United States Patent

Cowan

[15] **3,653,592**

[45] **Apr. 4, 1972**

[54] ELECTROSTATIC SPRAY GUN CONSTRUCTION

[72] Inventor: **Philip L. Cowan,** Basking Ridge, N.J.

[73] Assignee: **Electrogasdynamics, Inc.,** Hanover, N.J.

[22] Filed: **May 7, 1970**

[21] Appl. No.: **35,428**

[52] **U.S. Cl.**.....**239/15,** 239/412, 239/415, 310/6, 317/3

[51] **Int. Cl.**.....**B05b 5/02**

[58] **Field of Search**.....239/3, 15, 410, 411, 412, 414, 239/415, 526, 527, 528; 310/5, 6, 11; 317/3

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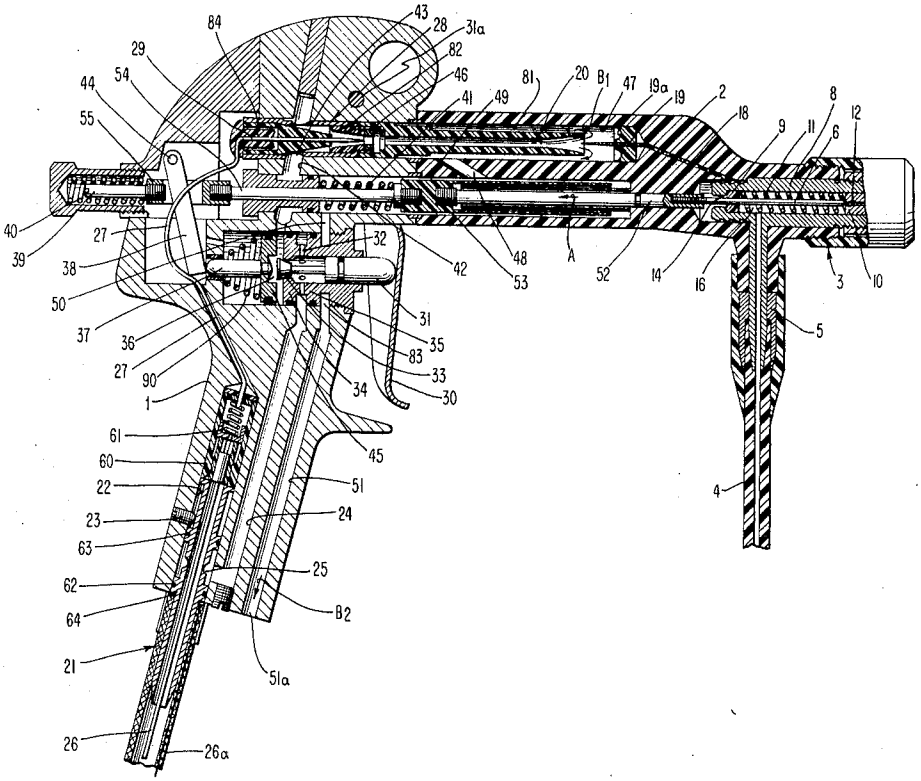
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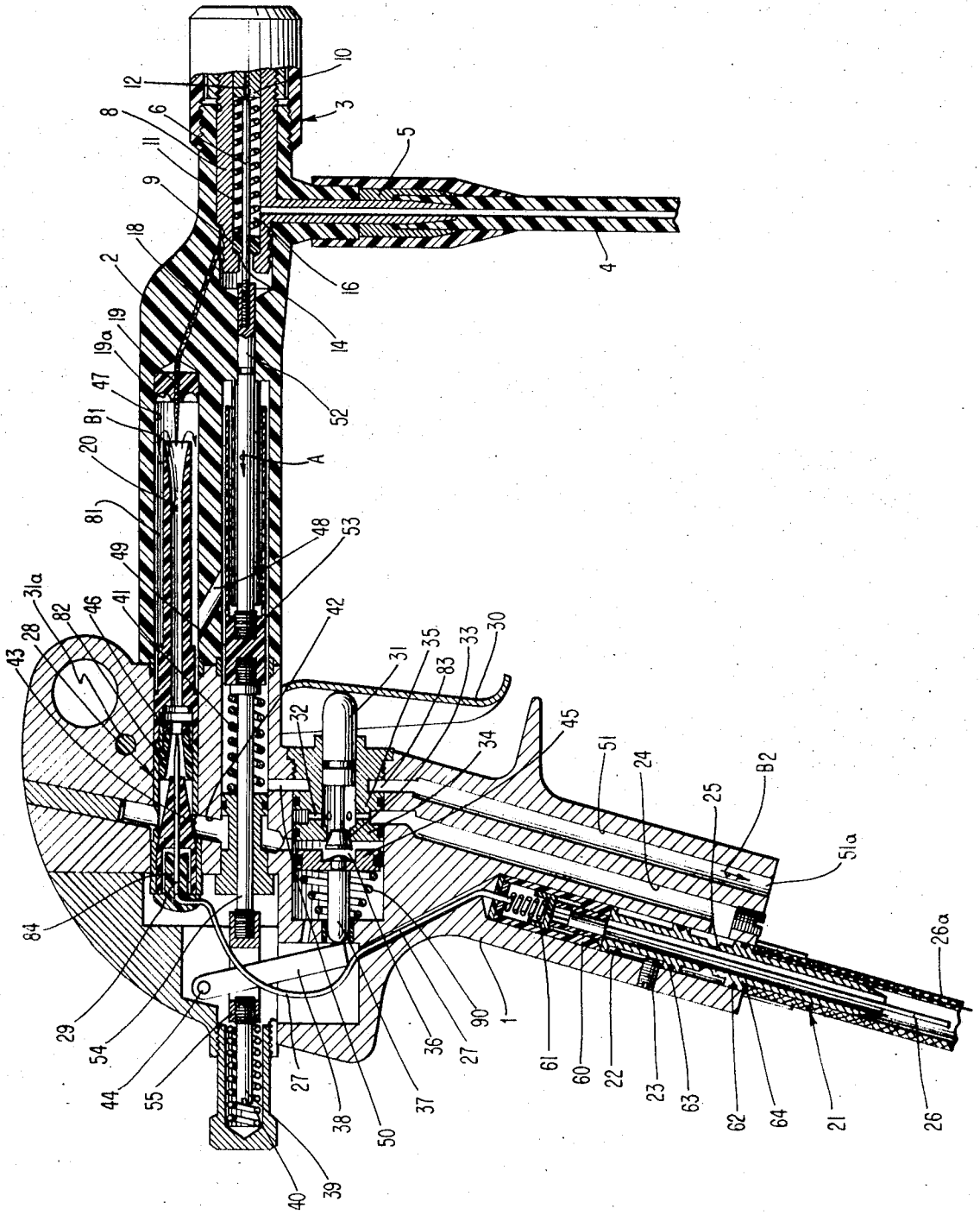
Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—Michael Y. Mar
Attorney—Robert E. Isner and Peter J. Franco

[57] **ABSTRACT**

An improved construction for a hand operated electrostatic spray coating device of the so-called airless type in which atomization is effected by the interaction of a high speed fluid stream with air, including a self-contained electrogasdynamic generator as a power source for charging the spray and maintaining an electrostatic depositing field and a pneumatically assisted fluid valve mechanism operatively responsive to at least a portion of the air flowing through the electrogasdynamic generator.

6 Claims, 1 Drawing Figure





INVENTOR.
PHILIP L. COWAN

BY

ATTORNEY

ELECTROSTATIC SPRAY GUN CONSTRUCTION

This invention relates to hand-operated electrostatic spray coating equipment and particularly to an electrogasdynamic powered device of the so-called airless type.

In the airless type of spray device wherein liquid coating material is emitted from an orifice as a thin high speed current liquid stream and is converted into a particulate spray by interaction with the ambient air downstream of the point of emission thereof, hydraulic pressures in the order of 300 to 3,000 p.s.i. are used to effect the emission of the liquid from the orifice. The required utilization of such high pressures to effect liquid emission has rendered manual control of such emission difficult because of the conflicting requirements of high sealing forces in the fluid control valve and the desired rapid or snap action of the fluid valve to prevent "dribbling" and "spitting" or incomplete atomization during opening and closing of the fluid valve. The provision of rapid fluid actuation without undue operator fatigue has been heretofore achieved typically through the use of special mechanical linkages or by means of a trigger operated pneumatic cylinder for fluid valve actuation.

This invention may, in its broad aspects, be briefly described as an improved construction for electrostatic hand spray guns that incorporate a self-contained electrogasdynamic power generator and in which the compressed air utilized to operate the electrogasdynamic power generator is utilized to provide a power assist to a manually operable trigger system to conjointly control both the release of liquid coating material and the generation of power for both charging the atomized coating materials and maintenance of the electrostatic depositing field therefor.

Among the advantages of the subject invention is the provision of an improved spray device of the "airless" type for use in electrostatic spray coating systems, which incorporates a self-contained electrogasdynamic power generator and is readily manipulatable and manually controllable, field serviceable, lightweight and relatively small in size. A further advantage is the provision of an easily manipulatable trigger assembly affording precise and rapid manual control of emission of liquid coating material over a wide range of liquid pressures without undue operator fatigue.

Other objects and advantages of the subject invention will become apparent from the following portion of this specification and from the appended drawing which illustrates, in accord with the mandates of the patent statutes, the principles of the invention as embodied in a presently preferred construction of an "airless" type of electrostatic paint spraying hand gun.

The drawing is a vertical section through the electrostatic hand spray gun constructed in accord with the principles of this invention.

Referring to the drawing, there is generally illustrated a hand manipulatable electrostatic paint spraying gun of the so-called "airless" type in which atomization of an emitted high speed coherent liquid stream of coating material, such as paint, is effected by interaction with air downstream of the point of emission thereof. The spray coating system in which a gun of this type would conventionally be employed includes a compressed air supply, a paint supply, a paint pump and an air hose connecting the source of compressed air to both the paint pump and to the hand gun. Preferably the compressed air supply line includes means for seeding the gun air supply with a condensible vapour and independent regulator and gauge assemblies which provide discrete and independent operational control over the pressure to the paint pump. The paint supply usually includes a reservoir and an air driven pump which draws paint from the reservoir and delivers it to the gun through a high pressure flexible hose.

The illustrated gun includes a selectively configured insulating barrel portion **2** having a pistol grip type of conducting handle portion **1** mounted at one end thereof and an atomizing nozzle and charging assembly, generally designated **3**, at the other end thereof. Disposed within the barrel portion **2** is a self-contained electrogasdynamic high voltage generator, generally designated **28**. The details of a preferred construction and mode of operation therefor are disclosed and described in my copending application Ser. No. 788,149, filed Dec. 31, 1968, now abandoned and reference should be had thereto for such details.

Suitable liquid coating material, such as paint, is introduced into the atomizing nozzle and charging assembly **3** under high pressure through a paint supply line **4** connected to a suitable fitting **5** disposed on the underside of the barrel portion **2**. A preferred construction for the atomizing and charging assembly **3** is disclosed in my copending application, Ser. No. 35,145, filed May 6, 1970, and reference should be had thereto for a detailed description of the structure and mode of operation thereof.

Insofar as here pertinent, such nozzle and charging assembly **3** includes a sleevelike member **8** defining a coating fluid reservoir **16** that is closed at its forward end by a valve plug member **10** having a longitudinal bore **12** through which fluid coating material is permitted to flow during coating operations. Disposed within rear end **14** of the reservoir **16** is a washerlike seal **9** disposed about a displaceable valve rod **6** and maintained in sealing relation by the helical spring **11**. The seal **9** prevents coating fluid from exiting from the rear of the reservoir **16** independent of the position of the valve rod **6**. The valve rod **6** has a convex end face in sealing relation with a valve seat entry portal of the bore **12** in the valve plug **10**. Retraction displacement of the valve rod **6** as indicated by the arrow A opens the bore **12** and permits coating fluid to flow from the supply hose **4** through reservoir **16** and through the bore **12** for ultimate emission through a selectively contoured orifice downstream thereof.

In order to desirably minimize the number of connecting conduits and thereby markedly add to the case of manipulation of the subject gun, the seeded air and the excitation voltage for the electrogasdynamic power generator **28** are conjointly supplied to the gun via a composite conduit and specialized entry fitting and connector unit, as described in detail in my earlier mentioned copending application. More specifically, the exciter voltage supply lead **26**, suitably in the form of an insulated wire, is disposed within the seeded air supply line **26***a* which carries seeded air, suitably under pressures in the range of from 40 to 75 p.s.i.g. or even higher. The composite seeded air-excitation voltage supply conduit terminates in a selectively shaped connector assembly generally designated **21** that is removably insertable through an aperture in the base of the handle **1** into a bore **22** longitudinally disposed therein. Disposed within the upper reaches of the bore **22** is an elongate insulating sleeve **60** surrounding a spring biased electrical contact receptacle type assembly comprising a displaceable receptacle type contact member **61** connected to one end of an internally disposed insulated excitation voltage lead **27** that is terminally connected to the electrogasdynamic power thereof.

The connector assembly **21** generally comprises a selectively shaped elongate sleeve assembly **64** incorporating a plurality of seeded air escape apertures **25** bounded by a pair of O-ring seals **62** and **63** disposed in the walls of the sleeve member **64** on either side of the seeded air escape apertures **25** for disposition in sealing relation with the walls of the bore **22** to prevent leakage of the compressed seeded air therepast and to direct such seeded atomizing air through aperture **25** into bore **24**.

As will be now apparent, insertion of the connector assembly **21** into the bore **22** serves to automatically effect proper interconnection of the gun to both the requisite supply of seeded compressed air and to the requisite source of excitation voltage for the electrogasdynamic power generator. The desired proper positioning of the connector within the bore is maintained by the set screw **23**.

The internally disposed excitation lead **27** is electrically connected, as at **84**, to the rear of the ionizing needle electrode **29** which is supported by an insulating mount in the rear of the electrogasdynamic generator **28**. The illustrated elec-

trogasdynamic power generator **28** broadly includes such a corona emitting or ionizing needle electrode **29**, a converging transition section **82**, an annular attractor electrode **46** and an elongate channel **20** together with a collector electrode **19** connected through lead **18** to the fluid nozzle assembly. The collector electrode **19** is mounted in an insulating support and flow director **19***a*. The electrogasdynamic power generator **28** is desirably designed such that the minimum gas flow diameter therein be less than one-tenth inch so as to insure the continued presence of sufficient operating pressures within the system.

In operation of the illustrated electrogasdynamic power generator unit, compressed air is introduced via the bore **42** and through entry ports **43** into a relatively large diameter and annularly shaped entry section so as to produce a relatively low flow velocity and minimal pressure drop in its passage therethrough. As the compressed seeded air moves through the conveying transition member **82**, it is markedly increased in speed with a concommitant drop in pressure as it approaches and passes through the attractor ring electrode **46**. After passage through the attractor ring electrode **46**, the air stream passes through the elongate channel **20** of relatively small diameter at near sonic velocity and exits into the bore **47**.

Control of release of coating fluid from the nozzle assembly and conjoint flow of compressed air through the electrogasdynamic power generator **28** is effected by pivotal displacement of a trigger **30** about its pivotal mounting pin **31***a*. Displacement of the trigger **30**, in the direction of arrow A, effects a conjoint rearward displacement of the valve shaft **31** which is slidably mounted within an annular and bushing shaped valve body **34** and is fixedly mounted in the handle portion **1**. The remote end of the valve shaft **31** operates an air valve assembly including a plug or sealing element **33** normally biased in sealing relation on the valve seat **32** of valve body **34**. The opening of the valve by retractive displacement of the shaft **31** and seal **33** permits air to flow from bore **24** through the orifices **35** in the valve body **34** and into the chamber **36**. The increase in the air pressure within chamber **36** effects a rearward displacement of the piston **45** again in the direction of arrow A against the action of its biasing spring **90**. Simultaneously therewith, the compressed air stream moves upward through bore **42** into and through the inlet port for the electrogasdynamic generator **28**. The piston **45** is fixed to the forward end of a piston rod or shaft **37**. Retractive displacement of the piston rod **37** in the direction of arrow A, as described above, effects a clockwise rotative displacement of the link **38** about its pivotal mounting **44**. The intermediate portion of the link **38** is operatively engaged by a coupling link **55** disposed between and interconnecting a stub shaft **39** and a connecting rod member **54**. The above described clockwise rotative displacement of the link **38** effects a conjoint retractive displacement of the stub shaft **39** against the action of the biasing spring **40** and of the connecting rod member **54** against the action of the biasing spring **41**. The connecting rod **54**, in turn, is connected by an insulating coupling member **53** to an insulating connecting rod member **52** which in turn is terminally connected to the valve rod **6**.

As will now be apparent, the above described retractive displacement of the connecting rods **54**, **52** and valve rod **6** opens the normally sealed valve entry portal to the bore **12** in the valve plug **10** and allows coating fluid to be displaced therethrough by the hydraulic pressure in the paint supply line **4** conjointly with the flow of seeded compressed air through the electrogasdynamic power generator **28** to initiate the application of high electrical potential to the charging assembly to effect charging of the emitted fluid coating material and maintenance of the electrostatic depositing field therefor. Because of the high hydraulic pressures extant in the fluid supply lines, the biasing springs **40** and **41** must be capable of normally applying a high degree of biasing force to valve rod **6**, closing the valve seat entry portal of the bore **12** in order to prevent leakage. Likewise, the spring **11** in the nozzle assembly **3** must be capable of applying sufficient force to the seal **9** to force the latter into tight compressive relation with both the surrounding walls and with the surfaces of the valve rod **6** passing therethrough, all of which cooperate in requiring the application of considerable force by the trigger components to effect displacement thereof. Such high required forces of course inherently militate against the rapidity of actuation that controls the emission of the coating liquid from the gun. As will now be apparent, the above described construction provides that most of the forces required to actuate and control the fluid emission is supplied by the compressed air pressure that is inherently required for operation of the electrogasdynamic generator **28** acting within the chamber **36** against the piston **45**. The degree of power assist that is to be supplied may be varied by selective sizing of the piston **45** and the mechanical advantage obtainable from the length of the link **38** and the location of its pivotal mounting **44**.

In the normal operation of the unit, the air exiting from the elongate channel **20** into the enlarged bore **47** flows, as indicated by the arrow **B1**, rearwardly in the annulus **81**, through the passage **48**, rearwardly in the annulus formed by the coupling member **53** and the bore **49**, past the forward end of the connecting rod **54** through the bore **50** and annular passage **83** in the valve body **34** and through the bore **51** as indicated by the arrow **B2** in the handle **1** to exit from the aperture **51** in the face thereof, where it cannot exert any deleterious effects on the spray of atomized coating material being directed towards the article being coated.

I claim:

1. A spray gun for use in the electrostatic spray coating of fluids wherein grounded articles are coated by having charged atomized spray particles electrostatically attracted toward and deposited thereon comprising

means for atomizing liquid coating material and projecting the atomized coating material towards an article to be spray coated,

first conduit means for directing liquid coating material under pressure to said atomizing means including normally closed valve means for supplying the liquid coating material to said atomizing means when in open position,

said valve means including seating surface means and closure means adapted to be displaced out of engagement therewith by a force having a magnitude at least as large as a preselected value whereby said valve will be opened,

electrogasdynamic power generating means,

second conduit means for directing a stream of pressurized air to said electrogasdynamic generating means for passage therethrough for charging the atomized spray particles and for maintaining an electrostatic depositing field having one terminus adjacent to locus of atomization,

trigger means for controlling the flow of pressurized air to said electrogasdynamic generating means,

pressure sensitive means operatively engaging said closure means and responsive to the trigger controlled flow of pressurized air having a pressure proximate thereto exceeding a predetermined value for applying a force at least as large as said preselected force to said valve closure means for opening said valve means

said electrogasdynamic generating means having a minimum flow diameter selected to maintain a pressure proximate to said pressure sensitive means at least as large as said predetermined value, and

third conduit means for exhausting the air discharged from said electrogasdynamic generating means from said spraying apparatus.

2. A spraying apparatus according to claim **1**, wherein said pressure sensitive means includes piston means.

3. A spraying apparatus according to claim **2** further comprising linkage means operatively linking said piston means to said closure means for stepping up the force applied to said closure means.

4. The hand gun as set forth in claim 1 wherein said generator has a minimum flow diameter not exceeding one-tenth inch.

5. The hand gun as set forth in claim 1, wherein said trigger means includes a slidable shaft abutting a trigger member, said

shaft carrying the compressed air for said generator.

6. A hand gun as set forth in claim 5, wherein said slidable shaft of said trigger means carries a washerlike air valve element which seats on a valve seat.

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