Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2461726 C 2015/06/09

(11)(21) 2 461 726

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2002/09/27
(87) Date publication PCT/PCT Publication Date: 2003/04/03
(45) Date de délivrance/Issue Date: 2015/06/09
(85) Entrée phase nationale/National Entry: 2004/03/26
(86) N° demande PCT/PCT Application No.: US 2002/031099
(87) N° publication PCT/PCT Publication No.: 2003/026751
(30) Priorités/Priorities: 2001/09/28 (US09/967,502);
2002/04/23 (US10/128,532)

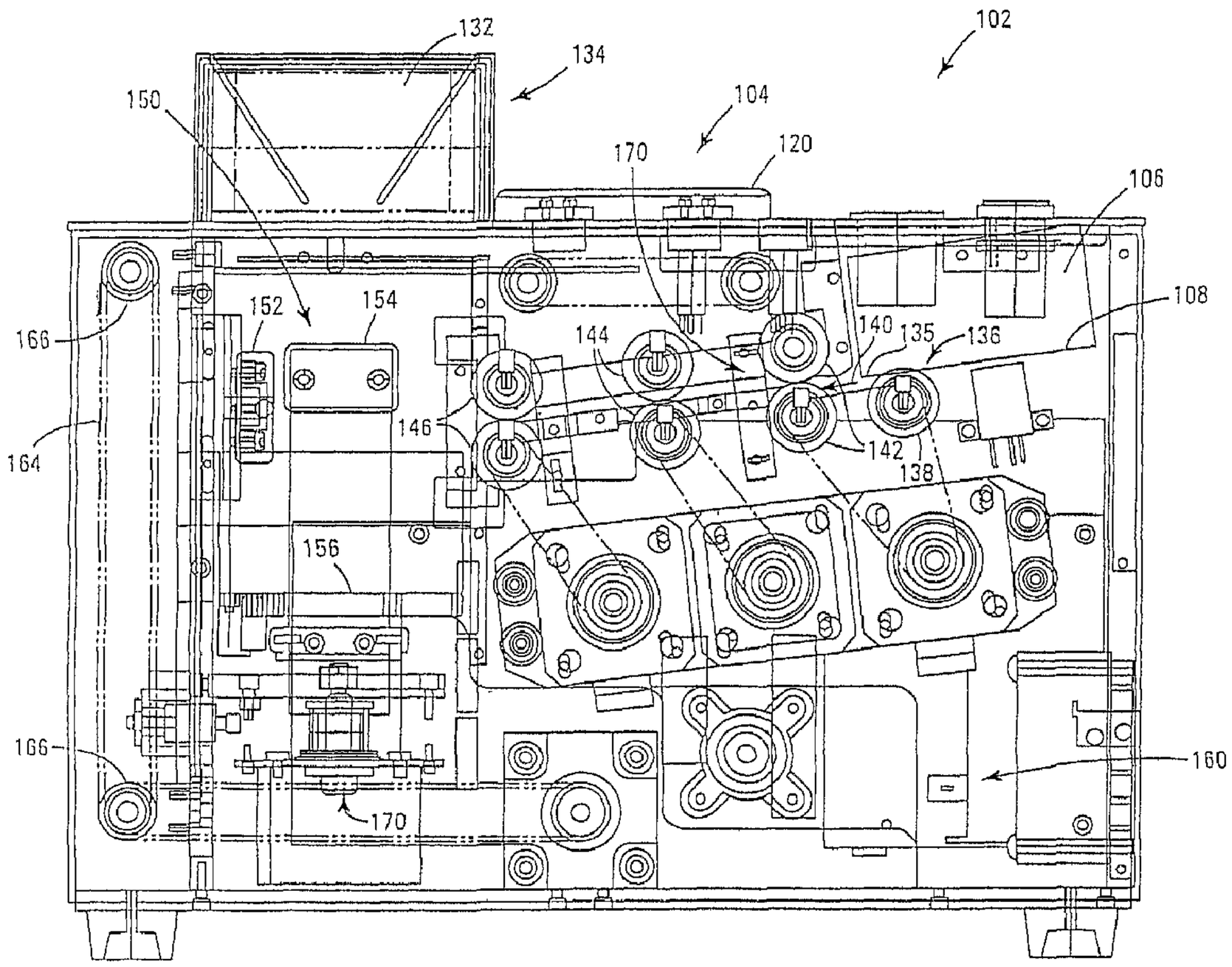
(51) Cl.Int./Int.Cl. *A63F 1/12* (2006.01)

(72) Inventeurs/Inventors:
GRAUZER, ATTILA, US;
BOURBOUR, FERAIDOON, US;
KELLY, JAMES V., US;
NELSON, TROY D., US;
SCHEPER, PAUL K., US;
STASSON, JAMES B., US;
SWANSON, RONALD R., US

(73) Propriétaire/Owner:
BALLY GAMING, INC., US

(74) Agent: TORYS LLP

(54) Titre : DISPOSITIF POUR BATTRE LES CARTES A MESURE AUTOMATIQUE DE LA TAILLE DES CARTES
(54) Title: CARD SHUFFLING APPARATUS WITH AUTOMATIC CARD SIZE CALIBRATION



(57) Abrégé/Abstract:
A card shuffling device (2) includes a top surface (4), a card receiving area (6) for receiving an initial set of playing cards, a randomizing or arranging system for the initial set of playing cards, a collection surface in a card collection area for receiving

CA 2461726 C 2015/06/09

(11)(21) 2 461 726

(13) C

(57) Abrégé(suite)/Abstract(continued):
randomized playing cards, the collection surface receiving cards positioned so that all cards collected are below the top surface of the device, and an elevator for raising the collection surface so that at least some randomized cards are elevated above the top surface of the device. An automated card shuffler includes a microprocessor with memory. An automated calibration system is provided that calibrates the precise position of the card supporting platform in the elevator so that precise insertion of cards can be performed during card handling procedures. A preferred method operates by a position of the elevator being randomly selected and the support surface is moved to the selected position, and after the gripping arm grasps at least one side of the cards, the elevator lowers, creating a space beneath the gripping arm, wherien, a card is moved from the infeed compartment into the space thereby randomizing the cards.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 April 2003 (03.04.2003)

PCT

(10) International Publication Number
WO 03/026751 A1

(51) International Patent Classification[7]: A63F 1/12

(21) International Application Number: PCT/US02/31099

(22) International Filing Date:
27 September 2002 (27.09.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/967,502 28 September 2001 (28.09.2001) US
10/128,532 23 April 2002 (23.04.2002) US

(71) Applicant: **SHUFFLE MASTER, INC.** [US/US]; 1106 Palms Airport Drive, Las Vegas, NV 89119 (US).

(72) Inventors: **GRAUZER, Attila**; 333 East Eldorado Lane, LAs Vegas, NV 89123 (US). **BOURBOUR, Feraidoon**; 2885 Knox Avenue South #808, Minneapolis, MN 55408 (US). **KELLY, James, V.**; 9460 Corato Street, Las Vegas, NV 89123 (US). **NELSON, Troy, D.**; 21898 181st Street, Big Lake, MN 55309 (US). **SCHEPER, Paul, K.**; 8246 Drexel Court, Eden Prairie, MN 55347 (US). **STASSON, James, B.**; 2461 Bridle Creek Trail, Chanhassen, MN 55317 (US). **SWANSON, Ronald, R.**; 12430 52nd Avenue, Plymouth, MN 55443 (US).

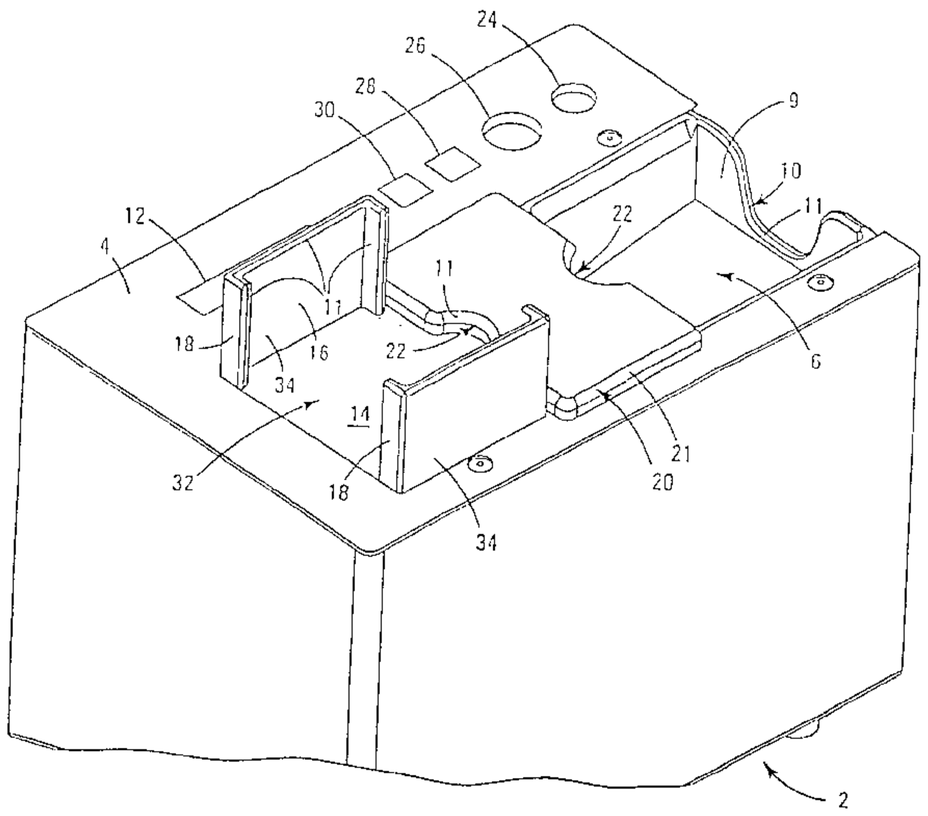
(74) Agent: **FARRAR, Jennifer, K.**; Shuffle Master, Inc., 1106 Palms Airport Drive, Las Vegas, NV 89119 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: CARD SHUFFLING APPARATUS WITH AUTOMATIC CARD SIZE CALIBRATION



(57) Abstract: A card shuffling device (2) includes a top surface (4), a card receiving area (6) for receiving an initial set of playing cards, a randomizing or arranging system for the initial set of playing cards, a collection surface in a card collection area for receiving randomized playing cards, the collection surface receiving cards positioned so that all cards collected are below the top surface of the device, and an elevator for raising the collection surface so that at least some randomized cards are elevated above the top surface of the device. An automated card shuffler includes a microprocessor with memory. An automated calibration system is provided that calibrates the precise position of the card supporting platform in the elevator so that precise insertion of cards can be performed during card handling procedures. A preferred method operates by a position of the elevator being randomly selected and the support surface is moved to the selected position, and after the gripping arm grasps at least one side of the cards, the elevator lowers, creating a space beneath the gripping arm, wherien, a card is moved from the infeed compartment into the space thereby randomizing the cards.

WO 03/026751 A1

WO 03/026751 A1

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

CARD SHUFFLING APPARATUS WITH AUTOMATIC CARD SIZE CALIBRATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to shuffling and sorting apparatus for providing randomly arranged articles and especially to the shuffling of playing cards for gaming uses. The invention also relates to a method and apparatus for providing randomly shuffled deck(s) of cards in a rapid and efficient manner and a capability of automatically calibrating the apparatus for various cards sizes, card thicknesses, and for initial setup.

2. Background of the Art

In the gaming industry, certain games require that batches of randomly shuffled cards be provided to players and sometimes to dealers in live card games. It is important that the cards are shuffled thoroughly and randomly to prevent players from having an advantage by knowing the position of specific cards or groups of cards in the final arrangement of cards delivered in the play of the game. At the same time, it is advantageous to have the deck(s) shuffled in a very short period of time so that there is minimal down time in the play of the game.

Johnson et al., U.S. Patent No. 5,944,310 (assigned to Shuffle Master, Inc., assignee of the present application) describes a card handling apparatus comprising: a loading station for receiving cards to be shuffled; a chamber to receive a main stack of cards; delivery means for delivering individual cards from the loading station to the chamber; a dispensing station to dispense individual cards for a card game; transfer means for transferring a lower most card from the main stack to the dispensing station; and a dispensing sensor for sensing one of the presence and absence of a card in the dispensing station. The dispensing sensor is coupled to the transfer means to cause a transfer of a card to the dispensing station when an absence of a card in the dispensing station is sensed by the dispensing sensor. Individual cards delivered from the loading station are randomly inserted by an insertion means into different

randomly selected positions in the main stack to obtain a randomly shuffled main stack from which cards are individually dispensed. The insertion means includes vertically adjustable gripping means to separate the main stack into two spaced apart sub-stacks to enable insertion of a card between the sub-stacks by the insertion means. The gripping means is vertically positionable along the edges of the main stack. After gripping, the top portion of the stack is lifted, forming two sub-stacks. At this time, a gap is created between the stacks. This shuffler is marketed under the name QUICKDRAW® shuffler in the United States and abroad.

Similarly, Johnson et al., U.S. Patent No. 5,683,085 (also assigned to Shuffle Master, Inc.) describes am apparatus for shuffling or handling a batch of cards including a chamber in which a main stack of cards are supported, a loading station for holding a secondary stack of cards, and a card separating mechanism for separating cards at a series of positions along the main stack. The separating mechanism allows the introduction of cards from the secondary stack into the main stack at those positions. The separating mechanism grips cards at the series of positions along the stack and lifts those cards at and above the separation mechanism to define spaces in the main stack for introduction of cards from the secondary stack.

U.S. Patent No. 5,676,372 describes an automated playing card shuffler, comprising: a frame; an unshuffled stack holder for holding an unshuffled stack of playing cards; a shuffled stack receiver for holding a shuffled stack of playing cards; at least one ejector carriage mounted adjacent to said unshuffled stack holder, said at least one ejector carriage and said unshuffled stack holder mounted to provide relative movement between said unshuffled stack holder and said at least one ejector carriage; a plurality of ejectors mounted upon said at least one ejector carriage adjacent the unshuffled stack holder, for ejecting playing cards from the unshuffled stack, the ejecting occurring at various random positions along the unshuffled stack.

Breeding et al., U.S. Patent Nos. 6,139,014 and 6,068,258 (assigned to Shuffle Master, Inc.) describe a machine for shuffling multiple decks of playing cards in a batch-type process. The device includes a first vertically extending magazine for

holding a stack of unshuffled playing cards, and second and third vertically extending magazines each for holding a stack of cards, the second and third magazines being horizontally spaced from and adjacent to the first magazine. A first card mover is positioned at the top of the first magazine for moving cards from the top of the stack of cards in the first magazine to the second and third magazines to cut the stack of unshuffled playing cards into two unshuffled stacks. Second and third card movers are at the top of the second and third magazines, respectively, for randomly moving cards from the top of the stack of cards in the second and third magazines, respectively, back to the first magazine, thereby interleaving the cards to form a vertically registered stack of shuffled cards in the first magazine. Elevators are provided in the magazines to bring the cards into contact with the card movers. This shuffler design is currently marketed under the name MD-1™ shuffler and MD1.1™ shuffler in the United States and abroad.

Sines et al. U.S. Patent No. 6,019,368 describes a playing card shuffler having an unshuffled stack holder that holds an infeed array of playing cards. One or more ejectors are mounted adjacent the unshuffled stack holder to eject cards from the infeed array at various random positions. Multiple ejectors are preferably mounted on a movable carriage. Extractors are advantageously used to assist in removing playing cards from the infeed array. Removal resistors are used to provide counteracting forces resisting displacement of cards, to thereby provide more selective ejection of cards from the infeed array. The automated playing card shuffler comprises a frame; an unshuffled stack holder for holding an unshuffled array of playing cards in a stacked configuration with adjacent cards in physical contact with each other and forming an unshuffled stack; a shuffled array receiver for holding a shuffled array of playing cards; at least one ejector for ejecting playing cards located at different positions within the unshuffled stack; and a drive which is controllable to achieve a plurality of different relative positions between the unshuffled stack holder and the at least one ejector. This shuffler design is currently marketed under the name Random Ejection Shuffler™ shuffler.

Grauzer et al., U.S. Patent No. 6,149,154 (assigned to Shuffle Master, Inc.) describes an apparatus for moving playing cards from a first group of cards into plural groups, each of said plural groups containing a random arrangement of cards, said apparatus comprising: a card receiver for receiving the first group of unshuffled cards; a single stack of card-receiving compartments generally adjacent to the card receiver, said stack generally adjacent to and movable with respect to the first group of cards; and a drive mechanism that moves the stack by means of translation relative to the first group of unshuffled cards; a card-moving mechanism between the card receiver and the stack; and a processing unit that controls the card-moving mechanism and the drive mechanism so that a selected quantity of cards is moved into a selected number of compartments. This shuffler is currently marketed under the name ACE® shuffler in the United States and abroad.

Grauzer et al., U.S. Patent No. 6,254,096 (assigned to Shuffle Master, Inc.) describes an apparatus for continuously shuffling playing cards, said apparatus comprising: a card receiver for receiving a first group of cards; a single stack of card-receiving compartments generally adjacent to the card receiver, said stack generally vertically movable, wherein the compartments translate substantially vertically, and means for moving the stack; a card-moving mechanism between the card receiver and the stack; a processing unit that controls the card-moving mechanism and the means for moving the stack so that cards placed in the card receiver are moved into selected compartments; a second card receiver for receiving cards from the compartments; and a second card-moving mechanism between the compartments and the second card receiver for moving cards from the compartments to the second card receiver. This shuffler design is marketed under the name KING™ shuffler in the United States and abroad.

Johnson et al., U.S. Patent No. 6,267,248 (assigned to Shuffle Master, Inc.) describes an apparatus for arranging playing cards in a desired order, said apparatus including: a housing; a sensor to sense playing cards prior to arranging; a feeder for feeding said playing cards sequentially past the sensor; a storage assembly having a plurality of

storage locations in which playing cards may be arranged in groups in a desired order, wherein the storage assembly is adapted for movement in at least two directions during shuffling; a selectively programmable computer coupled to said sensor and to said storage assembly to assemble in said storage assembly groups of playing cards in a desired order; a delivery mechanism for selectively delivering playing cards located in selected storage locations of the storage assembly; and a collector for collecting arranged groups of playing cards. The storage assembly in one example of the invention is a carousel containing a plurality of card storage compartments.

Pending U.S. Patent Application Serial No. 09/967,502 (also assigned to Shuffle Master, Inc.) describes a device for forming a random set of playing cards including a top surface and a bottom surface, and a card receiving area for receiving an initial set of playing cards. A randomizing system is provided for randomizing the initial set of playing cards. A collection surface is located in a card collection area for receiving randomized playing cards, the collection surface receiving cards so that all cards are received below the top surface of the device. An elevator is provided for raising the collection surface so that at least some randomized cards are elevated at least to the top surface of the device. A system for picking up segments of stacks and inserting cards into a gap created by lifting the stack is described.

Although these and other structures are available for the manufacture of playing card shuffling apparatus, new improvements and new designs are desirable. In particular, it would be desirable to provide a batch-style shuffler that is faster, provides random shuffling and which is more compact than currently available shuffler designs.

SUMMARY OF THE INVENTION

A device for forming a set of playing cards in a randomized order is described. The device includes a top surface and a bottom surface, and a card receiving area for receiving an initial set of playing cards. A randomizing system is provided for randomizing the initial set of playing cards. A collection surface is located in a card

collection area for receiving randomized playing cards, the collection surface receiving cards so that all cards are received below the top surface of the device. An elevator is provided for raising the collection surface so that at least some randomized cards are elevated at least to the top surface of the device. An automatic system is provided in the device for accurately calibrating the vertical position of the collection surface and identifying specific card level positions on stacks of cards placed onto the collection surface. Sensors to identify at least one card level position and support surface positions are used to calibrate the performance of card pickup grippers, platform positions, and card positions on the platform. A calibration routine is performed by the device, and that automated calibration routine assures a high level of performance of the device and reduces or eliminates the need for initial and periodic manual calibration and for technical maintenance on the device.

A device for forming a random set of playing cards is described. The device includes a top surface and a bottom surface of said device and a receiving area for receiving an initial set of playing cards. A randomizing system is provided for randomizing the initial set of playing cards. A collection surface is provided in a card collection area for receiving randomized playing cards. A card feed mechanism in one form of the invention individually transfers cards from the receiving area into the card collection area. The device further includes an elevator for raising and lowering the collection surface within the card collection area. At least one card supporting element within the card collection area supports and suspends a randomly determined number of cards within the card collection area. In one example of the invention, a pair of spaced apart gripping members are provided to grasp the opposite edges of the group of cards being suspended. A card insertion point is created in the card collection area beneath the suspended randomly determined group of cards. The card feed mechanism delivers a card into the insertion point.

An automatic card shuffling device is disclosed. The device includes a microprocessor with memory for controlling the operation of the device. An infeed compartment is provided for receiving cards to be randomized. In one example of the

invention, the lower surface of the infeed compartment is stationary. In another example of the invention, the lower surface is moveable in a vertical direction by means of an elevator. A card moving mechanism moves cards individually from the infeed compartment into a card mixing compartment. The card mixing compartment includes a plurality of substantially vertical supports and an opening for the passage of cards from the infeed compartment. In one form of the invention, the opening consists of a slot. The card mixing compartment also includes a moveable lower support surface and at least one stationary gripping arm, a lower edge of the gripping arm being proximate to the opening and the gripping arm, the opening allowing for the passage of cards into the card mixing compartment just below the gripped group of cards. The gripping arm is capable of suspending a card or a group of cards of a randomly determined size above the opening. In one example, the opening is a horizontal slot.

The device preferably includes an integrally formed automated calibration system. One function of the automated calibration system is to identify the position of the elevator support platform relative to a lowermost gripping position of the grippers so that the stack of cards can be separated at a precise location in the stack and so that a specific numbers of cards can be accurately lifted and specific card insert positions can be determined for insertion of cards into the randomizing stack of cards. Another function of the automated calibration system of the present invention is to automatically adjust the position of the grippers to compensate for different card length, width and/or card thicknesses.

Another function if the automated calibration system is to determine the number of incremental movements of the elevator stepper motors that corresponds to the thickness of each card. This information is then used to determine the precise location of the elevator in order to form each point of separation in the group of cards during shuffling.

An elevator is provided for raising and lowering the moveable card support surface. In operation, the vertical position of the elevator is randomly selected and the support surface is moved to the selected position. After the gripping arm grasps at least one side of the cards, the elevator lowers, suspending a group of cards, and creating a space (or point of insertion) beneath the gripping arm, wherein a single card is moved from the infeed compartment into the space created, thereby randomizing the order of the cards.

A method of calibrating a shuffling machine prior to and during the randomization of a group of cards is described. The method comprises the steps of placing a group of cards to be randomized into a card infeed tray and removing a calibration card from the infeed tray, and placing the card in the card randomizing area, also known as the card collection area. The elevator and grippers are operated until a precise location of the bottommost card that can be gripped is identified. Either before or after this calibration process, the card width is measured, and the grippers are adjusted to put sufficient tension on the cards to suspend the entire group of cards to be shuffled.

According to the invention, cards are individually fed from the card infeed tray and delivered into a card collection area. The card collection area has a moveable lower surface, and a stationary opening for receiving cards from the infeed tray. The method includes elevating the moveable lower surface to a randomly determined height and grasping at least one edge of a group of cards in the card collection area at a point just above the stationary opening. The method further includes the steps of lowering the moveable lower surface to create an opening in a stack of cards formed on the lower surface, the opening located just beneath a lowermost point where the cards are grasped and inserting a card removed from the infeed tray into the opening. A device capable of automatically calibrating is described that is capable of automatically making adjustments to process cards of different dimensions is described. The device includes a card infeed tray, a card moving mechanism that transports cards from the infeed tray into a card collection area; an elevator within the card collection area that raises and lowers the group of fed cards; a device capable of

suspending all or part of the fed cards above the card feeder; and a microprocessor that selects the position in the stack where the next card is to be inserted, and instructs the device capable of suspending and the elevator to create a gap, and then instructing the card moving mechanism to insert the card.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 shows a perspective view of an example of the exterior shell of a shuffling apparatus of the present invention.

Figure 2 shows a cutaway side view of the internal elements of a shuffling apparatus according to teachings of the present invention.

Figure 3 shows a perspective view of an off-set card transport mechanism according to an embodiment of the invention.

Figure 4 shows a top view of an off-set card transport mechanism according to an embodiment of the present invention.

Figure 5 shows a cross-sectional view of an embodiment of a picking system with a single or joint belt drive for moving picker elements.

Figure 6 shows an elevated perspective view of one embodiment of a shuffling apparatus according to the invention.

Figure 7 shows a side cut away view of one embodiment of a shuffling apparatus according to the invention.

Figure 8 shows a perspective view of a second example of the exterior shell of a shuffling apparatus of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

An automatic shuffling device is described for forming a randomly arranged set of playing cards. One embodiment of the device of the present invention shuffles between one and eight or more decks of cards (standard deck or decks of 52 cards each or 52 cards plus one or two jokers) and is particularly well suited for providing randomized batches of cards for games such as single deck blackjack, poker, double deck blackjack, and multi deck blackjack, for example. Another embodiment of the invention is suitable for shuffling either a single deck or two decks of cards.

The device includes a top surface and a bottom surface, a card receiving area for receiving an initial set of playing cards to be randomized and a randomizing system for randomizing an order of the initial set of playing cards. The device further includes a card collection area and a card collection surface within the card collection area for receiving randomized playing cards, the collection surface receiving cards in a manner such that that all cards are inserted into the collection area below the top surface of the device. An elevator is provided for raising and lowering the collection surface during shuffling, and elevating the shuffled (alternatively referred to as 'randomized') group of cards at least as high as the top surface of the device after shuffling (that is, the lowest card in the shuffled group of cards is raised to a level where it may be easily and manually removed from that level, preferably with the lowest card being level with or above a plane defining the top surface of the device). A card suspension mechanism such as a pair of oppositely spaced grippers grasp some or all of the cards on the card collection surface. The elevator is lowered, creating a gap or point of insertion for the next card to be fed. Once shuffling is complete, the cards are elevated, they can be removed by the attendant or dealer and used for dealing. While cards are being dealt, a second group of cards is being randomized. The use of two groups of cards eliminates any waiting on the part of the dealer or the casino patrons between rounds of play.

There are a number of special features that combine to make the present invention a significant advance over previously described card shuffling systems and card shuffling processes. Among individual features that constitute an advance, alone or in combination with other features include a system for automatically calibrating and inspecting the position and performance of an elevator for moving the final set of randomized cards upwardly so that the stack is accessible to the dealer or attendant. In one example of the invention, the elevator elevates the group of cards to the playing table surface. The same elevator advantageously assists in accomplishing shuffling within the card collection and/or mixing area.

The card collection area in one example of the invention has a plurality of vertical supports (e.g., 2 or 3 walls, or four walls with an manually accessible area where the lowest card may be gripped), and a moveable lower surface. The elevator supports this moveable lower surface (also referred to herein as the collection surface) and causes the surface to move back and fourth (relatively up and down) in a substantially vertical direction. One function of the movement of the second elevator (during the shuffling or randomizing sequence) is to position a stack of cards within the card collection area so that a card or cards can be inserted into the stack in a specifically selected or randomly selected precise position within the stack to randomize, organize or arrange the cards in a desired order, such as "pack order" for inspection (particularly after reading the suit and rank of cards) or to randomize the cards into a shuffled set of cards that can be dealt to players. The insertion of cards may be performed in a number of ways, such as by lifting or by dropping a section of the stack and inserting one or more (and preferably just one) cards into the gap, by positioning the stack near a card insertion position and inserting one or more cards into the stack, or inserting a wedge-like element or blade between cards in the stack to elevate a portion of the stack where card(s) may be inserted (as described in Breeding et al., U.S. Patent No. 5,695,189 (assigned to Shuffle Master, Inc.), which is incorporated herein by reference.

In a preferred mode of operation of the shuffler of the present invention, a picking, gripping or separating system is provided for suspending segments of the stack of cards present in the card collection area, creating an opening in the group of cards, so that a card or cards can be inserted in specific locations relative to other cards in the deck. A variant of this system is described in pending U.S. Patent Application, U.S. Serial No. 09/967,502, filed January 8, 2002 (assigned to Shuffle Master, Inc.). According to that invention, the picking, gripping or card suspending system is fixed in the vertical direction. By randomly selecting a vertical position for the moveable base of the card receiving area prior to picking, the location of an opening created in the stack of cards by gripping a portion of the cards and lowering another portion of

the cards below the gripping area is varied, with random insertion of cards into these openings causing randomization of the cards.

Offset rollers are the preferred mechanism provided for moving the individual cards from the card receiving area into the card collection area, although air jets, belts, injection plates, injection blades and the like may also be used for moving individual cards or small numbers of cards (e.g., 1, 2, 3, 4 or 5 cards) into the card receiving area.. A stack stabilizing area is provided in one example of the invention for receiving an elevated final set of cards lifted from the card collection area. This stack stabilization area should be positioned or positionable above the top of the device or begins at the top of the device. In another example of the invention, the elevator itself is equipped with a stack stabilizing structure that is lowered into the inside of the shuffler prior to the randomization of cards. In one embodiment later described in greater detail, a delivery or elevator platform provides its own card stabilization area or in conjunction with an elevator drive arm provides such a card stabilization area. A single belt drive is provided in one example of the invention for driving two spaced apart and opposed vertically disposed picking elements in a card segment picking system. The picking elements are vertically disposed along the path of movement of the collection area of cards in the collection shaft, and are horizontally disposed or opposed with respect to each other. A microprocessor is provided that employs a random number generator to identify or create an intended (including random) distribution of an initial set of cards in the card receiving area at the conclusion of shuffling. The microprocessor executes movement of elements in the shuffling apparatus, including the opposed picking elements and the elevator to effect placement of each card into spaces in the stack created by the shuffling apparatus, and a randomized set of cards is rapidly formed. That microprocessor (in the shuffling device or in an associated game device) or a separate or parallel microprocessor is used to direct the calibration steps. In one example of the invention, the picking elements move horizontally to grasp opposite edges of a group of cards. Other suspension systems are contemplated, such as inserting a flat member between the cards above the point of separation.

The individual and combined elements of the invention will be described in detail, after a more general description of the invention is provided. A first general description of the invention is a device for forming a random set of playing cards comprising: a top surface and a bottom surface of said device; a receiving area for an initial set of playing cards; a randomizing system for randomizing the order of the initial set of playing cards; a collection surface in a card collection area for receiving the randomized playing cards; an elevator for raising the collection surface within the card collection area; and at least one card supporting element within the card collection area that is horizontally fixed with respect to the vertical. The card supporting element will support and suspend a precise number of a randomly determined number of cards within the card collection area to create a gap or space within the stack of cards within the collection area that is a card insertion point. The card insertion point or gap is created in the card collection area just below the lowermost portion of the card supporting element or elements. Each time the card supporting elements support a next group of cards, and the elevator beneath the card collection area is lowered, lowering a remaining group of cards and creating a gap. .

The device may have one or more card supporting elements comprising at least one vertically disposed element on at least one side of the card collection area. In the alternative, the card supporting elements include at least two opposed supporting elements such as flexible or soft (e.g., polymeric, elastomer, rubber or rubber-coated) gripping elements that can move inwardly along a horizontal plane within the card collection area to contact and support the opposite edges of at least a portion of the stack, or substack or group of cards. Or, a horizontally disposed flat member such as a pair of forks or a flat plate may be inserted between the cards, so that when the elevator is lowered, an insertion point or gap is formed. The substack may be defined as all cards within the collection area at or above a randomly selected card or position in the stack within the card collection area. The device desirably has a microprocessor communicatively connected to the device. The microprocessor in one example of the invention is programmed to determine a distance that the card

supporting surface must be vertically moved in order to position each card in the desired order within the stack. In one example of the invention, cards fed into the card collection area may be placed anywhere in the stack, including the top or bottom position. This flexibility advantageously allows for a more random shuffle and avoids 'dead' areas within the collection stack of cards.

The device of the present invention advantageously senses the length or width of the cards and adjusts the horizontal distance between the gripping arms so that cards of varying lengths or widths can be suspended. Whether the width or length is sensed depends on the designer's selected location of the grippers within the card collection area.

In one example of the invention, the microprocessor instructs the device to feed a first card into the card collection area and to grip the card at a width representing the width of a standard group of cards. If the sensors sense that a card is suspended, no adjustments to a horizontal spacing between gripping arms is necessary. If no suspended cards are sensed, the microprocessor instructs an adjustable gripping support mechanism to move a preselected distance and the gripping and sensing process is repeated. When the final adjustment has been made, cards are suspended and their presence is sensed. The microprocessor then retains this gripping mechanism distance setting. Alternatively, when the processor instructs the grippers to suspend one or more cards and no suspended cards are sensed, the adjustment sequence is activated. This entire process will be described in further detail, below.

The microprocessor is communicatively connected to the device and is most preferably located within the exterior shell of the device. The microprocessor may be programmed to lower the card collection surface within the card collection area after the at least one card supporting element has contacted and supported cards suspending a group of cards within the card collection area, creating two vertically spaced substacks of cards, one suspended, separated by a gap or opening between the cards.

Recognition of the presence of suspended and/or supported card(s) within the card collection area may be provided by sensors that are capable of sensing the presence of card(s) within the area by physical (e.g., weight), mechanical (e.g., pressure), electrical (e.g., resistance or conductance), optical (e.g., reflective, opacification, reading) or other sensing. The microprocessor may direct movement of one or more individual cards into the gap created between the two segments (upper and lower) of cards. The microprocessor may be programmed to randomly determine a distance that the card supporting surface must be vertically moved to in order to position at least one specific card. This method, including measurement of card thickness, will be described in more detail below. In the alternative, the microprocessor may be programmed to select a specific card position below or above a certain card, creating the gap. When the card supporting element moves to contact cards within the card collection area, and the elevator moves the card supporting surface downwardly, a gap is created for receiving the next card.

The elevator operates in a unique manner to position cards relative to the pickers or grippers within the shuffling chamber. This unique operation offers significant benefits that remove the need for human intervention in the setup or continuing operation of the shuffling device. Among the alternative and optional unique features of the operation of the shuffling device of the present invention are included the following sequence of events. These events need not necessary be combined within a single process to represent inventive steps, as individual steps and combinations of two or more steps may be used to define inventive processes.

In order to calibrate the shuffling device of the present invention to operate for a particular card size, a calibration set of cards comprising at least one card (usually one, although two, three, four or more cards could be used) is inserted into the shuffling chamber prior to shuffling. The elevator base plate defining the base of the shuffling chamber moves the calibration set of cards to the position within the chamber approximating a position within the gripper (not necessarily at a level or equal position with the bottom of the grippers), and the grippers move inwardly

(towards opposed edges of the cards) and attempts to grip the card(s). If the gripper grips the card(s), a sensor identifies either that the card(s) have been gripped by the grippers or the card(s) remain on the collection surface of the elevator (depending upon the position of the sensors. If there is no indication that a card(s) has been gripped, then the grippers move inwardly toward each other horizontally a set number of steps (e.g., steps being units of movement as in movement through a microstepping motor or unit of movement through any other motivating system), and the process is repeated. This gripping, sensing and moving sequence is repeated until the sensor(s) sense that a card has been lifted off the support plate and/or is supported in the gripper. The microprocessor identifies a fixed progression of steps of predetermined sizes of steps that are used in this gripping calibration as well as the position that accomplished the gripping. These determinations of card dimensions, gripping positions and elevator position may be done independently and/or in concert.

It is logical to proceed with the gripping identification first. The grippers move inwardly a predetermined distance initially and in the repeat testing. For example, in the first gripping attempt, the grippers may move in 10 or 15 or other number of steps. A larger number than one step or unit is desirable initially to assure that a rapid first grip is attained. After the first grip of a card(s) is sensed, then the microprocessor will widen the grip by fixed numbers of steps (here single steps may be used), with the widening occurring until no card is gripped. Once no card is gripped, a sufficient number of steps are added to the gripper movement to assure gripping and even slight elastic bending of the card by the grippers so that more cards can be supported and so that cards will not slip. This may be 1, 2, 4, 5, 8, 10, 12, 15 or any other number of steps to assure that secure gripping is effected. This procedure defines the "gripping" and "card release" position of the grippers for a particular group of cards. The microprocessor records the stepper motor positions corresponding to the gripper positions and uses this information to position the grippers during shuffling.

Now the platform offset is to be set (as opposed to the gripper offset positioning). The elevator is put in a base or home position, which may be the position of the

elevator (the height of the elevator) at the lowest position possible, or at a position below a framing support at the base of the collection chamber or some other predetermined position. The elevator is then raised in a series of a number of steps (again, in the initial gripping attempt, using larger numbers of steps is desirable to speed up the overall process, while during a more refined positioned identification/calibration sequence, smaller numbers of steps, even single steps, would be used) and the grippers are activated after each step, until the card is caught by the gripper for the first time. The number of steps moved each time for the first gripping action is preferably larger than single steps to assure that this card will be gripped at the lowermost edge of the grippers.. Again this may be 1, 2, 3, 4, 5,...8,...10, 15 etc. steps (or any number in between or larger number of steps). Once the calibration card(s) is gripped, this is an indication that the platform has now raised the cards to at least the bottom of the grippers. Once gripping has occurred, the elevator is then lowered by a smaller number of incremental stop positions (a finer adjustment) and a new position evaluated as to whether the grippers would then grip the calibration card. The process is repeated until the calibration card is just below the lowermost gripping position. This position is then recorded in memory. The repositioning is accomplished by lowering the elevator and support plate to a position well below the grippers and then raising the plate to a position a predetermined number of steps lower than the last position where the card(s) was gripped, and sensing whether the card was gripped at the new position. Depending upon the arrangement of the sensors, plates, and cards, it is possible to merely ungrip the card, then lower the elevator one or more predetermined number of steps, then attempt to regrip the card, and sense whether the card has been gripped.

Once the card has been lowered just below the gripper, a second calibration card is added to the card collection surface. The elevator position is registered/recorded. The precision of the system enables options in the practice of the invention such as the following. After a single card has been gripped, and a position determined where that single card will not be gripped with a slightly lowered elevator position (e.g., movement downward, which may be anywhere from 2 to 20 steps or more), another

calibration card or cards may then be added to the shuffling chamber on top of the calibration card(s). The elevator and grippers may then be exercised with the elevator moving single steps, until the sensor(s) determined that one card has been gripped and lifted off the support plate and another card(s) remains on the support plate. To this position is added a number of steps equal to a card thickness, and this final position is defined as the platform offset and identifies the position where the bottom-most card would be lifted off of the support plate.

Prior to inserting the first calibration card, the elevator is raised to a predetermined sensed position in the card collection area, and that position or elevation is recorded in memory. After the first group of cards are inserted and randomized, the procedure is repeated, this time either measuring the height of the elevator when the top card in the stack was at the original height of the elevator, or measuring a new height of the top of the stack of cards when the elevator returns to that recorded position. The difference in distances represents the thickness of the deck or group of cards. As each card is fed into the card collection surface, the number of cards are counted and this number is recorded. The processor uses both pieces of information to calculate an average card thickness, and to associate the number of motor steps to one card thickness. This information is then used in positioning the elevator for precise placement in the next shuffle.

At this point, all of the remaining cards in the deck(s) may be added to the shuffling chamber (either directly or into the card receiving chamber and then into the card shuffling chamber). The system may then check on the efficiency of the grippers by raising the deck to a level where all cards should be gripped, the grippers grip the entire deck (one, two, three or more times), and the elevator lowered. If no cards are dropped in the chamber, the system may proceed to normal shuffling procedures. If the grippers leave a card or a card falls back into the shuffling chamber, the gripper action may be automatically or manually (by an operator signal) adjusted to provided greater force on the cards, and the deck lift procedure is then attempted again, until the entire deck is lifted. The entire calibration process may have to be repeated if

there is any uncorrectable failure in a complete deck lift test procedure. The shuffler preferably includes a multiple segment information display as described in Breeding et al., U.S. Patent 6,325,373 entitled "Method and Apparatus for Automatically Cutting and Shuffling Playing Cards", the disclosure of which is herein incorporated by reference. The display may then indicate information relating to the state of the shuffler, such as the indication "AUTO ADJUST COMPLETE" and the operator may proceed with normal shuffling procedures, with or without further instruction on the display panel.

The calibration process described above is preferably repeated periodically to compensate for swelling and bending of the cards. In a preferred form of the invention, two cards are fed into the device and separated prior to each shuffle to verify that the device is still calibrated properly. If the cards do not separate, the calibration sequence is repeated. The device of the present invention includes a jam recovery feature similar to that described in Breeding et al., U.S. Patent 6,325,373. However, upon the fourth (or other number of failures) failure to recover from a jam, one or more of the calibration features described above are automatically activated.

This element of the total calibration process will thus calibrate the shuffling device in advance of any shuffling procedure with respect to the position of the bottom card (the card touching the elevator base plate or support plate) by moving the elevator up and down, by gripping and regripping the cards to identify a position where no cards are gripped and then only one card is gripped. The other gripping-regripping procedure within the total calibration process will also identify and calibrate the shuffling apparatus with respect to the unique size of cards placed into the shuffling apparatus. Based on the knowledge of how many cards have been inserted into the shuffling chamber in the set (preferably 1 card and then two cards total), the microprocessor identifies and determines the position of the elevator support plate, and the appropriate position of the elevator support plate with respect to the grippers and also the relative height of the number of cards in the set on the elevator card support plate. This information is stored for use with the particular stack of cards to

be used in the shuffling process. When subsequent decks are inserted, the operator may optionally indicate that the decks are 'the same' or sufficiently similar that the entire process need not be performed, or may indicate that the process may be initiated, or the machine may automatically make a check of a single card to determine if it appears to be the same size, and then the shuffling program will be initiated if the card is identified as the same size.

Additionally or alternatively, once the calibration set of cards has been first gripped, the grippers release the cards and regrip the cards, measuring any one or more of the a) position of the grippers relative to each other (with one or more of the two opposed grippers moving, the 'steps' or other measurable indicator of extent of movement or position of the grippers) is determined and registered for use by the microprocessor, b) the force or tension between the grippers (with the calibration set of cards or only one card) gripped between the grippers, c) the height of a top card (or the single card) in the calibration set when cards are flexed by the force of the grippers (which may be measured by sensors positions in the shuffling chamber), or any other system that identifies and/or measures a property or condition indicative of the gripping of the cards with a force in a range between a force insufficient to support the weight of the calibration set against slippage and bending the cards to a point where a card might lift off other cards in the calibration set. The calibration distance is typically in a range of between 93-99.5% of the length of width of the cards (whichever is being measured by picker movement, usually the length of the cards).

The positioning, repositioning and gripping of the cards are performed automatically and directed by the microprocessor or an additional microprocessor (there may even be a networked central control computer, but a microprocessor in the device is preferred). The elevator and the grippers are moved by steps or microsteps by a micro-stepping motor or other fine movement control system (e.g., hydraulic system, screw system, geared system, and the like). The use of the automatic process eliminates the need for technicians to set up individual machines, which must be done at regular intervals because of wear on parts or when cards are replaced. As noted, the

positioning may be performed with a calibration set as small as a single card. After the automated calibration or position determination has been performed, the microprocessor remembers that position and shuffling can be initiated with the stack of cards from which the calibration cards were taken.

This calibration or preshuffling protocol may be used in conjunction with any system where an elevator is used, whether with grippers, card inserting devices, injectors and the like (as described above) are used, and not only the specific apparatus shown in the figures. A similar calibration system for determining specific positions of carousel chambers in a carousel-type shuffling device may also be used, without grippers. The carousel may be rotated and the position of the shelves in the carousel with respect to other functional elements in the device may be determined. For example, card reading devices, card injection components, card removal elements, and card receiving chambers may be calibrated with regard to each other. As is understood by those ordinarily skilled in the art, there may be variations chosen among components, sequences of steps, and types of steps performed, with those changes still reflecting the spirit and scope of the invention disclosed herein.

In addition, the card collection chamber need not be vertically disposed. The chamber could be angled with respect to the vertical to improve contact between the card edges and the support structure located within the card collection area.

As noted, this description reflects a detailed description of the preferred practice of the invention with grippers. Alternative systems, such as those with injectors or stack wedges may also be used with the calibration system of the invention with modifications reflecting the different systems. For example, where the calibration in the preferred embodiment addresses the level of the grippers with respect to cards and the elevator support plate, the system may be translated to calibration of air injectors, wedge lifters, and blade or plate injectors. This is done with an equivalent procedure for identifying the position of a card(s) placed on the support plate. For example, rather than repeated tests with a gripper, repeated tests with an air injector (to see

when a card is ejected or injected by its operation), repeated tests with a blade or plate injector (to see when a card is ejected or injected by its operation), or a wedge separator with associated card(s) insertion (to see when the stack [e.g., a single card or a number of cards] are raised or when a card may be ejected or injected by its operation with minimum force).

The device of the present invention is also capable of monitoring card thickness and uses this information to determine the location or position in the stack where separation is to occur with great accuracy.

In another embodiment, a first sensor located in the shuffling chamber senses the height of the platform within the shuffling chamber in its lowermost position prior to the beginning of the randomization process, when no cards are in the shuffling chamber. The sensor could also sense the platform position in any other predetermined or "home" position or assign such nomenclature to a position.

After randomization, when all cards have been transferred into the shuffling chamber, the platform is returned to this same position, and the same or another sensor located in the shuffling chamber (also referred to herein as the collection chamber) may sense the height of the top card in the stack. The difference between the two measurements represents the thickness of the stack of cards. This is an alternate method of measuring stack thickness.

Sensors (such as optical sensors, sonic sensors, physical sensors, electrical sensors, and the like, as previously described) sense cards as they are individually fed from the infeed tray into the shuffling chamber. This information is used by the microprocessor to verify that the expected number of cards is present. In one example of the invention, if cards are missing or extra cards are present, the display will indicate a misdeal and will automatically unload.

The microprocessor uses the two height measurements and the card count to calculate an average card thickness. This thickness measurement is used to determine what height the elevator must be in order to separate the stack between any two "target" cards.

The average card thickness can be recalculated each time the shuffler is activated upon power up, or according to a schedule such as every 10 to 30 minutes, with 20 minute intervals as one preferred example.

The inventors have recognized that deck thickness increases the more the cards are used, and as the humidity in the air increases, and when cards become worn. Under humid conditions, it might be desirable to check the card thickness more often than ever 20 minutes. Under extreme conditions of continuous use and high humidity, it might be desirable to recalculate an average card thickness after the completion of every shuffle.

A novel method of determining an average card thickness measurement during shuffling is disclosed herein as an invention. The method includes providing a stack of cards, providing a card feeder capable of relative motion between the card feeder and the stack, and measuring a home position of the stack platform. The home position indicating a height of the elevator platform when no cards are present in the stacking area, feeding cards into the stacking area, counting a number of cards placed into the stacking area as they are fed, sensing a height of a topmost card in the stack when the elevator is returned to the same home position, and computing an average card thickness from the collected information (e.g., stack height/number of cards = height/card).

The average card thickness is advantageously used to determine the position of card grippers used to grasp cards. Upon lowering the platform beneath the grippers, an opening is formed at a precise predetermined location, allowing precise placement of the next card between two "target" cards.

According to the present invention, a sensor is positioned at a point of insertion into the group of cards in the card collection area. Each time a gap is formed, the sensor verifies that the gap is open, e.g.—that no cards are suspended or are hanging due to static forces. The card feeder activates when the sensor indicates the opening is clear. This method avoids jams and provides faster shuffling as compared to programming a time delay between the gripping of cards and subsequent lowering of the elevator and the insertion of the next card.

Another general description of a preferred device according to the invention is a device for forming a random set of playing cards comprising: a top surface and a bottom surface of said device; a receiving area for supporting an initial set of playing cards to be randomized; a randomizing system for randomizing the initial set of playing cards; a collection surface in a card collection area for receiving randomized playing cards, the collection surface being moveable in a vertical direction. In one example of the invention, cards are received onto the collection surface, either positioned directly on the surface or positioned indirectly on a card supported by the surface. All cards being randomized in this example are inserted into the card collection area at a location below the top surface of the device. Cards are fed individually off of the bottom of the stack located in the card receiving area and into the card collection area in one example of the invention.

An elevator is provided for raising the collection surface so that at the conclusion of shuffling, at least some randomized cards are elevated to a position at or above the top surface of the device. The elevator may be capable of raising all or part of the randomized cards at or above the top surface of the device. A cover may be provided to protect or mask the cards until they are elevated into a delivery position from which a dealer may remove the cards manually. The device may have a stack stabilizing area defined by a confining set of walls defining a shuffled card delivery area that confine all randomized cards along at least two, and preferably three edges after the randomized cards are elevated.

Alternatively, the card collection surface itself, elements positioned on the top surface of the shuffler or elements moved above the top surface of the shuffler may act to stabilize the cards so that they are more easily removed by the dealers hand(s). The present invention also contemplates raising the shuffled group of cards to the top surface of the shuffler, where there are no confining structures around the cards. In one example of the invention, the top surface of the shuffler is flush mounted into the gaming table surface, and the cards are delivered directly to the gaming table surfaces after shuffling.

The delivery area may be positioned such that its lower interior surface is at the same elevation as the top surface of the shuffler. The lower interior surface may be elevated above the top surface, or positioned beneath the top surface of the shuffler. In one example of the invention, the lower interior surface is at the same elevation as the top of the exterior of the shuffler. If the shuffler is mounted into and completely surrounded by a gaming table surface, it would be desirable to deliver cards so that the bottom card in the stack is at the same elevation as the gaming table surface.

The card receiving area may be sloped downwardly towards to randomizing system to assist movement of playing cards. The device may have at least one pick-off roller to remove cards one at a time from the card receiving area and to move cards, one at a time towards the randomizing components of the system. Although in one example of the invention the randomizing system suspends cards and inserts cards in a gap created below the suspended cards, other randomization systems can be employed, such as the random ejection shuffling technique disclosed in Sines U.S. Patent 5,584,483, the disclosure which hereby is incorporated by reference. The at least one pair of speed up rollers desirably receive cards from the at least one pick-off roller. A microprocessor preferably controls movement of the pick-off roller and the at least one pair of speed up rollers. The first card is preferably moved by the pick-off roller so that, as later described in greater detail, movement of the pick-off roller is altered (stopped or tension contact with the card is reduced or ended) so that no card other

than the first (lowermost) card is moved by either the pick-off roller or the at least one pair of speed up rollers. This can be done by sensing of the movement or tension on the first card effected by the at least one pair of rollers, causing the pick-off roller to disengage from the drive mechanism and freely rotate and to not propel the card.

The microprocessor, for example, may be programmed to direct the pick-off roller to disengage from the drive mechanism and to cease propelling a first card being moved by the pick-off roller when it is sensed that the first card is being moved by the at least one pair of rollers. A preferred randomization system moves one card at a time into an area overlying the collection surface. It is desirable to have one card at a time positioned into a randomized set of playing cards over the playing card collection surface. Again, as with the first general structure, the card collection area may be bordered on two opposed sides by two vertically disposed horizontally opposed movable card supporting elements. There is preferably an insertion point, such as an opening or slot to the card collection area that is located below a bottom edge of the two movable card supporting elements. The card supporting surface is vertically positionable within the card collection area, usually under the control and direction of a microprocessor. For example, the card supporting surface is moved by a motivator or elevator that is able to move incremental vertical distances that are no greater than the thickness of a playing card, such as incremental vertical distances that are no greater than one-half the thickness of a playing card. The motor may be, for example, a micro-stepper motor or an analog motor.

A sensor may be present within the collection area, below the top surface of the device, the sensor detecting a position of a top card of a group of cards in the card collection area below the group of suspended cards. In the alternative or in concert, the sensor detects the level of the card collection surface. In addition, a preferred device monitors the elevation of the top card when the two groups of cards are combined into one group, and adjusts for changes in the thickness of the deck, due to swelling, humidity, card wear, bowing of cards, etc. A microprocessor is preferably present in the device to control vertical movement of the card collection surface. The

sensor may identify the position of the collection surface to place the top card at a position level with the bottom of at least one card supporting element that is movable substantially horizontally from at least one side of the collection area towards playing cards within the card collection area.

In one example of the invention, an opening such as a slot is provided in a side wall of the card collection area to permit transfer of cards from the card receiving area into the card collection area. The side wall may comprise a substantially solid support structure; adjoining edges of a plurality of vertical "L" shaped corner support structures, or other equivalent structure capable of retaining a stack of cards in a substantially upright position. The microprocessor may be programmed to determine a distance that the card supporting surface must be vertically moved to position at least one specific card, including or other than the top card at a bottom edge of the at least one card supporting element when the card supporting element moves to contact cards within the card collection area. As previously described, the at least one card supporting element may comprise at least two elements such as gripping pads that move from horizontally opposed sides of the collection area towards playing cards within the card collection area.

The microprocessor may be programmed to lower the card collection surface within the card collection area after the at least one card supporting element has contacted and supported cards within the card collection area, creating two vertically spaced apart segments or substacks of cards. The microprocessor directs movement of an individual card into the card supporting area between the two separated segments of cards. The microprocessor may direct movement of playing card moving elements within the device. The microprocessor randomly assigns final positions for each card within the initial set of playing cards, and then directs the device to arrange the initial set of playing cards into those randomly assigned final positions to form a randomized final set of playing cards. Each card is inserted into the building stack of collected (randomized or shuffled) cards by positioning them in respect to the other cards already in the stack. Thus, even if a first card is not intended to be adjacent to a

particular card, but is intended to be above that particular card, the first card is positioned above (and possibly adjacent to) the particular card, and intervening cards in the intended sequence added between the first card and the particular card.

In one embodiment of the invention, the card receiving area is located such that individual cards are fed off of the bottom of the stack, through the slot formed in the *card collection area, directly beneath the gripping elements. In another example of* the invention, a card loading elevator is provided so that the cards can be loaded into the card receiving area at an elevation above that of the first embodiment. The elevator then lowers the cards to a vertical position aligned with the feed mechanism.

When the device is used to process large batches of cards, such as groups of eight decks, it is desirable to provide a feed elevator to lower the entire batch of cards beneath the top surface of the shuffler, prior to shuffling. The card feeding mechanism from the card receiving area to the card collection or shuffling area is necessarily positioned lower in a shuffler that processes more cards than in a shuffler that processes fewer cards.

When a large number of cards is to be inserted into the machine for shuffling, a *retaining structure may be provided, consisting of a card stop or frame to limit card* movement on up to three sides of the elevator. The open side or sides permit the dealer to load the stack from the side of the elevator, rather than trying to load the elevator from above, and allowing cards to fall freely and turn over.

A randomizing elevator is provided for moving the cards being randomized and operates to raise and lower the bottom card support surface of the card collection area. This elevator moves during randomization, and also aids in the delivery of the shuffled group of cards by raising the shuffled cards to a delivery area. Reference to the figures will assist in appreciation and enablement of the practice of the present invention. Upwardly extending side walls on the card collection surface, an elevator arm or extension of an elevator arm, or another element attached to the arm may move

with the elevator and be used to move other portions of the shuffling apparatus. For example, the arm extension may be used to lift hinged or sliding covers over the cards as the cards are raised above a certain level that exceeds the normal shuffling elevation of the elevator.

Figure 1 shows a partial perspective view of the top surface **4** of a first shuffling apparatus **2** according to a practice of the invention. In this example of the invention, the device randomizes one or two decks of cards. The shuffling apparatus has a card accepting/receiving area **6** that is preferably provided with a stationary lower support surface that slopes downwardly from the nearest outer side **9** of the shuffling apparatus **2**. A depression **10** is provided in that nearest outer side **9** to facilitate an operator's ability to place or remove cards into the card accepting/receiving area **6**. The top surface **4** of the shuffling apparatus **2** is provided with a visual display **12** (e.g., LED, liquid crystal, micromonitor, semiconductor display, etc.), and a series of buttons, touch pads, lights and/or displays **24** and **26**. These elements on the top surface **4** of the shuffling device **2** may act to indicate power availability (on/off), shuffler state (jam, active shuffling, completed shuffling cycle, insufficient numbers of cards, missing cards, sufficient numbers of cards, complete deck(s), damaged or marked cards, entry functions for the dealer to identify the number of players, the number of cards per hand, access to fixed programming for various games, the number of decks being shuffled, card calibration information and the like), or other information useful to the operator or casino.

Also shown in Figure 1 is a separation plate **20** with a beveled edge **21** and two manual access facilitating recesses **22** that assists an operator in accessing and removing jammed cards between the card accepting area **6** and the shuffled card return area **32**. The shuffled card return area **32** is shown to be provided with an elevator surface **14** and two separated card-supporting sides **34**. In a preferred embodiment, sides **34** are removable. When the shuffler is flush-mounted into and surrounded by the top of a gaming table surface, removal of sides **34** enables the device to lift shuffled groups of cards onto the gaming table surface for immediate

use. The card supporting sides **34** surround a portion of the elevator surface **14** with interior faces **16** and blocking extensions **18**. It is desirable to provide rounded or beveled edges **11** on edges that may come into contact with cards to prevent scratching, catching or snagging of cards, or scratching of operators' fingers or hands.

Figure 2 shows a cutaway side view of a first embodiment of a shuffling apparatus **102** according to the present invention. The top surface **104** is shown with a separation plate **120** and the side panels **134** (card supporting sides) of the shuffled card return area **132**. The card accepting/receiving area **106** is recessed with respect to the top surface **104** and is shown with a declining sloping support surface **108**. At the front **135** of the sloping surface **108** is an opening **136** (not able to be seen in the direct side view) or slot through which a bottom pick-off wheel **138** may contact a bottom card in an unshuffled set of cards (not shown) within the card accepting/receiving area **106**. The bottom pick-off roller **138** drives a card in direction **140** by frictional contact towards a first pair of nip rollers or off-set rollers **142**. In one example of the invention, the upper roller of off-set rollers **142** is a break roller. This break roller retains the second top card for separation in the event that two cards are fed at the same time. In a preferred form of the invention, the upper roller does not rotate. In another form of the invention, the upper roller rotates, but is rotationally constrained.

There are an additional two pairs **144 146** of nip rollers or off-set rollers acting in concert (or only one pair is being driven) to move cards first moved by the first set of nip rollers **142**. In a preferred practice of the present invention, the operation of the apparatus **102** may perform in the following manner. When a card (not shown) is moved from the unshuffled card accepting/receiving area **106**, eventually another card in a stack of cards within the card accepting/receiving area **106** is exposed. The apparatus is designed, programmed and controlled to operate so that individual cards are moved into the first set of nip rollers or off-set rollers **142**. If more than one card from the card accepting/receiving area advances at any given time (even if in partial sequence, with a portion of one card overlapping another card), it will be more

difficult or even impossible for the apparatus to direct individual cards into predetermined positions and shuffle the cards randomly.

If two cards are moved at the same time and positioned adjacent to each other, this uncontrollably decreases the randomness of the shuffling apparatus. It is therefore desirable to provide a capability whereby when a card is moved into the control area of the first set of nip rollers or off-set rollers **142**, the drive function of the bottom pick-off roller **138** ceases on that card and/or before the bottom pick-off roller **138** drives the next card. This can be effected by a wide variety of techniques controlled or directed by a microprocessor, circuit board, programmable intelligence or fixed intelligence within the apparatus.

Among the non-limiting examples of these techniques are 1) a sensor so that when a pre-selected portion of the card (e.g., leading edge, trailing edge, and mark or feature on the card) passes a reading device, such as an optical reader, the bottom pick-off roller **136** is directed to disengage, revolve freely, or withdraw from the bottom of the set of cards; 2) the first set of nip rollers or off-set rollers **144** may have a surface speed that is greater than the surface speed of the bottom pick-off roller **138**, so that engagement of a card applies tension against the bottom pick-off roller **138** and the roller disengages with free rolling gearing, so that no forward moving (in direction **140**) forces are applied to the first card or any other card exposed upon movement of the first card; 3) a timing sequence so that, upon movement of the bottom pick-off roller for a defined period of time or for a defined amount of rotation (which correlates into a defined distance of movement of the first card), the bottom pick-off roller **138** disengages, withdraws, or otherwise stops applying forces against the first card and thereby avoids applying forces against any other cards exposed by movement of the first card from the card accepting/receiving area **106** and 4) providing a stepped surface (not shown) between pick-off roller **138** and off-set rollers **146** that contacts a leading edge of each card and will cause a card to be held up or retained in the event that more than one card feeds at a time.

The cards are eventually intended to be fed, one-at-a-time from final nip rollers or off-set rollers **146** into the card mixing area **150**. The cards in the mixing area **150** are supported on elevator platform **156**. The platform **156** moves the stack of cards present in the mixing area up and down as a group in proximity with a pair separation elements **154**. The pair of separation elements **154** grip an upper portion of cards, and supports those cards while the elevator drops sufficiently to provide an opening for insertion of a card into the stack. This movement within the apparatus **102** in the performance of the shuffling sequence offers a significant speed advantage in the shuffling operation as compared to U.S. Patent No. 5,683,085, especially as the number of cards in the card mixing area **150** increases. Rather than having to lower the entire stack of cards to the bottom of the card receiving area and reposition the pickers (as required by U.S. Patent No. 5,683,085), the cards in the present apparatus may be dropped by the pickers or the elevator needs to move only a slight distance to recombine the cards supported by the separation element **154** (a gripper, and insertion support, fingers, friction engaging support, rubber fingers, etc.) with the cards supported on the elevator platform **156**.

The stationary pair of gripping pads also maintains the alignment of the pads with respect to each other and grips the cards more securely than the device described in U.S. Patent 5,683,085, reducing or eliminating the unintentional dropping of a card or cards that were intended to be gripped, rather than lowered. Whenever cards are dropped, the randomness of the final shuffle may be adversely affected. Although the first example of the invention shows a pair of oppositely positioned gripping members, it is possible to utilize just one gripper. For example, the opposite vertical support surface could be equipped with a rubber or neoprene strip, increasing frictional contact, allowing only one gripper to suspend groups of cards.

The elevator of a device with stationary grippers may then be moved to the next directed separation position, which would require, on average, less movement than having to reset the entire deck to the bottom of the card supporting area and then

moving the picker, and then raising the picker to the card insertion point, as required in U.S. Patent No. 5,683,085.

The microprocessor **160** controls and directs the operation of the shuffling apparatus **102**. The microprocessor **160** also receives and responds to information provided to it. For example, a set of sensing devices **152** are used to determine the movement point of the elevator that positions the top card in a set of cards (not shown) within the card mixing area **150** at a specific elevation. The sensing devices **152** identify when an uppermost card on the platform **156** or the top of the platform itself is level with the sensors **152**. This information is provided to the microprocessor. A reading system **170** may also be used to provide information, such as the number of cards that have been fed from the card accepting/receiving area **106** into the card mixing area **150** so that the number of cards shuffled and the number of cards present on the platform **150** at any given time is known. This information, such as the number of cards present within the card mixing area **150**, is used by the microprocessor **160**, as later explained to randomly arrange and thus shuffle cards according to the programming of the system.

For example, the programming may be performed as follows. The number of cards in a set of cards intended to be used in the system is entered into the memory of the microprocessor. Each card in the set of cards is provided with a specific number that is associated with that particular card, herein referred to as the original position number. This is most conveniently done by assigning numbers according to positions within the original (unshuffled) set of cards. If cards are fed from the bottom of the stack into the randomizing apparatus, cards are assigned numbers from the bottom to the top. If cards are fed from the top of the stack or the front of a stack supported along its bottom edges, then the cards are numbered from top to bottom, or front to rear.

A random number generator (which may be part of the microprocessor **160**, may be a separate component or may be external to the device) then assigns a random position

number to each card within the original set of cards, the random position number being the randomly determined final position that each card will occupy in the randomly associated set of cards ultimately resulting in a shuffled set of cards. The microprocessor identifies each card by its original position number. This is most easily done when the original position number directly corresponds to its actual position in the set, such as the bottom-most card being CARD 1, the next card being CARD 2, the next card being CARD 3, etc. The microprocessor, taking the random position number, then directs the elevator to move into position where the card can be properly inserted into the randomized or shuffled set of cards. For example, a set of randomized positions selected by a random number generator for a single deck is provided below. OPN is the Original Position Number and RPN is the Random Position Number.

OPN	RPN		OPN	RPN		OPN	RPN		OPN	RPN
1	13		**14**	10		**27**	14		**40**	4
2	6		**15**	21		**28**	31		**41**	20
3	39		**16**	29		**29**	50		**42**	47
4	51		**17**	33		**30**	7		**43**	37
5	2		**18**	11		**31**	46		**44**	30
6	12		**19**	52		**32**	23		**45**	24
7	44		**20**	5		**33**	41		**46**	38
8	40		**21**	18		**34**	19		**47**	15
9	3		**22**	28		**35**	35		**48**	36
10	17		**23**	34		**36**	26		**49**	45
11	25		**24**	9		**37**	42		**50**	32
12	1		**25**	48		**38**	8		**51**	27
13	49		**26**	16		**39**	43		**52**	22

The sequence of steps in the shuffling or randomizing procedure may be described as follows for the above table of card OPN's and RPN's. OPN CARD 1 is carried from the card receiving area **106** to the final nip rollers or off-set rollers **146**. The final nip rollers or off-set rollers **146** place CARD 1 onto the top of the platform, which has been appropriately positioned by sensing by sensors **152**. OPN CARD 2 is placed on top of CARD 1, without the need for any gripping or lifting of cards. The microprocessor identifies the RPN position of CARD 3 as beneath both CARD 1 and CARD 2, so the elevator **156** lifts the cards to the gripping element **154** which grips both CARD 1 and CARD 2, then supports those two cards while the elevator retracts, allowing CARD 3 to be placed between the elevator platform **156** and the two supported cards. The two cards (CARD 1 and CARD 2) are then placed on top of CARD 3 supported by the platform **156**. The fourth card (CARD 4) is assigned position RPN 51. The elevator would position the three cards in the pile so that all three cards would be lifted by the card separation element, and the fourth card inserted between the three cards (CARD 1, CARD 2 and CARD 3) and the platform **156**. The fifth card (CARD 5) has an RPN of 2, so that the apparatus merely requires that the four cards be positioned below the insertion point from the last two nip rollers **146** by lowering the platform **150**. Positioning of the sixth card (CARD 6) with an RPN of 12 requires that the elevator raise the complete stack of cards, the sensors **152**

sense the top of the stack of cards, elevate the stack of cards so that the separators **154** grip only the top two cards (RPN positions 2 and 6), lower the platform **156** slightly, and then CARD 6 with an RPN of 12 can be properly inserted into an opening in the developing randomized set of cards. This type of process is performed until all 52 cards (for a single deck game) or all 104 cards (for a double deck game) are randomly associated into the final randomized set or shuffled set of cards. The apparatus may be designed for larger groups of cards than single fifty-two card decks, including 52 card decks with or without special (wild cards or jokers) cards, special decks, two fifty-two card decks, and two fifty-two card decks plus special cards. Larger groupings of cards (e.g., more than 108 cards) may also be used, but the apparatus of the first example of the invention has been shown as optimized for one or two deck shuffling.

Elevation of the elevator or platform **156** may be effected by any number of commercially available type systems. Motivation is preferably provided by a system with a high degree of consistency and control over the movement of the elevator, both in individual moves(e.g..—individual steps or pulses) and in collective movement of the elevator (the steps or revolutions made by the moving system). It is important that the elevator is capable of providing precise and refined movement and repeated movements that do not exceed one card thickness. If the minimum degree of movement of the elevator exceeds one card thickness, then precise positioning could not be effected. It is preferred that the degree of control of movement of the elevator does not exceed at least one-half the card thickness. In this manner, precise positioning of the cards with respect to the separating elements **154** can be effected. Additionally, it is often desirable to standardize, adjust, or calibrate the position of the elevator (and/or cards on the elevator) at least once and often at intervals to assure proper operation of the apparatus **102**. In one example of the invention, the microprocessor **160** calls for recalibration periodically, and provides the dealer with a warning or calibration instructions on the display 12.

As later described, a micro stepping motor or other motor capable of precise and small controlled movements is preferred. The steps for example may be of such magnitudes that are smaller than the card thickness, such as for example, individual steps of 0.0082 inches (approximately less than 1 card thickness), 0.0041 inches (less than 1/2 card thickness), 0.00206 inches (less than about 1/4th card thickness), 0.0010 inches (less than about 1/8th card thickness), 0.00050 inches (less than about 1/16th card thickness), 0.00025 inches (less than about 1/32nd card thickness) 0.000125 inches (less than about 1/64th card thickness), etc.

Particularly desirable elevator control mechanisms would be servo systems or stepper motors and geared or treaded drive belts (essentially more like digital systems). Stepper motors, such as micro-stepper motors, are commercially available that can provide or can be readily adjusted to provide incremental movements that are equal to or less than one card thickness, with whole fractions of card thicknesses, or with indefinite percentages of card thicknesses. Exact correspondence between steps and card thickness is not essential, especially where the steps are quite small compared to the card thickness. For example, with a card thickness of about 0.279 mm, the steps may be 0.2mm, 0.15mm, 0.1mm, 0.08mm, 0.075mm, 0.05mm, 0.04mm, 0.01mm, 0.001mm or smaller, and most values there between. It is most desirable to have smaller values, as some values, such as the 0.17mm value of a step, can cause the gripper in the separation element to extend over both a target position to be separated and the next lower card in the stack to be gripped, with no intermediate stepping position being available. This is within the control of the designer once the fundamentals of the process have been understood according to the present description of the practice of the invention. As shown in Figure 2, a drive belt **164** is attached to two drive rollers **166** which move the elevator platform **156**. The belt **164** is driven by a stepper motor system **170** which is capable of 0.00129 inch (0.003 mm) steps.

Figure 3 shows a perspective cutaway of the drive rollers or nip rollers **142**, **144** and **146** of a first example of the invention. These are not truly sets of nip rollers, but are

off-set rollers, so that rollers **142a** and (not shown), **144a** and **144b**, **146a** and **146b** are not precisely linearly oriented. By selecting a nip width that is not so tight as to press a card from both sides of the card at a single position, and by selecting offset rollers rather than aligned nip rollers, fluid movement of the card, reduced damage of the card, and reduced jamming may be provided. This is a particularly desirable aspect of a preferred practice of the present invention, which is shown also in Figure 4.

Figure 4 shows a set of off-set rollers **144a**, **144b**, **144c**, **144d** and **144e** transporting a card **200**. The card **200** is shown passing over rollers **144a** and **144d** and under rollers **144b**, **144c** and **144e**. As can be seen, the rollers are not capable of contacting a card to precisely overlap at a specific point on opposite sides of a card.

Figure 5 shows a cross-sectional view of one embodiment of a gripping system **204** that may be used in the practice of the invention. The Figure shows two oppositely spaced support arms **206** and **208** that support gripping elements **210** and **212**, which comprise semi-rigid gripping pads **214** and **216**. These gripping pads **214** and **216** may be smooth, grooved, covered with high friction material such as rubber or neoprene, ribbed, straight, sloped or the like to take advantage of various physical properties and actions. The support arms **206** and **208** are attached to separately moveable positioning arms **218** and **220**. These positioning arms are referred to as separately moveable, in that they are not physically connected, but one tends to move from left to right while the other moves right to left (with respect to the view shown in Figure 5) as the two positioning arms move in and out (substantially horizontally) to grip or release the cards. However, preferably they do not move independently, but should move in concert. It is also desirable that they are fixed with respect to the vertical. If the positioning arms moved completely independently (horizontally, during gripping), with only one moving to attempt to contact the cards at a time, the first contacting arm could move cards out of vertical alignment. For this reason, it is preferred that two opposed gripping arms be used.

Although the arms may not move the contact pads **214** and **216** into contact with absolute precision, they should contact opposite edges of the cards at approximately the same time, without moving any cards more than 5% of the length of a card (if contacted lengthwise) or 7% of the width (if contacting the cards widthwise). An example of one mechanism for moving the positioning arms in concert is by having a drive belt **226** that engages opposite sides of two connectors **222** and **224** that are attached to positioning arms **220** and **218**, respectively. The belt **226** contacts these connectors **222** and **224** on opposite sides, such as contact connector **224** on the rear side, and contact connector **222** on the front side. As the belt **226** is driven by rotors **228** and **230**, with both rotors **228** and **230** turning in direction **232**, connector **222** will be moved from left-to-right, and connector **224** will be moved from right to left. This will likewise move contact pads **214** and **216** inwardly to grip cards. The use of such pads is much preferred over the use of rigid, pointed, spatula elements to separate cards, as these can damage cards, not only increasing the need for replacement, but also by marking cards which could reduce security.

Alternative constructions comprise a flat elastic or a rubbery surface with knobs or nubs that extend upwardly from the surface to grab cards when pressed into contact with the sides of the cards. These elements may be permanently affixed to the surfaces of the pickers or may be individually removable and replaceable. The knobs and the flat surface may be made of the same or different materials, and may be made of relatively harder or softer, relatively rigid or relatively flexible materials according to design parameters.

The apparatus may also contain additional features such as card reading sensor(s) such as an optical sensor, neural sensing network, a video imaging apparatus, bar code reading, etc. to identify suits and ranks of cards; feed means for feeding cards sequentially past the sensor; at various points within the apparatus; storing areas in which the cards are stored in a desired order or random order; selectively programmable artificial intelligence coupled to the sensor(s) and to said storing areas to assemble in said storing areas groups of articles in a desired order; delivery systems

for selectively delivering the individual articles into the storing areas, and collector areas for collecting collated or randomized sub-groups of cards.

The sensor(s) may include the ability to identify the presence of an article in particular areas, the movement or lack of movement in particular areas, the rank and/or value of a card, reading of cards to identify spurious or counterfeit cards and detection of marked cards. This can be suitably effected by providing the sensor with the capability of identifying one or more physical attributes of an article. This includes the sensor having the means to identify indicia on a surface of an article. The desired order may be a specific order of one or more decks of cards to be sorted into its original pack order or specific order, or it may be a random order into which a complete set of articles is delivered from a plurality of sets of randomly arranged articles. For example, the specific order may be effected by feeding cards into the card accepting area with a sensor identifying the suit and rank, and having a pre-established program to assign cards, based upon their rank and suit, into particular distributions onto the elevator platform. For example, a casino may wish to arrange the cards into pack order at the end of a shift to verify all cards are present, or may want to deal cards out in a tournament in a specified random order. The sensing can take place in the card receiving area when the cards are stationary, or while the cards are in motion.

The suit, rank and position of all cards in the card accepting/receiving area will then be known, and the program can be applied to the cards without the use of a random number generator, but with the microprocessor identifying the required position for that card of particular suit and rank. The card may also be read between the off-set rollers or between the last off-set roller and the platform, although this last system will be relatively slow, as the information as to the card content will be known at such a late time that the platform cannot be appropriately moved until the information is obtained.

For example, the desired order may be a complete pack of randomly arranged playing cards sorted from holding means which holds multiple decks, or a plurality of randomly oriented cards forming a plurality of packs of cards. This may be achieved by identifying the individual cards by optical readers, scanners or any other means and then under control of a computer means such as a micro-processor, placing an identified card into a specific collector means to ensure delivery of complete decks of cards in the desired compartment. The random number generator is used to place individual cards into random positions to ensure random delivery of one to eight or more decks of cards, depending on the size of the device.

In one aspect the invention, the apparatus is adapted to provide one or more shuffled packs of cards, such as one or two decks for poker games or blackjack. According to another aspect of the invention, a method of randomizing a smaller or larger group of cards is accomplished using the device of the present invention. According to the invention, the method includes the steps of 1) placing a group of cards to be randomized into a card infeed tray; 2) removing cards individually from the card infeed tray and delivering the cards into a card collection area, the card collection area having a moveable lower surface, and a stationary opening for receiving cards from the infeed tray; 3) elevating the moveable lower surface to a randomly determined height; 4) grasping at least one edge of a group of cards in the card collection area at a point just above the stationary opening; 5) lowering the moveable lower surface to create an opening in a stack of cards formed on the lower surface, the opening located just beneath a lowermost point where the cards are grasped; and 6) inserting a card removed from the infeed tray into the opening. According to the method of the present invention, steps 2 through 6 are repeated until all of the cards originally present in the infeed tray are processed, forming a randomized group of cards.

As described above, the method and apparatus of the present invention can be used to randomize groups of cards, as well as sort cards into a particular desired order. When sensing equipment is used to detect rank and suit of the cards, the cards can be arranged in any predetermined order according to the invention. It is to be understood

that numerous variations of the present invention are contemplated, and the disclosure is not intended to limit the scope of the invention to the examples described above. For example, it might be advantageous to tip the card mixing area **150** slightly such that a top portion is further away from the card receiving area **106** than a bottom portion. This would assist in aligning the stack vertically in area **150** and would increase the efficiency and accuracy of the randomization or ordering process. In one preferred embodiment, the card receiving area **150** is tipped between 3 and 8 degrees from the vertical.

In another embodiment of the invention, the shuffler is mounted into the table such that infeed tray or card receiving area **106** is recessed beneath the top surface of a gaming table, and a lower horizontal surface **156** of the delivery area or card return area **132** in its upright position is flush with the elevation of the gaming table surface.

Although the machine can sit on the table top, it is preferably mounted on a bracket having a support surface located beneath the gaming table surface, and is completely surrounded by the table top, enabling a dealer to obtain and return cards without undue lifting above the surface of the gaming table. In one embodiment, the entire shuffler is mounted into the gaming table such that the infeed tray and card return areas are either flush or approximately flush with the gaming table surface. Such an arrangement would be particularly suited for use in conventional poker rooms.

In a second example of the invention, the device is configured to process larger groups of cards, such as a stack of eight complete decks. The individual components operate in much the same manner, but the specific configuration is designed to accommodate the greater height of the stack.

Figure 6 shows a vertical perspective view of another apparatus **500** according to the invention. That apparatus **500** is shown with a flip-up cover **502** with sections **504** and **506** that overlay the elevator platform **512** and the card insertion area **510**. An extension or tab **507** is provided to nest into open area **508** to assist lifting of the flip-

up cover **502** when needed. The open area **508** leaves some additional space for a finger or tool to be inserted against the extension **507** to assist in its lifting. That additional space may be designed to accommodate only a tool so as to reduce any possibility of ready player opening of the shuffling apparatus **500**. In a preferred embodiment of the invention, there is provided an arm extension **514** of the elevator that contacts an internal edge **513** of the flip-up cover **502**, here with a roller **515** shown as the contact element, to lift the cover **502** when the elevator platform **512** rises to a level where cards are to be removed, the extension **514** forces the cover **502** to lift from the top **517** of the apparatus **500**. The extension **514** also will buffer playing cards from moving as they are lifted from the elevator platform **512**, although additional elements (not shown) may be used to restrain movement of the cards when elevated to a removal level. In this example of the invention, side panels are not used to stabilize the stack of delivered cards.

Figure 6 also shows a display panel **516**, which may be any format of visual display, particularly those such as LED panels, liquid crystal panels, CRT displays, plasma displays, digital or analog displays, dot-matrix displays, multi-segment displays, fixed panel multiple-light displays, or the like, to provide information to a viewer (e.g., dealer, casino personnel, etc.). The display panel **516** may show any information useful to users of the apparatus, and show such information in sufficient detail as to enable transfer of significant amounts of information. Such information might include, by way of non-limiting examples, the number of cards present in the apparatus, the status of any shuffling or dealing operations (e.g., the number of complete shuffling cycles, hand information (such as the number of hands to be dealt, the number of hands that have been dealt, the number of cards in each hand, the position to which a hand has been dealt, etc.), security information (e.g., card jam identification, location of card jams, location of stuck cards, excess cards in the container, insufficient cards in the container, unauthorized entry into the apparatus, etc.), confirmation information (e.g., indicating that the apparatus is properly corresponding to an information receiving facility such as a network or microprocessor at a distal or proximal location), on-off status, self-check status, and

any other information about play or the operation of the apparatus that would be useful. It is preferred that the display and the software driving the display be capable of graphics display, not merely alphanumeric.

Buttons **518** and **520** can be on-off buttons, or special function buttons (e.g., raise elevator to the card delivery position, operate jam sequence, reshuffle demand, security check, card count demand, etc.) and the like. A sensor **524** (e.g., optical sensor, pressure sensor, magnetic detector, sonar detector, etc.) is shown on the elevator platform **512** to detect the presence of cards or other objects on the elevator platform **512**.

Figure 7 is a side cutaway view of an apparatus **600** according to an aspect of the invention, which may be compared with Figure 2 to provide an explanation of components and some of the variations possible within the practice of the invention. For example, the use of two belt drive motors **662** and **664** versus the three shown in Figure 2 allows for the apparatus **600** to be shortened, with motor **662** driving a belt **666** that moves three rollers **668, 669** and **670**. The roller pair **144** is removed from this example of the invention as superfluous. The drive roller **166** in Figure 2 that raises the elevator **156** is partially eliminated by having the elevator drive belt **672** driven by the motor **674** and the attached spindle **676**, which have been positioned in direct alignment with the drive belt **672** in Figure 5, instead of the right angle, double belt connection shown in Figure 2. Again, as the belt **672** moves far enough to display cards (not shown) on the elevator platform **612**, the extension **614** presses against the edge **613** of the cover section **604**, elevating the cover top **602**. The apparatus **600** is actually preferably configured with the sections **604** and **606** separated along area **680** so that they move independently. By separating these sections **604** and **606**, only the cards readied for delivery are exposed, and access to the area **682** where unshuffled cards are to be inserted is more restricted, especially where, as noted above, a tool or implement is needed to raise the cover section corresponding to **606** so that the unshuffled cards may not be too readily accessed.

In Figure 7, the motors **662**, **664** and **674** are preferably highly controlled in the degree of their movement. For example, one of the methods of providing precise control on motor movement is with micro stepped motors. Such micro stepping of motors controls the precise amount of movement caused by the motor. This is especially important in motor **674** that drives the elevator platform **612** which in turn carries the cards (not shown) to be separated for random card insertion. With micro stepping, the movement of the cards can be readily controlled to less than a card thickness per micro step. With such control, with no more than 0.9 card thickness movement, preferably less than 0.8 card thickness movement, less than 0.5 card thickness movement, less than 0.4 card thickness movement, less than 1/3 card thickness movement, less than 0.25 card thickness movement, less than 0.20 card thickness movement, and even less than .05 card thickness movement per micro step, much greater assurance of exact positioning of the elevator platform **612** and the cards thereon can be provided, further assuring that cards will be inserted exactly where requested by operation of the microprocessor. Sensing elements **684** may be positioned within the picker or grabbing element **686** to analyze the position of the picker with respect to cards being separated to determine if cards have been properly aligned with the picker **686** and properly separated. The elements **686** may alternatively be physically protruding sub-elements that grab small areas of cards, such as rubber or elastomeric bumps, plastic bumps, metal nubs, or the like. Sensors may alternatively be placed on other surfaces adjacent the picker **686**, such as walls **688** or **690** or other adjacent walls or elements. For increased security and enhanced performance, it is preferred that multiple sensors be used, preferably multiple sensors that are spaced apart with regard to edges of the cards, and multiple sensors (i.e., at least two sensors) that are positioned so that not only the height can be sensed, but also misalignment or sloping, or bending of cards at different locations or positions. The sensors can work independently of or in tandem with the microprocessor/step motor/encoder operation.

The micro step motors will also assist the apparatus in internal checks for the correct position. For example, an encoder can be used to check the exact position of the

elevator with regard to the measured movement and calculation of the precise movement of the elevator platform and hence the cards. The encoder can evaluate the position of the elevator platform through analysis and evaluation of information regarding, for example, the number of pulses/revolution of the spindle **676** on the motor **674**, which may be greater than 100 pulses/revolution, greater than 250 pulses/revolution, greater than 360 pulses/revolution, greater than 500 or greater than 750 pulses/revolution, and in preferred embodiments, greater than 1000 pulses/revolution, greater than 1200 pulses per revolution, and equal to or greater than 1440 pulses/revolution. In operation, the microprocessor moves the motor, the encoder counts the amount of movement driven by the motor, and then determines the actual position of the elevator platform or a space (e.g., four cards higher) relative to the elevator platform. The sensors may or may not be used to determine the correct position, initially calibrate movement and sensing positions on the platform, or as a security check

An additional design improvement with respect to the apparatus of Figure 1 and that of Figures 6 and 7 is the elimination of a staging area in the apparatus design of Figure 1. After a card (not shown) in Figure 1 passes from rollers **140** to rollers **144**, but before being passed to rollers **146**, the card would be held or staged by rollers **144**. This can be eliminated by the design of rollers shown in Figures 6 and 7, with the movement of the cards timed to the movement of the elevator platform and the separation of the cards by the pickers.

The apparatus **500** shown in Figure 6 is also provided with an outer flange **528** extending around an upper edge of the top surface that may be used to attach and support the apparatus **500** to a table or support the apparatus **500** so that the surface **517** if relatively parallel to the surface of the table or surface.

The use of a shuffler whose shuffling mechanism is concealed completely beneath the gaming table surface potentially poses security issues to a casino. In the event of a system malfunction, the dealer might not be aware that a shuffling sequence has

failed. Since there is no way to visualize the shuffling routine, and in order to avoid instances where the display lights may malfunction and erroneously show a shuffling sequence has been completed, an added level of security has been provided to the shuffler of the present invention.

According to the present invention, a number of cards to be randomized and the order of insertion of each card into the card randomizing or shuffling compartment is predetermined by the random number generator and microprocessor. By adding an encoder to the motor or motors driving the elevator, and by sensing the presence of groups of suspended cards, the MPU can compare the data representing the commands and the resulting movements to verify a shuffle has occurred. In the absence of this verification, the shuffler can send a signal to the display to indicate a misdeal, to a central pit computer to notify management of the misdeal, to a game table computer, if any with an output display to notify the dealer of a misdeal, to a central computer that notifies security, to a central system for initiating maintenance calls or combinations of the above.

Such a system is referred to as a "closed loop" system because the MPU creates the commands and then receives system signals verifying that the commands were properly executed.

Although the dealer control panel and display in the above examples of the present invention are located on the card shuffler, the present invention contemplates user-operated remote controls, such as a foot pedal, an infra-red remote control, the input of commands from a remote keyboard in the pit or other device initiated by a dealer or by management. Unlike the shuffler operation driven by software from a game computer, pit computer or central computer system, the shuffler of the present invention is controllable by an operator using remote equipment such as what is described above.

Although the randomizing system has been described as a vertically disposed stack of cards with a means for gripping a portion of the cards, and lowering the remaining cards to form two separate subgroups, forming an insertion point, the invention contemplates the use of a shuffler with a carousel-type card collection area. The gripping pads in this example of the invention grip a portion of cards that are horizontally disposed, and the card collection area rotated to create an insertion point for the next card. The cards are pushed out one at a time, or in groups to a card collection area.

Referring now to Figure 8, a perspective view of a shuffling machine **600** of the present invention is shown mounted to a shuffler support plate **602** behind a gaming table **(not shown)** that may or may not be modified to accommodate placement of the support plate **602**.

In this example of the invention, cards are loaded into an infeed tray**606**. In one example of the invention (not shown), the lower surface of the infeed tray is substantially horizontal and is provided so that cards can be loaded into the top **608** of the shuffler, and then lowered beneath the gaming table surface for randomization.

The infeed elevator may be equipped with a card support structure similar to the support structure surrounding deliver tray **612**, which in a preferred embodiment has two vertical supports and two sides are left open. Cards may be loaded into the infeed tray 606 and into a card support structure **(not shown)**, and lowered automatically, in response to the dealer pushing downwardly on the top of the stack of cards or upon a signal received from the dealer controls (not shown).

In this example of the invention, the loading station is positioned near the playing surface (for example, a casino table) and at the dealer's side, allowing the machine to be used without unnecessary strain or unusual needed physical movement on the part of the dealer. Loading and unloading large stacks of cards from the top of a machine

that is mounted to eliminate lifting, straining or reaching large distances addresses a need long felt in the industry for a more ergonomically friendly card shuffler.

The output tray elevator in the second described embodiment also includes a two-sided vertical structure 612 for supporting a group of randomized cards as the cards are raised to the top surface **608** of the shuffler. It is to be understood that the vertical support structures are preferably secured to the elevator platforms, but could also be secured to the frame, and attached in a manner to pop up into position when needed.

A method of handling cards is described, including inserting the cards into a card infeed tray, , feeding the cards into a card randomization apparatus, capturing the randomized cards in a support structure and raising the cards and support structure to an upper surface of the shuffler. The method may comprise providing a retractable support structure for extracting shuffled cards, inserting shuffled cards into the support structure while it is below the top surface of the device and moving the support structure to expose the cards and retracting the support structure both before and after card removal. The card infeed tray may also be positioned on an elevator capable of lowering the group of cards into the apparatus prior to shuffling. When a second elevator is used, it is preferable to provide a retractable support structure for supporting the cards as the cards are lowered for shuffling.

The method preferably includes providing two separate support structures that support a vertically stacked group of cards on at least two surfaces, and preferably three. The support structure can be a solid three-sided box, could consist of three vertically disposed bars, two parallel plates and two angle irons to retain corners or any other structure that keeps the stack in vertical alignment, or other suitable support structure. The structure can be fixed to the upper surface of the shuffler, can be fixed to the elevators or can be affixed to the frame of the shuffler and constructed to "pop up" when needed for card loading and unloading. Cover plates, such as hinged or rotating plates, can be provided over the two elevators to provide additional cover (e.g., dust cover and visual cover) over the card source and the card collection areas to assure

that visual inspection of the shuffling procedure can be reduced, and entry of foreign materials can be reduced. The cover plates should be light enough for the system to automatically lift the covers or for a dealer to easily lift the covers manually. The cards themselves may push up the cover plates, or a preceding post or element can be positioned on the elevator or supports attached or moving conjointly with the elevators to press against the interior surface of the cover plates to lift the plates in advance of contact with the cards.

All of the apparatus, devices and methods disclosed and claimed herein can be made and executed without undue experimentation in light of the present disclosure. While the apparatus, devices and methods of this invention have been described in terms of both generic descriptions and preferred embodiments, it will be apparent to those skilled in the art that variations may be applied to the apparatus, devices and methods described herein without departing from the concept and scope of the invention. More specifically, it will be apparent that certain elements, components, steps, and sequences that are functionally related to the preferred embodiments may be substituted for the elements, components, steps, and sequences described and/or claimed herein while the same of similar results would be achieved. All such similar substitutions and modifications apparent to those skilled in the art are deemed to be within the scope and concept of the invention as defined by the appended claims.

Although a description of preferred embodiments has been presented, various changes including those mentioned above could be made without deviating from the spirit of the present invention. It is desired, therefore, that reference be made to the appended claims rather than to the foregoing description to indicate the scope of the invention.

WHAT IS CLAIMED IS:

1. A device for card handling comprising:

a card receiving area for receiving an initial set of cards;

a card stacking area for receiving cards from the card receiving area;

a card moving system for moving cards from the card receiving area to the card stacking area;

an elevator in the card stacking area with a moving platform for moving a stack of cards;

a collection surface on the moving platform in the elevator, a processor associated with the device, the processor being programmed with software;

a motor to move the platform within the elevator;

at least one sensor for sensing at least one of a) position of the platform, b) height of the platform, c) position of a card in the elevator, d) height of a card or cards in the elevator, e) pressure applied to a card in the elevator, e) presence of the platform at a predetermined height, f) presence of the platform at a predetermined position, g) presence of card(s) on the platform, and h) absence of card(s) on the platform, and

the processor being accessible to direct the device to automatically calibrate the device using said at least one sensor to enable the device to accurately handle cards.

2. The device of claim 1 and further comprising a suspending element for suspending at least one card in the card stacking area, wherein the suspending element is a pair of grippers, and wherein the grippers are present in the card stacking area to support cards.

3. The device of claim 2 wherein the grippers can separate a stack of cards in the stacking chamber into two segments of cards.

4. The device of claim 3 wherein the software directs the device to perform at least the following steps; a) moving the platform from a base position below a card insertion point to a position above the card insertion point, and registering both positions of the platform in the microprocessor, b) moving a predetermined number of cards from the card receiving area into the stacking area, c) moving at least one gripper to attempt contact of the grippers with at least one card in the stacking area.

5. The device of claim 4 wherein the program directs the device to move at least one gripper a first distance into contact with cards in the stacking area while those cards are on the platform at a first gripping position, at least some subsequent moves of the at least one gripper being of a different distance as compared to a preceding movement, movement of the at least one gripper continuing at least until a predetermined degree of contact is effected between the at least one gripper and card(s) in the stacking chamber.

6. The device of claim 5 wherein the program directs two opposed grippers into contact with cards in the stacking area and movement of the two grippers continues until a predetermined degree of contact between the two opposed grippers and card(s) in the stopping chamber is effected.

7. The device of claim 5 wherein after a predetermined degree of contact is attained, another series of steps is performed in which card(s) on the platform are lowered below the first gripping position and then elevated into a second gripping position where the platform is lower than it was at the first gripping position, a gripping sensor identifying whether at least one card is gripped at the second gripping position.

8. The device of claim 7 wherein the software directs the device so that the platform is lowered from the second position to a first subsequent position in which the platform is lower than the height of the platform in the second position.

9. The device of claim 8 wherein the software directs the device so that after cards are gripped in a first subsequent position, cards supported by the gripper are released by the gripper to be supported on the platform, the platform and supported cards are lowered, the platform and supported cards are raised to a second subsequent position in which the platform is lower than the height of the platform in the first

subsequent position, and grippers are moved to grip cards in the card stacking area while the platform is at the second subsequent position.

10. The device of claim 1 wherein card injectors are able to insert individual cards into the stacking chamber.

11. The device of claim 1 wherein there is an insert that can separate a stack of cards in the stacking chamber into two segments.

12. A device for forming a random set of playing cards comprising:

a top surface and a bottom surface of said device;

a card receiving area for receiving an initial set of playing cards;

a processor communicatively associated with the device;

a randomizing system for randomizing the initial set of playing cards;

a collection surface in a card collection area for receiving randomized playing cards, the collection surface receiving cards so that all cards are received below the top surface of the device;

an elevator for raising the collection surface so that at least some randomized cards are elevated at least to the top surface of the device;

at least one sensor for sensing at least one of a) position of the platform, b) height of the platform, c) position of a card in the elevator, d) height of a card or cards in the elevator, e) pressure applied to a card in the elevator, e) presence of the platform at a predetermined height, f) presence of the platform at a predetermined position, g) presence of card(s) on the platform, and h) absence of card(s) on the platform, and

the processor to direct the device to automatically calibrate the device to enable the device to accurately handle cards.

13. The device of claim 12 wherein the elevator raises all randomized cards above the top surface of the device.

14. The device of claim 12 wherein a confining set of walls confines all randomized cards along at least two edges of the playing cards after the randomized cards are elevated.

15. The device of claim 12 wherein at least one pick-off roller removes cards one at a time from the card receiving area and moves cards one at a time towards the randomizing system.

16. The device of claim 15 wherein the processor controls movement of the pick-off roller and at least one pair of rollers that assist in moving cards between the card receiving area and the collection area.

17. The device of claim 12 wherein the randomization system moves one card at a time into an area overlying the collection surface.

18. The device of claim 12 wherein one card at a time is positioned into a randomized set of playing cards over the collection surface.

19. The device of claim 12 wherein the randomization surface may move to a position within the collection area where the collection surface is bordered on two opposed sides by two movable card gripping elements.

20. The device of claim 12 wherein the card supporting surface is moved by a motivator that is able to move incremental vertical distances that are less than the thickness of a playing card.

21. The device of claim 20 wherein the card supporting surface is moved by a motivator that is able to move incremental vertical distances that are less than one-half the thickness of a playing card.

22. The device of claim 20 wherein the motivator is a step motor.

23. The device of claim 20 wherein the motivator is an analog motor.

24. The device of claim 12 wherein a card sensing sensor is present within the collection area, below the top surface of the device, the card sensing sensor detecting position of a card on the collection surface with respect to elevation of the card within the collection area.

25. The device of claim 12 wherein the processor is a microprocessor and the microprocessor controls vertical movement of the card supporting surface.

26. The device of claim 25 wherein the at least one card gripping element comprises at least two gripping elements that move from opposed sides of the collection area towards playing cards within the card collection area.

27. The device of claim 26 wherein the microprocessor is programmed to lower the card collection surface within the card collection area after the at least one card gripping element has contacted and supported cards within the card collection area, creating two segments of cards.

28. The device of claim 27 wherein the microprocessor directs movement of an individual card into the card supporting area between the two segments of cards.

29. The device of claim 12 wherein the processor comprises a microprocessor that is controllably connected to the device, the microprocessor directing movement of playing card moving elements within the device, the microprocessor randomly assigning potential positions for each card within the initial set of playing cards, and then directing the device to arrange the initial set of playing cards into those randomly assigned potential positions to form a randomized final set of playing cards.

30. A device for forming a random set of playing cards comprising:

a top surface and a bottom surface of said device;

a processor communicatively associated with the device;

a receiving area for an initial set of playing cards;

a randomizing system for the initial set of playing cards;

a collection surface in a card collection area for receiving playing cards that are being randomized;

an elevator for raising the collection surface within the card collection area;

at least one card supporting element within the card collection area that will support a predetermined number of cards within the card collection area;

an insertion point to the card collection area positioned below said at least one card supporting element;

at least one sensor for sensing at least one of a) position of the platform, b) height of the platform, c) position of a card in the elevator, d) height of a card or cards in the elevator, e) pressure applied to a card in the elevator, e) presence of the platform at a predetermined height, f) presence of the platform at a predetermined position, g) presence of card(s) on the platform, and h) absence of card(s) on the platform, and

the processor to direct the device to automatically calibrate the device using said at least one sensor to enable the device to accurately handle cards.

31. An automatic card shuffling system comprising a shuffling device:

a microprocessor with memory for controlling the operation of the shuffling device communicatively associated with the shuffling device;

an infeed compartment for receiving cards to be randomized;

a card moving mechanism for moving cards individually from the infeed compartment into a card mixing compartment;

a card mixing compartment comprising a plurality of substantially vertically oriented supports, an opening for the passage of cards from the infeed compartment, a moveable lower card support surface; at least one stationary gripping arm, a lower edge proximate the opening, the at least one stationary gripping arm capable of suspending cards above the slot;

an elevator for raising and lowering the moveable support surface;

wherein a position of the elevator is randomly selected and the support surface is moved to the selected position, and after the at least one stationary gripping arm secures at least one side of the cards, the elevator lowers, creating a space beneath the at least one stationary gripping arm, wherein a card is moved from the infeed compartment into the space, thereby forming a randomized group of cards;

at least one sensor for sensing at least one of a) position of the platform, b) height of the platform, c) position of a card in the elevator, d) height of a card or cards in the elevator, e) pressure applied to a card in the elevator, e) presence of the platform at a predetermined height, f) presence of the platform at a predetermined position, g) presence of card(s) on the platform, and h) absence of card(s) on the platform, and the microprocessor to direct the device to automatically calibrate the device using said at least one sensor to enable the device to accurately handle cards.

32. An automatic card shuffler, having an upper surface and a lower surface, comprising;

a card infeed tray mounted to the upper surface of the card shuffler;

a microprocessor;

an elevator for raising and lowering a stack of randomized cards into a shuffled card delivery the shuffled card delivery tray mounted to the upper surface of the card shuffler; wherein the card infeed tray and shuffled card delivery trays are located proximate an elevation of a gaming table surface;

at least one sensor for sensing at least one of a) position of the platform, b) height of the platform, c) position of a card in the elevator, d) height of a card in the elevator, e) pressure applied to a card in the elevator, e) presence of the platform at a predetermined height, f) presence of the platform at a predetermined position, g) presence of card(s) on the platform, and h) absence of card(s) on the platform, and

the microprocessor to direct the device to automatically calibrate the device using said at least one sensor to enable the device to accurately handle cards.

33. The device of claim 32, wherein the top surface of the shuffler is approximately flush with the gaming table surface.

34. The device of claim 33, wherein the shuffler is mounted by a support bracket to a gaming table.

35. The device of claim 32, wherein the card shuffler is installed in a gaming table, and the card shuffler is at least partially surrounded by gaming table surface.

36. A method for calibrating a card handling device with a card receiving area and a card stacking area comprising an elevator with a card support platform and grippers, the method comprising:

automatically defining a gripping position on cards in the stacking area, and

automatically identifying an elevator height that corresponds to a height at which a single card on the card support platform is gripped, and wherein movement of the platform to a lower position of at least one card thickness would not allow even a single card to be gripped off the card support platform.

37. The method of claim 36, and further comprising the steps of measuring a height of the elevator at a predetermined location, loading and randomizing all cards, and measuring a height of a top card of the stack of cards on the elevator, and then using this information along with card count information to determine an average card thickness.

38. A method for calibrating a card handling device with a card receiving area and a card stacking area comprising an elevator with a card support platform and grippers, the method comprising:

automatically defining a gripping position on cards in the stacking area, and

automatically identifying an elevator height that corresponds to a height at which a single card on the card support platform is gripped, and where movement of the platform to a lower position of at least two card thicknesses would not allow even a single card to be gripped off the card support platform.

39. The method of claim 38 wherein automatically defining a gripping position on cards in the stacking area is performed by first gripping at least one card by moving a pair of grippers into a first contact position with said at least one card, then lowering the platform and sensing that the at least one card remains supported by the grippers at the first contact position.

40. The method of claim 39 wherein if the at least one card remains supported by the grippers at the first contact position, raising the elevator, releasing the at least one card to be supported by the platform, then moving the grippers to a second contact

position that has a greater distance of separation between the grippers than the separation distance between the grippers at the first contact position, yet with the grippers still in contact with said at least one card then lowering the platform and sensing whether or not the at least one card remains supported by the grippers at the second contact position.

41. The method of claim 40 wherein a sequence of steps of gripping the at least one card at increasingly distant separation positions between the grippers is repeated until the at least one card does not remain supported by the gripper, this position being identified as beyond a working limit distance of grippers where at least one card can be supported by the grippers.

42. The method of claim 40 wherein the grippers are capable of moving in increments of a first defined distance between grippers, and the greater distance of separation between the grippers in the second contact position and the first contact position exceeds at least two increments.

43. The method of claim 42 wherein the grippers are capable of moving in increments of a first defined distance between grippers, and the greater distance of separation between the grippers in the second contact position and the first contact position exceeds at least two increments.

44. The method of claim 43 wherein the grippers are capable of moving in increments of a first defined distance between grippers, and the greater distance of separation between the grippers in the second contact position and the first contact position is at least five increments.

45. The method of claim 44 wherein after the position identified as beyond a working limit distance of grippers has been determined, raising the elevator, releasing the at least one card, then moving the grippers to grip the at least one card with a separation distance between grippers that is at least one increment less than the separation distance beyond the working limit distance of grippers.

46. The method of claim 45 wherein

a) automatically identifying an elevator height that corresponds to a height at which a single card on the card support platform is gripped, and

b) movement of the platform to a lower position of at least two card thicknesses that would not allow even a single card to be gripped off the card support platform

is performed by repeated steps of raising the elevator, gripping the at least one card, and lowering the elevator until the at least one card is not gripped by movement of the grippers.

47. The method of claim 46 wherein exactly one or two cards are used as the at least one card.

48. The method of claim 47 wherein after a position of elevator height is determined where the at least one card is not gripped by the grippers, the elevator is raised by at least one increment from the position of elevator height where the at least one card is not gripped by the grippers and the grippers move to attempt to grip the at least one card.

49. The method of claim 44 wherein

a) automatically identifying an elevator height that corresponds to a height at which a single card on the card support platform is gripped, and

b) movement of the platform to a lower position of at least two card thicknesses that would not allow even a single card to be gripped off the card support platform

is performed by repeated steps of raising the elevator, gripping the at least one card, and lowering the elevator until the at least one card is not gripped by movement of the grippers.

50. The method of claim 43 wherein after the this position identified as beyond a working limit distance of grippers has been determined, raising the elevator, releasing the at least one card, then moving the grippers to grip the at least one card with a

second separation distance between grippers that is at least one increment less than the separation distance beyond the working limit distance of grippers.

51. The method of claim 50 wherein subsequent steps of moving the grippers to grip the at least one card with a separation distance between grippers that is at least one increment less than the separation distance beyond the working limit distance of grippers are repeated until an optimum gripping position is automatically determined based upon predetermined standards.

52. The method of claim 50 wherein

a) automatically identifying an elevator height that corresponds to a height at which a single card on the card support platform is gripped, and

b) movement of the platform to a lower position of at least two card thicknesses that would not allow even a single card to be gripped off the card support platform

is performed by repeated steps of raising the elevator, gripping the at least one card, and lowering the elevator until the at least one card is not gripped by movement of the grippers.

53. The method of claim 52 wherein exactly one or two cards are used as the at least one card.

54. The method of claim 53 wherein after a position of elevator height is determined where the at least one card is not gripped by the grippers, the elevator is raised by at least one increment from the position of elevator height where the at least one card is not gripped by the grippers and the grippers move to attempt to grip the at least one card.

55. The method of claim 42 wherein

a) automatically identifying an elevator height that corresponds to a height at which a single card on the card support platform is gripped, and

b) movement of the platform to a lower position of at least two card thicknesses that would not allow even a single card to be gripped off the card support platform

is performed by repeated steps of raising the elevator, gripping the at least one card, and lowering the elevator until the at least one card is not gripped by movement of the grippers.

56. The method of claim 43 wherein

a) automatically identifying an elevator height that corresponds to a height at which a single card on the card support platform is gripped, and

b) movement of the platform to a lower position of at least two card thicknesses that would not allow even a single card to be gripped off the card support platform

is performed by repeated steps of raising the elevator, gripping the at least one card, and lowering the elevator until the at least one card is not gripped by movement of the grippers.

57. The method of claim 40 wherein the grippers are capable of moving in increments of a first defined distance between grippers, and the greater distance of separation between the grippers in the second contact position and the first contact position is at least five increments.

58. The method of claim 57 wherein

a) automatically identifying an elevator height that corresponds to a height at which a single card on the card support platform is gripped, and

b) movement of the platform to a lower position of at least two card thicknesses that would not allow even a single card to be gripped off the card support platform

is performed by repeated steps of raising the elevator, gripping the at least one card, and lowering the elevator until the at least one card is not gripped by movement of the grippers.

59. The method of claim 40 wherein

a) automatically identifying an elevator height that corresponds to a height at which a single card on the card Support platform is gripped, and

b) movement of the platform to a lower position of at least two card thicknesses that would not allow even a single card to be gripped off the card support platform

is performed by repeated steps of raising the elevator, gripping the at least one card, and lowering the elevator until the at least one card is not gripped by movement of the grippers.

60. The method of claim 38 wherein

a) automatically identifying an elevator height that corresponds to a height at which a single card on the card support platform is gripped, and

b) movement of the platform to a lower position of at least two card thicknesses that would not allow even a single card to be gripped off the card support platform

is performed by repeated steps of raising the elevator, gripping the at least one card, and lowering the elevator until the at least one card is not gripped by movement of the grippers.

61. The method of claim 60 wherein exactly one or two cards are used as the at least one card.

62. The method of claim 61 wherein after a position of elevator height is determined where the at least one card is not gripped by the grippers, the elevator is raised by at least one increment from the position of elevator height where the at least one card is not gripped by the grippers and the grippers move to attempt to grip the at least one card.

63. A method of randomizing a group of cards with a card handling device after calibrating the device in accordance to claim 38, comprising the steps of:

placing a group of cards to be randomized into a card infeed fray;

removing cards individually from the card infeed tray and delivering the cards into a card stacking area, the card stacking area having a moveable lower surface, and a stationary opening for receiving cards from the infeed tray;

elevating the moveable lower surface to a randomly determined height;

securing at least one edge of a group of cards in the card stacking area at a point just above the stationary opening;

lowering the moveable lower surface to create an opening in a stack of cards being formed in the card stacking area, the opening located just beneath a lowermost point where the cards are secured; and

inserting a card removed from the infeed tray into the opening.

64. The method of claim 63, wherein after a card has been inserted, and when a presence of additional cards in the card infeed tray is sensed, a segment of cards is supported and the elevator moves to another and lower randomly determined height, creating another opening for insertion of the additional cards.

65. A method of arranging a group of cards into a desired order in a computer controlled automatic card shuffler after calibrating the card shuffler according to the method of claim 38, the card shuffler comprising an infeed tray, a feed mechanism, a card arranging area, a retaining device for suspending cards in the card shuffling area, a lower support surface in the card arranging area and an elevator for raising and lowering the lower support surface, the method comprising:

assigning each card in the infeed tray a final order;

feeding each card individually into the card arranging area, wherein the lower support surface is lowered beneath an elevation of the card feed mechanism when the computer instructs that the card being fed is to be placed on top of the stack, suspending all cards in the card shuffling area by means of the retaining device when the computer instructs that the card being fed is to be placed on the bottom of the stack, and instructing the elevator to move, causing the lower support surface to adjust to a preselected elevation, retaining a subgroup of cards above a feed elevation and

lowering the lower support surface, creating an opening, and placing a card between the subgroup of suspended cards and the remaining cards supported by the lower support surface.

66. The method of claim 65, wherein the final order is random.

67. The method of claim 65, wherein the final order is predetermined.

68. The method of claim 65 and further comprising the step of reading a suit and rank of each card prior to feeding the cards into the card arranging area.

69. A method of automatically calibrating a card shuffler to accommodate dimensions of cards to be shuffled, the steps including at least:

inserting cards into a card shuffler,

automatically sensing at least one dimension of a card height a card width, and a card thickness of at least one card from said cards inserted into the card shuffler,

automatically adjusting at least one component in the card shuffler to accommodate the at least one dimension sensed, and shuffling the cards.

70. The method of claim 69 wherein exactly one or two cards are used as the at least one card.

71. The method of claim 69 wherein automatically sensing comprises defining a gripping position on cards in a stacking area is performed.

72. The method of claim 71 wherein defining a gripping position is performed by first gripping at least one card by moving a pair of grippers into a first contact position with said at least one card, then lowering a platform and sensing that the at least one card remains supported by the grippers at a first gripping position.

73. A device for forming a random set of playing cards comprising:

a top surface and a bottom surface of said device;

a card receiving area for receiving an initial set of playing cards;

a randomizing system for randomizing the initial set of playing cards;

a collection surface in a card collection area for receiving randomized playing cards, the collection surface receiving cards so that all cards are received below the top surface of the device;

at least one card supporting element within the card collection area that will support a predetermined number of cards within the card collection area and separate at least a group of cards from the card supporting element to create a space between the at least a group of cards and remaining cards or the card supporting element, creating an insertion area receiving a next card to be randomized;

an insertion point to the card collection area positioned below said predetermined number of cards; and

an elevator for raising the collection surface so that at least some randomized cards are elevated at least to the top surface of the device.

74. The device of claim 73 wherein the elevator raises randomized cards above the top surface of the device.

75. The device of claim 73 wherein a confining set of walls confines all randomized cards along all edges of the playing cards after the at least some randomized cards are elevated.

76. The device of claim 73 wherein the card receiving area is sloped to assist movement of playing cards towards the randomizing system.

77. The device of claim 73 wherein at least one pick-off roller removes cards one at a time from the card receiving area and moves cards one at a time towards the randomizing system.

78. The device of claim 77 wherein at least one pair of rollers receives cards from the at least one pick-off roller.

79. The device of claim 78 wherein a microprocessor controls movement of the pick-off roller and the at least one pair of rollers.

80. The device of claim 79 wherein the microprocessor is programmed to direct the pick-off roller to cease propelling a first card being moved byte pick-off roller when it is sensed that the first card is being moved by the at least one pair of rollers.

81. The device of claim 78 wherein when a first card being moved by the pick-off roller is being moved by the at least one pair of rollers, movement of the pick-off roller is altered so that no card other than the first card is moved by either the pick-off roller or the at least one pair of rollers.

82. The device of claim 81 wherein tension on the first card effected by the at least one pair of rollers causes the pick-off roller to freely rotate and to not propel the first card.

83. The device of claim 81 wherein a microprocessor is controllably connected to the device, the microprocessor directing movement of playing card moving elements within the device, the microprocessor randomly assigning potential positions for each card within the initial set of playing cards, and then directing the device to arrange the initial set of playing cards into those randomly assigned potential positions to form a randomized final sot of playing cards.

84. The device of claim 73 wherein the randomization system moves one card at a time into an area overlying the collection surface.

85. The device of claim 73 wherein one card at a time is positioned into a randomized set of playing cards over the randomization surface.

86. The device of claim 85 wherein the playing surface is bordered on two opposed sides by two movable card gripping elements.

87. The device of claim 86 wherein an insertion point to the card collection area is located below a bottom edge of the two movable card gripping elements.

88. The device of claim 87 wherein a microprocessor is controllably connected to the device, the microprocessor directing movement of playing card moving elements within the device, the microprocessor randomly assigning potential positions for each card within the initial set of playing cards, and then directing the device to arrange the

initial set of playing cards into those randomly assigned potential positions to form a randomized final set of playing cards.

89. The device of claim 86 wherein the card supporting surface is vertically positionable within the card collection area.

90. The device of claim 89 wherein the card supporting surface is moved by a motivator that is able to move incremental vertical distances that are no greater than the thickness of a playing card.

91. The device of claim 89 wherein the card supporting surface is moved by a motivator that is able to move incremental vertical distances that are no greater than one-half the thickness of a playing card.

92. The device of claim 91 wherein the motivator is a step motor.

93. The device of claim 91 wherein the motivator is an analog motor.

94. The device of claim 73 wherein a sensor is present within the collection area, below the top surface of the device, the sensor detecting a position of a top card.

95. The device of claim 94 wherein a microprocessor is present in the device and the microprocessor controls vertical movement of the card supporting surface.

96. The device of claim 95 wherein the sensor identifies the position of the collection plate to place the top card at a position level with the bottom of at least one card gripping element that is movable from at least one side of the collection area towards playing cards within the card collection area.

97. The device of claim 96 wherein the microprocessor is programmed to determine a distance that the card supporting surface must be vertically moved to position at least one specific card other than the top card at a bottom edge of the at least one card gripping element when the card gripping element moves to contact cards within the card collection area.

98. The device of claim 97 wherein the at least one card gripping element comprises at least two gripping elements that move from opposed sides of the collection area towards playing cards within the card collection area.

99. The device of claim 98 wherein the microprocessor is programmed to lower the card collection surface within the card collection area after the two elements have contacted and supported cards within the card collection area, creating two segments of cards.

100. The device of claim 99 wherein the microprocessor directs movement of an individual card into the card supporting area between the two segments of cards.

101. The device of claim 99 wherein a microprocessor is controllably connected to the device, the microprocessor directing movement of playing card moving elements within the device, the microprocessor randomly assigning potential positions for each card within the initial set of playing cards, and then directing the device to arrange the initial set of playing cards into those randomly assigned potential positions to form a randomized final set of playing cards.

102. The device of claim 97 wherein the microprocessor is programmed to lower the card collection surface within the card collection area after the at least one card gripping element has contacted and supported cards within the card collection area, creating two segments of cards.

103. The device of claim 102 wherein the microprocessor directs movement of an individual card into the card supporting area between the two segments of cards.

104. The device of claim 96 wherein a microprocessor is controllably connected to the device, the microprocessor directing movement of playing card moving elements within the device, the microprocessor randomly assigning potential positions for each card within the initial set of playing cards, and then directing the device to arrange the initial set of playing cards into those randomly assigned potential positions to form a randomized final set of playing cards.

105. The device of claim 73 wherein a microprocessor is controllably connected to the device, the microprocessor directing movement of playing card moving elements within the device, the microprocessor randomly assigning potential positions for each card within the initial set of playing cards, and then directing the device to arrange the initial set of playing cards into those randomly assigned potential positions to form a randomized final set of playing cards.

106. A device for forming a random set of playing cards comprising:

a top surface and a bottom surface of said device;

a receiving area for an initial set of playing cards;

a randomizing system the initial set of playing cards;

a collection surface in a card collection area for receiving randomized playing cards;

an elevator for raising the collection surface within the card collection area;

at least one card supporting element within the card collection area that will support a predetermined number of cards within the card collection area and separate at least a subgroup of cards from the randomized cards on the card collection surface; and

an insertion point to the card collection area positioned below said predetermined number of cards.

107. The device of claim 106 wherein the at least one card supporting element comprises an element on at least one side of the card collection area that can move inwardly within the card collection area to contact and support the predetermined number of cards within the card collection area.

108. The device of claim 107 wherein the at least one card supporting element comprises at least two opposed card supporting elements that move inwardly within the card collection area to contact and support the predetermined number of cards within the card collection area.

109. The device of claim 108 wherein a microprocessor is communicatively connected to the device and the microprocessor is programmed to determine a distance that the card supporting surface must be vertically moved to position at least one specific card position other than the top card at a bottom edge of the at least one card supporting element when the card supporting element moves to contact cards within the card collection area.

110. The device of claim 109 wherein a microprocessor communicatively connected to the device is programmed to lower the card collection surface within the card collection area after the at least one card supporting element has contacted and supported cards within the card collection area, creating two segments of cards.

111. The device of claim 110 wherein the microprocessor directs movement of an individual card into the card supporting area between the two segments of cards.

112. The device of claim 107 wherein a microprocessor communicatively connected to the device is programmed to lower the card collection surface within the card collection

area after the at least one card supporting element has contacted and supported cards within the card collection area, creating two segments of cards.

113. The device of claim 112 wherein a microprocessor communicatively connected to the device is programmed to lower the card collection surface within the card collection area after the at least one card supporting element has contacted and supported cards within the card collection area, creating two segments of cards.

114. The device of claim 113, wherein the microprocessor directs movement of an individual card into the card supporting area between the two segments of cards.

115. The device of claim 106 wherein a microprocessor is communicatively connected to the device and the microprocessor is programmed to determine a distance that the card supporting surface must be vertically moved to position at least one specific card position other than the top card at a bottom edge of the at least one card supporting element when the card supporting element moves to contact cards within the card collection area.

116. An automatic card shuffling device comprising:

a microprocessor with memory for controlling the operation of the device;

an infeed compartment for receiving cards to be randomized;

a card moving mechanism for moving cards individually from the infeed compartment into a card mixing compartment;

a card mixing compartment comprising a plurality of substantially vertical supports, an opening for the passage of cards from the infeed compartment, a moveable lower support surface; at least one stationary gripping arm, a lower edge proximate the opening, the gripping arm capable of suspending cards above the opening,

an elevator for raising and lowering the moveable support surface;

wherein a position of the elevator is randomly selected and the support surface is moved to the selected position, and after the gripping arm grasps at least one side of the cards, the elevator lowers, creating a space beneath the gripping arm, wherein a card is moved from the infeed compartment into the space, thereby randomizing the cards.

117. The automatic card shuffling device of claim 116, wherein when each card in the infeed compartment has been fed into a space created by the gripping arm and random positioning of the lower support surface, the stack of cards in the card mixing area is randomized.

118. The device of claim 116, wherein the elevator is moveable to raise the stack of shuffled cards after all cards in the infeed compartment are fed.

119. The device of claim 116, further comprising a card delivery tray located above the moveable lower support.

120. The device of claim 119, wherein the moveable lower support defines a lower support surface of the card delivery tray.

121. The device of claim 119, wherein the card delivery fray is positioned on an upper surface of the device.

122. The device of claim 119, wherein a lower surface of the infeed tray and lower surface of the card deliver tray are positioned at an elevation proximate an elevation of a gaming table surface.

123. The device of claim 122, wherein after a card has been inserted, and when a presence of additional cards in the card infeed tray is sensed, the elevator moves to another randomly determined height, creating another opening.

124. The device of claim 123, wherein the shuffler is concealed beneath a gaming table surface.

125. The device of claim 123, wherein the shuffler is mounted to a support bracket.

126. The device of claim 123, wherein the card shuffler is built into a gaming table, and is at least partially surrounded by gaming table surface.

127. The device of claim 116, wherein two stationary gripping arms are provided to grip opposite sides of a stack of cards.

128. The device of claim 116, wherein the opening in the card mixing compartment is a horizontal slot, and wherein the infeed compartment comprises a lower surface, wherein the card moving mechanism comprises a pick off roller for moving a lowermost card in the infeed compartment toward the slot in the card mixing compartment.

129. A method of randomizing a group of cards, comprising the steps of:

removing cards individually from a card infeed tray containing a group of cards to be randomized, and delivering the cards into a card collection area, the card collection area having a moveable lower surface, and a stationary opening for receiving cards from the infeed tray;

elevating the movable lower surface to a randomly determined height;

grasping at least one edge of a group of cards in the card collection area at a point just above the stationary opening;

lowering the moveable lower surface to create an opening in a stack of cards formed on the lower surface, the opening located just beneath a lowermost point where the cards are grasped; and

inserting a card removed from the infeed tray into the opening.

130. A method of arranging a group of cards into a desired order in a computer controlled automatic card shuffler, the card shuffler comprising an infeed fray, a feed mechanism, a card arranging area, a retaining device for suspending cards in the card shuffling area, a lower support surface in the card arranging area and an elevator for raising and lowering the lower support surface, the method comprising:

assigning each card in the infeed tray a final order;

feeding each card individually into the card arranging area, wherein the lower support surface is lowered beneath an elevation of the card feed mechanism when the computer instructs that the card being fed is to be placed on top of the stack, suspending all cards in the card shuffling area by means of the retaining device when the computer instructs that the card being fed is to be placed on the bottom of the stack, and instructing the elevator to move, causing the lower surface to adjust to a preselected elevation, retaining a subgroup of cards above a feed elevation and lowering the lower surface, creating an opening, and placing a card between the subgroup of suspended cards and the remaining cards supported by the lower support surface.

131. The method of claim 130, wherein the final order is random.

132. The method of claim 130, wherein the final order is predetermined.

133. The method of claim 132, wherein the final order is an original playing card pack order.

134. The method of claim 130 and further comprising the step of reading a suit and rank of each card prior to feeding the cards into the card arranging area.

135. A device for forming a random set of playing cards comprising:

a top surface and a bottom surface of said device;

a card receiving area for receiving an initial set of playing cards;

a randomizing system for randomizing the initial set of playing cards;

a collection surface in a card collection area, the collection surface supporting and receiving all randomized playing cards, the collection surface receiving cards so that all cards are received below the top surface of the device;

at least one card supporting element within the card collection area that will support a predetermined number of cards within the card collection area and separate at least a group of cards from the card supporting element to create a space between the at least a group of cards and remaining cards or the card supporting element for random insertion of individual cards; and

an elevator for raising the collection surface so that at least some randomized cards are elevated at least to the top surface of the device.

136. The device of claim 135 wherein the elevator raises all randomized cards above the top surface of the device.

137. The device of claim 135 wherein a single stack of cards is supported on the collection surface, a top section of a subgroup of cards is separated from the single stack of cards to form two subgroups of cards with an opening between the two subgroups of cards, and a single card is inserted in said opening.

138. The device of claim 137 wherein a pair of grippers supports said top section of a subgroup of cards.

139. The device of claim 135 wherein a random number generator assigns a random position number to each card within the initial set of cards.

140. The device of claim 139 wherein the random position number determines a randomly determined position that each card will occupy in the randomized playing cards.

141. The device of claim 140 wherein a microprocessor identifies each card by an original position number within the initial set of cards, the microprocessor uses the random position number to direct the elevator to move into position where each card can be properly inserted into a randomized or shuffled set of cards.

142. A device for forming a random set of playing cards comprising:

a top surface and a bottom surface of said device;

a card receiving area for receiving an initial set of playing cards;

a randomizing system for randomizing the order of an initial set of playing cards;

a collection surface in a card collection area for receiving randomized playing cards, the collection surface receiving cards so that all cards are received below the top surface of the device;

an elevator for raising the collection surface so that at least some randomized cards are elevated at least to the top surface of the device; and

an automatically moveable cover over the elevator.

143. The device of claim 142 wherein the elevator raises all randomized cards above the top surface of the device and the automatically moveable cover is raised to allow the randomized cards to rise above the top surface of the device.

144. The device of claim 143 wherein the moveable cover is raised by an element moving in concert with the elevator or an elevator drive system.

145. The device of claim 142 wherein the card receiving area is sloped to assist movement of playing cards towards the randomizing system.

146. The device of claim 142 wherein at least one pick-off roller removes cards one at a time from the card receiving area and moves cards one at a time towards the randomizing system.

147. The device of claim 146 wherein at least one pair of rollers receives cards from the at least one pick-off roller.

148. The device of claim 147 wherein a microprocessor controls movement of the pick-off roller and the at least one pair of rollers.

149. The device of claim 148 wherein the microprocessor is programmed to direct the pick-off roller to cease propelling a first card being moved by the pick-off roller when it is sensed that the first card is being moved by the at least one pair of rollers.

150. The device of claim 147 wherein when a first card being moved by the pick-off roller is being moved by the at least one pair of rollers, movement of the pick-off roller is altered so that no card other than the first card is moved by either the pick-off roller or the at least one pair of rollers.

151. The device of claim 150 wherein tension on the first card effected by the at least one pair of rollers causes the pick-off roller to freely rotate and to not propel the first card.

152. The device of claim 142 wherein the randomization system moves one card at a time into an area overlying the collection surface.

153. The device of claim 142 wherein one card at a time is positioned into a randomized set of playing cards over the collection surface.

154. The device of claim 153 wherein the collection area is bordered on two opposed sides by two movable card gripping elements.

155. The device of claim 154 wherein an insertion point to the card collection area is located below a bottom edge of the two movable card gripping elements.

156. The device of claim 154 wherein the card collection surface is vertically positionable within the card collection area.

157. The device of claim 156 wherein the card collection surface is moved by a motivator that is able to move incremental vertical distances that are less than the thickness of a playing card.

158. The device of claim 156 wherein the card collection surface is moved by a motivator that is able to move incremental vertical distances that are less than one-half the thickness of a playing card.

159. The device of claim 158 wherein the motivator is a stepper motor.

160. The device of claim 158 wherein the motivator is an analog motor.

161. The device of claim 142 wherein a sensor is present within the collection area, below the top surface of the device, the sensor detecting a position of a designated card or position of a separation between cards.

162. The device of claim 161 wherein a microprocessor is present in the device and the microprocessor controls vertical movement of the card collection surface.

163. The device of claim 162 wherein the sensor identifies the position of the card collection surface so as to place the top card at a position that is level with or above the bottom of at least one card gripping element that is movable from at least one side of the collection area towards playing cards within the card collection area.

164. The device of claim 163 wherein the microprocessor is programmed to determine a distance that the card collection surface must be vertically moved to position at least one specific card at a bottom edge of the at least one card gripping element when the card gripping element moves to contact cards within the card collection area.

165. The device of claim 164 wherein the at least one card gripping element comprises at least two gripping elements, at least one of which moves from a side of the collection area towards playing cards within the card collection area.

166. The device of claim 142 wherein a microprocessor is controllably connected to the device, the microprocessor directing movement of playing card moving elements within the device, the microprocessor randomly assigning potential positions for each card within the initial set of playing cards, and then directing the device to arrange the initial set of playing cards into those randomly assigned potential positions to form a randomized final set of playing cards.

167. A device for forming a random set of playing cards comprising:

a top surface and a bottom surface of said device;

a card receiving area for receiving an initial set of playing cards;

a randomizing system for randomizing the order of an initial set of playing cards;

a collection surface in a card collection area for receiving randomized playing cards, the collection surface receiving cards so that all cards are received below the top surface of the device;

an elevator for raising the collection surface so that at least some randomized cards are elevated at least to the top surface of the device; and

an automatically moveable cover over the elevator,

wherein a microprocessor is present in the device and the microprocessor controls vertical movement of the card collection surface, the sensor identifies the position of the card collection surface so as to place the top card at a position that is level with or above the bottom of at least one card gripping element that is movable from at least one side of the collection area towards playing cards within the card collection area, the microprocessor is programmed to determine a distance that the card collection surface must be vertically moved to position at least one specific card at a bottom edge of the at least one card gripping element when the card gripping element moves to contact cards within the card collection area, the at least one card gripping element comprises at least two gripping elements, at least one of which moves from a side of the collection area towards playing cards within the card collection area, and wherein the microprocessor is programmed to lower the card collection surface within the card collection area after the at least one card gripping element has contacted and supported cards within the card collection area, creating two segments of cards, and a gap in between the segments.

168. The device of claim 167 wherein the microprocessor directs movement of an individual card into the gap, between the two segments of cards.

169. A device for forming a random set of playing cards comprising:

a top surface and a bottom surface of said device;

a card receiving area for receiving an initial set of playing cards;

a randomizing system for randomizing the order of an initial set of playing cards;

a collection surface in a card collection area for receiving randomized playing cards, the collection surface receiving cards so that all cards are received below the top surface of the device;

an elevator for raising the collection surface so that at least some randomized cards are elevated at least to the top surface of the device; and

an automatically moveable cover over the elevator,

wherein a microprocessor is present in the device and the microprocessor controls vertical movement of the card collection surface, the sensor identifies the position of the card collection surface so as to place the top card at a position that is level with or above the bottom of at least one card gripping element that is movable from at least one side of the collection area towards playing cards within the card collection area, the microprocessor is programmed to determine a distance that the card collection surface must be vertically moved to position at least one specific card at a bottom edge of the at least one card gripping element when the card gripping element moves to contact cards within the card collection area, the at least one card gripping element comprises at least two gripping elements, at least one of which moves from a side of the collection area towards playing cards within the card collection area, and wherein the microprocessor is programmed to lower the card collection surface within the card collection area after the two elements have contacted and supported cards within the card collection area, creating two segments of cards and a gap between the segments.

170. The device of claim 169 wherein the microprocessor directs movement of an individual card into the gap, between the two segments of cards.

171. A device for forming a random set of playing cards comprising:

a top surface and a bottom surface of said device;

a receiving area for an initial set of playing cards;

a randomizing system for randomizing the initial set of playing cards;

a collection surface in a card collection area for receiving randomized playing cards;

an elevator for raising the collection surface within the card collection area;

at least one card supporting element within the card collection area that will support a predetermined number of cards within the card collection area and suspends at least a subgroup of cards from the randomized cards over the card collection surface to create a card insertion opening; and

an automatically moveable cover over said card collection area.

172. The device of claim 171 wherein the automatically moveable cover comprises a single element that can pivot to display both the receiving area and the card collection area.

173. The device of claim 172 wherein a microprocessor communicatively connected to the device is programmed to lower the card collection surface within the card collection area after the at least one card supporting element has contacted and supported cards within the card collection area, creating two segments of cards and a gap between the segments.

174. The device of claim 173 wherein the microprocessor directs movement of an individual card into the gap between the two segments of cards.

175. The device of claim 171 wherein the automatically moveable cover comprises two individual elements that each can pivot to separately display the receiving area and the card collection area.

176. The device of claim 175 wherein an at least one card supporting element comprises an element on at least one side of the card collection area that can move inwardly within the card collection area to contact and support the predetermined number of cards within the card collection area.

177. The device of claim 176 wherein the at least one card supporting element comprises at least two opposed card supporting elements that move inwardly within the card collection area to contact and support the predetermined number of cards within the card collection area.

178. The device of claim 175 wherein a microprocessor is communicatively connected to the device and the microprocessor is programmed to determine a distance that the card collection surface must be vertically moved to position at least one specific card at a bottom edge of the at least one card supporting element when the card supporting element moves to contact cards within the card collection area.

179. The device of claim 178 wherein the microprocessor communicatively connected to the device is programmed to lower the card collection surface within the card collection area after the at least one card supporting element has contacted and supported cards within the card collection area, creating two segments of cards.

180. The device of claim 171 wherein a microprocessor is communicatively connected to the device and the microprocessor is programmed to determine a distance that the card collection surface must be vertically moved to position at least one specific card position other than the top card at a bottom edge of the at least one card supporting element when the card supporting element moves to contact cards within the card collection area.

181. A method of randomizing a group of cards, comprising the steps of:

removing cards individually from a card infeed tray containing a group of cards to be randomized, and delivering the cards into a card collection area, the card collection area having a moveable lower surface, and a stationary opening for receiving cards from the infeed tray;

elevating the moveable lower surface to a randomly determined height;

grasping at least one edge of a group of cards in the card collection area at a point just above the stationary opening;

lowering the moveable lower surface to create an opening in a stack of cards formed on the lower surface, the opening located just beneath a lowermost point where the cards are grasped;

inserting a card removed from the infeed tray into the opening; and

after randomizing all cards, elevating a collection of randomized cards and automatically raising a covering lid over the collection of randomized cards.

182. The method of claim 181 wherein after a card has been inserted, and when a presence of at least one additional card in the card infeed tray is sensed, the elevator moves to another randomly determined height, creating another opening.

183. An automatic card shuffler on a gaming table having a gaming table surface, having an upper surface and a lower surface, comprising:

a card infeed tray mounted to insert cards from the upper surface of the card shuffler;

a shuffled card delivery tray mounted on an elevator; and

at least one automatically moveable cover over at least one of the card infeed tray and the shuffled card delivery tray, wherein an opening to the card infeed tray is located proximate an elevation of a gaming table surface and the shuffled card delivery tray can be elevated from below the gaming table surface to an elevation at the gaming table surface to raise at least some cards on the shuffled card delivery tray that were below the gaming table surface to an elevation above the gaming table surface.

184. The device of claim 183 wherein at least a portion of the shuffler is concealed beneath the gaming table surface.

185. The device of claim 184 wherein elevation of the shuffled card delivery tray is effected by a stepper motor.

186. The device of claim 183 wherein the shuffler is mounted onto a table by at least one support bracket.

187. The device of claim 183 wherein the card shuffler is built or inserted into a gaming table, and is at least partially surrounded by gaming table surface.

188. A method of arranging a group of cards into a desired order in a computer controlled automatic card shuffler, the card shuffler comprising an infeed tray, a feed mechanism, a card arranging area, a retaining device for suspending cards in the card

arranging area, a lower support surface in the card arranging area and an elevator for raising and lowering the lower support surface, the method comprising:

a) assigning each card in the infeed tray a final order;

b) feeding each card individually into the card arranging area, wherein the lower support surface is lowered beneath an elevation of the card feed mechanism when the computer instructs that the card being fed is to be placed on top of the stack,

c) suspending all cards in the card arranging area by means of the retaining device when the computer instructs that the card being fed is to be placed on the bottom of the stack, and

d) instructing the elevator to move, causing the lower support surface to adjust to a preselected elevation, retaining a subgroup of cards above a feed elevation and lowering the lower surface, creating an opening, and placing a card between the subgroup of suspended cards and the remaining cards supported by the lower support surface wherein steps b), c) and d) are performed while an automatically moveable cover is closed over at least one of the infeed tray and the stack.

189. The method of claim 188, wherein the final order is random.

190. The method of claim 188, wherein the final order is predetermined.

191. The method of claim 190, wherein the final order is an original playing card pack order.

192. The method of claim 188 and further comprising the step of reading a suit and rank of each card prior to feeding the cards into the card arranging area.

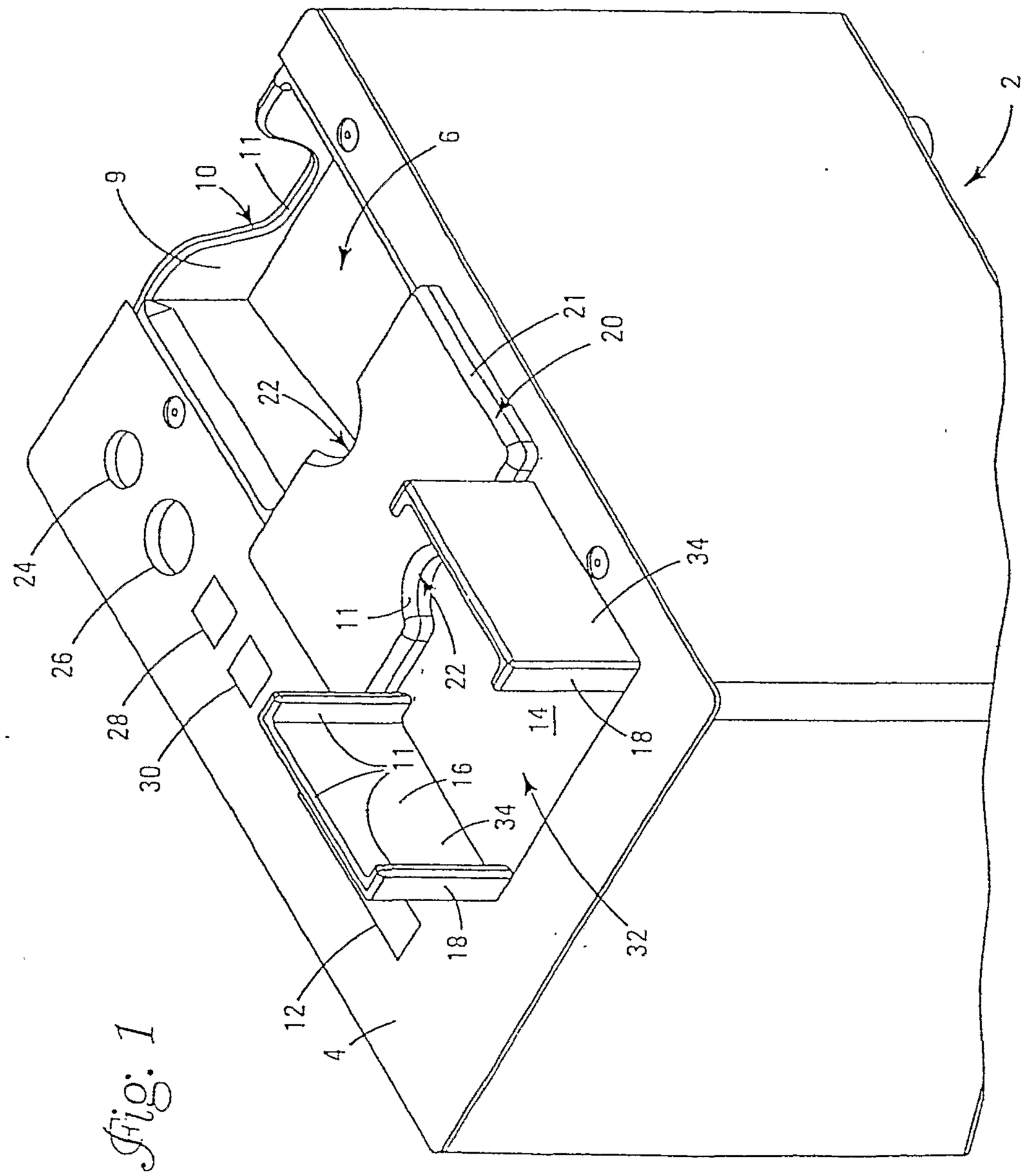
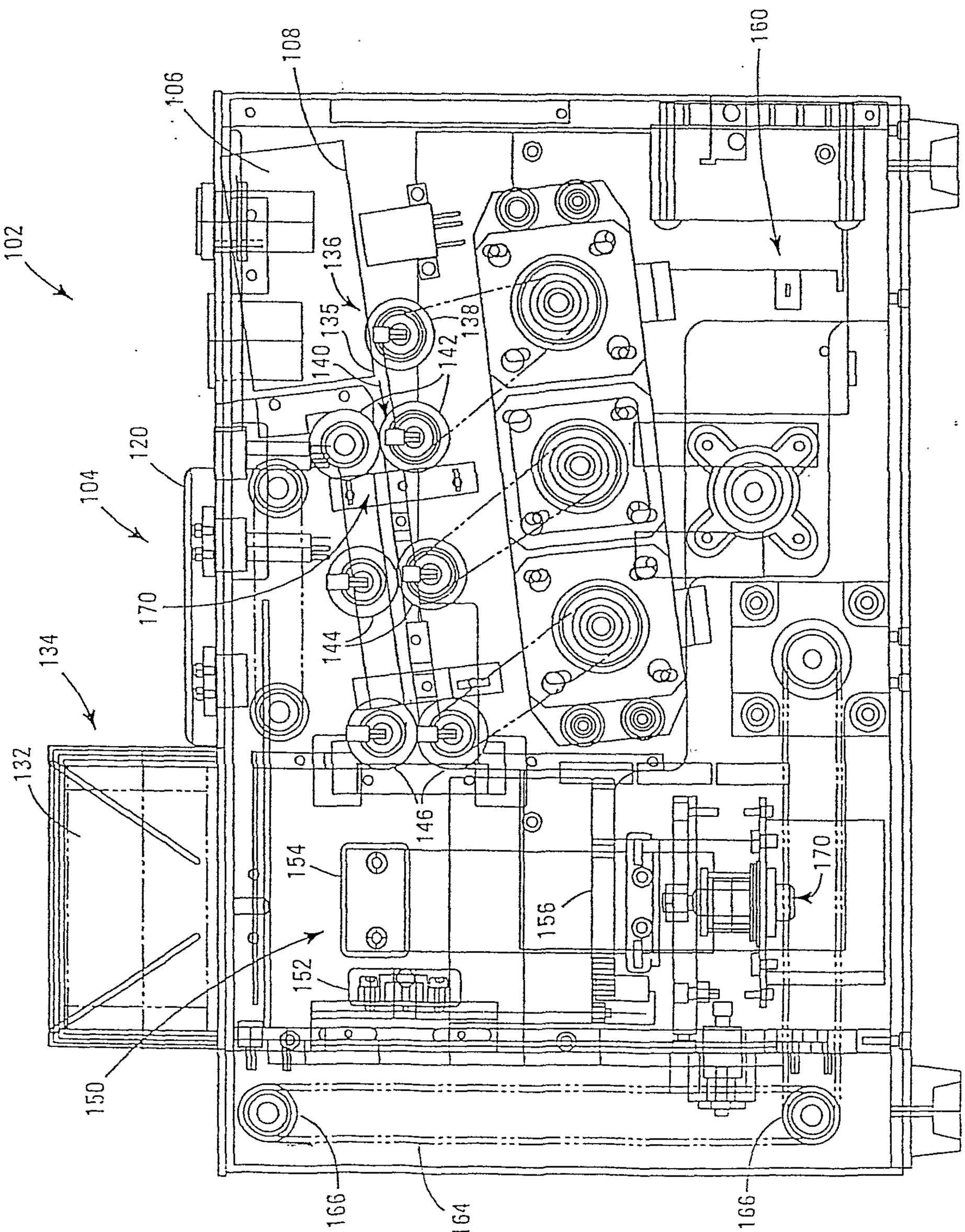


Fig. 1

Fig. 2


102
104
106
108
120
132
134
135
136
138
140
142
144
146
150
152
154
156
160
164
166
170

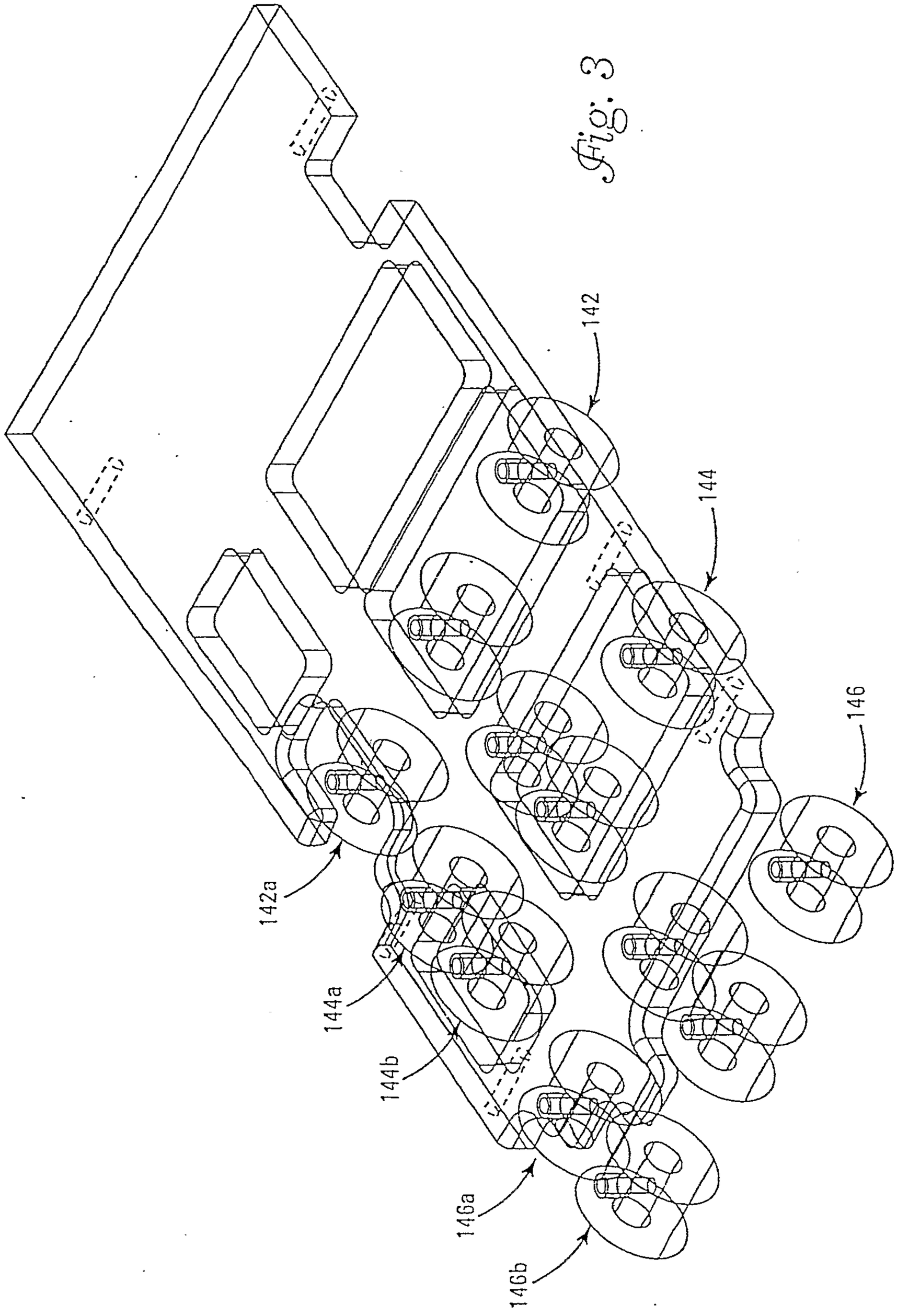


Fig. 3

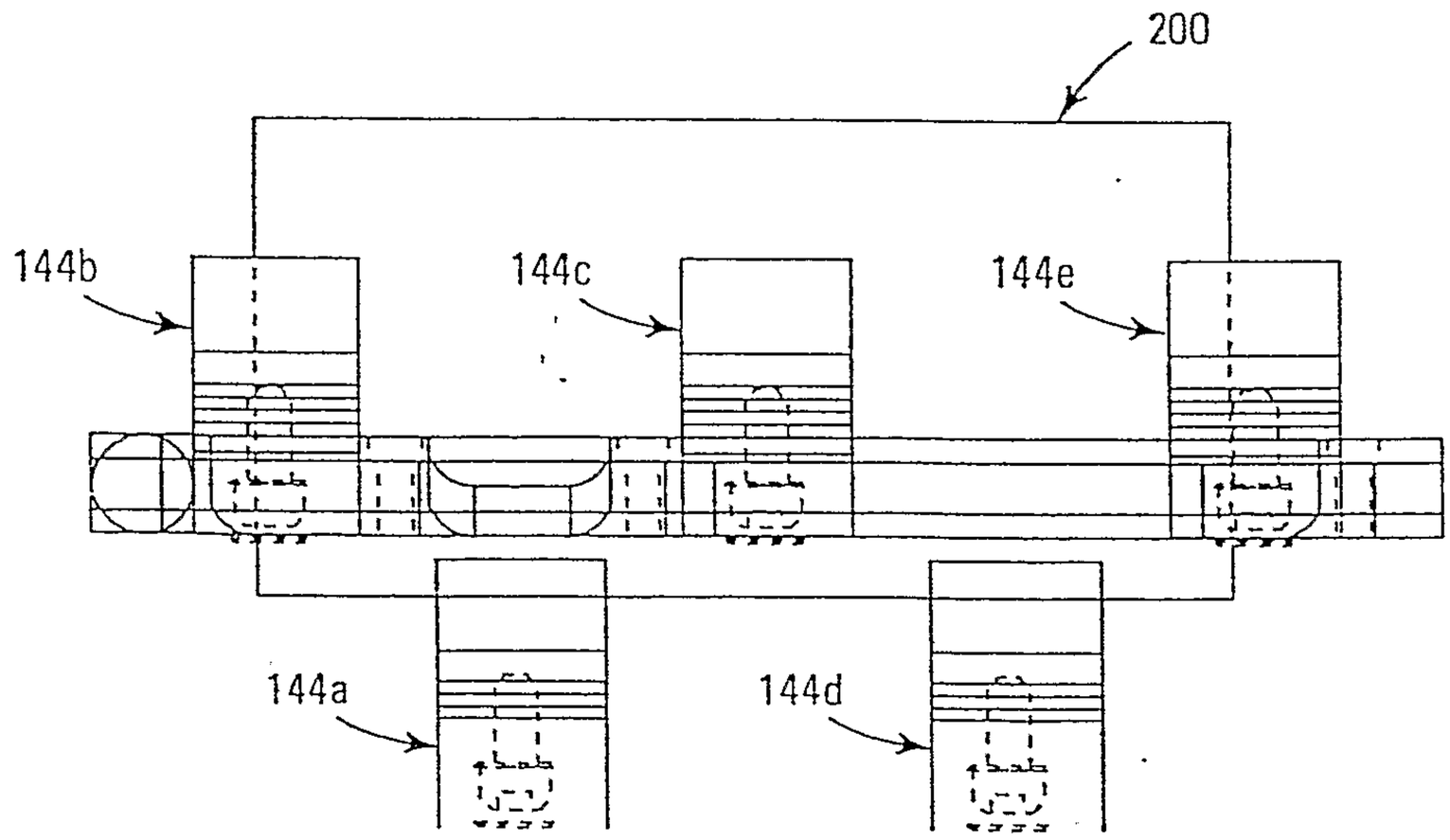


Fig. 4

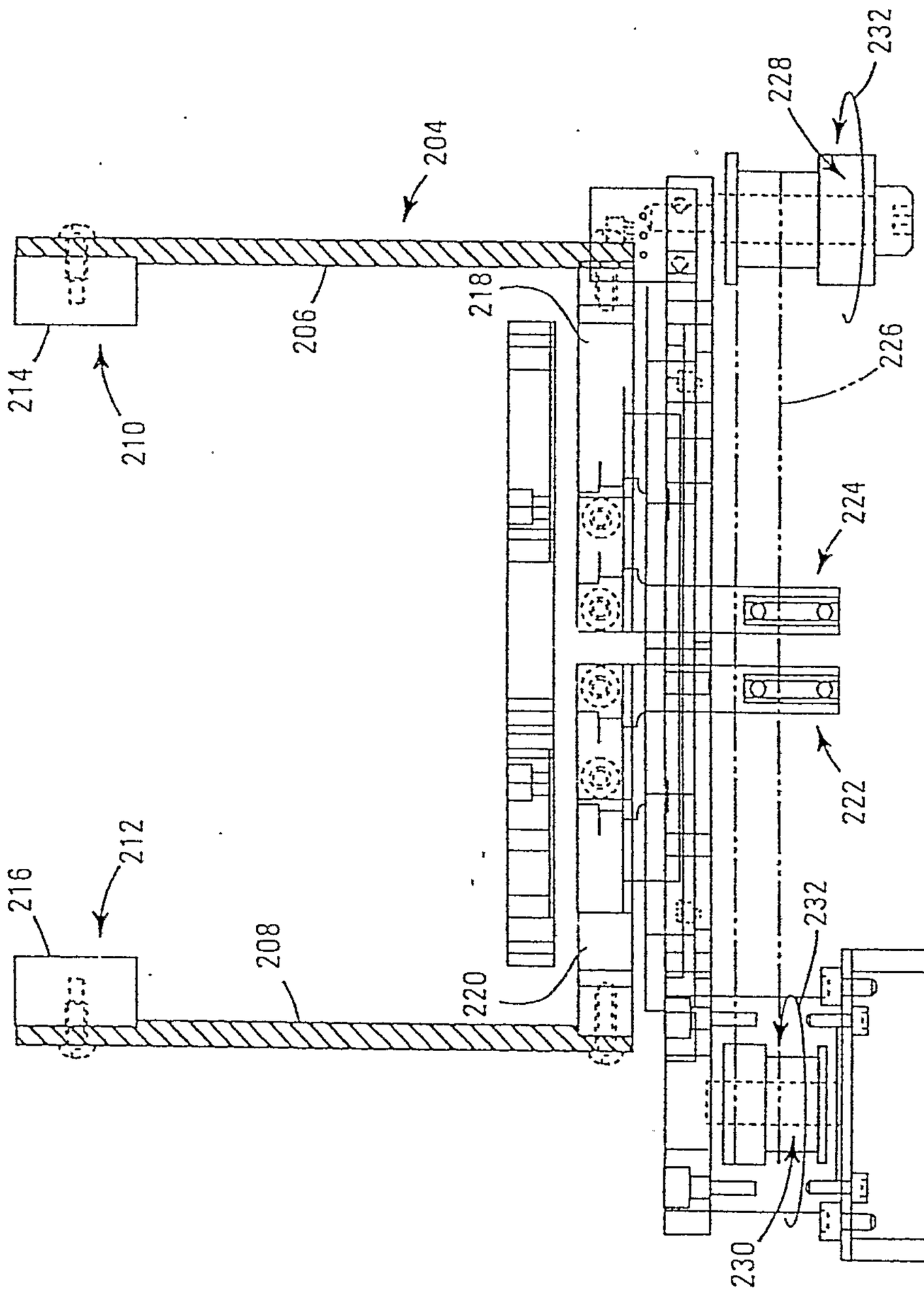


Fig. 5

Fig. 6

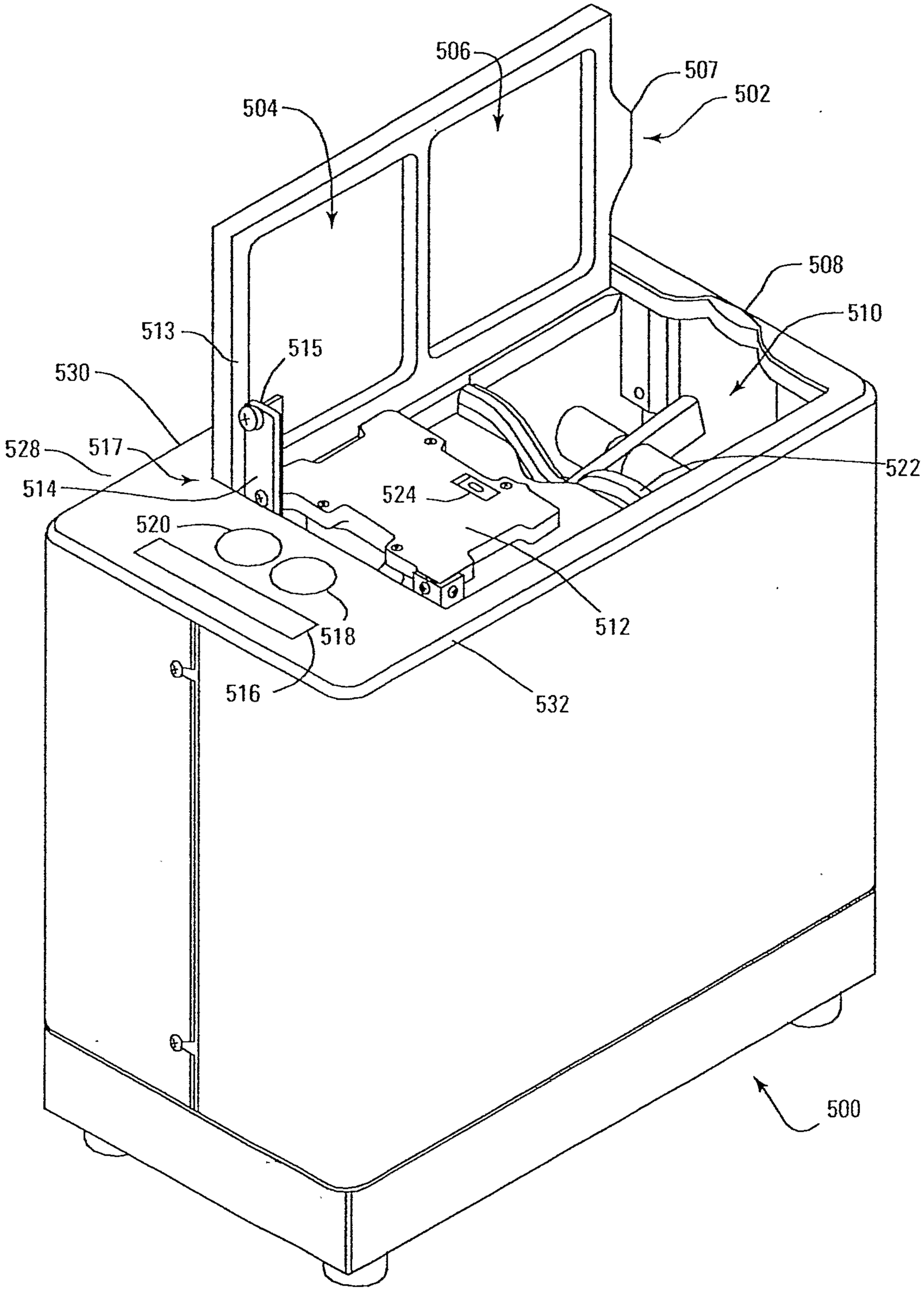
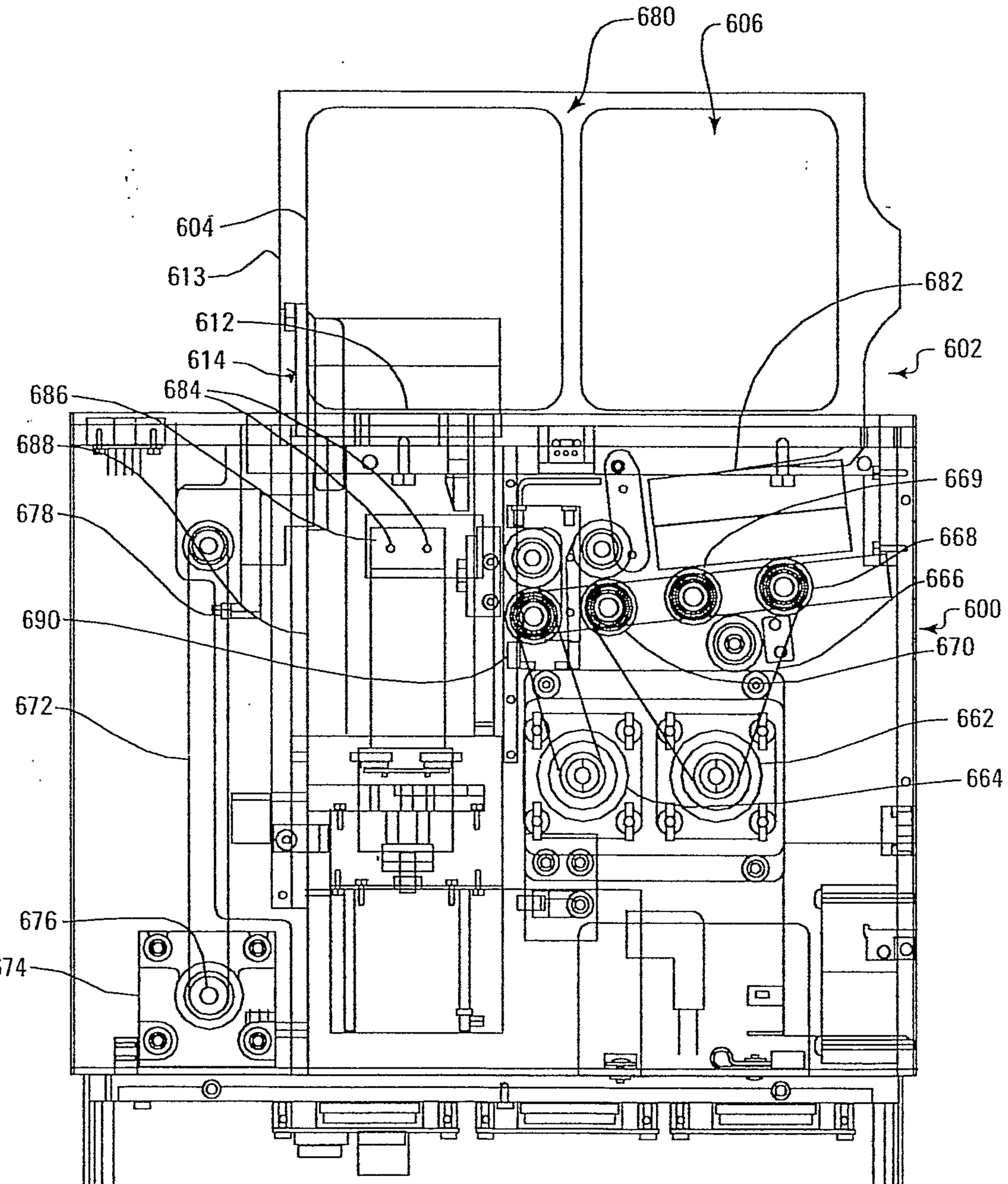

506
507
502
504
508
510
513
515
530
528
517
514
520
524
522
518
512
516
532
500

Fig. 7


680
606
604
613
612
614
686
684
688
678
690
672
676
674
682
602
669
668
666
600
670
662
664

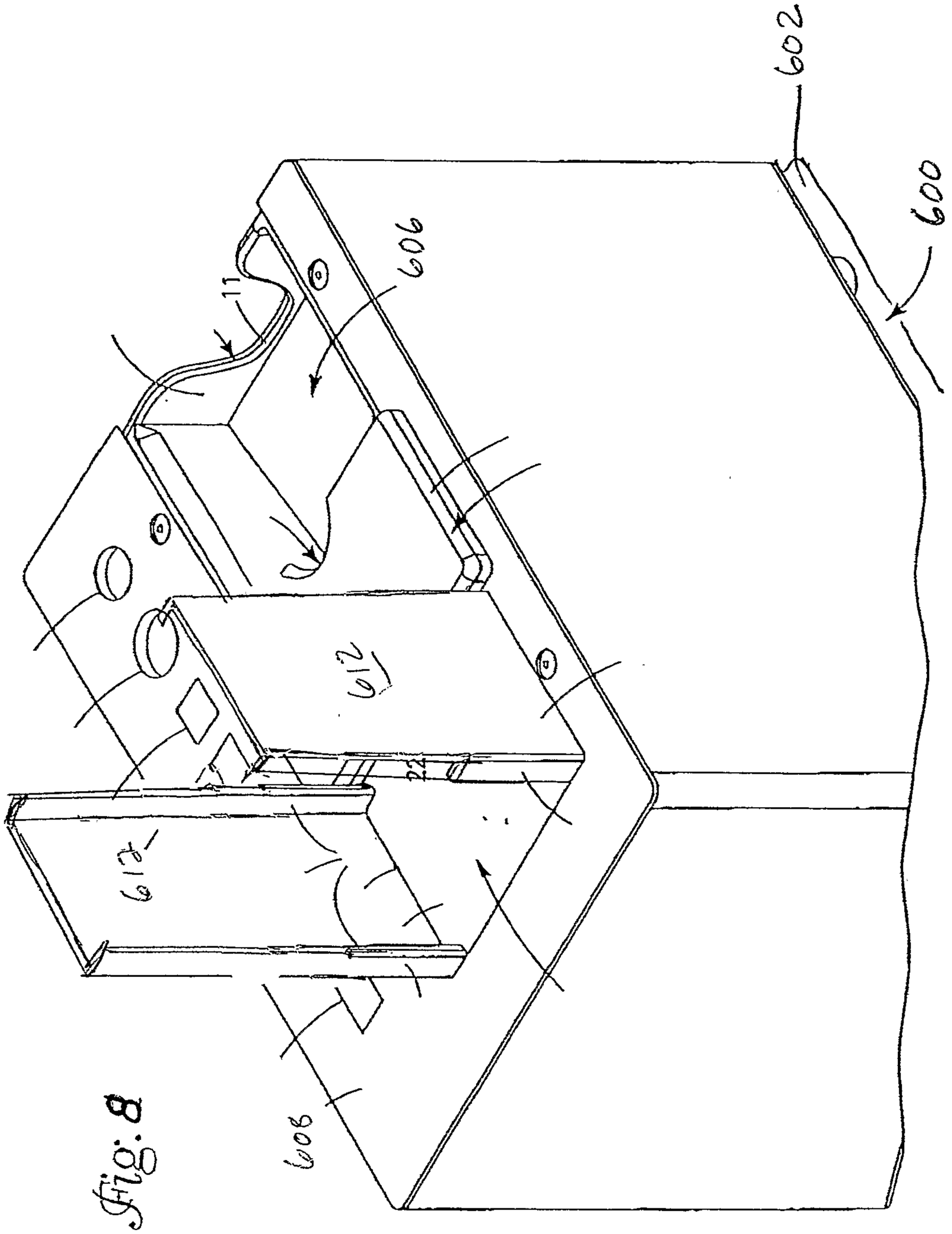
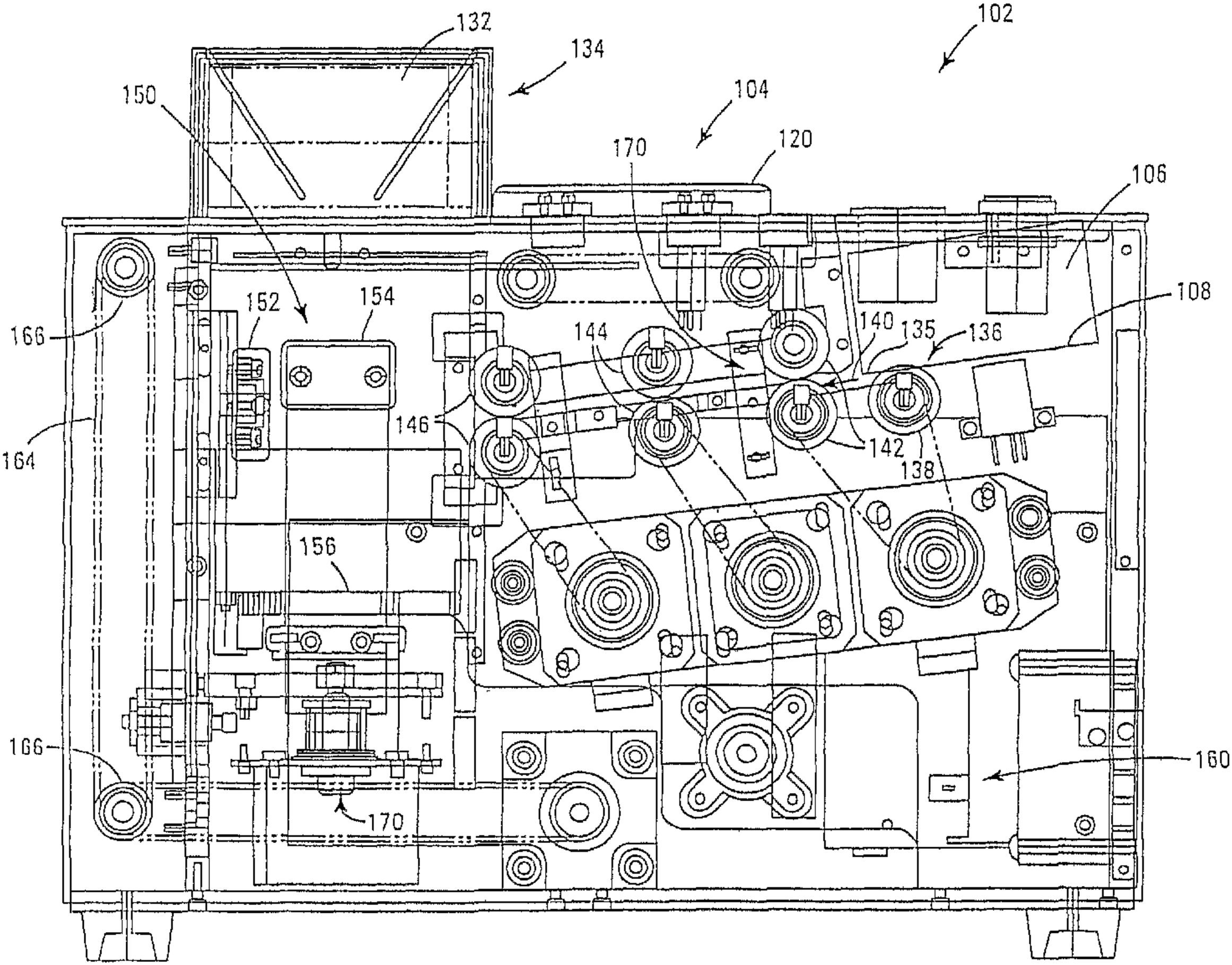


Fig. 8


132
134
102
150
104
170
120
106
108
152
154
166
144
140
135
136
146
142
164
138
156
166
160
170