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(54) **SPRAY GUN FOR PAINTING**

LACKIERSPRITZPISTOLE

PISTOLET DE PULVÉRISATION POUR PEINTURE

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Description

Technical Field

[0001] The present invention relates to a hand-held spray gun designed to spray paint by pulling a trigger, in which the load on the finger pulling the trigger is reduced to assure a higher safety of the painting worker using the spray gun.

Background Art

[0002] The painting spray guns are available in some types different in application and function from each other. Many of the most commonly used spray guns use compressed air to atomize paint for spraying to an object to be painted. Such spray guns include many hand-held types. In designing a hand-held spray gun, major consideration is given to its handleability and operability because it is operated directly by the painting worker.

[0003] Normally in each of the above-mentioned hand-held spray guns, two valves, that is, an air valve to inject compressed air and a paint valve to eject paint, are operated, namely, opened and closed. A spring is interposed between the valves and a trigger. When the trigger is pulled with a finger, the valves are opened. When the finger is released from the trigger, the valves are closed. Namely, the valves are normally closed under the action of the spring and opened when the worker pulls the trigger against the spring load.

[0004] In the course of painting, the worker has to pull and release the trigger repeatedly many times. So, such repeated trigger operation has ever made the workers tired and caused inflammation of the tendon sheath of them. It has been demanded in the industry of painting to reduce the spring load as much as possible in the hand-held spray guns. Further in the hand-held spray gun, the paint valve is designed to have the opening area thereof varied depending upon the moving-back distance thereof to adjust the amount of paint ejection. The spring provided at the rear of the valve is repeatedly compressed to a maximum set load.

[0005] The load against which the spray gun operator has to pull the trigger, which will be referred to as "trigger load" hereunder, includes the force of the spring to close each of the air and paint valves, back pressure of the compressed air introduced into the air valve and resistance of a sealing apparatus provided to prevent leak from a sliding portion of each valve when the latter is moved. To reduce such loads, countermeasures have ever been taken. For example, the principle of leverage is utilized to reduce such loads. In view of rearrangement of the gun supporting point for downsizing, increase of the trigger length for improved operability or the like, however, the structural alteration of the spray gun is limited.

[0006] To reduce the back pressure applied to the worker's finger when the air valve is opened, it is necessary to reduce the valve-opening area and pressure un-

der which air is supplied. However, a necessary amount of spraying air and spraying pressure for a spray gun must be maintained for satisfactory performance of the gun. They should never be lower than necessary.

[0007] Further to the above, a structure by which the back pressure applied to the rear of the air valve can be reduced is known from the disclosure in the Japanese Published Utility Model Application No. 43883 of 1993 etc. Also, an actuation mechanism using an air piston commonly used in the automatic spray guns and the like is well known for operation of the paint valve.

[0008] Especially in spray guns in which a large force is required for closing the paint valve, it is more necessary to reduce that force for easier operation of the spray gun. A technique to move back the paint valve by feeding compressed air supplied by pulling the trigger to a piston provided at the rear of the paint valve is known from the disclosure in the Japanese Published Utility Model Application No. 2776 of 1973 etc. in which there is described a mechanism for feeding compressed air to the piston. This patent literature discloses a special-purpose spray gun intended for use to spray paint of which the viscosity is higher than those used with common spray guns. In this special spray gun, the trigger load is larger than those in the common spray guns. The above-mentioned mechanism was worked out to reduce the trigger load. In the mechanism, the compressed air, namely, actuation air is fed directly into the air piston and a part thereof is fed as spraying air into the air valve.

[0009] Heretofore, employment of such an air piston in the common general-purpose spray guns has been a problem with respect to trade-off between the necessity of the air piston and the operability of the spray guns. Hence, no such an air piston has ever been adopted in the spray guns. However, reduction of the trigger load in the common spray guns has been demanded increasingly for the reasons that an improved safety and hygiene of painting with such spray guns have been demanded and that more and more spray guns have recently been used with the spring being compressed to reduce the opening area of the paint valve, resulting in an increased trigger load, to meet a recently increased tendency to make thinner-film coating with a smaller ejection of a higher-grade paint.

[0010] From the commercial point of view or from the viewpoint of an improved productivity in the industry of painting, reduction of the trigger load in many general-use spray guns is of course more desirable than the manufacture of a spray gun dedicated for a special painting. It will lead to reduction of the burden to the painting workers as well as to lessening of the danger in painting with the spray gun. That is, the spray guns in which the trigger can thus be operated more easily will be more user-friendly.

[0011] JP 49017510A discloses a spray gun having the features of the preamble of Claim 1.

[0012] US 2 101 164A discloses a spray gun with a pneumatic needle valve.

Disclosure of the Invention

[0013] As having been mentioned above, the reduction of the trigger load in the spray gun has been an important problem to solve. However, none of the commonly used spray guns has a structure that can accommodate such feature but it has been necessary to design and make a spray gun for each of intended special applications. The above special-purpose spray gun is only available at an increased price which has been a hindrance to the prevalence of such spray guns in the industry of painting. Accordingly, the present invention is intended to make a general-purpose spray gun into a one of which the trigger can be operated with a reduced force.

[0014] More particularly, the present invention is intended to change a commonly used spray gun, only by replacing some of its part, into a one of which the trigger is operable very lightly while the operability and handleability of the original spray gun is maintained, whereby the spray gun operator can be freed from the possible inflammation of the tendon sheath.

[0015] Accordingly, it is preferable to overcome the above-mentioned drawbacks of the background art by providing a spray gun adapted to form an appropriate paint film through prevention of paint spitting by positively keeping timing when the paint valve is opened after first injection of air at the time of paint spraying in such a manner that an appropriate paint film can be formed, and to control paint-spraying conditions so that the apparatus itself can be used in more ways and operated more easily.

[0016] According to the present invention, there is provided a spray gun including an air valve operable by a trigger and in which paint ejection is controlled by a needle valve, wherein a branch passage communicating with a connection passage provided between an exit passage of the air valve and an atomization cap is led to outside the apparatus through a restriction passage, a piston is disposed directly in the rear of the needle valve, a cylinder to house the piston in such a manner that the latter can reciprocate is provided at the rear of the apparatus, and an actuation air path is provided in an actuation air chamber at the front of the cylinder, having connected thereto the other end of the branch passage; characterised in that the trigger operates the needle valve.

[0017] Also, the restriction passage of the branch passage may have provided therein a flow control valve to adjust the air inflow into the cylinder so that the operation of the needle valve can be controlled precisely.

[0018] Further, the branch passage may form inside the valve ring of a pattern control valve an internal passage communicating with the connection passage and connected to the pattern control valve by a rotatable joint. Thus, a conventional spray gun can be made into a compact one of which the trigger can be operated more easily.

[0019] Owing to the above structural features, when the air valve is opened by pulling the trigger for spraying paint, compressed air is injected from an atomizer through the connection passage. At the same time, air

from the connection passage is fed into the actuation air chamber through a branch path and the branch passage. At this time, there is such a very short time before the actuation air chamber is sufficiently filled with air through the restriction passage that the needle valve will not be opened for ejection of paint before at least the atomization air is injected. Thus, the paint will be ejected in retard of the atomization air ejection from the atomizer. Namely, the paint is sprayed appropriately without paint spitting, that is, premature ejection of any insufficient amount of atomized paint particles.

[0020] The restriction passage serves to set operation timing of the needle valve. The timing is set depending upon the specifications of a spray gun in consideration and a diameter of the flow path in the restriction passage is selectable. Also, a speed control valve or the like capable of adjusting the flow rate may be used to control the force applied to the piston, which also contributes to easier setting of the timing. Even if any trouble takes place in the channel to the piston in a spray gun having such a speed control valve thus provided therein, closing the flow path permits the spray gun to function as a common spray gun.

[0021] Also, since the pressure applied to the piston can be adjusted, so it is possible to adjust the stroke of the trigger correspondingly to the force of a spring provided to close the needle valve. As a result, the ejection amount of paint is adjusted for appropriate painting. Thus, irrespectively of a force applied to operate the trigger, the ejection amount of paint can be adjusted to meet intended conditions of painting.

[0022] Moreover, since the spray gun is adapted to pass piston-actuating air through the valve ring of the pattern adjusting valve to outside for introduction into the cylinder, the spray gun can be altered with no modification of the spray gun body but with replacement of the pattern control valve. Namely, a general-purpose spray gun can be improved in function. Therefore, even a conventional spray gun can be operated with a reduced trigger load only by simple part replacement, which will lessen the burden on the spray gun operator and hence prevent possible industrial accidents.

[0023] The foregoing and other features, aspects and advantages of the present invention will be more apparent from the ensuing detailed description of embodiments of the present invention when taken in conjunction with the accompanying drawings. It should be noted that the present invention is not limited to the embodiments but can freely be modified without departing from the scope thereof defined in the claims given later.

FIG. 1 is a sectional view of a first embodiment of the spray gun according to the present invention.

FIG. 2 is also a sectional view of a second embodiment of the spray gun according to the present invention.

FIG. 3 is a sectional view of a conventional commonly used spray gun, schematically showing the con-

struction of the spray gun.

Best Model of Carrying Out the Invention

[0024] Referring to FIG. 3, there will be described a typical one of the conventional commonly used spray guns. The spray gun includes a body 1 having provided at the front end thereof a paint nozzle 2 and air cap 3, which form together an atomizer. A needle valve 4 engaged in the paint valve 2 to control the paint ejection is provided to extend rearward with its front end being in abutting contact with the ejection orifice of the paint nozzle 2. It is operated by a trigger 5 as will further be explained later.

[0025] In the rear portion of the spray gun body (will be referred to simply as "gun body" hereunder) 1, there are disposed an air valve 6, paint controller 7 and pattern controller 8. A grip 9 is formed under them. The trigger 5 is provided in front of the grip 9 to extend along the latter. The trigger 5 operates the needle valve 4 and air valve 6 to control paint spraying for painting.

[0026] The spray gun structures are different in some respects from one type to another of them. Generally, however, the air valve 6 used to spray paint is provided in an air passage 10 which feeds air introduced from below the grip 9 into the atomizer, a valve body 12 driven in by an air valve spring 13 is moved back when the trigger 5 is pulled, that is, the air valve 6 is opened. Thus, air is fed into a connection passage 11. The air valve spring 13 is disposed at the rear of the valve body 12 to close the air valve 6 when the trigger 5 is released. The air valve spring 13 should be strong enough to overcome the back pressure and also not to be influenced by the sliding resistance of a packing provided for prevention of air leak. For opening the air valve 6, there is required a sufficient force to overcome the above spring load and back pressure of the compressed air applied to the rear of the air valve 6.

[0027] Also, a spring 14 for the needle valve 4 is provided in the rear portion of the gun body 1. The needle valve spring 14 should also be strong enough to overcome the back pressure of paint and sliding resistance of the needle valve packing and close the needle valve 4. Since a paint leak during painting will cause a serious trouble and defect, it should positively be prevented. Generally, the sliding resistance is set large and the needle valve spring 14 is set to be openable only when it is applied with a large force.

[0028] In the embodiment of the spray gun according to the present invention shown in FIG. 1, a needle valve 4 is provided to extend along the center axis of an air valve 6 so that these valves are coaxially integral with each other. According to other embodiments of the present invention, the needle and air valves may be provided separately, to which however the present invention is not limited in any way.

[0029] In the conventional spray gun shown in FIG. 3, the load of the air valve spring 13 used is on the order of

1 kg when the trigger starts being pulled, while the load of the needle valve spring 14 is approximately 2 kg. The maximum load of the needle valve spring 14 will be on the order of 3 kg. Actually, the load applied to the finger pulling the trigger will be 1/2 to 1/3 of the above spring load values owing to the geometry of the trigger. At a point where the trigger is pulled to the full extent, however, the spring flexure will add to the load. The load thus increased and sliding resistance will act together on the operator's finger pulling the trigger. In painting work, the spray gun operator has to pull the trigger repeatedly many times, and will thus possibly suffer from a disorder such as the inflammation of tendon sheath.

[0030] Further, because of the spray gun structure, the opening of the needle valve 4 which controls the ejection amount of paint is adjusted correspondingly to a distance over which the needle valve 4 is slid back. The adjustment is done by putting the rear end of the needle valve 4 into abutting contact with the inner end of an adjust knob 15. Therefore, when the needle valve spring 14 is limited by the adjust knob 15 from moving back, it will undergo a maximum deflection to provide a maximum load. When it is necessary to adjust the ejection amount of paint, the needle valve spring 14 will be set to provide a large load and the trigger load should be reduced correspondingly.

[0031] The first embodiment of the spray gun according to the present invention is schematically illustrated in FIG. 1. As will be known, the spray gun is a partially modified version of the conventional spray gun having been explained above with reference to FIG. 3 and thus the same components as in the spray gun shown in FIG. 3 are indicated with the same reference numerals as those of the spray gun in FIG. 3. In this first embodiment of the spray gun according to the present invention, a piston 16 is installed integrally to the rear of the needle valve 4, and a cylinder 17 in which the piston 16 is to be received is installed to the gun body 1 with a guide 35 being laid between them. A piston spring 18 is provided at the rear of the piston 16, and the piston 16 is accommodated in the cylinder 17 with a lid 19 being fixed to the cylinder 17. An actuation air path 20 is provided in an actuation air chamber 28 of the cylinder 17 to move the piston backward when it is supplied with air from outside.

[0032] There is provided a branch passage 21 of the connection passage 11 for the compressed air introduced into the atomizer when the air valve 6 is opened, and a joint 22 is also provided to which the branch passage 21 is connected. Thus, the actuation air is introduced through the branch passage 21 and joint 22 into the actuation air chamber 28 of the cylinder 17 provided at the rear of the needle valve 4.

[0033] It should be noted that the valve ring of the needle valve 4 moving back the air valve 6 in cooperation with the trigger 5 is projected from the gun body 1 at the front end of the air valve 6, which structure being of course similar to that of the well-known spray gun. When the trigger 5 is pulled, the air valve 6 is opened and thus air is injected as spraying air from the atomizer. The con-

nection passage 11 communicating with the atomizer has provided therein a pattern control valve 23 as another valve device to control the spraying. The pattern control valve 23 has connected directly thereto a knob 24 extending outside the gun body 1. After the air valve 6 is opened, its rear end abuts a needle valve stop shaft 25, and will move back the stop shaft 25 when the trigger 5 is further pulled, to thereby open the needle valve 4.

[0034] In this embodiment, a branch path 31 open to outside through the connection passage 11 is formed in the ring of the pattern control valve 23 provided in the connection passage 11, and the branch passage 21 is connected to the knob 24 via the joint 22. When the air valve 6 is opened, air flows from the connection passage 11 to the atomizer from which it will be injected, and further flows through the branch path 31 and branch passage 21 into the actuation air chamber 28 of the cylinder 17 to move back the piston 16. Thus, the needle valve 4 is moved back to contribute to an easier operation of the trigger 5.

[0035] It should be noted that the joint 22 is a rotary one freely rotatable on the shaft of the knob 24 and a flow rate controller 30 is connected to the joint 22 and thus to the branch passage 21. Therefore, the opening of the pattern control valve 23 can be adjusted by freely turning the knob 24 with the branch passage 21 being fixed.

[0036] The force to move back the piston 16 varies depending upon the air pressure, piston spring 18 resisting the air pressure, sliding resistance, etc. When the air pressure is sufficient, the needle valve 4 is opened without pulling the trigger 5. In case the air pressure is insufficient, the trigger can be pulled with a reduced force. Therefore, to reduce the force for pulling the trigger 5 (namely, the trigger load), it suffices to introduce air which can reduce the trigger load. Introduction of air once introduced in the connection passage 11 from the branch passage 21, and a restriction orifice 32 provided along the air route, cause the piston 16 to operate in retard of air ejection so that no insufficiently atomized paint particles will possibly be injected. According to this embodiment, the restriction orifice 32 is formed in the inner path through the knob 24 of the pattern control valve 23. It should be noted however that the restriction orifice 32 may be provided anywhere between the connection passage 11 and actuation air path 20.

[0037] It should also be noted that the sizes etc. of the cylinder and piston may be set for a required trigger load on the basis of the standard spraying pressure etc. generally determined for the spray guns. Since the air path branched for operation of the piston 16 is provided in the connection passage 11 communicating with the atomizer, so the trigger load can be reduced correspondingly to a spraying pressure without storage of the pressure to the actuation air chamber 28.

[0038] However, the actuation force applied to the piston 16 varies from one intended type of finish to another depending upon a difference in spraying by the spray

gun. To reduce the trigger load more accurately and stably, the air inflow should be adjustable. For example, the flow rate controller 30 is provided in this embodiment to adjust the air inflow.

[0039] The flow rate controller 30 is not specifically described herein, but it is a device generally referred to as "speed controller". It is commercially available as a flow rate controller for use in a pneumatic apparatus, and can supply air stably under a constant pressure. Since the flow rate controller 30 can be used to control the air inflow correctly, keeping the movement of the piston 16 and force of the spring provided at the rear of the piston 16 in balance with each other will permit to control the backward movement of the needle valve 4 and stop the needle valve 4 in a position for half opening. Thus, the spray gun according to this embodiment can be used as a one in which the paint ejection is adjustable.

[0040] FIG. 2 is a fragmentary view of the second embodiment of the spray gun according to the present invention. The second embodiment includes a piston 41 provided at the rear of the needle valve in place of the piston 16 in the first embodiment shown in FIG. 1. As shown, the piston 41 is different in construction from the piston 16. The second embodiment is a partially modified version of a general-purpose spray gun, and it attains the effect of the present invention more simply than the first embodiment of the present invention shown in FIG. 1.

[0041] That is, the piston 41 is provided inside a retaining ring 40 which is larger in diameter than the piston 41. It is housed in a cylinder 42 in which there are formed an actuation air chamber 43 and packing chamber 44. A control knob 45 is screwed in the rear portion of the cylinder 42 to limit the position of the needle valve end. Air from an introduction path 47 installed outside the gun body is fed into the actuation air chamber 43 through an inlet 46.

[0042] As in the first embodiment, when the trigger 5 is pulled, a part of the spraying air is fed into the actuation air chamber 43 from the introduction path 47 to move back the piston 41. In this case, when the pressurized area of the piston 41 is not sufficient, there will not be given any force large enough to open the needle valve if the spraying pressure is low, while the trigger load is reduced, which is still advantageous to the spray gun operator.

Claims

1. A spray gun including an air valve (6) operable by a trigger (5) and in which paint ejection is controlled by a needle valve (4), wherein a branch passage (21) communicating with a connection passage (11) provided between an exit passage of the air valve (6) and an atomization cap (3) is led to outside the apparatus through a restriction passage; a piston (16) is disposed directly in the rear of the needle valve (4),

a cylinder (17) to house the piston (16) in such a manner that the latter can reciprocate is provided at the rear of the apparatus; and an actuation air path (20) is provided in an actuation air chamber (28) at the front of the cylinder (17), having connected thereto the other end of the branch passage (21)

characterized in that

the trigger (5) operates the needle valve (4).

2. A spray gun according to claim 1, wherein the restriction passage of the branch passage (21) has provided therein a flow control valve to adjust the air inflow into the cylinder.
3. A spray gun according to claim 1, wherein the branch passage (21) forms an internal passage extending inside the valve ring of a pattern control valve (23) to communicate with the connection passage (11) and connected to the pattern control valve (23) by a rotatable joint (22).

Patentansprüche

1. Spritzpistole, die ein Luftventil (6) umfasst, das mittels eines Abzugshebels (5) betätigt werden kann, und wobei der Farbausstoß mittels eines Nadelventils (4) gesteuert wird, wobei ein Abzweigkanal (21), der mit einem Verbindungskanal (11) in Verbindung steht, zwischen einem Austrittskanal des Luftventils (6) und einer Zerstäubungskappe (3) vorhanden ist, nach außerhalb der Vorrichtung durch einen Drosselungskanal geführt wird, wobei ein Kolben (16) direkt im Hinterteil des Nadelventils (4) angeordnet ist; ein Zylinder (17), um den Kolben (16) so aufzunehmen, dass letzterer hin- und hergehen kann, im Hinterteil der Vorrichtung bereitgestellt wird; und ein Betätigungsluftweg (20) in einer Betätigungsluftkammer (28) vor dem Zylinder (17) vorhanden ist, wobei damit das andere Ende des Abzweigkanals (21) verbunden ist, **dadurch gekennzeichnet, dass** der Abzugshebel (5) das Nadelventil (4) betätigt.
2. Spritzpistole nach Anspruch 1, bei der der Drosselungskanal des Abzweigkanals (21) darin einen Durchflussmengenregler aufweist, um das Einstromen der Luft in den Zylinder zu regulieren.
3. Spritzpistole nach Anspruch 1, bei der der Abzweigkanal (21) einen inneren Durchgang bildet, der sich innerhalb des Ventilringes eines Mustersteuerventils (23) erstreckt, um eine Verbindung mit dem Verbindungskanal (11) herzustellen, und mit dem Mustersteuerventil (23) mittels einer drehbaren Verbindung (22) verbunden ist.

Revendications

1. Pistolet pulvérisateur, englobant une soupape pneumatique (6) pouvant être actionnée par une gâchette (5), et dans lequel l'éjection de la peinture est contrôlée par une soupape à pointeau (4), dans lequel un passage de dérivation (21), communiquant avec un passage de connexion (11) agencé entre un passage de sortie de la soupape pneumatique (6) et un capuchon d'atomisation (3), est dirigé vers l'extérieur de l'appareil à travers un passage de restriction ; un piston (16) étant agencé directement dans la partie arrière de la soupape à pointeau (4) ; un cylindre (17), destiné au logement du piston (16), de sorte à permettre un mouvement de va-et-vient de ce dernier, étant agencé à l'arrière de l'appareil ; et un trajet d'air d'actionnement (20) étant agencé dans une chambre d'air d'actionnement (28) à l'avant du cylindre (17) l'autre extrémité du passage de dérivation (21) étant connectée à celui-ci ; **caractérisé en ce que** la gâchette (5) actionne la soupape à pointeau (4).
2. Pistolet pulvérisateur selon la revendication 1, dans lequel le passage de restriction du passage de dérivation (21) comporte une soupape de régulation du débit qui y est agencée, pour ajuster le flux d'air rentrant dans le cylindre.
3. Pistolet pulvérisateur selon la revendication 1, dans lequel le passage de dérivation (21) forme un passage interne, s'étendant vers l'intérieur de la bague de soupape d'une soupape de régulation du motif (23), afin de communiquer avec le passage de connexion (11), et connecté à la soupape de régulation du motif (23) par un joint rotatif (22).

FIG.1

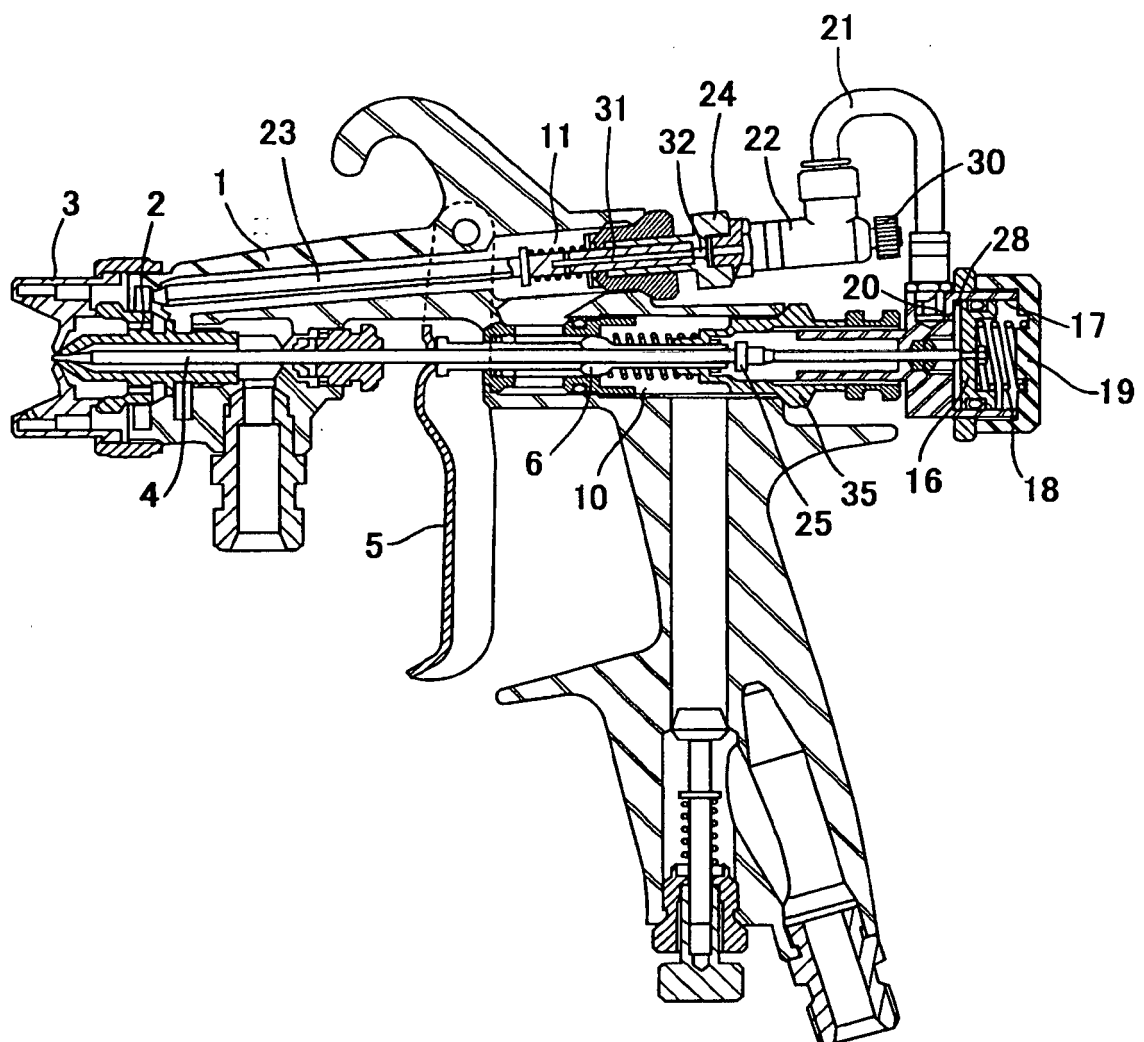


FIG.2

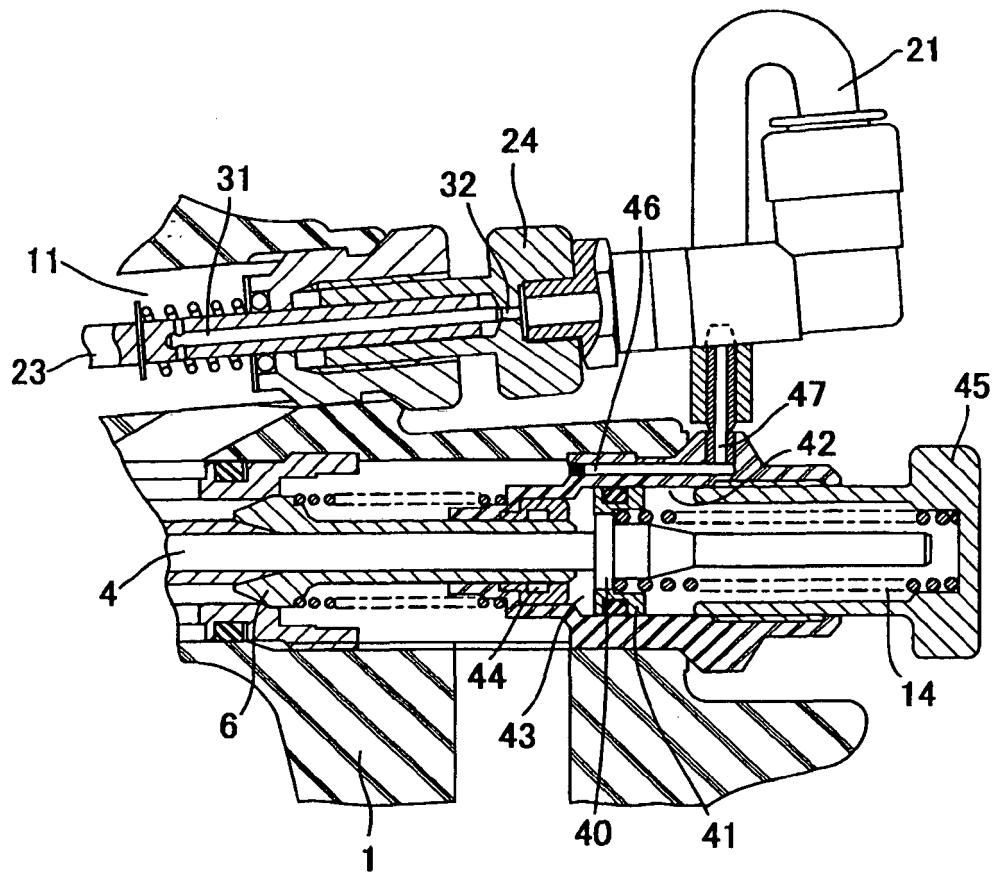
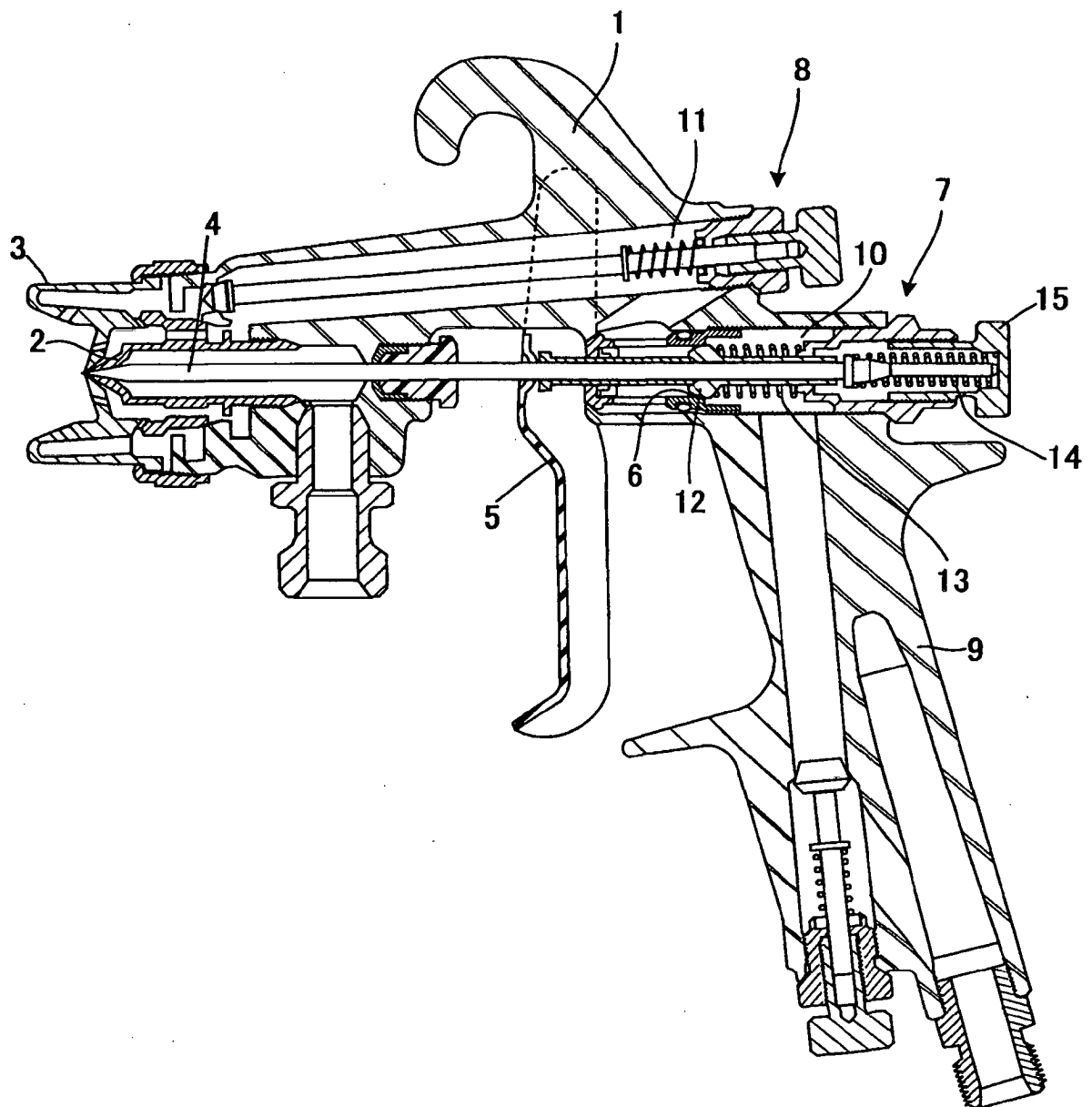


FIG.3



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

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