FLEXIBLE CONTAINER FOR BULK MATERIAL

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ABSTRACT
A flexible bulk material container has a container body having at least one opening for filling and emptying the bulk material container. Carrying loops are attached to the container body. The container body and the carrying loops are made from an electrically non-conductive base fabric. A first conductive element for conducting an electrostatic charge of the bulk material container is provided which electrostatic charge occurs primarily during filling or emptying of the bulk material container. At least one the carrying loops has a discharge device. The first conductive element is connected to the discharge device and is a coating of the container body. At least one of the coating and the discharge device is made from a thermoplastic synthetic material containing a conductivity-increasing additive and having a surface resistance of between $10^6$ Ohm and $10^{12}$ Ohm.

[Diagram of the flexible container]
FLEXIBLE CONTAINER FOR BULK MATERIAL

[0001] The invention relates to a flexible container for bulk material comprising a container body that can be filled with bulk material and emptied again through at least one opening, wherein the container body can be filled by means of carrying loops that are attached to the container body. The container body comprises an electrically non-conductive base fabric as well as a conductive element that is suitable for conducting an electrostatic charge of the bulk material container occurring preferably during filling or emptying, wherein the conductive element, for discharging the bulk material container, is connected to at least one discharge means correlated with a carrying loop.

[0002] DE 299 24 464 discloses a bulk material container of the aforementioned kind that is suitable for corona-discharge. Such a bulk material container has in the area of its carrying loops at least one discharge means correlated with a carrying loop wherein the discharge means projects from the material of the carrying loop in the form of an exposed conductor. Despite the fact that corona discharges are possible anytime, partial areas of the container body can become temporarily charged and this leads to the hazard of arc-over. On the one hand, this is so because the corona discharge occurs at a comparatively low rate in a secured area in the vicinity of the support frame, and, on the other hand, because the electric conductors woven into the fabric can still conduct charges well as a result of their comparatively minimal electrical surface resistance.

[0003] It is therefore an object of the present invention to improve the article according to the preamble of claim 1 with regard to its electrostatic properties.

[0004] The object is solved by an article of the aforementioned kind in which the conductive element that is formed as a coating of the container body and/or the discharge means are/is comprised of a thermoplastic synthetic material wherein, as a result of a conductivity-increasing additive, it has a surface resistance between $10^8$ and $10^{11}$ Ohm. The bulk material container according to the invention thus has a coating, preferably applied to the inner side of the container body, that takes over the tasks of the prior art conductive paths woven into the fabric material and arranged usually in a grid pattern. Because the resistance of the coating surface is between $10^8$ Ohm and $10^{11}$ Ohm, i.e., within a range that is above $10^8$ Ohm of an electrical conductor conventionally used in connection with bulk material containers, there is still charge transport in the direction of the discharge means correlated with the carrying loops but it is not capable of enabling arc-over in case of local charging because of the high resistance.

[0005] The container according to the invention thus has for dissipating its electrostatic charges only the anistatic coating as well as the discharge means correlated with at least one carrying loop. A mandatory requirement for the functioning of the bulk material container is that the coating is in contact with the discharge means. Depending on the configuration of the bulk material container, for example, with a container body having a rectangular or round cross-section, it must also be ensured that the coating of the individual walls of the container body are in contact with one another. This contact can be realized, for example, by applying the coating after individual walls have been sewn together.

[0006] It was found that for a surface resistance of the coating and/or of the discharge means between $10^8$ Ohm and $10^{10}$ Ohm, measured e.g. in accordance with DIN 53482, the bulk material container according to the invention functions particularly well.

[0007] Advantageously, the bulk material container according to the invention can have additional conductive elements, correlated respectively with the container body or the carrying loop and configured as ribbons or threads and also comprised of a thermoplastic synthetic material that, as a result of an additive that increases its conductivity, has a surface resistance between $10^9$ Ohm and $10^{11}$ Ohm. These additional conductive elements are to be provided, inasmuch as they are arranged in the area of the carrying loop fabric and extend in this area preferably in warp in the direction of longitudinal extension of the carrying loop, to connect the discharge means to the conductive means of the container body and to ensure a continuous charge transport.

[0008] The additional conductive elements are arranged moreover preferably in areas of the container body that are exposed to particularly high mechanical loads and enable thus also an excellent dissipation of the collected electrostatic charge in the direction of the discharge means and discharge thereof of the bulk material container by means of corona discharge, even in case of a coating that has been possibly damaged after extended use.

[0009] It is within the boundaries of the invention to provide grounding of the bulk material container that provides an additional safety means of the container in addition to the at least one discharge means arranged in the area of at least one carrying loop.

[0010] According to a further embodiment of the invention, the discharge means is configured as a thin thread and has thread loops preferably in the area of the edges of the carrying loops which thread loops project past the edges of the carrying loop or project from the material of the carrying loop. The thread is very thin in order to also enable a corona discharge and is incorporated in the weft direction into the base fabric of the carrying loop. Such a thread is advantageously in conductive contact with the surface of the container body by means of additional conductive elements that are incorporated in the warp direction as well as by means of the coating according to the invention and therefore contributes decisively to the discharge of the container body.

[0011] According to another advantageous embodiment of the invention, at least two carrying loops have discharge means wherein the carrying loops are in conductive contact with one another, for example, by means of conductive elements. These conductive elements that extend preferably in the corner areas of the container body assist in the uniform discharge of the bulk material container.

[0012] Further advantages and details of the invention result from the schematic illustrations of an article according to the invention described in the following. The illustrations show in:

[0013] FIG. 1 a perspective view of a bulk material container according to the invention;

[0014] FIG. 2 a plan view onto the area of a carrying loop with discharge means and additional conductive elements;

[0015] FIG. 3 a plan view onto a part of a discharge means.

[0016] The bulk material container according to the invention comprises a container body 1 that can be filled by means of filling socket 3 arranged at the topside 2 through an opening 4 (FIG. 1). Ties 5 serve for closing the filling socket 3. On
the bottom side 6 of the container body 1 there is also an opening 7 through which the bulk material can be emptied from the container body through an outlet socket 8 that can also be closed by ties 5.

[0017] In the corner areas of the topside 2 carrying loops 11 are sewn to the sidewalls 9 of the container body 1. All carrying loops 11 comprise parts of a discharge means 14 illustrated by thin lines 12.

[0018] Moreover, the bulk material container according to the invention has in accordance with the invention additional conductive elements 13 that are arranged approximately parallel to the longitudinal extension of the carrying loops 11, attached to the container body 1 and comprising the discharge means 14, in an area whose width transverse to the longitudinal extension of the carrying loop 11 is maximally two and half times, preferably maximally two times, the width of the carrying loop 11. In this way, the particularly kink-prone corner areas of the bulk material container, in addition to being provided with a coating, are also provided with conductive elements that ensure in the case of the coating of the bulk material container being damaged, in particular at the greatly loaded areas, an unimpeded dissipation of the charge that is being collected on the bulk material container.

[0019] The additional conductive elements 13, of which some can be arranged in the carrying loops as will be explained in more detail in the following, are preferably incorporated in the warp direction of the base fabric. The expenditure that has been required up to now for incorporating the conductive elements, usually employed in the prior art by frequently being incorporated in a grid arrangement in the base fabric, is reduced significantly in the bulk material container according to the invention.

[0020] In a further advantageous embodiment of the invention, the carrying loops 11 are provided on a different side of the container body 1 than the coating, for example, on its outer side. The additional conductive elements 13, woven in the longitudinal direction of the carrying loops into the base fabric of the container body 1, connect by means of their arrangement the coating and the conductive elements of a carrying loop 11 with one another without both of them having to be arranged on the same side of the container body. This is advantageous for the surface of the inner side of the container body 1.

[0021] In FIG. 2 a detail of the carrying loop 11 is shown; in addition to the conductive elements 13 incorporated in the warp direction, the carrying loop has discharge means 14 incorporated primarily in the weft direction and provided with a plurality of strips 16 that are projecting at least partially from the base fabric and are made of a conductive material, preferably a polymer film. In addition, the discharge means 14 projects in the area of edges 17 of the carrying loop 11 into the surroundings, preferably in the form of a loop, in order to assist particularly well corona discharge thereof. The distances between the individual additional conductive elements 13 that are used in the form of electrostatically discharging yarns or ribbons are between 3 and 20 mm for the conductive elements 13 correlated with the carrying loops 11 as well as for the conductive elements 13 correlated with the container body 1. It is understood that the additional conductive elements 13 of the container body 1 and carrying loop 11 are in contact with one another.

[0022] It is also advantageous when the individual strips 16 of the discharge means 14 are connected conductively with one another in order to enhance the uniform corona discharge.

[0023] Advantageously, the discharge means 14 is embodied as a polymer film strip from which the individual strips 16 are cut out (FIG. 3). Since a corona discharge preferably takes place at the narrow edge areas of the discharge means, as a result of the great edge area the polymer film is suitable for corona discharge across large areas. Instead of strips that are arranged perpendicularly to the longitudinal extension of the film, other cutting patterns or strip patterns are conceivable, in particular those that have long edge areas in comparison to their surface area.

[0024] For reinforcing the polymer film, a reinforcement seam 18 is applied to the film wherein for this purpose threads of synthetic material, metal or other materials can be used. The electrostatically conductive polymer film strips of the discharge means 14 as well as the fine yarn loops of the discharge means provided as an alternative or as a supplement and having, for example, a thickness of Dtex 1100/100, are incorporated in the transverse direction and are in contact with the additional conductive elements 13 that are woven in the longitudinal direction (warp) and embodied as electrostatically discharging ribbons or yarns. The carrying loops 11 produced in this way are then contacted with the conductive element embodied as a coating and the additional conductive elements 13 that are arranged on the sidewalls 9 of the container body 1. It is also conceivable that, instead of the coating, conventional conductive elements arranged in a grid pattern are used that discharge the bulk material container according to the invention in cooperation with the polymer film comprising the discharge strips 16.

[0025] The antistatic coating embodied as the conductive element can be comprised of a plurality of thermoplastic synthetic materials that comprise additives that increase their conductivity. The latter can be, for example, a polymer that is penetrated by an electrically conductive network of microrystalline needles that, depending on the quantity that is being embedded, can vary the discharge properties of the surface in the disclosed range. It was found that such an additive increasing the conductivity can be admixed in a quantity of 5 percent to 25 percent by weight into the synthetic material, comprised preferably of polyolefin, in order to bring the resistance into the disclosed range.

What is claimed is:

1-12. (canceled)

13. A flexible bulk material container comprising:
   a container body having at least one opening for filling and emptying the bulk material container;
   carrying loops attached to the container body;
   wherein the container body and the carrying loops are comprised of an electrically non-conductive base fabric;
   a first conductive element for conducting an electrostatic charge of the bulk material container which electrostatic charge occurs primarily during filling or emptying of the bulk material container;
   at least one the carrying loops having discharge means correlated therewith;
   wherein the first conductive element is connected to the discharge means;
   wherein the first conductive element is a coating of the container body;
   wherein at least one of the coating and the discharge means is comprised of a thermoplastic synthetic material containing a conductivity-increasing additive and having a surface resistance of between 10^9 Ohm and 10^11 Ohm.
14. The bulk material container according to claim 13, comprising second conductive elements correlated with the carrying loops or partial areas of the container body, respectively, wherein the second conductive elements are comprised of a thermoplastic synthetic material containing a conductivity-increasing additive and having a surface resistance of between $10^8$ and $10^{11}$ Ohm, wherein the second conductive elements are ribbons or threads.

15. The bulk material container according to claim 14, wherein the discharge means is arranged within said at least one carrying loop, wherein the second conductive elements are arranged approximately parallel to a longitudinal extension of the carrying loops in an area having a width transversely to the longitudinal extension of the carrying loops that is maximally two and a half times a width of the carrying loops, respectively.

16. The bulk material container according to 14, wherein the second conductive elements are incorporated in a warp direction in the base fabric.

17. The bulk material container according to 14, wherein the coating is arranged on a side of the container body opposite a side to which the carrying loops are attached, wherein the second conductive elements correlated with the partial areas of the container body connect the coating with the second conductive elements correlated with the carrying loops and/or the discharge means.

18. The bulk material container according to 13, wherein the discharge means is a thread having thread loops.

19. The bulk material container according to claim 18, wherein the thread loops are provided on edges of the at least one carrying loop.

20. The bulk material container according to claim 13, wherein the discharge means has a plurality of strips made from a conductive material and projecting at least partially from the base fabric.

21. The bulk material container according to claim 20, wherein the strips are conductively connected with one another.

22. The bulk material container according to claim 20, wherein the strips are part of a polymer film.

23. The bulk material container according to claim 20, wherein the discharge means has a seam reinforcement.

24. The bulk material container according to claim 13, wherein the discharge means is incorporated in the weft direction into the base fabric of said at least one carrying loop.

25. The bulk material container according to claim 14, wherein at least two of the carrying loops comprise the discharge means, wherein the second conductive elements of said at least two carrying loops are conductively connected to one another.

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