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(54) Title: ASSEMBLY AND APPARATUS FOR AGING RUBBING CLOTH

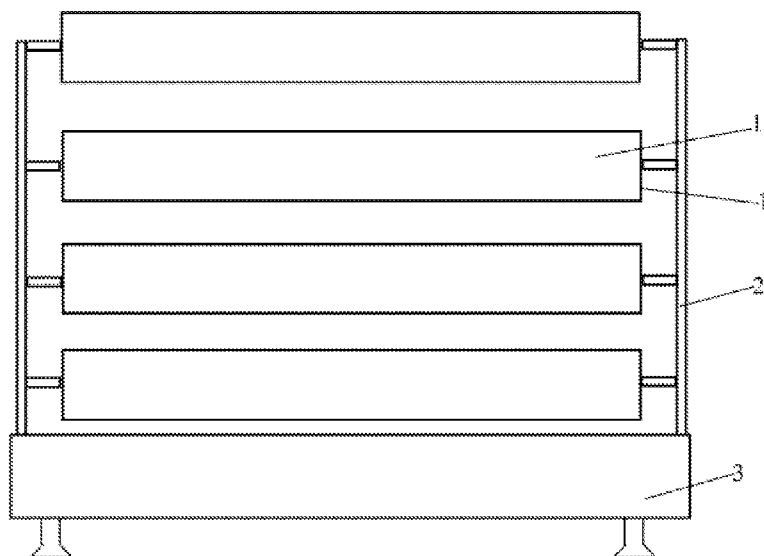


Figure 4

(57) Abstract: The present disclosure provides a system for aging rubbing cloth (4) used in the liquid crystal display (LCD) manufacturing process. The rubbing cloth (4) aging system includes a suction module configured to provide suction force to hold a piece of rubbing cloth (4) for aging and a supporting frame (2) configured to support the suction module. Further, the suction module holds the piece of rubbing cloth (4) on a pre-determined plane and flattens the piece of rubbing cloth (4).

ASSEMBLY AND APPARATUS FOR AGING RUBBING CLOTHCROSS-REFERENCES TO RELATED APPLICATIONS

[001] This PCT patent application claims priority of Chinese Patent Application No. 201410446249.5, filed on September 3, 2014, the entire content of which is incorporated by
5 reference herein.

FIELD OF THE INVENTION

[002] The present disclosure generally relates to the technologies used in the manufacturing process of liquid crystal display (LCD) devices and, more particularly, to a system and apparatus for aging rubbing cloth.

BACKGROUND

[003] The rubbing process in the LCD manufacturing process refers to using nylon, rayon, or cotton cloth to rub the alignment film on the array substrate and the color filter substrate to in certain directions. The rubbing process creates grooves with liquid crystals aligned according to pre-set inclinations. This process is known as the liquid crystal
15 molecular alignment process.

[004] In this rubbing process, the rubbing cloth may be pieces of cloth made of nylon, rayon, cotton, etc. The quality of the rubbing process is determined by the quality of the rubbing cloth as well as how well the rubbing cloth was aged before the rubbing process. Therefore, aging the rubbing cloth is an important and necessary step in the rubbing process.
20 Many conventional rubbing cloth aging systems may only flatten one piece of rubbing cloth on each platform. Further, there are often physical limitations as to the height of the machines so that the rubbing cloth can be laid out onto the platforms and picked up after the aging process. In one example, a rubbing cloth aging machine may only age a maximum of

15 pieces of rubbing cloth at the same time. To meet the demand for producing a large quantity of rubbing cloth, the manufacturer may need to acquire a large number of rubbing cloth aging machines. This increases the equipment cost for the manufacturer.

[005] The disclosed method and system are directed to solve one or more problems set forth above and other problems.

BRIEF SUMMARY OF THE DISCLOSURE

[006] The present invention addresses the above problems in the prior art and provides an apparatus for aging rubbing cloth. The rubbing cloth aging apparatus may achieve faster speed in flattening the rubbing cloth and improve the quality of the aged rubbing cloth.

[007] One aspect of the present disclosure provides a system for aging rubbing cloth used in an LCD manufacturing process. The system includes a suction module configured to provide suction force to hold a piece of rubbing cloth for aging and a supporting structure configured to support the suction module. Further, the suction module holds the piece of rubbing cloth on a pre-determined plane and ages the piece of rubbing cloth.

[008] Optionally, the suction module includes a suction wall, and the pre-determined plane and a horizontal plane form a pre-determined angle.

[009] Optionally, the suction module includes a main vacuum chamber and a suction tube connected to the main vacuum chamber. The suction tube may extract air from the main vacuum chamber.

[0010] Optionally, the main vacuum chamber includes one or more suction walls. Each suction wall has multiple suction holes. The suction holes hold the piece of rubbing cloth on the suction wall.

[0011] Optionally, the main vacuum chamber is a rectangular cuboid and includes two rectangular shaped side chambers that are perpendicular to the horizontal plane.

[0012] Optionally, two outside walls of the two rectangular shaped side chambers are suction walls.

5 [0013] Optionally, each rectangular shaped side chamber is divided into multiple sub-chambers, and each sub-chamber is connected to one or more suction tubes.

[0014] Optionally, the sub-chambers are of the same size and are connected to a same number of suction tubes.

10 [0015] Optionally, a suction switch is connected to a side chamber and the suction switch turns on or off air suction of the side chamber.

[0016] Optionally, the supporting structure includes a base and an outer frame. The base supports the weight of the suction module and the outer frame.

[0017] Optionally, the supporting structure supports multiple rows of the main vacuum chambers.

15 [0018] Optionally, a surface of the suction wall is larger than or equal to a surface of the piece of the rubbing cloth.

[0019] Another aspect of the present disclosure provides a method for aging rubbing cloth used in manufacturing LCD panels. The method includes switching on a suction module; providing suction force to hold a piece of rubbing cloth for aging; holding the piece
20 of rubbing cloth on a pre-determined plane; and flattening the piece of rubbing cloth.

[0020] Other aspects of the present disclosure can be understood by those skilled in the art in light of the description, the claims, and the drawings of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Figure 1 illustrates an exemplary structure of a piece of rubbing cloth;

[0022] Figure 2 illustrates a conventional rubbing cloth aging system;

[0023] Figure 3 illustrates another conventional rubbing cloth aging system;

[0024] Figure 4 illustrates an exemplary rubbing cloth aging apparatus according to the present disclosure as described in the first embodiment;

5 [0025] Figure 5 illustrates the sectional view of the internal structure of the main vacuum chamber as described in relation to Figure 4;

[0026] Figure 6 illustrates suction holes on the wall of the suction chamber as described in relation to Figure 5;

[0027] Figure 7 illustrates the sides view of the structure of the rubbing cloth aging
10 apparatus as described in relation to Figure 4; and

[0028] Figure 8 illustrates the sectional view of the internal structure of the main vacuum chamber as described in the second embodiment.

DETAILED DESCRIPTION

[0029] For those skilled in the art to better understand the technical solution of the
15 invention, reference will now be made in detail to exemplary embodiments of the invention, which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0030] In the illustrations of the present disclosure, numeral 1 refers to a main vacuum chamber; numeral 2 refers to a supporting frame; numeral 3 refers to a base; numeral
20 4 refers to a piece of rubbing cloth; numeral 41 refers to the backside of a piece of rubbing cloth; numeral 42 refers to the front or the pile of a piece of rubbing cloth; numeral 5 refers to a platform; numeral 6 refers to a handle; numeral 7 refers to an outer frame; numeral 8 refers to a roller stick; numeral 11 refers to a suction wall of a vacuum chamber; numeral 111 refers

to a suction hole; numeral 12 refers to a side chamber; and numeral 121 refers to a sub-chamber.

[0031] As shown in Figure 1, a piece of rubbing cloth 4 has a backside 41 and the front with pile 42. The backside 41 and the pile 42 may form an angle. In the rubbing process, to form a consistent groove, the pile 42 of rubbing cloth 4 must have good directivity. Because the rubbing cloth is usually transported in rolls before it is cut for the rubbing process, it is necessary to age the rubbing cloth (flattening the rubbing cloth so that the pile 42 has consistent directivity) before it can be used in the rubbing process.

[0032] Figure 2 shows a conventional rubbing cloth aging apparatus. The rubbing cloth aging apparatus includes a base 3, a plurality of platforms 5 for flattening rubbing cloth, a handle 6 that is used to move platforms 5, and an outer frame 7. The aging apparatus as shown in Figure 2 is often used to flatten rectangular or parallelogramatical shaped rubbing cloth, enabling the rubbing cloth aging process and preparing the rubbing cloth for the rubbing process.

[0033] There are a couple of ways to flatten rubbing cloth on platforms 5. First, the pile (front) of the rubbing cloth may face up, which may achieve better quality of the rubbing cloth aging results. However, this aging process may require more than 8 hours to complete. Sometimes, even after 8 hours of flattening, there may still be wrinkles in certain areas of a piece of rubbing cloth. The second way is to lay the pile (front) of the rubbing cloth face down. This aging process may be faster. However, the quality of the flattened rubbing cloth may be less desirable.

[0034] Figure 3 shows another example of the rubbing cloth aging process. As shown in Figure 3, the rubbing cloth 4 may be hung over the roller 8. This type of aging process may reduce the amount of time needed to flatten the rubbing cloth 4. However, the pile of the resulting rubbing cloth 4 may not have optimal directivity.

[0035] First Embodiment

[0036] Figures 4-7 describe various aspects of the first embodiment. In the first embodiment, the rubbing cloth aging apparatus may flatten the rubbing cloth and orient the direction of the pile on the front of the rubbing cloth. The rubbing cloth aging apparatus includes a suction module. The suction module may position the edges of the rubbing cloth on a pre-determined plane. The suction module may further hold and flatten the rubbing cloth, with the angle between the pre-determine plane and the horizontal level θ at $60^\circ \leq \theta \leq 90^\circ$. In the first embodiment and other embodiments, a control mechanism may be used to change the angle formed between the pre-determined plane and the horizontal plane, and hold the suction module at a set angle.

[0037] The suction module may flatten the rubbing cloth using the gravity together with the suction force produced by the suction module and reduce the time needed to flatten the rubbing cloth. Further, because the suction module may hold the rubbing cloth at any desired position on the pre-determined plane, it may therefore orient the direction of the pile on the aged rubbing cloth. This improves the quality of the aged rubbing cloth.

[0038] In the first embodiment, the pre-determined plane and the horizontal plane form an angle θ , which is 90° . As shown in Figure 4, the suction module may include a main vacuum chamber 1 and a suction tube connected to the main vacuum chamber 1 (not shown). The suction tube may extract air from the main vacuum chamber 1. The main vacuum chamber 1 may include one or more suction walls 11. As shown in Figure 6, each suction wall 11 may have one or more suction holes 111. The suction wall 11 sucks air through suction holes 111 and thus hold rubbing cloth 4 onto the outside wall of the main vacuum chamber 1. In this embodiment, the suction wall 11 may hold the rubbing cloth by the edges perpendicularly to the horizontal plane, and flatten the rubbing cloth. Combining the effect of gravity and the vacuum suction force, the rubbing cloth aging machine may

flatten the rubbing cloth faster. Further, the suction wall 11 would have the front of the rubbing cloth facing outwards (the backside of the rubbing cloth contacts the surface of the suction wall 11). This may orient the pile according to the pre-determined directions and improve the quality of the aged rubbing cloth.

5 [0039] As shown in Figure 5, in this embodiment, the main vacuum chamber 1 may be a rectangular cuboid. Further, the main vacuum chamber 1 may be divided into two rectangular cuboid side chambers 12 perpendicularly to the horizontal plane. The side chambers 12 form the outside walls of the main vacuum chamber 1. The outside walls of side chambers 12 are suction walls 11. Each suction wall 11 is larger than or equal to the
10 surface area of one piece or multiple pieces of rubbing cloth 4. As such, each main vacuum chamber may age more than 2 pieces of rubbing cloth. This improves the efficiency of the aging process and better meets the demand for a large quantity of aged rubbing cloth.

[0040] Further, in this embodiment, as shown in Figure 5, each side chamber 12 may be divided into sub-chambers 121. Each sub-chamber 121 may be connected to one or more
15 suction tubes. The distribution of the suction tubes may provide even suction across sub-chambers 121.

[0041] Moreover, a number of sub-chambers 121 may be of the same shape and size. The portion of suction wall 11 corresponding to each sub-chamber 121 may have an equal number of the suction holes 111. The suction holes 111 may be of the same size. As a result,
20 the suction wall 11 may have even suction force across the surface of multiple sub-chambers 121. The aging apparatus may therefore better flatten the rubbing cloth 4 because the suction force is evenly distributed across the suction wall 11.

[0042] The number of suction tubes distributed to each sub-chamber 121 and the size of the suction tubes may be adjusted to provide different suction power through the suction
25 wall 11 as needed.

[0043] In the first embodiment, the rubbing cloth aging apparatus further includes a switch for the suction system. A user may control the switch to turn on or turn off the suction tubes to produce stronger suction through suction wall 11 or stop providing suction force, respectively. Each of the rectangular cuboid side chambers 12 are connected to a group of suction tubes. Each rectangular cuboid side chamber 12 may have a switch that can be used to turn on or off the suction tubes associated to that rectangular cuboid chamber 12. Thus, a user may use the suction wall 11 associated with one or more of the cuboid side chambers 12 to age the rubbing cloth and produce fewer or more pieces of aged rubbing cloth as needed.

[0044] Further, as shown in Figure 7, the rubbing cloth aging apparatus may include a supporting frame 2. The supporting frame 2 is connected to the main vacuum chamber 1 and supports the main vacuum chamber 1. There may be a number of main vacuum chambers 1. The main vacuum chambers 1 may be evenly distributed perpendicularly to the horizontal plane (along the direct of gravity). There may be multiple rows of main vacuum chambers 1 in each rubbing cloth aging apparatus. The rubbing cloth aging apparatus may thus age a large quantity of rubbing cloth at the same time and meet the demand for producing more rubbing cloth.

[0045] The number of the main vacuum chambers 1 may be adjusted according to the need to lay the rubbing cloth and pick up the rubbing cloth. In one example, as shown in Figure 7, four rows of main vacuum chambers 1 may reach the maximum height that is convenient for workers to lay the rubbing cloth or pick up the rubbing cloth.

[0046] Also as shown in Figure 7, the rubbing cloth aging apparatus may include a base 3. The base 3 may connect to the supporting frame 2, which may bear the weight of the supporting frame 2 and the main vacuum chambers 1. The base 3 may also have wheels or other moving parts that make it easy to move the rubbing cloth aging apparatus to another location.

[0047] In one example, a user (e.g., a person or a machine) may lay a piece of rubbing cloth 4 onto the suction wall 11. The worker may lay the rubbing cloth 4 at a certain angle to properly orient the pile direction of the aged rubbing cloth. The worker may then turn on the suction switch for suction wall 11. The rubbing cloth aging apparatus may then hold the rubbing cloth 4 by the suction force. The rubbing cloth 4 starts the aging process. Once the aging process is complete, a worker may pick up the rubbing cloth 4 by its corner and turn off the suction switch. The worker may then remove the rubbing cloth 4 from the suction wall 11.

[0048] Second Embodiment

[0049] In the second embodiment of the rubbing cloth aging apparatus according to the present disclosure, as shown in Figure 8, the main vacuum chamber 1 may include two suction walls 11 aligned at a pre-determined angle θ in relation to the horizontal plane. For example, θ may be 60° . In the second embodiment, side chambers 12 may have a trapezoid cross section. The sub-chambers 121 may be of different sizes of trapezoids depending on their positions in side chambers 12. Other aspects of the second embodiment may be similar to the first embodiment, and will not be repeated here.

[0050] It should be understood that the above embodiments disclosed herein are exemplary only and not limiting the scope of this disclosure. Without departing from the spirit and scope of this invention, other modifications, equivalents, or improvements to the disclosed embodiments are obvious to those skilled in the art and are intended to be encompassed within the scope of the present disclosure.

INDUSTRIAL APPLICABILITY AND ADVANTAGEOUS EFFECTS

[0051] Without limiting the scope of any claim and/or the specification, examples of industrial applicability and certain advantageous effects of the disclosed embodiments are

listed for illustrative purposes. Various alternations, modifications, or equivalents to the technical solutions of the disclosed embodiments can be understandable to those skilled in the art and can be included in this disclosure.

[0052] Embodiments according to the present disclosure use suction modules that can
5 combine the effect of gravity and suction force to flatten rubbing cloth. Embodiments
according to the present disclosure may thus increase the speed of the rubbing cloth aging
process. Further, because the aging apparatus may hold the rubbing cloth at any pre-
determined angle during the aging process, the aging apparatus may better orient the pile of
the rubbing cloth. Embodiments according to the present disclosure thus improve the quality
10 of the aged rubbing cloth and the outcome of the rubbing process. Further, embodiments
according to the present disclosure may produce more than double the quantity of the
conventional aging systems. Embodiments according to the present disclosure thus meet the
demand for large quantity of aged rubbing cloth and decrease the cost of the rubbing cloth
aging process.

What is claimed is:

1. An assembly for aging rubbing cloth for use in a liquid crystal display (LCD) manufacturing process, comprising:

a suction module configured to provide suction force to hold a piece of rubbing cloth for aging, the suction module holding the piece of rubbing cloth on a first plane to flatten the rubbing cloth.
2. The assembly for aging rubbing cloth according to claim 1, wherein the suction module includes a suction wall for supporting the rubbing cloth on the first plane.
3. The assembly for aging rubbing cloth according to claim 1, wherein the first plane forms an angle of approximately 60 degree to 90 degree with respect to a horizontal plane.
4. The assembly for aging rubbing cloth according to any one of claims 1-3, wherein the suction module includes a main vacuum chamber and a suction tube connected to the main vacuum chamber.
5. The assembly for aging rubbing cloth according to claim 4, wherein the main vacuum chamber includes one or more suction walls, each suction wall having multiple suction holes, the suction holes holding the piece of rubbing cloth on the suction wall.
6. The assembly for aging rubbing cloth according to claim 5, wherein the main vacuum chamber includes two side chambers that are aligned perpendicularly to the horizontal plane.

7. The assembly for aging rubbing cloth according to claim 6, wherein two outside walls of the two side chambers are the suction walls.

8. The assembly for aging rubbing cloth according to claim 7, wherein each side chamber is divided into multiple sub-chambers, and each side chamber is connected to one or more suction tubes.

9. The assembly for aging rubbing cloth according to claim 8, wherein the sub-chambers are of the same size and are connected to a same number of suction tubes.

10. The assembly for aging rubbing cloth according to claim 6, wherein a suction switch is connected to a side chamber and the suction switch turns on or off air suction of the side chamber.

11. The assembly for aging rubbing cloth according to any of claims 2, 3, or 4, wherein the supporting structure includes a base and an outer frame, the base supporting weight of the suction module and the outer frame.

12. The assembly for aging rubbing cloth according to claim 4, wherein the supporting structure supports the suction module; the suction module includes one or more of the main vacuum chambers.

13. The assembly for aging rubbing cloth according to any of claims 2, 3, or 4, wherein a surface of the suction wall is larger than or equal to a surface of one or multiple pieces of the rubbing cloth.

14. A method for aging rubbing cloth used in manufacturing LCD panels, comprising:
providing suction force to hold a piece of rubbing cloth for aging;
holding the piece of rubbing cloth on a first plane by the suction force; and
flattening the piece of rubbing cloth.
15. The rubbing cloth aging method according to claim 14, wherein the first plane and a horizontal plane form a pre-determined angle.
16. The rubbing cloth aging method according to claim 15, further comprising:
extracting air from a main vacuum chamber of a suction module.
17. The rubbing cloth aging method according to claim 16, wherein the main vacuum chamber includes one or more suction walls, each suction wall having multiple suction holes, the suction holes holding the piece of rubbing cloth on the suction wall.
18. The rubbing cloth aging method according to claim 16, wherein the main vacuum chamber is a rectangular cuboid and includes two rectangular shaped side chambers that are perpendicular to the horizontal plane.

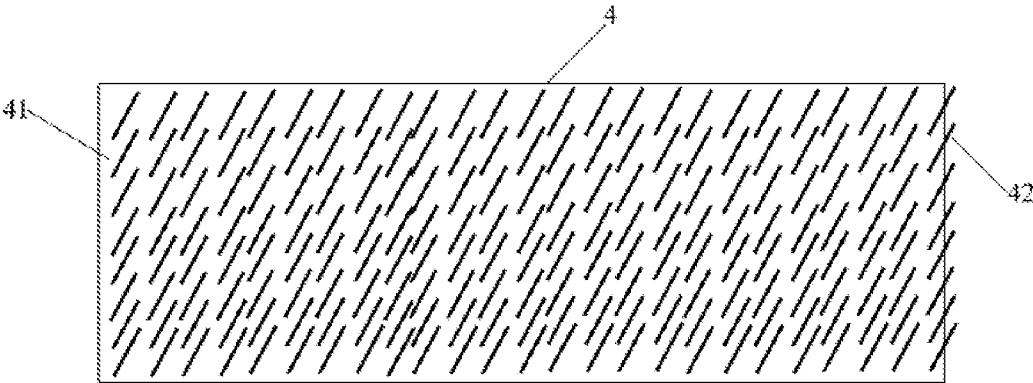


Figure 1

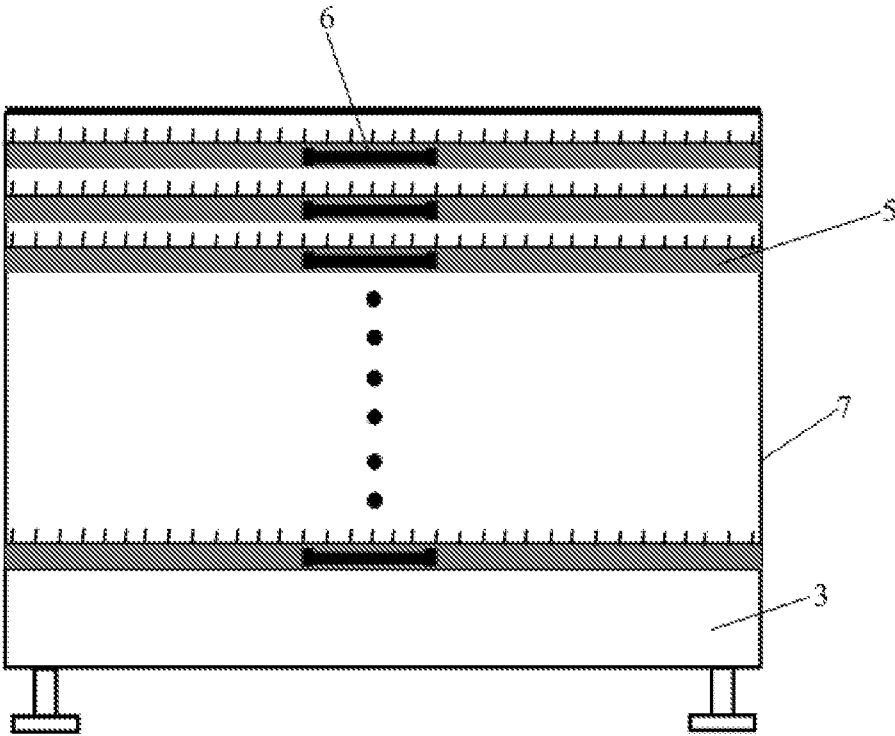


Figure 2

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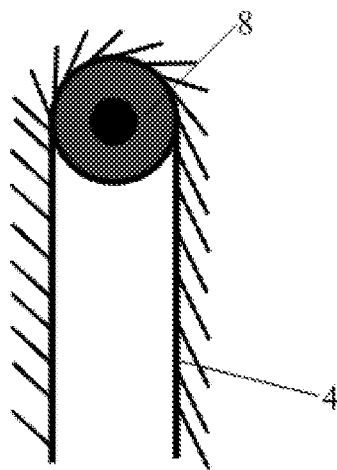


Figure 3

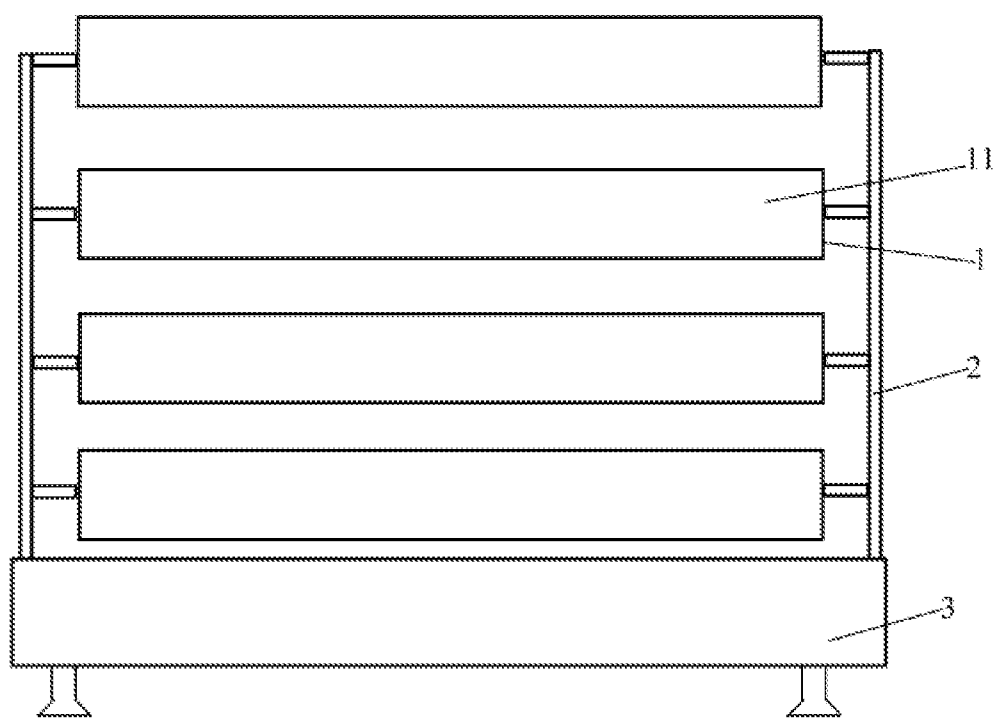


Figure 4

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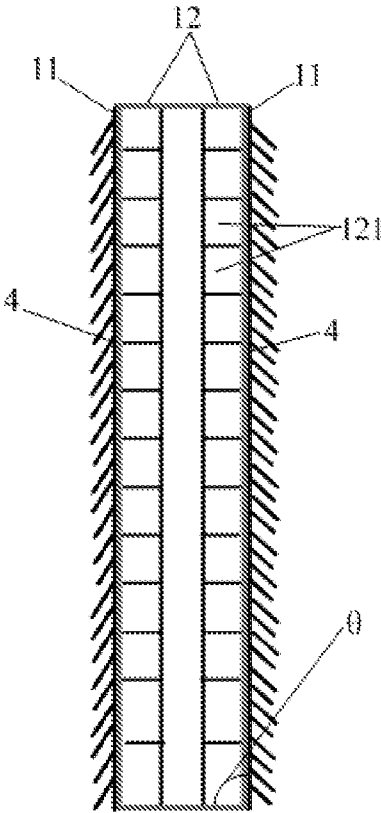


Figure 5

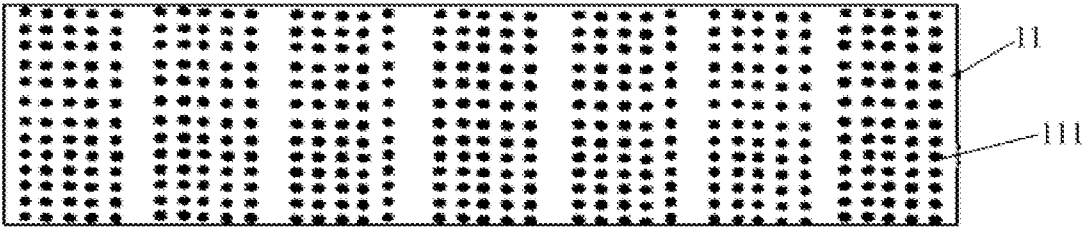


Figure 6

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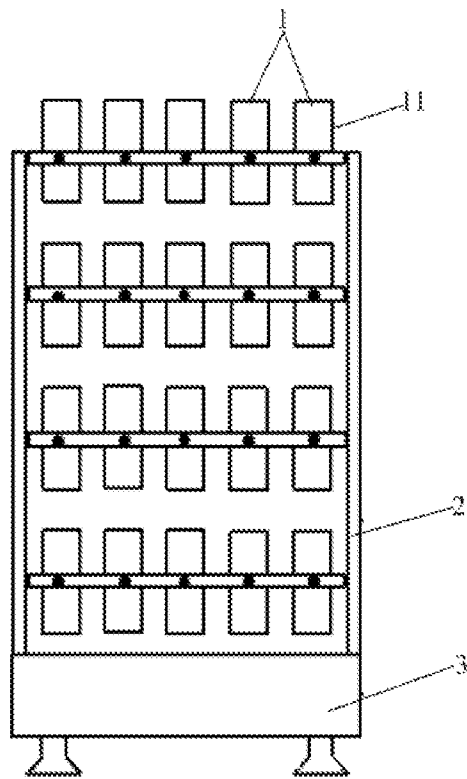


Figure 7

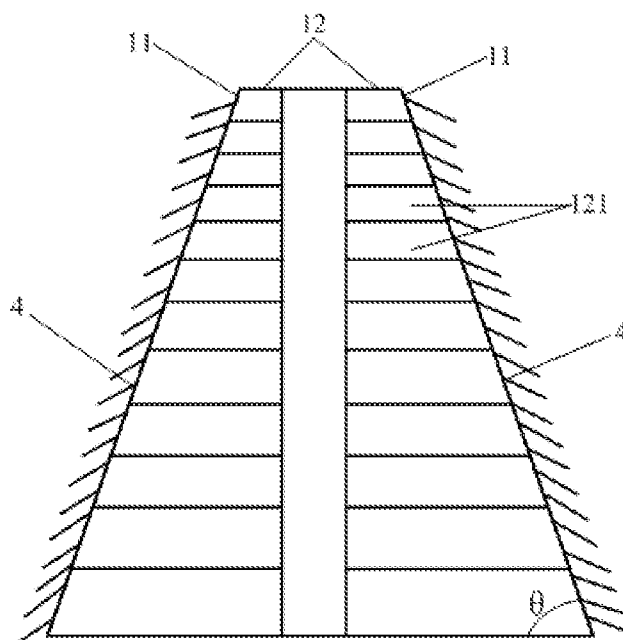


Figure 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/082465

A. CLASSIFICATION OF SUBJECT MATTER

G02F 1/1337(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS,CNTEXT, VEN:rubber, friction, orientation, cloth, fluff, pile,yarn,suction, absorb,vacuum

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP H086026 A (MITSUBISHI ELECTRIC CORP ET AL.) 12 January 1996 (1996-01-12) the whole document	1-18
A	JP 2004252341 A (ADVANCED DISPLAY KK) 09 September 2004 (2004-09-09) the whole document	1-18
A	CN 102929043 A (BOE TECHNOLOGY GROUP CO LTD ET AL.) 13 February 2013 (2013-02-13) the whole document	1-18
A	CN 101546068 A (FUJI FILM CO LTD) 30 September 2009 (2009-09-30) the whole document	1-18
A	JP 2007178553 A (NANOX CORP) 12 July 2007 (2007-07-12) the whole document	1-18
PX	CN 104238192 A (HEFEI XINSHENG OPTOELECTRONIC SCI & TECH ET AL.) 24 December 2014 (2014-12-24) description, paragraphs [0033]-[0049], figures 1-8	1-18



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

18 September 2015

Date of mailing of the international search report

29 September 2015

Name and mailing address of the ISA/CN

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2015/082465

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
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CN	102929043	A	13 February 2013	CN	102929043	B	18 February 2015
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				KR	20090103734	A	01 October 2009
JP	2007178553	A	12 July 2007	None			
CN	104238192	A	24 December 2014	None			