Nov. 11, 1941. S. R. IRETON, JR 2,262,184

METHOD AND APPARATUS FOR COATING MOLDS

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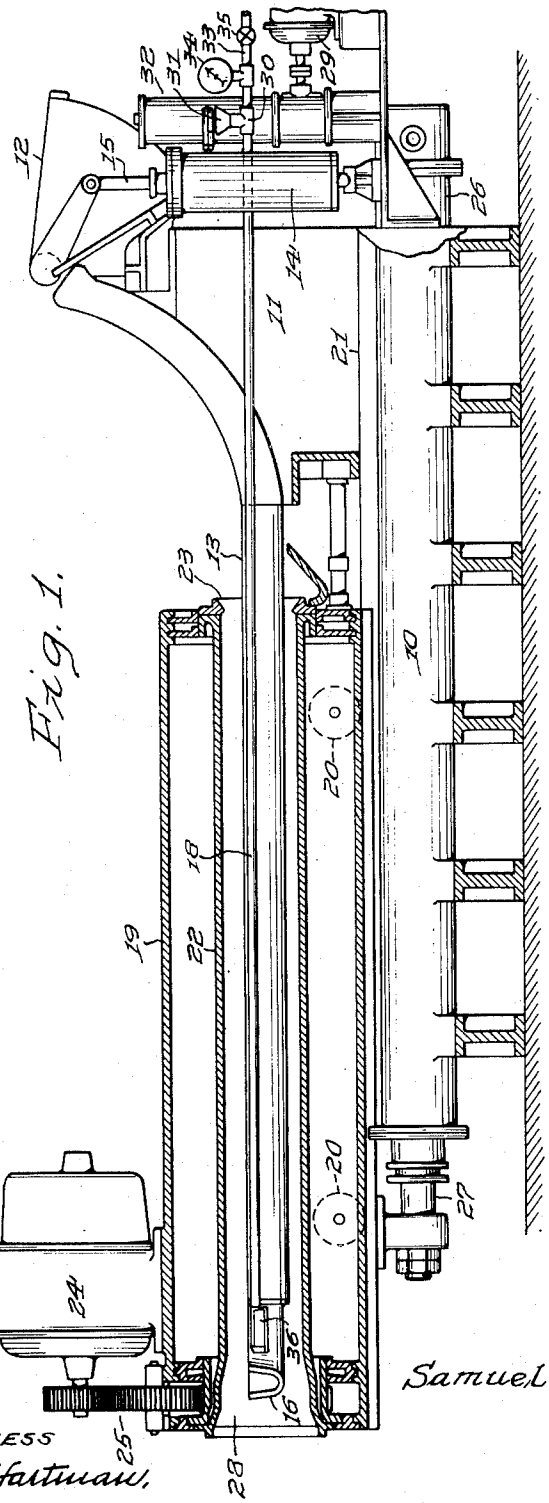


Fig. 1.

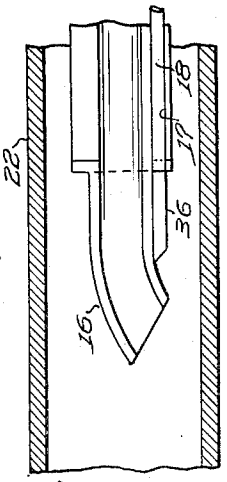


Fig. 4.

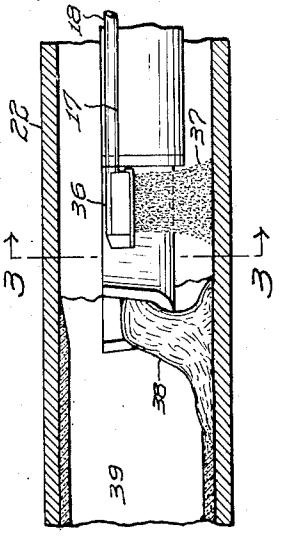


Fig. 2.

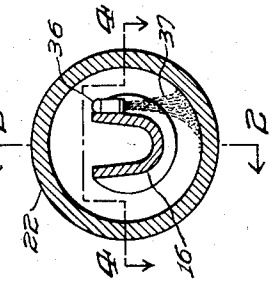


Fig. 3.

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Fig. 5.

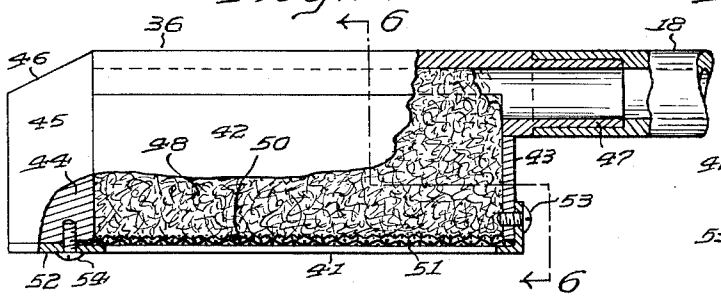


Fig. 6.

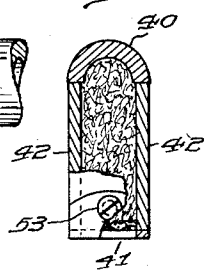


Fig. 7.

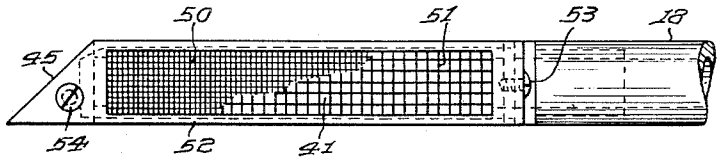


Fig. 8.

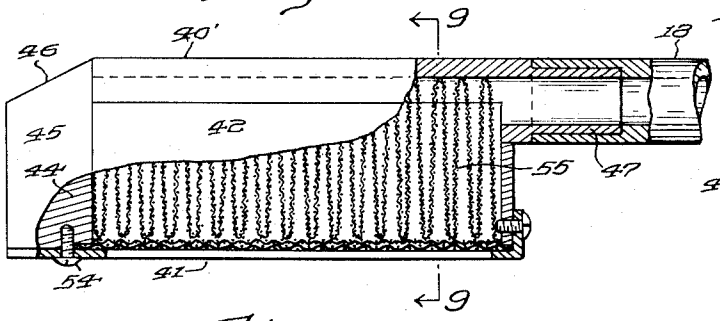


Fig. 9.

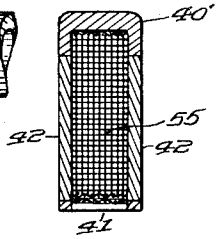


Fig. 10.

Fig. 11.

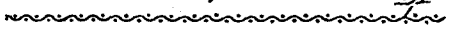
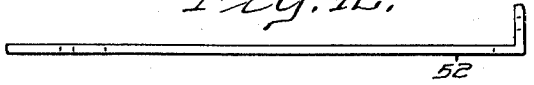


Fig. 12.



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UNITED STATES PATENT OFFICE

2,262,184

METHOD AND APPARATUS FOR COATING MOLDS

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Application December 14, 1940, Serial No. 370,110

10 Claims. (Cl. 22—88)

The invention relates to a method and apparatus for coating molds, and is particularly adapted for coating the inner surface of a centrifugal mold with finely divided, dry, coating material.

In accordance with one procedure heretofore practised, the finely divided coating material is entrained in a current of carrier gas and this current of carrier gas serves to transport the coating material to a position in proximity to the surface to be coated, where the carrier gas and entrained material are discharged from a coating device and the material is directed upon the surface of the mold to form a coating thereon. With the methods and apparatus heretofore available, such procedure has been only fairly satisfactory for producing a uniform coating. After extended experimentation I have found that the lack of uniformity in the distribution of the material on the mold surface is largely due to a lack of uniform distribution of the carrier gas over the area of the discharge opening in the coating device, and to a lack of uniform distribution of the particles of coating material in the carrier gas as the carrier gas leaves the coating device. I have also found that the known procedure is not sufficiently independent of the varying conditions which are encountered in different casting operations, such as variations in the character and amount of the coating material and variations in the pressure of the carrier gas employed for entraining the material and delivering it to the surface to be coated.

It is therefore one of the principal objects of my invention to provide a uniform distribution of finely divided, dry, coating material on the surface of a mold. A further object of my invention is the uniform distribution of such coating material in the carrier gas at or near the point of application of the coating material to the mold surface. A still further object of my invention is the provision of a method and apparatus for applying to the surface of a mold a finely divided, dry material entrained in a carrier gas, so as to form a coating in which the material is uniformly distributed notwithstanding variations in the pressure of the gas supply and variations in the character and amount of the coating material employed.

In the main, the above objects are accomplished by entraining the finely divided coating material in a confined current of the carrier gas and conducting the current and entrained material to a confined region in proximity to the mold surface to be coated. In this confined region the carrier gas is permitted to expand to such an extent as to reduce its velocity substantially before it is directed toward the mold surface. Simultaneously with the expansion of the carrier gas the energy of the moving particles of coating material is dissipated in such a manner as to reduce materially the velocity of the particles and the particles are uniformly distributed throughout the carrier gas in the region in which the expansion takes place. The particles thereupon emerge from the confined region at a substantially reduced velocity, and being uniformly distributed in the emerging carrier gas, they are distributed uniformly on the surface to be coated.

The apparatus which I utilize for the practice of my invention is illustrated in the accompanying drawings wherein:

Fig. 1 is a longitudinal sectional view, partly in elevation, showing centrifugal casting apparatus with my improved coating device incorporated therein;

Fig. 2 is a longitudinal sectional view, taken on the line 2—2 of Fig. 3, showing diagrammatically and in side elevation the arrangement of my improved coating device with respect to the runner of the casting apparatus;

Fig. 3 is a transverse sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a longitudinal sectional view of the mold taken on the line 4—4 of Fig. 3 and showing, in top plan view, the discharge end of the runner with my improved coating device mounted thereon;

Fig. 5 is a side elevational view of a preferred form of my coating device, with parts thereof broken away to illustrate details of construction;

Fig. 6 is a transverse sectional view of the device taken on the line 6—6 of Fig. 5;

Fig. 7 is a bottom plan view of the device illustrated in Fig. 5;

Fig. 8 is a view similar to Fig. 5, but showing another form of coating device;

Fig. 9 is a transverse sectional view taken on the line 9—9 of Fig. 8;

Fig. 10 is an edge view of the fine mesh screen utilized over the outlet opening of the coating device shown in Figs. 5 and 8;

Fig. 11 is an edge view of the coarse mesh screen utilized as a rigid support on the outside of the fine screen over the outlet opening of the discharge device; and

Fig. 12 is a side elevational view of the frame fitted upon the outlet opening of the coating device for retaining the above-described screens in place.

While my improved method and apparatus may be utilized with other forms of casting apparatus, I have disclosed the same herein and preferably employ the same in connection with centrifugal casting apparatus such as that shown and described in Russell and Langenberg Patent 1,949,433, granted March 6, 1934, for Method and apparatus for casting pipes centrifugally. In such casting apparatus, as illustrated in the drawings, 10 indicates the frame supporting the casting machine and its appurtenances. 11 indicates a supporting structure arranged on the frame to support the ladle 12, from which metal is fed to the runner 13. 14 indicates a hydraulic cylinder having its piston connected to the ladle 12 by a connecting rod 15 to actuate the same. The runner 13 is supported by the structure 11 and is provided at its discharge end with a spout 16 inclined to one side as shown in Fig. 4. Formed on the runner 13, along the side toward which the spout 16 extends, is a recessed seat 17 adapted to receive a conveyor pipe 18 which serves as a conduit for the carrier gas and entrained coating material.

19 indicates the usual water box mounted on a carriage supported on wheels 20 which run upon tracks 21 on frame 10. The rotatable mold 22 extends through the water box 19 and is provided at the spigot end with the annular ring 23 projecting inwardly in a radial direction to such an extent as to determine the wall thickness of the casting to be formed. The frame 10 and tracks 21 are partly cut away in Fig. 1, but it will be understood that the apparatus is of usual construction and is such as to permit the longitudinal travel of the mold carriage back and forth with respect to the stationary runner 13.

24 indicates a motor supported on the mold carriage and connected by gearing, indicated at 25, to the mold 22 to rotate the same. Longitudinal motion is given to the mold carriage by the hydraulic cylinder 26 having a piston working therein and connected to the mold carriage through a piston rod 27. 28 indicates the bell end of the mold, it being understood that a suitable core is inserted therein to assist in forming the bell end of the pipe to be cast.

The inlet end of the conveyor pipe 18 is connected with suitable means, such as an injector 30, for feeding the coating material to the current of carrier gas. The coating material is delivered to the injector 30 through a funnel 31 which is arranged to receive the material at a uniform rate from suitable feeding apparatus 32. A supply of suitable carrier gas, such as air, is connected to the injector 30 through a pipe 33 having a pressure gauge 34 and a regulating valve 35 therein. The feeding device 32 may be actuated by suitable means such as the electric motor 29.

All of the above features of the casting apparatus are of general construction. The apparatus is of the type commonly used in the method of progressively casting pipe in a centrifugal mold which, during the casting operation, is retracted relatively to the stationary runner through which the metal flows into the mold and is deposited in the form of a spiral extending from end to end of the mold.

Upon the end of pipe 18 which lies near the discharge end of the runner 13, I provide a coating means or material discharge device 36 of improved construction, for the purpose of reducing the velocity of the carrier gas and the entrained material and delivering the material uniformly upon the mold surface. The arrangement of the discharge device 36 is such that it will deliver the carrier gas and the powdered coating material in a direction which will deposit the coating material, as indicated at 37, on the surface of the mold slightly in advance of the area of contact of the metal 38, issuing from the spout 16, with the so coated portion of the mold. The powdered coating material is thus deposited upon the surface of the mold immediately in front of the freshly laid coil of still fluid metal, this being necessary to prevent the impact of the powdered coating material with the fluid metal already deposited in the mold and that issuing from the spout of the runner. For the best results, the discharge device 36 should be so located and directed as to deliver the coating material upon the surface of the mold in immediate advance of the contact of the molten metal issuing from the runner so that the deposited coating will be contacted by the metal issuing from the runner spout almost immediately after its deposition on the mold. As is well understood, the contrifugal force due to the rotation of the mold acts to distribute the molten metal uniformly to form the pipe wall as shown at 39.

The particular discharge device which I have found to be very efficient in the practice of my invention is in the form of an elongated, substantially rectangular, expansion chamber. Referring to the form of the device shown in Figs. 5 and 6, one of the longitudinal edges of this chamber may be curved in cross section as shown at 40, and the other longitudinal edge is open throughout its extent to form an outlet 41 for the carrier gas and the entrained coating material. The chamber is also provided with flat side walls 42 and a flat end wall 43, the opposite end wall 44 being beveled as indicated at 45 in order that the device may readily pass by the mold ring 23 without injury to the device. The upper end of the end wall 44 is likewise beveled, as indicated at 46, for the same reason. The inner surface of the curved edge wall 40 is substantially in alignment with the inner surface of the wall of conveyor pipe 18, which has its outlet end connected to a nipple 47 on the end wall 43 adjacent the curved edge wall 40. A mass of steel wool 48 forming a baffle for the carrier gas and entrained coating material is loosely packed within the expansion chamber and is retained therein by means of a screen 50 of fine mesh, which is in turn supported by a coarse screen 51 soldered over an opening in a frame 52 adapted to fit upon the edges of the outlet opening 41. One end of the frame 52 is bent angularly for engagement with the outer surface of the end wall 43 and is secured thereto by means of a screw 53, and the opposite end of the frame 52 is secured to the lower end of the beveled end wall 44 by means of a screw 54. With such a construction the mass of steel wool may be readily replaced to provide a different grade or for mere renewal.

From the experiments which I have conducted and from the actual use which has been made of this coating device in the centrifugal manufacture of cast iron pipe, I have found that careful attention must be given both to the size and amount of steel wool utilized in the expansion chamber. The expansion chamber shown in the drawings is approximately 4 1/8 inches long, 1 7/8 inches high, and 5/8 of an inch wide, inside measurements. The volume of the chamber is there-

fore approximately 5 cubic inches. When utilizing a fine grade of steel wool the filaments of which have a diameter of approximately .0015 inch, I have found that satisfactory results are obtained by using 4 to 6 grams of the wool loosely packed throughout the space within the chamber. With a medium size of steel wool having a filament diameter of approximately .003 inch, I have found that satisfactory results are obtained by utilizing from 5 to 7 grams similarly arranged within the chamber. With a coarse grade of steel wool having a diameter of .005 inch satisfactory results are obtained by using from 7 to 14 grams.

A better understanding of the extent to which the steel wool is packed in the device may be obtained when it is considered that the various amounts of fine grade wool utilized as just described occupy only .64% to .96% of the total volume of the chamber; the various amounts of the medium size occupy from .8% to 1.12% of the volume of the chamber; and the various amounts of the coarse wool occupy from 1.12% to 2.24% of the volume.

Another form of discharge device which I have found satisfactory is illustrated in Figs. 8 and 9 of the drawings. This form is generally similar to the form shown in Figs. 5 and 6 except for the baffle means used therein and the construction of the upper longitudinal edge wall. Otherwise the description of the form shown in Figs. 5 and 6 may be applied thereto. In this form the longitudinal edge wall **40'** is preferably flat in order to accommodate the baffle employed. The baffle in this case is made up of a multiplicity of folds or layers of wire screen **55** preferably arranged in a manner to extend across the chamber between the longitudinal edge walls. This form of baffle may be readily made up from a narrow strip of wire screen having a width equal to that of the expansion chamber and being reversely folded upon itself in the manner shown in Fig. 8 of the drawings. As illustrated in Figs. 8 and 9, the folds extend entirely across the chamber from side to side and from top to bottom, and are distributed throughout the length of the chamber.

As in the case of the steel wool described above, I have found that careful attention must be given both to the wire and mesh size and the number of the screens in order that satisfactory results may be obtained. Utilizing 6-mesh screen with a wire diameter of .034 inch, I have found that satisfactory results are obtained by using from 20 to 28 layers of the screen, this amount occupying from 1.2% to 6.7% of the total space within the chamber. When using an 18-mesh screen made of wire having a diameter of approximately .01 inch, satisfactory results are obtained when 40 to 100 layers of screen are used, this amount taking up from 2.4% to 6% of the total space within the chamber. When using 20-mesh screen made from wire having a diameter of approximately .015 inch, satisfactory results are obtained when 40 to 70 layers of layers of screen are used, this amount occupying from 6% to 10.5% of the space within the chamber.

The mold coating material used with the coating apparatus described above consists of one part of finely divided sand and three parts of finely divided ferro-silicion. A screen analysis of a typical specimen of the sand shows that 8% is retained on a 100-mesh screen, 50% is retained on a 150-mesh screen, 31% is retained on a 200-mesh screen, and 11% passes through the 200-mesh screen. A screen analysis of a typical specimen of the ferro-silicon shows that .8% is retained on a 100-mesh screen, 3.75% is retained on a 150-mesh screen, 7.25% is retained on a 200-mesh screen, 10.25% is retained on a 270-mesh screen, 1.5% is retained on a 325-mesh screen, and 76.45% passes through the 325-mesh screen.

The particle size of the coating material described above is such as is known to provide an effective coating on the mold. When such coating material is used in the practice of the present invention, it will be understood that the baffle means employed does not act as a sieve for the coating material but that the spacing of the filamentary baffle elements of both the steel wool and the wire screen is amply sufficient to permit the particles of coating material to pass freely between the baffle elements. This is likewise true with respect to the screens **50** and **51** on the outlet of the coating device.

While it is believed that my improved method as well as the operation of my improved coating device will be clear from the above description, it may be desirable to emphasize that the size of the expansion chamber and its outlet, with respect to the inlet to the chamber from the conveyor pipe, is such that the velocity of the carrier gas issuing from the outlet is materially reduced. As will be apparent from the dimensions given above, the area of the outlet from the coating device is many times the area of the inlet thereto from the conveyor pipe. This makes possible the deposition of the coating material on the mold surface without any substantial disturbance of the coating by the current of carrier gas issuing from the outlet of the coating device.

The multitude of filamentary baffles in the expansion chamber serves to dissipate the energy of the particles of material entering the chamber with the carrier gas to such an extent that they no longer have the velocity of the gas, and they must be again picked up by it and discharged through the outlet of the coating device at a materially reduced velocity. The number of baffle elements is also such that few, if any, particles escape the baffling action. The baffling action also serves to redistribute the particles in the carrier gas in such a manner that they are uniformly distributed in the carrier gas as it issues from the outlet of the coating device.

While I have disclosed two forms of apparatus by means of which my invention may be practised, as well as certain forms and arrangements of the various elements of the apparatus, such forms and arrangements are intended for illustrative purposes only, and it will be understood that such changes are contemplated in the invention as come within the scope of the appended claims.

What I desire to claim is:

1. In the method of coating molds wherein finely divided particles of coating material are entrained in a confined current of carrier gas and conveyed thereby to a confined region in proximity to the surface to be coated and then directed upon said surface, the improvement which comprises expanding said carrier gas at said region to substantially reduce its velocity, simultaneously therewith baffling the same and said particles to substantially reduce the velocity of said particles with respect to said carrier gas and uniformly distribute said particles in the

expanded gas, and then directing the current of expanded carrier gas and uniformly distributed particles toward said surface to uniformly coat the same with said particles.

2. In the method of coating rotary molds wherein finely divided particles of dry coating material are entrained in a confined current of carrier gas and conveyed thereby to a confined region in proximity to the surface to be coated and then progressively directed upon said surface, the improvement which comprises expanding said carrier gas at said region to substantially reduce its velocity, dissipating the energy of said particles in said region to substantially reduce the velocity of said particles and uniformly distribute said particles in the expanded carrier gas, and then directing the current of expanded carrier gas and uniformly distributed particles toward said surface to uniformly coat the same with said particles.

3. The method of coating the inner surface of a centrifugal mold with finely divided particles of dry coating material, which comprises entraining said material in a confined current of carrier gas, expanding said carrier gas in a confined region in proximity to the surface to be coated to substantially reduce the velocity of such gas, dissipating the energy of said particles in said region to substantially reduce the velocity of said particles with respect to said carrier gas and uniformly distribute said particles in the expanded carrier gas, and directing the expanded carrier gas and uniformly distributed particles toward and progressively over said surface to uniformly coat the same with said particles.

4. In apparatus for coating the inner surface of a rotary mold with finely divided particles of dry coating material, a conveyor pipe having an inlet and an outlet and having its outlet relatively movable longitudinally within said mold, means for supplying a carrier gas under pressure to the inlet of said pipe, means for entraining said material in said carrier gas at a uniform rate, an expansion chamber at the outlet of said pipe and having a delivery opening therein substantially larger than the outlet from said pipe into said expansion chamber, and a multiplicity of filamentary baffles in said expansion chamber for dissipating the energy of said particles within said chamber and uniformly distributing them in the carrier gas issuing from said delivery opening.

5. In centrifugal casting apparatus, a rotary mold, a runner relatively movable within said mold for delivering molten metal thereto, a conveyor pipe supported on said runner and having its outlet end terminating adjacent the spout of said runner, means for supplying a carrier gas under pressure to the inlet end of said pipe, means for entraining finely divided particles of coating material in said carrier gas, an expansion chamber on the outlet end of said pipe and having a delivery opening for directing said carrier gas and said material to the inner surface of said mold, said delivery opening being substantially larger than the outlet opening from said pipe, and a multiplicity of filamentary baffles in said expansion chamber for dissipating the energy of said particles within said chamber and uniformly distributing them in the carrier gas issuing from said delivery opening.

6. Mold coating apparatus comprising a conveyor pipe for finely divided particles of dry coating material entrained in a carrier gas, an expansion chamber for the carrier gas on the outlet end of said pipe and having a delivery opening to direct said carrier gas and said particles to the surface of said mold, said delivery opening being substantially larger than the inlet into said chamber from said pipe, and a multiplicity of filamentary baffles in said expansion chamber for dissipating the energy of the particles delivered to said chamber by said carrier gas and distributing them uniformly in the carrier gas issuing from said delivery opening.

7. Mold coating apparatus comprising a conveyor pipe for finely divided particles of dry coating material entrained in a carrier gas, an expansion chamber for the carrier gas on the outlet end of said pipe and having a delivery opening to direct said carrier gas and said particles to the surface of said mold, said delivery opening being substantially larger than the inlet into said chamber from said pipe, and a mass of metal wool loosely packed in said expansion chamber for dissipating the energy of the particles delivered to said chamber by said carrier gas and distributing them uniformly in the carrier gas issuing from said delivery opening.

8. Mold coating apparatus comprising a conveyor pipe for finely divided particles of dry coating material entrained in a carrier gas, an expansion chamber for the carrier gas on the outlet end of said pipe and having a delivery opening to direct said carrier gas and said particles to the surface of said mold, said delivery opening being substantially larger than the inlet into said chamber from said pipe, and a multiplicity of wire screens distributed throughout said expansion chamber for dissipating the energy of the particles delivered to said chamber by said carrier gas and distributing them uniformly in the carrier gas issuing from said delivery opening.

9. A device for coating a mold with finely divided particles of dry coating material entrained in a carrier gas, comprising an elongated rectangular chamber having an inlet opening for the entrained particles in an end wall adjacent one longitudinal edge and having the other longitudinal edge open to form a discharge opening, and a multiplicity of filamentary baffles arranged indiscriminately in said chamber to dissipate the energy of the particles and distribute them uniformly in the carrier gas.

10. A device for coating a mold with finely divided particles of dry coating material entrained in a carrier gas, comprising an elongated rectangular chamber having an inlet opening for the entrained particles in an end wall adjacent one longitudinal edge and having the other longitudinal edge open to form a discharge opening, a mass of metal wool loosely packed in said chamber to dissipate the energy of the particles and distribute them uniformly in the carrier gas as it issues from said discharge opening, and a screen removably secured over said discharge opening to retain said metal wool in position and permit the passage of said carrier gas and said particles therethrough.

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