Automatic spray gun.

An automatic spray gun has liquid atomizing means provided at the front end thereof, a needle valve adapted to control the amount of a liquid jetted out from the atomizing means, and an air piston received in a cylinder at the rear end of the needle valve and activated by means of compressed air. The spray gun is provided with distance measuring means for judging the distance between the spray gun and an object to be sprayed which is positioned in front of the spray gun, and a solenoid valve activated in response to an ON-OFF signal delivered from the distance measuring means, the solenoid valve being disposed in an air passage which extends from a compressed air supply source to the cylinder. Thus, the needle valve is selectively opened and closed by controlling the solenoid valve so as to start and stop a spraying operation automatically.
The present invention relates to an apparatus for spraying an object with a coating fluid such as a paint. More particularly, the present invention pertains to a spray gun which is so designed that the need for a manually-operated gun trigger is eliminated in a spraying operation.

Paint spray guns are well known as means for spraying various objects with liquid substances. A typical spray gun of this type is arranged such that an operator holds it in his hand and actuates a trigger or any other similar means such as a push-button provided on the spray gun to start and stop spraying of a liquid substance, thereby effecting the required spraying operation. In this type of operation, however, the operator must repeatedly move his hand and finger to control and trigger the spray gun, and this leads to injury or physical handicap. Therefore, efforts have been made to devise a measure for coping with this situation.

Further, the distance between the spray gun and the object is a important factor in a spraying operation, and it is necessary to hold the spray gun at an appropriate distance when spraying a coating on the object. In painting, this distance has a particularly significant effect on the grade or quality of finish, and it is necessary for the operator to conduct painting while constantly maintaining an appropriate spraying distance. However, with the conventional spray guns, the operator must estimate the distance from an object with the naked eye and actuate the trigger of the spray gun accurately and effectively on the basis of his own experience and skill, which means that technical skill is needed to effectively handle the conventional spray guns. In any type of conventional spray gun, it is necessary to actuate a trigger or a similar control member in order to control the amount of paint sprayed and the pressure of compressed air.

In view of the above-described circumstances, it is a primary object of the present invention to provide a spray gun which eliminates the need to take account of the distance between the spray gun and an object being sprayed, thereby allowing an operator to effect an optimal spraying operation without it being necessary for him to have particular technical skills in order to constantly maintain an appropriate spraying distance, and which also eliminates the need to conduct a manual operation when starting and stopping the spraying of an object with a coating.

To this end, the present invention provides an automatic spray gun which is provided with means for judging or measuring the distance between the spray gun and an object, and a solenoid valve which is activated in response to a control signal delivered from the distance measuring means, thereby allowing spraying to be automatically effected when the object is within a predetermined range.

In a practical embodiment of the present invention, the spray gun has a liquid atomizing means provided at the front end thereof, a needle valve adapted to control the amount of liquid sprayed, and an air piston received in a cylinder at the rear end of the needle valve, the piston being controlled such as to be selectively advanced and withdrawn by means of compressed air. The spray gun further has a sensor incorporated therein, the sensor being adapted to transmit a signal toward an object and receive the signal reflected theretofrom so as to measure the distance from the object. In addition, the spray gun is provided with a solenoid valve which allows compressed air to be blown off when the measured distance is within a predetermined range. The piston is adapted to control the needle valve so as to selectively start and stop a spraying operation. The piston is activated by compressed air, and in a pneumatic atomization type spray gun, the atomizing compressed air is employed to activate the piston.

Accordingly, the opening and closing operation of the solenoid valve replaces the trigger operation of the spray gun. The control of the solenoid valve is automatically effected on the basis of a value measured by the distance measuring means. Therefore, spraying is performed only when the distance between an object and the spray gun is within a predetermined appropriate range while the latter is pointed toward the object. Thus, spraying is automatically effected only when necessary without the need to actuate a manually-operated trigger or the like.

The above and other objects, features and advantages of the present invention will become more apparent from the following description of a preferred embodiment thereof, taken in conjunction with the accompanying drawing.

The accompanying drawing is a sectional view of a spray gun in accordance with one embodiment of the present invention.

Referring to Fig. 1, which is a sectional view of a paint spray gun in accordance with one embodiment of the present invention, the atomizing means of this spray gun is of the pneumatic atomization type and therefore adopts a conventional arrangement which is composed of an air cap 1, a paint nozzle 2 and a needle valve 3. An air piston 4 is operatively secured at the rear end of the needle valve 3, so that the needle valve 3 is selectively...
opened and closed by the action of the air piston 4. The air piston 4 is received in a cylinder 5, and a packing 6 for keeping the cylinder 5 airtight is provided on the sliding part of the air piston 4. A knob 7 is provided at the rear end portion of the piston 4. The knob 7 is fitted through a threaded portion 9 thereof into the central portion of a cap 8 which closes the rear end of the cylinder 5 in such a manner that the knob 7 is movable longitudinally for adjustment, thereby limiting the amount of movement (withdrawal) of the piston 4, and thus adjusting the degree of opening of the needle valve 3. The forward portion of the piston 4 is communicated with an air passage 12 which is connected to a compressed air supply source AS. The air passage 12 is selectively opened and closed by the action of a solenoid valve 11 which is provided at the lower end of a handle 10 of the spray gun. The arrangement is such that, when the solenoid valve 11 is opened, compressed air is introduced into the cylinder 5, thus causing the piston 4 to be withdrawn. In addition, a spring 13 is provided for the purpose of returning the needle valve 3 to its previous position when the compressed air is expelled from the cylinder 5. Air passages 14 and 15 for sending the compressed air from the solenoid valve 11 to the atomizing means extend toward the front end of the spray gun. A part of the air supplied through these passages 14 and 15 is jetted out from an atomizing nozzle 1a so as to cause a paint to be atomized, and the remaining air is blown off from a spray pattern adjusting orifice 1b so as to adjust the pattern of the atomized paint. In this spray gun, the flow rate of both the atomizing air and the spray pattern adjusting air is varied by the operation of a spray pattern adjusting valve 16. A distance measuring means 17 is provided in such a manner as to face the same direction as that of the atomizing means. The distance measuring means 17 is composed of an ultrasonic transmitting transducer and an ultrasonic receiving transducer and is adapted to measure the distance from an object which is located in the forward direction from the spray gun. This type of means is adapted to measure the distance from an object on the basis of the period of time which takes for an ultrasonic wave to travel from the point where it is transmitted to the object and then to return to a point where it is received on being reflected back from the object. Since this structure is known and its detailed structure per se does not constitute any part of the present invention, description thereof is omitted. Although not shown, the distance measuring means 17 includes a power supply and an arithmetic unit so that a control signal is delivered to the solenoid valve 11 from the means 17.

In this embodiment, the distance measuring means 17 employs an ultrasonic sensor for detection of the spray distance because this type of sensor works substantially irrespectively of the kind of material of which the object is formed and it is not readily affected by coatings such as paint which are sprayed and become undesirably attached to the sensor. However, the ultrasonic sensor is not necessarily limiting, and other types of known measuring means, e.g., optical and electrical means, may also be employed, provided that the measuring means employed meets particular conditions. It should be noted that a paint is supplied from a paint supply source PS in a manner similar to that in the conventional spray guns, and description of the paint supply method is therefore omitted.

In operation, the power supply for the distance measuring means 17 is first turned ON to make the spray gun operative. In consequence, the spray gun is immediately brought into a state wherein its spray coating operation is kept under control. More specifically, when the spray gun is directed toward an object, the distance measuring means 17 starts measurement of the distance from the object by means of constant pulses, and when the spray gun comes within a spraying distance of a predetermined range, the solenoid valve 11 is immediately opened and the compressed air is thereby sent to the air cap 1 which constitutes a part of the atomizing means of the spray gun.

At the same time, the compressed air is also supplied to the air cylinder 5, and the piston 4 is withdrawn by virtue of the pressure of the compressed air, thus causing the needle valve 3 connected directly to the piston 4 to also be withdrawn. In consequence, the paint 2 is jetted out from the paint nozzle 2 and atomized by the compressed air from the air cap 1 before being sprayed on the object. Accordingly, it is possible to effect spray coating simply by moving the spray gun along the object without the need to actuate a manually-operated trigger as in the case of conventional spray guns. In addition, painting is conducted only when the object is in front of the spray gun and is located at an appropriate distance from the spray gun. Therefore, the spray gun according to the present invention is capable of automatically painting while recognizing the configuration of the object at any time during the spray coating operation. In the present invention, the amount of paint jetted out from the spray gun and the pattern of the sprayed paint are adjusted by actuating the manually-operated knob. It is therefore only necessary for the distance measuring means to be able to generate an ON-OFF signal to control the spraying operation on the basis of the predetermined spraying distance range. In addition, the spray gun
is only required to have a simple structure such as that exemplified in the embodiment which enables the needle valve to be activated by the action of the air piston.

As has been described above, the spray gun according to the present invention enables painting to be automatically conducted only when an object is located within an appropriate range from the spray gun by confirming the distance from the object with the distance measuring means provided on the spray gun. It is therefore possible for the operator to effect an optimal painting operation simply by pointing the spray gun toward an object and moving the spray gun along the surface of the object, or fixing the spray gun and moving an object relative to it. In particular, a surface of an object which needs to be painted is automatically judged on the basis of the configuration of the object, and the spraying operation is automatically started and stopped. Accordingly, even an unskilled person can effect excellent painting without experiencing hand fatigue and without any fear of a painting failure due to misjudged spraying distance.

Although the present invention has been described through specific terms, it should be noted here that the described embodiment is not necessarily limitative, and various changes and modifications may be imparted thereto without departing from the spirit and scope of the invention which is limited solely by the appended claims.

Claims

1. An automatic spray gun comprising:

liquid atomizing means provided at the front end of said spray gun;
a needle valve adapted to control the amount of a liquid jetted out from said atomizing means;
an air piston secured to the rear end of said needle valve and received in a cylinder so that it is activated by means of compressed air:
distance measuring means for judging the distance between said spray gun and an object to be sprayed which is positioned in front of said spray gun; and
a solenoid valve activated in response to an ON-OFF signal delivered from said distance measuring means, said solenoid valve being disposed in an air passage which extends from a compressed air supply source to said cylinder,

whereby said needle valve is selectively opened and closed by controlling said solenoid valve so as to start and stop a spraying operation automatically.

2. An automatic spray gun according to Claim 1, wherein said air piston is biased by a spring in the direction in which said needle valve closes said atomizing means, said air passage being connected to said cylinder in such a manner that the compressed air supplied through said air passage presses said piston in the direction counter to the biasing force applied by said spring, and said solenoid valve being adapted to selectively assume a position where it closes said air passage and a position where it opens said air passage.

3. An automatic spray gun according to Claim 2, wherein said atomizing means has an air nozzle, said air passage being also communicated with said air nozzle.