. A cylindrical gun main body 1 comprises an inner
cylinder 2 provided in the tip portion, and a cover member 3 for
covering the outer periphery portion of the inner cylinder 2. A
tube-like opening portion 4 is formed on the center axis of the
inner cylinder 2 with a powder path 5 formed communicating with
the opening portion 4. A conical opening portion 6 is formed in
the front portion with respect to the opening portion 5,
communicating with the opening portion 4 and gradually expanding
toward the front portion.

A diffuser 7 is inserted in the opening portions 4 and
6 of the inner cylinder 2. The diffuser 7 has a diffuser main
body 10 comprising a column portion 8 and a conical portion 9,
communicating with the column portion 8 and gradually expanding
toward the front portion. The column portion 8 of the diffuser main body 10 has a diameter slightly smaller than the diameter of the opening portion 4 of the inner cylinder 2 so that a cylindrical channel 11 communicating with the powder path 5 is formed between the outer periphery surface of the column portion 8 and the opening portion 4 of the inner cylinder 2. On the other hand, the conical portion 9 of the diffuser main body 10 is formed slightly smaller than the conical opening portion 6 of the inner cylinder 2 so that a conical channel 12 communicating with the channel 11 is formed between the outer periphery surface of the conical portion 9 and the opening portion 6 of the inner cylinder 2 and a ring-like nozzle opening 13 communicating with the channel 12 is formed with respect to the tip portion of the cover member 3. Further, a compressed air path 14 which opens in the front end surface of the conical portion 9 is formed in the diffuser main body 10 on the center axis.

The diffuser 7 further comprises a diffuser front cover 15 made of a porous material attached on the front end portion of the diffuser main body 10. With the diffuser front cover 15, an air chamber 16 communicating with the compressed air path 14 can be formed with respect to the front end surface of the diffuser main body 10 inside the nozzle opening 13.

A pin type corona electrode 17 is provided inside the nozzle opening 13 at the front end portion of the diffuser main body 10 such that the tip portion of the corona electrode 17 penetrates through the diffuser front cover 15 so as to project to the front side of the diffuser 7. The corona electrode 17 is electrically connected with a high voltage generator (not illustrated) in the gun main body 1 through the compressed air path 14 of the diffuser main body 10.

A cylindrical air chamber 18 is formed between the cover member 3 and the outer periphery surface of the inner cylinder 2. A ring-like cover 19 made of a porous material is
provided at the tip portion of the cover member 3 and the outside the nozzle opening 13. With the ring-like cover 19, an air chamber 20 communicating with the air chamber 18 is provided.

A cylindrical outer cylinder 21 is provided at the outer periphery portion of the cover member 3 such that an air chamber 22 is provided between the outer periphery surface of the cover member 3 and the outer cylinder 21. The front half portion of the outer cylinder 21 is reduced to a diameter slightly larger than the outer diameter of the cover member 3 such that a ring-like air blowing opening 23 is formed with a gap of about 0.1 mm width between the front end portion of the outer cylinder 21 and the outer periphery surface of the cover member 3.

Ring members 24 are provided at the outer periphery of the gun main body 1. The ring members 24 project toward the front side of the gun and are attached with a rod-like ion trap supporting member 26 with a compressed air path 25 formed on the center axis thereof. An ion trap tip cover 29 is provided at the tip portion of each ion trap supporting member 26 such that an air chamber 28 for the ion trap cleaning, communicating with the compressed air path 25 is formed at the base portion of the ion trap electrode 27 and a nozzle hole 28a is formed for ejecting the compressed air in the air chamber 28 toward the tip portion of the ion trap electrode. The ion trap electrodes 27 are electrically connected by a ring-like conductive member 30 with each other and electrically connected with a ground terminal (not illustrated) provided at the rear part of the gun electrode 1. A free ion trap device is provided with the ion trap electrodes 27 and the conductive member 30.

A ring-like vortex air chamber 31 is provided in the inner cylinder 2, surrounding the conical surface-shaped channel 12. The vortex air chamber 31 and the channel 12 communicate with each other by a plurality of vortex air introduction
openings (not illustrated) formed in the direction of the tangent of the channel 12. The vortex air chamber 31 communicates with a vortex air path 32 formed in the inner cylinder 2.

The diffuser front cover 15 and the ring-like cover 19 are made by a porous material such as a temporarily-sintered polyethylene, a teflon, or another porous resin, and the like for allowing the passage of the compressed air. The other members including the inner cylinder 2, the cover member 3, the diffuser main body 10, the outer cylinder 21, the ion trap supporting member 26, and the like are formed by a resin such as a teflon and a high density polyethylene so as to prevent the adherence of the powder particles.

The operation of the electrostatic powder spray gun according to the embodiment will be explained. The power source is connected to a high voltage generator (not illustrated) so as to generate a high voltage. The high voltage is applied to the corona electrode 17 so as to generate the corona discharge from the corona electrode 17 toward an object to be coated (not illustrated). Since the ion trap electrode 27 at the ground level is provided to the rear side of the corona electrode 17, the line of electric force concentrates to the ion trap electrode 27. Most of free ions generated in the vicinity of the corona electrode 17 move along the line of electric force so as to be trapped by the ion trap electrode 27.

In the state, the powder particles are supplied from the powder path 5 to the cylindrical channel 11 with the conveyance air, and the compressed air is supplied from the vortex air path 32 to the vortex air chamber 31. When the powder particles reach at the conical surface-shaped channel 12 form the cylindrical channel 11, since the air supplied to the vortex air chamber 31 is ejected in the direction of the tangent of the channel 12 via the vortex air introduction openings (not illustrated), the conveyance air makes a flow around the central
axis of the channel 12 so that the powder particles are sprayed from the ring-like nozzle opening 13 through the channel 12 while moving in a vortex. The powder particles are charged by the ions generated by the corona discharge and sprayed to the object to be coated (not illustrated) so as to obtain a homogeneous coat film.

At the time, a part of the powder particles after charged by the ions generated by the corona discharge tends to move to the ion trap electrode 27 along the line of electric force with most of free ions. Therefore, the air is sprayed from the air blowing opening 23 by supplying the compressed air to the air chamber 22 formed between the outer periphery surface of the cover member 3 and the outer cylinder 21. Since the air blowing opening 23 is formed with a ring-like shape along the outer periphery surface of the cover member 3, the air sprayed from the air blowing opening 23 forms a cylindrical air curtain toward the front side of the gun main body 1. Owing to the air curtain, the powder particles can move to the object to be coated (not illustrated) without scattering to the ion trap electrode 27 direction. Accordingly, adherence of the powder particles to the outer periphery surface of the cover member 3 or the outer cylinder 21 can be prevented.

However, in the air curtain, a part of the powder particles sprayed from the nozzle opening 13 can easily be adhered to the vicinity of the diffuser front cover 15 and the ring-like cover 19. Therefore, the compressed air is supplied from the compressed air path 14 to the air chamber 16 and the compressed air is supplied to the inside of the air chamber 18 so that the compressed air passes through the diffuser front cover 15 and the ring-like cover 19 made by a porous material and is ejected forward for blowing the powder particles away to prevent the adherence.

Further, if the powder particles flow in the vicinity of the gun main body 1 in such a powder coating so as to be
adhered in the vicinity of the ion trap electrode 27, the compressed air is supplied to the compressed air path 25 of each ion trap supporting member 26. The compressed air passes through the compressed air path 25 and enters the air chamber 28 for the ion trap cleaning so as to be ejected from the nozzle hole 28a to the tip portion of the ion trap electrode 27. By the discharge of the compressed air, the powder particles can be blown away.

According to an electrostatic spray gun of the present invention, since the air curtain is formed by ejecting the air forward along the outer side of the gun main body, scattering of the powder particles can be restrained to prevent the adherence onto the gun main body and the transfer efficiency can be improved. The present invention is particularly effective for a fine particle powder since a powder particle with a small size is lightweight and easily scattered. Moreover, since the powder particles cannot be attracted to the free ion trap device by the electrostatic attracting force from the electric field formed between the charging electrode and the free ion trap device by adopting the present invention to a spray gun comprising a free ion trap device for trapping free ions, a particularly remarkable effect can be achieved in terms of the prevention of the adherence of the powder to the gun main body and the improvement of the transfer efficiency.

Powder particles may be sprayed without applying a high voltage to the charging electrode at the time of test spraying for setting the coating conditions but the powder particles can easily be charged by the friction with the wall surface of the conveyance path while passing through the conveyance path to be discharged from the nozzle opening of the spray gun. Therefore, the charged powder particles can easily adhere to the vicinity of the spray gun. However, according to an electrostatic powder spray gun of the present invention, since the air curtain is formed along the outer side portion of
the gun main body, the adherence of the powder particles to the spray gun can be prevented at the time of the test spraying.
WHAT IS CLAIMED IS:

1. An electrostatic powder spray gun for electrostatically coating charged powder particles on the surface of an electrically-grounded object to be coated comprising:
   a gun main body for spraying forward powder particles and charging the powder particles, and
   an air curtain forming means for forming an air curtain by ejecting air to the front side of the gun main body along the outer surface of the gun main body for preventing the powder particles from scattering.

2. The spray gun according to claim 1 wherein the air curtain forming means includes an outer cylinder covering the gun main body to form an air chamber around the outer surface of the gun main body, a ring-like air blowing opening being formed between the outer surface of the gun main body and the front end portion of the outer cylinder.

3. The spray gun according to claim 1 further comprising a free ion trap device for trapping free ion.

4. The spray gun according to claim 1 wherein the gun main body includes an inner cylinder having a powder flow path formed therethrough, a diffuser disposed to the front side of the powder flow path of the inner cylinder and having a substantially conical shape with a ring-like nozzle opening at the outer periphery portion thereof, and a cylindrical cover member covering the outer periphery portion of the inner cylinder.

5. The spray gun according to claim 4 wherein the diffuser includes a front cover composed of a porous material for forming the front end surface of the diffuser and a first air chamber formed in the rear side of the front cover, the air being ejected to the front side of the gun main body through the front cover by supplying the compressed air to the first air
chamber.

6. The spray gun according to claim 5 wherein the gun main body includes a plurality of pin type electrodes provided to the front end portion of the diffuser.

7. The spray gun according to claim 4 further comprising a ring-like cover disposed at the front side of the cover member and composed of a porous material, a cylindrical second air chamber being formed between the cover member and the outer periphery portion of the inner cylinder, the air being ejected to the front side of the gun main body through the ring-like cover by supplying the compressed air to the second air chamber.

8. The spray gun according to claim 4 further comprising a vortical flow forming means for forming a vortical air flow with a conveying air supplied to the powder flow path of the inner cylinder.

9. The spray gun according to claim 3 wherein the free ion trap device includes a ring member provided at the outer periphery portion of the gun main body, a plurality of ion trap supporting members provided to the ring member so as to project toward the front side of the gun main body, and an electrically-grounded ion trap electrode fixed to the tip of each ion trap supporting member.

10. The spray gun according to claim 9 wherein each ion trap supporting member has an air flow path formed therethrough, a compressed air being ejected forward through the air flow path from the periphery of each ion trap electrode.