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(54) **A manual spray gun and associated cup**

Handsprühpistole und zugehöriger Becher

Pistolet pulvérisateur manuel et réservoir associé

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**Via Maria Vittoria 18**  
**10123 Torino (IT)**

(56) References cited:  
**WO-A-98/43894 US-A- 3 236 459**  
**US-A- 3 381 845 US-A- 5 035 339**

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## Description

### Field of the Invention

**[0001]** The present invention relates to manual guns for the spraying application of coating substances such as paints, chemicals and the like.

**[0002]** More in particular the invention relates to a spray gun of the type comprising a body having a union for the inflow of a substance to be sprayed, whereto is able to be connected a cup containing the substance to be sprayed and having an outflow union designed to be coupled with said inflow union through removable connecting means.

### Background Art

**[0003]** Traditionally, the removable coupling between the inflow union of the gun body and the outflow union of the cup is achieved by means of a screw-on system: more in particular, through an external thread whereof is provided the inflow union of the gun body whereon is screwed an internal thread of the outflow union of the cup or, alternatively, by means of an external thread of the outflow union of the cup which is screwed into an inner thread of the inflow union of the gun body.

**[0004]** This traditional connection system has essentially two problems.

**[0005]** In the first place, the screwing and unscrewing between the cup and the gun body require a relatively long and inconvenient operation.

**[0006]** In the second place, with this system, which is technologically simple and hence easily reproducible, there is the risk that the guns of a given manufacturer may be equipped with cups not produced by the same manufacturer, i.e. not original. In this case, it is possible that non original cups may induce an improper operation of the gun, and otherwise an operation that does not correspond with the use of the original cups for which the gun was designed.

**[0007]** US-5,035,339 discloses a combination of a manual spray gun and a cup containing the substance to be sprayed corresponding to the pre-characterizing part of claim 1, i.e. comprising a bayonet coupling between a pair of axial arms projecting from a closure of the spray gun and formed with respective slots to be hooked into a corresponding pair of lateral projections of the cup formed with respective rectangular holes, and a rotatable thumb bolt is provided to positively secure the bayonet coupling. Since the sprayer closure is of a conventional type and the cup consists of a plastic canister which is still easily reproducible, the above mentioned second problem remains open.

**[0008]** To attempt to solve this second problem, international patent application WO-03/069208 proposes a particular removable system between the cup and the pistol, which provides a threaded coupling with a wedge system between the inflow union of the gun body and the

outflow union of the cup. However, this system, in addition to being relatively complicated from the constructive viewpoint, does not solve the first problem outlined above, but in fact complicates it further.

### Disclosure of the Invention

**[0009]** The object of the present invention is to provide a simple, economical and functional solution to both technical problems described above.

**[0010]** According to the invention, this object is achieved thanks to the features set forth in the characterizing portion of claim 1.

### Brief Description of the Drawings

**[0011]** The invention will now be described in detail in reference to the accompanying drawings, provided purely by way of non limiting example, in which:

- Figure 1 is an exploded schematic view of a combination of a manual spray gun and a cup according to a first embodiment of the invention,
- Figure 2 is an axial section view, in enlarged scale, showing the connection area between the body of the gun and the cup of the substance to be sprayed,
- Figure 3 is an exploded perspective view of Figure 2, and
- Figure 4 shows a variant of Figure 1.

### Detailed Description of the Invention

**[0012]** Initially referring to Figure 1, the number 1 designates the body of a gun for spray painting, provided posteriorly with a grip 2 and anteriorly with a generally conventional nebuliser nozzle 3.

**[0013]** In the upper part of the gun body 1 is formed a tubular boss 4 communicating with a feeding conduit, not shown, connected in known fashion to the atomising nozzle 3.

**[0014]** Into the boss 4 is permanently inserted, for example screwed, a tubular inflow union 5 adapted for the removable sealed connection of a cup 6 containing the substance to be sprayed by means of the gun 1. In the case of the illustrated example, the substance to be sprayed contained in the cup 6 is in use fed to the gun by gravity, placed in upside down position above the gun 1.

**[0015]** As shown in detail in Figures 2 and 3, the inflow union 5 has a cylindrical terminal portion 7, an intermediate portion with conical inner surface 8 and an initial cylindrical portion 9 with narrowed conformation, i.e. having reduced cross section with respect to that of the cylindrical terminal portion 7.

**[0016]** The edge of the free end of the narrowed initial portion 9 has an annular inner narrowing with conical surface 10.

**[0017]** The cylindrical terminal portion 7 is formed with

a pair of diametrically opposite slits 11, each whereof has, as shown in detail in Figure 4, a general "L" shape with an axially directed upper segment 12 and an inclined or generally horizontal lower segment 13.

**[0018]** The reference 14 designates a ring nut which coaxially surrounds in rotatable fashion the cylindrical terminal portion 7 of the inflow union 5 and is axially movable relative thereto for a downwards travel, i.e. the initial narrowed portion 9, by an extend that is limited inferiorly by an arresting ring 15. As Figure 3 shows in detail, the ring nut 14 is formed on its inner wall with an annular groove 16 communicating with a pair of diametrically opposite axial grooves 17, whereof one is shown in Figure 3.

**[0019]** The cup 6 shown in Figure 1 is generally conventional and consists of a container of generally cylindrical shape, for example metallic or made of moulded plastic material, provided at an end with a removable lid 18 which may have an opening and aerial valve 19, and formed at the opposite end with a generally funnel shaped bottom 20 provided with an axial outflow union 22 able to be coupled in sealed, removable fashion with the inflow union 5 of the gun body 1, in the manner made more readily apparent below.

**[0020]** Referring now in greater detail to Figures 2 and 3, the outflow union 22 has a complementary shape to the inflow union 5: in detail, it comprises a broadened cylindrical initial portion 23, complementary to the final portion 7 of the inflow union 5, an intermediate portion with conical outer surface 34 complementary to the conical inner surface portion 8 of the inflow union 5, and a cylindrical terminal tang 24, complementary to the initial portion 9 of the inflow union 5.

**[0021]** The terminal tan 24 of the outflow union 22 has at its free end an externally enlarged annular edge 25 with a conical outer surface 26 complementary to the conical surface 10 of the inflow union 5.

**[0022]** As shall be described below, one or the other of the conical surfaces 10 or 26 can be provided with a circumferential throat for the insertion of a sealing O-ring made of elastomeric material, not shown in the drawings. However, said sealing O-ring is optional.

**[0023]** The reference number 27 designates a radial pin or stake which traverses the broadened cylindrical initial portion 23 of the outflow union 22 and whose opposite ends project externally thereto. It should be noted that the through pin 27 could be replaced with two distinct and separate pins, projecting outside two diametrically opposite areas of the initial cylindrical portion 23, in a wholly equivalent manner at the opposite ends of said through pin 27. It should also be noted that, instead of two diametrically opposite projecting pins, a single pin could also suffice, projecting radially outside the initial cylindrical portion 23. In this case, the cylindrical terminal portion 7 of the inflow union 5 may be provided with a single L shaped slit 11 and, similarly, the ring nut 14 may be provided with a single axial groove 17.

**[0024]** With the above described arrangement, the removable connection between the outflow union 22 of the

cup 6 and the inflow union 5 of the gun is achieved, according to the peculiar characteristic of the invention, through a bayonet coupling with associated safety device for its reversible locking.

**[0025]** Said bayonet coupling is in practice constituted at one side by the opposite projecting end of the diametrical pin 27 of the outflow union 22, and at the other by the L shaped slits 11 of the inflow union 5, whilst the safety device is constituted by the rotatable and slidable ring nut 14.

**[0026]** To achieve the coupling between the cup 6 and the gun 1 it is simply necessary, starting from the configuration shown in Figure 1, to introduce axially the outflow union 22 into the inflow union 5, until the abutment between the conical surfaces 34 and 8 and 26 and 10, in the manner shown in Figure 2. During this manoeuvre, the projecting ends of the pin 27 are introduced into the axial portions 12 of the slits 11. Then, rotating the unions 22 and 5 relative to each other, the projecting ends of the pin 27 are made to slide along the portions 13 of the slits 11, until positioning themselves in correspondence with their terminal ends: the bayonet coupling between the unions 22 and 5 is thereby completed. The stability of said connection can be improved as a result of the yielding and of the consequence elastic reaction of the optional sealing O-ring inserted between the conical surfaces 10 and 26, or with the aid of possible additional elastic means. In any case, as explained above, the presence of the sealing ring is not strictly necessary, although it is preferable also for the purposes of a more secure hermetic seal between the unions 22 and 5.

**[0027]** To proceed with the positive locking of the bayonet coupling, it is therefore simply necessary axially to position the safety ring nut 14 engaging the projecting ends of the pin 27 into the axial grooves 17, and then to rotate said ring nut 14 to engage the ends of the pin 27 into the annular groove 16.

**[0028]** In this way, all risks of accidental or undesired disengagement between the cup 6 and the gun 1 are prevented.

**[0029]** To remove the cup 6, it will thus be sufficient to disengage the safety ring nut 14 from the projecting ends of the pin 27 and then disengage said ends of the pin 27, first by rotation and then axially, from the slits 11.

**[0030]** The bayonet coupling system with positive safety locking described above is applicable not only to conventional cups 6, but also to disposal cups, such as the one designated by the reference number 28 in Figure 4, in which parts that are identical or similar to those already described above are designated by the same numerical references.

**[0031]** According to said variant, the cup 28 comprises a disposable container 29, normally made of moulded plastic material, and the outflow union 22 is borne by a substantially funnel shaped bottom 30 separated from the container 29 and connected in removable fashion thereto by means of a ring nut 31. The arrangement of the cup 28 could be, for example, of the type described

and illustrated in document EP 1424135 by the same Applicant, not published as of the priority date of the present application. Otherwise, it may be of the type currently produced and marketed by the same Applicant with the commercial name "Mix & Spray Cup". In this case, the funnel shaped bottom 30 with the outflow union 22 may in practice constitute an integral part of the body of the gun 1, in the sense that it may remain permanently coupled to the gun by means of the bayonet coupling and the safety locking between the unions 22 and 5.

**[0032]** As an additional alternative, the funnel shaped bottom 30 can be disposable like the container 29: in this case, the outflow union 22 may also be, with the or with each projecting radial pin for the engagement of the or of each L-shaped slit 11, integrally formed by moulding of plastic material with said bottom 30.

**[0033]** Naturally, the construction details and the embodiments may vary widely from what is described and illustrated herein, without thereby departing from the scope of the present invention as defined in the appended claims.

## Claims

1. A combination of a manual spray gun and a cup (6; 28) containing the substance to be sprayed, said spray gun comprising a body (1) having an inflow union (5) of the substance to be sprayed designed to be connected to an outflow union (22) of said cup (6; 28) by removable connection means comprising a bayonet coupling (27, 11) to which a safety device (14) for the positive locking of said bayonet coupling (27, 11) in the coupled condition is operatively associated, **characterised in that:**

- said outflow union (22) of said cup (6, 28) consists of a tubular body having a broadened cylindrical initial portion (23), an intermediate portion with conical outer surface (34) and a narrowed terminal tang (24), said broadened cylindrical initial portion (23) bearing at least one radial stake (27) projecting outwards,

- said inflow union (5) of said gun body (1) has a cylindrical terminal portion (7), an intermediate portion with conical inner surface (8) and a narrowed initial portion (9), designed to be engaged by shape coupling respectively with said broadened cylindrical initial portion (23), said intermediate portion with conical outer surface (34) and said narrowed terminal tang (24) of said outflow union (22), said inflow union (5) further having said cylindrical terminal portion (7) formed with at least one L shaped slit (11) engageable by said at least one radial stake (27) of said cup (6, 28) so as to provide said bayonet coupling (27, 11),

- said safety device comprises a ring nut (14),

rotatable coaxially to said inflow union (5) of said gun body (1) and axially slidable outside said cylindrical terminal portion (7) thereof for a travel of a predetermined amount, said ring nut (14) having at least one inner groove (16, 17) to engage axially and in rotation said at least one radial stake (27) for the arrest in rotation between said inflow union (5) and said outflow union (22) in the coupled condition of said bayonet coupling (27, 11).

2. A gun and cup combination as claimed in claim 1, **characterised in that** said broadened cylindrical initial portion (23) of the outflow union (22) of said cup (6; 28) has a pair of projecting radial stakes (27), diametrically opposite to each other, said cylindrical terminal portion (7) of the gun body (1) is formed with a pair of corresponding L shaped slits (11), and said ring nut (14) has a pair of corresponding inner grooves (16, 17).
3. A gun and cup combination as claimed in claim 2, **characterised in that** said projecting radial stakes are defined by the end of a pin (27) inserted through said broadened cylindrical initial portion (23) of the outflow union (22).
4. A gun and cup combination as claimed in claim 1, **characterised in that** said narrowed terminal tang (24) of the outflow union (22) of said cup (6; 28) has an externally enlarged annular end edge (25) and said narrowed initial portion (9) of the inflow union (5) of said gun body (1) has a complementary inner annular narrowing to bear said externally enlarged annular end edge (25).
5. A gun and cup combination as claimed in claim 4, **characterised in that** said externally enlarged annular end edge (25) and said complementary inner annular narrowing having respective conical surfaces (26, 10).
6. A gun and cup combination as claimed in claim 4 or claim 5, **characterised in that** a sealing elastic ring is interposed between said externally enlarged annular end edge (25) and said inner annular narrowing.
7. A gun and cup combination as claimed in one or more of the previous claims, in which said outflow union (22) is borne by a substantially funnel-shaped bottom (20) of said cup (6), **characterised in that** said bottom (20) is integral with said cup (6).
8. A gun and cup combination as claimed in one or more of the claims 1 through 6, in which said outflow union (22) is borne by a substantially funnel-shaped bottom (30) of said cup (28), **characterised in that**

said bottom (30) is connected to said cup (28) in a removable fashion.

9. A gun and cup combination as claimed in one or more of the preceding claims, **characterised in that** said cup (28) is disposable.

#### Patentansprüche

1. Kombination aus einer Handspritzpistole und einem Behälter (6; 28), der die zu sprühende Substanz enthält, wobei die Spritzpistole einen Körper (1) aufweist, der einen Einströmanschluss (5) für die zu sprühende Substanz aufweist, der derart ausgelegt ist, dass er mit einem Ausströmanschluss (22) des Behälters (6; 28) über ein lösbares Verbindungsmittel verbindbar ist, das einen Bajonettverschluss (27, 11) aufweist, mit dem eine Sicherheitsvorrichtung (14) zum positiven Feststellen des Bajonettverschlusses (27, 11) in dem verbundenen Zustand wirkverbunden ist,

**dadurch gekennzeichnet, dass:**

- der Ausströmanschluss (22) des Behälters (6, 28) aus einem rohrförmigen Körper mit einem verbreiterten zylindrischen Anfangsbereich (23), einem Zwischenbereich mit einer konischen Außenfläche (34) und einem verjüngten Endansatz (24) besteht, wobei der verbreiterte zylindrische Anfangsbereich (23) wenigstens einen radialen Pfosten (27) trägt, der auswärts vorsteht,

- der Einströmanschluss (5) der Spritzpistole (1) einen zylindrischen Endbereich (7), einen Zwischenbereich mit einer konischen Innenfläche (8) und einen verjüngten Anfangsbereich (9) aufweist, die derart ausgelegt sind, dass sie entsprechend mit dem verbreiterten zylindrischen Anfangsbereich (23), dem Zwischenbereich mit der konischen Außenfläche (34) und dem verjüngten Endansatz (24) des Ausströmanschlusses (22) mittels Formschluss in Eingriff bringbar sind, wobei der zylindrische Endbereich (7) des Einströmanschlusses (5) mit wenigstens einem L-förmigen Schlitz (11) ausgebildet ist, der mit dem wenigstens einem radialen Pfosten (27) des Behälters (6, 28) in Eingriff bringbar ist, um den Bajonettverschluss (27, 11) zu erzeugen,

- die Sicherheitsvorrichtung einer Ringnut (14) aufweist, die koaxial zu dem Einströmanschluss (5) der Spritzpistole (1) drehbar und axial an der Außenseite des zylindrischen Endbereiches (7) derselben gleitbar ist, um sich um ein vorbestimmtes Maß zu bewegen, wobei die Ringnut (14) wenigstens eine Innennut (16, 17) aufweist, um mit dem wenigstens einen radialen Pfosten (27) axial und drehend in Eingriff zu kommen,

um die Drehbewegung zwischen dem Einströmanschluss (5) und dem Ausströmanschluss (22) in dem verbundenen Zustand des Bajonettverschlusses (27, 11) zu arretieren.

2. Kombination aus einer Spritzpistole und einem Behälter nach Anspruch 1,  
**dadurch gekennzeichnet, dass** der verbreiterte zylindrische Anfangsbereich (23) des Ausströmanschlusses (22) des Behälters (6; 28) ein Paar von vorstehenden radialen Pfosten (27) aufweist, die diametral einander gegenüber angeordnet sind, wobei der zylindrische Endbereich (7) des Spritzpistolenkörpers (1) mit einem Paar von entsprechenden L-förmigen Schlitz (11) ausgebildet ist, und wobei die Ringmutter (14) ein Paar von entsprechenden Innennuten (16, 17) aufweist.
3. Kombination aus einer Spritzpistole und einem Behälter nach Anspruch 2,  
**dadurch gekennzeichnet, dass** die vorstehenden radialen Pfosten durch das Ende eines Stiftes (27) definiert sind, der durch den verbreiterten zylindrischen Anfangsbereich (23) des Ausströmanschlusses (22) eingesetzt ist.
4. Kombination aus einer Spritzpistole und einem Behälter nach Anspruch 1,  
**dadurch gekennzeichnet, dass** der verjüngte Endansatz (24) des Ausströmanschlusses (22) des Behälters (6; 28) eine außen vergrößerte ringförmige Endkante (25) aufweist, und dass der verjüngte Anfangsbereich (9) des Einströmanschlusses (5) des Spritzpistolenkörpers (1) eine komplementäre innere, ringförmige Verjüngung aufweist, um die außen vergrößerte ringförmige Endkante (25) aufzunehmen.
5. Kombination aus einer Spritzpistole und einem Behälter nach Anspruch 4,  
**dadurch gekennzeichnet, dass** die außen vergrößerte ringförmige Endkante (25) und die komplementäre innere ringförmige Verjüngung entsprechende konische Flächen (26, 10) aufweisen.
6. Kombination aus einer Spritzpistole und einem Behälter nach Anspruch 4 oder 5,  
**dadurch gekennzeichnet, dass** ein elastischer Dichtring zwischen der außen vergrößerten ringförmigen Endkante (25) und der inneren ringförmigen Verjüngung eingesetzt ist.
7. Kombination aus einer Spritzpistole und einem Behälter nach einem oder mehreren der vorhergehenden Ansprüche, bei welcher der Ausströmanschluss (22) durch einen im Wesentlichen trichterförmigen Boden (20) des Behälters (6) getragen wird,

**dadurch gekennzeichnet, dass**

der Boden (20) einteilig mit dem Behälter (6) ausgebildet ist.

8. Kombination aus einer Spritzpistole und einem Behälter nach einem oder mehreren der Ansprüche 1 bis 6, bei welcher der Ausströmanschluss (22) von einem im Wesentlichen trichterförmigen Boden (30) des Behälters (28) getragen wird,  
**dadurch gekennzeichnet, dass**  
 der Boden (30) in lösbarer Weise mit dem Behälter (28) verbunden ist.
9. Kombination aus einer Spritzpistole und einem Behälter nach einem oder mehreren der vorhergehenden Ansprüche,  
**dadurch gekennzeichnet, dass**  
 der Behälter (28) ein Einwegbehälter ist.

**Revendications**

1. Combinaison d'un pistolet pulvérisateur manuel et d'un réservoir (6 ; 28) contenant la substance à pulvériser, ledit pistolet pulvérisateur comprenant un corps (1) présentant un raccord-union d'entrée (5) de la substance à pulvériser conçu pour être raccordé à un raccord-union de sortie (22) dudit réservoir (6 ; 28) par des moyens de raccordement amovibles comprenant un accouplement à baïonnette (27, 11) auquel est associé en fonctionnement un dispositif de sécurité (14) en vue du verrouillage positif dudit accouplement à baïonnette (27, 11) à l'état couplé, **caractérisée en ce que**
- ledit raccord-union de sortie (22) dudit réservoir (6, 28) est composé d'un corps tubulaire présentant une partie initiale cylindrique élargie (23), une partie intermédiaire avec une surface externe conique (34) et un tenon terminal rétréci (24), ladite partie initiale cylindrique élargie (23) comportant au moins un jalon radial (27) faisant saillie vers l'extérieur,
  - ledit raccord-union d'entrée (5) dudit corps de pistolet (1) présente une partie terminale cylindrique (7), une partie intermédiaire avec une surface interne conique (8) et une partie initiale rétrécie (9), conçue pour être mise en prise par couplage de forme respectivement avec ladite partie initiale cylindrique élargie (23), ladite partie intermédiaire avec la surface externe conique (34) et ledit tenon terminal rétréci (24) dudit raccord-union de sortie (22), ledit raccord-union d'entrée (5) présentant en outre ladite partie terminale cylindrique (7) pourvue d'au moins une fente en forme de L (11) pouvant être mise en prise par ledit au moins un jalon radial (27) dudit réservoir (6, 28) de façon à former ledit accou-

plement à baïonnette (27, 11),

- ledit dispositif de sécurité comprend un écrou à oeil (14), orientable de manière coaxiale par rapport au dit raccord-union d'entrée (5) dudit corps de pistolet (1) et pouvant coulisser axialement vers l'extérieur de ladite partie terminale cylindrique (7) de celui-ci pour une course d'une distance prédéterminée, ledit écrou à oeil (14) présentant au moins une rainure interne (16, 17) pour mettre en prise axialement et en rotation ledit au moins un jalon radial (27) pour l'arrêt de la rotation entre ledit raccord-union d'entrée (5) et ledit raccord-union de sortie (22) à l'état couplé de l'accouplement à baïonnette (27, 11).

2. Combinaison de pistolet et de réservoir selon la revendication 1, **caractérisée en ce que** ladite partie initiale cylindrique élargie (23) du raccord-union de sortie (22) dudit réservoir (6 ; 28) présente une paire de jalons radiaux faisant saillie (27), diamétralement opposés l'un à l'autre, ladite partie terminale cylindrique (7) du corps de pistolet (1) est pourvue d'une paire de fentes (11) en forme de L correspondantes, et ledit écrou à oeil (14) présente une paire de rainures internes correspondantes (16, 17).
3. Combinaison de pistolet et de réservoir selon la revendication 2, **caractérisée en ce que** lesdits jalons radiaux faisant saillie sont définis par l'extrémité d'une broche (27) insérée à travers ladite partie initiale cylindrique élargie (23) du raccord-union de sortie (22).
4. Combinaison de pistolet et de réservoir selon la revendication 1, **caractérisée en ce que** ledit tenon terminal rétréci (24) du raccord-union de sortie (22) dudit réservoir (6 ; 28) présente un bord d'extrémité annulaire agrandi à l'extérieur (25) et ladite partie initiale rétrécie (9) du raccord-union d'entrée (5) dudit corps de pistolet (1) présente un rétrécissement annulaire interne complémentaire pour supporter ledit bord d'extrémité annulaire agrandi à l'extérieur (25).
5. Combinaison de pistolet et de réservoir selon la revendication 4, **caractérisée en ce que** le bord d'extrémité annulaire agrandi à l'extérieur (25) et ledit rétrécissement annulaire interne complémentaire présentent des surfaces coniques respectives (26, 10).
6. Combinaison de pistolet et de réservoir selon la revendication 4 ou la revendication 5, **caractérisée en ce qu'un** anneau élastique d'étanchéité est intercalé entre ledit bord d'extrémité annulaire agrandi à l'extérieur (25) et ledit rétrécissement annulaire interne.

7. Combinaison de pistolet et de réservoir selon l'une ou plusieurs des revendications précédentes, dans laquelle ledit raccord-union de sortie (22) est supporté par un fond sensiblement en corolle (20) dudit réservoir (6), **caractérisée en ce que** ledit fond (20) est formé d'un seul tenant avec ledit réservoir (6). 5
8. Combinaison de pistolet et de réservoir selon l'une ou plusieurs des revendications 1 à 6, dans laquelle ledit raccord-union de sortie (22) est supporté par un fond sensiblement en corolle (30) dudit réservoir (28), **caractérisée en ce que** ledit fond (30) est raccordé au dit réservoir (28) de manière amovible. 10
9. Combinaison de pistolet et de réservoir selon l'une ou plusieurs des revendications précédentes, **caractérisée en ce que** ledit réservoir (28) est jetable. 15

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FIG. 1

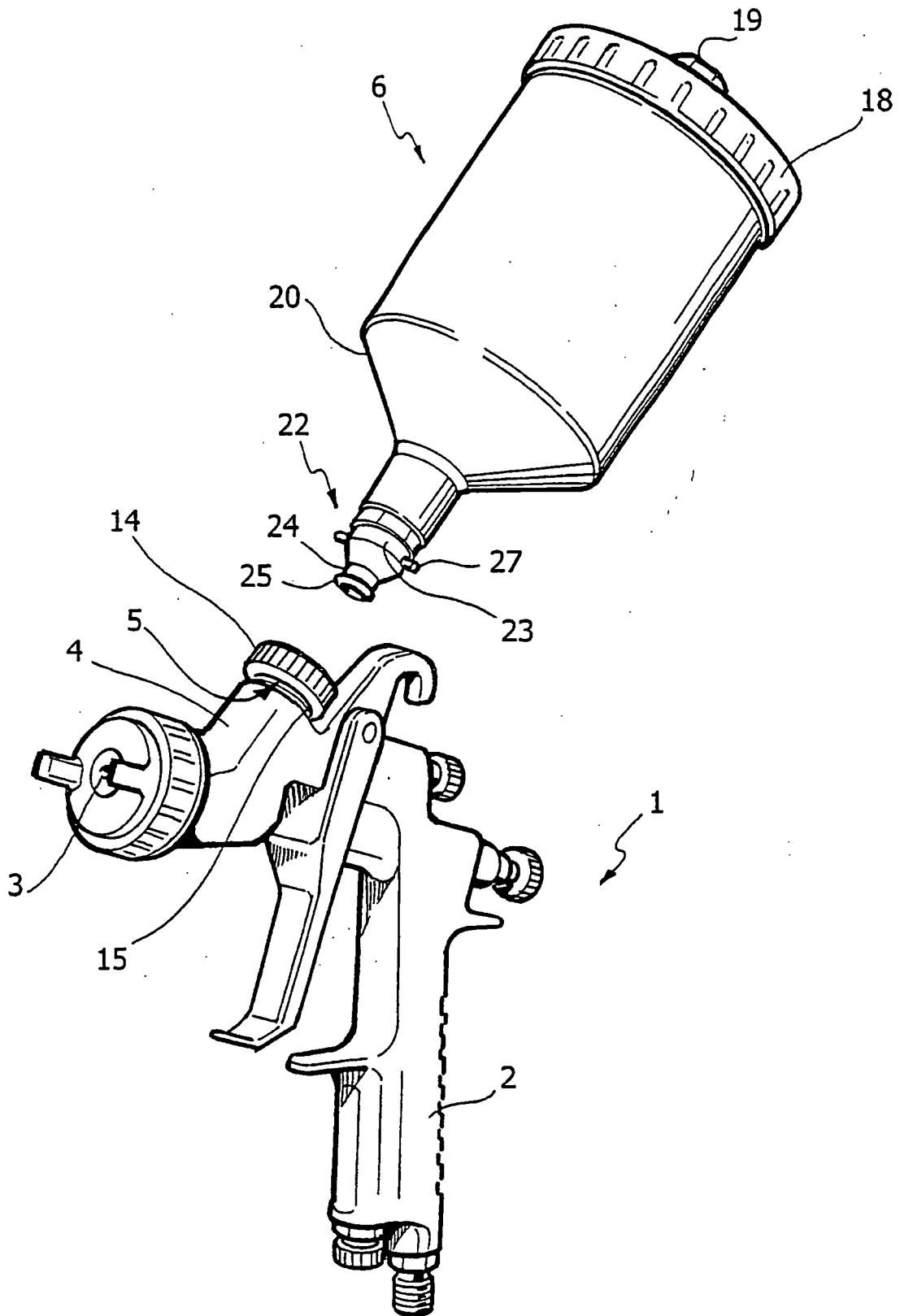




FIG. 2

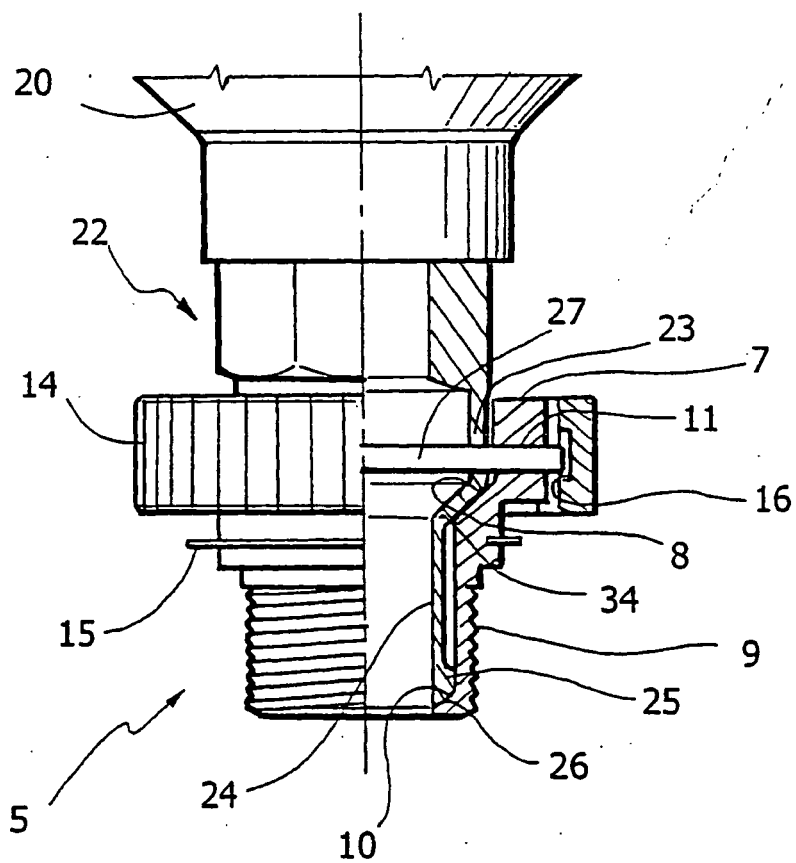


FIG. 3

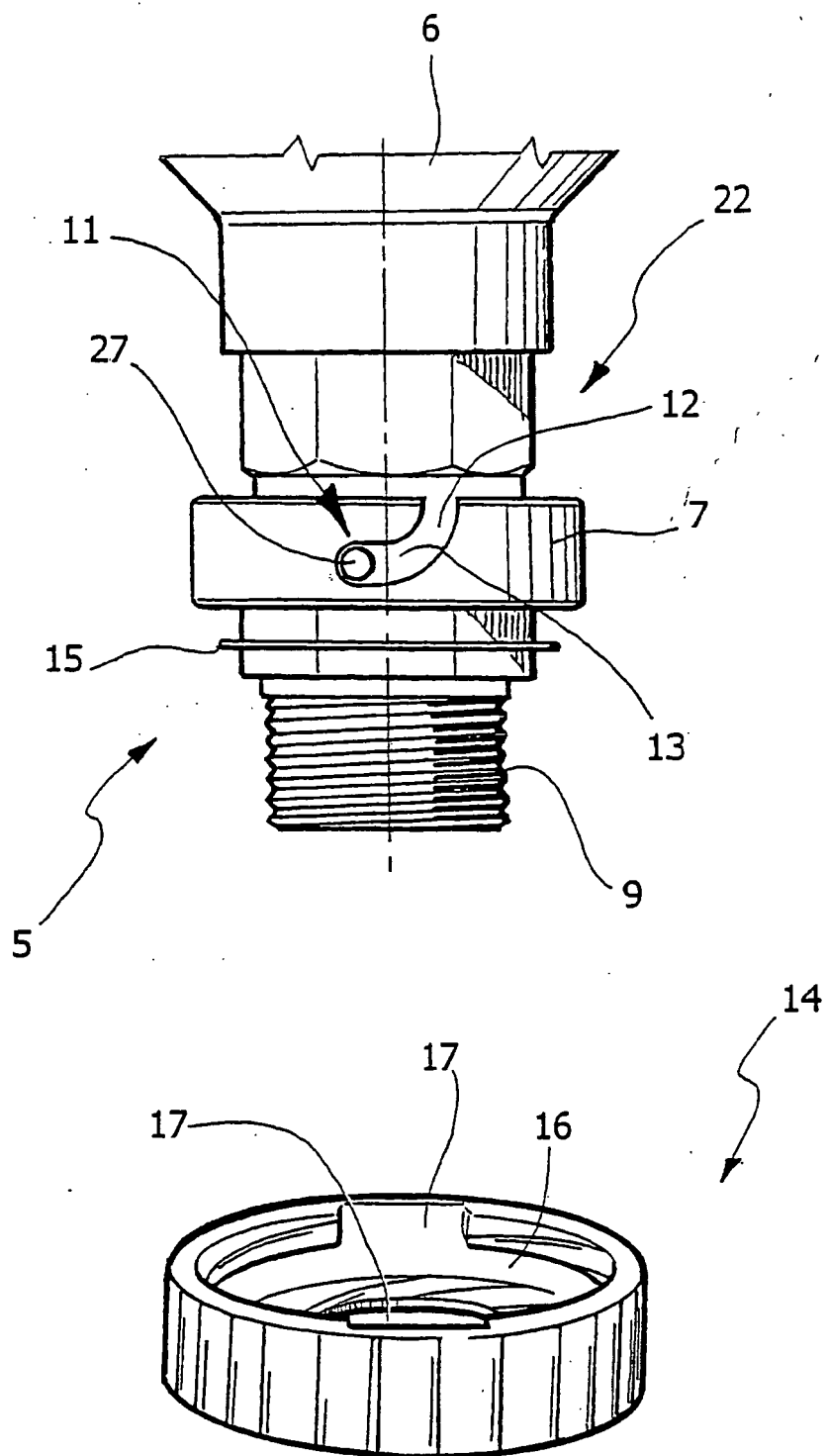
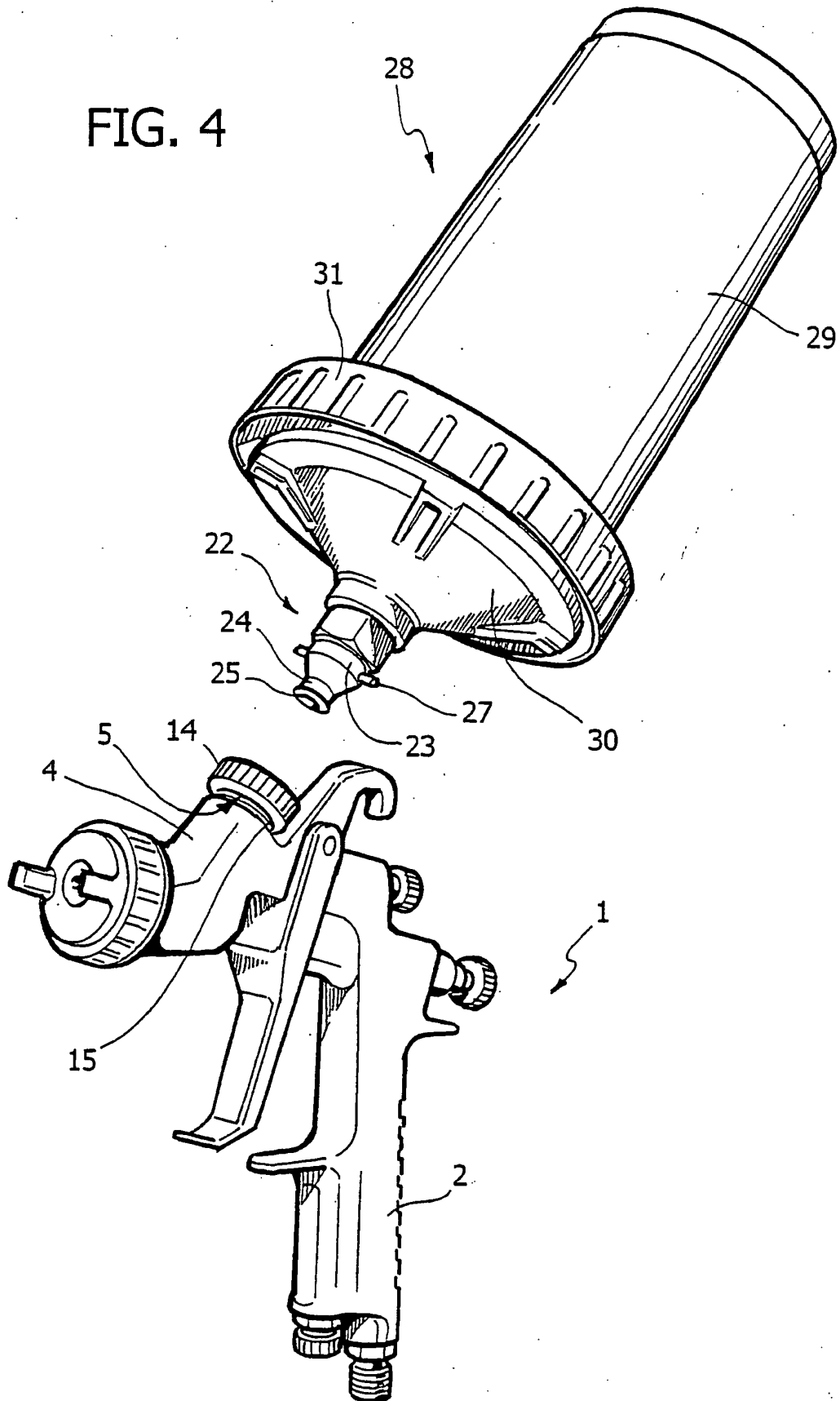


FIG. 4



**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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