GLASS PLATE PACKING PALLET

The present invention relates to a glass plate packing pallet.

For glass substrates for flat panel displays (hereinafter referred to as "FPD"), such as liquid crystal displays and plasma displays, a glass plate having a small thickness, for example, of 0.5 to 0.7 mm is used. There has been an increase in size of such glass plates for FPD glass substrates in recent years. For example, glass plates of the seventh generation have a size of 1870 mm × 2200 mm.

Dedicated glass plate packing pallets, which enable the delivery or storage of the glass plates in the state where the glass plates are stacked in an upright posture, are used for packing these glass plates for FPD glass substrates. For example, JP 2008-143540 A discloses a glass plate packing pallet indicated in Fig. 8.

The glass plate packing pallet indicated in Fig. 8 has a mounting portion 12 onto which glass plates 100 are mounted while being stacked, and a back plate 11 supporting the stacked glass plates 100 from the back side. Further, the glass plate packing pallet disclosed in JP 2008-143540 A has a cushioning material 13 made of a rubber sheet or a foamed resin sheet, a metal plate 14, and a protective sheet 15 stacked on the mounting portion 12 in this order, as a receiving member for receiving the lower edge surfaces of the glass plates 100.

Glass plates are loaded onto a glass plate packing pallet, for example, by a robot while a slip sheet is interposed between the glass plates. If the glass plates are merely mounted on a receiving member by the robot, gaps are possibly formed between the glass plates. Therefore, the loading of the glass plates is performed while the lower part of the glass plates mounted on the receiving member is being pushed by a pusher toward the back plate side. Thus, the formation of the gaps between the glass plates is reduced. Then, after the completion of the loading, packing is performed, so that the glass plates are fixed to the back plate. Thereafter, the glass plates are delivered together with the glass plate packing pallet.

During the delivery of the glass plates, there is a case where the glass plates move due to vibration, causing the cracking of the glass plates. In order to prevent this, the coefficient of static friction of the surface of the receiving member in contact with the lower edge surfaces of the glass plates preferably is set as high as possible. However, in the case of mounting glass plates onto the surface with such a high coefficient of static friction, the force required for pushing the glass plates (the above-mentioned operation for reducing the formation of gaps between the

glass plates) increases. Particularly, in the case of the glass plates of the seventh generation or later, the self weight of the glass plates also increases, and therefore the pushing force increases too much, which may cause the cracking of the glass plates.

JP 2008-143540 A describes a heavy paper, a rubber sheet, and a foamed resin sheet as an example of the protective sheet 15, but all of these are intended to prevent the glass plates 100 from being damaged by being in contact directly with the metal plate 14, and they are not intended to achieve the ease or difficulty of sliding of the glass plates.

In view of the circumstances, it is an object of the present invention to provide a glass plate packing pallet to be used for packing large glass plates, in which the prevention of cracking of the glass plates during the delivery and the prevention of cracking of the glass plates when pushed are compatible.

That is, the present invention provides a glass plate packing pallet to be used for packing large glass plates, in which the glass plate packing pallet includes: a body having a mounting portion onto which the glass plates are mounted while being stacked in an upright posture and a back plate that supports the stacked glass plates from the back side; and a receiving member that is provided on the mounting portion, that receives the lower edge surfaces of the glass plates, and that includes a cushioning material and a stress distribution plate stacked on the cushioning material. In the glass plate packing pallet, the surface of the receiving member in contact with the lower edge surfaces of the glass plates has a coefficient of static friction on glass of at least 0.50 but not more than 0.90.

Here, the "large glass plates" mean the glass plates for FPD glass substrates equal to or more than the seventh generation (1870 mm × 2200 mm) in size.

Further, the "coefficient of static friction on glass" means a value to be determined by a test method according to JIS K7125, as illustrated in Fig. 7 A. Specifically, a glass plate is put on the surface layer of a receiving member, and then a 200 g weight is put further on it. As the glass plate, a glass plate of 63 mm × 63 mm having a thickness of 0.7 mm (e.g., NA32SG, manufactured by AvanStrate Inc.) may be used, after being processed so that two corners of the glass plate are rounded to a radius of about 1.0 mm and the side between the two corners has a curved surface having a radius of 0.4 mm, as illustrated in Fig. 7 B. Then, the side of the glass plate having the curved surface is joined to a load cell, and the surface layer is moved in the direction opposite to the load cell at a speed of 100 mm/minute. The load (N) detected by the load cell at the time of the occurrence of the relative positional shift between the glass plates and the surface layer is divided by the total

weight (N) of the glass plate and the weight. The value thus obtained is referred to as the "coefficient of static friction on glass".

According to the present invention, the prevention of cracking of the glass plates during the delivery and the prevention of cracking of the glass plates when pushed are compatible.

Fig. 1 is a perspective view as seen from the front side illustrating a glass plate packing pallet according to one embodiment of the present invention.

Fig. 2 is a perspective view as seen from the back side illustrating the glass plate packing pallet of Fig. 1.

Fig. 3 is an exploded perspective view illustrating crossbars and a coupling member.

Fig. 4 is an enlarged view of relevant parts illustrating the state immediately before the coupling member is fixed to one of the crossbars.

Fig. 5 is an enlarged view of relevant parts illustrating the portion where a fastener member is arranged.

Fig. 6 is a sectional view of a receiving member.

Fig. 7 A is a view illustrating a method for determining the coefficient of static friction on glass for the surface of the receiving member, and Fig. 7 B is a view illustrating a glass plate to be used for the determination.

Fig. 8 is a side view illustrating a conventional glass plate packing pallet.

Hereinafter, embodiments for carrying out the present invention is described with reference to the drawings. It should be noted that the following descriptions concern an example of the present invention and thus the present invention is not limited by these descriptions.

Fig. 1 and Fig. 2 each indicate a glass plate packing pallet 1 according to one embodiment of the present invention (hereinafter, simply referred to as the "pallet 1"). This pallet 1 is to be used for packing large glass plates 10. Normally, the glass plates 10 are loaded onto the pallet 1 in a posture such that its longitudinal direction is the horizontal direction.

Specifically, the pallet 1 includes a body 2 having a base portion 20, a mounting portion 22 provided on the base portion 20 and a back plate 21 provided on the base portion 20, and a receiving member 3 disposed on the mounting portion 22. It should be noted that the glass plates 10, the after-mentioned rods 5 and the like are omitted in Fig. 2.

The body 2 is, for example, a welding structure made of metal such as steel.

The base portion 20 forms a substantially rectangular plate as a whole, and the base portion 20 has its edge surfaces provided with openings 20a into which forks of a forklift are inserted.

The mounting portion 22 is capable of mounting the glass plates 10 thereon while the glass plates 10 are stacked in an upright posture. In this embodiment, the mounting portion 22 is coupled to the base portion 20 by a plurality of ribs 22a so as to be in a downwardly inclined position toward the back plate 21.

The back plate 21 supports the stacked glass plates 10 from the back side. The back plate 21 is supported by support poles 25 provided on the base portion 20 in a position perpendicular to the mounting portion 22, that is, in a backwardly inclined position. More specifically, the ribs 21a extending in the vertical direction are arranged on the back surface of the back plate 21 at specific intervals, and the support poles 25 are coupled to the ribs 21a. It should be noted that a cushioning material similar to the after-mentioned cushioning material 31 is attached onto the front surface of the back plate 21 for the purpose of the prevention of damage to the glass plates 10, although illustration is omitted.

Furthermore, in this embodiment, a space S for accommodating the after-mentioned holding plates 4, a pair of crossbars 6 and a coupling member 7 is formed in front of the support poles 25 and behind the back plate 21 by making use of the backwardly inclined position of the back plate 21.

The receiving member 3 functions to receive the lower edge surfaces of the glass plates 10, and it has a surface 3a in contact with the lower edge surfaces of the glass plates 10. Specifically, the receiving member 3 includes a cushioning material 31 stacked on the mounting portion 22, a stress distribution plate 32 stacked on the cushioning material 31, a resin film 33 stacked on the stress distribution plate 32, as indicated in Fig. 6. The surface of the resin film 33 constitutes the surface 3a of the receiving member 3.

The cushioning material 31 is an elastic body having an appropriate restoring force and it functions to absorb vibration during the delivery. The cushioning material 31 may be made of rubber, but it preferably is made of a foamed resin. Examples of the foamed resin include polyethylene, polypropylene, polystyrene, urethane, propylene-ethylene copolymer, and the like.

The stress distribution plate 32 is a plate having an appropriate rigidity, and it functions to prevent the stress concentration in the glass plates 10 from occurring due to the deformation of the mounting portion 22 as well as to distribute the self weight of the glass plates 10 uniformly to the cushioning material 31. The stress distribution plate 32 may be made of a metal such as stainless steel and

aluminum, but it preferably is made of a resin. Examples of the resin include polypropylene, acrylic, polycarbonate, polystyrene, ABS and the like. Among these, polypropylene is particularly preferable for use, in view of the balance of the rigidity and the strength, the ease of processing, the cost, the weight reduction, and the like.

The resin film 33 functions to allow the movement of the glass plates 10 when pushed in the loading, as well as to regulate the movement of the glass plates 10 due to vibration during the delivery. Further, the resin film 33 functions also as a cushion during the mounting of the glass plates 10. The "resin film" herein means a flexible film that is different from a resin plate having a high rigidity and that forms a non-foamed solid continuum having no internal voids. It should be noted that the thickness of the resin film 33 is preferably 0.5 to 1.0 mm, more preferably 0.7 to 1.0 mm.

It is preferable to use the resin film 33 with a surface having a coefficient of static friction on glass of at least 0.50 but not more than 0.90. This is because the coefficient of static friction on glass less than 0.50 leads to failure to sufficiently function as a slip resistance during the delivery, and the coefficient of static friction on glass exceeding 0.90 increases the possibility of cracking of the glass plates 10 when pushed. The coefficient of static friction on glass of the surface of the resin film 33 is more preferably at least 0.52 but not more than 0.80, further preferably at least 0.54 but not more than 0.70.

It is possible to use thermoplastic polyurethane, polyethylene, polybutylene, polyamide, polypropylene, polystyrene, fluororesin, polycarbonate, polyvinyl chloride and the like, as a material composing the resin film 33. Among these, thermoplastic polyurethane is particularly preferable for use, in view of the coefficient of friction, the durability, the chemical resistance, and the cushioning properties.

Furthermore, the pallet 1 of this embodiment includes holding plates 4 that cover the stacked glass plates 10 from the front side and that are separated laterally, the pair of the crossbars 6 that fix the glass plates 10 to the back plate 21 by holding the holding plates 4 at vertically spaced positions, and the coupling member 7 in a ladder shape that couples the pair of the crossbars 6 to each other at a position corresponding to the center of the glass plates 10. Further, two rods 5 extending forwardly and passing by the glass plates 10 are provided at each of the left and right sides of the back plate 21, and the pair of the crossbars 6 are engaged to the rods 5. The pair of the crossbars 6 are pressed toward the holding plates 4 by fastener members 8 attached to the rods 5.

Each of the holding plates 4 is, for example, a plate (plastic corrugated

board) having a harmonica shaped hollow structure made of resin such as acrylic, polycarbonate, polystyrene, and ABS.

The pair of the crossbars 6 each are a flat bar squashed in the forward and backward directions as indicated in Fig. 3. Both ends of the crossbars 6 each are provided with an engage groove 61 opening downwardly so that each rod 5 is fitted into the engage groove 61.

Each fastener member 8 has a lever operated clamp portion 81 to be fixed to the rod 5 and a nut portion 82, as indicated in Fig. 5. A thread portion (not illustrated) is formed on the outer peripheral surface around one of the edge portions of the clamp portion 81, and the nut portion 82 is capable of moving reciprocably in the axis direction of the rod 5 by being screwed onto the thread portion. Further, the nut portion 82 is provided with three levers 82a at equal angular intervals.

The fastener member 8 is used as follows. First, after the glass plates 10 are covered by the holding plates 4, each rod 5 is fitted into the engage groove 61, and the pair of the crossbars 6 are engaged to the rods 5. Next, the rod 5 is passed through the clamp portion 81, and the clamp portion 81 is fixed at a position where the fastener member 8 is in contact with the crossbars 6. Thereafter, the nut portion 82 is rotated by the levers 82a, and thereby the nut portion 82 is allowed to press the crossbars 6 toward the holding plates 4. Thus, the glass plates 10 are fixed to the back plate 21.

Returning to Fig. 1, the lower crossbar 6 among the pair of the crossbars 6 is provided with an upwardly opening U-shaped pendent portion 60 for holding the lower center of the glass plates 10. In this regard, the pendent portion 60 is set to be pendent from the lower crossbar 6 in a manner such that the pendent portion 60 is not in contact with the surface 3a of the receiving member 3.

The coupling member 7 has a pair of left and right longitudinal members 7a, a pair of upper and lower cross members 7b coupling the upper end portions of the pair of the longitudinal members 7a to each other and the lower end portions thereof to each other, a plurality (two in the illustrated example) of joint members 7c coupling the middle portions of the pair of the longitudinal members 7a to each other between the pair of the cross members 7b, as indicated in Fig. 3. These members 7a to 7c each have the same thickness as the crossbars 6 in the forward and backward direction. Further, handgrips 75 for operating the coupling member 7 are provided at the centers of the longitudinal members 7a.

Toggle clamps 9 are provided on the pair of the crossbars 6 for fixing the coupling member 7. Specifically, tongue shaped fixing pieces 71 are provided

projecting upwardly and downwardly on the front surfaces of the upper end portions and the lower end portions of the longitudinal members 7a of the coupling member 7, as indicated in Fig. 4. On the other hand, guide pieces 62 are provided on the pair of the crossbars 6 for guiding the fixing pieces 71 from the inside, while the toggle clamps 9 are arranged at positions where the toggle clamps 9 can hold the fixing pieces 71 guided by the guide pieces 62. With that, the coupling member 7 is fixed to the crossbars 6 by holding the fixing pieces 71 with the toggle clamps 9 in a state where the coupling member 7 is fitted between the pair of the crossbars 6 so that the guide pieces 62 are fitted between the fixing pieces 71. Thus, the back surfaces of the members 7a to 7c of the coupling member 7 match the back surfaces of the pair of the crossbars 6, so that the holding plates 4 are held also by the coupling member 7.

As described above, in the pallet 1 of this embodiment, the surface 3a of the receiving member 3 is set to have a coefficient of static friction on glass of at least 0.5 but not more than 0.9. Therefore, the prevention of cracking of the glass plates 10 during the delivery and the prevention of cracking of the glass plates 10 when pushed are compatible.

Here, the coefficient of static friction on glass was determined for various materials. The following are the results.

· Resin film A: 3.81
(a resin film made of thermoplastic polyurethane with a smooth surface: TPU (thermoplastic polyurethane) thin film FT1029, manufactured by Ding Zing Chemical Products Co., Ltd. (Taiwanese manufacturer))

· Resin film B: 0.60
(a resin film made of thermoplastic polyurethane with a rough surface: TPU (thermoplastic polyurethane) thin film FT1029X3, manufactured by Ding Zing Chemical Products Co., Ltd. (Taiwanese manufacturer))

· Natural rubber sheet: 1.26

· Foamed resin sheet: 1.00

· Heavy paper: 0.30

· Polypropylene plate: 0.43

· Acrylic plate: 0.49

· Wood plate: 0.30

· Iron plate: 0.33

In the case of actually using the resin film A with a high coefficient of static friction on glass as the resin film 33, the cracking of the glass plates occurred when the glass plates are pushed. In contrast, in the case of actually using the resin film

B with an appropriate coefficient of static friction on glass as the resin film 33, no cracking of the glass plates occurred both when the glass plates are pushed and the glass plates are delivered. In the cases of using the polypropylene plate, the iron plate or the like, it can be estimated, without the need for actual use, that the cracking of the glass plates occurs during the delivery due to the excessively low coefficient of static friction on glass. Further, the natural rubber sheet has a problem that rubber dusts are generated during the use. The foamed resin sheet has a problem of being depressed due to the weight of the glass plates, so that it cannot be used repeatedly.

Further, in this embodiment, the holding plates 4 hold the glass plates 10 by a plane surface, and thus the movement of the glass plates 10 during the delivery is regulated all over the surface. Thus, the cracking of the glass plates 10 can be prevented more effectively.

If the glass plates 10 are fixed, for example, by belts, the center of the glass plates 10 may bend forward. Such bend remains after releasing the belts to unfix the glass plates 10, which may make it impossible to hold the glass plates 10 by vacuum when a robot tries to do so. In contrast, in this embodiment, the coupling member 7 holds the center of the glass plates 10, and therefore the flatness of the glass plates 10 can be maintained, which makes it possible for a robot to hold the glass plates 10 by vacuum without problems.

Further, in this embodiment, the glass plates 10 are fixed by the screw type fastener members 8, and therefore the glass plates 10 can be fixed with an appropriate force. In addition, both ends of each of the crossbars 6 are pressed toward the side of the back plate 21, thereby giving a uniform pressing force to the glass plates 10 across the longitudinal direction. As a result, a well-balanced fixing can be achieved.

Moreover, in this embodiment, the coupling member 7 is fixed to the pair of the crossbars 6 by the toggle clamps 9, which allows the coupling member 7 to be attached and detached easily.

Furthermore, the space S for accommodating the holding plates 4, the pair of the crossbars 6 and the coupling member 7 is formed behind the back plate 21, and therefore it is not necessary to ensure a space for storing the members in the work area, which can save space.

Although the surface 3a of the receiving member 3 is constituted by the surface of the resin film 33 in the above-described embodiment, it also is possible to omit the resin film 33 and to constitute the surface 3a of the receiving member 3 using the surface of the distribution plate 32 that has been roughened to have a

coefficient of static friction on glass of at least 0.5 but not more than 0.9. However, it is more preferable to use the resin film 33 in view of the cushioning properties, the repeated usability by replacement, the ease of storage of repair parts and the like.

The present invention is particularly suitable for use as a glass plate packing pallet for packing glass plates for FPD glass substrates.

The invention may be embodied in other forms without departing from the spirit or essential characteristics thereof. The embodiments disclosed in this specification are to be considered in all respects as illustrative and not limiting. The scope of the invention is indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are intended to be embraced therein.

CLAIMS

1. A glass plate packing pallet to be used for packing large glass plates, the pallet comprising:

a body having a mounting portion onto which the glass plates are mounted while the glass plates are stacked in an upright posture, and a back plate configured to support the stacked glass plates from the back side; and

a receiving member including a cushioning material and a stress distribution plate stacked on the cushioning material, the receiving member being provided on the mounting portion and being configured to receive the lower edge surfaces of the glass plates, wherein

the surface of the receiving member in contact with the lower edge surfaces of the glass plates has a coefficient of static friction on glass of at least 0.50 but not more than 0.90.

2. The glass plate packing pallet according to claim 1, wherein

the mounting portion is inclined downwardly toward the back plate, and

the back plate is perpendicular to the mounting portion.

3. The glass plate packing pallet according to claim 1, wherein

the receiving member further includes a resin film stacked on the stress distribution plate, and

the surface of the resin film constitutes the surface of the receiving member.

4. The glass plate packing pallet according to claim 3, wherein

the resin film is made of a thermoplastic polyurethane.

5. The glass plate packing pallet according to claim 1, wherein

the stress distribution plate is made of a resin.

6. The glass plate packing pallet according to claim 1, wherein

the cushioning material is made of a foamed resin.

7. The glass plate packing pallet according to claim 1, further comprising:

holding plates configured to cover the stacked glass plates from the front side, the holding plates being separated laterally;

a pair of crossbars configured to fix the glass plates to the back plate by

holding the holding plates at vertically spaced positions; and

a coupling member in a ladder shape configured to couple the pair of the crossbars to each other at a position corresponding to the center of the glass plates.

8. The glass plate packing pallet according to claim 7, wherein

the lower crossbar among the pair of the crossbars is provided with a pendent portion for holding the lower center of the glass plates.

9. The glass plate packing pallet according to claim 7, wherein

the coupling member is configured to be fixed to the pair of the crossbars by a toggle clamp.

10. The glass plate packing pallet according to claim 7, wherein

each of both ends of the crossbars is provided with an engage groove,

back plate is provided with a rod extending forwardly while passing by the glass plates, the rod being fitted into the engage groove, and

the pallet further comprises a fastener member attached to the rod, the fastener member being configured to press the pair of the crossbars toward the holding plates.

11. The glass plate packing pallet according to claim 10, wherein

the fastener member has a clamp portion to be fixed to the rod and a nut portion capable of moving reciprocably in the axis direction of the rod by being screwed onto the cramp portion.

12. The glass plate packing pallet according to claim 7, wherein

a space capable of accommodating the holding plates, the pair of the crossbars and the coupling member is formed behind the back plate.