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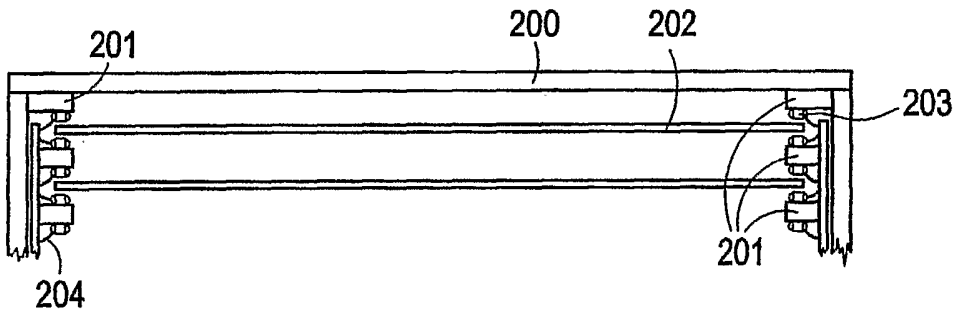
(54) **Title:** METHOD AND APPARATUS FOR TRANSPORTING ARTICLES



(57) **Abstract:** In accordance with an illustrative embodiment, a method and apparatus for transporting articles includes a container, which has at least one support member and at least one stabilizing member. The stabilizing elements are adapted to engage the articles and secure the articles to the support members, and disengage the articles during unloading.

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Method and Apparatus for Transporting Articles

RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Application No. 10/437,850, filed May 14, 2003, the entirety of which is incorporated herein by reference.

Background

[0002] Display devices based on a variety of technologies use glass substrates, or panels, as the viewable and interactive surface. Illustratively, many computer monitors and televisions are based on liquid crystal display (LCD) and plasma technologies and use glass substrates as the display panel.

[0003] Often, certain demands are placed on the glass substrates used as LCD and plasma display panels. For example, compared to cathode ray tube displays, the LCD and plasma display panels require glass substrates that are very thin, and very uniform in thickness. Additionally, as larger display viewing/interactive areas are desired, it is necessary to increase the areal surface dimensions of the glass.

[0004] As can be appreciated, as the demand for thinner and larger displays increases, there are certain challenges to be met by the manufacturer of the glass substrates used for the displays. One challenge is in the transportation of the glass substrates, which is not only from the manufacturer to the customer, but also between the manufacturer's production locations where the glass goes though different stages of processing (e.g., finishing and inspection).

[0005] In addition to the relatively obvious challenge of preventing breakage, it is necessary to ensure the cleanliness of the glass substrates. For example, because it is necessary in many LCD and plasma display devices to locate electronic devices such as CMOS transistors on the substrate, it is necessary to provide a sterile surface. To wit, for the above and other reasons, there is an ever increasing demand and stringent requirements for surface cleanliness and reduction numbers and size of contaminants on the faces of the substrate. As such, increases in areal size and reductions in thickness of glass substrates have significantly increased the complexity and the challenge to manufacture and transport the glass without breakage or contamination.

[0006] While certain efforts have been made to meet the increased demands placed on the transportation of large size glass panels, these have met with mixed results. Moreover, the likelihood of success of these known transportation techniques is suspect, particularly as the areal dimensions of the substrates increase, and their thicknesses decrease.

[0007] What is needed, therefore, is a method and apparatus for transporting glass substrates, which overcomes at least some of the drawbacks of known methods described above.

Summary

[0008] In accordance with an illustrative embodiment, an apparatus for transporting articles includes providing a container, which has a at least one support member and at least one stabilizing member. Each of the support members is adapted to engage at least one of the articles and secure the articles to its respective support member, and to disengage the article during unloading.

[0009] In accordance with another illustrative embodiment, method of transporting articles includes a container having at least one support member and at least one stabilizing member. The method also includes engaging each of the articles with one or more of the stabilizing members and securing the articles to one or more of the support members.

Brief Description of the Drawings

[00010] The invention is best understood from the following detailed description when read with the accompanying drawing figures. It is emphasized that the various

features are not necessarily drawn to scale. In fact, the dimensions of the various features may be arbitrarily increased or decreased for better clarity of description.

[00011] Fig. 1 is a cross-sectional view of a container for transporting articles in accordance with an exemplary embodiment.

[00012] Fig. 2 is a top view of a container for transporting articles in accordance with an exemplary embodiment.

[00013] Fig. 3 is a perspective view of a container for transporting articles in accordance with an exemplary embodiment.

[00014] Fig. 4 is a cross-sectional view of a container for transporting articles in accordance with an exemplary embodiment.

[00015] Fig. 5 is a cross-sectional view of the illustrative container shown in Fig. 4 with a plurality of stabilizing members engaging respective articles in accordance with an exemplary embodiment.

Detailed Description

[00016] In the following detailed description, for purposes of explanation and not limitation, exemplary embodiments disclosing specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be apparent to one of ordinary skill in the art that the present invention may be practiced in other embodiments that depart from these specific details. In other instances, detailed descriptions of well-known devices and methods are omitted so as to not obscure the description of the present invention.

[00017] Fig. 1 shows a container 100 used to transporting articles 103. The container 100 is provided with a plurality of support members 101, each of which has at least one stabilizing member 102 adjacent thereto. The stabilizing members 102 are adapted to engage the articles 103 and secure the articles 103 against their respective support member 101 during transportation of the articles 103. Illustratively, the stabilizing members are clamping devices. The container 100, support members 101 and stabilizing members 102 are made of a material that provides the requisite strength to support the articles 103, and is readily cleaned before and/or after use. For example, aluminum may be used. The stabilizing members 102 may have a cushioning material (e.g., rubber) disposed thereon to provide a shock-absorbing effect to the articles 103.

[00018] During loading of the articles 103, the stabilizing members 102 are adapted to be disengaged from the articles 103, and after the articles are loaded, the stabilizing members engage their respective article 103 to ensure its secure transit. When it is desired to unload the articles from the container, the stabilizing members are disengaged from the articles 103. This engaging and disengaging may be effected by rotational or linear motion of the stabilizing members 102, for example. It is noted that the stabilizing members 102 may be adapted to engage/disengage independently of one another, or may be adapted to engage/disengage simultaneously. Moreover, the stabilizing members 102 may be adapted to engage/disengage in select groups within the container 100.

[00019] It is also noted that the support members 101 may be adapted to move in a cooperative manner with respective stabilizing member 102 to facilitate the engaging/disengaging of the stabilizing members 102 and support members 101 with the articles 103, and during the transportation of the articles 103 in the engaged positions. Beneficially, the stabilizing members 102 and support members 101 are disposed so that they engage only a minimal portion of the article 103 on its perimeter (designated "non-quality" area) so as to avoid contamination of the article. Finally, it is noted that some or all of the support members 101, or stabilizing members 102, or both, could be removable to provide flexibility for loading articles of varying sizes. These and other features and benefits are described in further details herein.

[00020] As will become clearer as the present description proceeds, the methods and apparati of the exemplary embodiments described herein may be useful in a variety of applications when the integrity of the articles to be transported and the desire to maintain the cleanliness of the article are important, among other considerations. The present illustrative embodiments are described in connection with the transporting of flat glass substrates, which are used in display devices. The description of these illustrative embodiments conveys some useful characteristics and benefits of the apparatus and method. Clearly, the artisan of ordinary skill having had the benefit of the present disclosure will recognize that these salient features, and their legal equivalents may be applied to effectively transport other articles as well. Examples of other articles include, but are not limited to, electronic equipment and devices, optical and optoelectronic equipment and devices, and laboratory and surgical equipment.

[00021] Moreover, the artisan of ordinary skill having had the benefit of the present disclosure will recognize that devices other than those explicitly described may be used for the support members 101 and the stabilizing members 102. The variations to meet these desired ends necessarily include the salient features and characteristics of the exemplary embodiments described, and are, therefore, within the purview of the method and apparatus of the present invention.

[00022] Fig. 2 is a top view of a section of a container 200 in accordance with an exemplary embodiment of the present invention. The container 200 includes a plurality of support members 201. One or more, if not all, of the support members 201 may be integrally formed with the container 200. Alternatively, one or more, if not all, of the support members 201 may be inserted into the container 200, and secured therein for stable transportation of articles 202, which may be fragile and may be required to remain clean throughout transportation. In either case, one or more, if not all of the support members may 201 may be adjustable in order to accommodate articles of different thickness, or areal dimension or both in the container. As can be appreciated, by having one or more of the support members 201 removable, or adjustable, or both, it is possible transport articles of varying thickness, and/or with varying areal dimensions. Of course, the stabilizing devices 203 may be of varying sizes as well. It is noted that the support members 201 may be stationary, or moveable/adjustable. Moreover, the support members 201 may also be adapted to be removed from the container, providing flexibility in the loading/unloading of articles.

[00023] The articles 202 are illustratively large sheet substrates that eventually may be cut to size and divided for use as display panels in display devices, such as LCD displays. In an exemplary embodiment these substrates are glass, having dimensions of approximately 1m x 1m, and a thickness of approximately 0.7mm. Of course, these dimensions are merely for purposes of illustration, and it is noted that glass panels having areal dimensions greater than $1m^2$ and thickness less than 7mm may benefit from the present method and apparatus. In particular, the dimensions of the substrates are limited by the capability to fabricate them in large areal dimensions and/or small thickness; and are limited by the capability of the transit vehicles such as planes and trucks, etc. Moreover, it is further noted that glass substrates having areal dimensions less than those noted, and thickness greater than those noted may be transported in the container 200.

[00024] Stabilizing members 203 are illustratively disposed between the support members 201, and on either side of the surface of the edge of the articles 202. In the presently described exemplary embodiment, the stabilizing members 203 are devices into which a fluid is introduced to provide a desired amount of a stabilizing force. The fluid may be a gas, such as air, or a liquid. When the fluid is introduced into the devices, the devices engage the surfaces on the perimeter of the articles. As can be appreciated, when fluid is disposed in the devices, the devices cooperatively engage their respective support members 201. Thereby the support members 201 and the stabilizing members 203 provide the support and stability to the articles 202, and the stabilizing members 203 provide useful shock absorption.

[00025] In accordance with an exemplary embodiment, the stabilizing members 203 are inflatable rubber seals, having a tubular shape. These inflatable rubber seals are manufactured by the Presray Corporation, Pawling, NY. Of course, this is merely illustrative, and other devices into which a fluid may be introduced may be used as the stabilizing members in accordance with the present embodiment.

[00026] The stabilizing members 203 are substantially free of fluid during the loading of the articles 202. Once loaded, the fluid is introduced into the stabilizing members 201. In the exemplary embodiment in which the inflatable seals are used as the stabilizing members, air may be introduced using an air supply line/valve 204, which may be coupled to the container 200 by one of a variety of known methods. The stabilizing members 201 in the inflated state are shown in Fig. 3. The container 200 includes the stabilizing members 201 inflated and engaging the articles 202 on either side thereof, as shown. The stabilizing members also engage the support members on their sides that are opposite the side that engages the article 202. This is shown in Fig. 3 as well.

[00027] The apparatus and method of the exemplary embodiment of Figs. 2 and 3 enables the loading of the articles 202 with the stabilizing members in a deflated state; and after loading is complete, the stabilizing devices 203 are inflated and engage the articles on either side thereof, and engage the support members 201 on their other side. To wit, the stabilizing members are disposed between the articles 203 and the support members 201. This illustrative arrangement allows for the transportation of the articles substantially without breakage, and substantially without contamination of the articles.

[00028] It is noted that the stabilizing members 203 engage the articles 202 at the edges thereof. These engagement edges are within a prescribed width (known as the non-quality area) that is trimmed off during sizing of the article (glass substrate) by the end user, and thereby the stabilizing members do not engage the substrate in the area that must be kept substantially free of contaminants. Illustratively, this non-quality area is about the perimeter of the glass substrate and has a width of approximately 5 mm to approximately 20 mm.

[00029] In accordance with an exemplary embodiment, the stabilizing members 203 are disposed along the length of the non-quality areas of the glass substrates. However, this is not necessary. Illustratively, these elements may be disposed only along a portion of the length of the non-quality area (e.g., the corners). Of course other variants of the disposition of the stability members 203, such as a combination of having them along the length and only in the corners may be used as well.

[00030] In accordance with an exemplary embodiment, after the articles 202 are loaded in the container and the stabilizing members 203 are engaged as described above, the container is sealed in a substantially airtight manner. This may be achieved using a lid (not shown) of the same material as the container, which has a suitable sealing mechanism (not shown). After transit is complete, the stabilizing members 203 are disengaged and the articles 202 are unloaded.

[00031] The container 200 is and the support members 201 are illustratively aluminum. Of course this is merely illustrative, and other materials may be used for the container 200 and support members 201. Usefully, the material has the structural strength to prevent damage to the articles during transportation, remains sterile after cleaning, and is easily cleaned before and after use. The container may be cleaned before use, or after use, or both using a suitable cleaning solution.

[00032] Additionally, it is noted that the container 100 may be collapsible, so that after shipping of articles, it may be returned easily to the shipper for further use by the shipper. Moreover, the container 200 may be the container used for shipping, and may have wheels (not shown in Fig. 2 or 3) or other form of locomotion for facilitating the movement of the container 200. Alternatively, the container 200 may be a cassette that is inserted into another container (not shown) for shipment. The container 200 would have wheels (not shown in Fig. 2 or 3) or other form of locomotion as well. Beneficially, the container in which the cassette is disposed is easily cleaned after use,

and may be substantially airtight sealed after the cassette is enclosed for shipment. This ensures the glass substrates will be received in a clean condition as is needed.

[00033] Finally, it is noted that the exemplary embodiment is drawn to a container 200 that is loaded from the top. Of course, this is merely illustrative, and in this and other embodiments, the side(s) of the container 200 may be adapted for removal so that the articles 202 may be loaded from the side. It may be useful in such an embodiment to have a groove or guide along the floor of the container to minimize the stresses and strains on the article during loading.

[00034] Another exemplary embodiment of the present invention is described in conjunction with Figs. 4 and 5. This exemplary embodiment has similar attributes to the exemplary embodiments described thus far for transporting of glass substrates and/or other articles. Additionally, the present exemplary embodiment includes a container having many, if not more, of the attributes described above. As such, to the extent feasible, common features will not be duplicated.

[00035] Fig. 4 shows a container 400 in accordance with an exemplary embodiment of the present invention. The container 400 has clamping mechanisms 401 and 402, which are illustratively rack and pinion mechanisms. The container 400 may be a cassette that is disposed in another container for transit as described above. Alternatively, the container 400 may be a stand-alone unit with wheels 410 or similar form of locomotion, such as rollers or bearings.

[00036] As will become clearer as the present description proceeds, mechanisms 401 and 402 cooperatively engage stabilizing members 403 and support members 404, to hold the articles (not shown in Fig. 4) securely during transportation. The stabilizing members 403 and support members 404 usefully have a compliant or soft material (e.g., rubber) thereon, which engages the glass in the non-quality area. As such members 403 and 404 provide the required stability during transit, yet provide a cushion for shock absorption.

[00037] Illustratively, the stabilizing members 403 are clamps. The stabilizing members 403 are movable along the shafts 405 of the clamping mechanisms 401 and 402, and the support 404 members are fixed in place. Alternatively, one or more, or all of the support members may be moveable as well. Moreover, one or more, or all of the support members 404 may be removeable. As described above, the ability to move and/or remove one or more of the support members provides beneficial flexibility in

transporting articles of various thickness and areal dimensions. Finally, it is noted that the support members are usefully made of, or are coated with, a substantially frictionless material such as Teflon ®.

[00038] In the exemplary embodiment of Fig. 4, the clamp mechanisms 401 and 402 are not engaged, and the container 400 is ready for loading articles for transit. A plurality of articles 406 (e.g., glass substrates) is then loaded in between respective ones of the stabilizing members 403 and the support members 404, as shown in Fig. 5. These may be loaded with the container 400 at a slight incline so the articles 405 rest against their respective support member 404. After all of the articles 406 are loaded, clamping mechanisms 401 and 402 are actuated, which draw the shafts 405 in the direction 407. This engages the respective articles 406 between the stabilizing members 403 and the support members 404. A substantially frictionless bottom pad 408 on the interior of the container 400 eases the motion of the articles during the motion of the clamps 403 and articles 406. The bottom pad 408 may be a separate element or may be the bottom floor of the container, made from the same material as the container (e.g. aluminum), and coated with a substantially frictionless material such as Teflon®, or some other suitable material.

[00039] Beneficially, the stabilizing members 403 provide flexibility in the force applied to the glass substrates to provide a relatively uniform force to the articles 403. The stabilizing members 403 may be spring-loaded or have a soft pad thereon to account for variations in the glass from one end to the other. For example, the variations in the dimensions of the glass from one end to the other, or variations in the relative positions of the articles 406 to their respective support members 404 could result in a support member's (403) engaging the top end (e.g., 411) of the article 406 to the point of breakage, while the bottom end (e.g., 412) would not yet be in contact with its respective support member. Likewise, if there were no flexibility in the force applied by the stabilizing members 403, and the one of the articles 406 has a different dimension than the others, or the articles 406 are not in the same positions relative to their respective stabilizing members 403, or respective support members 404, or both, at the time of actuating the clamp mechanism 401 and 402, a disproportionate force could be applied to one or more of the articles 406, and there could be breakage. Thus, the spring loading/cushioning provides the needed flexibility to account for the

warpage of the sheet or variations in the glass substrate size from one substrate to the next.

[00040] After the stabilizing members 403 are drawn into position, the clamp mechanism 401 and 402 is locked in place by lock handles 413 and the container 400 is ready for transportation. As was the case in the discussion of the exemplary embodiments described above, many variations are possible to meet the desired end of transporting the articles 403 in the container. For example, the stabilizing members 403 may extend along the width of the articles, or may be disposed only at the corners thereof. These stabilizing members 403 could also be disposed at other locations along the articles, as well a combination of these locations.

[00041] After the articles are loaded into the container 400, a lid 409 is disposed over the container 400. The lid usefully provides a substantially airtight seal to prevent contamination during transit. As described before, the container may be cleaned after use, and may be collapsible. After transit is complete, the stabilizing members 403 are disengaged from the articles by reversing the movement of the clamping members 401 and 402. The articles 404 may then be unloaded.

[00042] Finally, as described previously, the side(s) of the container 400 may be removable for loading articles 406. In this case, after the articles have been loaded, the side(s) would be positioned and sealed in an airtight manner for transpotation.

[00043] The invention having been described in detail in connection through a discussion of exemplary embodiments, it is clear that modifications of the invention will be apparent to one having ordinary skill in the art having had the benefit of the present disclosure. Such modifications and variations are included in the scope of the appended claims.

CLAIMS:

1. An apparatus for transporting articles, comprising:

a container;

at least one stabilizing member; and

at least one support member, wherein the at least one stabilizing member is adapted to cooperatively engage at least one of the articles and secure the at least one article to at least one support member, and to disengage the at least one article during unloading.

2. An apparatus as recited in claim 1, wherein the at least one stabilizing element is adapted to receive a fluid.

3. An apparatus as recited in claim 1, further comprising at least one clamping mechanism that moves the stabilizing elements relative to the support members.

4. An apparatus as recited in claim 1, wherein the at least one stabilizing member and the at least one support member are disposed in the container.

5. An apparatus as recited in claim 1, wherein the container is adapted to collapse.

6. An apparatus as recited in claim 2, wherein the fluid is as gas, and the at least one stabilizing element is inflated during the cooperative engaging of the article, and deflated during the disengaging of the article.

7. An apparatus as recited in claim 3, wherein the container has an interior bottom surface that is substantially frictionless.

8. An apparatus as recited in claim 3, wherein each of the at least one stabilizing elements has at least one cushioning surface that contacts a portion of a respective one of the articles.

9. An apparatus as recited in claim 3, wherein the at least one clamping mechanism is a rack and pinion mechanism.

10. An apparatus as recited in claim 3, wherein each of the at least one clamping mechanisms is spring loaded.

11. An apparatus as recited in claim 1, wherein at least one of the at least one support members is stationary relative to the container.

12. An apparatus as recited in claim 1, wherein at least one of the at least one support members is adapted to move relative to the container.

13. An apparatus as recited in claim 1, wherein at least one of the at least one support members is adapted to be removed from the container.

14. An apparatus as recited in claim 1, wherein at least one of the support members are integral with the container.

15. An apparatus as recited in claim 1, wherein the container is a cassette that is loaded on a structure for transportation.

16. An apparatus as recited in claim 1, wherein the container includes a device for locomotion.

17. An apparatus as recited in claim 1, wherein at least one of the articles is a glass substrate.

18. An apparatus as recited in claim 1, wherein at least one of the stabilizing members is adapted to be removed.

19. An apparatus as recited in claim 1, wherein one or more of the stabilizing members are adjustable.

20. A method of transporting articles, the method comprising:

providing a container having at least one support member and at least one stabilizing member;

engaging each of the articles with one or more of the at least one stabilizing members and securing each of the articles to one or more of the at least one of the support

members.

21. A method as recited in claim 20, the method further comprising disengaging the articles during unloading of the articles in the container.

22. A method as recited in claim 20, wherein each of the at least one stabilizing members provide a cushion to the articles during transportation.

23. A method as recited in claim 20, wherein each of the at least one the stabilizing members is adapted to receive a fluid.

24. A method as recited in claim 20, further comprising at least one clamping mechanism that moves the at least one stabilizing element relative to a respective one of the at least one support members.

25. A method as recited in claim 20, wherein the at least one stabilizing member and the at least one support member are disposed in the container.

26. A method as recited in claim 20, wherein the container is adapted to collapse.

27. A method as recited in claim 21, wherein the fluid is as gas, and the at least one stabilizing element is inflated during the cooperative engaging of the article, and deflated during the disengaging of the article.

28. A method as recited in claim 22, wherein the container has an interior bottom surface that is substantially frictionless.

29. A method as recited in claim 22, wherein each of the at least one stabilizing elements has at least one cushioning surface that contact a portion a respective one of the articles.

30. A method as recited in claim 22, wherein each of the at least one clamping mechanisms are rack and pinion mechanisms.

31. A method as recited in claim 22, wherein each of the at least one clamping mechanisms is spring loaded.

32. A method as recited in claim 20, wherein at least one of the at least one support members is stationary relative to the container.

33. A method as recited in claim 20, wherein at least one of the at least one support embers is adapted to move relative to the container.

34. A method as recited in claim 20, wherein at least one of the at least one support members is adapted to be removed from the container.

35. A method as recited in claim 20, wherein at least one of the support members are integral with the container.

36. A method as recited in claim 20, wherein the container is a cassette that is loaded on a structure for transportation.

37. A method as recited in claim 20, wherein at least one of the articles is a glass substrate.

38. A method as recited in claim 20, wherein at least one of the stabilizing members is adapted to be removed.

39. A method as recited in claim 20, wherein one or more of the stabilizing members are adjustable.

FIG. 1

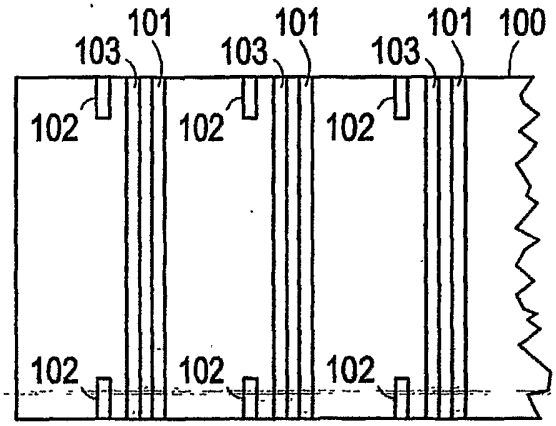

FIG. 2

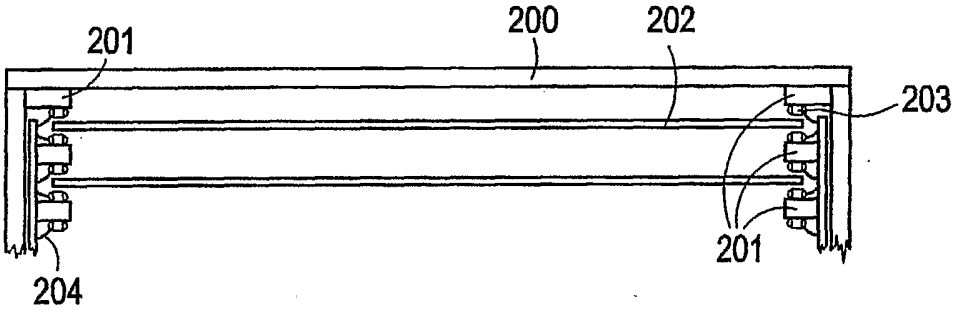

FIG. 3

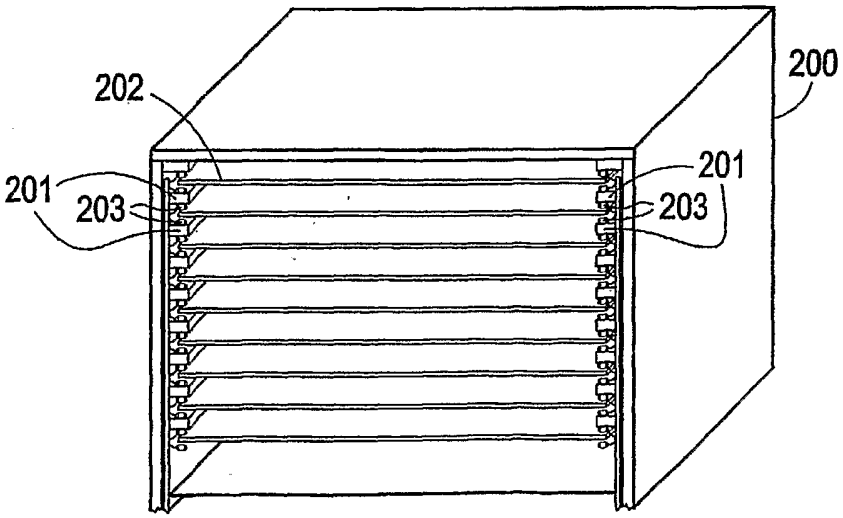

FIG. 4

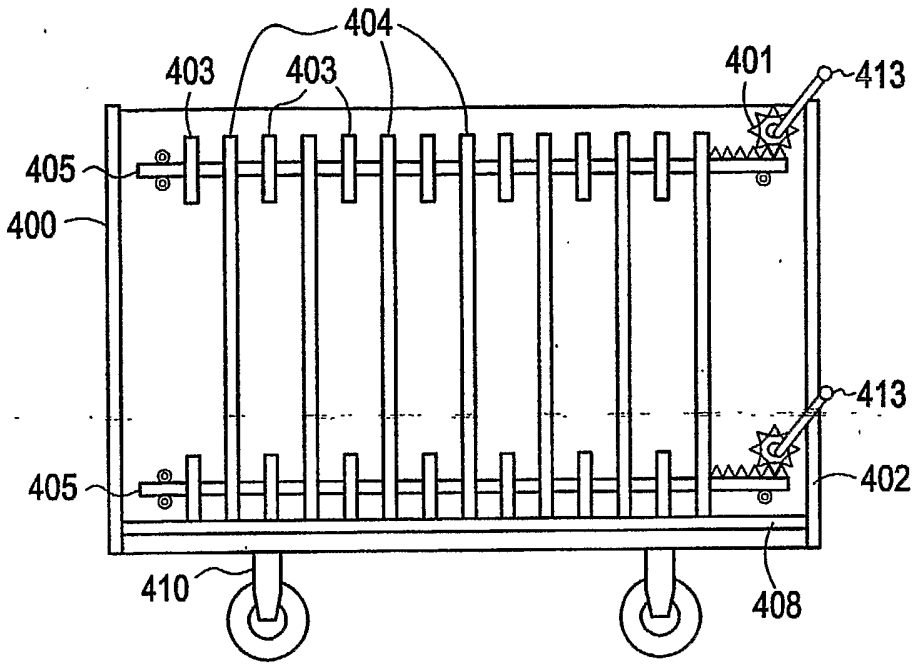
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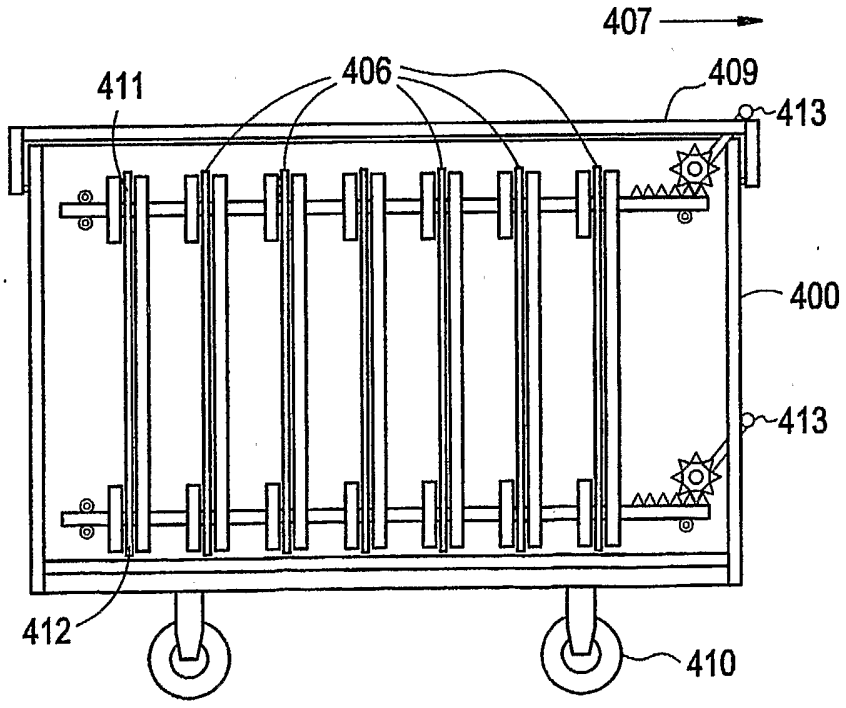
FIG. 5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