

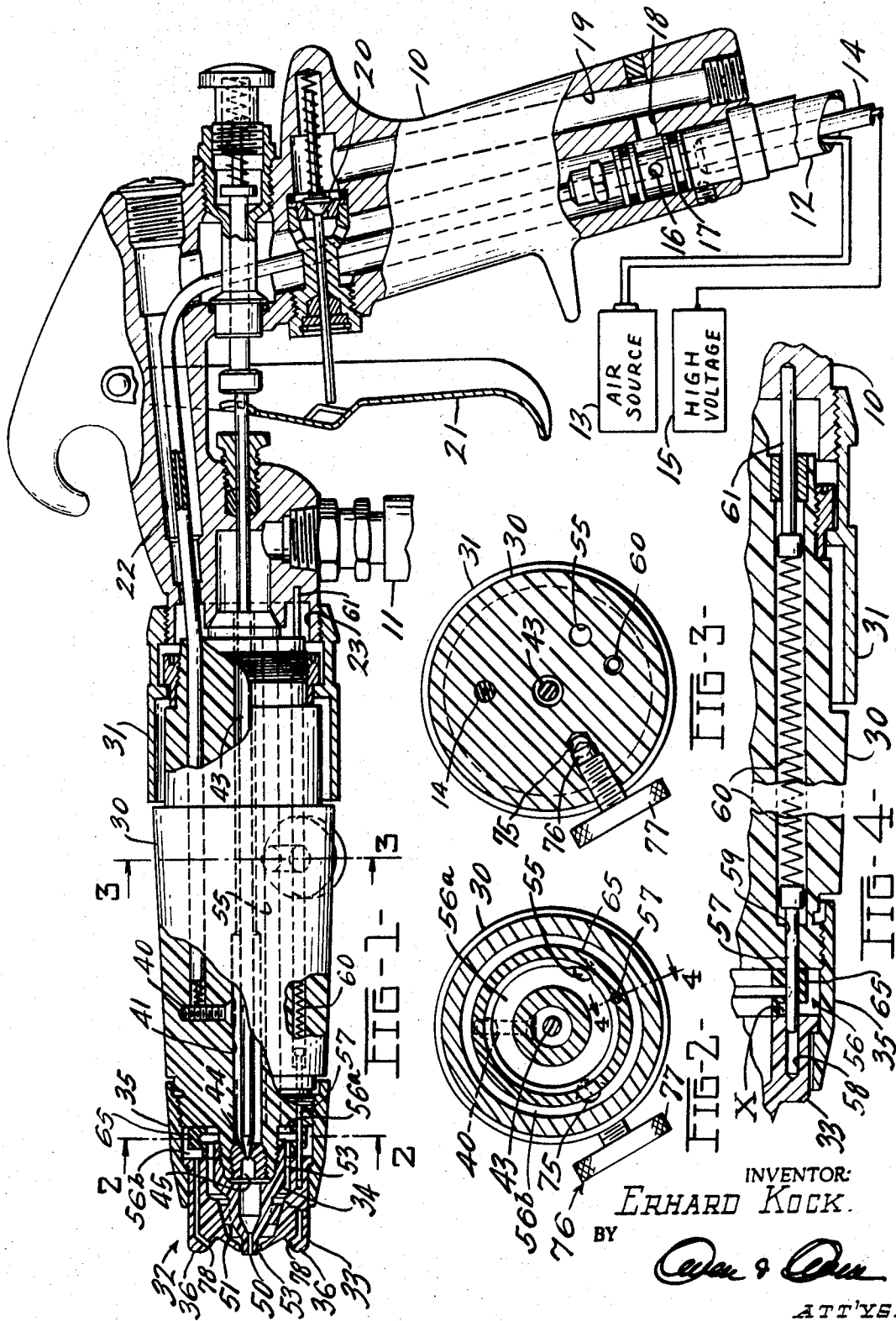
Oct. 7, 1969

E. KOCK

3,471,089

ELECTROSTATIC SPRAY GUN

Filed Jan. 10, 1968



1

3,471,089

ELECTROSTATIC SPRAY GUN

Erhard Kock, Toledo, Ohio, assignor to The De Vilbiss Company, Toledo, Ohio, a corporation of Ohio
Filed Jan. 10, 1968, Ser. No. 696,938
Int. Cl. B05b 5/02

U.S. Cl. 239—15

6 Claims

ABSTRACT OF THE DISCLOSURE

The invention is directed to an air atomizing electrostatic spray gun having a spray head of insulating material. Electrostatic charging of the fluid stream is accomplished by conduction, and it has been found that prolonged spraying causes a charge to accumulate on the spray head, with a resulting deterioration in transfer efficiency. The invention includes means to maintain the efficiency of the system by the incorporation of a grounded electrode to remove any accumulation of charge from the front surfaces of the gun.

BACKGROUND AND BRIEF DESCRIPTION OF THE INVENTION

It has long been known that an electrostatic charge can be imparted to sprayed paint particles by conduction from an electrode recessed within the gun. Preferably, the distance to the electrode from the front of the gun is in excess of the distance that can be referred to as the "sparking distance" in air. Such guns comprise a spray head made of insulating material such as glass or plastic. Being held by a grounded handle or support the surface of the gun body, then, is subject to a potential difference from the discharge end where the potential is at or near the potential of the charged material stream, to ground potential at the support. It has recently been discovered that it is desirable in the interests of high transfer efficiency to avoid building up a charge or potential on the surface of the spray head which might distort an electrostatic field between the spray head and the grounded work being coated. In contradistinction to known spray guns in which the coating material stream is charged by ion bombardment, conduction charging is accomplished by transfer of potential directly from the recessed electrode to the fluid coating material stream and there is no well defined point of origin for an electrostatic field between the spray head and the grounded work.

I have found that an electrostatic spray gun having a plastic spray head and in which the coating material stream is charged by conduction has a relatively high transfer efficiency when spraying first commences, but deteriorates in efficiency after spraying persists. The time required for efficiency deterioration depends on many factors which are not presently fully understood and may require from several seconds to several minutes. The full efficiency of the gun can be restored by periodically grounding the spray head or sometimes by periodically triggering the gun on and off. I have now found that the efficiency can be substantially maintained during even the most prolonged spraying if a grounded path is established over which the surface charge, if one exists, may be dissipated continuously during operation of the gun.

Since it is ideally necessary for the front elements of the spray gun to be made of a plastic material, and since it is also highly desirable that the fluid control needle for the spray gun be located close to the front thereof to prevent an excessively long column of liquid from standing in the gun when it is turned off, I have found it to be important that the fluid control needle for the spray gun be made of a plastic material and that the valve seat with

2

which the needle cooperates should also be made of a plastic material and, therefore, easily replaceable from the front of the gun.

It the spray gun is of the type that utilizes air horns to produce a fan-shaped pattern, I have found that regulation of the air flow to the air horns should be accomplished separately from any regulation of the air flow to the orifice or orifices from which atomizing air is discharged. The present invention provides a simple and expedient seal at the spray head in which atomizing air and shaping air can be divided into separate and independently controllable passages.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred form of the invention is shown in the attached drawings, in which:

FIG. 1 is a longitudinal sectional view, with parts in full, and other parts diagrammatically shown, of an electrostatic spray gun embodying the present invention;

FIG. 2 is a section on line 2—2 of FIG. 1, somewhat enlarged;

FIG. 3 is a section on line 3—3 of FIG. 1, somewhat enlarged; and

FIG. 4 is a fragmentary section on line 4—4 of FIG. 2.

One form of an electrostatic spray gun incorporating the present invention, as shown in the drawings, includes a metallic electricity conducting, grounded, handle and body portions 10 into which fluid coating material is fed by a fluid hose 11. Air for atomizing and, if desired, shaping a spray of coating material enters the handle end of the gun through an air hose 12 from any convenient air source 13. The air hose 12 is woven with a conventional grounded strand in its wall so that the gun body and handle may be grounded in a known manner. An insulated charging wire or cable 14 is taken from a power source 15 inside the air hose 12 to connect to the electrostatic charging system hereinafter described.

Within the handle portion of the spray gun the air is passed through a series of radial passages 16 in a fitting 17 and thence through an opening 18 into the normal gun air passage 19 which is controlled by a conventional air valve 20 operated by a trigger 21.

At the front of the metallic body portion 10 the spray gun includes a barrel 30 of insulating material held against the body by a gland nut 31. A spray head 32 of insulating material consisting of an air cap 33 and a fluid tip 34 is attached to the end of the barrel 30 by an insulating gland nut 35. In one form of spray gun the air cap is provided with air horns 36. Details of the air cap and fluid tip will be subsequently disclosed.

The charging wire or cable 14 passes through the normal air passage 19 of the spray gun into the insulating barrel portion and through an axial bore extending part-way through the barrel where the cable contacts a charging electrode 40 which extends radially of the barrel into a coating material passage 41 which extends through the barrel 30 and receives coating material from the fluid hose 11. An elongated needle valve 43 controls the discharge of coating material from the passage 41 and the needle valve is operated by trigger 21 in the normal manner. The needle valve seats against a valve seat 44 formed in a plastic material element 45 that is threaded into the front of the barrel 30. The front portion of the needle valve, at least that portion thereof within the barrel 30, is made of a plastic material so that the plastic needle valve 43 seats against the plastic seat 44. Fluid coating material in the passage 41 is charged by conductivity from the charging electrode 40, and the electrode 40 is spaced rearwardly from the front of the gun by a distance greater than the sparking distance in air. The electrode 40 is charged to a voltage that is lower than the voltages used with present electrostatic spray guns in which charging

of the spray particles takes place by ion bombardment. In such known guns the charging voltage must be high enough (at least 40 kv.) to cause substantial ionization of air in the vicinity of the charging electrode which is usually made as a sharp point. With conduction charging as in the present spray gun there is no measurable air ionization.

The fluid tip 34 comprises an insulating body that is threaded to the end of the insulating barrel 30. Fluid passing from the fluid needle valve flows through the interior of the tip 34 to a discharge orifice 50 which may be a single axial hole or may be an annular orifice as is known from the copending application of Juvinal and Kock Ser. No. 677,981.

The fluid tip is formed with locating and centering ribs 51 that engage the interior surfaces of the air cap 32 to maintain the proper location of these cooperating parts.

The air cap 32 is an insulating body formed with a central air orifice 53 which cooperates with the exterior of the fluid tip 34 to form an annular discharge passage for the atomizing air. Atomizing air is taken from space 23 at the front of the metallic gun body 10 through a longitudinal bore or passage 55 (FIGS. 1 and 3) to an annular space 56 within the gland nut 34 and at the front of the insulating barrel 30. The air thus flows from the annular space 56 to the annular atomizing air orifice 53.

The air cap is located circumferentially relative to the barrel 30 by a plurality of locating pins 57 which extend into holes 58 in the air cap and into holes 59 in the barrel (FIG. 4). At least one of the locating pins 57, in accordance with the present invention, is made of metal and is made to perform an additional function. The metal pin 57 is grounded, through an elongated spring 60, back to the gun body 10 through a barrel locating pin 61. It will be apparent that other metal elements may be used as a grounding electrode which perform no locating function.

It has been found that an electrostatic spray gun in which the discharged fluid is charged by conduction as in the present instance by the electrode 40 will exhibit a satisfactorily high transfer efficiency when spraying first commences, but that the transfer efficiency falls off after prolonged spraying. Transfer efficiency is a ratio of paint sprayed to paint actually deposited on the work and should obviously be kept as high as possible. The time required for deterioration may vary from a few seconds to several minutes. It has also been found that the initial high efficiency can be restored if the spray head (the air cap, the fluid tip and the gland nut surfaces) are periodically grounded as by touching the exterior of the spray head with a grounded wand. At times, even triggering the spray gun on and off seems to have a similar effect. The precise reason for this phenomenon is not fully understood but it is believed to be attributable to the accumulation of a potential or charge on the exterior of the spray head which serves to distort or diminish the electrostatic field between the spray gun and the work. With conduction charging of the paint stream there is no well defined electrode for the origin of the electrostatic field as is the case where the paint is charged by ion bombardment. It has been determined that the presence of a grounded electrode in contact with the surface of the spray head has the effect of noticeably increasing the transfer efficiency of the spray gun, probably by dissipating the charge accumulated on the surface of the spray head. In the form shown, the pin 57 is in contact with the surface of the spray head or air cap at point X and, of course, is grounded through the elongated spring 60 and the barrel locating pin 61 to the gun body 10. It will be seen that the electrode is protected by the volume insulation of the air cap 32 and of the barrel 30 so that there is no current flow between the charged paint stream and the grounded electrode. It is believed that any charge that accumulates on the surface of the air cap will flow over the surface under the gland nut 35 to grounded point X, and, any charge that accumulates on the exterior of the fluid tip has a similar leakage

path across the exterior surface of the fluid tip to the interior surface of the air cap by reason of the mating relationship between the interior of the air cap and the ribs 51, thence along the remaining interior surface of the air cap to the grounded point X.

The phenomenon of charge accumulation, if this be the reason for efficiency deterioration, appears to be related not only to the surface configuration of the front of the spray head, but also to the surface and volume characteristics of the material from which the spray head is made.

In one spray gun according to the present invention, the air cap is provided with air horns 33 which serve to discharge shaping air jets against the atomized fluid stream so that the pattern of sprayed particles is elongated or fan-shaped. Air horns for similar purposes are, of course, well known in the art. In conventional air atomizing spray guns the air horns protrude beyond the front of the gun. In the present instance the air horns are rounded off to prevent field concentration and, for the same purpose, terminate about in a plane passing radially across the atomizing air orifice 53. As shown in FIGS. 2 and 3 the insulating barrel 30 is provided with two angularly spaced axial air passages 55 and 75 from air space 23 at the front of the gun body 10 to the annular space 56 within gland nut 35.

To separate the air in this latter annular space there is a readily compressible seal 65 within the annulus which is compressed axially between the rear face of the air cap 33 and the front of the barrel 30. The seal 65 divides the annulus 56 into two radially spaced chambers with the inner chamber 56a receiving atomizing air from barrel passage 55 while the outer chamber 56b receives shaping air from barrel passage 75. The passage 75 is provided with an adjustable valve 76 intermediate its length, and valve 76 is operated manually by a knob 77 extending radially from the barrel. By this expedient the air flowing to the outer chamber 56 is adjustable independently of the quantity of air to the inner chamber 56a which is used for atomization. From the outer chamber 56b the air is led into the axially and inwardly directed passages in the air horns 33, said passages being designated 78 in FIG. 1. By adjusting the position of valve 76 through knob 77 the operator can elongate the pattern to any desired extent or, by shutting off the shaping air can utilize the spray gun with a round pattern which is, in some instances, advantageous when spraying highly open articles such as bicycle frames or tubular metal furniture.

While the invention has been disclosed in conjunction with a specific form and disposition of the parts, it should be expressly understood that numerous modifications and changes therein may be made.

What I claim is:

1. In an electrostatic spray gun having a barrel and spray head of insulating material in which a stream of fluid material is charged by conduction from an electrode recessed in the barrel and in which the coating material is atomized by interaction with air, the improvement comprising a grounded electrode recessed within the spray head, said electrode being insulated from the charged fluid material stream by the insulation of the spray head and in direct contact with the surface of the spray head to dissipate any undesirable charge accumulation on such surface.

2. The improvement defined in claim 1 in which the spray gun has a grounded metallic body portion and an insulating barrel, and said electrode extends axially through said barrel to said grounded body portion.

3. In an electrostatic spray gun, a metallic handle and body portion, an insulating barrel carried by and extending forwardly from said body portion, said barrel having axial passages therethrough for the passage of air and fluid coating materials, means to supply air and fluid coating materials respectively to said passages, a valve seat of insulating material received in said barrel at the

5

front thereof and at the front of said fluid coating material passage, said valve seat being removable from the front of said barrel, a needle valve disposed in said coating material passage and operable by a trigger carried by said body portion, at least that portion of said needle valve within said barrel portion being of insulating material and cooperating with said insulating valve seat to control the flow of coating material from said passage, a fluid tip of insulating material threaded to the end of said barrel and having a bore therethrough to receive coating material from said valve seat and terminating in a forward discharge orifice, an air cap of insulating material carried by said barrel portion in surrounding relationship to said fluid tip, said air cap having an annular air orifice surrounding said fluid orifice and receiving air from said barrel air passage to atomize coating material discharged from said discharge orifice, a charging electrode carried in said insulating barrel and having a portion thereof extending into said fluid coating material passage rearwardly of said fluid orifice, and means to impose a voltage on said electrode sufficient to cause atomized particles discharged from said discharge orifice to carry a significant electrostatic charge.

4. The combination of elements defined in claim 3 in which said barrel has two axial passages for air, one of said passages carrying air directed to said annular air

6

orifice and the other of said passages carrying shaping air, air horns carried by said air cap to receive said shaping air and to discharge it against a stream of atomized particles, and means to control separately, the air flowing in said atomizing air passage and said shaping air passage.

5. The combination of elements defined in claim 4 in which said air horns terminate in a plane that is not beyond a plane passing radially across said atomizing air orifice.

6. The combination of elements defined in claim 3 and a grounded electrode recessed within said barrel, said electrode being insulated from said charged fluid material passage and in direct contact with the surface of said air cap, said electrode extending through said barrel to grounding contact with said metallic body portion, whereby a surface charge built up on said spray head will be dissipated to said body portion.

References Cited

UNITED STATES PATENTS

3,056,557	10/1962	Walberg	118—629	X
3,317,138	5/1967	Fraser	239—15	

ROBERT B. REEVES, Primary Examiner

H. S. LANE, Assistant Examiner