

Feb. 4, 1969

R. O. PROBST

3,425,625

ELECTROSTATIC SPRAY DEVICE

Filed Aug. 11, 1967

Sheet 1 of 2

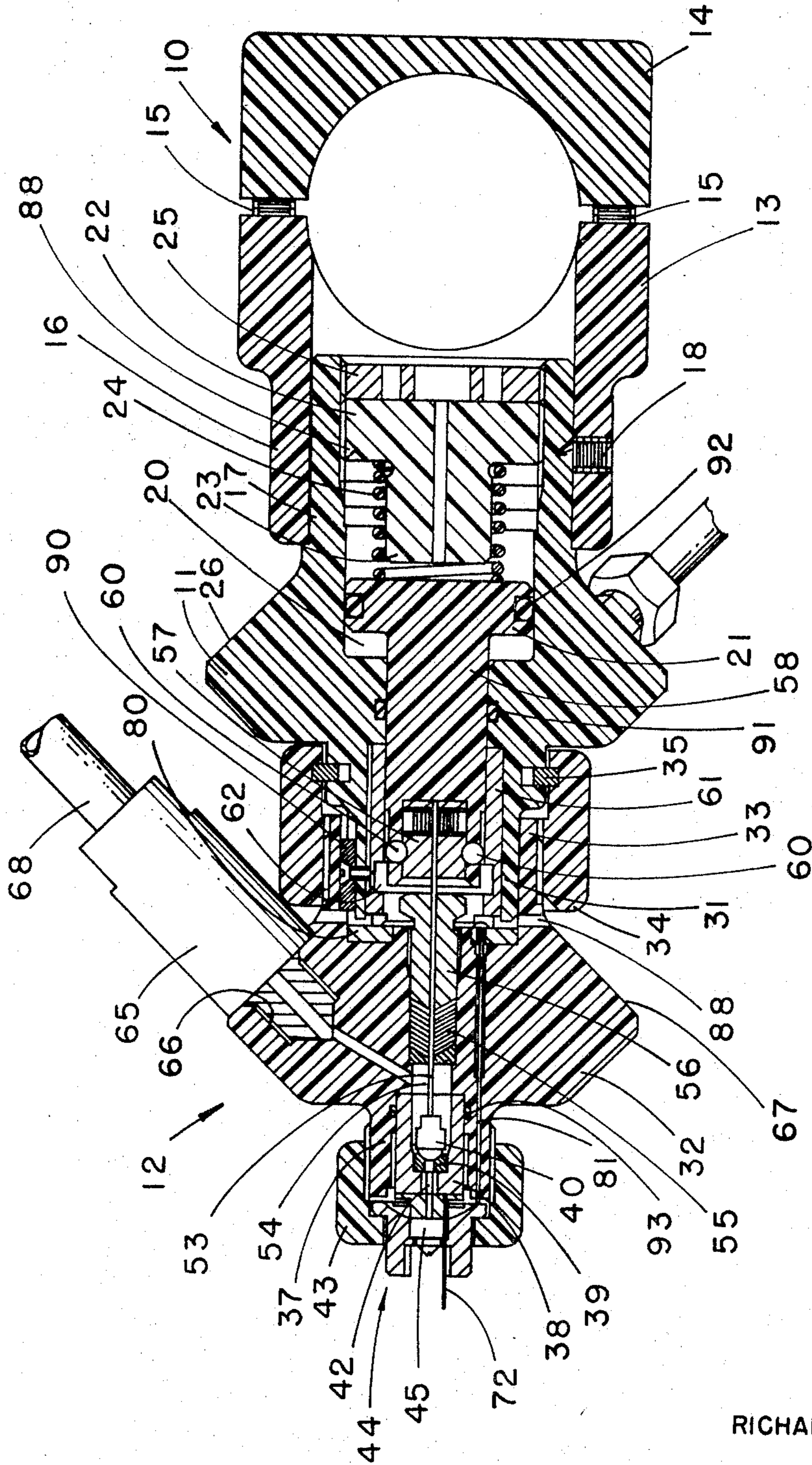


Fig. 1

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Sheet 2 of 2

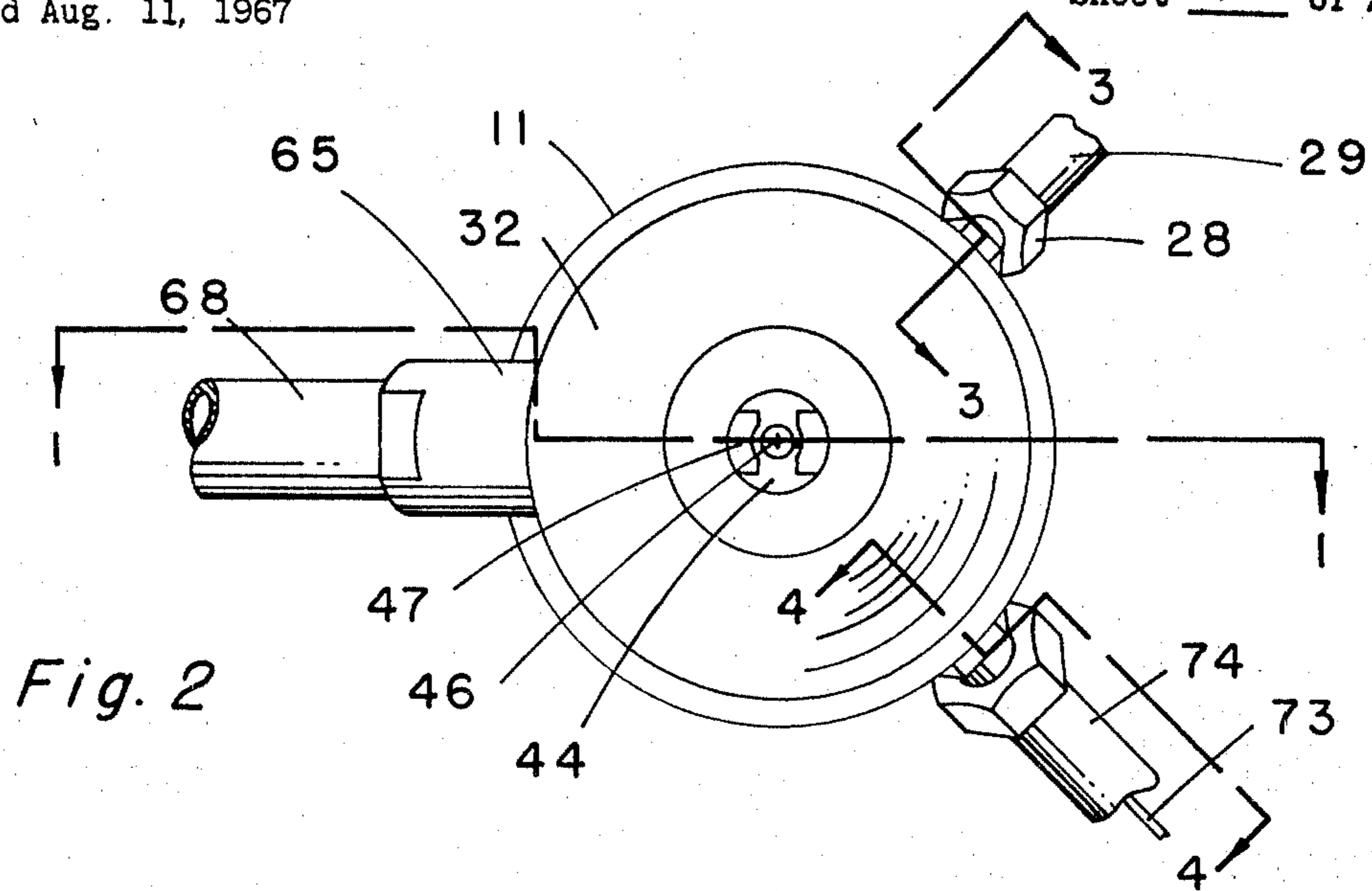


Fig. 2

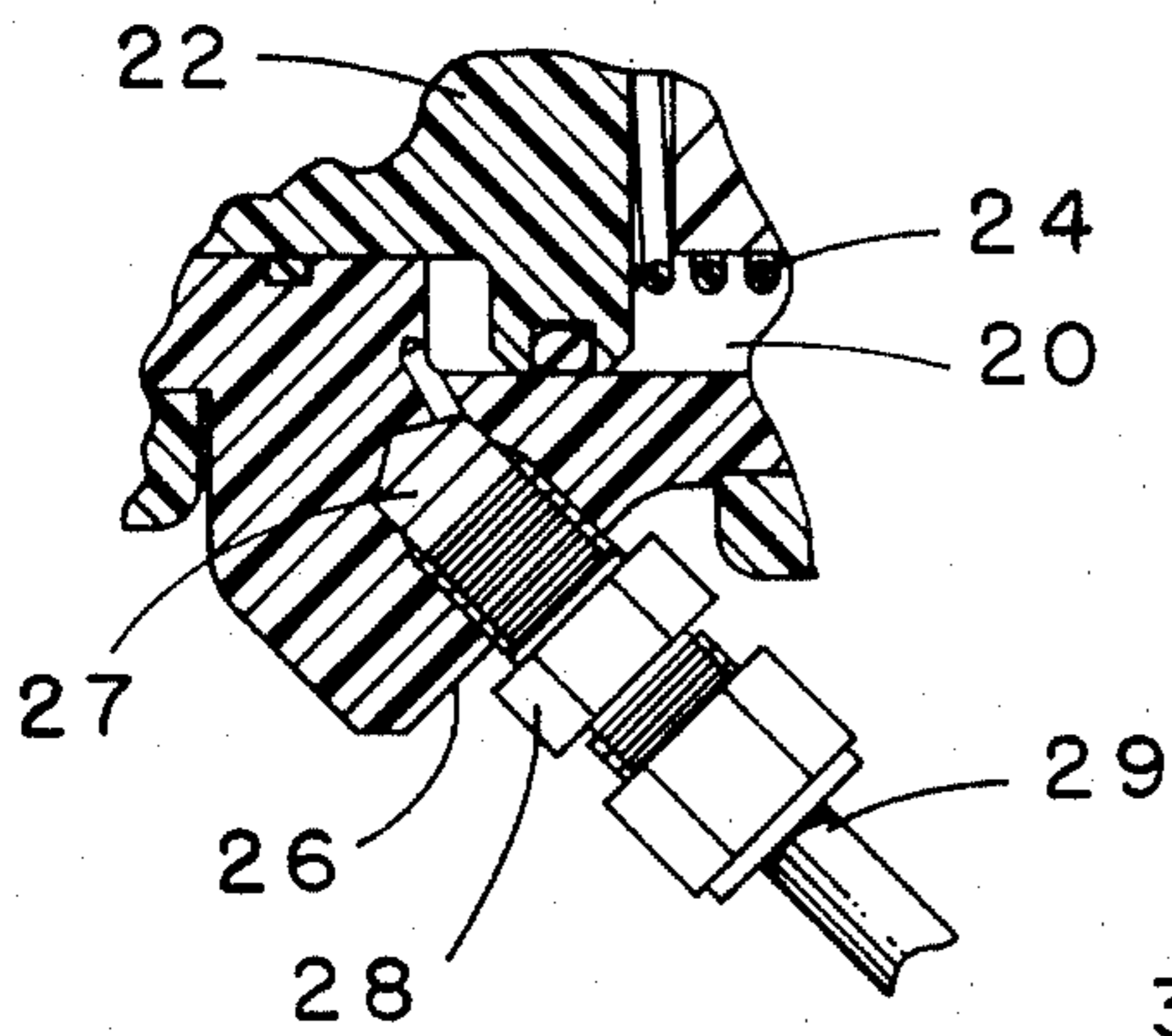


Fig. 3

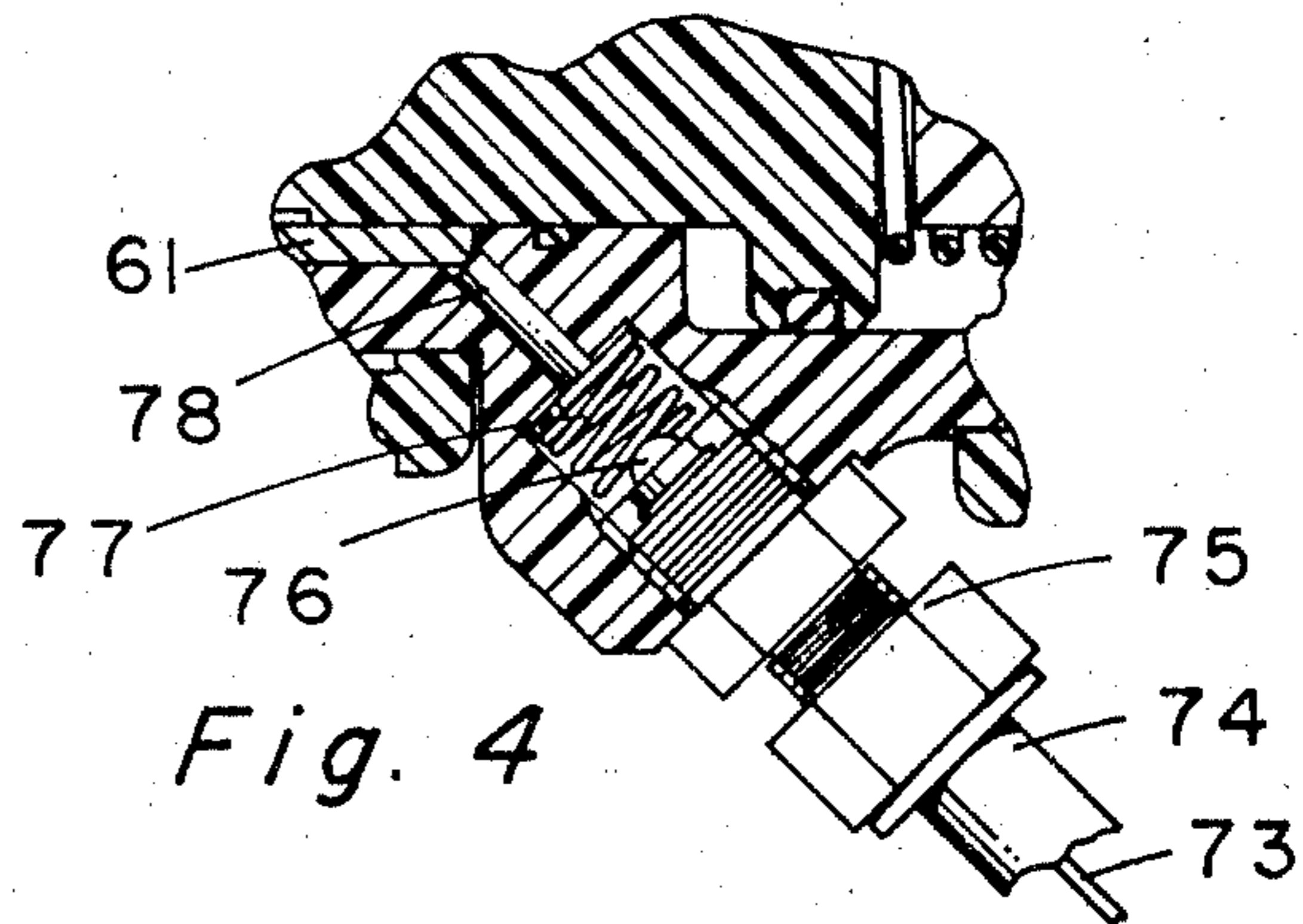


Fig. 4

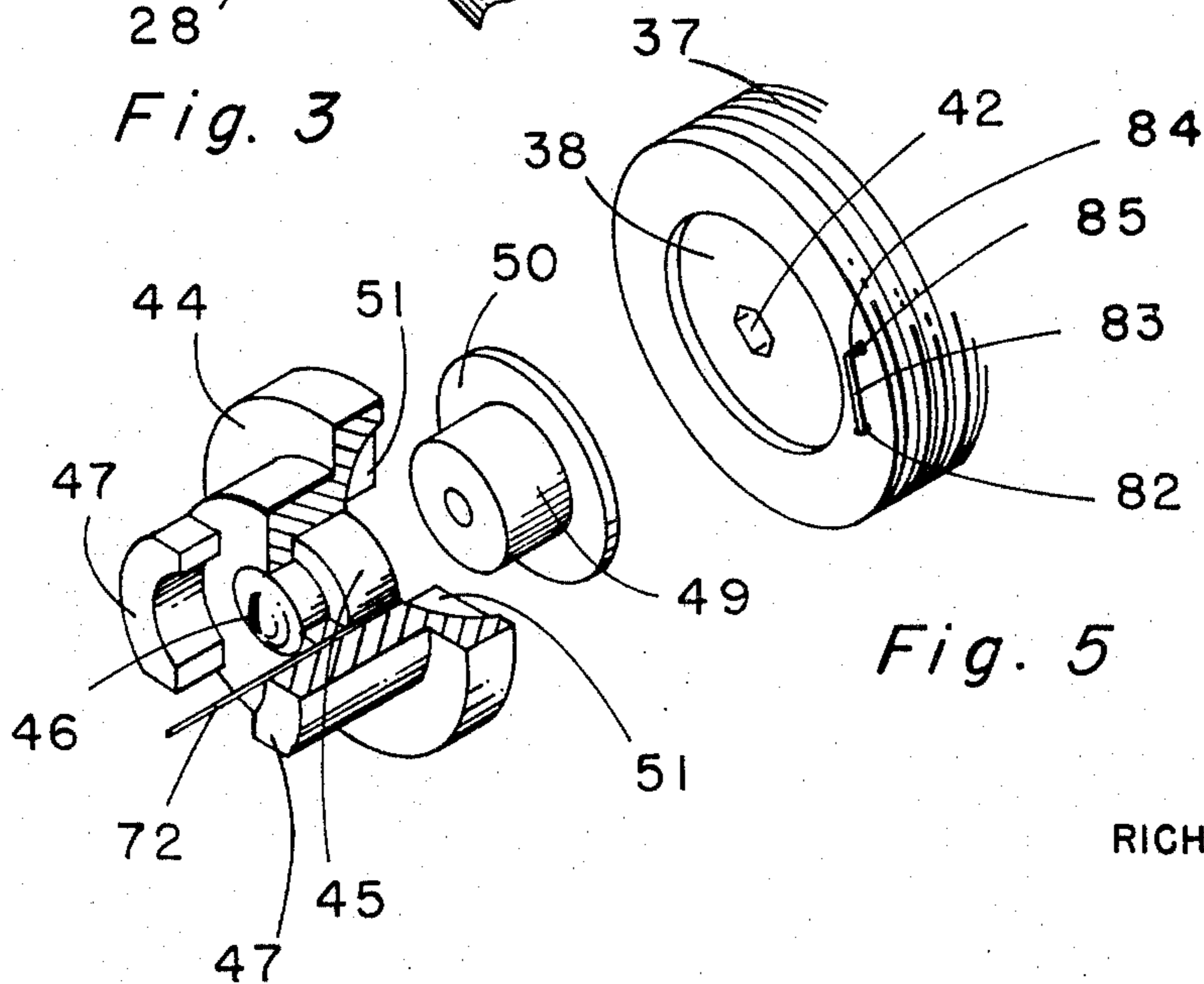


Fig. 5

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1

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ELECTROSTATIC SPRAY DEVICE

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12 Claims

Int. Cl. B05b 5/00, 1/32

ABSTRACT OF THE DISCLOSURE

A remotely controlled electrostatic spray gun comprising removably interconnected front and rear sections, each comprising a body of insulating material. The front section has (1) a liquid passage provided with a valve and terminating in a discharge orifice, (2) a spray charging electrode adjacent the orifice, and (3) a conductive element connected to said electrode and extending rearwardly therefrom. The rear section has a remotely controlled motor and a conductive element adapted for connection to a source of high voltage and for contact with the first mentioned conductive element when the two sections are assembled. Means for operatively interconnecting the motor and valve includes two members and a mechanism for automatically connecting them together when the two sections are assembled and automatically separating them when the two sections are separated.

This invention relates to an electrostatic spray gun for use in spray-coating systems, and more particularly to that type of gun in which paint is discharged through a small orifice at high velocity to be atomized by interaction with air and in which the atomized spray particles are charged by a needle-like or fine-wire electrode disposed at the side of the orifice. Primarily, the invention is concerned with a spray gun adapted for use in so-called "automatic" systems, in which articles to be coated are conveyed past the gun and in which the gun embodies a paint valve and a valve operating compressed-air motor adapted to be controlled from a remote point. Broadly, such guns are not new.

Among the more important objects of the invention are to produce a gun in which the paint-conveying and spray-charging elements are embodied in a subassembly readily separable from the remainder of the gun for purposes of replacement; to produce a gun whose outer and larger parts are adapted to be formed from insulating material; and to produce a gun in which the high-voltage supply cable, the paint line or lines, and the conduit supplying air to the valve-controlling motor can all be readily connected to the gun in such a manner that, without bending, they will extend away from the forward, or discharge, end of the gun.

A preferred form of gun embodying the invention comprises two removably interconnected sections, one an air-motor cylinder adapted to be secured to an appropriate mount and the other a subassembly including a body provided with paint passages, a nozzle, a paint valve, and the spray-charging electrode. The body of the subassembly is formed with a forwardly flaring frustoconical outer surface portion in which is located at least one opening communicating with the nozzle and adapted for connection to a paint conduit. The cylinder is also formed with a similar frustoconical surface portion containing an opening for the passage of the high-voltage lead and a second opening communicating with the air-motor cylinder and adapted for connection to an air line. Means automatically severable when the subassembly is removed from the cylinder provide an operative connection between the paint valve and the air motor,

2

and a second and similarly severable means provides an electrical connection between the electrode and the high-voltage lead. The gun may be arranged to be secured to a support through the medium of a two-member clamp which grips the support and in one member of which the cylinder is mounted. Preferably, the paint nozzle and valve are located on the projected axis of such cylinder, the cylinder is adjustable to different positions about such axis relative to the clamp, and the subassembly is similarly adjustable relative to the cylinder.

Other objects and features of the invention will appear from the following more detailed description and from the accompanying drawings in which:

FIG. 1 is an axial section through the gun on the line 1—1 of FIG. 2;

FIG. 2 is a front elevation of the gun;

FIG. 3 is a fragmental section on the line 3—3 of FIG. 2;

FIG. 4 is a fragmental section on the line 4—4 of FIG. 2; and

FIG. 5 is an exploded, isometric view showing, on an enlarged scale, the construction of parts at the forward end of the gun.

Referring to FIG. 1, it will be seen that the apparatus there shown comprises a clamp 10, a cylinder 11, and a subassembly 12 containing a paint valve, a paint nozzle, and a spray-charging electrode, all to be described in detail hereinafter. The gun proper consists of the cylinder 11 and subassembly 12, the clamp 10 being but one of several forms of means through which the gun may be mounted. The clamp 10 shown comprises two members 13 and 14 provided in their opposed faces with semi-cylindrical seats for a support to which the gun is to be secured by clamp screws 15 operating between the members 13 and 14. The clamp member 13 embodies a sleeve portion 16 which rotatably receives a cylindrical boss 17 on the cylinder 11. A pointed set screw 18 in the sleeve 16, by engaging in a conical recess in the boss 17, secures the cylinder to the clamp member 13. The clamp members 13 and 14, the screws 15, and the cylinder 11 are all desirably formed of insulating material.

The cylinder 11 is provided with a rearwardly opening bore 20 slidably receiving a piston 21. Bore 20 is sealed by O-rings 91 and 92 slidably engaging piston 21 and cylinder 11. A cylinder head 22 screw-threadedly mounted in the rear end of the bore 20 is provided with a forwardly projecting central boss 23 which serves both as a stop to limit rearward movement of the piston 21 and as a guide for a compression spring 24 that urges the piston 21 forwardly in the bore 20. A lock nut 25 engaging the head 22 secures the head in adjusted position. Axial passages in the head 22 and lock nut 25 provide for the displacement of air resulting from movement of the piston 21 in the bore 20.

The intermediate portion of the cylinder 11 lying forwardly of the boss 17 is enlarged and provided with a forwardly flaring frustoconical surface 26. Opening into the surface 26 and communicating with the forward end of the cylinder-bore 20 (FIG. 3) is a screw-threaded recess 27 receiving a fitting 28 adapted for connection to an air line 29 connected to a source of air under pressure through a conventional three-way valve (not shown) operable alternatively to admit compressed air to the bore 20 to force the piston 22 rearwardly against the effort exerted on it by the spring 24, or to vent the bore and permit such spring to move the piston forwardly.

Projecting forwardly from the intermediate portion of the cylinder 11 is an integral hollow boss 31 from which the subassembly 12 is supported. Such subassembly comprises a body 32 desirably of insulating material, having a rearwardly projecting, externally screw-threaded, an-

nular flange 33 slidable on the boss 31 and receivable in an internally screw-threaded collar 34 rotatably secured to the boss 31 by a snap ring 35. As will be apparent, the subassembly 12 can be attached to or removed from the cylinder 11 by rotation of the collar 34 in the appropriate direction.

Screw-threadedly mounted in a boss 37 projecting forwardly from the body 32 is a valve cage 38 containing a valve seat 39 with which there cooperates a paint valve 40 connectable, by means hereinafter described, to the piston 21. Valve cage 38 is sealed with the inside surface of boss 37 by an O-ring 93. At its forward end, the valve cage 38 is provided with a paint-passing opening 42 which is desirably of non-circular cross-section to permit the reception of a wrench by which the cage can be rotated to effect its insertion into or removal from the boss 37.

A screw-threaded collar 43 mounted on the boss 37 removably secures to the front end of such boss a nozzle holder 44 having a bore and counterbore for the reception of a centrally located nozzle 45 provided with an orifice 46 (FIG. 2 and FIG. 5). The nozzle is inserted into the holder 44 from the rear thereof through the counterbore, and is provided with an annular shoulder which seats against the base of the counterbore, as shown in FIGS. 1 and 5. As is customary in spray guns in which paint is atomized by high velocity, the orifice 46 is desirably elongated to provide a relatively flat, fan-like spray. Also as is customary in guns of the type indicated, the nozzle holder 44 shown is provided with forwardly projecting ears 47 lying on opposite sides of the spray.

Extending between the rear face of the nozzle 45 and the front face of the valve cage 38 is a seal 49 (see FIG. 5) having an axial paint passage. Such seal is desirably formed of nylon or a similar plastic and has a body portion fitting the counterbore in the nozzle holder 44 and a length such that, upon tightening of the collar 43, the seal will be compressed between the nozzle and the valve cage. To facilitate removal of the seal from the nozzle holder it may be provided at its rear end with an annular flange 50 which overlies one or more diametrically extending grooves 51 in the rear face of the nozzle holder 44. The grooves 51 extend radially outward beyond the periphery of the flange 50 to permit the insertion of a tool engageable with the front face of the flange to pry the seal from the holder 44. The rear face of such holder may be provided with a flange-receiving recess deep enough to insure that the presence of the flange will not interfere with the clamping of the seal in firm engagement with the opposed faces of the nozzle 45 and valve cage 38.

As will be clear from FIG. 1, the valve 40 is provided with a stem 53 which extends rearwardly through a control passage 54 and a seal 55 in the assembly-body 32 and through and beyond a seal-compressing screw 56 mounted in such body. At its rear end, the stem 53 is secured, as by set-screws, in a cylindrical plug 57 which is slidably received in a central recess in the front end of a piston-stem 58 shown as integral with the piston 21. When the assembly 12 is secured in position on the cylinder 11, the plug 57 is operatively connected to the piston-stem 58 by a means which is automatically releasable upon removal of the subassembly 12 from the cylinder. The means shown for that purpose comprises a pair of balls 60 carried in diametrically opposite holes located near the front end of the piston-stem. The balls 60 are receivable in an annular groove in the plug 57 and, in the mounted position of the assembly 12, are held in such groove by their engagement with the inner surface of a sleeve 61 which lines the boss 31, protrudes a slight distance beyond the forward end thereof, and slidably receives the front end of the piston-stem. Immediately ahead of the axial position occupied by the balls 60 when the valve 40 is closed, the sleeves 61 is provided with an internal annular groove 62 deep enough to permit the

balls, upon forward movement of the piston and piston-stem, to move out of the groove in the plug 57 far enough to permit the plug to be released from the piston-stem. The valve 40, valve-stem 53, screw 56, plug 57, and sleeve 61 are conveniently of metal, but the balls 60 are desirably of a ceramic.

When the assembly 12 is mounted on the cylinder 11 and the gun is not operating, the valve 40 is held closed by the spring 24, the effort of which is transmitted to the valve through the piston, piston stem, balls 60, plug 57, and valve-stem 53. In this condition, the piston 21 is displaced rearwardly from the base of the cylinder bore 20. Accordingly, when the collar 34 is unscrewed from the flange 33 and the assembly 12 moves forwardly, the spring 24 forces the piston 21 to the base of the bore 20 bringing the balls 60 into the plane of the groove 62 and allowing the balls to move outwardly to free the plug 57 and valve-stem 53 for removal from the cylinder 11 with the rest of the assembly 12. The extreme inner ends of the ball-receiving holes in the piston-stem 58 have a diameter slightly less than that of the balls to prevent the balls from falling inwardly out of the holes when the plug is removed, while the groove 62 is shallow enough to prevent the balls from moving outwardly out of the holes. Upon remounting of the assembly 12, insertion of the plug 57 displaces the balls outwardly into the groove 62 to permit initial entry of the plug into the recess in the piston-stem, whereafter tightening of the collar 34 forces the plug rearwardly until the balls enter the plug-groove and are carried out of the groove 62 to restore the parts to the condition shown in FIG. 1.

Paint is supplied to the passage 54 through a fitting 65 mounted in a recess 66 opening at its outer end into a forwardly flaring frustoconical surface 67 on the body 32 and communicating at its inner end with the passage 54. The fitting 65 is adapted for connection to a paint-supply line 68. To adapt the gun for use in a system in which paint is continuously circulated, the body 32 may be provided with a second recess (not shown) similar to the recess 66 and adapted to receive a fitting through which the passage 54 may communicate with a paint-return line. When no paint-return line is to be employed any additional recess may be closed by a removable plug.

The spray discharged from the orifice 46 when the gun is in operation is electrically charged by an electrode 72 (FIG. 5) electrically connected in a manner described below to a high-voltage lead 73 (FIGS. 2 and 4) extending from the ungrounded terminal of any appropriate high-voltage source (not shown). Preferably, the electrode is in the form of a fine wire extending longitudinally through the nozzle holder 44 and projecting forwardly just inside one of the ears 47 to a point a slight distance beyond the front end of such ear.

The connection of the electrode 72 to the high-voltage lead is conveniently effected over a conductive path which includes the metal sleeve 61. Tracing that path forwardly of the gun from the lead 73, and referring first to FIG. 4, an insulated cable 74 containing the lead 73 is secured to the cylinder 11 by a fitting 75 of insulating material mounted in the forwardly flaring surface 26 of the cylinder. Immediately inside the fitting 75, the cable terminates in a conductive button 76 connected to the lead 73 and engaged by one end of a conductive compression spring 77 the opposite end of which engages the head of a metal pin 78 slidably received in the cylinder-body 11 and disposed in an oblique position coaxial with the fitting 75 with its inner end held in contact with the sleeve 61 as a result of the force exerted on it by the spring 77. When the subassembly 12 is secured in place by the collar 34, the front end of the sleeve 61 is held in contact with a metal ring 80 mounted in an annular recess in the body 32 at the base of the flange 33. A spring wire 81 soldered to the ring 80 extends forwardly through the body 32 and emerges at 82 (FIG. 5) from the front of the boss 37 to make contact with the rear face of the nozzle-holder 44.

Preferably, the wire 81 is bent at 82 to provide a first, or contact, portion 83 extending generally chordally of the end face of the boss 37 and at an acute angle thereto, and a second, or guiding, portion 84 which extends rearwardly to be loosely received in a recess 85 in the boss 37. The recess 85 is deep enough to allow the contact portion 83 to be resiliently bent to the extent necessary to permit the seal 49 to be clamped between the valve cage 38 and the nozzle 45 when the collar 43 is tightened.

To provide electrical connection between the contact portion 83 of wire 81 and the electrode 72, and thus to complete the conductive path from the high-voltage lead 73 to the electrode, the rear face of the nozzle holder 44, the surfaces of the grooves 51, and the rear end of the electrode 72, which extends into one of the grooves 51, are all coated with a continuous coating of conductive paint such, for example, as that disclosed in U.S. Patent 3,021,077 to W. D. Gauthier. Thus, although the nozzle holder 44 is of insulating material the electrode 72 will be connected through the conductive paint coating to the wire 81 irrespective of the orientation of the nozzle holder with respect to the axis of the gun.

Returning to the engagement of the sleeve 61 with the ring 80, it is noted that if the contact between those two elements were circumferentially continuous any paint escaping rearwardly past the seal 55 and screw 56 would be trapped within the sleeve, where its presence would be undesirable. Accordingly, the front end of sleeve 61 is provided with notches through which any paint entering the sleeve can flow by gravity into the interior of flange 33 to escape therefrom through an opening 88 extending radially through the flange. The appearance of paint at the opening 88 constitutes a warning that the seal 55 is leaking.

Reference has been made to the screw 18 which, by engaging in a recess in the boss 17, secures the cylinder 11 to the clamp member 13. Desirably, the boss 17 has a plurality of screw-receiving recesses 88 spaced angularly about the axis of the boss, thus providing a plurality of angularly spaced positions for the cylinder 11, relative to the clamp member 13 or other gun support.

Just as a plurality of positions are provided for the cylinder 11 relative to the clamp, it is desirable that a plurality of positions be provided for the subassembly 12 relative to the cylinder. For this purpose, the boss 31 of the cylinder may be provided with a key 90 receivable in a key-way in the inner surface of the flange 33. It has been found convenient to provide the flange 33 with two of such key-ways spaced 90° apart.

When assembled as shown in FIGS. 1-4 and applied to a suitable clamp-engaged support, the gun is readied for operation by connecting to it the paint line 68, the high-voltage lead 73, and the air line 29. In the condition shown, the paint valve 40 is closed by the spring 24 and the pressure of the paint behind it. To operate the gun, air is admitted to the cylinder-bore 20 from the air line 29, thus forcing the piston 22 rearwardly and causing the valve 40 to open. Upon opening of the valve 40, paint supplied under high pressure to the gun through the paint line 68 will be discharged through the orifice 46 and atomized into a spray the particles in which will be charged by ions emanating from the electrode 72. To terminate spraying, the cylinder 20 is vented to permit the spring 24 to move the piston 22 forwardly and close the valve 40.

The rotatability of the cylinder 11 relative to the clamp member 13 and of the subassembly 12 relative to the cylinder provides a number of different arrangements of the directions in which the air line 29, the paint line 68, and the high-voltage lead 73 can extend from the gun. Because of the possibility of disposing the subassembly 12 in any of a plurality of different positions about the axis of the gun, there should be a corresponding number of paint-escape openings 88 in the flange 33 so that one of said openings will always be at the lowest point of the

flange when the gun-axis is horizontal, as it will most frequently be in commercial installations.

If at any time any part of the front section consisting of the subassembly 12 requires repair that section can readily be removed from the rear, or motor, section by merely unscrewing the collar 34 from the flange 33. As explained above, the unscrewing of the collar brings the balls 60 into the plane of the groove 62 and thereby allows the plug 57 to be released from the piston-stem 58 and the entire subassembly to be removed, leaving the rear section of the gun and its connections to the air line 29 and lead 73 undisturbed. If necessary or desirable the removed subassembly can be disconnected from the paint line 68 and replaced with another. The ready severability of the gun sections is also advantageous in the case of a gun used to spray paint of different colors. In such a case, there could be, for each color of paint to be sprayed, a separate subassembly connected through a paint line 68 to its own source of paint under pressure. Since the valve 40 of each subassembly used closes with pressure, it is not necessary to relieve the associated paint line 68 of pressure while the subassembly is removed from the motor section, as the pressure in the passage 54 will maintain the valve closed.

Ready severability of the two gun sections, in addition to facilitating repair or replacement of the front section, also facilitates repair or replacement of the rear, or motor, section. It can be removed from the front section and the clamp 10 without disturbing either the connection of the paint line 68 or the mounting of the clamp on its support.

I claim:

1. A remotely controlled electrostatic spray gun comprising front and rear sections each having a body formed of insulating material; releasable means for rigidly interconnecting said bodies; said front section having a liquid passage containing a valve and terminating in a discharge orifice for forming liquid supplied to said passage into a spray; a conductive means in and extending longitudinally of the front section body and having a front end portion forming a spray-charging electrode; said rear section comprising a motor having a reciprocable power-operated element; a conductive means carried by the rear-section body, adapted for connection to a high-voltage source, and having a portion disposed to engage the rear end of the first-mentioned conductive means where the two bodies are connected together by said interconnecting means; and means for operatively interconnecting said reciprocable element with said valve, said last mentioned means including first and second members respectively movable with said valve and power-operated element and a device automatically operable upon interconnection of said bodies to connect said members together and upon separation of said bodies to disconnect said members.

2. A spray gun according to claim 1 wherein said liquid passage has, in a laterally presented surface of the first-section body, an inlet opening adapted for connection to a paint-source, said front and rear sections being relatively angularly adjustable about the axis of said discharge orifice.

3. A spray gun according to claim 1 wherein the rear-section body has means for securing to it a high voltage lead extending laterally outward from the body, and a support for said rear-section body, said rear-section body being angularly adjustable relative to said support about the axis of said discharge orifice.

4. A spray gun according to claim 1 wherein the bodies of said front and rear sections are circular in cross-section.

5. A remotely controlled electrostatic spray gun comprising front and rear sections each having a body; releasable means for rigidly interconnecting said bodies; said front section having a liquid passage containing a valve and terminating in a discharge orifice for forming liquid supplied to said passage into a spray; said rear

section comprising a motor having a reciprocable power-operated element; and means for operatively interconnecting said reciprocable element with said valve, said last mentioned means including first and second members respectively movable with said valve and power-operated element and a device automatically operable upon interconnection of said bodies to connect said members together and upon separation of said bodies to disconnect said members.

6. A spray gun according to claim 5 wherein said first member is slidably receivable in a recess in said second member, said connecting device comprising a connecting element carried by said second member and engageable with said first member to interconnect the members for joint valve-operating movement, said connecting element being movable out of engagement with the first member, and means in the rear-section body for holding said element in engagement with the first member only when the two bodies are interconnected.

7. A spray gun according to claim 5 wherein the front-section body has a forwardly flaring frustoconical surface, the paint passage having in said surface an inlet opening adapted for connection to a paint source.

8. A spray gun according to claim 5 wherein said motor is an air motor having a cylinder bore and a piston slidable therein, said rear-section body having a forwardly flaring frustoconical surface and an air passage extending from an inlet opening in said surface to said cylinder bore.

9. A spray gun, comprising front and rear sections each having a body, said front section having a liquid passage terminating in a discharge orifice at the forward end of the front section, a valve in said passage movable forwardly of the gun into closed position, said front section being separable from said rear sections by forward movement from an operating position, releasable means for retaining said first section in operating position on said rear section, a reciprocable valve operating member mounted in said rear section and movable rearwardly from a forwardmost position, means biasing said member toward such forwardmost position, power-operated means for moving said member rearwardly, a releasable operative connection between said member and valve for moving the valve rearwardly from closed position when said member is moved rearwardly upon actuation of said power operated means, said connection being so constructed and arranged that with the front section in operative position on the rear section and with the valve closed said member will be displaced rearwardly from its forwardmost position, and connection controlling means for automatically releasing said connection when said member moves into its forwardmost posi-

tion under the influence of said biasing means upon forward movement of the front section from its operative position on the rear section and for reestablishing said connection when the front section is moved rearwardly into such operative position.

10. In a spray gun, a front section having a discharge orifice and valve means for controlling flow of liquid to said orifice, a rear section comprising a valve-operating member movable in opposite directions from an intermediate position, releasable means for securing said two sections together in fixed relationship, a releasable operative connection between said valve and said member so constructed and arranged that with said two sections secured together in said fixed relationship said valve will be closed and said member will be in its intermediate position, power-operated means for moving said member in valve-opening direction from its intermediate position, means biasing said member for movement in valve-closing direction to and beyond said intermediate position, and connection-releasing means being operative to release said connection when said member is moved from its intermediate position by said biasing means.

11. An electrostatic spray gun comprising front and rear sections each having a body; releasable means for rigidly interconnecting said body; said front section having a liquid passage containing a valve and terminating in a discharge orifice for forming liquid supplied to said passage into a spray; conductive means carried by the first section and including a spray charging electrode; said rear section comprising a movable control member; and releasable means for operatively interconnecting said movable control member with said valve; and conductive means in the second section adapted to be connected to a high voltage source, said two conductive means respectively having severable cooperating portions held in conductive engagement with each other by said interconnecting means.

12. A spray gun according to claim 11 wherein said first and second sections are angularly adjustable with respect to each other about an axis, one of the severable cooperating portions being so formed to contact the other in different angular position of the two sections.

References Cited

UNITED STATES PATENTS

3,248,059 4/1966 Fischer et al. ----- 239—15

EVERETT W. KIRBY, *Primary Examiner.*

U.S. Cl. X.R.

239—3

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,425,625

February 4, 1969

Richard O. Probst

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading to the printed specification, lines 3 and 4, "Ramsburg" should read -- Ransburg --. Column 3, line 63, "cylinder" should read -- cylinder. --. Column 5, line 35, "scarew" should read -- screw --. Column 8, line 25, "body" should read -- bodies --.

Signed and sealed this 31st day of March 1970.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents