

A Marking Apparatus and a Plate Extractor and a Method of Extracting the Plate

Technical Field

[0001] The present invention relates to a marking apparatus for marking a plate, in particular, a plate extractor for extracting a top plate from the plurality of plates in the marking apparatus.

Background

[0002] In many industries, marking of equipment and installations is critical in the identification of the equipment and installation so as to prevent confusion and therefore errors on site and ultimately, prevent accidents or downtime due to misidentification.

[0003] One form of markings may be the use of marking plates where markings are created on a medium which may be subsequently attached to the equipment and installations. The benefit of such a method is that the markings can be first created on the mediums by machines and later attached to the equipment and installations.

[0004] There are also many mediums suitable for the processes used. One conventional type of medium is the use of plates, particularly metal plates, e.g. stainless steel plates, which may be corrosion resistant and therefore longer lasting. The plates are usually attached to the equipment and installation by way of screws, adhesive and straps. The metal plates may have a thickness between 0.5mm and 2mm.

[0005] It is not uncommon that plates for marking on equipment and installations are installed on-site and usually, these plates, due to on-site condition, are preferably secured to the equipment and installations by screw or strap rather than adhesive for more durability of the installation. Where possible, attaching a plate using straps is preferred over screws as the latter may weaken or damage and therefore subject the surface of the equipment or installations to localized failure or oxidization of the material under the surface.

[0006] In order to secure a plate by straps, there are features incorporated into the design of the plate to hold the straps in place. For example, bridges may be formed on the plate whereby a loop is formed between bridge and the plate surface so that a strap can be inserted

through the loop between the bridge and the plate to secure the strap to the plate. Thereafter, the plate may be secured to an equipment or installation, e.g. a pipe, by strapping the strap around the equipment or installation. A bridge may be formed on one side of the plate by pressing and deforming a strip portion of the plate out of that side of the plate thereby creating a depression on the other side of the plate. Straps may be conventional cable ties used for binding cables together.

[0007] To allow on-site fabrication of marking plates, there have been available marking machines which enable marking of plates as and when required. To facilitate the loading of marking plates for such marking machines, the marking plates may be stacked onto each other forming a plurality of stacked plates so that a plate may be retrieved from the stacked plurality of plates prior to marking.

[0008] However, due to the thinness of the plates, stacking the plates into a marking machine may be cumbersome and a user may be cut and injured by the plates. Further, the bridges formed on the plates to allow fastening of the plates to the equipment and installations hinder the retrieval of a plate from the stacked plates. In a stacked configuration of the same type of plates, the bridges of a bottom plate under a top plate would protrude into the depressions formed by the bridges of the top plate. In this way, retrieval of a plate from the stacked plurality of plates may be hindered by the interface between the bridges and the depressions.

[0009] It is thus an object of the present invention to provide a marking apparatus for marking a plurality of plates, a plate extractor for extracting a top plate from the plurality of plates and a method for extracting the top plate from the plurality of plates in a stacked arrangement positioned in the marking apparatus to avoid or reduce the disadvantages described above.

Summary

[0010] The present invention provides a plate extractor for extracting a top plate from a plurality of plates in a stacked arrangement positioned in a marking apparatus, said plate extractor including, a holder adapted to hold the stacked plurality of plates, said holder including one end and another end substantially opposite the one end, a front wall and a back wall opposite the front wall, both front wall and back wall extending from the one end to the another end, a first opening at about the one end of the holder, guiding elements designed to

retain the stacked plurality of plates and guide the stacked plurality of plates to maneuver in a longitudinal direction, an extracting mechanism adapted to extract the top plate from the stacked plurality of plates in the longitudinal direction through the first opening.

[0011] Said plate may include a longitudinal axis extending along the elongated shaped plate wherein said longitudinal axis may extend substantially perpendicular to said longitudinal axis of the plate or perpendicular to the parallel planes defined by the stacked plates, respectively.

[0012] Said longitudinal direction may be perpendicular to one side of the plate and extend perpendicularly from said one side of plate.

[0013] Said holder, when placed adjacent said extracting mechanism, said longitudinal direction of the stacked plurality of plates may be in a vertical direction or perpendicular to a ground or a base which the plate extractor is placed on.

[0014] Said extracting mechanism may include, an engaging device disposed at about the one end of the holder, the engaging device adapted to engage the top plate, and a feeding mechanism adapted to manoeuvre the stacked plurality of plates along the guiding elements in the longitudinal direction towards or away from the engaging device, wherein the stacked plurality of plates is elevated to contact the engaging device for the engaging device to engage the top plate and lowered away from the extracting device to separate the top plate from the stacked plurality of plates thereby extracting the top plate from the stacked plurality of plates.

[0015] Said guiding elements may be disposed within the holder and extend from about the one end to about the another end of the holder.

[0016] Said holder may include a slot extending along the back wall in the longitudinal direction from about the one end to about the another end.

[0017] Said holder may further include a pair of side walls, each side wall extend from the front wall to the back wall and from the one end to the another end of the holder, the guiding elements may extend from at least one side wall.

[0018] Said guiding element may include a pair of fins, each fin extending from a side wall and spaced from the front wall, such that the stacked plurality of plates are held between the

fin and the front wall and between the pair of side walls and guided to maneuver in the longitudinal direction.

[0019] Said holder may further include a second opening at about the another end of the holder, and wherein the slot may be connected to the first opening and second opening.

[0020] Said holder may further include a stopper at about the another end of the holder and may be adapted to prevent the stacked plurality of plates from exiting the holder.

[0021] Said holder may further include securing means for allowing the holder to be secured to the extracting mechanism.

[0022] Said holder may be removably attachable to the extracting mechanism.

[0023] Said engaging device may include a suction pad, wherein the suction pad, when in contact with the top plate, may provide a suction force to engage the top plate to the suction pad.

[0024] Said extracting mechanism may further include a vacuum pump in fluid communication with the suction pad.

[0025] Said feeding mechanism may include an actuating means for actuating the feeding mechanism, the elevating means coupled to the actuating means, wherein the elevating means, when actuated by the actuating device, elevates the stacked plurality of plates along the longitudinal direction towards the engaging device or lower the stacked plurality of plates and away from the engaging device.

[0026] Said feeding mechanism may further include a relay mechanism coupled to the actuating means and the elevating means for relaying power transmission between the actuating means and the elevating means.

[0027] Said relay mechanism may include a first pulley coupled to the actuating means, a second pulley coupled to the elevating means, and a belt looped around the first pulley and second pulley.

[0028] Said elevating means may include a translating element having a threaded through hole and a lead screw disposed through the threaded through hole.

[0029] Said actuating means may be a stepper motor.

[0030] The present invention further provides a marking apparatus for marking a top plate from a plurality of plates in a stacked arrangement including, a plate extractor according to any one of the features mentioned above, a marking device for marking the top plate, a picking device adapted to pick the top plate from the plate extractor and transfer the top plate from the plate extractor to the marking device, wherein the top plate is fed to the marking device for marking.

[0031] Said picking device may include an actuating member, a pair of fingers coupled to the actuating member, the pair of fingers adapted to switch between an open position where the fingers are spaced apart and a pinching position where the fingers come together, wherein the pair of fingers may be switched from the open position into the pinching position when actuated by the actuating member to pinch the top plate.

[0032] Said picking device may include at least two pairs of fingers, each pair of fingers spaced apart from another pair of fingers.

[0033] Said picking device may be adapted to travel between the plate extractor and the marking device for transferring the top plate from the plate extractor to the marking device.

[0034] Said marking device may be an embossing device.

[0035] Said marking device may further include a controller in signal communication with and adapted to control the extracting mechanism.

[0036] The present invention further provides a method of extracting a top plate from a plurality of plates in a stacked arrangement positioned in a marking apparatus, the plurality of plates stacked in a longitudinal direction, the method includes, holding the stacked plurality of plates, and extracting the top plate from the stacked plurality of plates in the longitudinal direction.

[0037] Said method may further include, elevating the stacked plurality of plates to contact an engaging device, engaging the top plate by the engaging device, and lowering the stacked plurality of plates thereby separating the top plate from the stacked plurality of plates thereby extracting the top plate from the stacked plurality of plates.

Brief Description of the Drawings

[0038] Fig. 1 shows a perspective view of an exemplary embodiment of a marking apparatus;

[0039] Fig. 1a shows an elevation view of the marking apparatus as shown in Fig. 1;

[0040] Fig. 2a shows a perspective view of a marking plate;

[0041] Fig. 2b shows an elevation view of a stacked plurality of marking plates as shown in Fig. 2a;

[0042] Fig. 3 shows a perspective view of an exemplary embodiment of a plate extractor of the marking apparatus in Fig. 1;

[0043] Fig. 4a shows a perspective view of an exemplary embodiment of a holder as shown in Fig. 3;

[0044] Fig. 4b shows a sectional view of the holder along line A-A in Fig. 4a;

[0045] Fig. 5a-5c shows a perspective view of further exemplary embodiments of the holder as shown in Fig. 4a;

[0046] Fig. 5d shows a sectional view of the holder as shown in any one of the exemplary embodiments in Fig. 4a, 4b and 5a-5c, the holder holding a stacked plurality of plates;

[0047] Fig. 5e shows a perspective view of the holder as shown in Fig. 5d;

[0048] Fig. 6 shows a perspective view of another exemplary embodiment of the holder as shown in Fig. 4a, 4b, and 5a-5e;

[0049] Fig. 7 shows a sectional view from the top of another exemplary embodiment of the holder as shown in Fig. 4a, 4b, 5a-5e and 6;

[0050] Fig. 8 shows a sectional view from the top of another exemplary embodiment of the holder as shown in Fig. 4a, 4b, 5a-5e, 6 and 7;

[0051] Fig. 9 shows a sectional view from the top of the holder in Fig. 6;

[0052] Fig. 10 shows an elevation view of an exemplary embodiment of an extracting mechanism of the marking apparatus as shown in Fig. 1;

[0053] Fig. 11 shows an elevation view of an exemplary embodiment of an engaging device of the extracting mechanism as shown in Fig. 10;

[0054] Fig. 12 shows an elevation view of an exemplary embodiment of a feeding mechanism of the extracting mechanism as shown in Fig. 10;

[0055] Fig. 13 shows a perspective view of the extracting mechanism as shown in Fig. 10;

[0056] Fig. 14 shows an elevation view of an exemplary embodiment of a picking device of the marking apparatus as shown in Fig. 1;

[0057] Fig. 15 shows a perspective view of the picking device as shown in Fig. 14;

[0058] Fig. 16 shows a top view of the picking device as shown in Fig. 14 in various locations within the marking apparatus;

[0059] Fig. 17 shows a schematic diagram of the communication between the components in the marking apparatus as shown in Fig. 1;

[0060] Fig. 18 shows a perspective view of an exemplary embodiment of a chute of the marking apparatus in Fig. 1;

[0061] Fig. 19 shows a flow diagram of a method for extracting a marking plate using the plate extractor in Fig. 3;

[0062] Fig. 20 shows a flow diagram of the method in Fig. 19 for extracting the top plate from the stacked plurality of plates in the longitudinal direction;

[0063] Fig. 21 shows an elevation view of another exemplary embodiment of an elevating means of feeding mechanism as shown Fig. 12; and

[0064] Fig. 22 shows an elevation view of an exemplary embodiment of a guiding rail suitable for feeding mechanism as shown in Fig. 12.

Detailed Description

[0065] Fig. 1 shows an exemplary embodiment of a marking apparatus 10 for marking a plurality of plates 20, e.g. for marking a plate 24 (see Fig. 2a) from a plurality of plates 20 in a stacked arrangement. As shown in Fig. 1, the marking apparatus 10 has a plate extractor

100 for extracting a top plate 22 (not shown in Fig. 1 and will be explained below) from a plurality of plates 20 in the stacked arrangement positioned in the marking apparatus. In addition, the marking apparatus 10 may have a marking device 400 for marking the top plate 22, a picking device 500 that is adapted to pick the top plate 22 from the plate extractor 100 and transfer the top plate 22 from the plate extractor 100 to the marking device 400 so that the top plate may be fed to the marking device 400 for marking.

[0066] Fig 1a shows an elevation view of the marking apparatus 10.

[0067] Marking may include embossing, ink stamping, inscribing, etc. As such, marking apparatus may also be known as an embossing apparatus, stamping apparatus, inscribing apparatus etc.

[0068] Fig. 2a shows an exemplary embodiment of a plate 24. Plate 24 may be an elongated shaped plate, e.g. rectangular shaped plate. Plate 24 as shown in Fig. 2a may have a first end 26 and a second end 28 opposite the first end 26. Plate 24 may have at least one loop 30 formed at least at about the first end 26. Fig. 2a shows an exemplary embodiment of plate 24 having a loop 30 each at the first end 26 and second end 28. Plate 24 may include a longitudinal axis extending along the elongated shaped plate 24. Loops 30 may be disposed along the longitudinal axis. As shown in Fig. 2a, the loops 30 may be formed by a bridge 32 connected to the plate 24 at one side 34 of the plate 24. Bridge 32 may be formed by pressing and deforming a strip portion of the plate to protrude out from the one side 34 of the plate 24 thus forming a depression on the other side of the plate 24. Bridges 30 may be spaced apart at a distance from each other. Plate 24 may be made from a malleable material. Plate 24 may be made from a metal, e.g. stainless steel, copper.

[0069] As shown in Fig. 2b, a plurality of plates 20 may be stacked with one plate stacked on top of another forming a stacked plurality of plates 20. The plurality of plates 20 may be stacked in a longitudinal direction L. With reference to the plate 24 as shown in Fig. 2a, longitudinal direction L may be substantially perpendicular to the longitudinal axis of the plate 24. Longitudinal direction L may be perpendicular to the one side 34 of the plate 24 and extend perpendicularly from the one side 34 of plate 24. Top plate 22 may be a first plate or outermost plate in the stacked plurality of plates 20 such that the top plate 22 may be accessible and retrieved or separated from the stacked plurality of plates 20 without removing

any plates from the stacked plurality of plates 20. Each of the stacked plurality of plates 20 may be of the same shape. A skilled person would understand that the size, e.g. length and width, and thickness of plate 24 may vary according to design requirements. Plate 24 may have a substantially square shape such that the length and width of the plate 24 are substantially the same.

[0070] As shown in Fig. 3, the plate extractor 100 has a holder 210 that is adapted to hold the stacked plurality of plates 20 and an extracting mechanism 300 that is adapted to extract the top plate 22 (not shown in Fig. 3) from the stacked plurality of plates 20 in the longitudinal direction L when the stacked plurality of plates 20 is held within the holder 210. Holder 210 may be placed adjacent to the extracting mechanism 300 or spaced from the extracting mechanism 300 as long as the top plate 22 from the holder 210 can be extracted by the extracting mechanism 300. When placed adjacent the extracting mechanism 300, the longitudinal direction L of the stacked plurality of plates 20 may be in a vertical direction or perpendicular to a ground or a base which the plate extractor 100 is placed on.

[0071] Holder 210 may be removably attachable to the extracting mechanism 300. Holder 210 may be clipped onto the extracting mechanism 300, or attachable by magnetic means, or attachable by fasteners like screws, bolts etc.

[0072] To enable the attachment of holder 210 to the extracting mechanism 300, extracting mechanism 300 may have securing means 240 for securing the holder 210 to the extracting mechanism 300 as shown in Fig. 3. Securing means 240 may include a pair of latches 306 adapted to secure the holder 210 by latching on a pair of corresponding openings 252 on the holder 210 (Fig. 3 showing one of the pair of latches 306). Latches 306 may be an extended arm having a first end and a second end opposite the first end. First end of the latch 306 may extend from the extracting mechanism 300. Latches 300 may have a hook at about the second end for latching onto the holder 210. Latches 306 may be pivotally attached at about the first end to the housing 302 and biased towards each other via a biasing means, e.g. a spring, in an engaging configuration. To engage the holder 210, holder 210 may be pressed against the latches 306 thus parting the latches 306 away from each other until the latches 306 find the corresponding openings 252 and snaps back into the engaging configuration due to the biasing means which is when the hook engages the opening 252. As shown in Fig. 3, the latches 306 have engaged the openings 252 of the holder 210 in the engaging configuration.

[0073] Securing means 240 may include magnetic means. Magnetic means may be formed on the engaging wall 306 such that the holder 210 may be magnetically engaged to the extracting mechanism 300. Securing means 240 may include aligning means to align the holder 210 to the extracting mechanism 300 when the holder 210 is magnetically attached to the extracting mechanism 300.

[0074] Securing means 240 may include fasteners, e.g. bolts. Holders 210 may have portions, e.g. panels extending from the back wall 228, with holes which when the holder 210 is positioned to engage the extracting mechanism 300, the holes corresponds with threaded holes on the extracting mechanism 300. Fasteners, e.g. bolts, may then be used to secure the holder 210 in place by fastening the fasteners into the threaded holes.

[0075] Fig. 4a shows a perspective view of an exemplary embodiment of a holder 210. Holder 210 may include a casing 230. Holder 210 may have one end 216 and another end 226 at least substantially opposite the one end 216. Holder 210 may have a front wall 218 and a back wall 228 opposite the front wall 218. Both the front wall 218 and the back wall 228 may extend from the one end 216 of the casing 230 to the another end 226. Front wall 218 may be substantially parallel to the back wall 228. Holder 210 may have a pair of side walls 232 which extend from the front wall 218 to the back wall 228 and from the one end 216 to the another end 226 of the holder 210. Side walls 232 may be substantially parallel to each other. Holder 210 may have at least a first opening 214 at about the one end 216 of the holder. Holder 210 may have a second opening 224 (shown in Fig. 4b) at about the another end 226 of the holder 210. Extracting mechanism 300 is adapted to extract the top plate 22 (not shown in Fig. 4a) from the stacked plurality of plates 20 in the longitudinal direction L through the first opening 214.

[0076] As shown in Fig. 4a, holder 210 may have a slot 234 which extends along the back wall 228 in the longitudinal direction L from about the one end 216 of the holder 210 to about the another end 226. Slot 234 may be extended along a centre portion of the back wall 238 from about one end 216 to about the another end 226 such that a centre longitudinal axis 238 of the slot 234 is substantially in line with a centre longitudinal axis of the holder 210 when viewed from the back wall 228 towards the front wall 218. In other words, the slot 234 may be centralized on the back wall 228 such that the width of a left back wall portion 238a on one side of the slot 234 corresponds with the width of a right back wall portion 238b on the

other side of the slot 234. It is also possible that the widths may not be the same in a way that the slot 234 may be biased towards one edge adjacent a side wall 232.

[0077] Holder 210 may have a second opening 224 at about the another end of the holder 210. First opening 214 and second opening 224 may be linked to form a through hole in the holder 210.

[0078] Fig. 4b shows a sectional view of the embodiment along line A-A of the exemplary embodiment as shown in Fig. 4a. As shown in Fig. 4b, although stopper 236 may extend from the front wall 218 towards the back wall 228 like a cantilever, stopper 236 may extend from the back wall 228 towards the front wall 218 or from the side walls 232. Stopper 236 may be a single protrusion or cantilever or at least two protrusions or cantilevers from one or both walls 218,228.

[0079] As shown in Fig. 4b, holder 210 may have a stopper 236 at about the another end 226 of the holder 210 adapted to prevent the stacked plurality of plates 20 from exiting the holder 210 through the second opening 224. When the stacked plurality of plates 20 is inserted into the holder 210, the stacked plurality of plates 20 may be stopped by the stopper 236. For the embodiment without a second opening 224, the stopper 236 may still be necessary to provide a gap between the another end 226 of the holder 210 and the stacked plurality of plates 20.

[0080] As shown in Fig. 5a, 5b or 5c, slot 234 may be connected to the first opening 214 and/or second opening 224 to form different configurations of the holder 210. In Fig. 5a, slot 234 may be connected to first opening 214 such that the back wall 228 is bordered along the edges where the back wall 228 meets the side walls 232 and the second opening 224 thus forming a U-shaped wall. In Fig. 5b, slot 234 may be connected to the second opening 224 such that the back wall 228 is bordered along the edges where the back wall 228 meets the side walls 232 and the first opening thus forming an inverted U-shaped wall. Fig. 5c shows the slot 234 may be connected to the first opening 214 and the second opening 224 such that back wall 228 forms two longitudinal left back wall portions 238a and right back end wall portions 238b, each longitudinal portion being extended from both edges where the back wall 228 meets the side walls 232 and toward each other. Although not shown in Fig. 5a-5c, stopper 234 may extend from the front wall 218 or the back wall 228.

[0081] For the exemplary embodiment as shown in Fig. 5a, the border portion of back wall 228 along the edge where the back wall 228 meets the second opening 224, the stopper 236 may be spaced in the longitudinal direction of the holder 210 away from or above the border portion so that elevating means 326 (as shown in Fig. 12-13) can be inserted between stacked plurality of plates 20 when the stacked plurality of plates 20 rests on the stopper 236 and the border portion when the holder 210 is attached to the extracting mechanism 300 (see Fig. 3).

[0082] From the description and as shown in another exemplary embodiment in Fig. 5d, the skilled person may appreciate that the front wall 218, back wall 228 and the side walls 232 may be used to hold the stacked plurality of plates 20 within the holder 210 and guide the stacked plurality of plates 20 to maneuver in the longitudinal direction L. As such, back wall 228 and side walls 232 may be guiding elements for guiding the stacked plurality of plates 20.

[0083] Fig. 5e shows a perspective view of the holder 210 having the stacked plurality of plates 20 loaded in the holder 210. Although stopper 236 is not shown in Fig. 5e, the stacked plurality of plates 20 is shown to be resting on the stopper 236 thus causing a gap between the second opening 224 and the stacked plurality of plates 20.

[0084] Fig. 6 shows a perspective view of another exemplary embodiment of the holder 210. Holder 210 may have casing 230 with front wall 218, back wall 228 opposite the front wall 218, and side walls 232 joining the front wall 218 and the back wall 228 as exemplified in the earlier embodiments. Holder 210 may have first opening 214 and second opening 224 opposite the first opening 214. Further, as shown in Fig. 6, the holder 210 may have guiding elements 212 designed to retain the stacked plurality of plates 20 and guide the stacked plurality of plates 20 to maneuver in the longitudinal direction L. The holder 210 may include the stopper 236 at about the another end 226 of the holder 210.

[0085] Holder 210 may have a plurality of openings 222 on the front wall 218. Openings 222 may be of an elongated profile extending from about the one end 216 to the another end 226 of the holder 210. Openings 222 allow visual inspection of the stacked plurality of plates 20 within the holder 210. Openings 222 also allow lesser material to be used in forming the holder 210. Holder 210 may have 3 openings extending parallel to each other.

[0086] Holder 210 may be made of metal or plastic.

[0087] As shown in Fig. 6, guiding elements 212 may be disposed within the holder 210. Guiding elements 212 may extend from the side walls 232 towards each other and extend from about the one end 216 to about the another end 226 of the holder 210. Guiding elements 212 may extend at least from or from about the stopper 236 to or to about the first end 26 of the holder 210. However, it is possible that the guiding elements 212 may extend from only one side wall 232. Guiding elements 212 may be spaced from the front wall 218 such that the spacing between the guiding elements 212 and the front wall 218 corresponds to substantially the width of the stacked plurality of plates 20.

[0088] Fig. 7 shows a top view of the holder 210. As shown in Fig. 7, guiding element 212 may include a pair of fins 242 which extends from both side walls 232 toward each other, each fin 242 may be spaced from the front wall 218. The pair of fins 242 may be spaced from the front wall 218 and the spacing may correspond to substantially the width of a plate 24. As shown in Fig. 7, stacked plurality of plates 20 may be held between the pair of fins 242 and the front wall 218 and between the side walls 232 and guided to maneuver in the longitudinal direction L. Fin 242 may extend from one side wall 232 instead of both side walls 232. Fins 242 may extend longitudinally from about the one end 216 of the holder 210 to about the another end 226. As mentioned earlier, the stacked plurality of plates 20 may be prevented from exiting the second opening 224 by the stopper 236 (not shown in Fig. 7).

[0089] As shown in Fig. 8, guiding element 212 may include a pair of channels 244 such that each channel 244 has a receiving face for receiving and guiding the stacked plurality of plates 20. The receiving faces of the pair of channels 244 face each other such that the stacked plurality of plates 20 can be retained between the pair of channels 244 within the respective receiving faces of the pair of channels 244.

[0090] Referring to Fig. 9 and as shown in Fig. 6, holder 210 may include spacers 246 for maintaining a space between the stacked plurality of plates 20 and the side walls 232. Spacers 246 may be at least one fin 248 extended from a side wall 232. Fin 248 may extend from about the one end 216 to about the another end 226 or to about the stopper 236.

[0091] Although not shown in the other exemplary embodiments, the skilled person would appreciate that the guiding elements 212 and spacer 246 may be applicable to any of the exemplary embodiments of the holder 210.

[0092] Further, as shown in Fig. 9, the guiding elements 212 and/or the spacers 246 may be used to keep the stacked plurality of plates 20 fixed in the directions perpendicular to the longitudinal direction L. The skilled person would appreciate that the use of guiding elements 212 and the spacers 246 allow a holder 210 wider than the planar size of the plate 24 to be used while maintaining the position of the stacked plurality of plates 20 within the holder 210. In this way, it is possible to maintain a standard sized casing 230 while plates 24 of varying planar size can be held in the holder 210. The skilled person would appreciate that having a standard sized casing 230 enable a standard sized holder 210 for multiple sized plates 24 to be held within the holder 210. Such an arrangement allows a standard arrangement for attaching the holder 210 to the extracting mechanism 300. Comparatively, having different holders with different dimensions to hold plates of various sizes may require adjustment of the means or a plurality of means to attach the holders to the extracting mechanism 300.

[0093] Fig. 10 shows a sectional view of the extracting mechanism 300. Extracting mechanism 300 may include an engaging device 310 adapted to engage the top plate 22 (not shown in Fig. 10) and a feeding mechanism 320 for feeding the stacked plurality of plates 20 to the engaging device 310. Extracting mechanism 300 may include a housing 302 having an engaging wall 304 on one side of the housing 302. Engaging wall 310 may have at least one slot 318 (see Fig. 3) extending from about a top end portion of the engaging wall 310 to about a bottom end portion of the engaging wall 304 opposite the top end portion of the engaging wall 310. Slot 318 may be adapted for the feeding mechanism 320 to extend from within the housing 302 to the outside of the housing 302 and the feeding mechanism 320 may move along the slot 318 to move the stacked plurality of plates 20 towards the engaging device 310, i.e. elevate the stacked plurality of blades 20, or away from the engaging device 310, i.e. lower the stacked plurality of blades 20. In the exemplary embodiment as shown in Fig. 3, the engaging wall 302 may have two slots 318.

[0094] Fig. 11 shows a close up view of the engaging device 310. Engaging device 310 may be disposed at about the one end 216 of the holder 210 (not shown in Fig. 11) when the holder 210 is attached to the extracting mechanism 300. With respect to the engaging wall 304, engaging device 310 may be disposed at about the top end of the engaging wall 304 and spaced from the engaging wall 304. As shown in Fig. 10, engaging device 310 may be spaced

from the one end 216 of the holder in the longitudinal direction, e.g. engaging device 310 may be disposed above the holder 210.

[0095] As shown in Fig. 11, engaging device 310 may include a suction pad 312 such that the suction pad 312, when in contact with the top plate 22, provides a suction force to engage the top plate 22 to the suction pad 312. Engaging device 310 may be attached to an arm 314 extended from the engaging wall 304. As shown in Fig. 11, engaging device 310 may be spaced from the engaging wall 304 via the arm 314 such that the engaging device 310 may be positioned directly above the stacked plurality of plates 20.

[0096] In another exemplary embodiment, engaging device 310 may be adapted to move with respect to the holder 210 in the longitudinal direction while the stacked plurality of plates 20 remain stationary such that the engaging device 310 may be moved or lowered towards the stacked plurality of plates 20 to engage the top plates 22 and moved or elevate away from the stacked plurality of plates 20 to separate the top plate 22 from the stacked plurality of plates 20.

[0097] Engaging device 310 may be a solenoid magnet adapted to magnetically engage the top plate 22 or a clamp adapted to clamp the top plate 22 so as to extract the top plate 22 from the stacked plurality of plates 20. Solenoid magnet may be magnetized to engage the top plate 22 when lowered to contact the top plate 22 and demagnetized to release the top plate 22 when required.

[0098] As shown in Fig. 11 extracting mechanism 300 may include a sensor 380 for sensing the presence of the holder 210. Sensor 380 may include a light emitter (not shown in Fig. 11) for emitting a light and a light receiver (not shown in Fig. 11) for receiving the light reflected from the holder 210 when the holder 210 is attached to the extracting mechanism 300 to detect the presence of the holder 210 or the stacked plurality of plates 20.

[0099] As shown in Fig. 12, an exemplary embodiment of the feeding mechanism 320 may include an actuating means 332 for actuating the feeding mechanism 320, an elevating means 326 coupled to the actuating means 332 such that the elevating means 326, when actuated by the actuating means 332, elevates the stacked plurality of plates 20 along the longitudinal direction L towards the engaging device 310 (not shown in Fig. 12) or lower the stacked plurality of plates 20 and away from the engaging device 310.

[00100] Feeding mechanism 320 may be adapted to maneuver the stacked plurality of plates 20 along the guiding elements 212 in the longitudinal direction towards or away from the engaging device 310 such that the stacked plurality of plates 20 can be elevated to contact the engaging device 310 into a feeding position for the engaging device to engage the top plate and lowered into a base position away from the extracting device to separate the top plate from the stacked plurality of plates thereby extracting the top plate from the stacked plurality of plates.

[00101] Actuating means 332 may include a motor, e.g. a stepper motor.

[00102] As shown in Fig. 12, elevating means 326 may include a translating element 350 having a threaded through hole 352 and a lead screw 342 disposed through the threaded through hole 352. The thread of the lead screw 342 meshes with the thread of the threaded through hole 352. In this way, translating element 350 may be arranged to engage with the lead screw 342 such that the translating element 350 may be maneuverable in the longitudinal direction L when the lead screw 342 is rotated by the actuating means 332.

[00103] When the lead screw 342 is rotated by the actuating means 332, the translating element 350, being held in a rotationally rigid orientation, may be translated along the lead screw 342 due to the effect of the rotation of the lead screw 342 on the translating element 350.

[00104] Lead screw 342 may be disposed in a substantially vertical direction wherein a longitudinal axis of the lead screw 342 is substantially parallel to the longitudinal direction L. Lead screw 342 may be rotatable about the longitudinal axis.

[00105] Translating element 350 may be held in a rotationally rigid orientation such that the translating element 350 may translate in the longitudinal direction L and along the lead screw 342 when the lead screw 342 is being rotated by the actuating means 332.

[00106] Elevating means 326 may include fingers 328 extending from the translating element 350 and substantially perpendicular to the longitudinal direction L. As understood by a skilled person, the fingers 328 may translate in the longitudinal direction L when the translating element 350 moves along the lead screw 342.

[00107] Fingers 328 may be disposed at about the another end 226 of the holder 210 when the holder 210 is attached to the extracting mechanism 300.

[00108] As shown in Fig. 12, fingers 326 may be extended from an engaging wall 304 through the slots 318 and protrude into the holder 210 (see Fig. 10) via the slot 234 (not shown in Fig. 10) along the back wall 228 of the holder 210 when the holder 210 is attached to the extracting mechanism 300.

[00109] As mentioned above, a finger 328 may extend from the translating element 350 and through slot 318 in the engaging wall 304. As shown in Fig. 13, the exemplary embodiment of the housing 302 may have two slots 318 and therefore there may be two fingers 317 extending from the slots 318.

[00110] As shown in Fig. 10, fingers 328 may extend into the holder 210 through the slot 234 along the back wall 228 of holder 210. Fingers 328 may extend into the holder 210 and under the stacked plurality of plates 20, i.e. between the second opening 224 of the holder 210 and the stacked plurality of plates 20. Although it may be possible to have fingers 328 extend into the holder 210 from the back wall 228, the fingers 328 may extend through the front wall 218 through openings 222.

[00111] Referring to Fig. 12, feeding mechanism 320 may include a relay mechanism 334 coupled to the actuating means 332 and the elevating means 326 for relaying actuating force from the actuating means 332 to the elevating means 326.

[00112] Relay mechanism 334 may include a pulley and belt system wherein a belt 336 is adapted to loop around a first pulley 338 and a second pulley 340. First pulley 338 may be coupled to the actuating means 332 and the second pulley 340 may be coupled to the elevating means 326. Second pulley 340 may be couple to the lead screw 342.

[00113] When actuated, the actuating means 332 may rotate the first pulley 338 which in turn rotates the second pulley 340 via the belt 336. Second pulley 340 when being rotated, rotates the lead screw 342 and, as described above, translate the translating element 350 along the lead screw 342.

[00114] In another exemplary embodiment, relay mechanism 334 may include a gear and chain system, instead of the pulley and belt system, such that a driving gear may be

coupled to the actuating means, a pinion gear may be coupled to the lead screw 342 and a chain looped around and coupled to the driving gear and pinion gear. When actuated, the actuating means 332 may rotate the driving gear which in turn rotates the pinion gear via the chain and therefore rotates the lead screw 342.

[00115] Referring to Fig. 10, extracting mechanism 300 may include a vacuum pump 316 in fluid communication with the suction pad 312. Vacuum pump 316 may be adapted to remove air between the suction pad 312 and the top plate 24 to create a suction force when the suction pad 312 contacts the top plate 24 and forms an air-tight seal.

[00116] Vacuum pump 316 may be connected in series to the engaging device 310 via a vacuum switch.

[00117] Feeding mechanism 320 may include a pressure indicator for indicating the pressure of the vacuum pump 316.

[00118] Marking device 400 may include any device that is suitable for making the plurality of plates 20, e.g. embossing device, ink stamping device, inscribing device.

[00119] Fig. 14 shows an elevation view of the picking device 500. Picking device 500 may include an actuating member 510, a pair of pincer 520 coupled to the actuating member 510, the pair of pincer 520 may be adapted to switch between an open position where the pair of pincer 520 are spaced apart and a pinching position where the pincer 520 come together (as shown in Fig. 14). The pair of pincer 520 may be switched from the open position into the pinching position when actuated by the actuating member 510 to pinch the top plate 22.

[00120] As shown in Fig. 15, picking device 500 may have at least two pairs of pincer 520, one pair of pincer 520 spaced apart from another pair of pincer 520.

[00121] The two pairs of pincer 520 may be spaced apart to about a width lesser than the distance between the bridges at about the ends of the plate 24. Accordingly, the width between the two pairs of pincer 520 may be designed to be about the distance between the bridges of a shortest plate where there may be a plurality of plates of various sizes.

[00122] Picking device 500 may be adapted to travel between the plate extractor 100 and the marking device 400 for transferring the top plate 22 from the plate extractor 100 to the marking device 400.

[00123] As shown in Fig. 15, marking apparatus 10 may have a rail 12 extending from the extracting mechanism 300 to the marking device 400 such that the picking device 500 may be adapted to glide on the rail 12 so as to move between the extracting mechanism 300 and the marking device 400 to transfer the top plate 22 between the extracting mechanism 300 and the marking device 400. Picking device 500 may have at least a through hole for receiving the rail 12 so as to extend the rail 12 through the picking device 500 so that the picking device 500 may glide along the rail 12. As shown in Fig. 15, rail 12 may be a pair of parallel rods such that the picking device 500 may glide on the pair of parallel rods. Such a configuration allows a more secured movement of the picking device 500 as the picking device 500 may be restricted to the parallel rods.

[00124] As shown in Fig. 16, picking device 500 may be transit between a pick up location 532 for picking the top plate 22 from the extracting mechanism 300, a marking location 534 for feeding the top plate 22 to the marking device 400 in the first direction D1 for marking and a release location 536 for releasing a marked top plate 22 into the collector 150. Locations 532, 534, 536 of the picking device 500 may be along the rail 12. Release location 536 may be between picking location 532 and marking location 534.

[00125] At the pick up location 532, picking device 500 may be moved towards the extracting mechanism 300 to pick the top plate 22 and moved away from the extracting mechanism 300 along the second direction D2 after picking the top plate 22. The first direction D1 may be perpendicular to the second direction D2.

[00126] At the marking location 534, picking device 500 may be moved towards the marking device 400 to place the top plate 22 for marking and moved away from the marking device 400 after marking of the top plate 22.

[00127] Fig. 18 shows a perspective view of a chute 140. Marking apparatus 10 may have a chute 140 for channeling the marked plates 24 to a collector 150, e.g. a box (see Fig. 1).

[00128] Referring to Fig. 18, chute 140 may have an entry point 142, an exit point 144 and a channel 146 between the entry point 142 and exit point 144. Entry point 142 of the chute 140 may be positioned adjacent the picking device 500 at the release location 536.

Entry point 140 of the chute 14 may be positioned below and between the two pairs of pincer 520 or spaced from the two pairs of pincer 520 in the longitudinal direction L.

[00129] Fig. 17 shows a schematic diagram of the control system of the marking apparatus 10. Marking apparatus 10 may include a controller 600 in signal communication with and adapted to control the extracting mechanism 300. Controller 600 may be in signal communication with and adapted to control the feeding mechanism 320 and the picking device 500.

[00130] The actuation of the actuating means 332 may be controlled by the controller 600. In the exemplary embodiment where the actuating means 332 is a stepper motor, controller 600 may control the direction of rotation of the stepper motor and the time required to actuate the actuating means 332, e.g. in one direction. The time required may be the time required for the elevating the stacked plurality of plates 20 to contact the engaging device 310 and subsequently lower the stacked plurality of plates 20 to a predetermined position within the holder 210, e.g. lowest point in the holder 210.

[00131] Controller 500 may be in signal communication with marking device 400 and picking device 500 for controlling the respective functions as described above.

[00132] Marking apparatus 10 may include a user interface for inputting of instructions to the controller 500, e.g. size of plates to be marked and the text to mark on the plates. The user interface may be a buttoned panel. User interface may include a display unit, e.g. a monitor, for displaying a graphic user interface and an input module, e.g. a keyboard, for input of text and instructions. Marking apparatus 10 may include a display port for connection of the display unit.

[00133] Marking apparatus 10 may include a wireless transceiver, e.g. BluetoothTM transceiver, for communicating with a wireless communication device, e.g. keyboard.

[00134] Marking apparatus 10 may include a central processing unit (CPU) for processing instructions input via the user interface and for controlling the controller 500.

[00135] Marking apparatus 10 may include a input/output interface, e.g. USB interface, for input and output of data.

[00136] Marking apparatus 10 may include a power supply port for connecting an auxiliary device and supplying power to said auxiliary device.

[00137] Fig. 19 shows a method 1000 of extracting the top plate from the plurality of plates 20 in a stacked arrangement positioned in the marking apparatus 10. Plurality of plates 20 may be stacked in a longitudinal direction L.

[00138] As shown in step 1100, method 1000 includes holding the stacked plurality of plates 20. As mentioned earlier, the stacked plurality of plates 20 is held by the holder 210 prior to extracting the top plate 22.

[00139] Holder 20 with the stacked plurality of plates 20 may be loaded into the marking apparatus 10. Holder 20 may be attached to the extracting mechanism 300.

[00140] The presence of the stacked plurality of plates 20 in the holder 210 may be sensed by the sensor 380 when the holder 210 is attached to the extracting mechanism 300, i.e. onto the engaging wall 304.

[00141] A user may input the size of the plates 24 to be marked and the text to be marked on the plates 24 via the user interface.

[00142] As shown in step 1200, method 1000 includes extracting the top plate 22 from the stacked plurality of plates 20 in the longitudinal direction L.

[00143] As shown in Fig. 20, step 1200 may include the steps as described below.

[00144] As shown in step 1210, the stacked plurality of plates 20 may be elevated to contact the engaging device 310.

[00145] To elevate the stacked plurality of plates 20, actuating means 332 may be actuated. Once actuated, the elevating means 326, e.g. fingers 328, may be actuated to move or elevate the stacked plurality of plates 20 towards the engaging device 310. For example, the lead screw 342 may be rotated about its longitudinal axis and the translating element 350 which is rotationally fixed with respect to the longitudinal axis of the lead screw 342 translates in the longitudinal direction towards the engaging device 310.

[00146] Method 1000 may further include step 1220 of engaging the top plate 22 by the engaging device 310. When the stacked plurality of plates 20 is elevated sufficiently to

contact the engaging device 310, the top plate 22 comes into contact with the engaging device 310, specifically, the suction pad 312.

[00147] Engaging device 310 may then be activated to engage the top plate 22. Controller 600 may activate the vacuum pump 316 to remove the air enclosed between the suction pad 312 and the top plate 22 thus creating a suction force. Top plate 22 may then be engaged to the suction pad 312.

[00148] Once the top plate 22 is engaged, as shown in step 1230, the stacked plurality of plates 20 may be lowered thereby separating the top plate 22 from the stacked plurality of plates 20 thereby extracting the top plate 22 from the stacked plurality of plates 20.

[00149] Meanwhile, the picking device 500 may be activated by the controller to pick up the top plate 22. Picking device 500 may be actuated by the actuating member when the picking device 500 is activated. When actuated, the two pairs of pincer 520 may be moved towards the top plate 22 to a predetermined pick up location 532 for picking the top plate 22. Once in the position 532, the two pairs of pincer 520 may switch from the open position to the pinching position thereby pinching the top plate 22.

[00150] At this juncture, the engaging device 310 may disengage the top plate 22. Vacuum pump 316 may be activated by the controller 600 to remove the suction force created, e.g. by pumping air back into the vacuum created earlier.

[00151] When the top plate 22 is pinched by the picking device 500, the top plate 22 may be transferred from the extracting mechanism 300 to the marking device 400. Picking device 500 may move from the pick up location 532 to the marking location 534. Picking device 500 may glide along the rails 12 towards the marking device 400 and feed the top plate 20 to the marking device 400 for the top plate 22 to be marked, e.g. embossing, stamping, inscribing.

[00152] Once the top plate 22 is marked, the picking device 500 may retract the top plate 22 away from the marking device 400. The picking device 500 may transfer the top plate 22 to a release location 536. At the release location 536, the two pairs of pincer 520 may be positioned above the entry point 142 of chute 140. The two pairs of pincer 520 may be

activated to switch from the pinching position to the open position thereby releasing the top plate 22 from the picking device 500 and dropping the top plate 22 into the chute 140.

[00153] At this point, the method 1000 may then be repeated for the next top plate 22 where the next top plate 22 may be extracted for marking again.

[00154] Fig. 21 shows another exemplary embodiment of the feeding mechanism 320. Actuating means 332 may be coupled directly to the elevating means 326. Actuating means 332 may include a gear coupled to the actuating means 332. Elevating means 326 may include a rack mounted or integrally formed on the elevating means 326 and engaged to the gear.

[00155] In this exemplary embodiment, elevating means 326 may be a piston and extend into the holder 210 through the second opening 224 of the holder 210 and the rack may be formed on the piston as mentioned.

[00156] When actuated, the gear, coupled to the rack, rotates and elevates or lowers the elevating means 326 towards or away from the engaging device 310 in the longitudinal direction L thereby moving the stacked plurality of plates 20 towards or away from the engaging device 310.

[00157] Fig. 22 shows an exemplary embodiment of a guiding rail 324 which may be included in any one of the embodiments, for guiding the translating element 350. Feeding mechanism 320 may include a guiding rail 324 for guiding the movement of the translating element 350 such that the translating element 350 when actuated by the actuating device 330, is adapted to glide along the guiding rail 324 to elevate the stacked plurality of plates 20 along the longitudinal direction L towards the engaging device 310 or lower the stacked plurality of plates 20 and away from the engaging device 310.

[00158] As shown in Fig. 22, guiding rail 324 may be a pair of elongated members spaced apart from each other and extended along the longitudinal direction L such that the translating element 350 may be disposed between the pair of elongated members and adapted to glide along the pair of elongated members. Guiding rail 324 may include an elongated member, e.g. a rod, extended in the longitudinal direction L. Guiding rail 324 may extend in a

direction substantially parallel to the engaging wall 304 so as to guide translating element 350 to move along the engaging wall 304.

Claims

1. A plate extractor for extracting a top plate from a plurality of plates in a stacked arrangement positioned in a marking apparatus, said plate extractor comprising,
 - a holder adapted to hold the stacked plurality of plates, said holder comprising one end and another end substantially opposite the one end, a front wall and a back wall opposite the front wall, both front wall and back wall extending from the one end to the another end, a first opening at about the one end of the holder, guiding elements designed to retain the stacked plurality of plates and guide the stacked plurality of plates to maneuver in a longitudinal direction,
 - an extracting mechanism adapted to extract the top plate from the stacked plurality of plates in the longitudinal direction through the first opening.
2. The plate extractor according to claim 1, wherein the extracting mechanism comprises,
 - an engaging device disposed at about the one end of the holder, the engaging device adapted to engage the top plate, and
 - a feeding mechanism adapted to manoeuvre the stacked plurality of plates along the guiding elements in the longitudinal direction towards or away from the engaging device, wherein the stacked plurality of plates is elevated to contact the engaging device for the engaging device to engage the top plate and lowered away from the extracting device to separate the top plate from the stacked plurality of plates thereby extracting the top plate from the stacked plurality of plates.
3. The plate extractor according to any one of the preceding claims, wherein the guiding elements are disposed within the holder and extend from about the one end to about the another end of the holder.
4. The plate extractor according to any one of the preceding claims, wherein the holder comprises a slot extending along the back wall in the longitudinal direction from about the one end to about the another end.

5. The plate extractor according to any one of the preceding claims, wherein the holder further comprises a pair of side walls, each side wall extend from the front wall to the back wall and from the one end to the another end of the holder, the guiding elements extend from at least one side wall.
6. The plate extractor according to claim 5, wherein the guiding element includes a pair of fins, each fin extending from a side wall and spaced from the front wall, wherein the stacked plurality of plates are held between the fin and the front wall and between the pair of side walls and guided to maneuver in the longitudinal direction.
7. The plate extractor according to any one of claim 4 to 6, wherein the holder further comprises a second opening at about the another end of the holder, and wherein the slot is connected to the first opening and second opening.
8. The plate extractor according to any one of the preceding claims, wherein the holder further comprises a stopper at about the another end of the holder and adapted to prevent the stacked plurality of plates from exiting the holder.
9. The plate extractor according to any one of the preceding claims, wherein the holder further comprises securing means for allowing the holder to be secured to the extracting mechanism.
10. The plate extractor according to any one of the preceding claims, wherein the holder is removably attachable to the extracting mechanism.
11. The plate extractor according to any one of claims 2 to 10, wherein the engaging device comprises a suction pad, wherein the suction pad, when in contact with the top plate, provides a suction force to engage the top plate to the suction pad.
12. The plate extractor according to claim 11, wherein the extracting mechanism further comprises a vacuum pump in fluid communication with the suction pad.
13. The plate extractor according to any one of claims 2 to 12, wherein the feeding mechanism comprises an actuating means for actuating the feeding mechanism, the elevating means coupled to the actuating means, wherein the elevating means, when actuated by the actuating device, elevates the stacked plurality of plates along the longitudinal direction

towards the engaging device or lower the stacked plurality of plates and away from the engaging device.

14. The plate extractor according to claim 13, wherein the feeding mechanism further comprises a relay mechanism coupled to the actuating means and the elevating means for relaying power transmission between the actuating means and the elevating means.

15. The plate extractor according to claim 14, wherein the relay mechanism comprises a first pulley coupled to the actuating means, a second pulley coupled to the elevating means, and a belt looped around the first pulley and second pulley.

16. The plate extractor according to any one of claims 13 to 15, wherein elevating means comprises a translating element having a threaded through hole and a lead screw disposed through the threaded through hole.

17. The plate extractor according to any one of claims 13 to 16, wherein the actuating means is a stepper motor.

18. A marking apparatus for marking a top plate from a plurality of plates in a stacked arrangement comprising,

a plate extractor according to any one of the preceding claims,

a marking device for marking the top plate,

a picking device adapted to pick the top plate from the plate extractor and transfer the top plate from the plate extractor to the marking device, wherein the top plate is fed to the marking device for marking.

19. The marking apparatus according to claim 18, wherein the picking device comprises an actuating member, a pair of fingers coupled to the actuating member, the pair of fingers adapted to switch between an open position where the fingers are spaced apart and a pinching position where the fingers come together, wherein the pair of fingers is switched from the open position into the pinching position when actuated by the actuating member to pinch the top plate.

20. The marking apparatus according to claim 18 or 19, wherein the picking device comprises at least two pairs of fingers, each pair of fingers spaced apart from another pair of fingers.
21. The marking apparatus according to any one of claims 18 to 20, wherein the picking device is adapted to travel between the plate extractor and the marking device for transferring the top plate from the plate extractor to the marking device.
22. The marking apparatus according to any one of claims 18 to 21, wherein the marking device is an embossing device.
23. The marking apparatus according to any one of claims 18 to 22, further comprising a controller in signal communication with and adapted to control the extracting mechanism.
24. A method of extracting a top plate from a plurality of plates in a stacked arrangement positioned in a marking apparatus, the plurality of plates stacked in a longitudinal direction, the method comprising,
 - holding the stacked plurality of plates, and
 - extracting the top plate from the stacked plurality of plates in the longitudinal direction.
25. The method according to claim 24, further comprising,
 - elevating the stacked plurality of plates to contact an engaging device,
 - engaging the top plate by the engaging device, and
 - lowering the stacked plurality of plates thereby separating the top plate from the stacked plurality of plates thereby extracting the top plate from the stacked plurality of plates.