



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 0 899 015 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
03.03.1999 Bulletin 1999/09

(51) Int. Cl.⁶: **B05B 5/03**

(21) Application number: **98114891.9**

(22) Date of filing: **07.08.1998**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **21.08.1997 JP 224861/97**

(71) Applicant:
**Ransburg Industrial Finishing KK
Yokohama-shi, Kanagawa-ken 236-0004 (JP)**

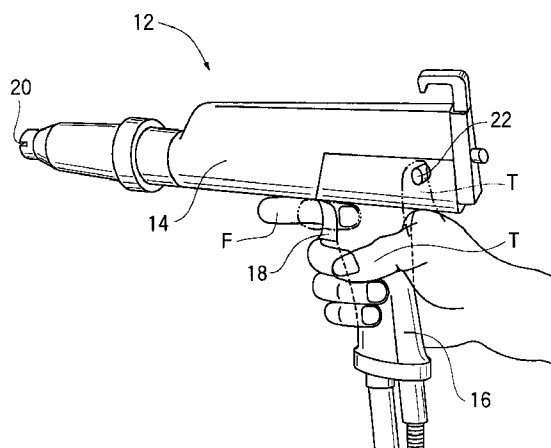
(72) Inventor:
**Katoh, Mikio,
Ransburg Industrial Finishing K.K.
Yokohama-shi, Kanagawa-ken 236-0004 (JP)**

(74) Representative:
**Vetter, Ewald Otto, Dipl.-Ing. et al
Patentanwaltsbüro
Allgeier & Vetter
Postfach 10 26 05
86016 Augsburg (DE)**

(54) **Hand-gun for powder coating comprising switch for changing the amount of discharged powder**

(57) A powder coating hand-gun usable in an electrostatic coating method in which the powder coating hand-gun is instantaneously responsive to a change or variation in the coating environment during the coating operation without the operator's interrupting the coating operation, and a coating system incorporating the same are provided. The rearward section of a barrel portion 14 of a hand-gun 12 includes a switch 22 which can be operated by releasing only the thumb T of the right hand holding the hand-gun 12 from a grip portion 16 and standing the thumb T. The amount of the coating material discharged from the hand-gun 12 can be changed, for example, from 400 g/cm³ to 200 g/cm³ by operating the switch 22 when the hand-gun is approaching an interior corner while coating a box.

FIG. 2



EP 0 899 015 A1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention generally relates to electrostatic coating using a powder coating material and more particularly to a hand-gun for powder coating and a coating system incorporating the same.

Prior art

[0002] Among methods for electrostatic coating with coating materials, powder coating is noticed as being suitable for addressing up-to-date problems on Pollution (see, for example, Japanese Patent Publication No. 55-51628). As with electrostatic liquid coating, hand-guns suitable for coating an object of a small lot with a powder coating material are commercially available. A conventional powder coating hand-gun comprises a barrel portion, a grip portion and a trigger. An operator can hold the grip portion with its one hand and squeeze the trigger with the forefinger to spray a coating powder material entrained in air from an injector toward an object to be coated through a discharge port at an end of the barrel portion.

[0003] The trigger is equipped with means for effecting on-off control of discharge of the powder from the hand-gun. Regulation of the amount of the powder discharged from the hand-gun is made by adjusting the amount of control air supplied to the injector. In a prior art powder coating system, a valve mounted in a controller, more specifically on a control panel, is adjusted to regulate the amount of the powder coating material discharged from the hand-gun.

[0004] According to the prior art powder coating system, an operator pre-sets the amount of the powder discharged from the gun at a preparation step by adjusting the valve on the control panel prior to initiating coating operation, but for example, in the case where the rate of conveying a line of objects to be coated should be changed or in the case where an object to be coated comprises a box having corners inside, problems such as over-spraying tend to occur and the operator handling the hand-gun must be skillful in addressing these problems. When such a change or variation in the coating conditions has occurred, the operator, of course, can stop the coating operation to adjust the valve on the control panel again, but in terms of operating efficiency, it is not preferred that the coating operation be interrupted every time adjustment of the valve is needed.

SUMMARY OF THE INVENTION

[0005] An object of the present invention is to provide a powder coating hand-gun usable in an electrostatic coating method in which the powder coating hand-gun

is instantaneously responsive to a change or variation in the coating conditions during the coating operation without the need for interrupting the coating operation, and to provide a coating system incorporating the same.

[0006] In accordance with one aspect of the present invention, there is provided a powder coating hand-gun having a grip portion and a barrel portion and usable in an electrostatic coating system for discharging a powder coating material toward an object to be coated, characterized in including means disposed at a position in which it can be operated by a finger of an operator's hand without loosening the operator's hold on said grip portion for changing the amount of the powder coating material discharged from said hand-gun.

[0007] In accordance with the other aspect of the present invention, there is also provided a coating system comprising,

a pressurized air source;

a powder coating material source;

an injector for sucking the powder coating material from said powder coating material source and discharging the powder under the action of the pressurized air supplied from said pressurized air source; air regulating means for regulating the amount of air to be supplied from said pressurized air source to said injector;

an electrostatic coating hand-gun having a grip portion and a barrel portion for receiving the powder coating material from said injector and discharging it toward the object to be coated;

a switch located on said hand-gun at a position in which it can be operated by a finger of an operator's hand without loosening the operator's hold on said grip portion of said hand-gun; and

control means for receiving a signal from said switch and controlling said air regulating means so that the amount of the powder coating material discharged from said hand-gun will be changed.

[0008] The present invention enables the operator to change the mount of the powder discharged from the hand-gun by means or the switch provided in the hand-gun for changing the amount of the discharged powder without loosening the operator's hold on the hand gun, in other words, all the while continuing the coating operation, thereby instantaneously changing the amount of the the coating material from the gun in response to changes in coating condition.

[0009] In a hand-gun or a coating system according to the present invention, means for changing the discharge of the powder coating material or the switch as described above is preferably disposed within an area in which it can be operated by the thumb of the operator's hand holding said grip portion, or alternatively a switch which is sensitive to the amount of squeeze of the trigger or responsive to the motion of squeezing the trigger when it is squeezed may be disposed in a position in

which it can be operated by the forefinger of the operator's hand so that the amount of the powder coating material discharged from the gun be changed in response to a signal from this switch.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Other features and advantages of the present invention will be apparent from the following description of the preferred embodiments thereof in conjunction with the accompanying drawings in which :

FIG. 1 is a general block diagram of a conventional powder coating system.

FIG. 2 is a perspective view of a hand-gun according to the first embodiment of the present invention.

FIG. 3 is a partial view of an air control system of a coating system according to the present invention.

FIG. 4 is a perspective view of a hand-gun according to the second embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0011] FIG. 1 shows a general view of an electrostatic powder coating system 1. The powder coating system 1 comprises a pressurized air source 2 such as a compressor, a controller 4 for controlling the air from the pressurized air source 2, a powder source 6 such as a container or a hopper containing a powder coating material, an injector 8 such as a venturi which sucks the powder from the source 6 and discharges the powder under the action of the pressurized air supplied from the controller 4, and a hand-gun 12 which sprays the powder coating material entrained in conveying air through a flexible tube or hose 10 from the injector 8 toward an object to be coated (not shown).

[0012] The amount of the powder discharged from the injector 8 or the amount of the coating material sprayed from the hand 12 can optionally be regulated by controlling the control air fed into the injector 8 from the controller 4. This control is made by adjusting a regulating valve (not shown) self-contained in the controller 4 and will be described later with reference to FIG. 3. The system 1 is well known in the art and will not be described in greater detail. In generally, the amount of the coating material sprayed from the gun 12 is pre-set by an operator at a preparation step prior to the coating operation.

[0013] FIG. 2 is a side view of a hand-gun in accordance with the present invention. As can be seen from FIG. 2, the hand-gun 12 includes a barrel portion 14 and a grip portion 16 which is equipped with a trigger 18. For performing coating operation, an operator can hold the grip portion 16 with one hand and direct the forward end of the barrel portion toward the object (not shown) and then squeeze the trigger 18 with the forefinger F to spray the powder toward the object through a discharge port 20 at the forward end of the barrel portion 14. The

hand-gun 12 includes a switch 22 for changing the amount of the powder discharged from the port 20. The switch 22 may be located on any of the barrel portion 14 and the grip portion 16 and is preferably disposed within an area in which it can be operated by the thumb T of the operator's hand holding the hand-gun 12. If the operator is right-handed, as shown in FIG. 2, the switch 22 may be disposed within an area in which it can be operated by the thumb T of the right hand when the operator holds the gun 12 with the right hand, such as on the left side of the rearward section of the barrel portion 14 as illustrated in FIG. 2. Thus, the operator can release and stand only the thumb T of the right hand from the grip portion 16 to thereby operate the switch 22 while continuously holding the gun 12 with the other fingers during the coating operation.

[0014] The switch 22 in this embodiment comprises a push switch, but other types of switches may also be used. A variety of types of switches such as a rotary switch and a toggle switch are known and any of the known switches may be used. A push switch, which can be on and off only by pushing it with a finger, and a toggle switch, which the operator can actuate by moving a swing lever, are preferred since these switches require no particular labor or attention to turn on and off and the operator can change the amount of the powder sprayed from the gun 12 throughout the coating operation. A toggle switch is more advantageous since the force for operating the switch 22 is not oriented in a direction across the axis of the barrel portion 14 and the direction of the barrel portion 14 or the direction in which the coating material is sprayed from the gun 12 will not be changed when the switch is operated. Specifically, a water-proof toggle switch under M-W Series sold by NIKKAI Co. is preferred.

[0015] FIG. 3 shows part of an air line disposed within the controller 4. Reference numeral 30 represents a main conduit for feeding the pressurized air received from the source 2 such as a compressor to an injector 8 and the arrow as shown indicates the direction in which the air flows. The conduit 30 includes, sequentially from upstream to downstream, a main solenoid valve (SOL-M) 32, an upstream regulating valve (AR-M) 34 and a high flow rate solenoid valve (SOL-H) 36. The main conduit 30 also includes a by-pass conduit 38 to by-pass the high discharge solenoid valve 36.

[0016] The bypass conduit 38 is connected at its upstream end to the main conduit 30 between the upstream regulating valve 34 and the high flow rate solenoid valve 36 and is connected at its downstream end to the main conduit 30 downstream of the high flow rate solenoid valve 36. The main conduit 30 further includes, sequentially from upstream to downstream, an downstream regulating valve (AR-L) 40 and a low flow rate solenoid valve (SOL-L) 42.

[0017] The main solenoid valve 32 is subjected to on-off control by operating the trigger 18 of the gun 12. Specifically, as is known in the art, the main solenoid

valve 32 is subjected to on-off control by the starting motion of the trigger such that when the operator squeezes the trigger 18, the main solenoid valve will be turned on to open the main conduit 30 and when the operator releases the trigger, the main solenoid valve will be turned off to close the main conduit 30.

[0018] The high flow rate solenoid valve 36 and the low flow rate solenoid valve 42 are subjected to on-off control by operating the switch 22. When the operator turns off the switch 22, the high flow rate solenoid valve 36 will be turned on and the low flow rate solenoid valve 42 will be turned off to generate a first mode in which the main conduit is opened and the bypass conduit 38 is closed. In the first mode, the control air is supplied to the injector 8 via the main conduit 30. On the other hand, when the operator turns on the switch 22, the high flow rate solenoid valve 36 will be turned off and the low flow rate solenoid valve 42 will be turned on to generate a second mode in which the main conduit is closed and the bypass conduit 38 is opened. In the second mode, the control air is supplied to the injector 8 by means of the bypass conduit 38.

[0019] The flow rate of the control air in the first mode or the flow rate of the air at which it is fed to the injector through the main conduit 30 can be regulated in a non-stepped manner by manually operating the upstream regulating valve 34. A first meter (AG-H) 44 connected to the upstream valve 34 makes it possible to confirm the flow rate of the control air after it is regulated or the amount of the powder discharged from the gun 12 which amount is controlled by the upstream valve 34. This amount of the powder discharged in the first mode is set, for example, at a rate of 400 g/cm^3 . The flow rate of the control air in the second mode or the flow rate of the air at which it is fed to the injector via the bypass conduit 38 can be regulated in a non-stepped manner by manually operating the downstream valve 40. A second meter (AG-L) 46 connected to the downstream valve 40 makes it possible to confirm the flow rate of the control air after it is regulated or the amount of the powder discharged from the gun 12 which amount is controlled by the downstream valve 40. This amount of the powder discharged in the second mode is set, for example, at a rate of 200 g/cm^3 .

[0020] At a preparation step prior to starting the coating operation, considering the various operating conditions such as the types and the shapes of the objects to be coated and the running rate of the coating line, the operator sets the amount of the powder discharged in the first mode at an appropriate rate by operating the upstream valve 34 and the amount of the powder discharged in the second mode at an appropriate rate by operating the downstream valve 40. The amount of the powder discharged in the second mode which is set at a relatively low rate is preferably set at a rate such that the difference between the amounts of the discharge in the first mode and in second mode will be sufficiently considerable to visually recognize a change in the

amount of the discharged powder which occurs when the mode is switched. For example, if the amount of the powder discharged in the first mode is set at a rate of 400 g/cm^3 , the amount of the powder discharged in the second mode is preferably set at a rate of 200 g/cm^3 to 150 g/cm^3 and if the amount of the powder discharged in the first mode is set at a rate of 300 g/cm^3 , the amount of the powder discharged in the second mode is preferably set at a rate of 100 g/cm^3 .

[0021] For example, if an object to be coated comprises a box, when the direction of the hand-gun approaches an interior corner of the box, the switch 22 can simply be operated to switch the mode to the second mode whereby the amount of the powder coating material discharged from the gun 12 can be instantaneously reduced. Thus, a uniform thickness of the coating can be achieved without producing the "splash of coating material" which could occur with over-splaying or excess coating. This is also the case when a rate of conveying a line of objects to be coated is changed. If a rate of line is changed to a low rate, the amount of the powder discharged from the gun 12 can accordingly be switched to that of the second or low discharge mode.

[0022] Thus, depending on the cases where the coating conditions are varied, the shape of an object to be coated is changed or the like, the operator can instantaneously switch the mode to the high amount discharge mode or the low amount discharge mode all the while spraying the powder toward the object from the hand-gun without interrupting the coating operation, thereby improving operating and coating efficiencies or uniformity of the coating. Obviously, where a rate of line is initially set at a low rate, if the discharge of the second mode corresponds to such a low rate of line, the switch 22 can simply be operated to adequately set the amount of the powder to be discharged corresponding to the rate of line without effecting the presetting or operating the upstream valve 34 of the controller 4 prior to starting the coating operation, whereby the presetting prior to the coating operation can be eliminated.

[0023] FIG. 4 is a side view of a hand-gun according to the second embodiment of the present invention with like elements bearing the same reference numerals as in the first embodiment as described above. In FIG. 4, the overall shape of the hand-gun is illustrated in phantom line for clarity of the essential part of this embodiment. In the second embodiment, a hand-gun 50 includes a built-in switch or sensor 54 associated with a pivot 52 of the trigger 18. The switch or sensor 54 corresponds to the switch 22 of the first embodiment and is adapted to switch the first or high discharge mode and the second or low discharge mode as described above depending on the amount of squeezing the trigger 18. The setting of the switching timing of the first and second modes can optionally be made. In this embodiment, the gun 50 is set to operate in the first mode when the trigger 12 is squeezed to the maximum limit position (which is indicated by "H") and in the second mode

when the trigger 12 assumes a position which does not reach the maximum limit position (which is indicated by "L"). Thus, the operator can control the increase or decrease in the amount of the powder discharged from the gun 50 between the first and second modes by simply squeezing the trigger 18 to the maximum limit or slightly loosening the trigger depending on the varying coating conditions.

Claims

1. A powder coating hand-gun having a grip portion (16) and a barrel portion (14) and usable in an electrostatic coating system for discharging a powder coating material toward an object to be coated, characterized in including means (22) disposed at a position in which it can be operated by a finger of an operator's hand without loosening the operator's hold on said grip portion (16) for changing the amount of the powder coating material discharged from said hand-gun. 15
2. A powder coating hand-gun as claimed in claim 1, wherein said changing means (22) is disposed at a position in which it can be operated by the thumb of the operator's hand holding said grip portion. 25
3. A powder coating hand-gun as claimed in claim 1, wherein said changing means (22) is located on a rearward section of said barrel portion. 30
4. A coating system as claimed in any preceding claim, wherein said changing means (22) comprise a switch in the form of an on-off push switch that can be depressed by an operators's finger. 35
5. A coating system as claimed in any one of claims 1 to 3, wherein said changing means (22) comprise a switch in the form of an on-off toggle switch that the operator can actuate by moving a swing lever of said toggle switch. 40
6. A coating system comprising a powder coating hand-gun as claimed in any one of claims 1 to 5 and further comprising : 45
 - a pressurized air source;
 - a powder coating material source;
 - an injector for sucking the powder coating material from said powder coating material source and discharging the powder under the action of the pressurized air supplied from said pressurized air source; 50
 - air regulating means for regulating the amount of air to be supplied from said pressurized air source to said injector; 55
 - control means for receiving a signal from said changing means (22) and controlling said air

regulating means so that the amount of the powder coating material discharged from said hand-gun will be changed.

7. A coating system as claimed in claim 6, wherein said air regulating means comprises a first flow control valve mounted in a main conduit for supplying the pressurized air from said pressurized air source to said injector; a first solenoid valve disposed downstream of said first flow control valve; and a second flow control valve and a second solenoid valve both of which are mounted in a bypass conduit adapted to bypass said first solenoid valve.

FIG. 1

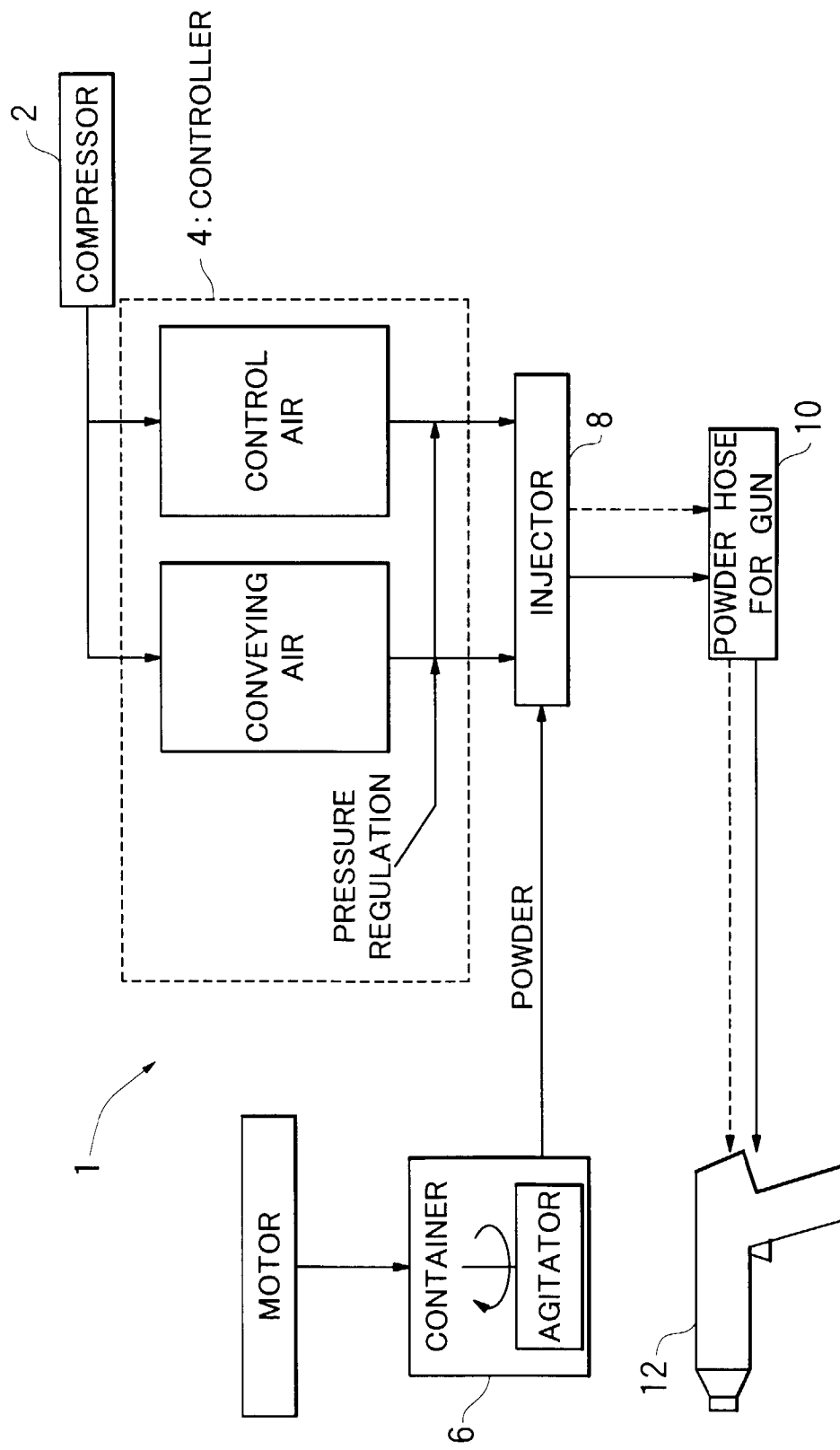


FIG. 2

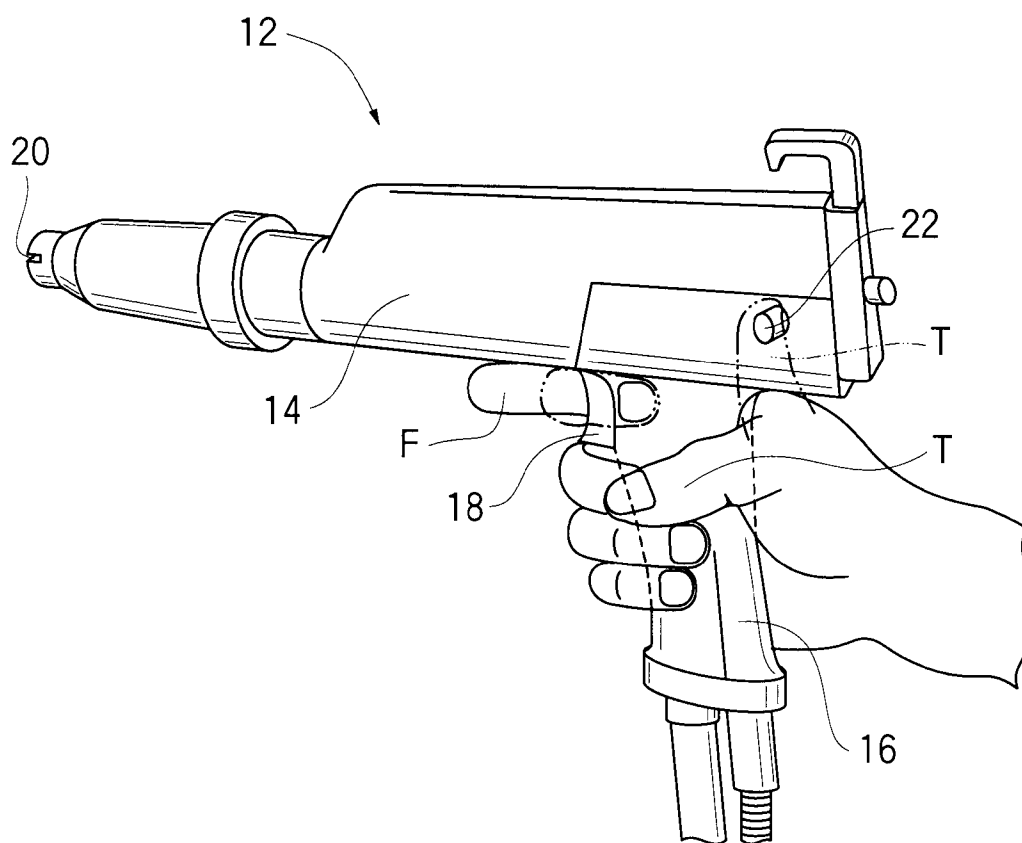


FIG. 3

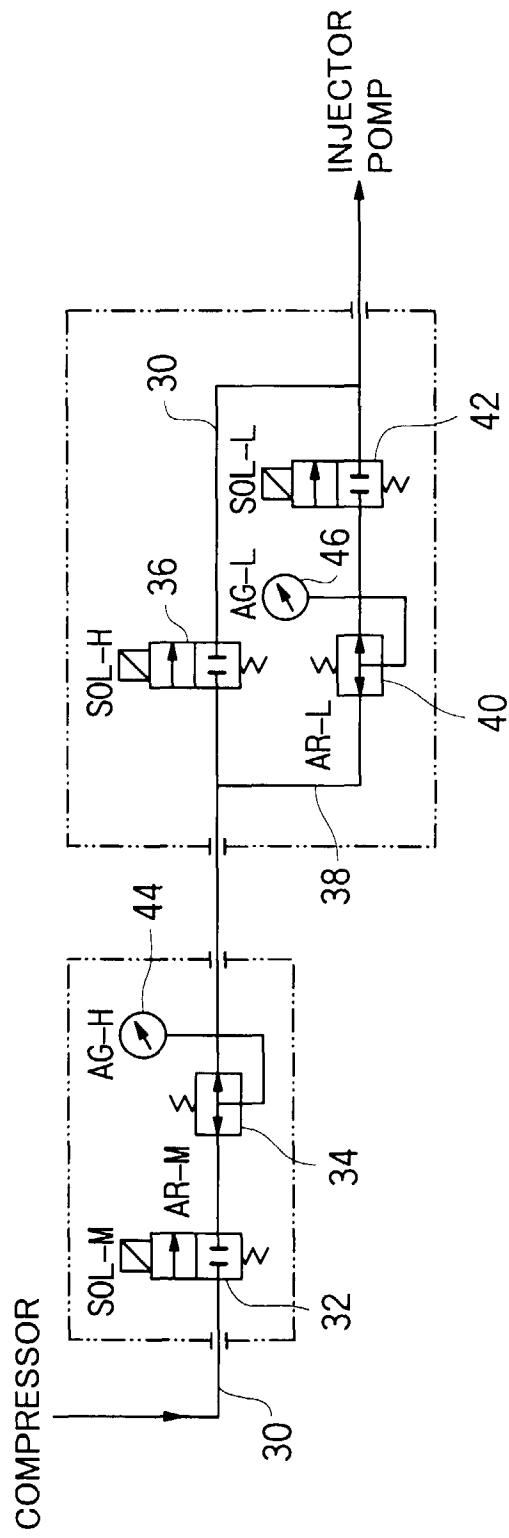
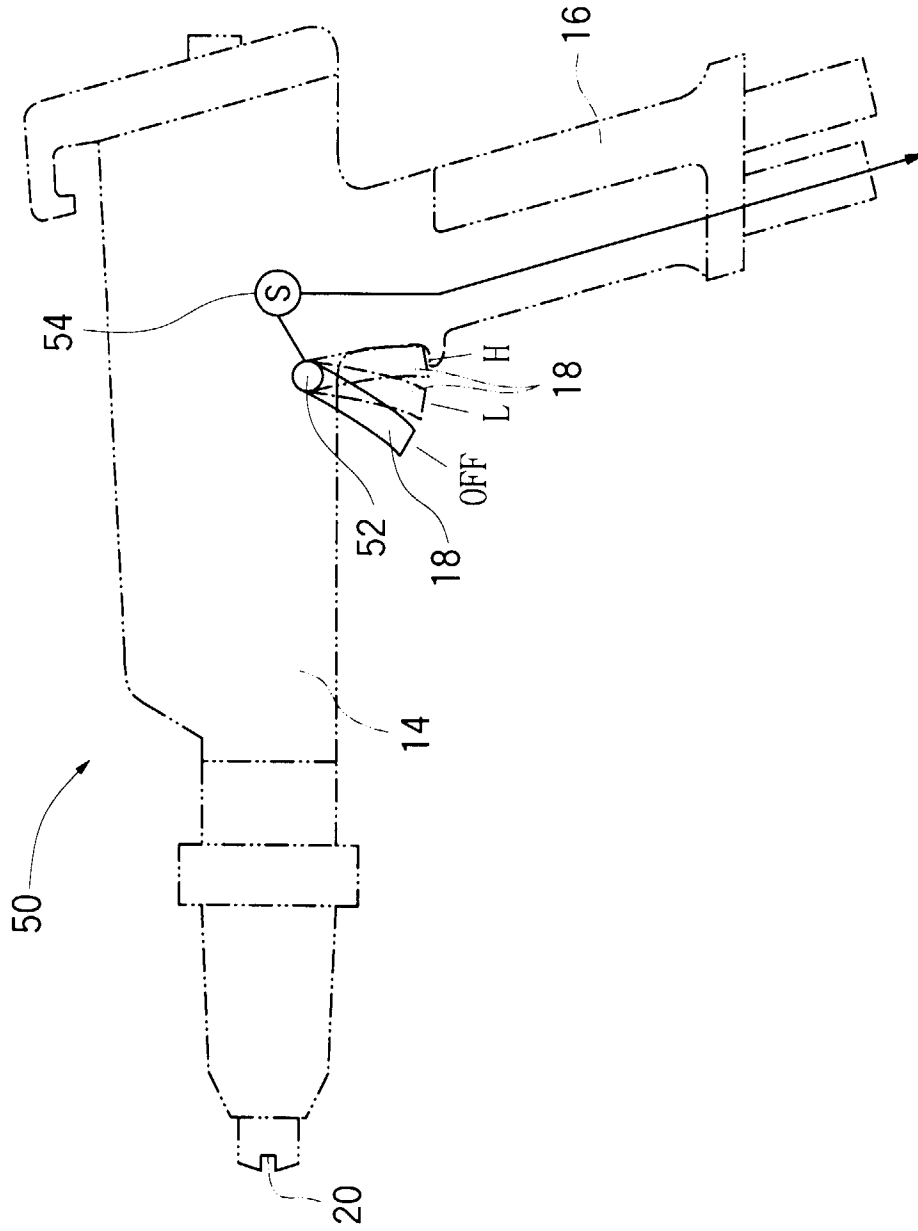


FIG. 4





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 11 4891

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 216 915 A (BAUMANN, KURT ET AL) 12 August 1980 * column 2, line 57 - column 3, line 63; figure 2 *	1-6	B05B5/03
X	US 3 674 209 A (LIEDBERG, KURT HERMAN) 4 July 1972 * column 1, line 58 - column 2, line 67; figure *	1-3	
X	DE 19 66 244 A (ERNST MUELLER KG) 24 February 1972 * page 4, line 21 - page 5, line 15; claims 1-3; figures 2,3 *	1,2,6	
X	PATENT ABSTRACTS OF JAPAN vol. 004, no. 098 (C-018), 15 July 1980 & JP 55 059860 A (KANSAI PAINT CO. LTD.), 6 May 1980 * abstract *	1,2	
X	DE 22 64 386 A (NORDSON CORPORATION) 30 May 1973 * page 11, line 24 - page 13, line 2 * * page 23, line 2 - page 26, line 35; figures 1,8 *	1,2	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B05B
X	US 3 940 061 A (GIMPLE, JAMES J. ET AL) 24 February 1976 * column 4, line 44 - column 7, line 8; figure 5 *	1,2	
A	US 3 008 645 A (MOREL, ROGER ET AL) 14 November 1961 * column 2, line 12-43; figure 1 *	1	
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 27 November 1998	Examiner Innecken, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 11 4891

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

27-11-1998

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4216915 A	12-08-1980	CH 620600 A	15-12-1980
		BR 7803015 A	26-12-1978
		CA 1092801 A	06-01-1981
		DE 2819602 A	23-11-1978
		FR 2390212 A	08-12-1978
		GB 1554851 A	31-10-1979
		JP 53140610 A	07-12-1978
US 3674209 A	04-07-1972	SE 332772 B	15-02-1971
		CA 919134 A	16-01-1973
		DE 2048043 A	29-04-1971
		FR 2062820 A	25-06-1971
		GB 1278138 A	14-06-1972
		NL 7014654 A,B,	08-04-1971
		ZA 7006575 A	27-05-1971
DE 1966244 A	24-02-1972	DE 1915657 A	08-10-1970
		AT 301723 B	15-08-1972
		BE 732185 A	01-10-1969
		CH 505653 A	15-04-1971
		DE 1771263 A	16-08-1973
		FR 2007075 A	02-01-1970
		GB 1271731 A	26-04-1972
		GB 1273330 A	10-05-1972
		NL 6906440 A	28-10-1969
		US 3691991 A	19-09-1972
		US 3637135 A	25-01-1972
		AT 307595 B	15-04-1973
		AT 312768 B	15-12-1973
		BE 732186 A	01-10-1969
		CH 521173 A	15-04-1972
		CH 520528 A	31-03-1972
		FR 2011817 A	13-03-1970
		GB 1270452 A	12-04-1972
		GB 1272380 A	26-04-1972
		NL 6906439 A	28-10-1969
		SE 356226 B	21-05-1973
DE 2264386 A	30-05-1973	AU 4801372 A	02-05-1974
		BE 790830 A	15-02-1973
		CA 973702 A	02-09-1975
		CA 1005982 A	01-03-1977
		DE 2252474 A	03-05-1973
		FR 2159946 A	22-06-1973
		GB 1409424 A	08-10-1975
		GB 1409425 A	08-10-1975

EPO FORM P449

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 11 4891

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

27-11-1998

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 2264386 A		GB 1409423 A	08-10-1975
		JP 978870 C	29-11-1979
		JP 51105347 A	17-09-1976
		JP 54012499 B	23-05-1979
		JP 48054140 A	30-07-1973
		NL 7214751 A	04-05-1973
		US 3870375 A	11-03-1975
		US 3746254 A	17-07-1973
		US 3960323 A	01-06-1976
US 3940061 A	24-02-1976	AU 8456275 A	10-03-1977
		BE 833418 A	31-12-1975
		BR 7505963 A	03-08-1976
		CA 1058857 A	24-07-1979
		CH 609586 A	15-03-1979
		DE 2539627 A	01-04-1976
		FR 2284373 A	09-04-1976
		GB 1518517 A	19-07-1978
		JP 1144974 C	12-05-1983
		JP 51055343 A	15-05-1976
		JP 55032433 B	25-08-1980
		SE 7510280 A	17-03-1976
US 3008645 A	14-11-1961	CH 348087 A	
		FR 1216250 A	22-04-1960
		FR 1216251 A	25-04-1960
		GB 851092 A	