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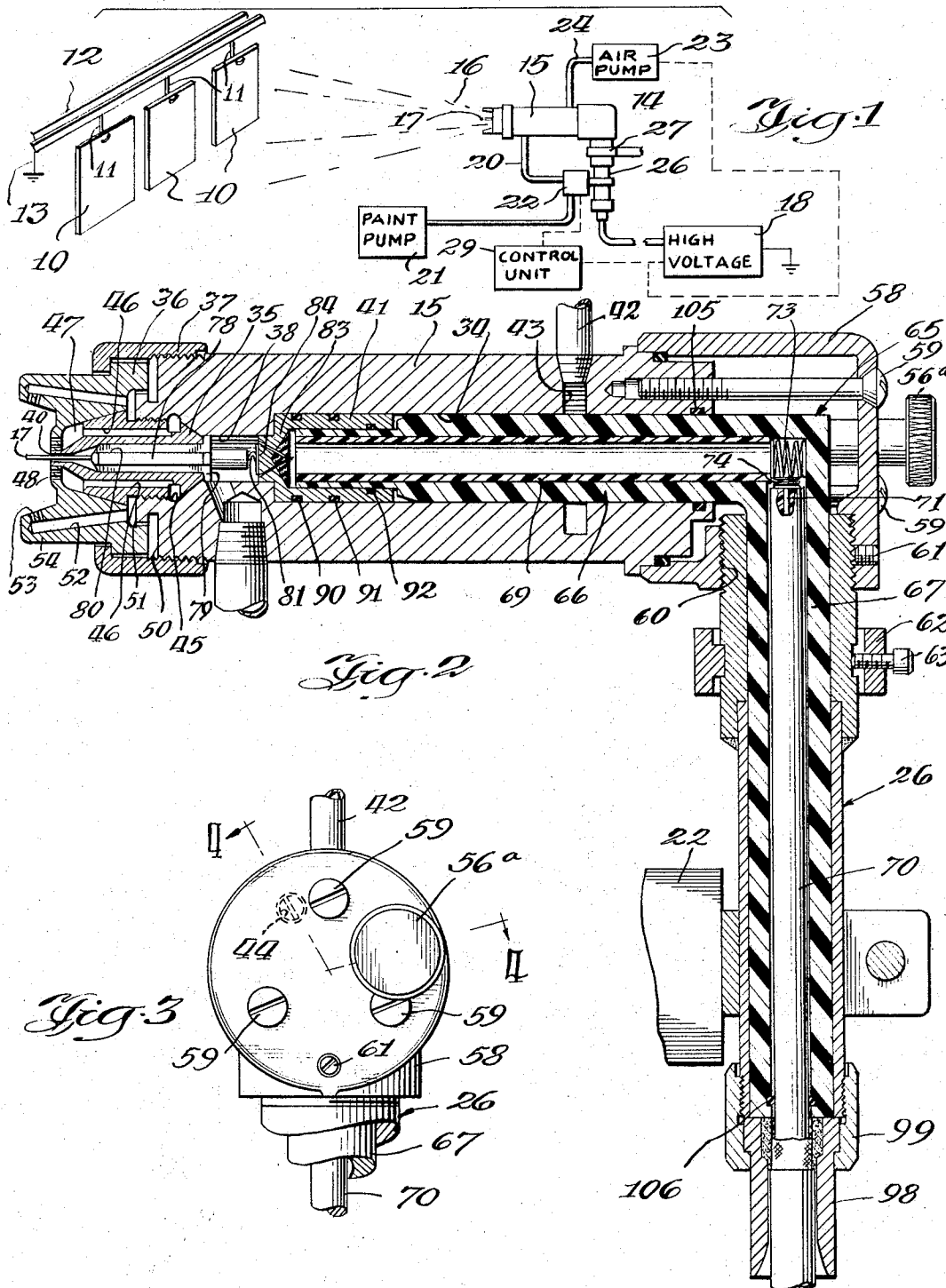
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3,292,860

ELECTROSTATIC SPRAY COATING APPARATUS

Filed Oct. 28, 1963

2 Sheets-Sheet 1



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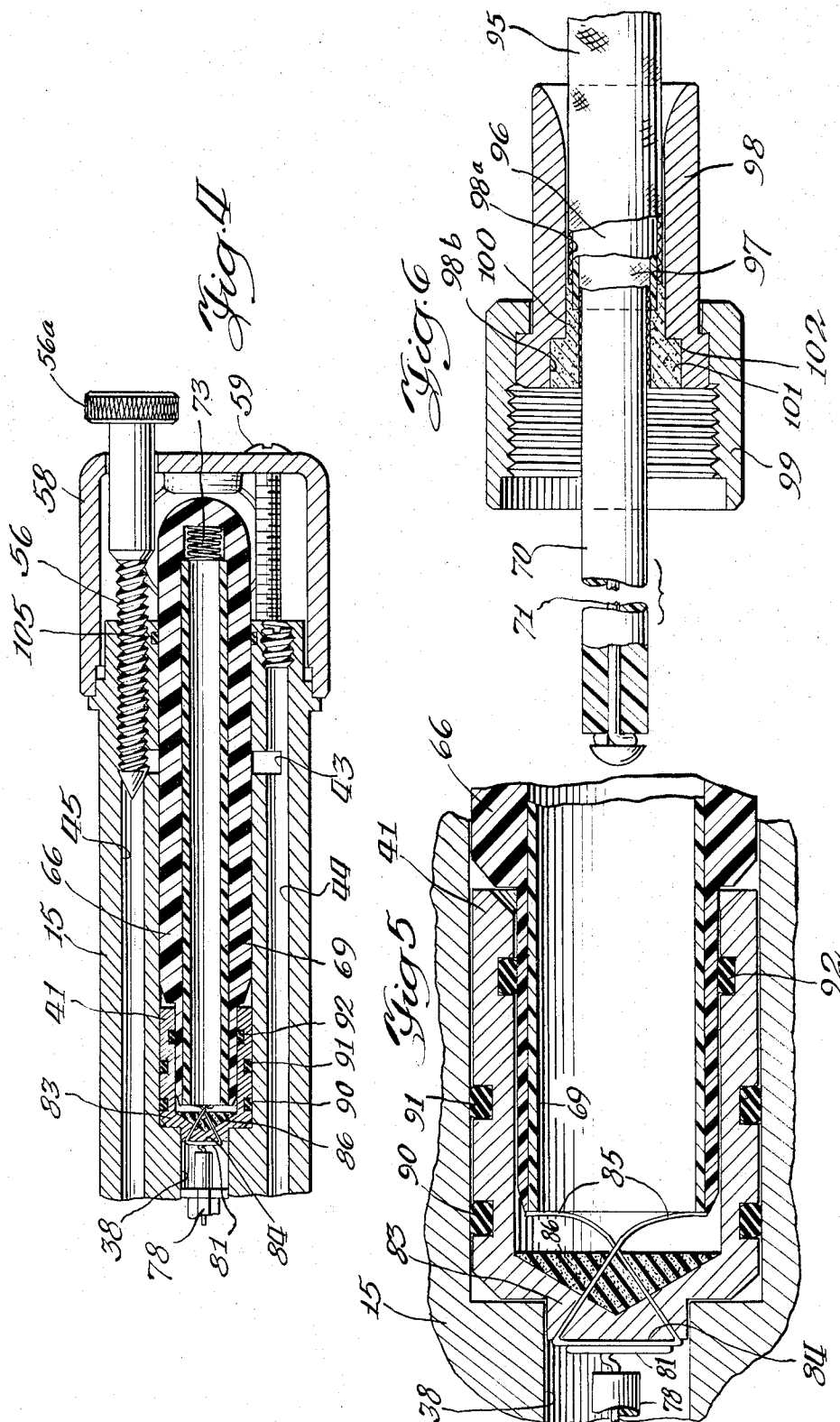
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ELECTROSTATIC SPRAY COATING APPARATUS
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This invention relates to an electrostatic spray coating apparatus and more particularly to an apparatus for air atomization and electrostatic charging and deposition of a coating material, as paint.

Various forms of air atomizing electrostatic spray guns particularly designed for hand use are known. The present invention relates to a gun which incorporates modifications and improvements of an electrostatic air gun, some of which are particularly suited for automatic or remotely controlled operation, rather than hand use.

One feature of the invention is that coating material is introduced into the gun through a non-conductive coating material conduit and at an ungrounded point in the gun. This permits use of highly conductive coating materials as metallic paints, water paints, hot lacquers and the like.

Another feature is that the gun has a conductive support portion and the coating material supply conduit is connected with a grounded valve of conductive material which controls the flow of coating material to the gun.

A further feature is that the barrel has an air chamber formed therein connected with a source of air under pressure and a passage is formed in the barrel connecting the air chamber with an air discharge orifice adjacent the coating material discharge orifice.

Yet another feature is that the barrel has a bore in which the high voltage circuit is located, and the air chamber is annular in configuration, surrounding the high voltage circuit. A shaping air passage is connected with the annular air chamber through a valve which controls the flow of air to a shaping air discharge orifice.

Still a further feature is that the bore extending through the gun barrel has a coating material chamber at the forward or front end from which the coating material is discharged through an orifice. The high voltage circuit extends into the bore from the rear of the barrel, and a plug in the bore seals the rear of the coating material chamber and carries a conductor which affords an electrical connection between the high voltage circuit in the bore and the charging electrode. Yet another feature is that the resistor extends into and is sealed with a recess in the rear of the connector plug.

And a further feature is that the high voltage cable has a terminal fitting including a sleeve with a bore through which the cable extends, the cable having a conductive braid surrounding an insulating body and a central conductor. The braid is electrically connected with the sleeve with a conductive cement and the cable is securely anchored in the fitting with a structural cement.

Further features and advantages of the invention will readily be apparent from the following specification and from the drawings, in which:

FIGURE 1 is a diagrammatic illustration of a system embodying the invention;

FIGURE 2 is a longitudinal section through a gun embodying the invention;

FIGURE 3 is a view looking from the right of FIGURE 2;

FIGURE 4 is a fragmentary section taken generally along the line 4—4 of FIGURE 3;

FIGURE 5 is an enlarged fragmentary section of the electrical connection at the front end of the resistor; and

FIGURE 6 is an enlarged section through the cable fitting.

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In a hand spray gun the various connecting cables or hoses, as for paint, air and high voltage, should enter the gun in such a manner that they do not destroy the balance or maneuverability of the gun. It is generally desirable that they enter through the rear of the gun and preferably through the base of the handle. This presents certain problems in isolating the coating material passage from the high voltage circuit. Furthermore, in a hand gun a coating material valve must be provided, which valve generally requires metal parts to withstand the wear and abrasion of the coating material. Where the valve is close to the high voltage circuit, conductive coating materials cannot be used as the electrical capacity of the apparatus would be excessive. If the valve is grounded, eliminating the capacity problem, the heavy current flow through the coating material may drop the high voltage below a satisfactory operating level.

A gun which is automatically operated from a remote point may be mechanically mounted rather than handheld. Accordingly, balance is of little moment and the coating material conduit may enter the gun at any point. A valve is not necessary in the gun as the flow of paint can be controlled through an external valve spaced away from the gun.

In the system of FIGURE 1 of the drawings, articles 10 to be coated are suspended from hangers 11 carried by conveyor 12 which is preferably at ground or reference potential as indicated at 13. The spray gun 14 has a barrel portion 15 with a spray 16 of particles of coating material emitted from the front thereof and directed generally toward the articles 10. A spray charging electrode 17 is connected through a circuit in the gun with a source of high voltage 18, establishing a high intensity electrostatic field extending from the electrode to the grounded articles 10. The spray particles acquire a charge and are attracted to and deposited on the grounded articles. A coating material conduit 20, of insulating material, is connected with the gun near the front of the barrel and supplies coating material from a pump 21 through a valve 22. Air pump 23 is connected through hose 24 with an air inlet at the rear of the barrel 15.

A conductive support 26 extends downwardly from the rear of barrel 15 through a carrier ring 27 on which the gun is mounted. Valve 22, preferably of a conductive material, is mounted on gun support 26, through which it is grounded.

A control unit 29, shown in diagrammatic form, may be provided to control valve 22, high voltage source 18 and air pump 23. The details of the control unit are not important to the present invention. It is sufficient to point out that paint valve 22 should not be opened except when both air and high voltage are available.

The coating material enters the gun through ungrounded conduit 20 of insulating material connected between valve 22 and the front portion of barrel 15. As there is no large body of conductive material immediately adjacent the point of discharge of the coating material or the point at which the high voltage circuit joins the coating material conduit, the capacity of the apparatus does not unduly increase even when using highly conductive coating materials. Little energy is dissipated from the high voltage circuit through the coating material.

The interior construction of gun 14 is illustrated in FIGURE 2. The barrel 15 of the gun is formed from a cylindrical block of insulating material, as Delrin, which has a longitudinal bore 34 extending therethrough. The barrel provides a support for coating material nozzle 35 and air nozzle 36, which are held to the barrel by a threaded retainer ring 37. The coating material and air nozzles and the retaining ring are of a non-conductive material, to reduce the electrical capacity of the apparatus

and to facilitate in the establishment of a concentrated high intensity electric field from charging electrode 17.

A coating material chamber 38 is formed in the forward portion of the bore 34 of barrel 15 and includes the interior passage through coating material nozzle 35. Coating material enters chamber 38 through an inlet port 39 extending generally transversely outwardly through the lateral wall of barrel 15. A coating material discharge orifice 40 is located at the front of nozzle 35. The rear of coating material chamber 38 is closed by a plug 41.

Compressed air from pump 23 is introduced at the rear of the barrel 15 through a nipple 42. The air enters an annular chamber 43 which surrounds bore 34. As best seen in FIGURE 4, air from chamber 43 is conducted forwardly through the barrel by passages 44 and 45. Atomizing air passage 44 joins with annular chamber 45 at the rear of nozzle 35, from which the air passes through channels 46 to the annular space 47 surrounding the front end of the nozzle. The air is discharged through orifices 48 surrounding the coating material discharge orifice 40, and interacts with the coating material causing it to break up into discrete spray particles.

Shaping air passage 45 is joined, through annular chambers 50, 51 and passages 52 with shaping air ports 53 on horns 54. The air discharged from ports 53 modifies the shape of the spray pattern of the particles discharged from orifice 40. Without shaping air a cone shaped or annular pattern is formed. As the shaping air is increased, the pattern becomes more fanlike in configuration. The flow of shaping air is controlled by a needle valve 56 threaded into the rear of barrel block 15 and extending through air chamber 43 into passage 45. The rear portion of valve 56 extends outwardly from the rear of the gun and is provided with a knob portion 56a for adjustment.

An elbow 58, of conductive material, is secured to the rear of barrel block 15 by screws 59. The elbow is grounded, as will appear, and provides a counterelectrode or ground reference to stabilize the electrostatic field intensity in the vicinity of charging electrode 17. Support 26, which is a steel sleeve, extends downwardly from the bottom of elbow 58. The support is received in elbow opening 60 and secured by a set screw 61. The gun may suitably be mounted by inserting the support in a carrier ring 62 and securing it in place as by set screw 63. Ring 62 is carried by a suitable mount (not shown).

An L-shaped high voltage circuit housing 65 has a first leg 66 which extends through the bore of barrel 15 and a second leg 67, at right angles to the first leg, which extends through support tube 26. High voltage housing 65 is of a suitable high dielectric material, as polyethylene. A series connected high voltage dropping resistor 69 is located within leg 66 of the high voltage housing while the center insulating body 70 and inner conductor 71 of high voltage cable 18 extend through leg 67. A coil spring 73, between the rear end of resistor 69 and the inner wall of housing 65 forces the resistor forwardly of the housing, and provides an electrical connection with the conductive rear face of resistor 69. A second coil spring 74 is located between the end of high voltage cable body 70 and spring 73, completes the connection with high voltage conductor 71.

Charging electrode 17 is carried by a supporting body 78 within the coating material chamber 38. A flange 79 at the rear of the electrode support engages the rear surface of nozzle 35, locating the electrode support within the chamber. The support is fluted with grooves 80 providing a flow passage for the coating material through the nozzle. Electrode 17 extends longitudinally through the support and has a coiled spring portion 81 which extends outwardly from the rear thereof engaging the front surface of plug 41 and urging the electrode and its support forwardly of the chamber 38.

With particular reference to FIGURE 5, plug 41 has a front wall 83 which closes the rear of coating material chamber 38. A wire connector 84 has a portion extending across the front face of wall 83 with two legs which extend rearwardly through the wall and terminate in divergent spring connector portions 85. The wire is sealed into the plug by a body of epoxy cement 86. The front end of resistor 69 has a conductive surface which bears against the wire ends 85 and spring portion 81 of electrode 17 bears against the portion of the wire extending across the face of plug wall 83. Thus, the high voltage circuit is completed from cable 70 through springs 73 and 74, resistor 69, wire 84 and spring portion 81 to the electrode 17.

It is essential that coating material and solvents used in cleaning the gun be kept from contact with resistor 69, as they would cause deterioration of the resistor body. Plug 41, which is generally cup-shaped in configuration, is sealed with the bore 34 of barrel 15 by O-rings 90 and 91. The front end of resistor housing leg 66 extends into the recess of plug 41 and is sealed therewith by O-ring 92. Thus, coating material and solvent cannot leak rearwardly from chamber 38 around the plug and reach resistor 69 and any solvent or coating material which gets into the air system cannot pass forwardly around the housing leg 66 and enter the resistor chamber.

The high voltage cable, best seen in FIGURE 6, has an outer covering of conductive braid 95 surrounding a neoprene sheath 96. Within the sheath is an inner braid 97 of conductive material which overlies the polyethylene insulating body 70. The high voltage fitting which is secured to the cable and provides for attachment of the cable to the lower end of support 26, includes a ferrule 98 and a threaded ring 99. Ferrule 98 has bore portions 98a and 98b of differing diameter. The outer steel braid and neoprene sheath are cemented to narrower bore portion 98a. It is important that a good electrical connection be formed between the inner braid and the ferrule, to ground the apparatus through the inner braid which is grounded at the high voltage power supply 19. Thus, elbow 58, support 26 and coating material valve 22 (FIGURE 1) are electrically grounded.

A quantity of conductive epoxy cement 100 connects the braid and ferrule. The remainder of the recess between the ferrule and the cable is filled with a body 101 of structural epoxy cement which bears against shoulder 102, locking the cable and ferrule together.

An O-ring 105 seals the joint between the rear portion of the barrel 15 and high voltage circuit housing leg 66, to prevent air from chamber 43 escaping into elbow 58. Cable 70 is sealed with the interior of housing leg 67 by an O-ring 106.

While we have shown and described certain embodiments of our invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

We claim:

1. An electrostatic spray coating apparatus comprising, a barrel of nonconducting material having a bore therein, said bore defining a coating material chamber at the forward end of the barrel; a plug in said bore closing the rear of said coating material chamber, and sealed at its periphery with the wall of the bore, an electrical conductor passing through the forward wall of the plug, and a seal between the conductor and the plug, said plug having a recess in the rear thereof; a casing of insulating material forming a high voltage circuit housing carrying electroconductive means including a resistor and extending forwardly through said bore to said plug, said housing and resistor extending into the recess and being sealed with the plug wall, the resistor being connected with said conductor; means at the front of said barrel defining a coating material discharge orifice connected with said

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coating material chamber and an atomizing air orifice, a passage connecting said atomizing air orifice with a source of air and a spray charging electrode operably associated with said coating material discharge orifice and connected with the resistor by said conductor.

2. An electrostatic spray coating apparatus comprising, a solid barrel of nonconducting material having a bore therein, said bore having a portion of small cross-section adjacent the forward end of the barrel, and a portion of larger cross-section throughout the remainder of its length, there being an annular cavity in the wall of the bore adjacent the rear of the barrel; a plug in said bore seated at the transition between the portions of large and small cross-section of the bore and sealed at its periphery with the wall of the bore, an electrical conductor passing through the forward wall of the plug, and a seal between the conductor and the plug; a casing of insulating material carrying electroconductive means to define with the annular cavity an annular air chamber at the rear of said barrel; means at the front of said barrel defining a coating material discharge orifice, an atomizing air orifice, and a shaping air orifice; a first passage in said barrel connecting said atomizing air orifice with said annular chamber; a second passage in said barrel connecting said shaping air orifice with said annular chamber; and a spray charging electrode operably associated with said coating material discharge orifice and connected with the electroconductive means by said conductor.

3. The spray coating apparatus of claim 2 wherein said plug has a recess at its rear, into which said conductor extends and the forward end of said casing is received in and sealed with said recess.

4. In an electrostatic spray coating apparatus comprising a gun having a barrel with a bore therethrough, a coating material chamber in the bore at the front of the barrel, means defining a coating material discharge orifice at the front of said chamber, a wall closing the rear of the coating material chamber and a spray charging electrode operably associated with the coating material dis-

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charge orifice and having a connector portion at the rear of said wall, the improvement which comprises: a high voltage circuit connected with the connector portion of said electrode and including a high voltage housing with two hollow legs, one located in said barrel and the other extending at an angle therefrom, the axis of said one leg intersecting an inner wall of the other leg; a resistor in said one leg of the high voltage housing, said resistor having conductive surfaces at each end; a first spring in said one leg of the housing and acting between the rear end of said resistor and the inner wall of said other housing leg; a high voltage cable having a conductive surface at one end thereof located in the other leg of said housing; and a second spring in said housing between the conductive cable surface and the first spring.

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