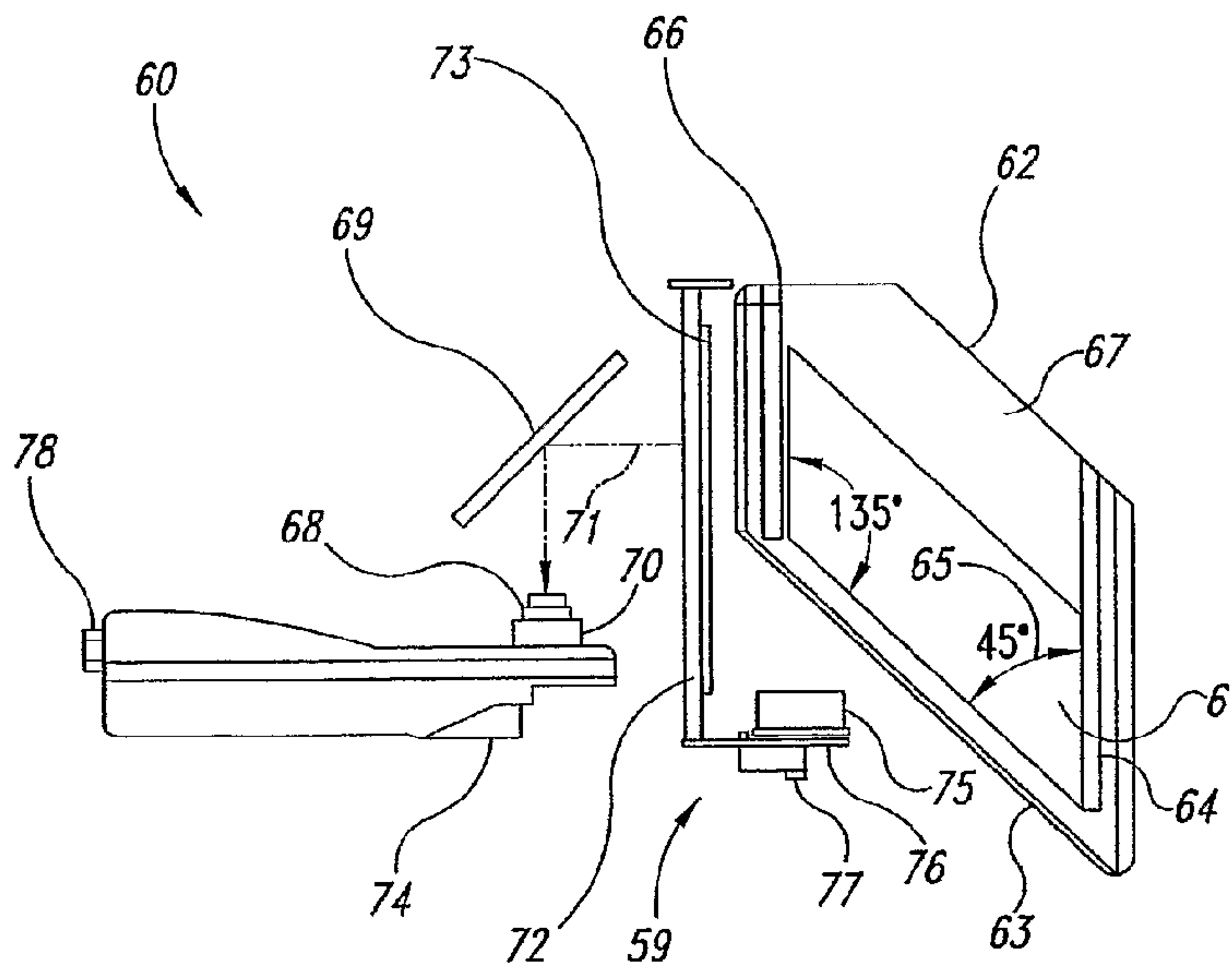




(86) **Date de dépôt PCT/PCT Filing Date:** 2004/02/09  
 (87) **Date publication PCT/PCT Publication Date:** 2004/08/26  
 (45) **Date de délivrance/Issue Date:** 2016/10/04  
 (85) **Entrée phase nationale/National Entry:** 2005/08/03  
 (86) **N° demande PCT/PCT Application No.:** US 2004/003649  
 (87) **N° publication PCT/PCT Publication No.:** 2004/071604  
 (30) **Priorité/Priority:** 2003/02/07 (US10/360,508)

(51) **Cl.Int./Int.Cl. A63F 1/18** (2006.01)  
 (72) **Inventeurs/Inventors:**  
 SOLTYS, RICHARD, US;  
 HUIZINGA, RICHARD, US;  
 MOUCHOU, ROBERT B., US  
 (73) **Propriétaire/Owner:**  
 WALKER DIGITAL TABLE SYSTEMS, LLC, US  
 (74) **Agent:** GOWLING WLG (CANADA) LLP

(54) **Titre : METHODE, APPAREIL ET ARTICLE POUR EVALUER DES JEUX DE CARTES, NOTAMMENT LE BLACKJACK**  
 (54) **Title: METHOD, APPARATUS AND ARTICLE FOR EVALUATING CARD GAMES, SUCH AS BLACKJACK**



(57) **Abrégé/Abstract:**

Identifiers are read from playing cards collected before completion of at least one hand of a card game, such as blackjack, and the value of a hand is determined from the resulting sequence of read identifiers (i.e., ending sequence). The playing cards are collected in a defined order, such as from players in order from a dealer's right to left, and finally from the dealer. The cards, and the play of the game, can be validated based at least in part on the ending sequence. Identifiers may also be read from cards before or while dealing the card game to produce an initial sequence.

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

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
26 August 2004 (26.08.2004)

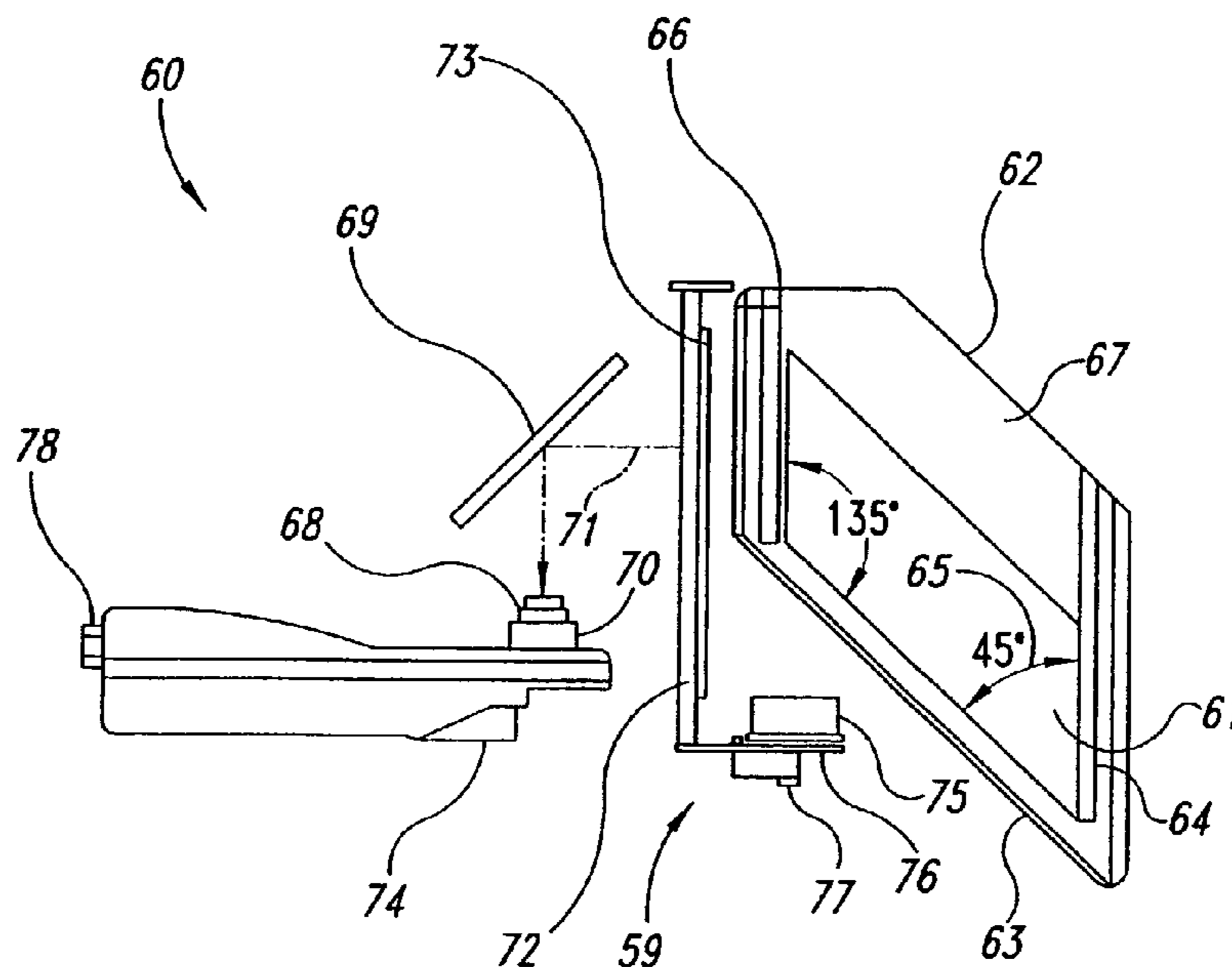
PCT

(10) International Publication Number  
**WO 2004/071604 A3**

- (51) International Patent Classification<sup>7</sup>: **A63F 1/18** 98059 (US). MOUCHOU, Robert, B. [US/US]; 4385 Bitterroot Road, Reno, Nevada 89509 (US).
- (21) International Application Number: PCT/US2004/003649 (74) Agents: ABRAMONTE, Frank et al.; Seed Intellectual Property Law Group PLLC, Suite 6300, 701 Fifth Avenue, Seattle, WA 98104-7092 (US).
- (22) International Filing Date: 9 February 2004 (09.02.2004)
- (25) Filing Language: English (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, 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, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (26) Publication Language: English (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK,
- (30) Priority Data: 10/360,508 7 February 2003 (07.02.2003) US
- (71) Applicant (for all designated States except US): MIND-PLAY LLC [US/US]; 11225 Southeast 6th Street, Bldg. C, Suite 110, Bellevue, Washington 98004 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): SOLTYS, Richard [US/US]; 14529 Southeast 85th Street, Newcastle, Washington 98059 (US). HUIZINGA, Richard [CA/US]; 14529 Southeast 85th Street, Newcastle, Washington

[Continued on next page]

(54) Title: METHOD, APPARATUS AND ARTICLE FOR EVALUATING CARD GAMES, SUCH AS BLACKJACK



(57) Abstract: Identifiers are read from playing cards collected before completion of at least one hand of a card game, such as blackjack, and the value of a hand is determined from the resulting sequence of read identifiers (i.e., ending sequence). The playing cards are collected in a defined order, such as from players in order from a dealer's right to left, and finally from the dealer. The cards, and the play of the game, can be validated based at least in part on the ending sequence. Identifiers may also be read from cards before or while dealing the card game to produce an initial sequence.

WO 2004/071604 A3

**WO 2004/071604 A3**



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,  
ML, MR, NE, SN, TD, TG).

**(88) Date of publication of the international search report:**  
16 December 2004

**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.*

METHOD, APPARATUS AND ARTICLE FOR EVALUATING CARD GAMES,  
SUCH AS BLACKJACK

BACKGROUND OF THE INVENTION

Field of the Invention

5           This invention is generally related to gaming, and particularly to card games, such as blackjack.

Description of the Related Art

10           Card games are a well-known form of recreation and entertainment. Games are typically played with one or more decks of cards, where each deck typically includes 52 cards. Each deck of cards will typically include four suits of cards, including: hearts, diamonds, clubs, and spades, each suit including fourteen cards having rank: 2-10, Jack, Queen, King and Ace. Card games may, or may not, include wagering based on the game's outcome.

15           One popular card game is known as blackjack. In blackjack, one or more players each compete against a dealer. The players attempt to collect a hand having a total value equal to, or as close to twenty-one, without going over. The value of the hand is determined by the rank of the card. Thus, cards having rank 2-10 have the value 2-10, respectively. Face cards (*i.e.*, Jack, Queen, King ) have the value 10, while Aces can have the value 1 or 10 at the player's discretion. An initial hand of two cards having the value of twenty-one (*i.e.*, an Ace plus a ten or a face card) is referred to as a natural "21", or blackjack, and beats other hands with the value of twenty-one. Suits have no bearing on the game of blackjack.

25           In blackjack, the dealer will initially deal two cards to each of the players and the dealer. The dealer deals in two passes around the table, starting with players at the dealer's far left (*i.e.*, first base) and extending through players at the dealer's far right (*i.e.*, third base) and finally to them self.

The players' cards are dealt face up in games where the cards are dealt from a shoe, and face down in hand-held games (*i.e.*, games dealt by hand). The rules of play for the dealer are strictly dictated, leaving no decisions up to the dealer. Therefore, there is not a problem with the dealer, or any of the other  
5 players at the table, seeing the cards in a player's hand.

The dealer turns over or is dealt one of the dealer's first two cards face up, such that the value of the card is visible to the players at the table. This card is commonly referred to as the "top" card. The dealer leaves or is dealt the second card face down, such that the value of the card is not visible  
10 to the players at the table. The face down card is commonly referred to as the "hole" card. In some variations of blackjack, the dealer will immediately determine the value of the hole card, while in other variations of the game the dealer waits until all players have played their hands before checking the value of the hole card.

The dealer then offers each player in succession, from the dealer's left to right the opportunity to accept additional cards from the deck. Each player's hand is completed before the dealer offers the next player the opportunity to receive additional cards. Accepting cards is commonly referred to as "hitting" or taking a "hit." At each player's turn, the player may accept  
15 cards, one at a time, trying to build a hand with a value as close to twenty-one as possible, without going over twenty-one. The player may decline further cards at anytime, which is commonly referred to as "standing." The player must terminate play if the value of the player's hand exceeds twenty-one. A hand with a value exceeding twenty-one is commonly referred to as a "bust" or  
20 "busted." If the player busts, or has a natural twenty-one (*i.e.*, blackjack), the dealer must complete the player's hand and place that player's cards into a discard holder. Before receiving a third card after the initial hands are dealt, a player can split the player's initial hand. This is commonly referred to as  
25 splitting. The player uses one of the initial cards to form a new hand, placing a  
30 wager for the new hand, and retains the other of the initial cards as a part of the original hand.

After each player in turn has declined to accept further cards, the dealer may accept further cards from the deck, with goal of obtaining a hand having a value as close to twenty-one as possible, without exceeding twenty-one. Casinos have rules based on the value of the dealer's hand that dictate when the dealer must take an additional card from the deck (*i.e.*, hit) and when the player must decline further additional cards (*i.e.*, stand). For example, many casinos require the dealer to stand if the dealer's hand has a value of seventeen or more. Some, casinos permit the dealer to take an additional card if the value of the dealer's hand is a soft seventeen, that is, if the value of the dealer's hand is seventeen by counting an Ace held by the dealer as eleven.

If the dealer busts, players who have not also busted win. If the dealer does not bust, all remaining players and the dealer must display their hands to allow the dealer to compare each of the player's hands to the dealer's hand. Those players having a hand with a higher value than the dealer's hand, and who have not exceed twenty-one win. The winning players are paid based on the size of their wager and the odds. Blackjack includes additional rules such as "doubling down" and "insurance" bets, and other variations that are commonly known by those who play blackjack, and will not be further described in the interest of brevity.

Blackjack is particularly popular in casinos and other gaming establishments. Players wager large sums of money while playing blackjack. Thus, it is important to ensure that those playing the game are not cheating. It is also important to monitor the game in a relatively unobtrusive manner to allow casino customers to feel comfortable in their surroundings.

## BRIEF SUMMARY

In one illustrative embodiment, a method of analyzing a card game includes reading an identifier from each of a number of playing cards constituting a hand of playing cards of at least one player playing the card game, and determining a value of the at least one hand of the at least one player based on the read identifiers and based on a number of playing cards dealt to the at least one hand of the at least one player. The number of playing cards dealt to each hand may be determined in a number of

ways, for example, by optically detecting the appearance of each playing card dealt to the player such as by one or more cameras mounted above the gaming table or by optical or other 5 sensors positioned in or under the surface of the gaming table. Also for example, the number of playing card dealt to each hand may be determined by  
5 reading identifiers from a dealer's initial hand and locating the cards forming the initial hand in a starting sequence (*i.e.*, original order of playing cards prior to dealing) and/or an ending sequence (*i.e.*, order of discarded playing cards collected after completion of hand).

In another illustrative embodiment, a method of analyzing a card game includes  
10 reading an identifier from each of a number of playing cards collected after completion of at least one hand of the card game, and determining a value of the at least one hand of the at least one player based on the read identifiers and based on a number of playing cards dealt to the at least one hand of the at least one player. The playing cards may be collected from each of the players at a completion of at least one hand of the  
15 card game, in an order from a first base position through a third base position, and then from the dealer. A defined order helps to ensure that the cards making up each player's hand can be located in the ending or discard sequence.

In a further illustrative embodiment, a method of analyzing a card game includes determining a starting sequence of playing cards corresponding to an order of the  
20 playing cards in a set of playing cards before the playing cards are dealt to at least one hand of at least one player in the card game; determining an ending sequence of playing cards corresponding to an order of the playing cards in a set of playing cards collected after completion of at least one hand of the at least one player of the card game; and determining a value of the at least one hand of the at least one player based  
25 on at least one of the starting sequence and the ending sequence.

In yet a further illustrative embodiment, a method of analyzing a card game includes collecting a plurality of playing cards dealt to each of a number of players at a completion of at least one hand of the card game, the playing cards collected from player-to-player in a defined; reading a respective identifier from each of the playing  
30 cards in the order collected; determining a value of at least one hand of at least one player based at least in part on the read identifiers.

In another illustrative embodiment a method of analyzing a card game includes reading, via a discard card reader, an identifier from each of a number of playing cards collected after completion of at least one hand of at least one player of the card game to determine an ending sequence of playing cards. The method further includes  
5 automatically determining, via at least one processor communicably coupled to the discard card reader, a quantity of playing cards dealt to the at least one complete hand of the at least one player, before determining the ending sequence of playing cards. The method further includes, for at least one player, automatically determining, by a client computer system, a value of the at least one complete hand based on the ending  
10 sequence and based on the determined quantity of playing cards dealt to the at least one complete hand of the at least one player.

The method may further include optically detecting, with at least one camera, at least one appearance of at least one dealt playing card at a respective position on the gaming table associated with a respective player of the at least one player. In such an  
15 embodiment, the step of automatically determining may be based at least in part on the at least one appearance of the at least one dealt playing card optically detected with the at least one camera.

In another illustrative embodiment, a system for analyzing a card game includes means for reading an identifier from each of a number of playing cards collected after  
20 completion of at least one hand of at least one player of the card game to determine an ending sequence of playing cards, and means for automatically determining a total quantity of playing cards dealt to the at least one complete hand of the at least one player before determining the ending sequence of playing cards. The system further includes means for automatically determining a value of the at least one complete hand  
25 based on the ending sequence and based on the determined quantity of playing cards dealt to the at least one complete hand of the at least one player.

The system may further include means for optically detecting at least one appearance of at least one dealt playing card at a respective position on the gaming table associated with a respective player of the at least one player. The means for  
30 automatically determining may include means for automatically determining the quantity



of playing cards dealt to the at least one complete hand of the at least one player before determining the ending sequence of playing cards, based at least in part on the at least one appearance of the at least one dealt playing card optically detected with the means for optically detecting.

5 Other aspects and features of illustrative embodiments will become apparent to those ordinarily skilled in the art upon review of the following description of such embodiments in conjunction with the accompanying figures.

#### BRIEF DESCRIPTION OF THE DRAWINGS

10 In the drawings, identical reference numbers identify similar elements or acts. The size and relative positions of elements in the drawings are not necessarily drawn to scale. For example, the shapes of various elements are not drawn to scale, and some of these elements are arbitrarily enlarged and positioned to improve drawing legibility. Further, the particular shapes of elements, as drawn are not intended to convey any  
15 information regarding the actual shape of the particular elements, and have been solely selected for their ease and recognition in the drawings.

Figure 1 is a schematic drawing showing an environment in which an embodiment of the invention can operate, including a network coupling a number of client computing systems, a server computing system, a card hand reader, and a  
20 discard shoe having a discard shoe reader.

Figure 2 is a high level system block diagram showing various hardware elements of the client computing systems of Figure 1.

Figure 3 is perspective view of the discard card reader of Figure 1, showing an optical lens assembly, imager, reflector, aperture, illumination assembly and connector.

25 Figure 4 is side elevation view of the discard card reader of Figure 3.

Figure 5 is side elevation view of an alternative discard card reader, including an actuator for moving the cards relative to an aperture.

Figure 6 is side elevation view of an alternative discard card reader, including a magnetic reading head for reading magnetic markings on the cards.

Figure 7 is a schematic drawing showing the environment of Figure 1, including a number of software applications loaded into memory on the client and server computing systems.

Figure 8 is a flow diagram of an overview of an illustrated method  
5 of operating the card game evaluation system of Figure 1.

Figure 9 is a flow diagram of an illustrated method of operating a blackjack game including operating the card game evaluation system of Figure 1 to identify the sequence of the deck and the initial hands of the dealers and players.

10 Figures 10A and 10B are a flow diagram of an illustrated method of operating a blackjack game including dealing and collecting cards after the initial hands have been dealt and read according to the method of claim 8.

Figures 11A and 11B are a flow diagram of an illustrated method of operating a blackjack game including operating the game evaluation system  
15 of Figure 1 for evaluating the game and game results.

Figure 12 is a flow diagram of a method of reading identifiers from the cards in the discard card reader.

Figure 13 is a schematic view of a portion of a deck of playing cards.

20 Figure 14 is a schematic view of a dealer's initial hand of two playing cards.

Figure 15 is a schematic view of the playing cards in the discard shoe, after playing a round of blackjack.

25 Figure 16 is a schematic view contrasting a first player's completed hand in a game dealt from a shoe and in a game dealt by hand.

Figure 17 is a schematic view of a gaming environment including a gaming table such as a blackjack gaming table and cameras positioned for imaging activity on the surface of the gaming table, such as the appearance of playing cards at one or more player positions.

30 Figure 18 is a schematic view of a gaming environment including a gaming table such as a blackjack gaming table and a plurality of optical

sensors positioned for detecting activity on the surface of the gaming table, such as the appearance of playing cards at one or more player positions.

Figure 19 is a flow diagram of a method of operating a card game evaluation system.

5 Figure 20 is a flow diagram of an additional method of operating a card game evaluation system.

## DETAILED DESCRIPTION OF THE INVENTION

In the following description, certain specific details are set forth in order to provide a thorough understanding of various embodiments of the invention. However, one skilled in the art will understand that the invention may be practiced without these details. In other instances, well-known structures associated with cameras, optics, computers, computer networks, data structures, databases and networks such as the Internet, have not been described in detail to avoid unnecessarily obscuring the descriptions of the 10 embodiments of the invention.

15 Unless the context requires otherwise, throughout the specification and claims which follow, the word "comprise" and variations thereof, such as "comprises" and "comprising" are to be construed in an open, inclusive sense, that is as "including but not limited to."

### 20 System Environment

Figure 1 shows a card game evaluation system 10 including a number of client computing systems 12, a server computing system 14, a number of card hand readers 15, a discard shoe 16a, 16b, and a number of card deck readers 17a, 17b that communicate over a network 18. The card 25 game evaluation system 10 and method of operation is illustrated in the environment of a blackjack game, although some components and methods are applicable to other types of card games.

The client computing systems 12 each include a display 20, screen 22, cabinet 24, keyboard 26 and mouse 28. The mouse 28 can have

one or more user selectable buttons for interacting with a graphical user interface ("GUI") displayed on the screen 22. The cabinet 24 includes a slot 30 for receiving computer-readable media, such as a CD-ROM disk 32. Although the computer-readable media is represented as a CD-ROM disk 32, the card  
5 game evaluation system 10 can employ other computer-readable media, including but not limited to, floppy disks, tape, flash memory, system memory, and hard drives. The CD-ROM disk 32 can hold software applications discussed in detail below.

The server computing system 14 includes a cabinet 29 having a  
10 slot 30 for receiving computer-readable media, such as a CD-ROM disk similar to the CD-ROM disk 32. The server computing system 14 can optionally include a display, screen, keyboard, and/or mouse as described above. The server computing system 14 also includes a server database 34. The server database 34 is shown as being external to the cabinet 29 for ease of  
15 representation in the drawings, although in many embodiments the server database 34 can be located within the cabinet 29.

The card hand reader 15 has a slot 19 sized and dimensioned for receiving a hand of cards, such as the dealer's initial hand 21 which consists of the face up top card 23 and the face down hole card 25. As described in detail  
20 in commonly assigned U.S. patent application 60/259,658, filed January 4, 2001, and entitled "Method, Apparatus And Article for Verifying Card Games, Such As Blackjack," the card hand reader 15 is capable of reading an identifier associated with each of the cards 23, 25. The identifier can be encoded, for example, in a machine-readable symbol such as a bar code, or in a magnetic  
25 strip, carried by the card 23, 25. The identifier may take the form of a unique identifier, such as a serial number that uniquely identifies each card in the deck of cards, and/or the rank and/or suit of the cards 23, 25. As illustrated, the card hand reader 15 can be directly connected to one of the client computing systems 12, or can be coupled to a client computing system 12 via the network  
30 18.

The card deck reader can take a hand-held form 17a for games dealt by hand, or can take a card shoe form 17b for games dealt from a card shoe. The hand-held card deck reader 17a includes a slot 25 sized and dimensioned to receive one or more decks of playing cards 27. The dealer can  
5 insert the deck 27 into the slot 25 prior to beginning a game. The shoe card deck reader 17b contains one or more decks of playing cards 27, and includes a slot 25 sized and dimensioned to allow the dealer to remove one card at a time. The card deck reader 17a, 17b is capable of reading a unique identifier such as a serial number, identifying each card in the deck of cards 27, and/or  
10 the rank and suit of the cards in the deck of cards 27. A similar reader is described in commonly assigned patent applications: Serial No. 60/130,368 filed April 21, 1999, and Serial No. 09/474,858 filed December 30, 1999, and entitled "Method and Apparatus For Monitoring Casino Gaming." Thus, the sequence of the cards in the deck 27 is known to the card game evaluation  
15 system 10 at the start of the game. As illustrated, the card deck reader 17a, 17b can be directly connected to one of the client computing systems 12, or can be coupled to a client computing system 12 via the network 18.

The discard shoe 16a, 16b includes a slot 13 for receiving cards collected by the dealer after the hands are completed. The discard shoe  
20 includes suitable electronics and/or optics for identifying the cards placed in the slot 13, for example by reading a unique identifier such as a serial number or the rank and suit of each card, as described in detail below.

The network 18 can take the form of any conventional network, such as one or more local area networks ("LANs"), wide area networks  
25 ("WANs"), and/or extranets, intranets, or the Internet.

### Low-level System

Figure 2 shows a system block diagram of the client computing systems 12 used in executing an illustrated embodiment of the present invention. As in Figure 1, the client computing systems 12 each include the  
30 display 20, keyboard 26 and mouse 28. Additionally, each of the client

computing systems 12 can include subsystems, such as a processor 36, system memory 38, fixed persistent memory 40, media drive 42, display adapter 44, sound card 46, speakers 48, and network interface 50. Arrows 52 represent the system bus architecture of the client computing systems 12.

5           The client computing systems 12 can take any of a variety of forms, such as a micro- or personal computer, a mini-computer, a workstation, or a palm-top or hand-held computing appliance. The processor 36 can take the form of any suitable microprocessor, for example, a PENTIUM II, PENTIUM III, PENTIUM IV, POWER PC 603 or POWER PC 604 processor. The system  
10 memory 38 can take the form of random access memory ("RAM") or other dynamic storage that temporarily stores instructions and data for execution by the processor 36. The fixed persistent memory 40 can take the form of a hard drive or other nonvolatile computer-readable media. The media drive 42 can take the form of a CD-ROM reader, a DVD reader, an optical disk reader,  
15 floppy disk reader, or other similar device that reads instructions and/or data from computer-readable media.

While not shown in detail, the server computing system 14 can have a similar structure to the client computing systems 12, as shown in Figure 2. In practice, the server computing system 14 will typically take the form of a  
20 network server, the details of which are commonly understood by those skilled in the art.

The computing systems 12, 14 are illustrative of the numerous computing systems suitable for use with the present invention. Other suitable configurations of computing systems will be readily apparent to one of ordinary  
25 skill in the art. Other configurations can include additional subsystems, or fewer subsystems, as is suitable for the particular application. For example, a suitable computing system 12, 14 can include more than one processor 36 (*i.e.*, a multiprocessor system) and/or a cache memory. The arrows 52 are illustrative of any interconnection scheme serving to link the subsystems. Other  
30 suitable interconnection schemes will be readily apparent to one skilled in the

art. For example, a local bus could be utilized to connect the processor 36 to the system memory 38 and the display adapter 34.

### Discard Card Reader

Figures 3 and 4 show the structure of a discard card reader 60 which can be housed within the discard shoe 16. The discard card reader 60 reads an identifier, such as a machine-readable symbol, from the cards 61 constituting one or more completed hands. The machine-readable symbol can take any of a variety of forms, for example, a bar code symbol, or an area or matrix code symbol such as that disclosed in commonly assigned U.S. Patent applications: Serial No. 60/130,368 and Serial No. 09/474,858.

The machine-readable symbol can be printed on an end 54 of a face 56 of the cards 61. The machine-readable symbol is preferably printed such that it is not visually perceptible to humans. For example, the machine-readable symbol can be printed in an ink that is visible only under a particular wavelength of light, such as ultraviolet. Alternatively, the machine-readable symbol can be incorporated into the design on the face 56 of the card, such that the symbol blends in with the design. In a further alternative, the machine-readable symbol can be printed in a magnetic ink. The identifier is preferably printed on a front face (*i.e.*, face with rank and suit indicia) of the cards 61.

A card guide 62 holds the cards 61 and ensures that the cards 61 are properly positioned with respect to a set of reading components, such as electronics and optical components, described below. The card guide 62 includes a card support surface 63. The card support surface 63 is sloped with respect to a base of the discard shoe 16 (Figure 1), to hold the cards 61 in the card shoe 20 such that the cards 61 are slightly shifted or staggered with respect to adjacent cards (as shown in Figures 3 and 4) when the discard shoe 16 is on the horizontal playing surface 26 of the gaming table (not shown). A bottom end wall 64 supports the cards 61 on the sloped card support surface 63, and forms an acute angle 65 therewith. An angle 65 of approximately 45 degrees is suitable. A top end wall 66 is transparent, or has a window formed

therein, to expose the ends 54 of the faces 56 of the cards 61 in the card guide 62. Side walls 67 help ensure the cards 61 are properly aligned to form a stack within the card guide 62.

The reading electronics and optics can include an optical lens assembly 68, a reflector 69, and an imager 70 aligned along an optical path illustrated by broken line arrow 71. The optical lens assembly 68 can include one or more optical lenses and filters. For example, a 9.9 FL lens assembly available from Sunex Inc., Carlsbad, California, part number DSL900, can serve as a suitable optical lens. Also for example, the optical lens assembly 68 can include a narrow band pass filter that passes light having a wavelength of approximately 450 nanometers, while stopping other light, such as light coming directly from an illumination source 72. A suitable filter is available from Edmond Scientific, of Barrington, New Jersey, as part number 00151-11859.

The imager 70 includes photo-sensitive elements, such as charged-coupled devices ("CCDs") and suitable electronics for producing a digital representation of a captured image. A CMOS color sensor, such as the CMOS color sensor available from Photobit Corporation, Pasadena, California, part number PB300, can serve as a suitable imager 70.

The reflector 69 can be positioned at an angle, such as a 45 degree angle, to the top end wall 66 and the imager 70 to pass an image of the ends 54 of the cards 61 to the imager 70. The discard card reader 60 can include additional optical components, such as reflectors, defractors, splitters, polarizers, filters and lenses, where such would be suitable to the particular application. For example, the discard card reader 60 can include an aperture 73 between the reflector 69 and the top end wall 66, which can improve the field of depth of the imager 70. The optical path 71 is defined by the optical properties and position of the optical components, and thus does not necessarily have to be a straight line. Many of the components can be housed in an arm 74, formed from a pair of molded plastic halves.

The discard card reader 60 includes an illumination system 75 having one or more illumination sources 72 that provide low intensity



illumination for the cards 61. The illumination sources 72 can take the form of one or more lamps. The illumination sources 72 produce light suitable to the particular embodiment. For example, the discard card reader 60 can employ illumination sources 72 that produce predominately UV light where the  
5 machine-readable symbols are only visible under UV illumination. Suitable lamps can include ultraviolet ("UV") lamps available from JKL Components Corporation of Pacoima, California, as part number BF350-UV1, having a diameter of 3 millimeters and a length of 50 millimeters. The illumination sources 72 are located proximate the top end wall 66 of the card guide 62. The  
10 illumination sources 72 receive power from a high voltage power inverter 75 via a printed circuit board 76 that receives power from a 5V power source 77. A suitable high voltage power inverter is available from JKL Components Corporation as part number BXA 501A.

The discard card reader 60 is coupled to the network 18 or host  
15 computer 12 by way of a connector 78, such as a FIREWIRE connector or Universal Serial Bus ("USB") connector. For example, a FIREWIRE connector available from Molex Electronics, Ltd. of Canada, part number 52462-0611, can serve as a suitable connector 78. The connector 78 can deliver the digital representation of the captured image to the appropriate client computing  
20 system 12 for image processing and card validation.

Figure 5 shows an alternative embodiment of the discard card reader 60, that is suitable for reading large numbers of cards (e.g., two to six decks). This alternative embodiment, and those alternative embodiments and other alternatives described herein, are substantially similar to previously  
25 described embodiments, and common acts and structures are identified by the same reference numbers. Only significant differences in operation and structure are described below.

The embodiment shown in Figures 3 and 4 is particularly suited for reading up to two decks of cards, the imager 70 typically having a field of  
30 view encompassing up to two decks. The embodiment of Figure 5 has a

similar field of view and moves field of view relative to the cards to incrementally read all of the cards in the discard shoe 16.

The discard card reader 60 employs an actuator, such as a jack screw or a hydraulic actuator 79, to incrementally move the cards past the field  
5 of view of the imager 70. The actuator 79 moves the card support surface 63 to incrementally pass the cards 61 by the aperture 73. The card support surface 63 is slidably mounted with respect to the bottom end wall 64, top end wall 66 and side walls 67. The card support surface 63 can include a number of tabs 80 which fit in grooves 81 formed in the side walls 67 to guide the card  
10 support surface 63 as it advances upward and downward in the card guide 62. The tops and bottoms of the grooves can serve as stops to limit the travel of the card support surface 63. The discard card reader 60 can, of course, employ other guide mechanisms, or may function without such a mechanism. While the illustrated embodiment shows the actuator 79 moving the cards 61,  
15 other embodiments can move the reflector 69, imager 70, and/or one or more of these components to sweep the field of view of the imager 70 across all of the cards 61 in the card guide 62.

The hydraulic actuator 79 includes a cylinder 82 and piston 83, which is moved relative to the cylinder 82 by controlling the pressure within the  
20 cylinder 82 via a reservoir 84, valve 85 and conduit 86. The discard card reader 60 can of course employ other types of actuators 79. The valve 85 is operated by a solenoid 87 that is controlled via a processor, such as a microprocessor 88 mounted on the circuit board 76.

The discard card reader 60 includes one or more position sensors  
25 89 that detect the position of the card support surface 63, the piston 83, or the cards 61 to determine the height of cards in the card guide 62. This allows the microprocessor 88 to activate the solenoid to adjust the level of the card support surface 63 so that the cards are properly positioned with respect to the aperture 73 to be imaged. The position sensors 89 can take the form of optical  
30 switches, mechanical switches, or magnetic switches. For example, an optical switch can take the form of a light source, such as a light emitting diode

(“LED”), and a light sensor opposed to the light source across the card guide 62. The insertion of the cards 61 between the light source and light sensor interrupts the reception of light by the light sensor, that acts as the switch. Also for example, a conductor mounted on, or forming a part of, the card support surface 63 can contact one of a number of conductors on the side walls 67 to close a circuit, providing an indication of the position of the card support surface 63, and hence the position of the cards 61. Similarly, a magnet mounted on the card support surface 63 or piston 83 can pass one of a number of magnetic sensors such as a reed switch to provide position information to the microprocessor 88.

The discard card reader 60 incrementally reads groups of cards. The microprocessor 88 can be programmed to advanced the cards in set increments, for example  $\frac{1}{4}$  inch increments, past the aperture 73. The microprocessor employs the position of the cards 61 as a trigger for advancing the cards. For example, a signal from a single position sensor 89 positioned above the aperture 73 can indicate that there are cards 61 in the card guide 62 that have not been read. The microprocessor 88 advances the cards by activating the solenoid 87 to open and close the valve 85 to the reservoir 84, thereby controlling the flow of a fluid, such as air, into the cylinder 82. The discard card reader 60 can employ other methods of positioning the cards, for example turning a jack screw coupled to the card support surface 63.

#### Magnetic Discard Card Reader

Figure 6 illustrates a further alternative embodiment, in which the discard card reader 60 can employ a magnetic head assembly 90 for reading cards marked with a magnetic strip. The magnetic head assembly 90 can include one or more magnetic heads 91, positioned in the aperture 73 closely spaced from the ends 54 of the cards 61. The magnetic heads 91 read the information encoded in the magnetic strips as the cards are successively incremented past the magnetic head assembly. Cables 92 couple each of the magnetic heads to the circuit board 76.

### Software

As shown in Figure 7, the system memory 38 of the client computing system 12 and server computing system 14 contain instructions and data for execution by the respective processors 36 for implementing the illustrated embodiments. For example, the system memory 38 includes an operating system ("OS") 95, 96 to provide instructions and data for operating the respective computing systems 12, 14. In the case of the client computing systems 12 the OS 95 can take the form of conventional operating systems, such as WINDOWS 95, WINDOWS 98, WINDOWS NT 4.0 and/or WINDOWS 2000, available from Microsoft Corporation of Redmond, Washington. In the case of the server computing system 14, the OS 96 can take the form of conventional server operating systems; such as WINDOWS NT 4.0 Server, and/or WINDOWS 2000 Server, also available from Microsoft Corporation. The OS 95, 96 can include application programming interfaces ("APIs") (not shown) for interfacing with the various subsystems and peripheral components of the computing systems 12, 14, as is conventional in the art. For example, the OS 95, 96 can include APIs for interfacing with a display subsystem 20, 44, keyboard 26, sound subsystem 46, 48 and communications or network subsystem 50.

The system memory 38 of the client and server computing systems 12, 14 can also include additional communications or networking software (not shown) for wired and/or wireless communications on networks, such as local area networks ("LANs"), wide area networks ("WANs"), or the Internet. For example, the client computing system 12 can include a Web client or browser for communicating across the World Wide Web portion of the Internet using standard protocol (e.g., Transmission Control Protocol/Internet Protocol ("TCP/IP"), User Datagram Protocol ("UDP")). A number of Web browsers are commercially available, such as NETSCAPE NAVIGATOR from America Online, and INTERNET EXPLORER available from Microsoft of Redmond, Washington. The server computing system 14 can include a Web

server, such as any of the many commercially available Web server applications.

The system memory 38 of the client computing system 12 includes instructions and/or data in the form of a decoding application 97 for  
5 resolving the digital image into machine-readable symbols and converting the machine-readable symbols into their respective identifiers and/or ranks and suits. Software for resolving digital images into machine-readable symbols and converting the machine-readable symbols into identifiers is commonly known in the automatic data collection ("ADC") arts. The system can additional, or  
10 alternatively, include other software for reading and converting other types of identifiers, such a magnetic strips.

The system memory 38 of the client computing system 12 also includes instructions and/or data in the form of a evaluation application 98 for determining the value and/or status of the hand (*e.g.*, blackjack or not). The  
15 evaluation application 98 also can authenticate the cards in the hand (*i.e.*, determine that the cards belong to the deck being played), and validate the sequence of the cards comprising the hand with respect to a known sequence of cards for the deck (*i.e.*, no cards missing or inserted).

### Overall Method

20 Figure 8 shows an overview of an illustrated method 100 of operating the card game evaluation system 10. Additional flow diagrams (Figures 9-12) illustrate more detailed aspects of the operation of the card game evaluation system 10, as well as actions of the dealer employing the game evaluation system 10.

25 The method 100 starts at step 102, for example in response to the insertion of a deck of cards into the deck reader. In step 104, the card game evaluation system 10 determines the original sequence of cards in the deck. In step 106, the card game evaluation system 10 determines the identity of the cards in the dealer's initial hand. In step 108, the card game evaluation  
30 system 10 determines the number of active player positions (*i.e.*, hands being

played). In step 110, the card game evaluation system 10 determines the identity of the cards in the initial hand for each of the active positions. In step 112, the card game evaluation system 10 determines the identity of the hit cards for the dealer. In step 114, the card game evaluation system 10  
5 determines the value of the dealer's complete hand. In step 116, the card game evaluation system 10 determines the identity of the hit cards for each active position. In step 118, the card game evaluation system 10 determines the value of the completed hands for each active position. It is noted that step 114 can follow step 116 and/or step 118. In step 120, the card game  
10 evaluation system 10 determines the outcome of the game for each active position. In step 122, the card game evaluation system 10 verifies the dealer's completed hand against the original deck sequence. In step 124, the card game evaluation system 10 verifies the completed hand against the original deck sequence for each of the active positions. It is noted that steps 114  
15 and/or step 118 can follow steps 122 and/or step 124. In step 126, the card game evaluation system 10 notifies the dealer and/or other casino personnel of the outcome of the games for each of the active positions and of the outcome of the verification, if any.

Figure 9 shows an exemplary method 130 of operating in the  
20 gaming environment of blackjack. In particular, method 130 identifies specific acts by the card game evaluation system 10 and the dealer. In overview, the method 130 includes: first, determining the sequence of cards in the deck; second, dealing each player and the dealer their respective initial hands; third, determining the value of the dealer's initial hand; and fourth, determining the  
25 value of all active hands.

In step 132, the card deck reader 17a, 17b reads identifiers from each of the cards composing the deck of cards. A suitable deck reader is disclosed in commonly assigned U.S. patent application Serial No. 09/474,858, filed December 30, 1999, entitled "Method and Apparatus For Monitoring  
30 Casino Gaming." In step 134, the card game evaluation system 10 determines

the initial sequence of the cards in the deck of cards based on the identifiers read by the card deck reader 17a, 17b.

In step 136, the dealer deals a first card to each player. As explained above the dealer may deal by hand or may deal from a card shoe.

5 The dealer deals to each player starting from the dealer's left (*i.e.*, first base) to the dealer's right (*i.e.*, third base). In step 138, the dealer deals herself a top card. In step 140, the dealer deals a second card to each player, again from first base to third base. In step 142, the dealer deals herself a hole card.

In step 144, the dealer places the dealer's initial hand (*i.e.*, top  
10 card and hole card) into the card hand reader 15 for reading. In step 146, the card hand reader reads the dealer's initial hand as explained in U.S. patent application Serial No. 60/130,368. In step 148, the card game evaluation system 10 determines the identity of cards in the dealer's initial hand. As explained above, the card game evaluation system 10 can rely on a machine-  
15 readable symbol such as a bar code or magnetic strip encoding a serial number of the suit and rank of the card read by the card hand reader 15.

In step 150, the card game evaluation system 10 compares the dealer's initial hand to the card sequence in the deck.

In step 152, the card game evaluation system 10 determines the  
20 number of cards between the top and hole cards. The card game evaluation system 10 determines the number of active positions in step 154, from the number of cards between the top and hole cards. In step 156, the card game evaluation system 10 can determine the active positions at the gaming table, for example by detecting the location of cards and/or chips, as described in  
25 commonly assigned patent application .

In step 158, the card game evaluation system 10 determines the rank and suit for cards (*i.e.*, players' initial hands) at each of the active positions based on the knowledge of the sequence of cards in the deck and the number of active positions.

30 Figures 10A and 10B show a method 200 of operating a blackjack game, in particular the method 200 identifies specific acts by the dealer after

the initial hands have been dealt, and would typically follow the acts of method 100.

In step 202, the dealer selects a first player. The first player is the player at the first base position. In step 204, the dealer determines whether the  
5 player's hand is complete. The player's hand will only be complete if the player has a total value of twenty or a blackjack (*i.e.*, initial hand with value of twenty-one). If the player's hand is complete (*i.e.*, blackjack), the dealer may immediately pay the player in step 208, or may wait to perform the step until all hands have been played. The dealer then places the player's hand into the  
10 discard shoe in step 210.

If the player's hand is not complete, the dealer offers the player an additional card in step 212. In step 214, the dealer determines whether the player stands. If the player does not stand the dealer deals another card to the player in step 216 and returns to step 206 to repeat the process 206-216 for  
15 the player. If the player stands, the dealer determines whether there are additional players in step 218. If there are additional players, the dealer selects the next player in step 220 and repeats the process 206-216 for the next player. This repeats until the dealer determines that there are no more additional players.

20 In step 222, the dealer determines whether the dealer's hand is complete (*i.e.*, twenty-one or blackjack).

If the dealer's hand is complete, control passes to step 224. If the dealer's hand is not complete, the dealer determines whether the dealer stands in step 226. The house rules typically determine whether the dealer stands or  
25 takes another card. For example, the rule may require the dealer to stand if the value of the dealer's is 17 or more. Under some rules, the dealer may take another card if the value of the dealer's hand is a soft 17 (*i.e.*, Ace counted as eleven). If the dealer does not stand, the dealer takes an additional card in step 228, and returns to step 222, repeating the process 222-228 until the  
30 dealer's hand is complete or the dealer stands. If the dealer stands, control passes to step 224.



In step 224, the dealer compares the dealer's hand to the players' hands, starting with the player on the dealer's far right (*i.e.*, third base). In step 230, the dealer determines whether the player wins. If the player wins, the dealer pays the player in step 232. If the player does not win, the dealer  
5 collects the player's wager in step 234. In step 236, the dealer takes the player's hand and places the hand in the discard shoe. In step 238, the dealer determines if there are more players. If there are more players the dealer selects the next player in step 240 and returns to step 224. The dealer selects  
10 players from the dealer's right to left until the cards from the last player have been collected and placed in the discard shoe. The method terminates in step 242, and a new round of blackjack can be played.

Figures 11A and 11B show a method 300 of operating a blackjack game including validating the game and game results. In particular, the method 300 identifies specific acts by the game evaluation system 10 after the  
15 hands have been completed, and would typically follow the acts of method 200. The method 300 starts at step 302.

In step 304, the dealer positions the cards in the discard shoe 16. In step 306, the discard card reader 60 reads the identifiers from the cards in the discard shoe 16. The discard card reader 60 may employ an incremental  
20 process, successively adjusting the field of view of the discard card reader 60 to read the identifiers from successive sets of discarded cards.

In step 308, the card game evaluation system 10 identifies the location of the initial hands in the read sequence of discarded cards (*i.e.*, discard or ending sequence). The card game evaluation system 10 knows the  
25 identity of the cards composing the initial hands from previously determining the initial hands based on a knowledge of the original sequence of the deck of cards and a knowledge of the dealer's initial hand, as explained above (Figure 9).

In step 310, the card game evaluation system 10 determines the  
30 number of active hands. For example, the number of cards between the dealer's initial hand and the first card in the first successive player's initial hand.

The card game evaluation system 10 may employ the previously determined number of active hands, if splits are not permitted or have not occurred. In step 312, the card game evaluation system 10 determines the dealer's hit cards. In step 314, the card game evaluation system 10 determines the value of the  
5 dealer's hand based on the value of the cards in the dealer's initial hand and the value of the dealer's hit cards.

In step 316, the card game evaluation system 10 determines whether a split hand has occurred. The method 300 branches based on the determination.

10 If a split hand has not occurred, the method 300 follows a first branch 318. In step 318, the card game evaluation system 10 determines the hit cards for a player's hand (*i.e.*, cards between successive hands). The card game evaluation system 10 can employ its knowledge of the identity and sequence of cards collected from the dealer and players which comes from  
15 reading the identifiers from each of the cards by the discard card reader 60. The hit cards are typically the cards preceding the cards in the subject player's or dealer's initial hand that are not part of another player's or dealer's initial hand, which is most clearly illustrated in Figure 15, below. In step 320, the card game evaluation system 10 determines the value of the player's hand. In step  
20 322, the card game evaluation system 10 compares the value of the dealer's and player's hands. In step 324, the card game evaluation system 10 determines whether the player wins, and records the outcome in step 326. In step 328, the card game evaluation system 10 determines whether there are additional player's hands to analyze. If there are additional player hands to  
25 analyze the card game evaluation system 10 determines the hit cards for the player's additional hand in step 330, and returns to step 318.

If a split hand has occurred, the method 300 follows a second branch 332-340. In step 332, the card game evaluation system 10 determines the hit cards for a player's first hand (*i.e.*, cards between first initial card and  
30 next successive initial hand). In step 334, the card game evaluation system 10 then determines the value of the player's hand. In step 336, the card game

evaluation system 10 compares the value of the dealer's and player's hands. In step 338, the card game evaluation system 10 determines whether the player wins, and records the outcome in step 340.

In step 342, the card game evaluation system 10 determines  
5 whether there are hands to analyze for additional players. If there are additional players, the card game evaluation system 10 selects the next player's hand in step 344 and returns control to step 316. If there are no additional players, the method 300 terminates at step 346.

Figure 12 shows a method 400 of reading identifiers from cards  
10 61 in the card guide 62 starting at step 402, which can implement the step 306 of method 300. In step 404, the imager 70 captures a digitized image of the symbol on each card 61. In step 406, digitized image is sent to either the microprocessor 88 (Figure ), the server computing system 14 (Figure 1), or one of the client computing systems 12. In step 408, the microprocessor 88, server  
15 computing system 14, or one of the client computing systems 12 resolves the digitized image into machine-readable symbols. In step 410, the microprocessor 88, server computing system 14, or one of the client computing systems 12 converts the machine-readable symbols into respective serial numbers and/or card ranks. The method 400 terminates at step 412.

## 20 Example

Figures 13-16 show an example blackjack game, illustrating the concepts discussed above, including the verification process.

Figure 13 shows a portion of a deck of cards 93, from which the dealer deals to the players and herself during a game of blackjack. The  
25 sequence of cards in the portion of the deck of cards 93 is known from the prior reading of the deck of cards by the card deck reader 17a, 17b.

Figure 14 shows the cards 23, 25 composing the dealer's initial hand 21. The identity of the cards composing the dealer's initial hand 21 are known from the use of the card hand reader 15. In this case, the dealer's top

card 23 is the ace of spades and the dealer's hole card 25 is the eight of hearts.

The card game evaluation system 10 can determine the initial hands for each of the players based on a knowledge of the initial sequence of cards in the deck 93 and the identity of cards 23, 25 in the dealer's initial hand 21. The card game evaluation system 10 determines the number of active players from the number of cards appearing between the dealer's top card 23 and hole card 25 in the sequence of cards 93 (Figure 13). In this case, there are three cards between the Ace of spades and the eight of hearts (*i.e.*, the eight of clubs, ten of spades and seven of spades), and thus three active players.

Knowing that there are three active players in addition to the dealer, the card game evaluation system 10 can map the original sequence of cards to each of the players. From the first base to the third base position, each of the three players received a first card (*i.e.*, two of hearts, nine of spades and seven of clubs, respectively) before the dealer's top card (*i.e.*, Ace of spades). From the first base to the third base position, each of the three players received a second card (*i.e.*, eight of clubs, ten of spades and seven of spades, respectively) before the dealer's hole card (*i.e.*, eight of hearts). Thus, for players  $i$  from 1 through  $n$ , where  $i$  is the player position from the dealer's left to right, and  $n$  is the total number of players, the player's( $i$ ) initial hand is composed of a first card corresponding to the " $i^{\text{th}}$ " card in the sequence of the deck and a second card corresponding the " $n+1+i^{\text{th}}$ " card in the sequence of the deck. The initial hand of the dealer is composed of a first card corresponding to the " $n+1^{\text{st}}$ " position in the sequence of the deck and a second card corresponding to the " $2n+2^{\text{nd}}$ " position. The initial hands of the players and dealer in this example are shown in table 1, below.

	Initial Cards
Player 1	2 8 ♥, ♣
Player 2	9 10 ♠, ♠
Player 3	7 7 ♣, ♠
Dealer	A 8 ♠, ♥

**Table 1:** Initial cards

Figure 15 shows the cards 94 found in the discard shoe 16, after the round. These may include all of the cards 94 in the discard shoe 16, or only the cards added to the discard shoe 16 since the last round of blackjack.

5 The card game evaluation system 10 can then ascertain the players and dealer's hit cards based on the sequence of cards 94 in the discard shoe 16 and a knowledge of the player's and dealer's initial hands. For example, the dealer's initial hand 21 (*i.e.*, Ace of spades, eight of hearts) is not preceded by any cards, thus the dealer did not have any hit cards. (Note: most casinos  
10 would not allow the dealer to hit with a hand having a value of eighteen.)

The second player's initial hand (*i.e.*, nine of spades, ten of clubs) immediately follows the dealer's initial hand 21 (*i.e.*, Ace of spades, eight of hearts). Thus, since there are no intervening cards, it is clear that the second player did not have any hit cards. One card (*i.e.*, queen of hearts) immediately  
15 precedes the first player's initial hand (*i.e.*, two of hearts, eight of clubs), and follows the second player's hand. Thus, the first player had one hit card, a queen having a value equal to 10. The third player has two cards immediately preceding the third player's initial hand (*i.e.*, seven of clubs, seven of spades), and following the second player's hand. Thus, the third player received two hit  
20 cards, a ten of diamonds, followed by an Ace of clubs. The hit cards for a hand are found in a successive number of locations in the deck, starting at a position given by the formula  $2n+2+$  the total number of hit cards taken by all previous positions, where  $n$  corresponds to the total number of player hands. This is dictated by the way blackjack is played, successively dealing two cards around  
25 the table to form the initial hands, including the dealer (*i.e.*,  $2n+2$ ). Then each

player is given an opportunity to take cards until the player's hand is complete (*i.e.*, total number of hit cards taken by all previous positions).

The card game evaluation system 10 can automatically determine the value of the player's and dealer's hands, and can determine the outcome of the games between the various players and the dealer. The outcome of the games in this example are shown in table 2, below.

	Initial Cards	Hit Cards	Outcome
Player 1	2 8 ♥, ♣	Q ♥	Win
Player 2	9 10 ♣, ♣		Push
Player 3	7 7 ♣, ♣	A 10 ♣, ♠	Bust
Dealer	A 8 ♣, ♥		

**Table 2: Round Outcome**

The dealer has an Ace and an eight for a total value of nineteen. The first player has a two, an eight and a queen, for a total value twenty, which beats the dealer's nineteen. The second player has a nine and ten for a total value of nineteen, which ties the dealer's total of nineteen. The third player has a pair of sevens, an Ace valued as one, and a ten for a total value of twenty-five. Twenty-five exceeds twenty-one the so third player busted on the final card (*i.e.*, ten of diamonds).

The example is only slightly more complicated when one or more split hands occur, but the card game evaluation system 10 can employ the same general process to validate the game.

Figure 16 shows that the order of cards in a player's completed hand will differ based on whether the card are dealt from a shoe or by hand. The cards are dealt in the order shown in the table, two of hearts, eight of clubs and Queen of hearts. In a shoe dealt game the completed hand 1 has the order two of hearts, eight of clubs and Queen of hearts. In a hand dealt game the completed hand 2 has the order Queen of hearts, two of hearts, and eight of clubs.

Figure 17 shows a gaming environment including a gaming table 502 and one or more imagers such as cameras 504 positioned for imaging activity on a surface 506 of the gaming table 502. For example, the cameras 504 may be positioned to capture an image of the appearance of playing cards at one or more player positions 508 and/or the appearance of chips at one or more wagering circles 510 associated with each of the respective player positions 508. The cameras 504 may be coupled to provide image data or information to the card game evaluation system 10 (Figures 1 and 7).

The card game evaluation system 10 can include imaging processing software to detect changes between frames or images captured by the cameras 504, thus allowing the card game evaluation system 10 to detect the appearance of each playing card and/or wager. Thus, the card game evaluation system 10 may be able to determine the number of hands and/or players in a card game by detecting the appearance of playing cards at the player positions 508 and/or wagers at the respective wager circles 510. The card game evaluation system 10 may further be able to maintain a count of the number of playing cards dealt to each of the players and/or dealer, for example, to determine the number of hit cards taken by each player and/or the dealer. This can simplify the methods discussed above and below. For example, a knowledge of the number of playing cards dealt to each player may permit the elimination of structures and/or a number of the steps or acts of the methods, discussed above. In particular, it may be possible to eliminate identifying the dealer's initial hand, eliminating one or more steps and associated structure such as a dealer initial hand reader 15 (Figure 1) or "no peak" device. Further it may be possible to eliminate determining an original or initial card sequence, eliminating one or more steps and the associated deck reader 17 (Figure 1), unless the card game evaluation system 10 is to detect certain forms of cheating in addition to analyzing the outcome of the card game.

Figure 18 shows a gaming environment including a gaming table 502 and one or more sensors positioned for detecting activity on a surface 504

of the gaming table 502. For example, the sensors may take the form of optical sensors, positioned to detect the appearance of playing cards at one or more player positions and/or the appearance of chips at one or more wagering circles associated with each of the respective player positions. The sensors  
5 may be coupled to provide sensor data or information to the card game evaluation system 10 (Figures 1 and 7).

In particular, the sensors may take the form of optical source/receiver pairs such as LEDs and photodiodes, located in or under the surface 504 of the gaming table 502. As illustrated, the surface 504 of the  
10 gaming table 502 can include a plurality of apertures 512 to provide light paths between the surface and each source/receiver pair. Light from the source is reflected back to the receiver when a playing card or chip is present at the position on the gaming table 502 (*i.e.*, covering certain of the apertures 512), but is not reflected back when no playing card or chip is present. In this way,  
15 the optical source/receiver pair can detect the presence and absence of playing cards and/or wagers.

The embodiment of Figure 18 includes many of the same advantages discussed in reference to the embodiment of Figure 17. The card game evaluation system 10 may employ other types of sensors, which may or  
20 may not be optically sensitive, for detecting the appearance and/or location of playing cards on the surface 50 of the gaming table 502. For example, the card game evaluation system 10 may employ magnetic sensors where the playing cards include an appropriate indicator.

Figure 19 shows another exemplary method 600 of operating the  
25 card game evaluation system 10. In act 602, the dealer deals playing cards to one or more players, and to the dealer's own self. After all players have completed their respective hands, and the dealer has completed their own hand, the dealer collects the dealt cards in act 604. While this may occur before the dealer pays winning wagers and collects losing wagers, typically the  
30 dealer will not collect the dealt card until after paying and collecting the wagers.



As discussed above, the dealer may collect the dealt cards in a defined order. For example, the dealer may collect the dealt cards starting with the player farthest to the dealer's right (*i.e.*, first base position) and ending with the player farthest to the dealer's left (*i.e.*, second base position). The dealer  
5 may collect the dealt cards in other orders, for example from the dealer's left to right, so long as the order is defined.

In act 606, the dealer inserts the collected playing cards into the discard shoe having the discard reader 60. In act 608, the discard reader 60 reads identifiers from the collected playing cards in order (*e.g.*, first-to-last or  
10 last-to-first), resulting in a discard or "ending" sequence. In act 610, the card game evaluation system 10 determines a value of the player and/or dealer's hands and/or status of the game, based at least in part on the determined ending sequence, for example, as discussed above in reference to method 300. The method 600 may employ all or some of the acts or steps of the other  
15 methods discussed herein, as will be readily recognized by those skilled in the art.

Figure 20 shows an additional method 612 of operation, which may be incorporated into the method 600 (Figure 19), or some of the other methods discussed above. In act 614, the card game evaluation system 10  
20 detects the dealing or appearance of a number of playing cards. For example, the card game evaluation system 10 may employ image or video information from the cameras 504 positioned to image the surface 506 of the gaming table 502 (Figure 17). Alternatively, or additionally, the card game evaluation system 10 may employ information from optical sensors as described above in  
25 reference to Figure 18. Alternatively, or additionally, the card game evaluation system 10 may rely on a sensor positioned in the card shoe 17b (Figure 1) for detecting the removal of playing cards from the card shoe 17b. Alternatively, or additionally, the card game evaluation system 10 may rely on sensors other than optical sensors.

30 In act 616, the card game evaluation system 10 determines the number of playing cards for each hand, based at least in part on the detected

dealing or appearance of playing cards. For example, as discussed above, the method 612 may allow the elimination of some of the acts or steps of the previously discussed methods, for example, reading the dealer's initial hand and/or locating the dealer's initial hand in the initial sequence. Likewise, the method 612 may allow the elimination of some of the apparatus or structures discussed above, for example, the hand reader 15 and/or deck reader 17a, 17b.

### Summary

Although specific embodiments, and examples for, the invention are described herein for illustrative purposes, various equivalent modifications can be made without departing from the scope of the invention as defined by the claims, as will be recognized by those skilled in the relevant art. The teachings provided herein of the invention can be applied to other systems for evaluating card games, not necessarily the blackjack card evaluation system 10 generally described above. For example, the teachings can employ other networks, such as the World Wide Web portion of the Internet. The various embodiments described above can be combined to provide further embodiments. For example, the illustrated methods can be combined, or performed successively. The illustrated methods can omit some acts, can add other acts, and can execute the acts in a different order than that illustrated to achieve the advantages of the invention.. Aspects of the invention can be modified, if necessary, to employ systems, circuits and concepts of the various patents, applications and publications cited herein to provide yet further embodiments of the invention.

These and other changes can be made to the invention in light of the above detailed description. In general, in the following claims, the terms used should not be construed to limit the invention to the specific embodiments disclosed in the specification, but should be construed to include all computers, networks and card  
5 reading and card evaluation systems that operate in accordance with the claims. Accordingly, the invention is not limited by the disclosed embodiments, but instead its scope is to be determined entirely by the following claims.

THE SUBJECT-MATTER OF THE INVENTION FOR WHICH AN EXCLUSIVE PRIVILEGE OR PROPERTY IS CLAIMED IS DEFINED AS FOLLOWS:

1. A method of analyzing a card game, the method comprising:  
reading, via a discard card reader, an identifier from each of a number of playing cards collected after completion of at least one hand of at least one player of the card game to determine an ending sequence of playing cards;  
automatically determining, via at least one processor communicably coupled to the discard card reader, a quantity of playing cards dealt to the at least one complete hand of the at least one player, before determining the ending sequence of playing cards; and  
for at least one player, automatically determining by a client computer system, a value of the at least one complete hand based on the ending sequence and based on the determined quantity of playing cards dealt to the at least one complete hand of the at least one player.

2. The method of claim 1 further comprising:  
optically detecting, with at least one camera, at least one appearance of at least one dealt playing card at a respective position on the gaming table associated with a respective player of the at least one player;  
wherein the step of automatically determining the quantity of playing cards dealt to the at least one complete hand of the at least one player before determining the ending sequence of playing cards is based at least in part on the at least one appearance of the at least one dealt playing card optically detected with the at least one camera.

3. The method of claim 1 or 2 wherein reading an identifier from each of a number of playing cards collected after completion of at least one hand of at least one player of the card game includes reading, via the discard card reader, a respective one of the identifiers from each of the playing cards collected from at least two players.

4. The method of claim 1 or 2 wherein reading an identifier from each of a number of playing cards collected after completion at least one hand of at least one player of the card game includes reading, via the discard card reader, a respective one of the identifiers from each of the playing cards collected from the at least one player and a dealer.

5. The method of claim 1 or 2, further comprising:  
collecting the playing cards dealt to the at least one complete hand of the at least one player and collecting playing cards dealt to a dealer at the completion of the at least one hand of the at least one player of the card game in a defined order in a discard shoe operably coupled to the discard card reader.

6. The method of claim 5 wherein  
the defined order is from a first base position to a third base position and then from the dealer.

7. The method of claim 1 or 2 wherein automatically determining a quantity of playing cards dealt to the at least one complete hand of the at least one player further comprises:

automatically detecting, via a card deck reader communicably coupled to the at least one processor, a dealing of each of the playing cards to the at least one hand of the at least one player.

8. The method of claim 2 wherein automatically determining a quantity of playing cards dealt to the at least one complete hand of the at least one player comprises:

optically detecting, via at least one card hand reader communicably coupled to the at least one processor, presence of each playing card dealt to the at least one hand of the at least one player at the position on the gaming table associated with the respective player of the at least one player.

9. The method of claim 2 wherein automatically determining a quantity of playing cards dealt to the at least one complete hand of the at least one player further comprises:

for each hand of the at least one hand of the at least one player, counting, by the at least one processor, a number of detected appearances of each dealt playing card of the at least one dealt playing card.

10. The method of claim 1 or 2, further comprising:  
determining, by the at least one processor, an outcome of the card game based at least in part on the determined value of the at least one hand of the at least one player.

11. The method of claim 1 or 2, further comprising:  
comparing, by the at least one processor, data indicative of decisions by the at least one player to voluntarily receive additional playing cards beyond an initial hand of playing cards to data indicative of decisions under at least one card counting scheme.

12. The method of claim 1 or 2, further comprising:  
determining, via a card shoe reader, an initial sequence of dealt playing cards corresponding to an order that the dealt playing cards in a set of

playing cards are dealt to the at least one hand of the at least one player in the card game.

13. The method of claim 12 wherein determining an initial sequence of dealt playing cards corresponding to an order that the dealt playing cards in the set of playing cards are dealt to the at least one hand of the at least one player in the card game includes reading, by the card shoe reader, the identifier from each of the number of playing cards before a first one of the number of playing cards is dealt.

14. The method of claim 12 wherein determining an initial sequence of dealt playing cards corresponding to an order that the dealt playing cards in the set of playing cards are dealt to the at least one hand of the at least one player in the card game includes reading, by the card shoe reader, the identifier from each of the number of playing cards as each one of the number of playing cards is dealt.

15. The method of claim 12, further comprising:  
determining, by the at least one processor, whether a playing card has been inserted into the card game after the initial sequence of dealt playing cards has been determined.

16. The method of claim 12, further comprising:  
determining, by the at least one processor, whether a playing card has been removed from the card game after the initial sequence of dealt playing cards has been determined.

17. A system for analyzing a card game, the system comprising:

means for reading an identifier from each of a number of playing cards collected after completion of at least one hand of at least one player of the card game to determine an ending sequence of playing cards;

means for automatically determining a total quantity of playing cards dealt to the at least one complete hand of the at least one player, before determining the ending sequence of playing cards; and

means for automatically determining a value of the at least one complete hand based on the ending sequence and based on the determined quantity of playing cards dealt to the at least one complete hand of the at least one player.

18. The system of claim 17 further comprising:

means for optically detecting at least one appearance of at least one dealt playing card at a respective position on the gaming table associated with a respective player of the at least one player;

wherein the means for automatically determining comprises means for automatically determining the quantity of playing cards dealt to the at least one complete hand of the at least one player before determining the ending sequence of playing cards, based at least in part on the at least one appearance of the at least one dealt playing card optically detected with the means for optically detecting.



19. The system of claim 17 or 18 wherein the means for automatically determining a quantity of playing cards dealt to the at least one complete hand of the at least one player comprises an optical reader.

20. The system of claim 17 or 18 wherein the means for automatically determining a quantity of playing cards dealt to the at least one complete hand of the at least one player comprises a camera.

21. The system of claim 17 or 18, further comprising:  
means for determining an outcome of the card game based at least in part of the determined value of the at least one complete hand of the at least one player.

22. The system of claim 17 or 18, further comprising:  
means for comparing decisions by the at least one player to voluntarily receive additional playing cards beyond an initial hand of playing cards to decisions under at least one card counting scheme.

23. The system of claim 17 or 18, further comprising:  
means for determining an initial sequence of playing cards corresponding to an order that the playing cards in a set of playing cards are dealt to at least one complete hand of at least one player in the card game.

24. The system of claim 23, further comprising:  
means for determining whether a playing card has been inserted into the card game after the initial sequence of playing cards has been determined.

25. The system of claim 23, further comprising:  
means for determining whether a playing card has been removed  
from the card game after the initial sequence of playing cards has been  
determined.

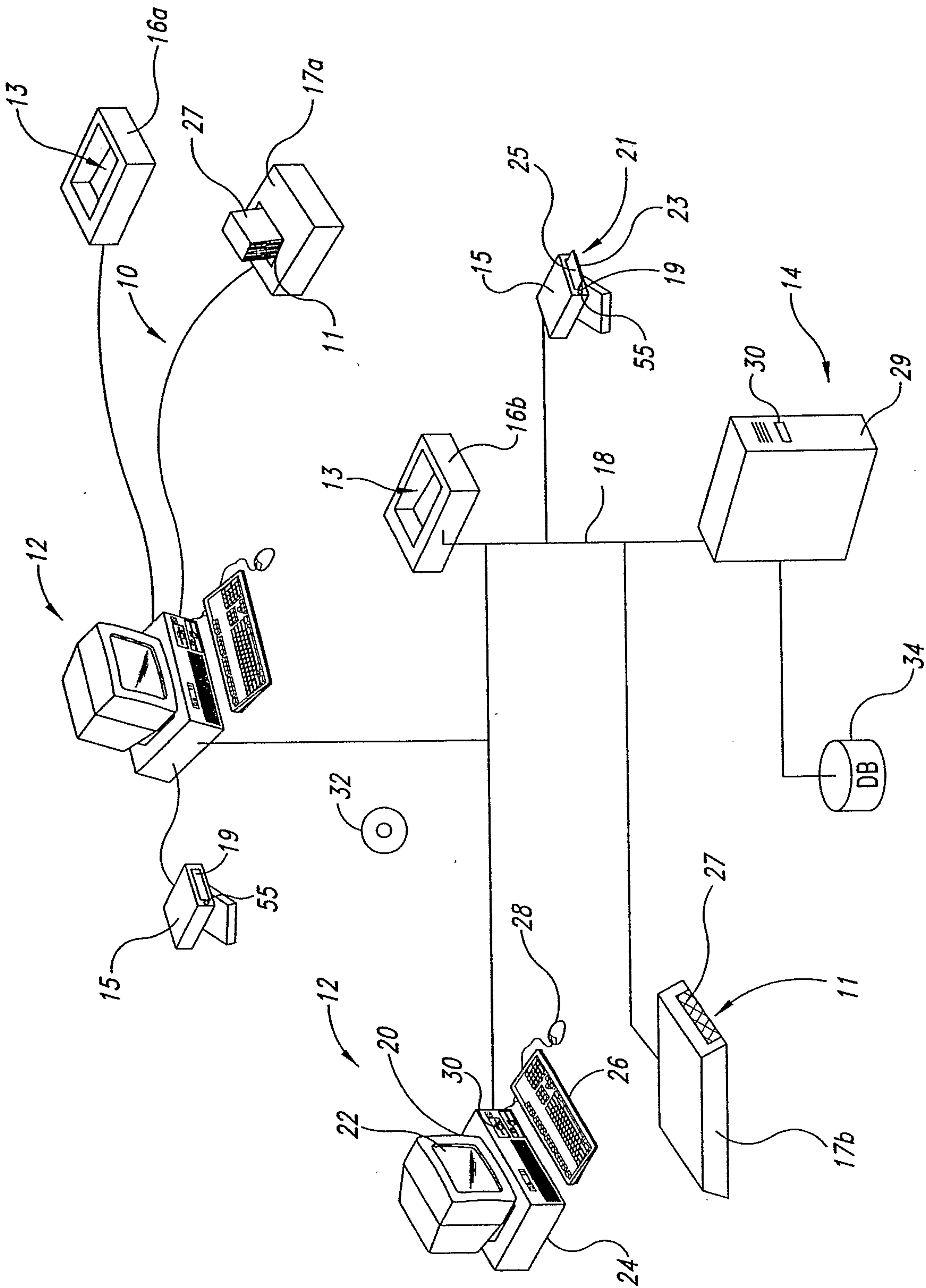


Fig. 1

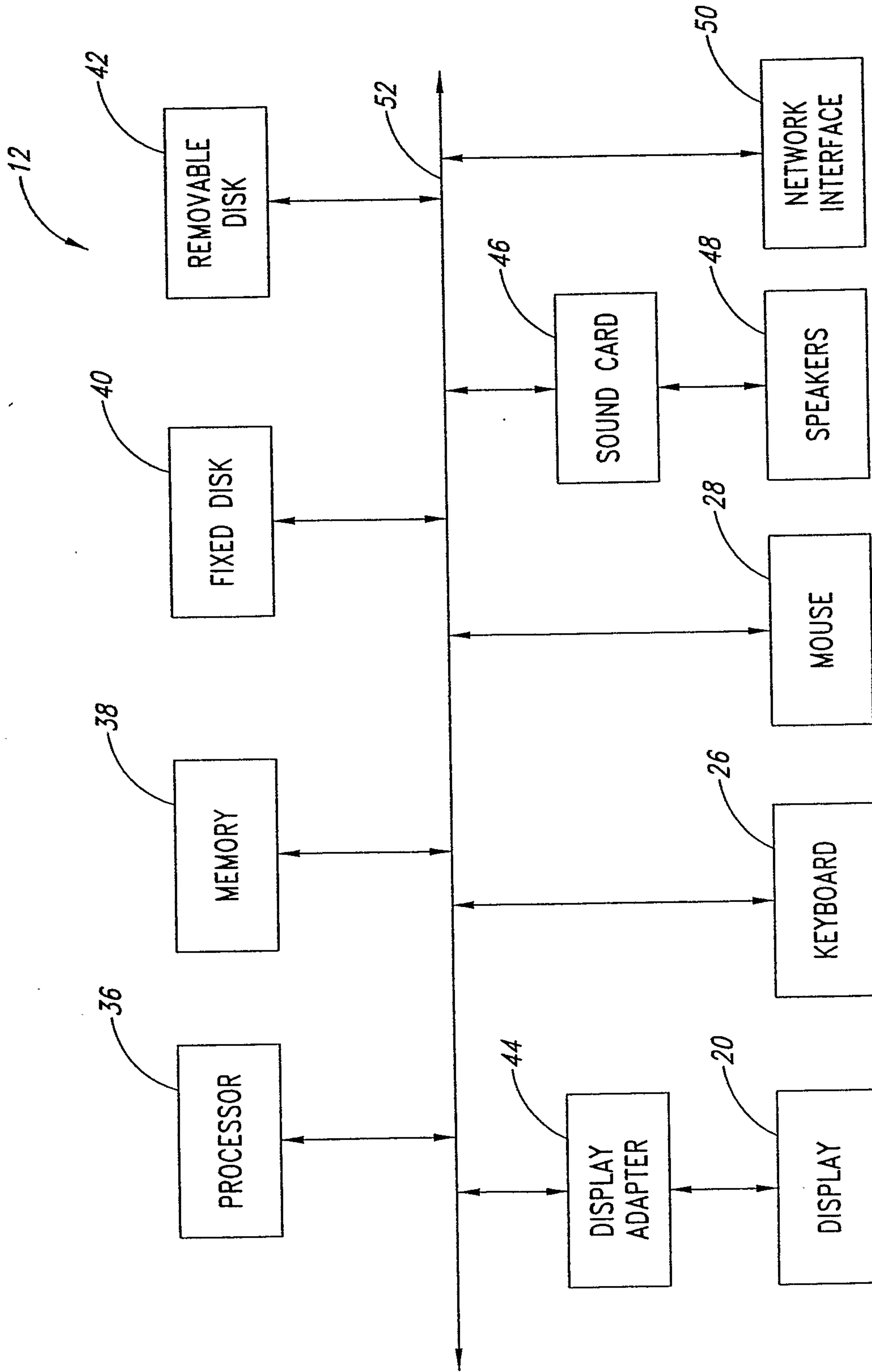
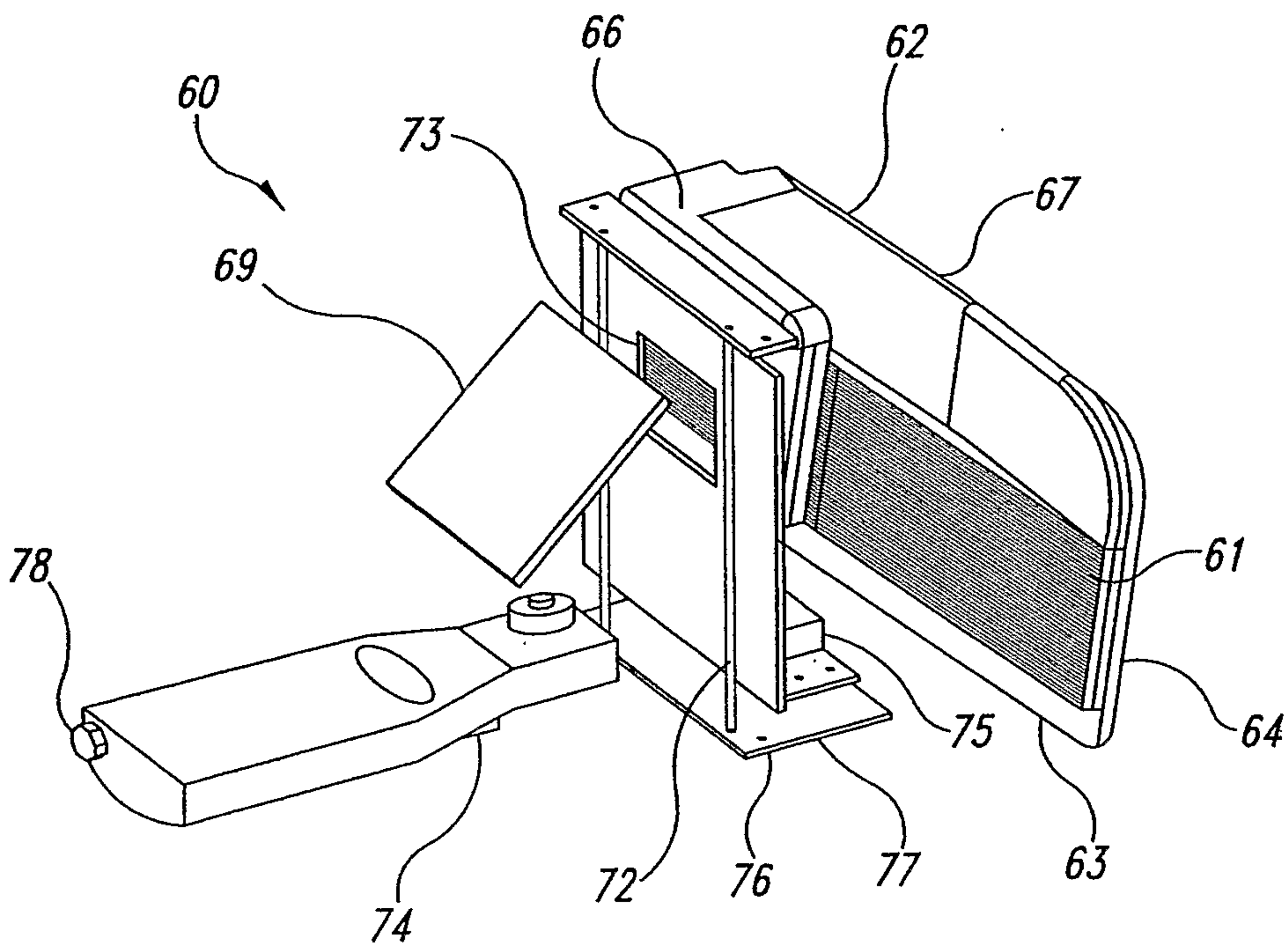
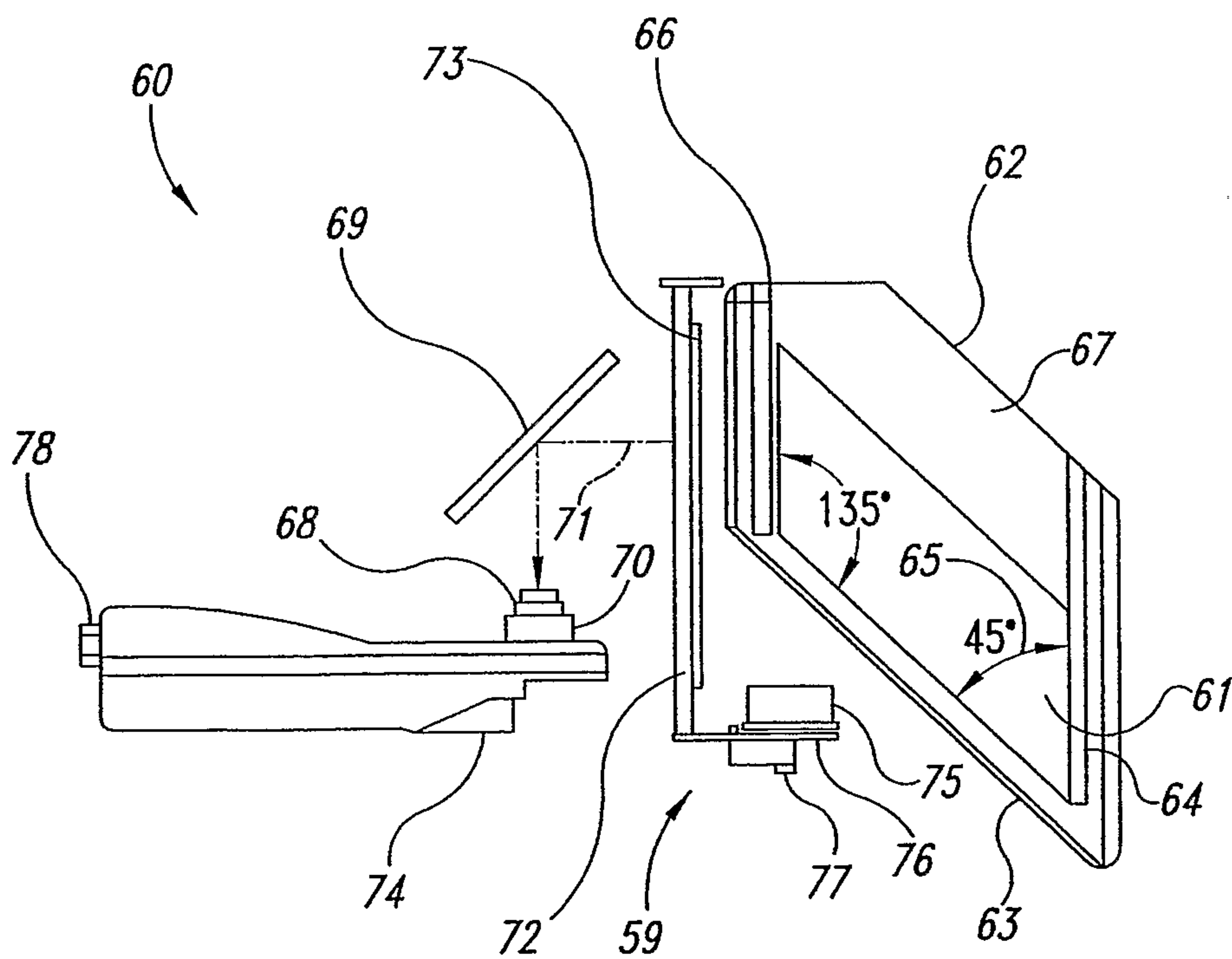


Fig. 2



*Fig. 3*



*Fig. 4*

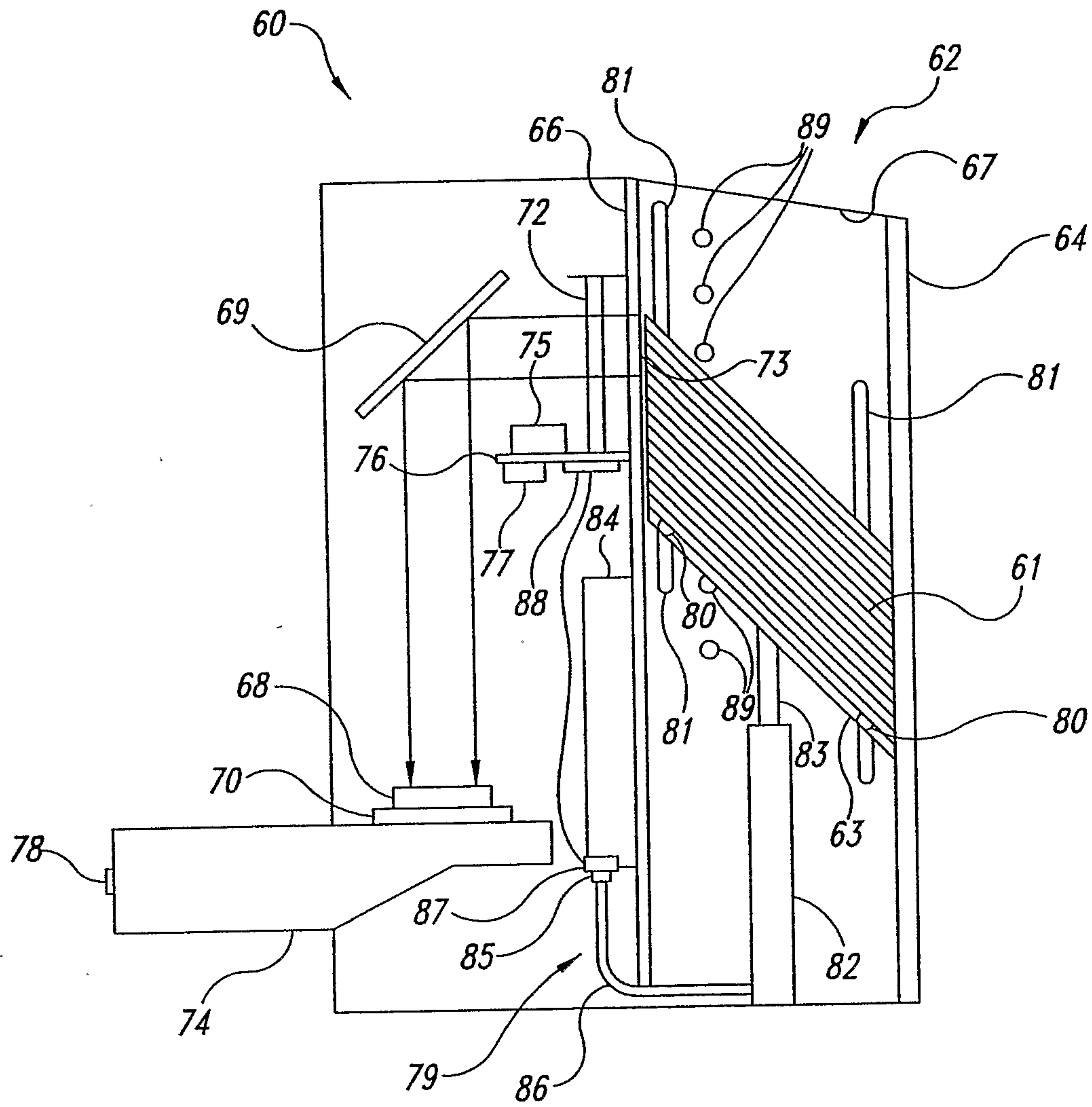
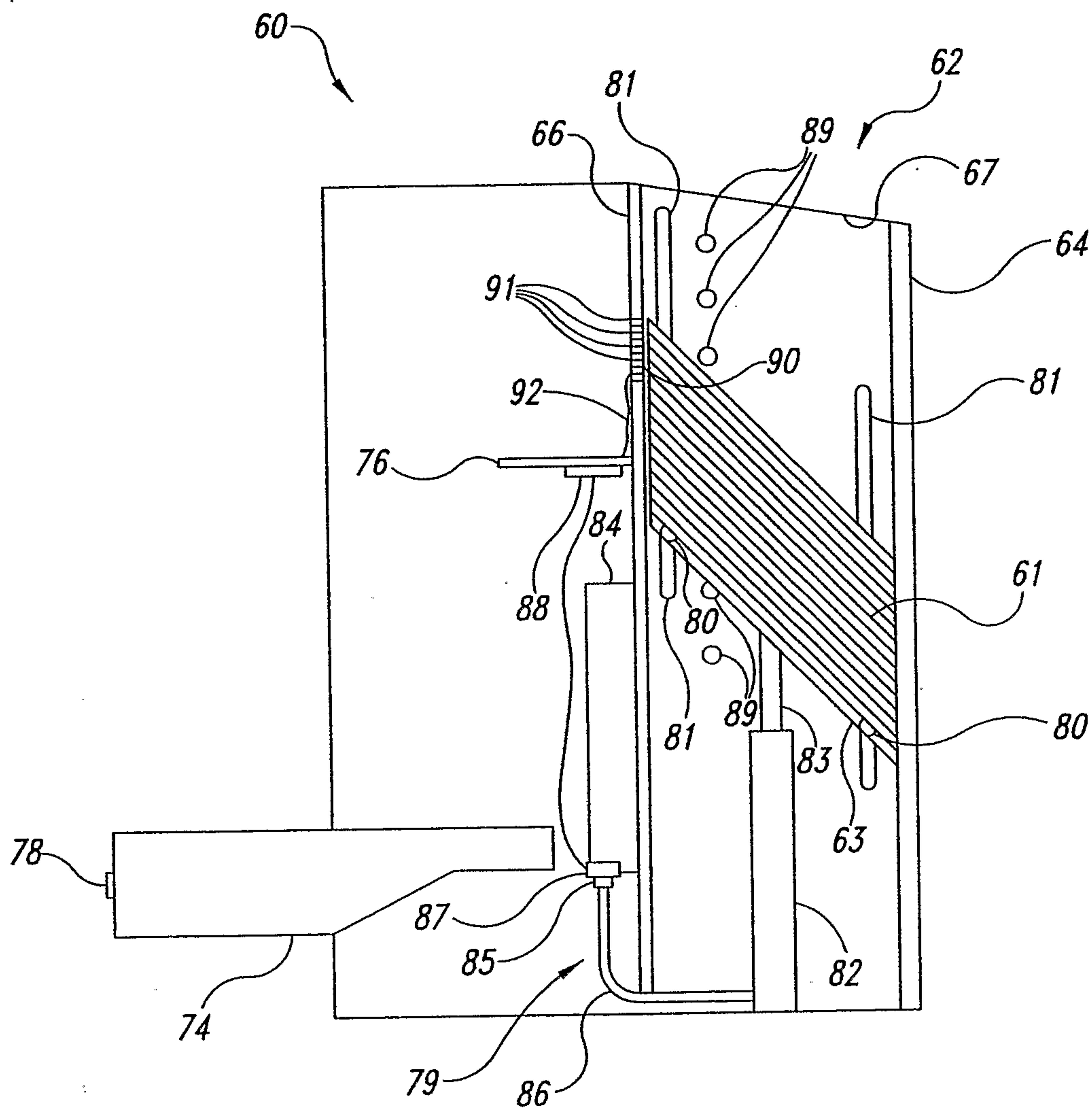


Fig. 5



*Fig. 6*

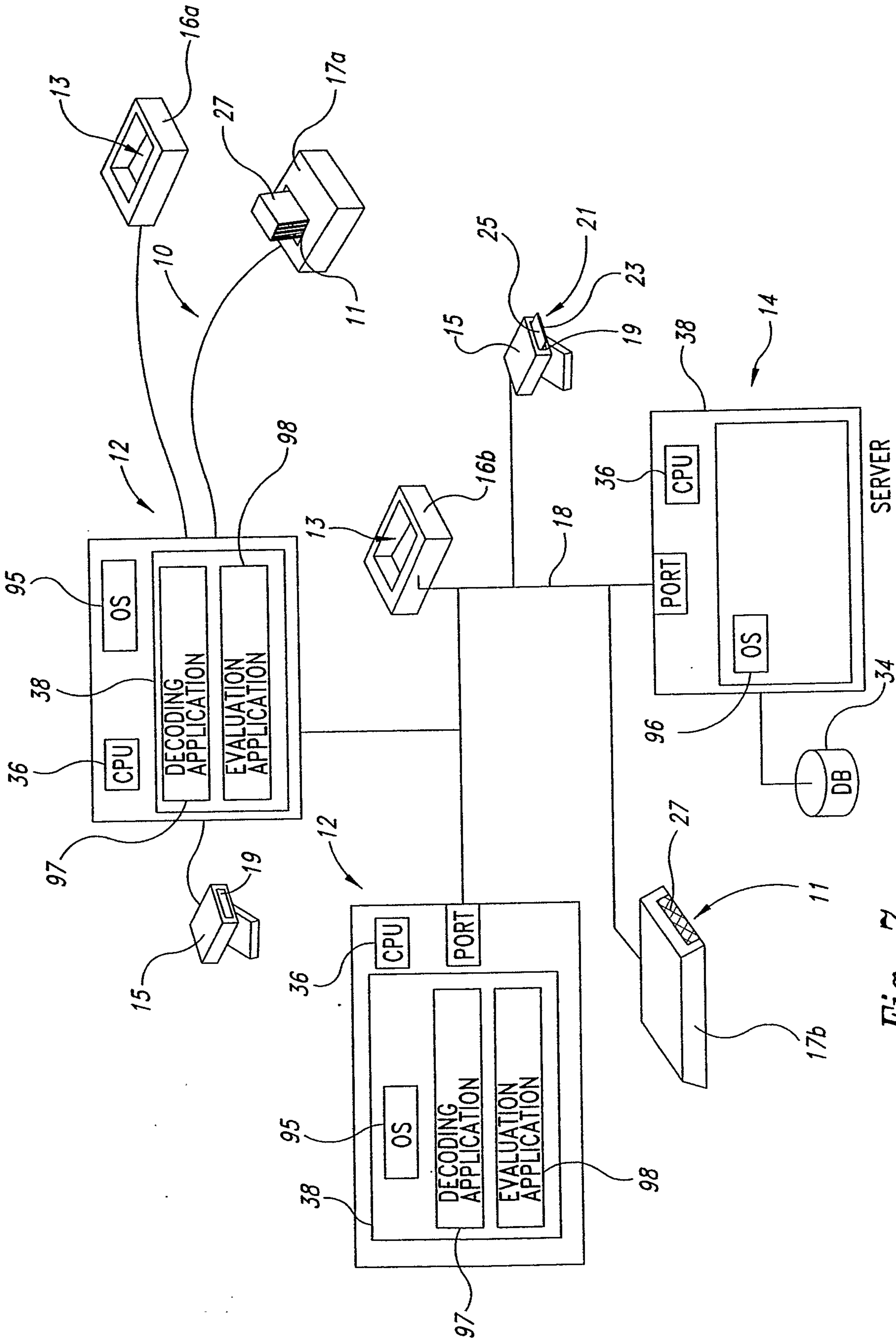
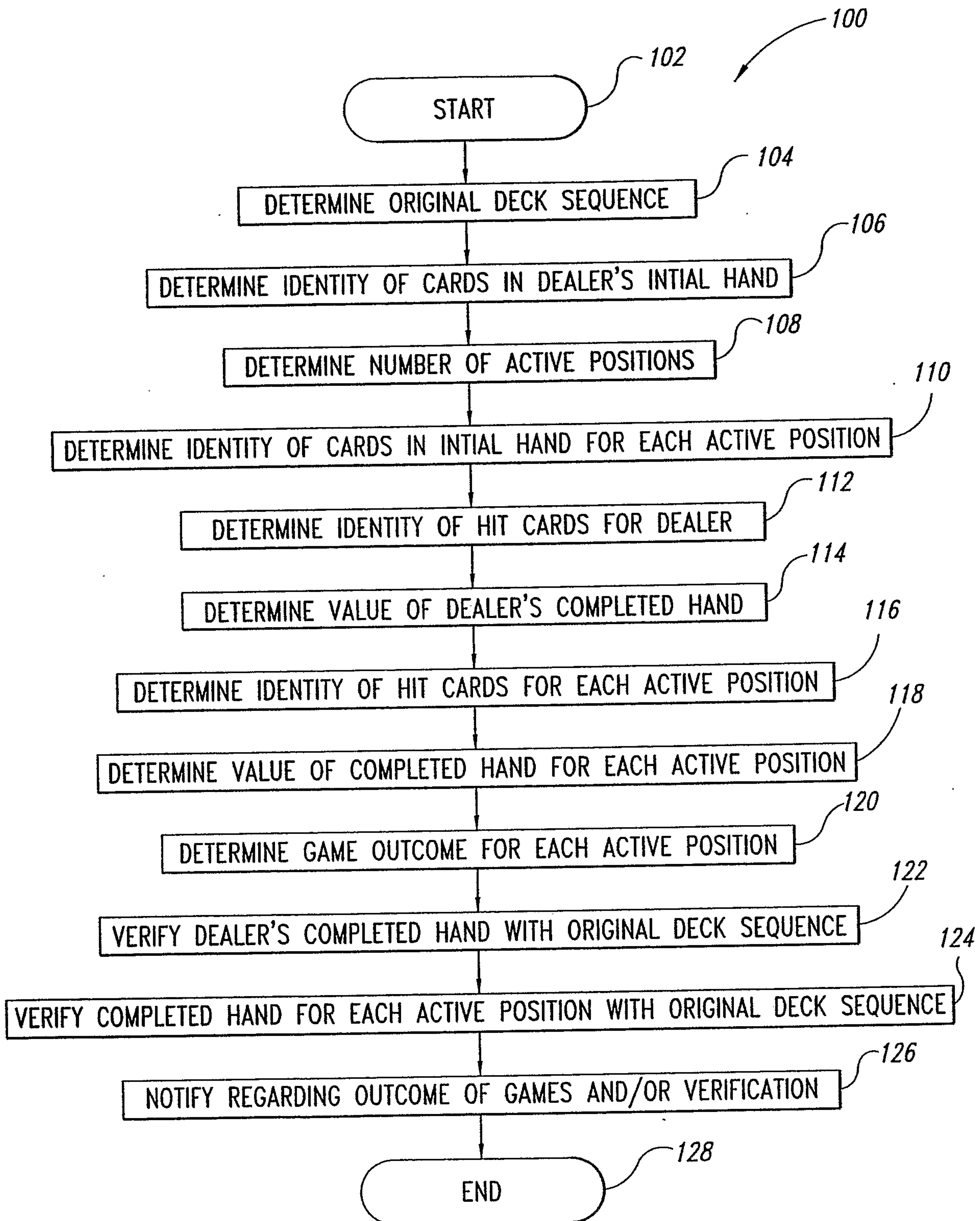
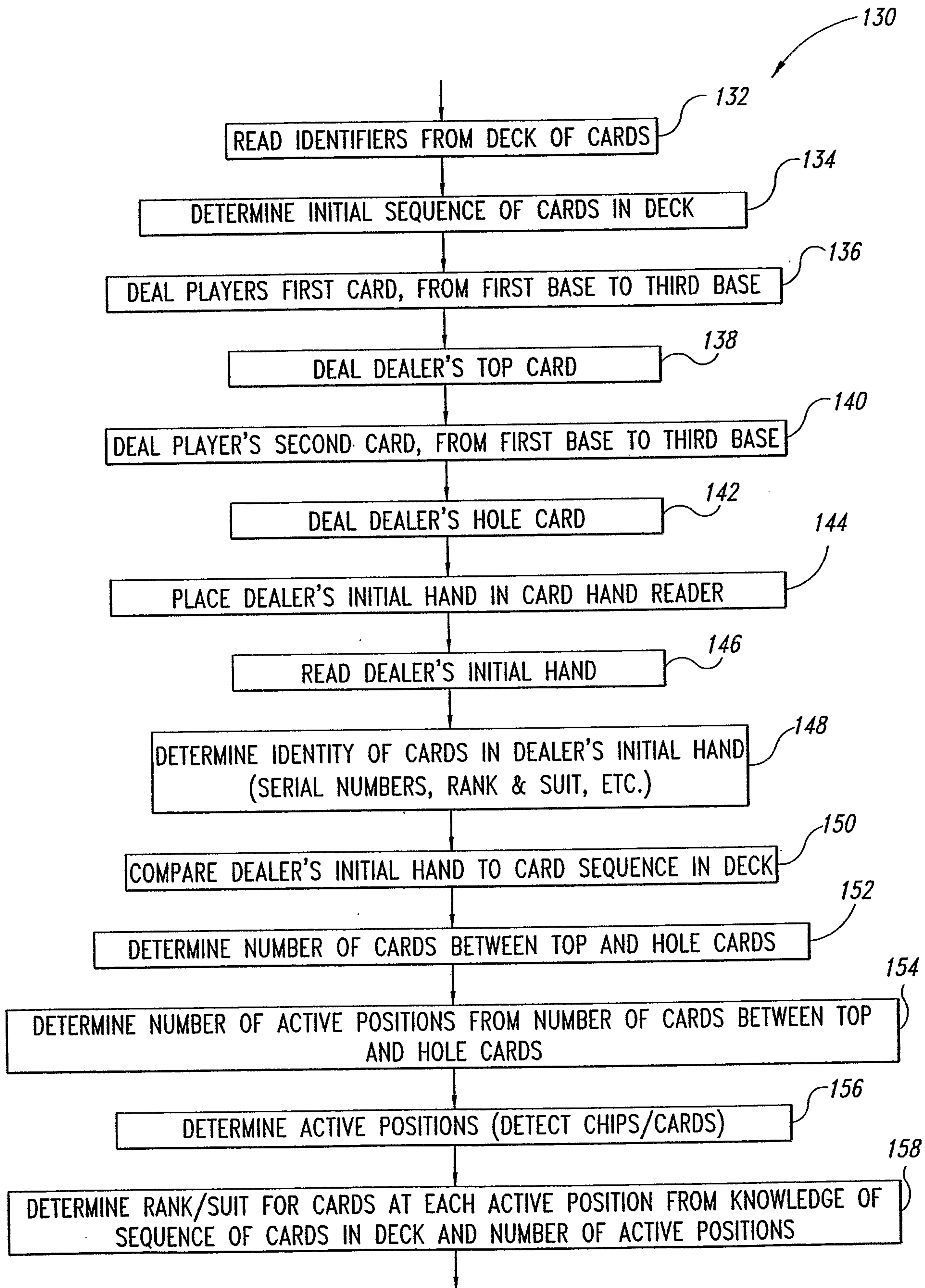


Fig. 7



*Fig. 8*



*Fig. 9*

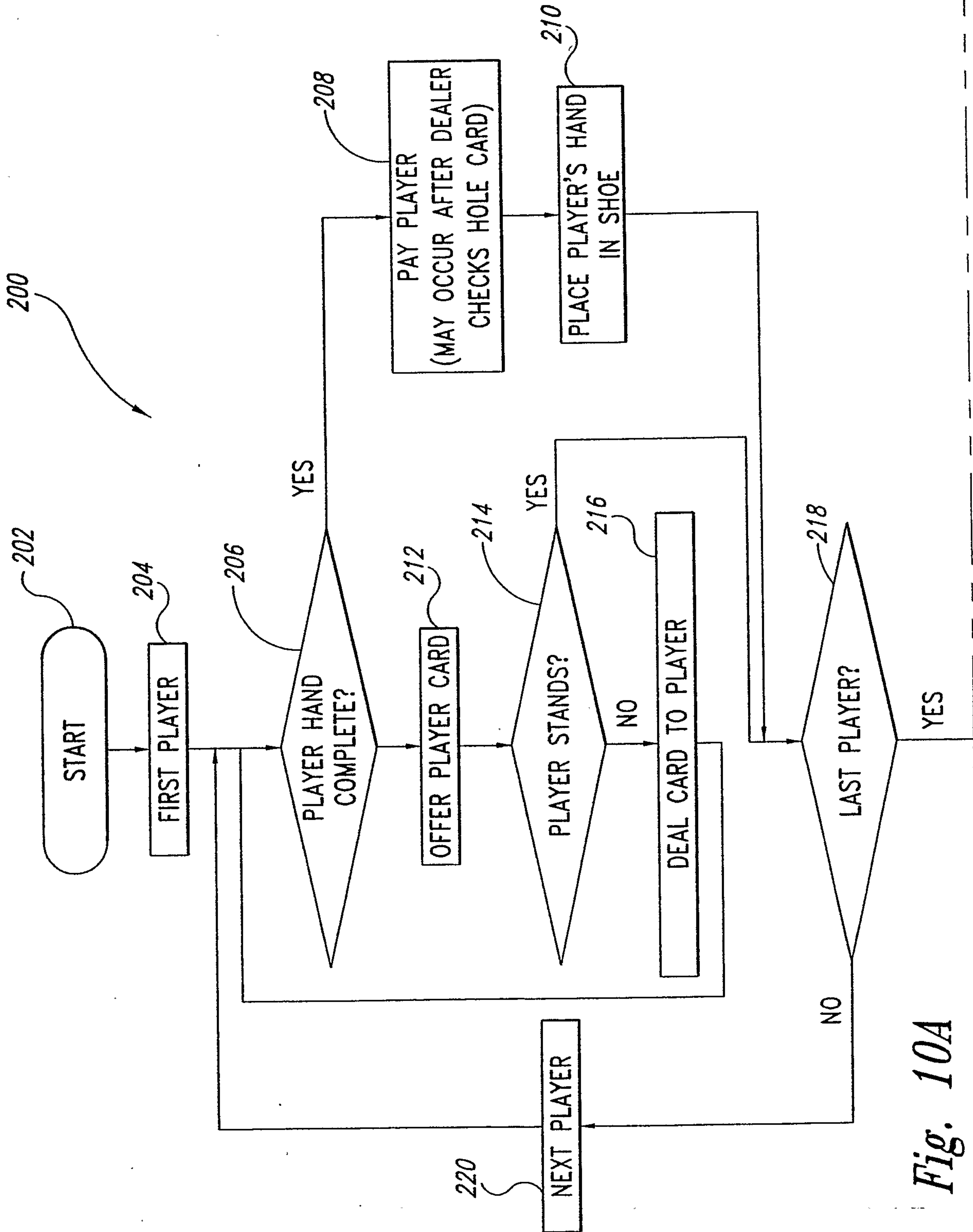


Fig. 10A

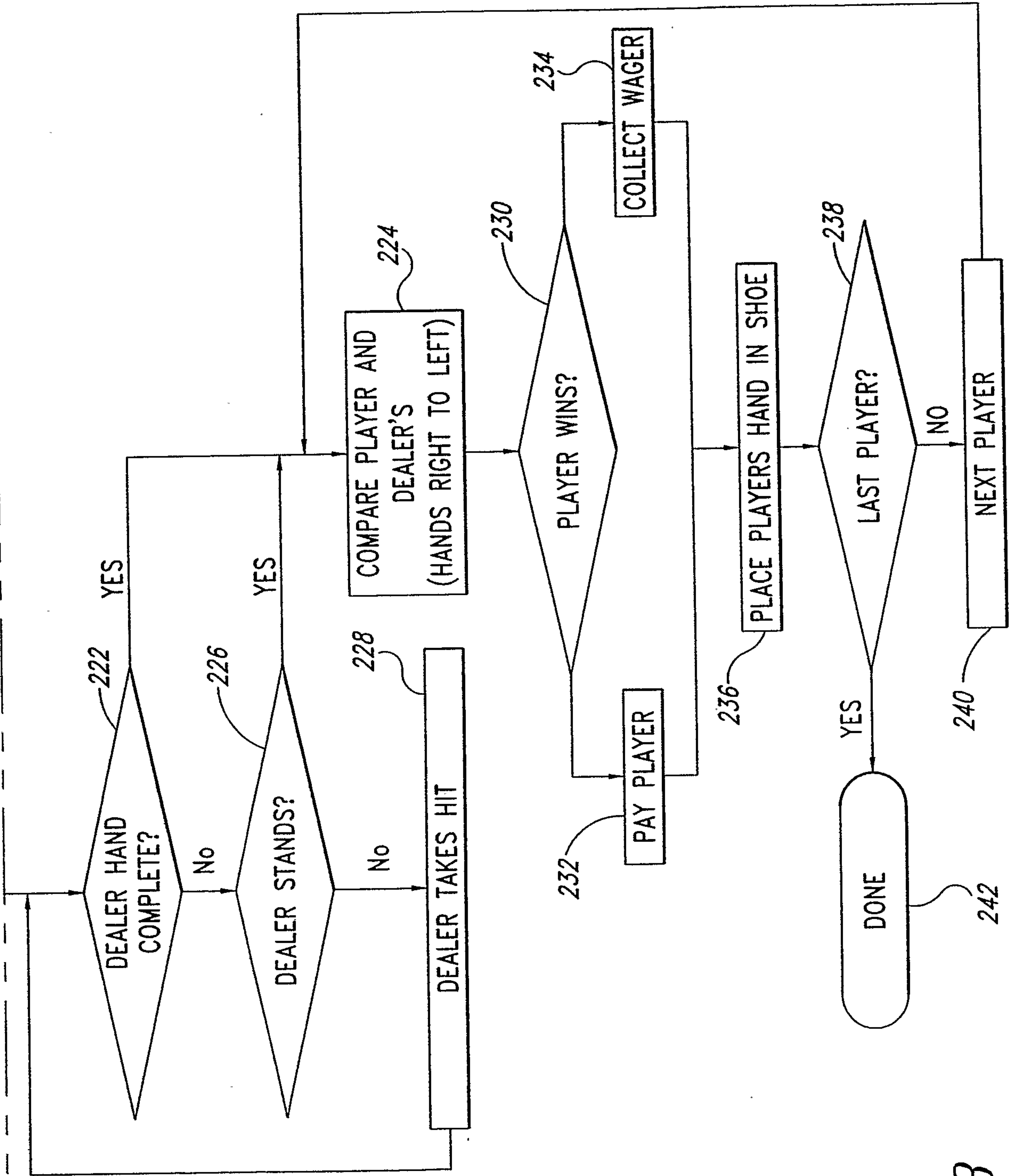


Fig. 10B

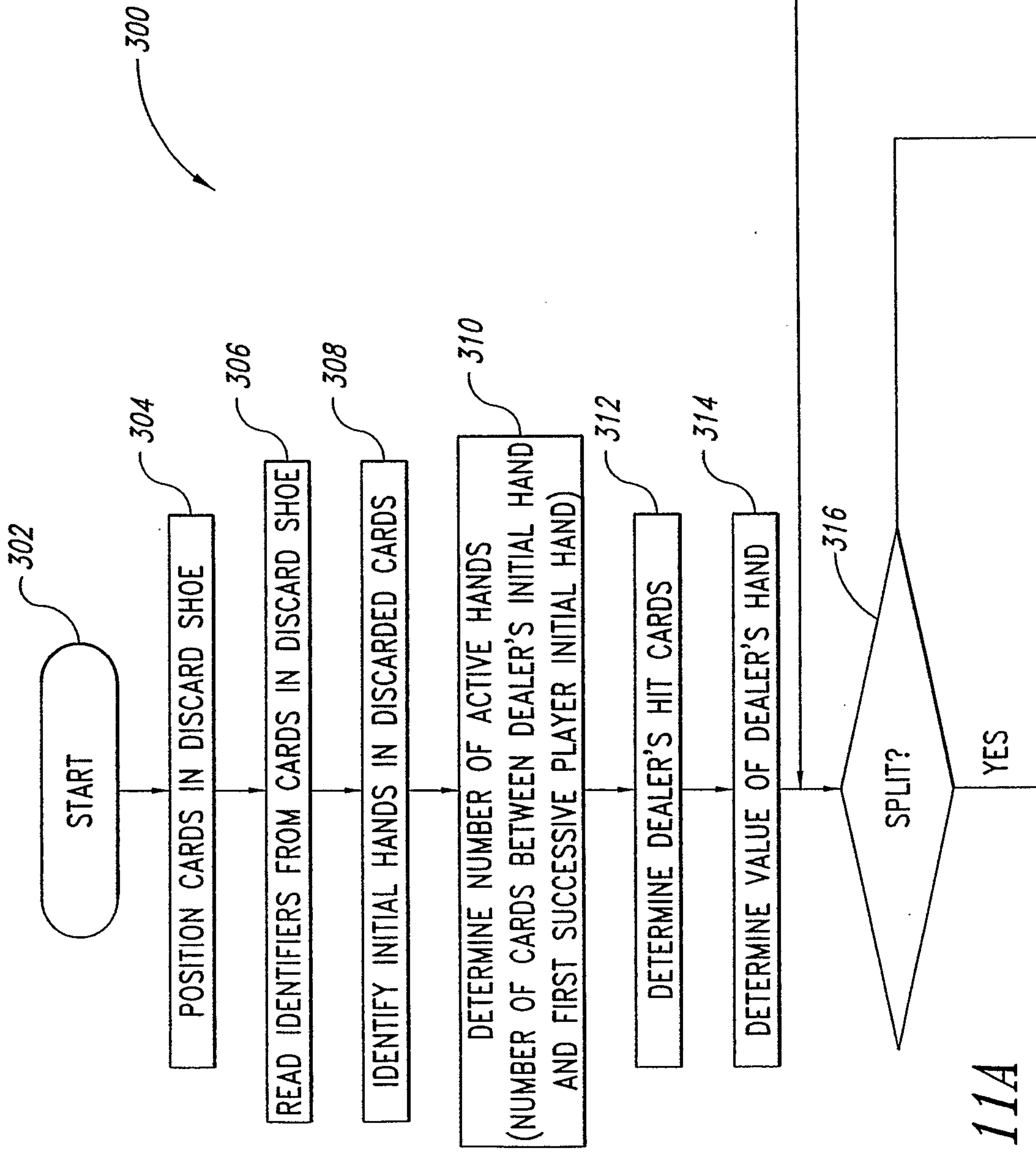


Fig. 11A

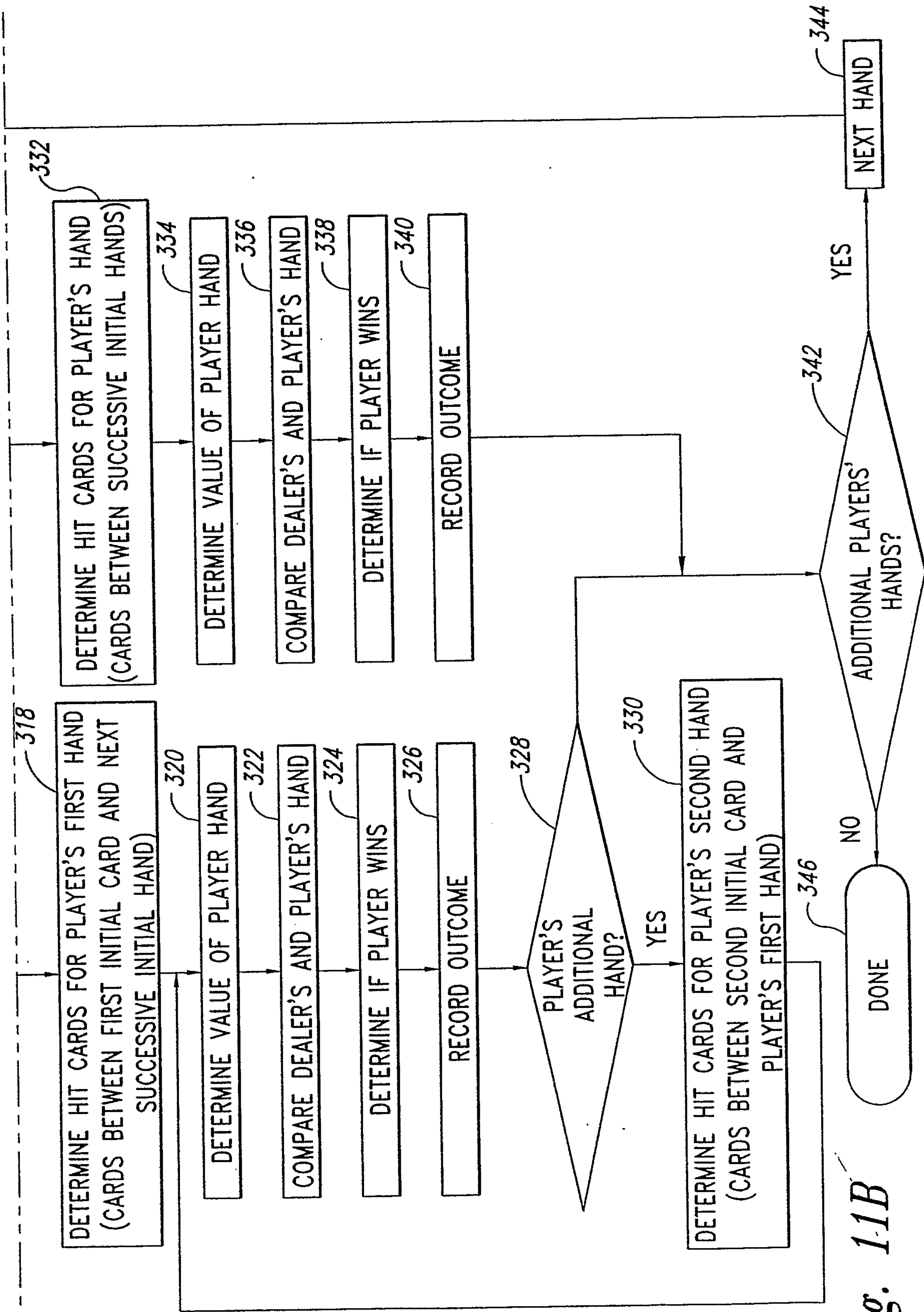
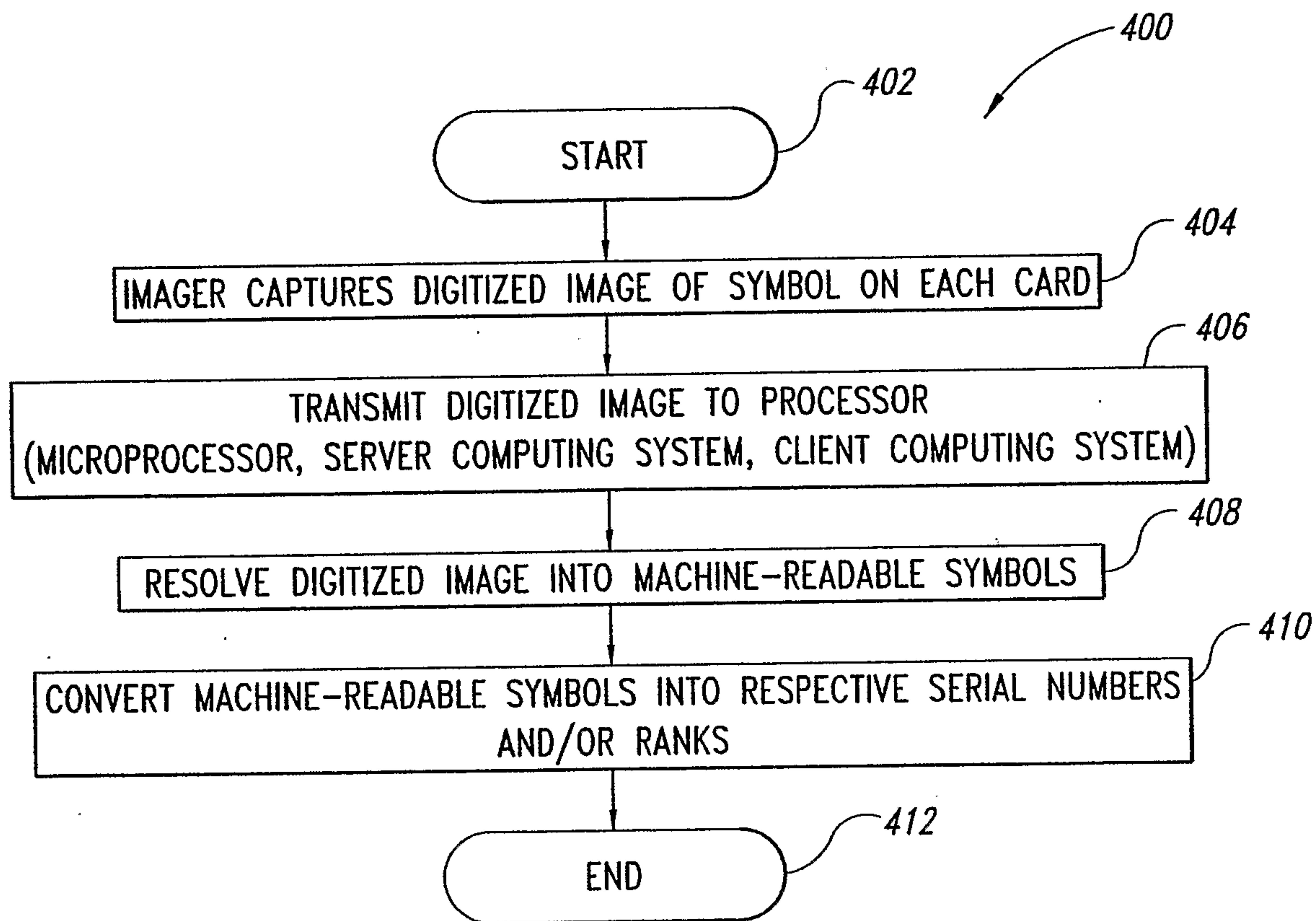


Fig. 1-1B

*Fig. 12*

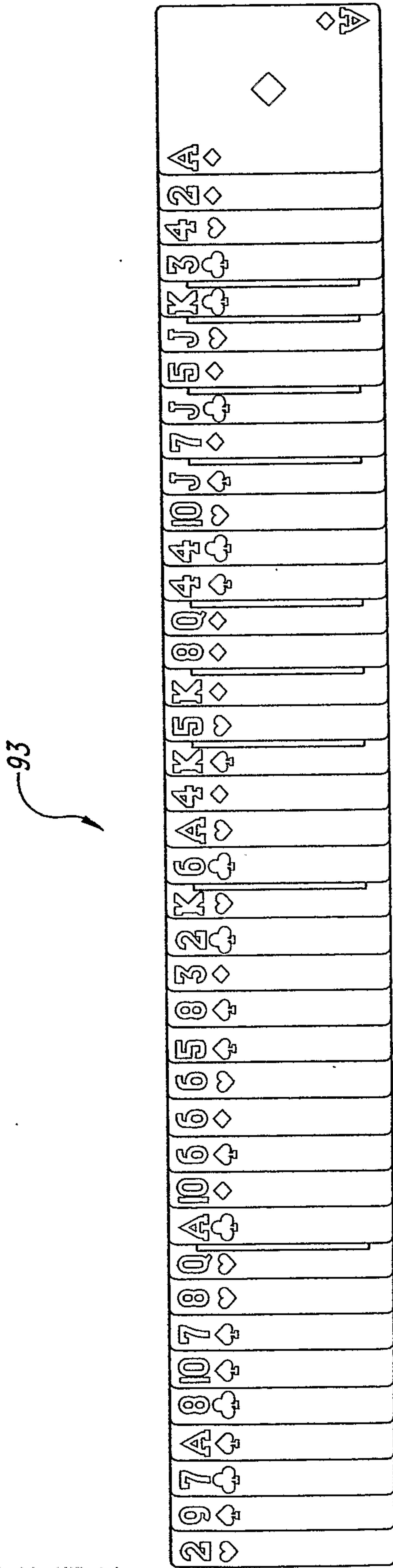


Fig. 13

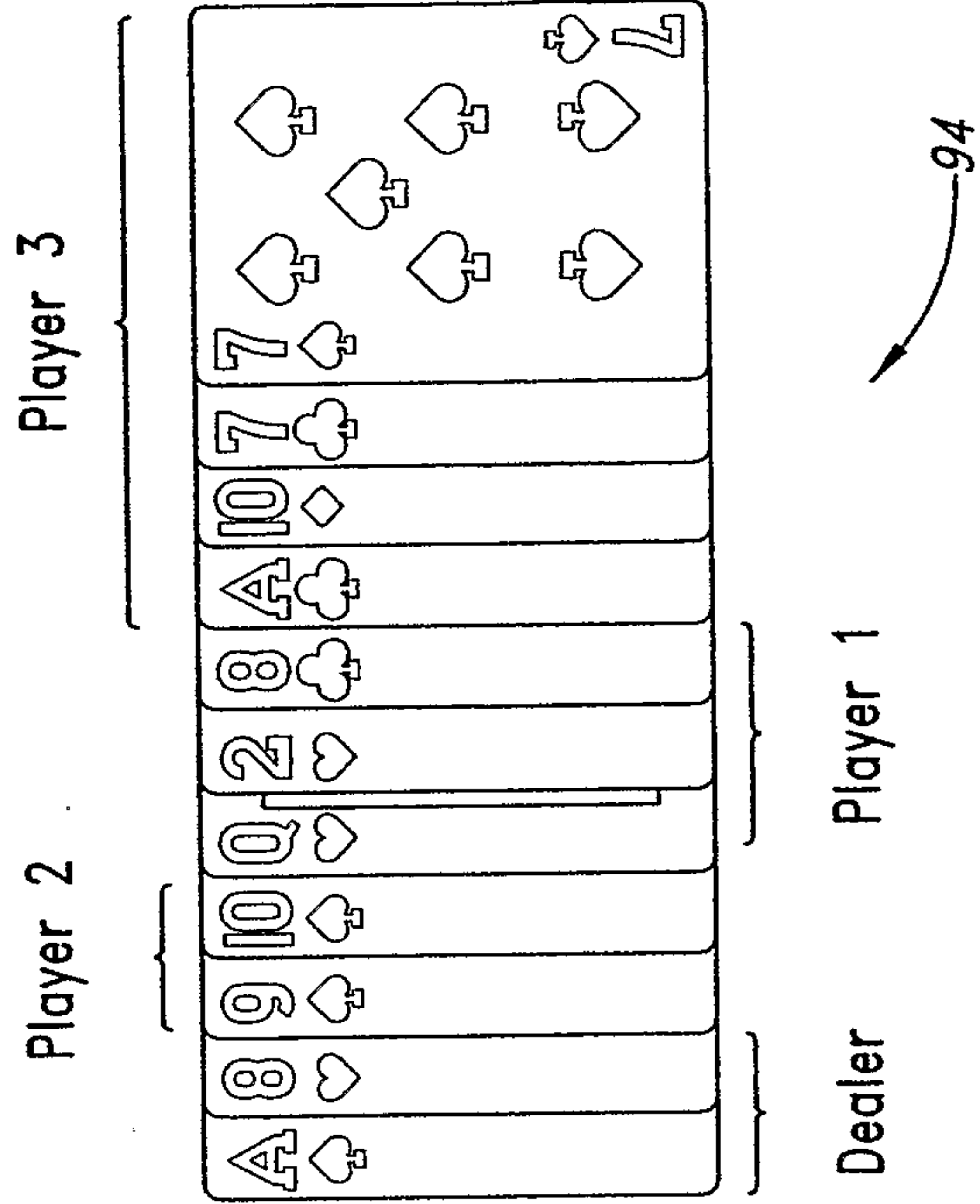


Fig. 15

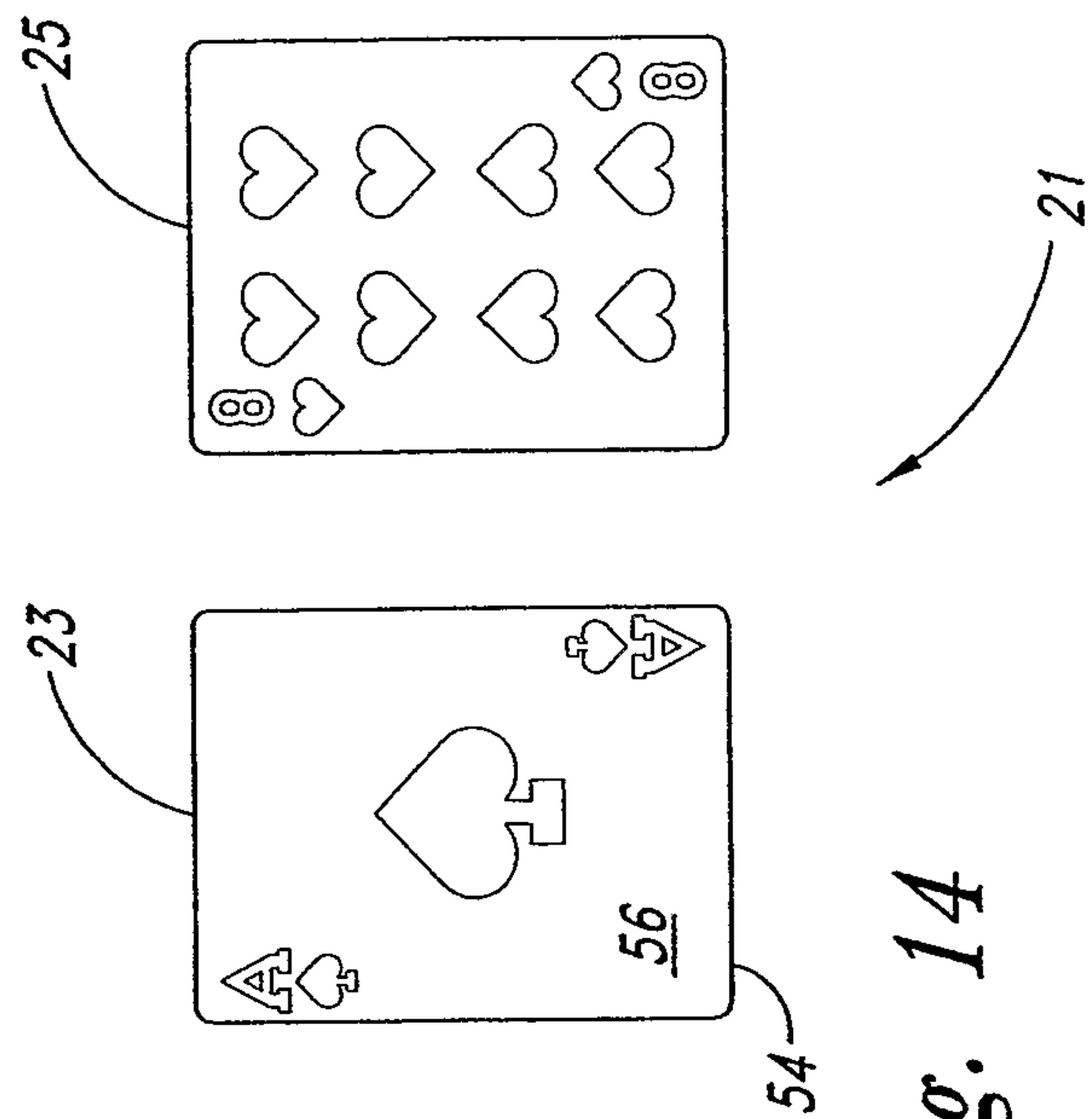


Fig. 14



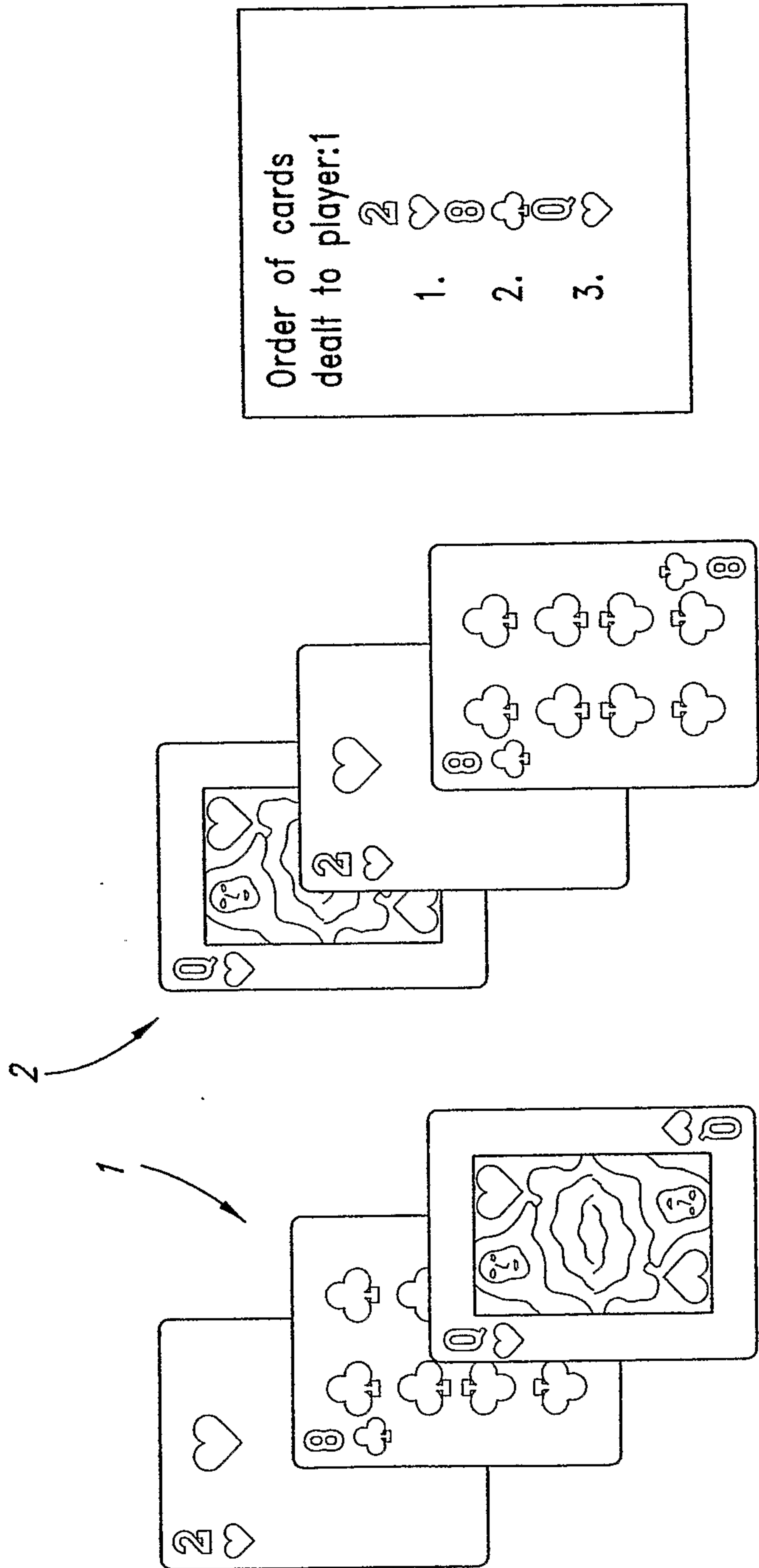


Fig. 16

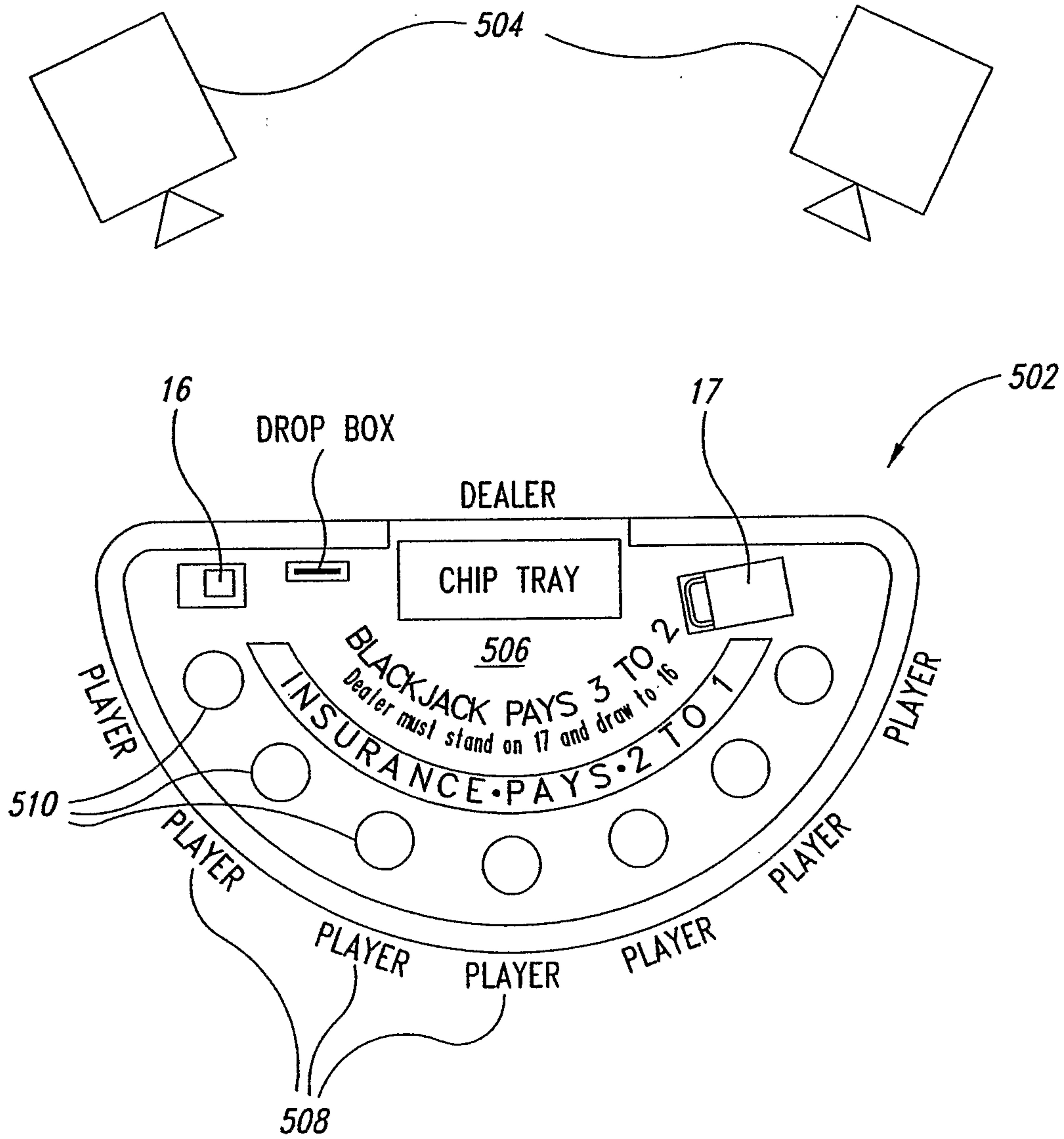
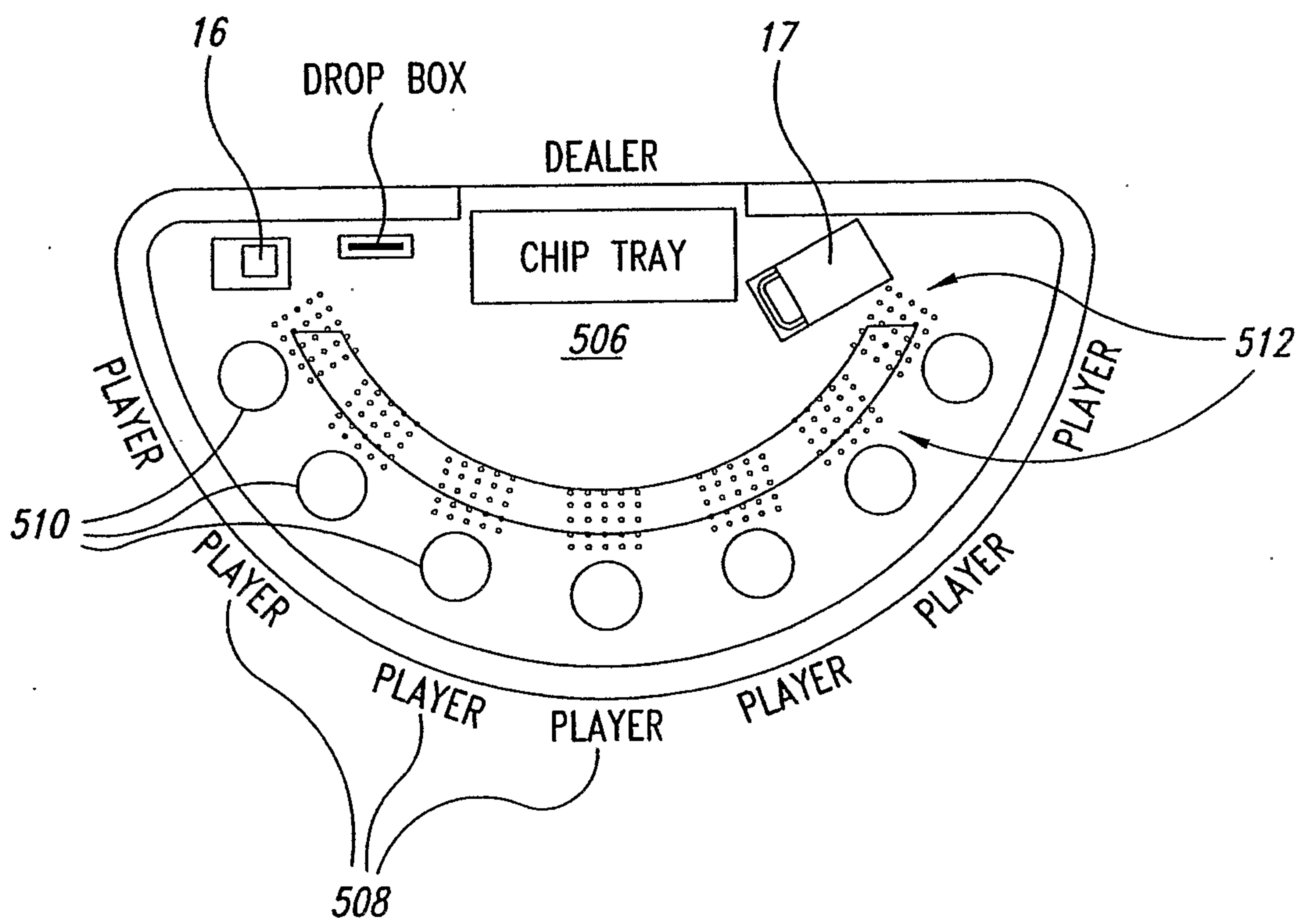
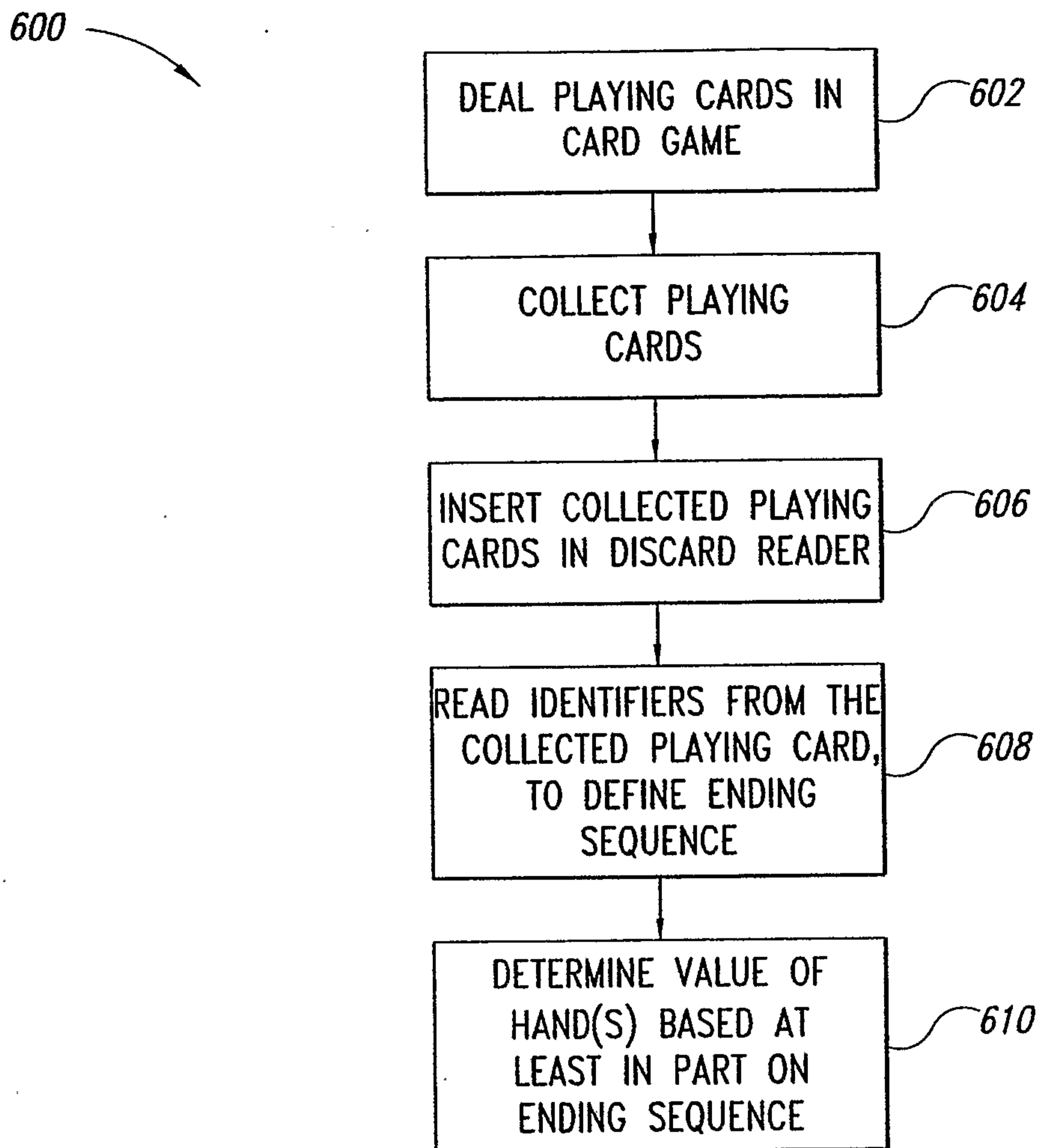


Fig. 17

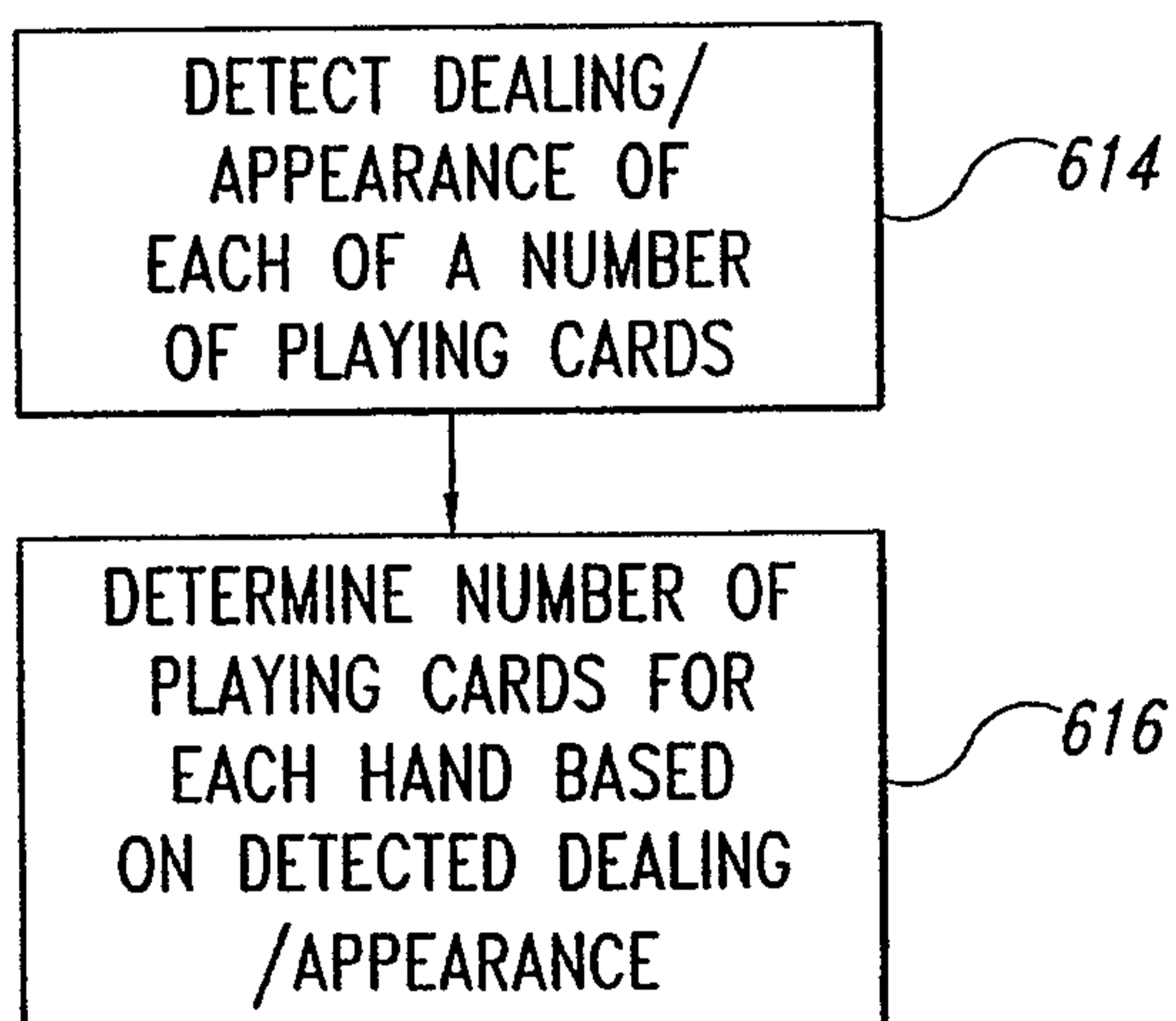


*Fig. 18*



612

*Fig. 19*



*Fig. 20*

