

Description

The invention relates to a spray valve arrangement for an aerosol can, comprising a one-piece valve housing comprising plastics material, which can be fixedly fitted sealingly with an upper end in the upper portion of the can, which defines a main duct for the content of the can to pass therethrough and which has a main valve with a valve stem in the main duct, manually actuatable against the force of a spring, a siphon tube which extends the main duct, a secondary duct connecting the space inside the can to the main duct, above the maximum level of filling of the can, and a valve seat of an auxiliary valve, which is formed at the junction between the main duct and the secondary duct, with a valve ball comprising metal, in a cylindrical auxiliary valve chamber surrounded by an outer cylindrical valve housing portion which is within the cross-section of the upper end of the valve housing, wherein the auxiliary valve seat is below the valve ball so that in the normal position of the can the valve ball does not obstruct the main duct and blocks the secondary duct whereas in the inverted position of the can the valve ball opens the secondary duct, and wherein the main duct is taken laterally past the auxiliary valve.

In a known spray valve arrangement of that kind (US patent specification No 3 447 551), the auxiliary valve chamber is disposed concentrically with respect to the valve housing. The portion of the main duct which is taken laterally past the auxiliary valve therefore necessarily has, in consideration of the predetermined external dimensions of the valve, a very small flow cross-section which is disadvantageous in regard to flow therethrough, over its entire length. As the dimensions of the valve housing must also be minimised having regard to a minimum level of expenditure on material in relation to cans of that kind which are produced in large numbers, the flow resistance in that main duct portion is comparatively high. That results in a pressure drop which has an undesirably adverse effect on the spray action of the valve arrangement. The upper opening

of the auxiliary valve chamber, which is provided for fitting the auxiliary valve ball in position, is closed by a second ball which is subjected to the pressure of the return spring of the main valve stem. Therefore, the propellant or pressure gas which is above the level of liquid in the can and which penetrates into the auxiliary valve chamber by way of the secondary passage urges the auxiliary valve ball downwardly on to its valve seat so that the communication between the secondary and the main ducts is interrupted in the normal position of the can and the pressure gas cannot flow out of the upper space in the can. On the other hand, in the inverted position of the can, the auxiliary valve ball drops downwardly so that the secondary duct is now in communication with the main duct and the liquid can be discharged by way of the secondary duct to the main duct and by way of the latter. However, without particular steps being taken at the same time, the pressure gas can also escape by way of the main duct. In that case, there is no longer a sufficient discharge pressure available in the normal position of the can, for the remaining liquid in the can.

US patent specification No 3 315 693 and German laid-open application (DE-OS) No 28 17 393 disclose a similar spray valve arrangement in which the auxiliary valve chamber (including its wall and the auxiliary valve) is disposed outside the cross-section of the upper end of the valve housing which can be fixedly fitted sealingly in the upper portion of the can. That construction requires a correspondingly large amount of material and in addition in (automatic) assembly it requires the arrangement of the valve housing in a predetermined rotary angular position relative to the means for feeding the auxiliary valve ball thereto, in order to ensure that the auxiliary valve ball is introduced into the auxiliary valve chamber.

The invention is based on the problem of providing a spray valve arrangement of the general kind set forth and the construction of which meets the requirements of mass production and which in particular ensures lower levels of discharge pressure losses.

In accordance with the invention, that problem is solved in that the auxiliary valve in the outer valve housing portion which surrounds the auxiliary valve chamber has an eccentricity which is approximately equal to the difference between the inside radii of the outer valve housing portion and the auxiliary valve chamber and that the difference between the outside diameter of the auxiliary valve chamber and the inside diameter of the outer valve housing portion is smaller than the diameter of the valve ball of the auxiliary valve.

That configuration ensures that the flow cross-section of the main duct, relative to the outside diameter of the housing, is increased in size in the comparatively long section beside the auxiliary valve. Therefore, in that section, in comparison with a concentric arrangement with an otherwise identical outside diameter of the housing, the flow losses and thus the discharge pressure losses are lower. Consequently, with the same pressure, the liquid can be discharged at a higher velocity and accordingly in a more finely atomised form. At the same time the outside wall of the outer valve housing portion forms a part of the wall of the auxiliary valve chamber. That not only gives a marked saving in material, in regard to mass production, but in addition, by virtue of the increase in size of the flow cross-section of the main duct, it also contributes to reducing the pressure losses. The selected difference between the outside diameter of the auxiliary valve chamber and the inside diameter of the outer valve housing makes it easier to fit the ball of the auxiliary valve in position. It only needs to be thrown into the valve housing which is open at the upper end and it automatically aligns itself above the insertion opening of the auxiliary valve chamber, without having to be held beforehand with the same degree of eccentricity as that of the auxiliary valve chamber, in the desired position of installation.

The mouth of the secondary duct which opens into the auxiliary valve chamber can be disposed below the ball. If, in that arrangement,

possible escape of the pressure gas upon actuation of the main valve in the inverted position of the nozzle is tolerated, then it is possible to eliminate a shut-off valve or the like for the opening for inserting the ball into the auxiliary valve chamber. As aerosol
5 canes are produced in large numbers, the elimination of a single component, in comparison with the previously known construction, ultimately signifies a considerable saving in regard to the amount of material involved and the expenditure on assembly. With a suitable valve dimension, the natural weight of the ball of the auxiliary
10 valve is sufficient for reliably interrupting the communication between the secondary and the main ducts when the main valve is actuated in the normal position of the aerosol can.

Although it is basically possible for the secondary duct to open at the conical surface of the auxiliary valve seat, it is
15 more desirable for the mouth opening of the secondary duct to terminate at the lowest point of the auxiliary valve seat. In that arrangement, with the aerosol can in the vertical normal position, the ball closes the auxiliary valve against the gas pressure not only with a component of force due to its own weight, but with its
20 entire weight.

If the ball is retained in the auxiliary valve chamber by a blocking means which is disposed above the ball, so that the ball cannot drop out of the valve chamber in the inverted position, the blocking means may liberate an assembly passage for the ball to
25 pass therethrough from the main valve housing chamber to the auxiliary valve chamber. That arrangement therefore does not require any additional component for the blocking means. Nonetheless the arrangement ensures that not only can the ball be easily fitted into the auxiliary chamber in the assembly operation but in addition
30 the liquid can be discharged through the auxiliary valve chamber by way of a comparatively large flow cross-section when the main valve is actuated with the can in the inverted position. If the passage

is in parallel-axis relationship and the blocking means is formed by at least one flexible projection which projects radially inwardly at the passage, the ball, in the assembly operation, can be easily pushed beyond the projections into the auxiliary valve chamber.

5 Instead of securing the ball in position in the auxiliary valve chamber by the above-indicated blocking means, it is possible to provide a housing insert which delimits the chamber and which preferably has control or regulating openings for the path of the flow outside the chamber, which can be of larger or smaller size,
10 depending on the particular purpose of use of the spray valve.

Preferably, the valve housing has a projection which extends peripherally in an annular configuration at its inside wall and beyond which the housing insert can be pushed upon assembly of the arrangement and can latch therebehind for securing the components
15 in position in the axial direction. The spring which serves to return the main valve stem bears against the housing insert. That construction also additionally ensures that the housing insert bears sealingly against the upper wall of the chamber of the auxiliary valve.

It is also advantageous for the cross-section of the narrowest
20 part of the secondary duct to be larger than that of the narrowest part of that portion of the main duct which within the valve housing adjoins the secondary duct in the direction of flow. That arrangement also ensures against any gas loss from the container in the inverted position of the container as more fluid can always flow into the
25 main duct by way of the secondary duct, than can flow away below the mouth opening of the secondary duct into the main duct.

Then, in another embodiment, in an arrangement with a valve insert which delimits the auxiliary valve chamber, the housing insert may have a second auxiliary valve seat above the ball and may
30 surround a mouth opening of the main duct into the auxiliary valve chamber. That arrangement now also ensures, in the inverted position

of the can, that the same ball, by virtue of its own weight, blocks the mouth opening of the main duct into the auxiliary valve chamber, so that the pressure gas cannot flow out before the level of liquid (or the surface of the liquid) of the container, in the inverted position, has not dropped at least to below the intake opening of the secondary duct into the valve housing. If in the normal position the secondary duct opens into the auxiliary valve chamber from below and the main duct opens thereinto from above, the flow pressure of the liquid which flows out when the main valve is in an open condition by way of the auxiliary valve chamber, together with the natural weight of the ball, acts to resist the ball lifting away from the valve seat due to the gas pressure, irrespective of whether the aerosol can is held in the normal vertical position or upside down (inverted).

It is also advantageous if, in regard to the change-over valve, the mouth opening of the secondary duct in the first auxiliary valve seat and the mouth opening of the main duct in the second auxiliary valve seat are coaxial with each other. In that way the liquid flow pressure, upon discharge of the liquid, acts in precise opposition to the gas pressure on the valve ball so that the liquid flow pressure is fully effective as a closing pressure to resist the escape of gas. At the same time that arrangement ensures that the ball only has to be thrown into the upper opening of the valve housing in order to bring it into the position of installation in precisely central relationship on the lower valve seat of the auxiliary valve before the housing insert is fitted.

The valve housing preferably has a transversely extending slot and an axial bore, which form the secondary duct. When producing the valve housing which comprises plastics material therefore all that is required is a simply plate-shaped slider for the transverse slot and a cylindrical round mandrel for the axial bore

on the core of the mould. The mandrel can bear with its end face against the plate over a large area, in contrast to the design configuration involving two cylindrical bores which are disposed at an angle to each other and in relation to which a correspondingly cylindrical slider would be required, which would only come into line contact with a flat end face of the core mandrel, so that that end face would have to be of a correspondingly cylindrical configuration, which is expensive, in order to provide a flow cross-section of large area between the two bores.

10 Then, it is preferably provided that below the junction between the main and secondary ducts, the main duct has a second eccentric valve with a second valve ball of metal and a second auxiliary valve seat above the second ball. In that way, gas is prevented from escaping not only in the normal position but also in the inverted position of the can, by virtue of the first or second valve balls. 15 With this arrangement however it is possible to eliminate a housing insert.

In this arrangement, it is desirable for the auxiliary valves to be axially displaced and radially to overlap each other. In 20 that way the flow cross-section for the main duct is retained, even with a small outside diameter in respect of the valve housing and two auxiliary valves.

The ratio of the inside diameter of the outer valve housing portion to the diameter of the first valve ball may be in the range of 25 from 1.5 to 2 and preferably 1.75. That provides, in relation to the maximum diameter of the valve housing, a comparatively large ball of correspondingly high weight which provides for reliable closure.

Particularly advantageous is a configuration of the arrangement 30 in which the inlet opening of the secondary duct is in the direct vicinity of the upper portion of the can. With that design configuration, when the can is in the inverted position, virtually all the liquid

can be discharged from the can, without leaving any behind, because the inlet opening of the secondary duct occupies the lowest position in the can (in the inverted position).

- The above-mentioned low position of the inlet opening of the secondary duct may be achieved for example by virtue of the intake of the secondary duct into the auxiliary valve chamber being formed as an axial bore in the outside wall of the valve housing. A simpler construction however can provide that an initial portion of the secondary duct is formed by a groove which is provided in the outside of the valve housing and which begins at the inside of the upper portion of the can and which is covered, to a position in the vicinity of the upper portion of the can, by a siphon tube which is pushed over the valve housing. A groove is easier to produce in a plastics housing than a bore.
- The auxiliary valve chamber or the two auxiliary valve chambers may be partially delimited by two housing inserts. That not only simplifies manufacture of the valve housing but, when the arrangement has two auxiliary valve chambers, it also simplifies insertion of the valve balls only from the one open side of the valve housing.
- The invention and developments thereof are described in greater detail hereinafter with reference to the drawings of preferred embodiments, in which:
- Figure 1 shows a first embodiment of a spray valve arrangement according to the invention, with an eccentric auxiliary valve which has only one valve ball and which acts as a change-over valve with two valve functions, in the normal vertical position, in axial section on B-B in Figure 1a,
- Figure 1a shows a view in section on A-A in Figure 1,
- Figure 2 shows a view in axial section in the normal vertical position of a part of a second embodiment of a spray valve arrangement

according to the invention with an eccentric auxiliary valve which has only one valve function,

Figure 3 shows a view in axial section in the normal vertical position of a part of a third embodiment of the spray valve arrangement according to the invention with two eccentric auxiliary valves,

Figure 4 is a view in axial section in the normal vertical position of a part of a fourth embodiment of a spray valve arrangement according to the invention with two eccentric auxiliary valves,

Figure 5 is a view in axial section in the normal vertical position of a fifth embodiment of a spray valve arrangement according to the invention, with only one eccentric auxiliary valve,

Figure 6 is a view in axial section in the normal vertical position of a part of a sixth embodiment of a spray valve arrangement according to the invention with two eccentric auxiliary valves,

Figure 7 is a view in axial section in the normal vertical position of a part of a seventh embodiment of a spray valve arrangement according to the invention with two eccentric auxiliary valves, and

Figure 8 is a view in axial section in the normal vertical position of a part of an eighth embodiment of a spray valve arrangement according to the invention with only one eccentric auxiliary valve.

In the embodiment illustrated in Figures 1 and 1a, fitted in an upper portion 1, of which only part is shown, of an aerosol can, is a valve which is illustrated in the open condition, with an actuating valve stem 2 which is shown partly in section, a closure member 3 in the form of a resilient annular disc and a valve housing 4 of plastics material.

The valve housing 4 comprises an upper valve housing portion 5 and a lower valve housing portion 6 which are integrally connected

together.

The upper valve housing portion 5 is sealingly fitted in the upper portion 1 of the can by a flange connection. The lower valve housing portion 1 has a connecting nipple 7 for a siphon tube 5 of which only part is shown and which projects into the content of the can to a position in the vicinity of the bottom of the can and which is open at its bottom.

The valve stem 2 is guided with its lower thicker end which has vertical ribs on its outside, in an upper valve housing portion 5 and is seated with its upper end in a main valve actuating head 9 which has a spray opening.

The lower end of the valve stem 2 is supported by way of a spring 10 for returning the valve stem 2 in a housing insert 11 and presses same sealingly against an internal shoulder 12 on the 15 lower valve housing portion 6.

The housing insert 11, together with the lower valve housing portion 6, defines an auxiliary valve chamber 13 of an auxiliary valve which acts as a change-over valve and which has a valve ball 14 of metal, preferably steel, a first frustoconical valve seat 15 below the 20 ball 14 in the lower valve housing portion 6 and a second frustoconical valve seat 16 above the ball 14 in the housing insert 11.

A secondary duct 17 which, in the illustrated vertical position of the valve arrangement, is disposed above the maximum level of filling of the can, forms a communication in that position between 25 the region of the space inside the can which is filled with pressure gas and the lower valve seat 15, the mouth opening 18 thereof being disposed at the lowest position of the valve seat, below the ball 14. At its beginning, the secondary duct 17 is formed as a transversely extending or horizontal slot 19 which merges into 30 a vertical bore 20.

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The path of the main duct 21 for the contents of the can to pass therethrough is shown by a broken line. A part 22 of the main duct 21 extends laterally beside the auxiliary valve through an axial duct 23 in the lower valve housing portion 6, an axial groove 5 24, a radial bore 25 and an axial bore 26 in the housing insert 11 to a mouth opening 27 which is disposed coaxially with respect to the mouth opening 18, above the ball 14 in the upper valve seat 16. The main duct is continued by way of a radial opening 28 in the form of a groove in the wall of the housing insert 11 and an axial groove 10 29 which is also provided in the housing insert 11. The grooves 28 and 29 form a direct passage from the auxiliary valve chamber 13 to the main valve housing space 33. In order to ensure upon assembly of the arrangement that the duct 23 and the groove 24 are aligned with each other, an axial projection at the underside of the housing 15 insert 11 can engage into an opening at the top of the shoulder 12.

The upper part of the housing insert 11 is in the form of a cup into which the spring 10 engages.

A radial retaining projection 31 at the one and the diametrically opposite inward sides of the upper valve housing portion 5 which can 20 also be formed as a peripheral annular projection, for the purposes of axially securing the housing insert 11, engages directly over the upper edge of the housing insert 11 and, when the housing insert 11 is fitted into place, it can be compressed thereby radially outwardly to such a degree that the housing insert 11 can be passed beyond 25 the retaining projection 31.

The auxiliary valve chamber 13 is provided eccentrically with respect to the outer part of the valve housing 4 or with respect to the valve housing portion 6. The degree of eccentricity is approximately equal to the difference between the inside radii of 30 the auxiliary valve chamber 13 and the valve housing portion 6 so that the outside wall of the valve housing portion 6 simultaneously

forms a part (being the part shown on the left in Figure 1) of the wall of the auxiliary wall chamber 13.

The axial grooves 24 and 29 are separated by a wall 43 which bears with its radially outward edge sealingly against the inside of the upper portion 5 of the valve housing. The groove 29 is open upwardly while the groove 24 is closed upwardly by the transverse wall 44 of the insert 11.

Due to the eccentricity of the auxiliary valve chamber 13, the main duct portion 22 has a larger flow cross-section than if the auxiliary valve chamber 13 and the valve housing 4 were arranged concentrically. In addition, the amount of material used for the valve housing is less than in a concentric arrangement.

Then, the difference between the outside diameter of the auxiliary valve chamber 13 and the inside diameter of the valve housing 6 at the level of the auxiliary valve chamber is less than the diameter of the ball 14 so that, in the assembly operation, before the housing insert 11 is fitted into position, the ball is simply thrown from above into the valve housing 4 and, in spite of the eccentricity of the auxiliary valve chamber 13, can be pressed easily and without any particular guidance into the auxiliary valve chamber 13, for example by means of a pressing punch.

In the illustrated normal vertical position of the aerosol can and the valve arrangement, the ball 14, by virtue of its own weight, closes off the secondary duct against the gas pressure so that the gas cannot escape. On the other hand, it opens the main duct 21 at the mouth opening 27 so that the liquid contained in the can can issue under the gas pressure by way of the main valve if the main valve has been opened by the head 9 being depressed, as illustrated.

If on the other hand the can is held in the inverted position, that is to say, with the head 9 downwardly, when the main valve 9 is opened,

then the secondary duct 17 is immersed into the liquid, whereas the inlet opening of the siphon tube 8 is disposed above the level of liquid in the can, then the ball 14 rolls against the valve seat 16 so that in that position only the liquid can escape by way of the secondary duct 17, the auxiliary valve chamber 13 and the grooves 28 and 29, but not the pressure gas.

In the embodiment of the spray arrangement according to the invention, as illustrated in Figure 2, and all following embodiments, the main valve actuating head 9 shown in Figure 1 has been omitted for the sake of simplicity of the drawings. Insofar as the components of the arrangements correspond to those shown in Figure 1, they are denoted by the same reference numerals.

The embodiment illustrated in Figure 2 differs from that shown in Figure 1 substantially insofar as the auxiliary valve operates only in one direction and a wider straight passage 34 is left free from the auxiliary valve chamber 13 to the main valve housing space 33.

The inside diameter of an inwardly projecting annular bead 35 which delimits the passage 34 at the upper edge of the opening of the auxiliary valve chamber 13 is somewhat smaller than the diameter of the valve ball 14 so that the annular bead serves as a blocking means which prevents the ball 14 from escaping out of the auxiliary valve chamber 13 under the pressure of the fluid which presses against the ball by way of the secondary duct 17.

In the illustrated normal position of the spray valve arrangement shown in Figure 4, the liquid contained in the can flows out under the pressure of the gas thereabove, by way of the siphon tube, through the main duct 24, when the main valve 2 and 3 is opened, while the valve ball 14 holds the auxiliary valve in a blocked condition by virtue of the natural weight of the valve ball so that the pressure gas cannot escape by way of the secondary duct

17. On the other hand in the inverted position of the can the liquid can escape by way of the secondary duct 17, when the main valve is opened, as the ball 14 is now lifted away from the valve seat 15. The liquid which is urged by way of the secondary duct 5 17 into the auxiliary valve chamber 13 is discharged by way of lateral slots 36 in the wall of the auxiliary valve chamber 13 into the main valve housing portion 33. Although, in the embodiment shown in Figure 2, the pressure gas can in part also escape by way of the main duct 21 when the can is in the inverted position, nonetheless 10 that embodiment is simpler in regard to manufacture and assembly, by virtue of the omission of the housing insert 11.

In the embodiment illustrated in Figure 3 in contrast, the installation of a secondary auxiliary valve with a second ball 37 in the main duct portion 22 also prevents the pressure gas from 15 escaping from the can by way of the main duct 21 when the can is in the inverted position. In order to permit the liquid to be discharged in the illustrated normal position, the nipple 7 is provided at the lower end with slots 38 which extend to the bottom thereof, the wall portions, which define the slots, of the second 20 auxiliary valve chamber 39 being provided at the lower edge of the opening with radially inwardly projecting projections 40 as a blocking means for preventing the valve ball 37 from coming out. The siphon tube 8 which is pushed over the nipple 7 closes off the slots 38 in an outward direction.

25 In a modification of the embodiment shown in Figure 2 the wall of the auxiliary valve chamber 13 is not provided with radial slots 36 but with axial ribs 41 which define between them grooves 42 which extend axially as far as the upper edge of the opening of the auxiliary valve chamber 13. Both auxiliary valve 30 chambers 13 and 39 are also arranged eccentrically in diametrically opposite relationship like the single auxiliary valve chamber 13 of the embodiment shown in Figure 2. The slot 19 has been completely

eliminated by virtue of the eccentric configuration of the nipple. Then, the auxiliary valve chambers are axially displaced, overlapping each other in a radial direction.

The embodiment shown in Figure 4 differs from that shown in Figure 3 only in the following respect: the lower valve housing portion 6 and therewith the nipple 7 is of larger diameter than in the embodiment shown in Figure 3 so that the siphon tube 8 can be fitted into the nipple 7, and the second auxiliary valve chamber is partially surrounded by the valve housing portion 6. =

10 The embodiment shown in Figure 5 differs from that shown in Figure 2 in that, instead of the blocking means 35, the arrangement has an insert 11 with a through groove 29 which delimits the main duct, the insert closing off the auxiliary valve chamber 13 under the pressure of the spring 10. The secondary duct 17 opens into the
15 auxiliary valve chamber 13 above the valve ball 14. The housing insert provides at the same time for sealing the auxiliary valve chamber 13 in the illustrated normal position in which the pressure gas passes into the auxiliary valve chamber 13 by way of the secondary duct 17 and urges the ball 14 against the valve seat 15, in
20 addition to the natural weight of the ball. At the same time the housing insert 11 provides that the ball 14 remains in its position of installation during the assembly operation.

The embodiment illustrated in Figure 6 differs from that shown in Figure 5 by virtue of the use of a secondary auxiliary valve
25 16 and 37 which is designed in a similar manner to the second auxiliary valve shown in Figure 4. It therefore has in that respect the same function as the embodiment of Figure 4.

The embodiment of Figure 7 differs from that shown in Figure 6 in principle only insofar as a second housing insert 47 forms
30 an inner valve housing portion which delimits the first valve chamber 13 and the second valve chamber 39 in part and the main duct 22. That makes it easier to produce the valve housing 4 from

plastics material and facilitates insertion of the second ball 37 from above, that is to say, insertion is in the same direction as that of the first ball 14 so that the valve housing 4 does not have to be turned when fitting the arrangement together. In this
5 embodiment a middle holding member 48 corresponds to the lower blocking means 40, the holder member 48 being connected to the wall of the nipple 7 by radial limbs 49. The slots 38 are formed by spaces between axial ribs.

Figure 8 shows a modification of the embodiment illustrated
10 in Figure 5 in which an axial groove 45 is provided in the outside of the valve housing 4, forming an initial portion of the secondary duct 17 and beginning at the inside of the upper portion of the can.

The groove 45 is covered by the siphon tube 8 to a position
15 in the vicinity of the upper portion 1 of the can so that an inlet opening 46 remains open. If the can is held in the inverted position, then with this embodiment virtually all the liquid can be discharged from the can by way of the secondary duct 17 without any residual liquid worth mentioning remaining in the can,
20 as the inlet opening 46 is virtually at the lowest position when the can is in an inverted condition. Another advantage of this embodiment over that shown in Figure 5 is that the nipple 7 can be omitted.

If, with the valve arrangements shown in Figures 2, 5 and 8,
25 very large amounts of spray must be produced per unit of time without a loss of pressure gas when the container is held inverted, then it is recommended that use be made of the above-described arrangements illustrated in Figures 1, 3, 4, 6 and 7. If however adequate effects can also be achieved with a low spray rate,
30 then it is possible not to use those more expensive arrangements. The constructions shown in Figures 2, 5 and 8 can also be used for spraying without a loss of pressure gas when the container is held

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in an inverted condition if, in the flow region of the main valve, the narrowest part of the ducts 17, 20, 36 (Figure 2) or 45, 17, 17a (Figures 5 and 8) is provided with a larger cross-section than the narrowest part of the main duct region 22a (Figure 2) or 22a, 22, 29 (Figures 5 and 8) adjoining it in the direction of flow.

The following dimensions are preferred in the illustrated embodiment:

- Diameter D of the ball 14, 37: 3-4.5 mm, preferably 3.5 mm;
- Inside diameter of the outer housing portions 5, 6: 6-9 mm, preferably 6.9 mm when D = 3.5 mm;
- Minimum width of the main duct 21: 1.5 mm;
- Inside diameter of the auxiliary valve chamber 13, 39: 3.75 mm when D = 3.5 mm;
- Thickness of the wall of the auxiliary valve chambers 13, 39 which does not coincide with the outer housing portion 6: 0.7-0.8 mm when D = 3.5 mm;
- Radial depth of the grooves 23, 24, 29 in Figure 1: 0.8 mm when D = 3.5 mm.

Modifications in the illustrated embodiments fall within the scope of the invention. Thus, the walls of the auxiliary valve chambers shown in Figures 3 and 4 may be formed in the same way as those of the auxiliary valve chamber 13 in Figure 2, and vice-versa. In addition, the walls of the auxiliary valve chamber 13 shown in Figures 2 to 4 may also be provided with slots 38, like the wall of the auxiliary valve chamber 39 shown in Figure 3, and vice-versa.



(31)

Translation of the claims in the German language

1. A spray valve arrangement for an aerosol can, comprising a one-piece valve housing (4) comprising plastics material, which can be fixedly fitted sealingly with an upper end in the upper portion (1) of the can, which defines a main duct (21) for the content of the can to pass therethrough, and which has a main valve with a valve stem (2) in the main duct (21), manually actuatable against the force of a spring (10), a siphon tube (8) which extends the main duct, a secondary duct (17) connecting the space inside the can to the main duct above the maximum level of filling of the can, and a valve seat (15) of an auxiliary valve, which is formed at the junction between the main duct and the secondary duct, with a valve ball (14) comprising metal, in a cylindrical auxiliary valve chamber (13) surrounded by an outer cylindrical valve housing portion (16) which is within the cross-section of the upper end of the valve housing, wherein the auxiliary valve seat (15) is below the valve ball (14) so that in the normal position of the can the valve ball does not obstruct the main duct (21) and blocks the secondary duct (17) whereas in the inverted position of the can the valve ball opens the secondary duct, and wherein the main duct is taken laterally past the auxiliary valve, characterised in that the auxiliary valve (14, 15), in the outer valve housing portion (6) which surrounds the auxiliary valve chamber (13) has an eccentricity which is approximately equal to the difference between the inside radii of the outer valve housing portion (6) and the auxiliary valve chamber (13), and that the difference between the outside diameter of the auxiliary valve chamber (13) and the inside diameter of the outer valve housing portion (6) is smaller than the diameter of the valve ball (14) of the auxiliary valve.

2. An arrangement according to claim 1 characterised in that the inlet opening (18) of the secondary duct (17) into the auxiliary valve chamber (13) is below the valve ball (14).



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3. An arrangement according to claim 1 or claim 2 characterised in that the valve housing (4) has a transversely extending slot (19) and an axial bore (20) which form the secondary duct (17).

4. An arrangement according to claim 1 characterised in that the outlet opening (17a) of the secondary duct (17) from the lowest part of the auxiliary valve seat (15) opens into the housing chamber (21a), which is below the valve ball (14), of the main duct.

5. An arrangement according to one of claims 1 to 3 wherein the valve ball is retained in the auxiliary valve chamber by a blocking means which is disposed above the valve ball, characterised in that the blocking means (35) liberates an assembly package (34) for the valve ball (14) to pass therethrough from the main valve housing chamber (33) to the auxiliary valve chamber (13).

6. An arrangement according to claim 5 characterised in that the passage (34) is parallel to the axis and the blocking means (35) is formed by at least one flexible projection (35) which projects radially inwardly at the passage (34).

7. An arrangement according to one of claims 1 to 4 with a housing insert which delimits the auxiliary valve chamber, characterised in that the insert (11) at the same time has control or regulating openings (28/29) for the path of the flow outside the auxiliary valve chamber.

8. An arrangement according to claim 7 characterised in that at its inside wall the valve housing (4) has a projection (31) behind which the housing insert can be latched.



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9. An arrangement according to claim 7 or claim 8 characterised in that the spring (10) bears against the housing insert (11).

10. An arrangement according to one of claims 1 to 9 characterised in that the cross-section of the narrowest part of the secondary duct is larger than that of the narrowest part of that portion of the main duct which within the valve housing adjoins the secondary duct in the direction of flow.

11. An arrangement according to one of claims 7 to 9 characterised in that the housing insert (11) has a second auxiliary valve seat (16) above the ball (14) and surrounds a mouth opening (27) of the main duct (21) into the auxiliary valve chamber (13).

12. An arrangement according to claim 11 characterised in that the mouth opening (18) of the secondary duct (17) in the first auxiliary valve seat (15) and the mouth opening (27) of the main duct (21) in the second auxiliary valve seat (16) are coaxial with each other.

13. An arrangement according to one of claims 1 to 9 characterised in that below the junction between the main and secondary ducts (21, 17), the main duct (21) has a second eccentric auxiliary valve (16, 37) with a second valve ball (37) of metal and a second auxiliary valve seat (16) above the second ball (37).

14. An arrangement according to claim 13 characterised in that the auxiliary valves are axially displaced and radially overlap each other.

15. An arrangement according to one of claims 1 to 14 characterised in that the ratio of the inside diameter of the outer



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valve housing portion (6) to the diameter of the first valve ball (14) is in the range from about 1.5 to 2, preferably 1.75.

16. An arrangement according to one of claims 1 to 15 characterised in that the inlet opening (46) of the secondary duct (17) is in the direct vicinity of the upper portion (1) of the can.

17. An arrangement according to claim 16 characterised in that an initial portion of the secondary duct (17) is formed by a groove (45) which is provided in the outside of the valve housing (4) and which begins at the inside of the upper portion (1) of the can and which is covered, to a position in the vicinity of the upper portion (1) of the can, by a siphon tube (8) which is pushed over the valve housing (4).

18. An arrangement according to one of claims 1 to 17 characterised in that the auxiliary valve chamber or chambers (13, 39) is or are partially delimited by two housing inserts (11, 47).



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Translation of the claims in the French language

1. A spray valve arrangement for an aerosol can, comprising a one-piece valve housing (4) comprising plastics material which can be fixedly fitted sealingly by its upper end in the upper portion (1) of the can, which defines a main duct (21) for the content of the can to pass therethrough, and which has a main valve with a valve stem (2) in the main duct (21), manually actuatable against the force of a spring (10), a siphon tube (8) which extends the main duct, a secondary duct (17) connecting the space inside the can to the main duct above the maximum level of filling of the can and a valve seat (15) of an auxiliary valve, which is formed at the junction between the main duct and the secondary duct, with, in a cylindrical chamber, an auxiliary valve ball (14) of metal, surrounded by a cylindrical valve housing portion (16), and disposed within the cross-section of the upper end of the valve housing, wherein the auxiliary valve seat (15) is below the valve ball so that in the normal position of the can the valve ball does not obstruct the main duct (21) and blocks the secondary duct (17) whereas in the inverted position of the can the valve ball opens the secondary duct, and wherein the main duct is taken laterally towards the auxiliary valve, characterised in that the auxiliary valve (14, 15) disposed in the outer valve housing portion (6) which surrounds the auxiliary valve chamber (13) has an eccentricity which is approximately equal to the difference between the inside radii of the outer valve housing portion (6) and the auxiliary valve chamber (13), and that the difference between the outside diameter of the auxiliary valve chamber (13) and the inside diameter of the outer valve housing portion (6) is smaller than the diameter of the valve ball (14) of the auxiliary valve.

2. An arrangement according to claim 1 characterised in that the inlet opening (18) of the secondary duct (17) into the auxiliary valve chamber (13) is below the valve ball (14).



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3. An arrangement according to claim 1 or claim 2 characterised in that the valve housing (4) has a transverse slot (19) and an axial bore (20) which form the secondary duct (17).

4. An arrangement according to claim 1 characterised in that the outlet opening (17a) of the secondary duct (17) from the lowest part of the auxiliary valve seat (15) opens into the housing chamber (21a) which is below the valve ball (14).

5. An arrangement according to one of claims 1 to 3 wherein the valve ball is retained in the auxiliary valve chamber by a blocking means which is disposed above the valve ball, characterised in that the blocking means (35) liberates an assembly package (34) for the valve ball (14) to pass therethrough from the main valve housing chamber (33) to the auxiliary valve chamber (13).

6. An arrangement according to claim 5 characterised in that the passage (34) is parallel to the axis and the blocking means (35) is formed by at least one flexible projection (35) which projects radially inwardly at the passage (34).

7. An arrangement according to one of claims 1 to 4 with a housing insert which delimits the auxiliary valve chamber, characterised in that the insert (11) at the same time has control and guide openings (28/29) for the path of the flow outside the auxiliary valve chamber.

8. An arrangement according to claim 7 characterised in that on its inside wall the valve housing (4) has a projection (31) behind which the housing insert can be latched.



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9. An arrangement according to claim 7 or claim 8 characterised in that the spring (10) bears against the housing insert (11).

10. An arrangement according to one of claims 1 to 9 characterised in that the cross-section of the narrowest part of the secondary duct is larger than that of the narrowest part of that portion of the main duct which within the valve housing adjoins the secondary duct in the direction of flow.

11. An arrangement according to one of claims 7 to 9 characterised in that the housing insert (11) has a second auxiliary valve seat (16) above the ball (14) and surrounds a mouth opening (27) of the main duct into the auxiliary valve chamber (13).

12. An arrangement according to claim 11 characterised in that the mouth opening (18) of the secondary duct (17) in the first auxiliary valve seat (15) and the mouth opening (27) of the main duct (21) in the second auxiliary valve seat (16) are coaxial with each other.

13. An arrangement according to one of claims 1 to 9 characterised in that below the junction between the main and secondary ducts (21, 17), the main duct (21) has a second eccentric auxiliary valve (16, 37) with a second valve ball (37) of metal and a second auxiliary valve seat (16) above the second ball (37).

14. An arrangement according to claim 13 characterised in that the auxiliary valves are axially displaced and radially overlap each other.

15. An arrangement according to one of claims 1 to 14 characterised in that the ratio of the inside diameter of the outer



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valve housing portion (6) to the diameter of the first valve ball (14) is in the range from about 1.5 to 2, preferably close to 1.75.

16. An arrangement according to one of claims 1 to 15 characterised in that the inlet opening (46) of the secondary duct (17) is in the direct vicinity of the upper portion (1) of the can.

17. An arrangement according to claim 16 characterised in that an initial portion of the secondary duct (17) is formed by a groove (45) which is provided in the outside of the valve housing (4) and which begins at the inside of the upper portion (1) of the can and which is covered, to a position in the vicinity of the upper portion (1) of the can, by a siphon tube (8) which is pushed onto the valve housing (4).

18. An arrangement according to one of claims 1 to 17 characterised in that the auxiliary valve chamber or chambers (13, 39) is or are partially delimited by two housing inserts (11, 47).