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(54) Dimensions of air and fluid orifices of nozzle for HVLP spray gun

(57) A painting device (10) comprising a shaped hollow body (11) provided with a duct (12) for feeding a coating product which ends with a spray nozzle (14), and a duct (15) for feeding pressurized gas which ends in an atomization cap (17) which forms, together with the body, a chamber (19) which leads into a hole (20) which is coaxial to the nozzle (14) and forms a ring of gas around it. Manually- or automatically-actuated valves (24,25) are associated with the hollow body to cut off the ducts (12,15). The passage section of the ring of gas that surrounds the nozzle (14) is smaller than, or equal to, one square millimeter.

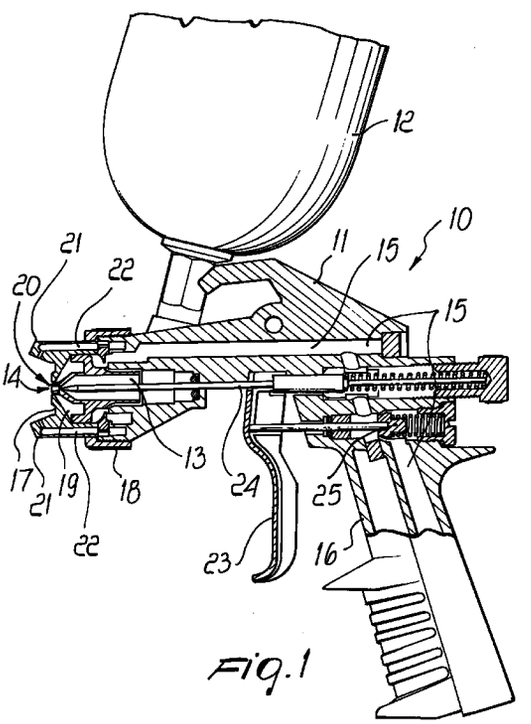

Fig.1

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Description

The present invention relates to a painting device with low overspray.

The method of applying coatings by using spray guns is currently the most widely used one in many professional fields in order to achieve high-quality coating combined with low investments in equipment and low running costs.

Currently commercially available spray guns have a structural configuration which includes a shaped hollow body provided with a duct for feeding a coating product, which ends with a spray nozzle, and with a duct for feeding pressurized gas (air) which ends with an atomizing cap which forms a chamber together with the body.

The chamber leads into a hole which is coaxial to the nozzle and forms a ring of gas that surrounds it.

Diametrically opposite wings are also formed in the cap and have respective internal passages for pressurized gas which are connected to said chamber and lead into the region located downstream of said nozzle, crossing their flows with those of said nozzle and of the ring of gas that surrounds it.

This atomizes the coating, which is generally a chemical compound in liquid form.

Manually or automatically-operated valves for cutting off the supply passages are associated with the hollow body.

Conventional spray guns that are currently used, although providing a performance whose quality level is appreciated by users, are the source of intense atmospheric pollution caused by the dispersion of the volatile organic compounds contained in liquid coatings.

Actually, conventional spray guns seldom achieve a transfer efficiency (ratio between the product actually applied to the surface and the amount of product used) higher than 58%.

Several factors affect transfer efficiency: in particular, the pressure of the air supply, the ambient temperature, the distance between the spray gun and the target, the inflow and outflow distance of the jet with respect to the edge in the target, the type of target (size and shape), the type of spray gun, the type of coating product being sprayed, the viscosity of the coating product, the air used for ventilation and the brand of the spray gun.

As regards air supply pressure, experience has shown that transfer efficiency is linked to the air pressure in the cap of the spray gun, which is closely linked to the supply pressure.

Since the internal channels for the flow of the air and of the coating are constructively different among different spray guns, it is not possible to predict the value of the transfer efficiency as the air pressure at the grip varies.

Transfer efficiency is also linked, as mentioned, to the brand and type of spray gun, since it essentially depends on the shape of the jet, on the pressure in the cap and on the atomization.

In the United States of America, more specifically in California, a law was passed in 1983 with the aim of regulating, but most of all of reducing, atmospheric emissions of pollutants generated by coatings.

This law substantially mandates a gradual reduction of the volatile and organic components contained in coatings and the need to use application equipment having a transfer efficiency of at least 65%.

Since there is no officially recognized method that allows an exact evaluation of transfer efficiency, which as shown is determined by a plurality of factors, the law simply recognizes as legal only spray guns of the kind known as H.V.L.P. (high volume low pressure), i.e., spray guns which operate with a "high" volume of air and a low pressure (limited to 10 psi, i.e., 0.7 bar), measured dynamically inside the atomization cap.

These spray guns have already been commercially available for several years and are used mainly to apply coatings in the building sector, for hobby work, and in all fields in which reduction of overspray is required without demanding high-quality finishes.

There are also fields which require very high finish qualities, such as car body repairs, interior decoration, industrial painting of many commonly used products, etcetera, and are accordingly penalized by this American legal requirement indeed as regards the quality of the final work.

Moreover, if one considers that, as mentioned, apart from the structural issues of spray guns, many other factors affect transfer efficiency and are difficult to control in practice, it has been observed that some H.V.L.P. spray guns considered legal by American law may offer slightly higher efficiencies than prescribed by the law, despite working at a pressure of 0.8 bar and therefore in conditions deemed illegal.

It should also be noted that the same law explicitly provides that other application systems, different from those mentioned by said law, may be recognized as being valid, provided that they are demonstrated to be equal to current ones or better.

The American law has been taken as reference in Europe as well and will have to be enforced by 1998 in order to take another step toward preservation of the environment.

The aim of the present invention is to provide a device for painting with liquid coatings which has a high transfer efficiency combined with high atomization power and very easy and inexpensive use.

Within the scope of this aim, an important object of the present invention is to provide higher transfer efficiency than conventional spray guns without compromising performance in terms of quality.

An important object of the present invention is to provide, conditions being equal, a transfer efficiency which is at least equal to that of H.V.L.P. spray guns, achieving finer atomization of coatings and thus improving the quality of the final work.

Another object of the present invention is to provide a device which does not require the aid of secondary equipment which is not already available in painting sites and thus does not compromise the investment and management costs for the user.

Another object of the present invention is to provide a device which entails no changes to the working habits of users.

This aim, these objects and others which will become apparent hereinafter are achieved by a painting device comprising a shaped hollow body provided with a duct for feeding a coating product which ends with a spray nozzle having an aperture of at least one square millimeter and a duct for feeding pressurized gas which ends in an atomization cap which forms, together with said body, a chamber which leads into a hole which is coaxial to said nozzle and forms a ring of gas around it, manually- or automatically-actuated valves being associated with said hollow body to cut off said ducts; characterized in that the passage section of said ring of gas that surrounds said nozzle is smaller than, or equal to, one square millimeter.

Further characteristics and advantages of the present invention will become apparent from the following detailed description of an embodiment thereof, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a sectional view of a spray gun according to the invention;
figure 2 is an enlarged-scale front perspective view of the atomization cap of the spray gun of figure 1;
figure 3 is an enlarged-scale front view of the spray nozzle and of the regions adjacent thereto.

With reference to the above figures, a spray gun for applying coatings is generally designated by the reference numeral 10 and conventionally assumes the shape of a hollow body 11.

A container or duct 12 for the coating is fixed to the body 11 and is connected to a supply duct 13 which ends with a spray nozzle 14 whose passage section is at least one square millimeter.

In the hollow body 11 there is also provided a duct 15 for feeding pressurized gas, particularly compressed air, which arrives from a hose, not shown for the sake of simplicity, which is connected in the grip region 16.

The duct 15 ends inside an atomization cap 17, which is joined to the body 11 by means of a threaded ring 18 and forms a chamber 19 which leads into a hole 20 which is coaxial to the nozzle 14 and forms a ring of air around it.

Two diametrically opposite wings 21 are also formed in the cap 17 and have two internal passages 22 which are connected to the duct 15 and lead into the region downstream of the nozzle 14 so as to cross their streams with the stream arriving from said nozzle and from the ring that surrounds it.

Cutoff valves 24,25 are also associated with the hollow body 11 in a conventional manner; in this case, the valves are actuated manually by means of a lever 23; the valve 24 is meant to adjust the passage for supplying the coating product and consists of a needle-shaped obturator which is coaxial to the nozzle 14 and is suitable to open and close it, while a valve 25 is meant to adjust the air supply.

According to the invention, the passage section of the pressurized air ring that surrounds the nozzle 14 and is determined by the hole 20 is smaller than, or equal to, one square millimeter.

In normal spray gun supply pressure conditions (between 4 and 6.0 bar, measured dynamically at the internal center of the atomization cap 17), this produces a 20% higher transfer efficiency than a conventional spray gun, and thus an efficiency which is equal to, or greater than, that of a H.V.L.P. spray gun, maintaining atomization characteristics which are comparable to those of a conventional spray gun.

By reducing the pressurized air passage section to these values, a system is obtained which operates at high pressure (4-6 bar instead of 0.7 bar) and with a low air volume, and accordingly with a conceptual approach which is the opposite of the H.V.L.P. approach.

In this device, the coating product may optionally be fed without pressure to the apparatus and atomization may be caused exclusively by the mixing between the air and the product, which is aspirated spontaneously by means of a Venturi effect.

The reduced passage section causes the need for very precise coupling, in view of the fact that it is essential for the hole 20 of the atomization cap 17 to be as concentric as possible to the nozzle 14 in order to obtain an air ring which has the same force on all sides, so that the coating product is propelled axially with respect to the nozzle 14 and the cap 17.

For this reason, the spray nozzle 14 has been given an external polygonal shape and a hole 20 has been provided whose diameter is such that the corners, designated by the reference numeral 26, of the nozzle 14 are in contact with its walls.

The resulting effect is a radial ring of holes shaped like circular segments which have the same passage section.

Conveniently, the number of faces of the polygon can vary as a function of the outside diameter of the nozzle 14 in order to obtain the chosen passage section.

Advantageously, in any case, the number of faces must be at least four.

In any case it should be noted that if the machining equipment allows precise couplings with acceptable costs, an annular passage can be provided around the nozzle 14.

In practice it has been observed that the intended aim and objects of the present invention have been achieved.

As mentioned earlier, comparative tests of the device according to the present invention with conventional and H.V.L.P. spray guns have in fact shown that starting from an operating concept which is the opposite of conventional criteria, which are even governed by laws and thus are particularly deeply rooted in experts in the field, and therefore from a concept which in one's mind (because high-pressure conditions are produced) might appear to be even outside the law, in identical conditions, an at least equal transfer efficiency is obtained and in any case an increase in finish quality.

More particularly, with respect to conventional spray guns it is possible to achieve higher transfer efficiency and thus achieve the main goal of the above-mentioned laws without however compromising performance in terms of quality, while with respect to spray guns using H.V.L.P. technology it is possible to achieve, conditions being equal, an equal or higher transfer efficiency with a finer atomization of the coating products and therefore with an improvement in final quality.

It should be noted that the aid of auxiliary equipment which is not already present at coating sites is not required and that accordingly the investment and running costs of the user are not compromised.

Moreover, no changes are entailed in the working habits of painters, who furthermore may find it very difficult to reduce transfer efficiency (for example by increasing the air pressure).

The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept.

All the details may also be replaced with other technically equivalent elements.

In practice, the materials employed, so long as they are compatible with the contingent use, as well as the dimensions of the components, may be any according to requirements.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A painting device comprising a shaped hollow body provided with a duct for feeding a coating product which ends with a spray nozzle and a duct for feeding pressurized gas which ends in an atomization cap which forms, together with said body, a chamber which leads into a hole which is coaxial to said nozzle, has a passage section of at least one square millimeter, and forms a ring of gas around it, manually- or automatically-actuated valves being associated with said hollow body to cut off said ducts, characterized in that the passage section of said ring of gas that surrounds said nozzle is smaller than, or equal to, one square millimeter.

2. A device according to claim 1, characterized in that said hole has a circular cross-section and said nozzle externally has a polygonal profile with corners which make contact with the wall of said hole.

3. A device according to claim 2, characterized in that said nozzle has a polygonal profile with at least four faces.

4. A device according to claim 1, characterized in that atomization is achieved by mixing pressurized gas and the coating product, which is spontaneously aspirated by a Venturi effect.

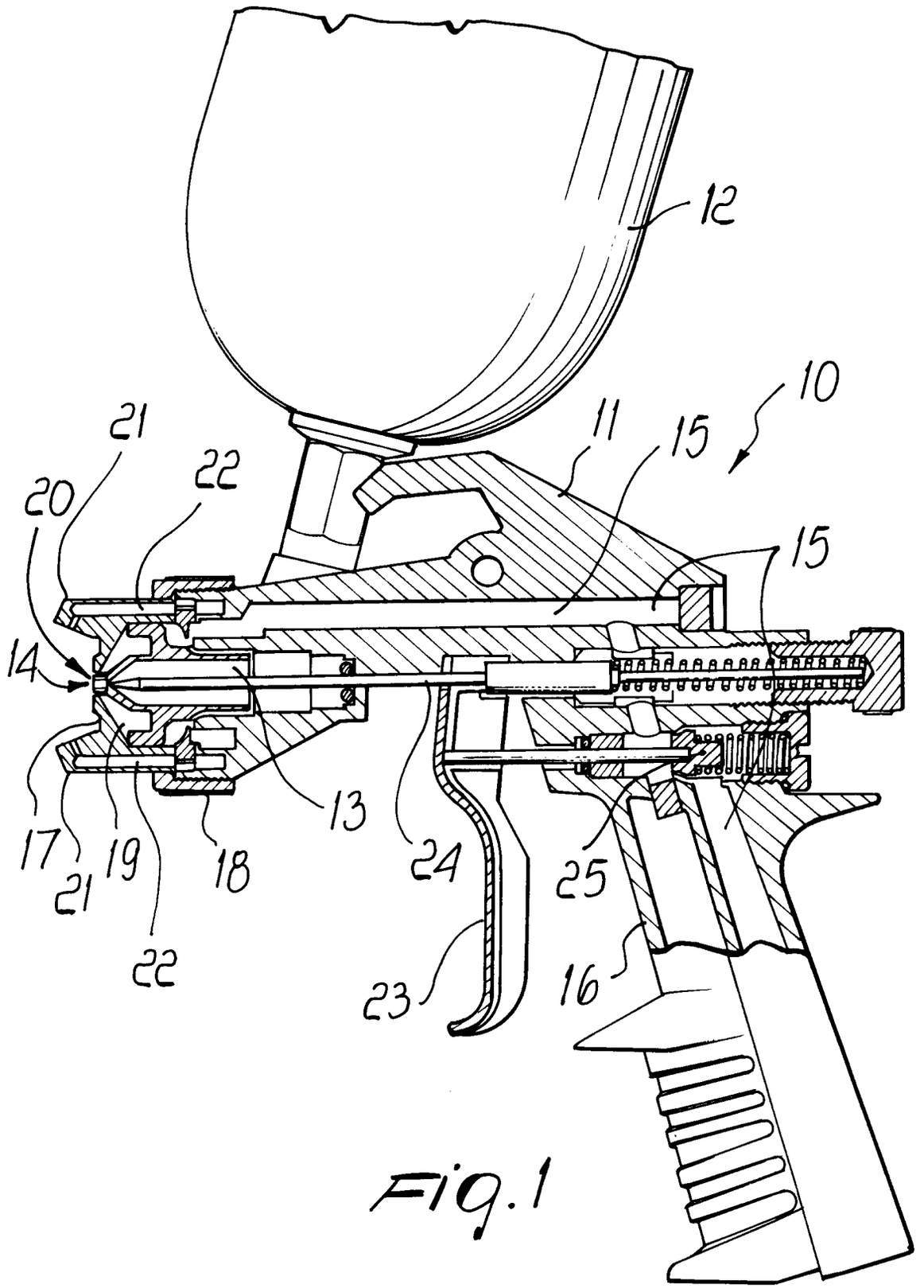

Fig.1

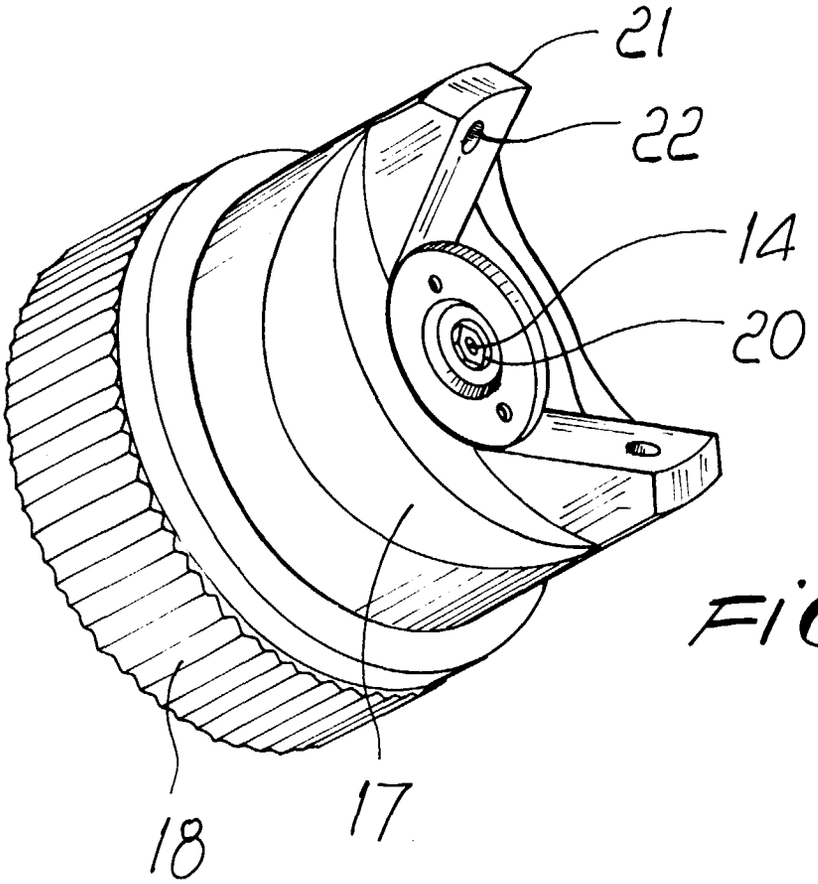

FIG. 2

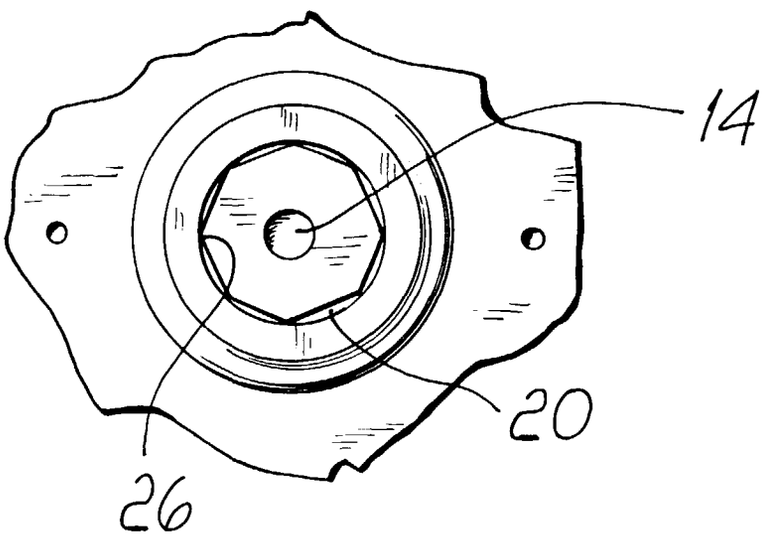

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 97 11 8345

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	GB 1 522 013 A (BING & GRONDAHL PORCELAINFAB) 23 August 1978 * page 3, left-hand column, line 22-47; figure 1 *	1	B05B7/06
Y	US 4 844 347 A (KONHAEUSER PETER ET AL) 4 July 1989 * column 4, line 30-32; figures 1,2 *	1	
Y	US 4 171 096 A (HAVRILLA JOHN V ET AL) 16 October 1979 * column 5, line 59 - column 6, line 44; figure 1 *	1	
A	US 4 381 081 A (HASTINGS DONALD R) 26 April 1983 * column 5, line 57 - column 6, line 40; figures 7-12 *	1-4	
A	EP 0 650 766 A (RANSBURG CORP) 3 May 1995 * column 6, line 27 - column 7, line 18; figures 1,2 *	1,4	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B05B
A	PATENT ABSTRACTS OF JAPAN vol. 095, no. 008, 29 September 1995 & JP 07 124503 A (MITSUBISHI CHEM CORP), 16 May 1995, * abstract *	1	
A	EP 0 654 305 A (ITW LTD) 24 May 1995 * column 4, line 2-10; figures 1-4 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	12 February 1998	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
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