Oct. 19, 1965 E. H. COCKS 3,212,715

SOLENOID AIRLESS SPRAY GUN

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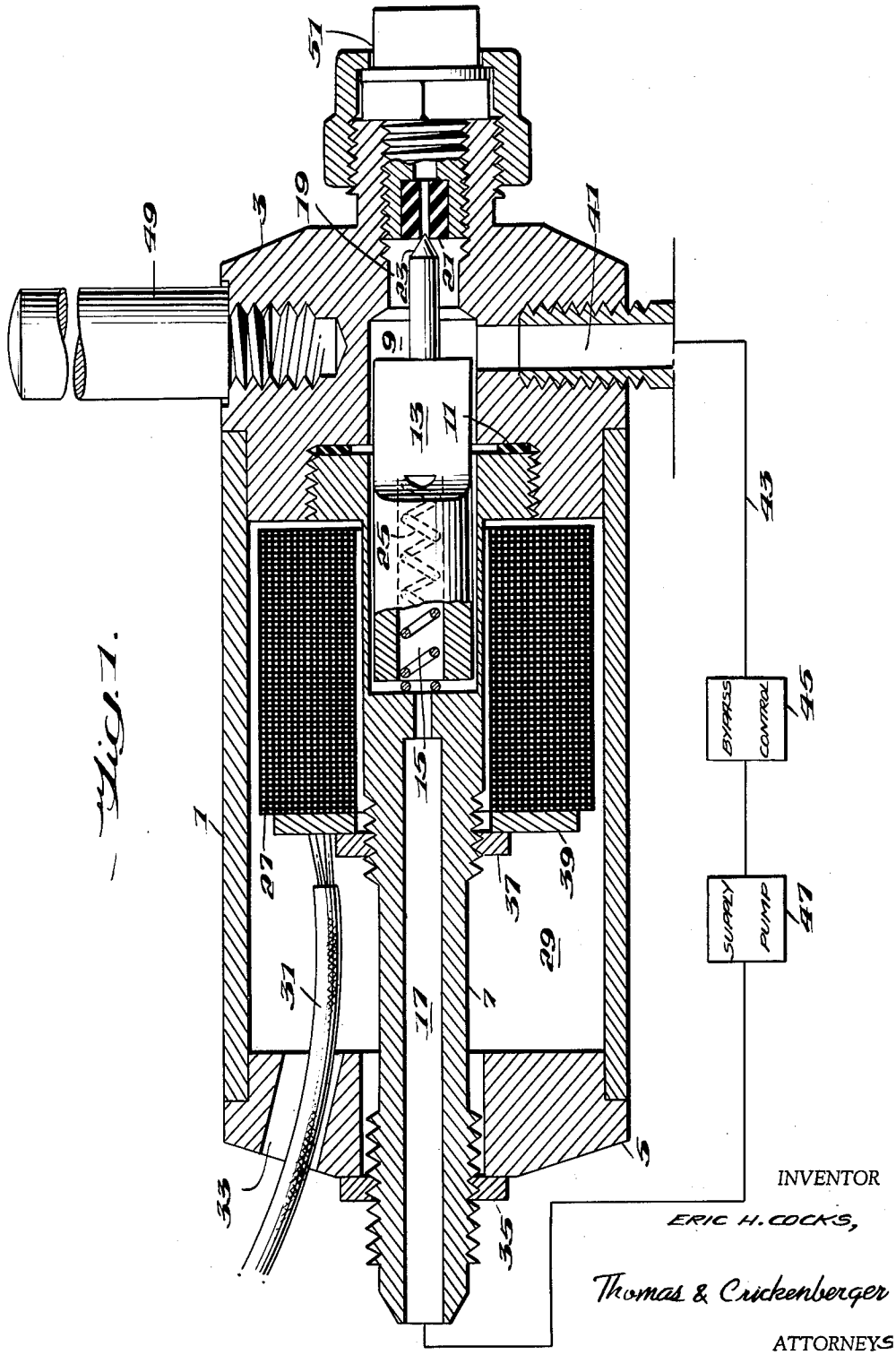


Fig. 1.

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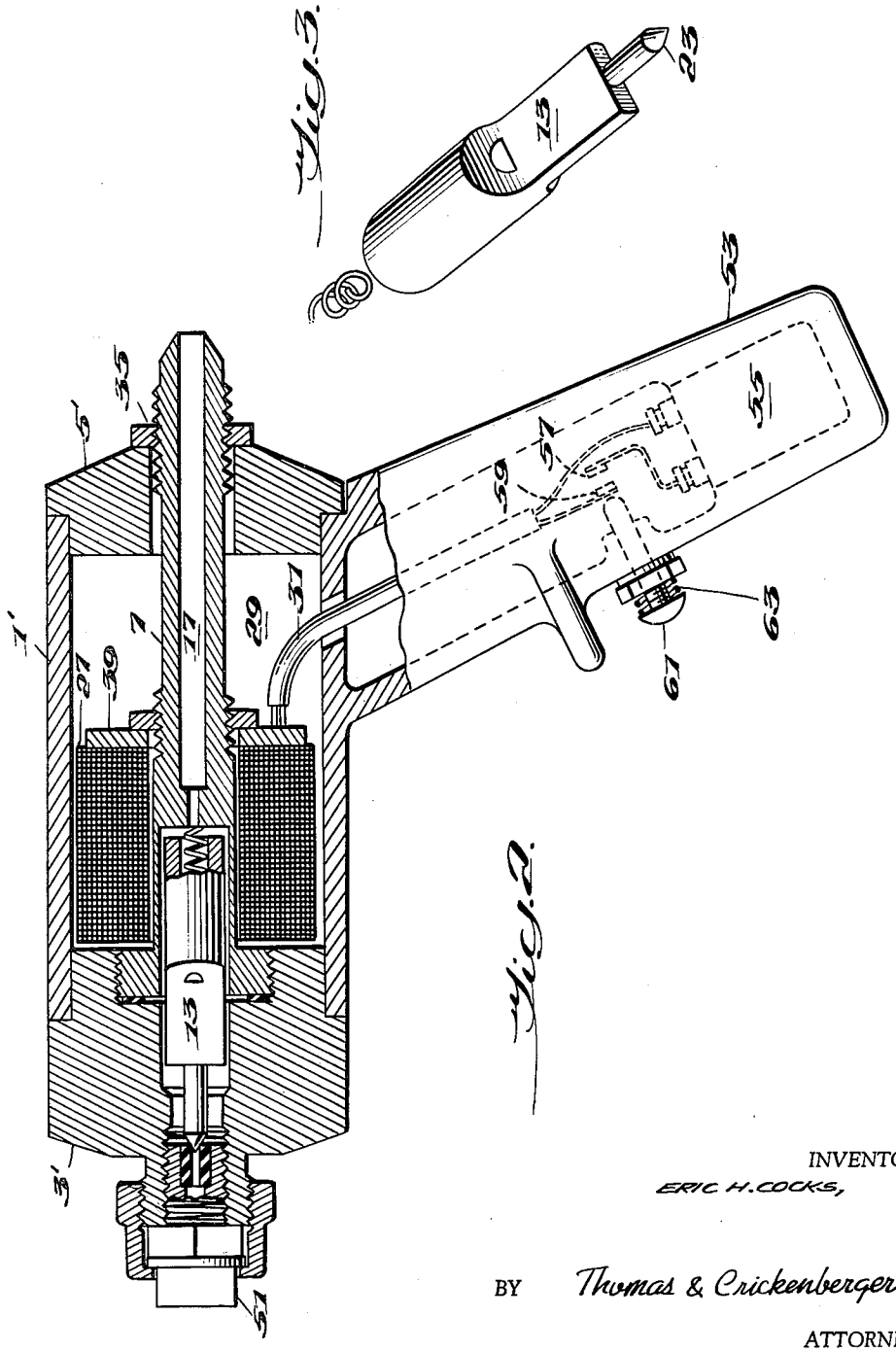
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SOLENOID AIRLESS SPRAY GUN

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United States Patent Office 3,212,715 Patented Oct. 19, 1965

3,212,715
SOLENOID AIRLESS SPRAY GUN

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Filed June 19, 1963, Ser. No. 289,030
1 Claim. (Cl. 239—125)

This invention relates to a spray gun, and more particularly to an airless spray gun used to atomize fluids by hydraulic pressure without the use of a compressed air supply.

In the field of automatic spray painting it is desirable that the spray guns be trouble free and repetitive in action, since in many instances there are not attendants to make corrections for erratic operation. An electrically operated spray apparatus is ideally suited for automatic operation, particularly when the apparatus is at a location remote from the point of control. The use of a solenoid control for operating the valve mechanism of a spray gun has been suggested in the past, and this arrangement is adapted readily for automatic operation. However, with all of the known devices, the problems of erratic plunger operation because of improper cleaning and excessive wear have remained a deterrent for the production of an apparatus having reliable operations. The principal reason for this is that the structure of the gun does not lend itself readily to a complete cleaning or flushing to remove old fluids from the operating mechanism.

It is an object of this invention to provide a spray gun for high pressure airless spraying which will be simple in construction and rapid and reliable in operation.

Another object of the invention is to provide a spray gun which is not subject to leakage around seals under pressure.

Another object of the invention is to provide a spray gun which is cleaned easily both internally and externally.

A further object of the invention is to provide an electrically operated spray gun with means for quickly and reliably connecting the operating solenoid to an external power supply.

A still further object of the invention is to provide an electrically operated spray gun suitable for hand operation.

In accordance with the invention these objects are realized in an apparatus comprising a cylinder having end closure members forming a hollow housing. The end closure members are held in position by a tubular member which is threaded at both ends and mounted concentrically with said cylinder. One end of the tubular member is threaded into the first closure member to define a fluid chamber. The first closure member also has an aperture with a resilient valve seat insert communicating with the fluid chamber.

The tubular member has an internal fluid passageway in alignment with the fluid chamber. The pasageway is enlarged at the end nearest the first closure member to the same diameter as the fluid chamber. A valve plunger having an internal fluid passageway is slidably positioned within the enlarged end of the tubular member. One end of the plunger has a tapered tip which serves as the closure for the resilient valve seat insert. A solenoid is positioned within the housing around the tubular member to attract the valve plunger away from the resilient seat when the solenoid is energized. The plunger has a spring member within the fluid passageway to bias the plunger against the resilient valve seat when the solenoid is not energized.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of two embodiments of the invention as illustrated in the accompanying drawings in which:

FIG. 1 is a cross-sectional view in elevation of a first embodiment of the invention adapted for stationary installation in an automatic system;

FIG. 2 is a cross-sectional view in elevation of a second embodiment of the invention adapted for hand-held use; and

FIGURE 3 is a perspective view of the valve plunger and biasing spring.

The invention will be understood more readily by making reference to FIG. 1 of the drawings which is a cross-sectional view of an assembled gun construction in accordance with the features of the invention. The gun comprises a cylinder member **1** having end closure members **3** and **5**. The end closure members **3** and **5** are held in assembled relationship against cylinder **1** by means of a tubular member **7** which has external threads on each end and an internal fluid passageway **17**. One end of the tubular member **7** is threaded into the end closure **3** to form a fluid chamber indicated generally by the numeral **9**. An appropriate fluid seal such as gasket **11** is provided between tubular member **7** and end closure **3**.

Fluid chamber **9** has a valve plunger **13** slidably mounted therein. The valve plunger **13** has an internal fluid passageway **15** which is in substantial alignment with the internal fluid passageway **17** of tubular member **7**. The fluid chamber **9** has an aperture **19** in which is mounted a resilient valve insert **21**. The valve plunger **13** is provided with a tapered tip **23** which provides the closure for the resilient valve insert **21**. Tapered tip **23** is normally biased against resilient valve insert **21** to close completely aperture **19** by means of a spring **25** located within the internal passageway **15** of valve plunger **13**.

A solenoid **27** is mounted within hollow portion **29** of the housing concentrically with cylinder member **1** and tubular member **7**. An electrical connecting cable **31** is connected to soleoid **27** and passes through aperture **23** in end closure **5** to an appropriate external source of electrical power. Easy access is provided for the electrical assembly since nuts **35** and **37** provide the only retaining means for end closure **5**, cylinder member **1**, solenoid **27** and solenoid retaining plate **39**. Also, since the hollow portion **29** provides ample internal space, the electrical connecting cable **31** may be connected to solenoid **27** such that all connections are located within the housing itself.

Fluid chamber **9** may be provided with an additional aperture **41** which serves as a by-pass connection for a fluid supply line illustrated diagrammatically by numeral **43**. When a by-pass line is utilized a suitable by-pass control arrangement shown generally at **45** and a supply pump arrangement **47** are connected in closed circuit with the spray gun so that a continuous circulation of fluid can be maintained when the gun is not operating. This prevents the settling of any sediment in the fluid and clogging of the apparatus.

The gun shown in FIG. 1 is designed for an automatic installation to be operated at a remote location. The gun is held in position to spray articles, which may be moving past the gun on an assembly conveyor, by means of mounting post **49** which is threaded into end closure **3**. Appropriate positioning linkages (not shown) may be connected to mounting post **49** to allow the positioning of the gun in any desired manner.

In operation the supply pump **47** supplies fluid under pressure to the gun through internal fluid passageway **17** of tubular member **7**. The operating pressure of the system may be 3000 p.s.i. which is very high compared to conventional systems. The valve plunger **13** is biased by spring **25** so that tapered tip **23** engages the resilient valve insert seat **21** to close off aperture **19**. When it is desired to begin the spring operation, solenoid **27** is energized from a remote location through electrical connecting cable **31**. The energizing of solenoid **27** causes valve plunger **13** to be attracted away

from aperture **19**, and the tapered tip **23** is removed from engagement with the resilient valve insert **21**, thereby opening aperture **19**. The gun is designed so that a very small movement of valve plunger **13** in either direction is all that is required to open and close aperture **19**. The use of the tapered tip **23** in combination with resilient valve seat insert **21** provides a positive sealing action. This positive sealing action, together with the very short plunger travel, enables rapid actuation of the gun and insures positive shut off.

The valve action of the present spray gun has operational advantages over conventional valve actions because of the short, but rapid, plunger travel. A typical airless spray gun has a relatively slower moving valve. In high pressure operation the slower moving valve of the prior art would permit an initial escape of fluid before it is fully open. The reverse action would occur when closing. Any change in size in the orifice results in a change of pressure on the fluid, and even though it is of very short duration, it is reflected in the spray pattern by a change in the degree of atomization. This produces a spattering effect at the start and finish of the spray. The apparatus of the present invention is not subject to these undesirable features.

When solenoid **27** is operated and aperture **19** is opened, the fluid under pressure from supply pump **47** is forced in a straight line through the gun assembly and out nozzle structure **51**, which is of conventional design. The high pressure flow of fluid through nozzle structure **51** causes atomization of the fluid and the formation of a suitable spray pattern in accordance with features which are well known in the art. When valve plunger **13** is closed upon de-energizing the solenoid, by-pass control **45** is opened to allow circulation of the fluid through the system and maintain the apparatus in condition for immediate operation. Since the fluid passes through solenoid **27** at all times, the heat generated by current through solenoid **27** is quickly dissipated.

When the apparatus is to be cleaned, a cleaning fluid is substituted for the working fluid normally supplied, and the pump **47** forces the cleaning fluid through the system. Because of the straight line arrangement of fluid flow, there is no opportunity for fluid to collect in out-of-the-way recesses present in conventional gun arrangements. Therefore, the spring **25**, plunger **13** and all passageways are cleared of any residue by the flow of cleaning therethrough. This marks a substantial improvement over conventional guns in which the valve plunger and biasing spring are normally located out of the line of flow of fluid, and residue collects readily to impair the spring and valve action.

A second embodiment of the invention is shown in FIG. 2 where corresponding parts have been given the same numerals as those appearing in FIG. 1. This gun is designed for hand-held operation. The end closure members **3'** and **5'** are similar to end closure members **3** and **5** of FIG. 1, except that the apertures for by-pass control, mounting posts and electrical connecting cable are not required. The cylinder member **1'** forming the body of the gun apparatus has an integral handle member **53** which is hollow and contains a battery **55**. A pair of contacts **57**, **59** are operated by a finger-actuated plunger **61**, which is biased by spring **63**. Access to the battery **55** for replacement purposes may be gained by means of a removable plate (not shown).

The operation of the gun of FIG. 2 is identical to the operation of the embodiment shown in FIG. 1 except that the solenoid is actuated by the operator holding the gun, instead of at a remote location. In this case it is not necessary to provide a by-pass fluid arrangement, since continuous operation over long periods of time is not contemplated in a hand apparatus.

From the foregoing description it will be appreciated that the present invention has provided a spray gun for high pressure spraying which will be simple and fast in operation, will have a minimum number of parts and will be cleaned easily both internally and externally. The housing structure for the electrical solenoid provides a means of easily and reliably connecting the solenoid to a power supply without hazardous and unsightly external electrical connections. The fast action and positive feeding of the valve enable this device to be used in applications where precise control is required.

While the invention has been shown and described with particular reference to preferred embodiments, it will be understood by those skilled in the art that various changes in form and details may be made without departing from the spirit and scope of the invention.

What is claimed is:

An airless spray gun for fluids comprising a cylinder having first and second end closure members forming a hollow housing, a tubular member having a first internal fluid passageway mounted concentrically with said cylinder to define a hollow annular space within said cylinder, one end of said tubular member being threaded into said first closure member to define a fluid chamber and the other end being adapted to be connected to a source of fluid supply, a first aperture within said fluid chamber, a valve plunger having a second internal fluid passageway movably mounted within said fluid chamber to open and close said first aperture, a resilient valve seat in said first aperture to receive said valve plunger, a spring member mounted within said first fluid passageway biasing said valve plunger in a normally closed position, a solenoid mounted within said hollow annular space to operate said valve plunger, a second aperture within said second closure member for making electrical connections to said solenoid solely within said cylinder, and a third fluid passageway communicating with said fluid chamber to provide a bypass path for said fluid to insure continuous fluid circulation when said gun is not in operation, said second internal fluid passageway in said valve plunger being in substantial alignment with said first aperture and said first internal fluid passageway in said tubular member, whereby the flow of fluid through said gun is substantially in a straight line passing through said first and second fluid passageways and over said spring member to insure rapid and thorough cleaning of the moving plunger and spring member.

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