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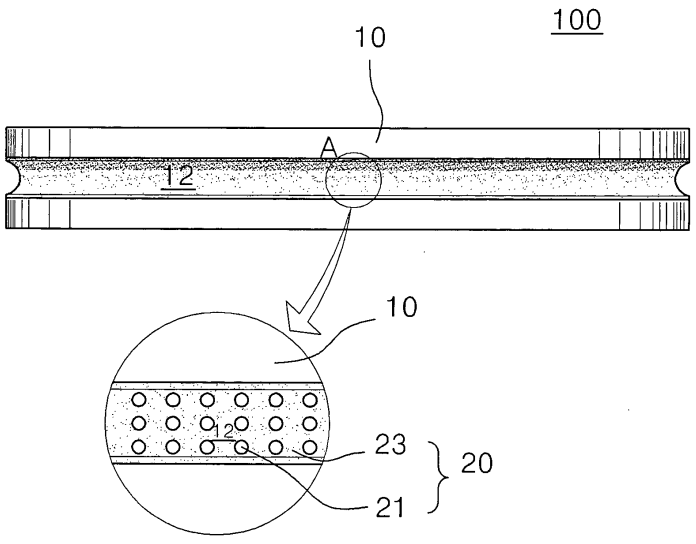
(54) Grinding wheel for grinding edges of glass substrates and method of manufacturing of the same

(57) The present invention discloses a wheel (100) for grinding edge of a glass substrate and method of manufacturing of the same that does not require profiling work and improves grinding speeds by stabilizing quality of processed edge with uniformly arranged abrasive particles (21) and adjusting exposure degree of abrasive particles (21). A metal binder (23) is applied to a groove (12) along the centre part of the grinding face forming the circumference of the disk and the abrasive particles are partially buried into the metal binder (23). The plurality of abrasive particles (21) are arranged at the crossing points of columns and rows with regular intervals. For this, a pattern plate (30) with holes (31) is used at the crossing points of columns and rows with regular intervals on the metal binder (23).

【Fig. 1】



EP 2 671 677 A2

Description

Technical Field

[0001] The present invention relates to a wheel for grinding edge of a glass substrate and method of manufacturing of the same, more specifically, a wheel for grinding edge to complete the outline of glass substrate by grinding or cutting the edge of a flat or curved glass substrate with abrasive particles and method of manufacturing of the same.

Background Art

[0002] Glass substrates are widely used to protect automobiles, buildings, furniture, home appliances, etc. from the outside or to design their exteriors. These glass substrates are formed by grinding or cutting edge with an edge grinding wheel containing abrasive particles. On a disk-shaped edge grinding wheel (hereinafter, referred to as 'edge wheel'), grinding layers containing abrasive particles are formed in the groove along the center part of the circumference (hereinafter, referred to as 'grinding face'). The outline of a glass substrate is formed by inserting the edge of a glass substrate into the above groove and grinding or cutting the edge by spinning of the edge wheel.

[0003] In case of the conventional edge wheels, when the grinding layer mixed with metal binder and abrasive particles is damaged, profiling process of exposing a new grinding layer by removing the damaged grinding is required. Generally, a maximum of 6 to 12 times of profiling processes may be performed for one edge wheel depending on the situation. However, the profiling processes should be precise and quality deviation may occur from consecutive profiling processes, requiring great amount of additional expense to correct the quality deviation.

[0004] In addition, abrasive particles are non-uniformly placed on the grinding layer mixed with metal binder and abrasive particles in the conventional edge wheels. That is, excessive or insufficient numbers of abrasive particles are placed on some parts because abrasive particles are non-uniformly exposed outside of the metal binder or abrasive particles are partially concentrated. The non-uniform arrangement of abrasive particles causes edges with shell-shaped or chipped surface. Further, in the conventional edge wheels, approximately 1/5 of the size of abrasive particles is exposed to the outside in order to stably process the edge of a glass substrate. However, the above exposure degree of abrasive particles is not enough to get sufficient grinding speeds for substrates with higher strength and higher density.

Disclosure of Invention

Technical Problem

[0005] The technical objectives of this invention is to provide an edge wheel for a glass substrate that stabilizes quality of edge of a processed glass substrate by uniformly arranging abrasive particles and improves grinding speeds by adjusting exposure degree of abrasive particles, and to provide method of manufacturing of the same.

Technical Solution

[0006] The edge wheel for glass substrates in the present invention is disk-shaped, and a grinding layer is formed in the groove along the center part of the grinding face, that is, the circumference of the disk. At this time, the grinding layer is a single layer. Also said single-layered grinding layer is partially buried into metal binder coated on the groove and the metal binder, and contains a plural number of abrasive particles that are arranged at the crossing points of columns and rows with regular intervals.

[0007] For a wheel in the present invention, the metal binder may be at least one of bronze, cobalt(Co), iron (Fe), nickel(Ni), chrome(Cr), tungsten(W) and alloy thereof, or their mixture. It is preferable that exposure degree of the abrasive particles from the metal binder is bigger than 1/4 and smaller than 1/2 of the whole abrasive particles by volume. Also it is preferable that sizes of the abrasive particles of parts of the substrate with high hardness are 5~20% smaller than other parts by volume.

[0008] For a preferable wheel in the present invention, bigger abrasive particles and smaller abrasive particles may be arranged repeatedly by turns. In some cases, a plural number of bigger abrasive particles and smaller abrasive particles may be grouped and the groups may be arranged with a certain pattern, or densities of the groups may be differentiated according to the location of the edge wheel. At this time, it is preferable that diameter difference between the bigger abrasive particles and smaller abrasive particles is 10~50%, and it is characterized that the grinding layer is consumed without profiling.

[0009] In order to produce an edge wheel for grinding glass substrates in the present invention, metal binder is applied in grinding groove along the center part of the grinding face consisting of the circumference of the disk. Then, a pattern plate with holes is located at the crossing points of columns and rows with regular intervals. Abrasive particles are attached on the metal binder by sprinkling the abrasive particles on the pattern plate through the holes. A grinding layer is formed by sintering the metal binder with the abrasive particles attached.

[0010] In a method of the present invention, it is preferable that exposure degree of the abrasive particles from the metal binder is bigger than 1/4 and smaller than 1/2 of the whole abrasive particles by volume. Also, big-

ger abrasive particles and smaller abrasive particles may be arranged forming repeated rows by turns, and a plural number of bigger abrasive particles and smaller abrasive particles may be grouped and the groups may be arranged with a certain pattern.

[0011] In addition, densities of the groups may be differentiated depending on the location of the edge wheel, and the pattern plate may have holes through which the bigger abrasive particles and smaller abrasive particles pass.

Advantageous Effects

[0012] According to a wheel for grinding edge of a glass substrate and method of manufacturing of the same in the present invention, single-layered abrasive particles are arranged regularly on grinding groove that process edge of a substrate. Therefore, profiling work is not required, and grinding speeds may be improved by stabilizing quality of processed edge of with uniformly arranged abrasive particles and relatively enlarging exposure degree of abrasive particles compared to the conventional methods.

Brief Description of Drawings

[0013]

Fig. 1 is a front view that shows the first edge wheel of a substrate by an embodiment in the present invention.

Fig. 2 is a cross-sectional drawing to explain a grinding layer by the embodiment in the present invention.

Fig. 3 is a flow chart that shows how to produce the first edge wheel by the embodiment in the present invention.

Fig. 4 shows a pattern plate that is used to produce the first edge wheel by the embodiment in the present invention.

Fig. 5 is a front view that shows the second edge wheel of a substrate by another embodiment in the present invention.

Fig. 6 is a flow chart that shows how to produce the second edge wheel by another embodiment in the present invention.

Best Mode for Carrying Out the Invention

[0014] Desirable embodiments of the present invention are described below in detail in reference to the figures attached. As the present invention may evolve into various forms without departing from the main characteristics thereof, the scope of this invention is not limited to the below-described embodiments. Therefore, the embodiments of the present invention are provided to explain more explicitly this invention to a person or persons with appropriate knowledge.

[0015] The embodiments of this invention describe a wheel for grinding edge of a glass substrate (hereinafter, referred to as 'edge wheel') and method of manufacturing of the same that doesn't require profiling work and improves grinding speeds by stabilizing quality of processed edge with uniformly arranged abrasive particles and relatively enlarging exposure degree of abrasive particles compared with the (conventional) methods, through arranging single-layered abrasive particles regularly on grinding groove that process edge of a substrate. A structure in which the single-layered abrasive particles are regularly arranged on the grinding groove that processes the edge of glass substrate will be described. Also how to embody the structure and the edge of a substrate that is produced accordingly will be explained in more details.

[0016] This invention is limited to glass substrates that widely used to protect automobiles, buildings, furniture, home appliances, etc. from the outside or to design their exteriors because the embodiments of the present invention disclosed regular arrangement of single-layered abrasive particles with no profiling, differently from the conventional methods, and accordingly stabilized quality of processed edges. In addition, the present invention improved grinding speeds by enlarging exposure degree of abrasive particles compared to the existing methods. Therefore, it is preferable that the diameter of an edge wheel in the present invention is between 30mm and 200mm.

[0017] Fig. 1 is a front view that shows the first edge wheel of a substrate by an embodiment in the present invention. A is an extended picture of a part of the wheel to offer a better view of the grinding layer of the first edge wheel.

[0018] According to Fig. 1, the first edge wheel **100** of the present invention is preferably disk-shaped and its main component is stainless or iron. Also its thickness may be vary according to conditions under which the first edge wheel **100** of the present invention is used. The first edge wheel **100** includes abrasive particles **21.** The abrasive particles **21** form a grinding layer **20** by being partially buried into metal binder **23** which is applied in the groove **12** along the center part of the grinding face **10** forming the circumference of the disk. Artificial diamond particles, CBN(cubic boron nitride) and super-abrasive particles are known as abrasive particles **21,** and among them, artificial diamond particles are mostly widely used.

[0019] The present invention uses metal binder **23** because other kinds of binders such as electro-deposition and polymer resin has insufficient binding force to process edge of glass substrate in the present invention. The metal binder **23** may contain bronze, copper(Cu), zinc (Zn), cobalt(Co), iron(Fe), nickel(Ni), silver(Ag), tim(Sn), aluminum(Al), indium(In), phosphorus(P), antimon(Sb), titanum(Ti), tungsten(W), zirconum (Zr), chrome(Cr) and hafnium (Hf), and alloy thereof, or their mixture. In this case, the metal binder **23** may be at least one of bronze, cobalt(Co), iron(Fe), tungsten(W) and alloy thereof, or their mixture. Other forms of metal binder **23** contain nick-

el(Ni)-chrome(Cr) alloy. In this case, the metal binder **23** may be at least one of nickel(Ni)-chrome(Cr) alloy, cobalt (Co), iron(Fe), tungsten(W) and alloy thereof, or their mixture.

[0020] The grinding layer **20** of the first edge wheel **100** in the present invention is used only one time without profiling because abrasive particles have single-layered arrangement differently from the existing methods. Therefore, expense for precise profiling may be reduced. On the other hand, if the edge wheel **100** spins while maintaining the contact between the edge and the groove **12,** the outline of the substrate is formed by grinding or cutting the edge with the grinding layer **20.**

[0021] The groove **12** may have various shapes according to usages of the first edge wheel **100,** that is, the shape of grooved section may be circular, rectangular or wedged. In addition, depth and width of the groove **12** may be set differently according to usages of the first edge wheel **100.** The abrasive particles in the grinding layer **20** that is formed in the groove **12** of the first edge wheel **100** of the present invention are uniformly arranged at the crossing points of columns and rows with regular intervals.

[0022] Some parts of the abrasive particles **21** are buried into metal binder **23** while the other parts are exposed outside of the metal binder **23.** That is, the abrasive particles **21** of the grinding layer **20** are partially buried in the metal binder **23.** Fig. 2 is a cross-sectional drawing to explain a grinding layer by the embodiment in the present invention. As shown in the figure, it is preferable that exposure degree of the abrasive particles **21** from the metal binder **23** is bigger than 1/4 and smaller than 1/2 of the whole abrasive particles by volume. Exposure degree less than 1/4 causes low economic feasibility because grinding speeds of the edge are slow, while exposure degree more than 1/2 may cause drop-out of the abrasive particles **21** from the metal binder **23.** That is, grinding speeds may be improved by increasing exposure degree of the abrasive particles **21.** At this time, exposure degree of the abrasive particles **21** is adjusted by controlling the thickness of the metal binder **23,** more specifically, exposure degree of the abrasive particles may be gained by grinding the abrasive particles after the metal binder is hardened.

[0023] In case of glass substrate, high cooling speed during manufacturing process causes high surface hardness, which produces shell-shaped or chipped surface. In order to avoid this, abrasive particles **21** 5~20% smaller than other parts by volume may be arranged on the surface. Here, the surface may be defined differently according to manufacturing conditions of glass.

[0024] The first edge wheel **100** in the present invention may stabilize quality of processed edge by arranging abrasive particles **21** that are contained on the grinding layer formed in the groove **12** at the crossing points of columns and rows with regular intervals. In other words, uniformed arrangement of abrasive particles assure uniformed chipping of the entire edge at a time of grinding. Further, grinding speeds may be improved by relatively increasing exposure degree of the abrasive particles compared to the existing methods.

[0025] Fig. 3 is a flow chart that shows how to produce the first edge wheel by the embodiment in the present invention. Fig. 4 shows a pattern plate that is used to produce the first edge wheel 1 by the embodiment in the present invention. Here, Fig. 1 explains the first edge wheel.

[0026] According to Figs. 3 and 4, metal binder **23** is applied in the groove **12** along the center part of the grinding face **10** forming the circumference of the disk(S10). At this time, one of well-known pre-sintering methods may be used in order to stabilize the metal binder layer **23.** Then, a pattern plate **30** with holes **31** is placed at the crossing points of columns and rows with regular intervals on the metal binder **23**(S20). The holes **31** formed on the pattern plate **30** adjust size of abrasive particles **21** that are attached on the metal binder **23.** At this time, the pattern plate **30** may be apart from the metal binder **23** at regular intervals or may be contacted with the metal binder **23.**

[0027] On the other hand, intervals between rows **d** and columns **w** of the holes **31** may set differently according to conditions used. In addition, the pattern plate **30** may be flat or the same as shape of the groove **12.** Further, in case of the pattern plate **30,** any kinds of pattern plates are possible if they provide abrasive particles at regular intervals, therefore, other pattern plates that are different from the mesh-type plate disclosed in the present invention may be also used. For example, abrasive particles may be attached on the metal binder **23** through holes at regular intervals.

[0028] Abrasive particles **21** are attached on the metal binder **23** on locations corresponding to holes **31** of the pattern plate **30** by sprinkling the abrasive particles **21** on the pattern plate **30**(S30). At this time, the height of the abrasive particles **21** may be adjusted in order to make exposure degree of the abrasive particles **21** from the metal binder **23** bigger than 1/4 and smaller than 1/2 of the whole abrasive particles by volume. The grinding layer **20** is produced by removing the pattern plate **30** and sintering the combined abrasive particles **21** and metal binder **23** using hot press sintering, vacuum sintering, etc.(S40).

[0029] Fig. 5 is a front view that shows the second edge wheel of a substrate by another embodiment in the present invention. Fig. 6 is a flow chart that shows how to produce the second edge wheel by another embodiment in the present invention. At this time, B is an extended picture of a part of the wheel to offer a better view of the grinding layer of the second edge wheel. Here, the second edge wheel is identical to the first edge wheel except for the grinding layer in which abrasive particles with different diameters are arranged in turns repeatedly. Detailed explanation will be omitted because structure of the edge wheel and the manufacturing method were already explained in detail.

[0030] According to Figs. 5 and 6, disk-shaped the second edge wheel **200** of the present invention has a grinding layer **60** containing abrasive particles in a groove **52** along the center part of a grinding face **50** forming the circumference of the disk. The grinding layer **60** of the second edge wheel **200** in the present invention is used only one time without profiling because abrasive particles have single-layered arrangement differently from the existing methods. The groove **52** may have various shapes according to usages of the second edge wheel **200,** that is, the shape of grooved section may be circular, rectangular or wedged. In addition, depth and width of the groove **52** may be set differently according to usages of the second edge wheel **200.**

[0031] The abrasive particles **61, 62** in the grinding layer that is formed in the groove **52** of the second edge wheel **200** of the present invention are uniformly arranged at the crossing points of columns and rows with regular intervals. The grinding layer **60** is partially combined with the metal binder **63** in which abrasive particles with relatively bigger diameter **61** and abrasive particles **62** with smaller diameter form repeated rows in turns. By doing so, the bigger abrasive particles **61** grind the edge of substrate directly while the smaller abrasive particles **62** make discharge of grinding waste easy. The above process not only prevents the groove **52** from being blocked with the grinding waste but also prevents the metal binder **63** from being damaged.

[0032] It is preferable that diameter disparity between the bigger abrasive particles **61** and smaller abrasive particles **62** is 10~50%. This diameter disparity makes the bigger abrasive particles **61** and smaller abrasive particles **62** function appropriately. A pattern plate **70** that is used to make this grinding layer **60** may have holes **72** through which the bigger abrasive particles **61** and smaller abrasive particles **62** pass. At this time, intervals between rows **d** and columns **w** of the holes **71, 72** may set differently according to conditions in which the second edge wheel **200** is used.

[0033] Some parts of the abrasive particles **61, 62** are buried into metal binder **63** while the other parts are exposed outside of the metal binder **63.** That is, as set in forth in the first edge wheel **100,** it is preferable that exposure degree of the big abrasive particles **61** from the metal binder **63** is bigger than 1/4 and smaller than 1/2 of the whole abrasive particles by volume. Exposure degree less than 1/4 causes low economic feasibility because grinding speeds of the edge are slow, while exposure degree more than 1/2 may cause drop-out of the big abrasive particles **61** from the metal binder **63.** That is, grinding speeds may be improved by increasing exposure degree of the bigger abrasive particles **61.**

[0034] The second edge wheel **200** of the present invention has following advantages by arranging the single-layered abrasive particles uniformly at the crossing points of columns and rows with regular intervals. First of all, expense for precise profiling may be reduced because the edge wheel of the present invention does not require profiling. Secondly, quality of processed edge may be stabilized because abrasive particles are uniformly arranged. Thirdly, grinding speeds may be improved by enlarging exposure degree of abrasive particles compared to the existing methods. Fourthly, various combinations of abrasive particles allow active reaction according to conditions under which the edge wheel is used.

[0035] In some cases, a plural number of bigger abrasive particles **61** and smaller abrasive particles **62** may be grouped, and the groups may be arranged with a certain pattern on the pattern plate **70.** At this time, the certain pattern means that the bigger abrasive particles **61** and smaller abrasive particles **62** are uniformly arranged at the crossing points of columns and rows with regular intervals.

[0036] Further, densities of the groups may be differentiated according to the location of the edge wheel in the present invention. More groups of bigger abrasive particles **61** may be arranged in parts with relatively severe abrasion of abrasive particles, while fewer groups of bigger abrasive particles **61** may be arranged in parts with low abrasion of abrasive particles. On the other hand, when differentiating densities of the groups, intervals between high density parts and low density parts may be different, however, each group may have regular intervals in high density parts and low density parts, respectively. The regular intervals may be set considering the number of groups of the bigger particles **61,** etc.

[0037] As mentioned above, even though this invention is explained in detail through embodiments, this invention is not limited to the embodiments and therefore it is possible to create different variations that are within the technical realms of this invention by a person or persons with adequate knowledge in the pertinent field.

[Explanation of referring numbers]

[0038]

100; first edge wheel
10, 50; grinding face
12, 52; groove
20, 60; grinding layer
21, 61, 62; abrasive particles
23, 63; metal binder
30, 70; pattern plate
31, 71, 72; holes on the pattern plate
200; second edge wheel

Claims

1. Edge wheel for grinding glass substrates, comprising:

   a disk-shaped grinding layer on the groove along the center part of the grinding face forming the

circumference of the disk;
a metal binder that is applied in the groove; and
a plural number of abrasive particles that are partially buried into the metal binder and arranged at the crossing points of columns and rows with regular intervals.

2. The edge wheel for grinding edge of a glass substrate according to Claim 1, wherein the metal binder is at least one of bronze, cobalt(Co), iron(Fe), nickel (Ni), chrome(Cr), tungsten(W) and alloy thereof, or their mixture.

3. The edge wheel for grinding edge of a glass substrate according to Claim 1, wherein exposure degree of the abrasive particles from the metal binder is bigger than 1/4 and smaller than 1/2 of the whole abrasive particles by volume.

4. The edge wheel for grinding edge of a glass substrate according to Claim 1, wherein sizes of the abrasive particles of parts of the substrate with high hardness are 5~20% smaller than other parts by volume.

5. The edge wheel for grinding edge of a glass substrate according to Claim 1, wherein bigger abrasive particles and smaller abrasive particles are arranged repeatedly by turns.

6. The edge wheel for grinding edge of a glass substrate according to Claim 1, wherein a plural number of bigger abrasive particles and smaller abrasive particles are grouped and the groups are arranged with a certain pattern.

7. The edge wheel for grinding edge of a glass substrate according to Claim 6, wherein densities of the groups are differentiated according to the location of the edge wheel.

8. The edge wheel for grinding edge of a glass substrate according to one of Claims 5-7, wherein diameter difference between the bigger abrasive particles and smaller abrasive particles is 10~50%.

9. The edge wheel for grinding edge of a glass substrate according to Claim 1, wherein the grinding layer is consumed without profiling.

10. A method of manufacturing edge wheel for grinding edge of a glass substrate comprising the operations of:

applying the metal binder in the groove along the center part of the grinding face forming the circumference of the disk;
locating a pattern plate with holes at the crossing points of columns and rows with regular intervals on the metal binder;
attaching abrasive particles on the metal binder by sprinkling the abrasive particles on the pattern plate through the holes; and
forming a grinding layer by sintering the metal binder with the abrasive particles attached.

11. The edge wheel for grinding edge of a glass substrate according to Claim 10, wherein exposure degree of the abrasive particles from the metal binder is bigger than 1/4 and smaller than 1/2 of the whole abrasive particles by volume.

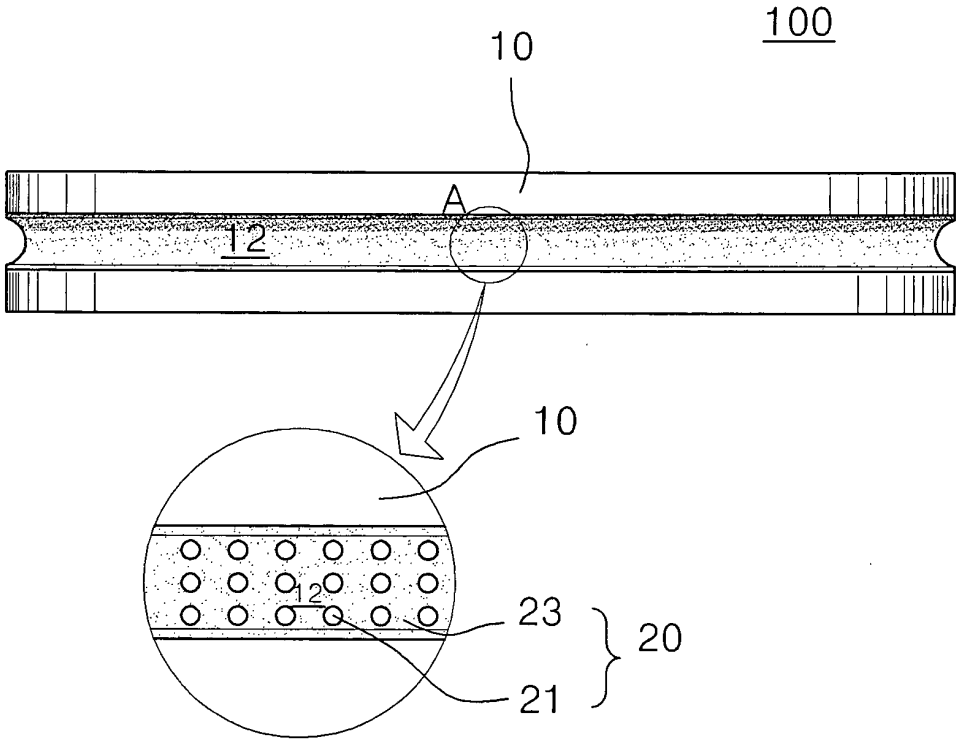
12. The edge wheel for grinding edge of a glass substrate according to Claim 10, wherein bigger abrasive particles and smaller abrasive particles are arranged forming repeated rows by turns..

13. The edge wheel for grinding edge of a glass substrate according to Claim 10, wherein a plural number of the bigger abrasive particles and the smaller abrasive particles are grouped and the groups are arranged with a certain pattern.

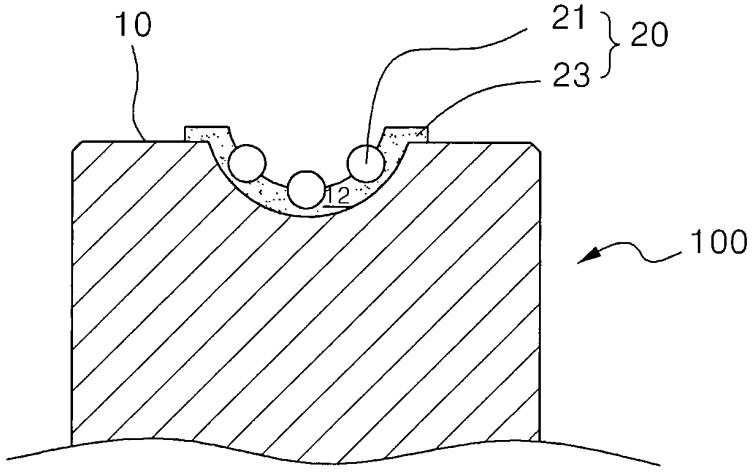
14. The edge wheel for grinding edge of a glass substrate according to Claim 13, wherein densities of the groups are differentiated according to the location of the edge wheel.

15. The edge wheel for grinding edge of a glass substrate according to one of Claims 12-14, wherein the pattern plate has holes through which the bigger abrasive particles and smaller abrasive particles pass.

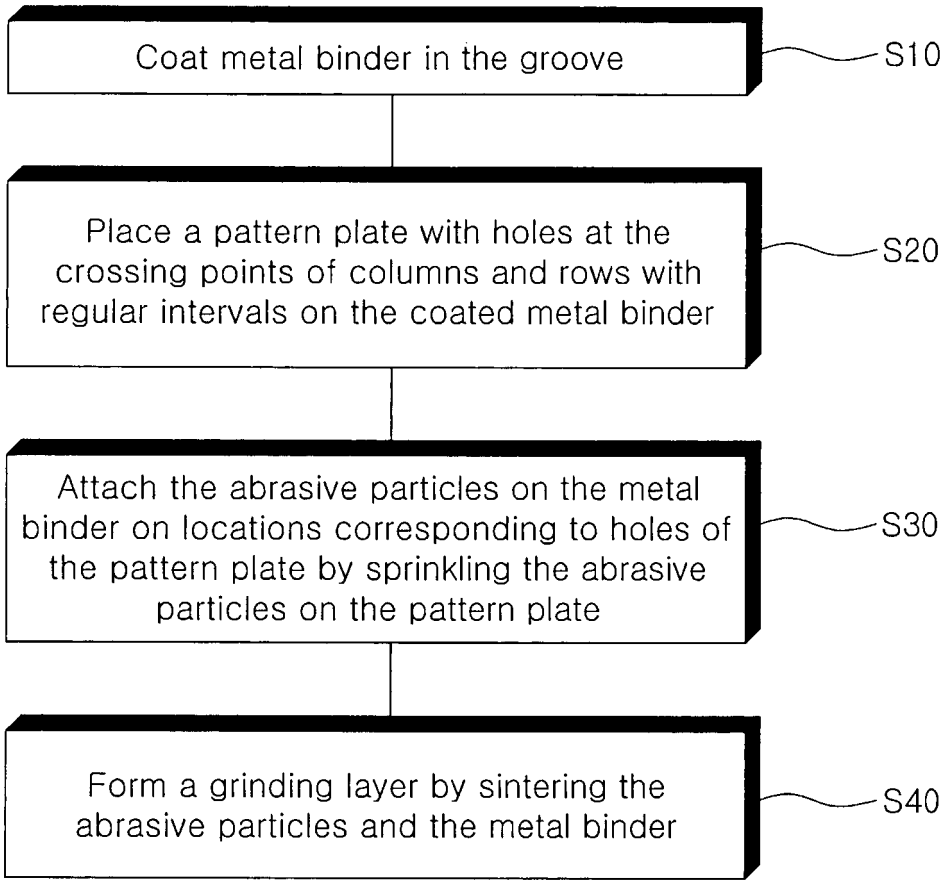
【Fig. 1】



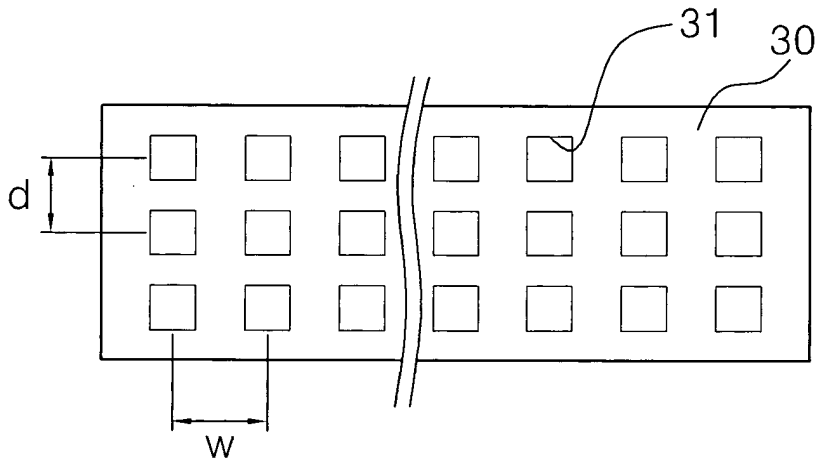
【Fig. 2】



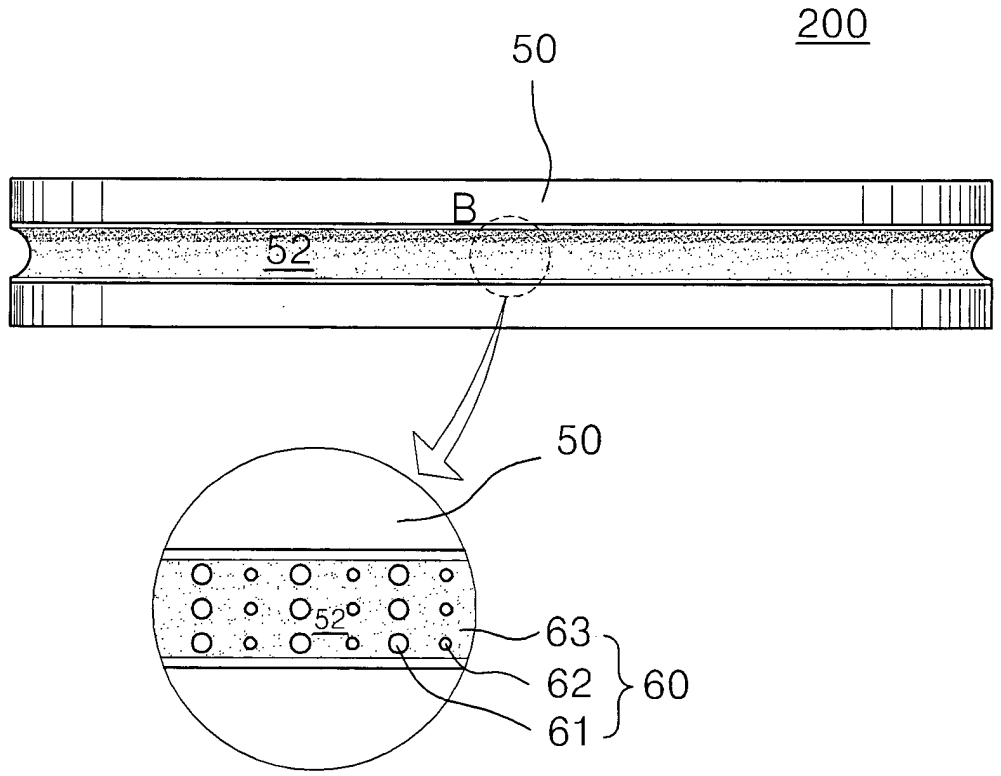
【Fig. 3】


Coat metal binder in the groove
S10
Place a pattern plate with holes at the crossing points of columns and rows with regular intervals on the coated metal binder
S20
Attach the abrasive particles on the metal binder on locations corresponding to holes of the pattern plate by sprinkling the abrasive particles on the pattern plate
S30
Form a grinding layer by sintering the abrasive particles and the metal binder
S40

【Fig. 4】



【Fig. 5】



【Fig. 6】