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(54) **CARD READER APPARATUS AND METHOD**

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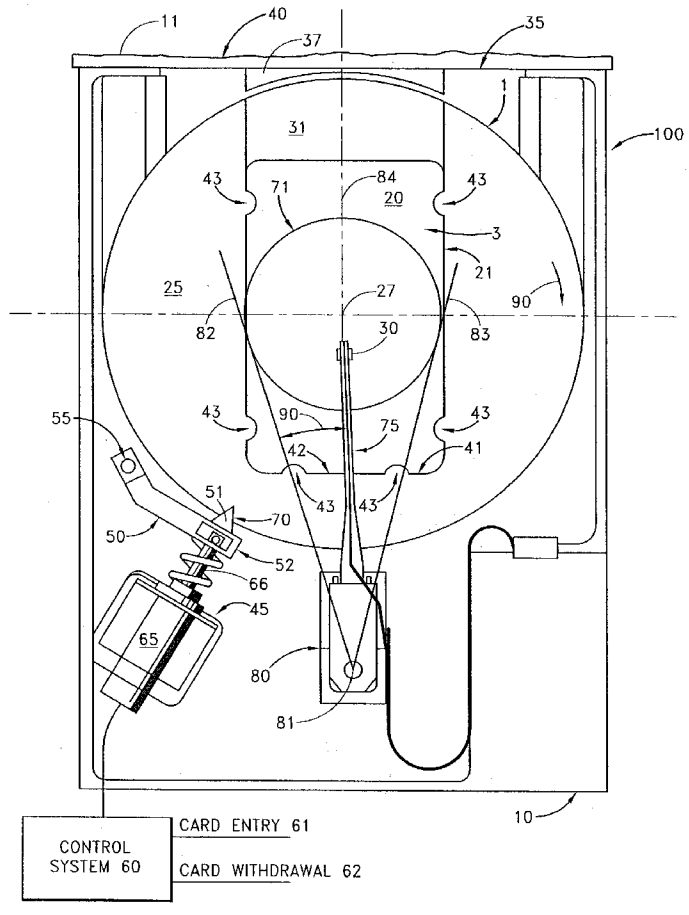
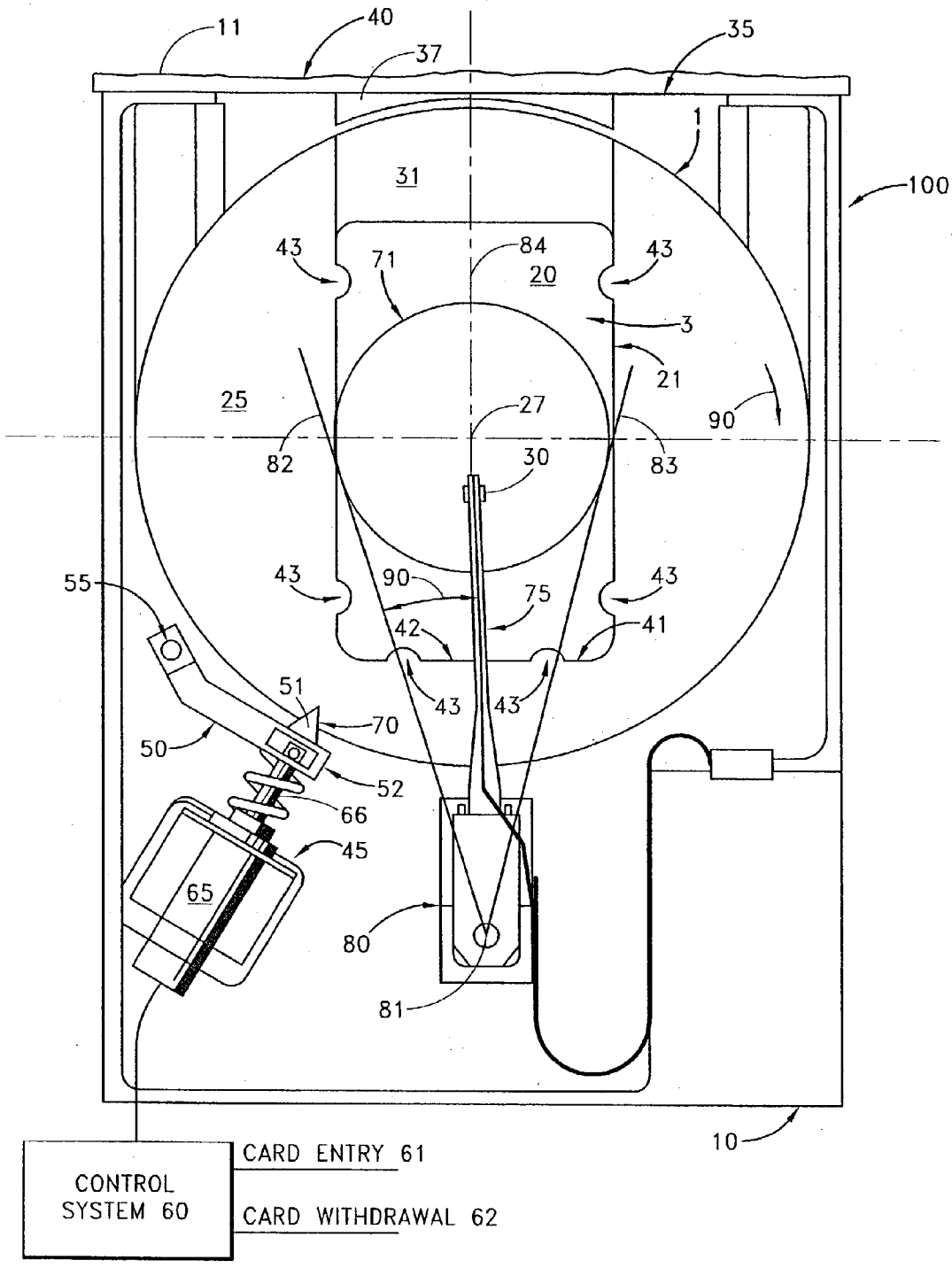
(57) **ABSTRACT**

Apparatus and method whereby a credit card sized high-memory card, composed of recordable storage media such as plastic or ceramic having a suitable recording medium inserted therein or placed thereon, can be inserted into an operative position adjacent to a rotating read/write head and the rotating head can be moved linearly relative to the high-memory card, while at the same time rotating, to permit the head to write data to or read data from the recording medium of the high-memory card. In the preferred embodiment, a high-memory card is fixed in position under a read/write head mounted in or on a holding assembly that can be rotated about its own axis. The read/write head assembly can then be moved incrementally, by stepper motor, voice coil actuator or other stepping device, in an arc, or linearly across the surface of the media, thus sweeping a recording path along the length of the high-memory card. One or more recording paths are swept parallel to each other along either axis of the high-memory card, or alternatively, recording paths are swept on both sides of a high-memory card by turning the card over or by placing read/write head assemblies on both sides of the high-memory card and providing the high-memory card with recording surfaces on both sides.

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CONTROL SYSTEM 60
CARD ENTRY 61
CARD WITHDRAWAL 62

FIG. 1

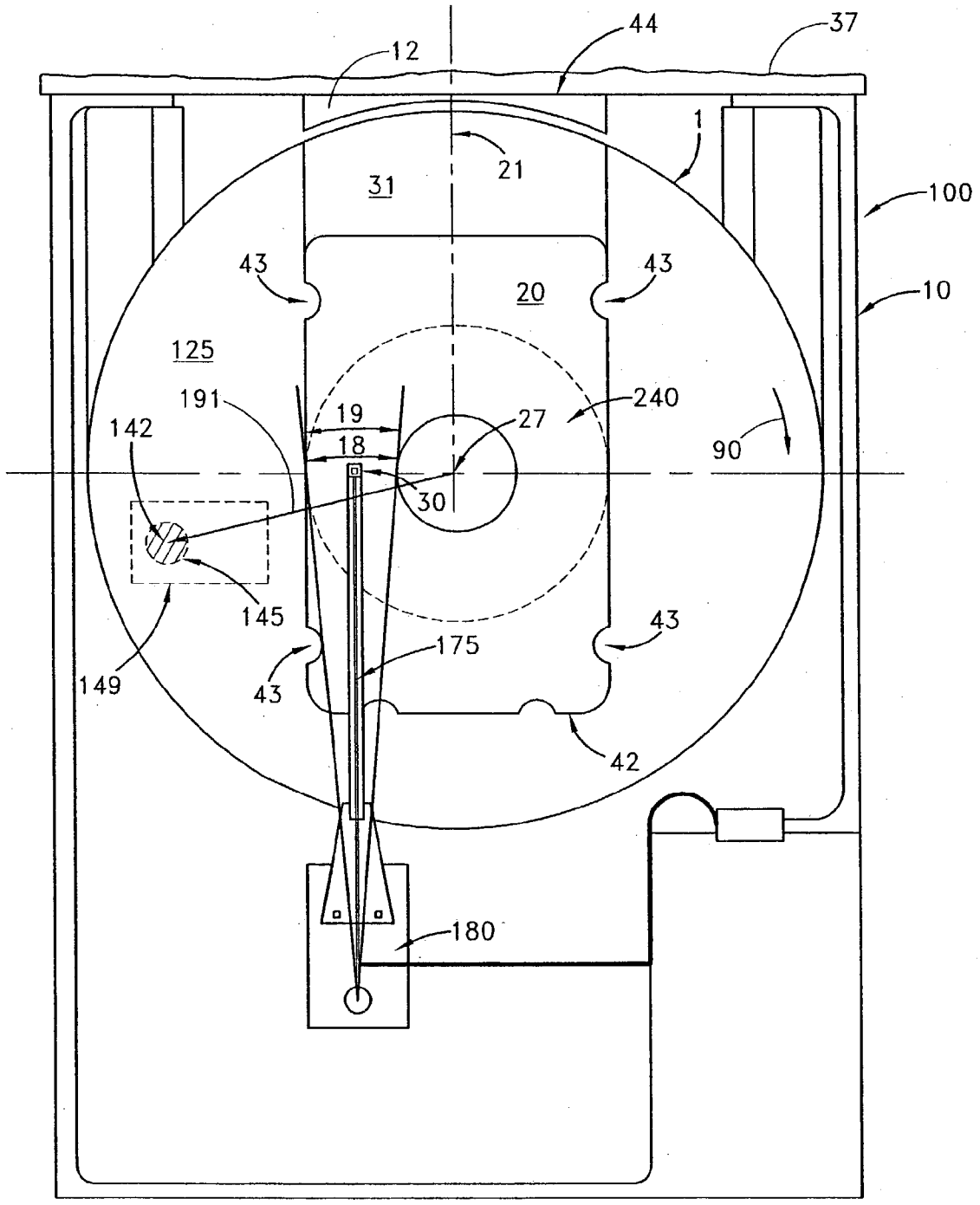
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FIG. 2

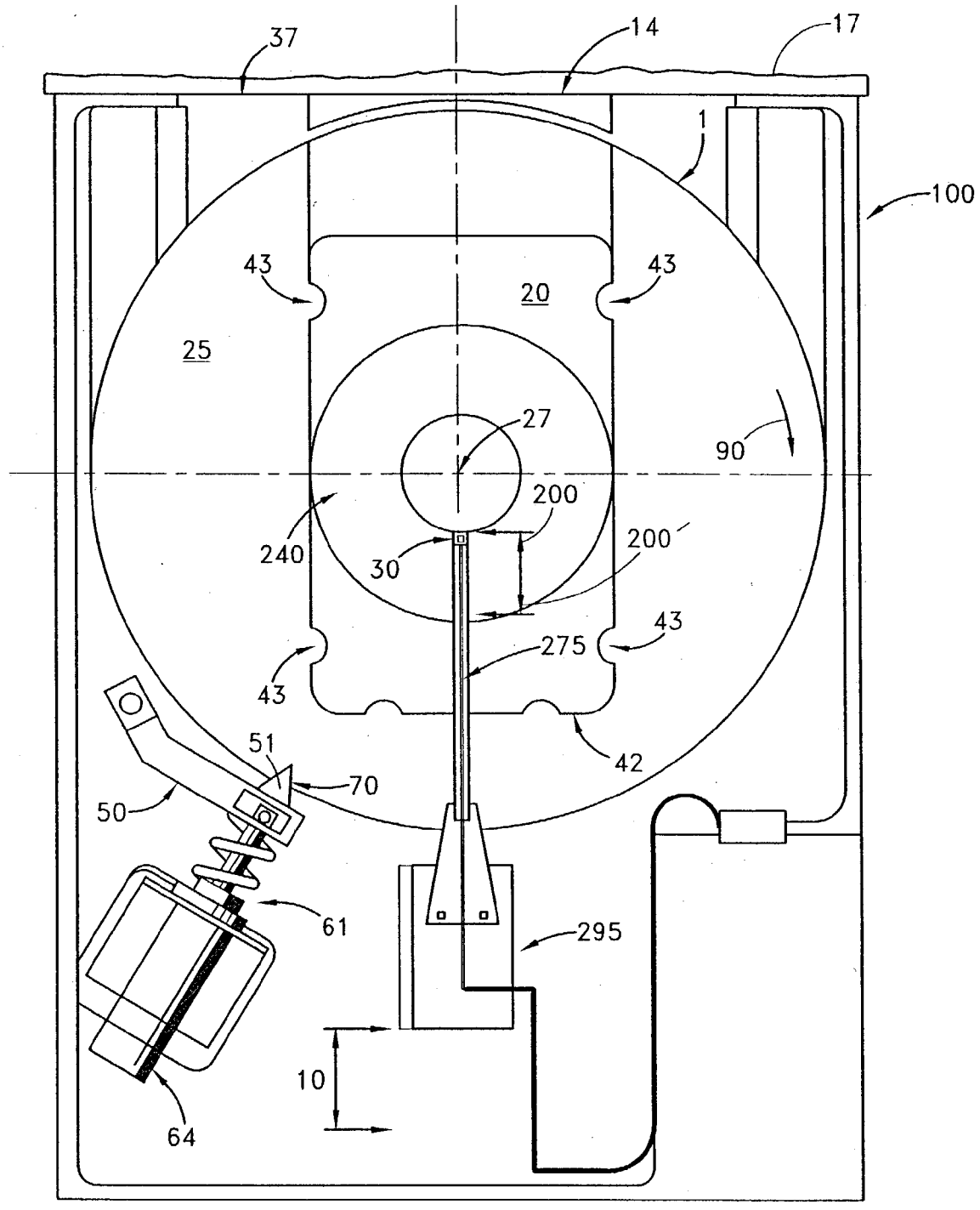
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FIG. 3

CARD READER APPARATUS AND METHOD

PRIORITY CLAIM

[0001] This application claims the benefit of U.S. provisional Application No. 60/161,302 filed Oct. 23, 1999 entitled "Data Storage Device, Apparatus and Method for Using Same".

FIELD OF THE INVENTION

[0002] This invention relates to read-write apparatus and methods for high density data recording on recordable media supported by a compact card.

BACKGROUND OF THE INVENTION

[0003] Cards the size of a credit card or business cards supporting a layer of magnetizable medium, offer a convenient and highly portable data storage device. However, typical cards have a non-circular or irregularly shaped data storage configuration, for example, U.S. Pat. No. 5,107,099 describes such a card as well as a reader for the card. These designs present substantial difficulties in use, and design of high density data recording and storage.

[0004] In the prior art, recordable media supported on certain types of card have a largely asymmetric geometry, creating a difficult to use storage medium, with a low surface area to used space ratio. Additionally, the card is typically placed asymmetrically in the reader. This asymmetry can cause rotational vibrations, leading to difficulties in wear and read head accuracy. Moreover, transition of the head on and off the card as it moves around the reader causes excessive wear on the read head. Additionally, the media will only periodically be in contact with the read head, seriously reducing access time, and efficiency. Furthermore, the control circuitry required to read the media in this periodic fashion can be costly, and complicated.

SUMMARY OF THE INVENTION

[0005] The preferred embodiments of the present invention provide a card reader apparatus in which a thin card, supporting a large storage capacity recording media, is inserted. In preferred embodiments of this invention the cards are the size of a credit card (e.g., ISO #2894, ANSI x4.13-1971) or common business card. The novel features of this invention enable the card reader to be efficiently, and effectively used in a variety of applications. The card is placed in a recessed platen and rotated proximate to a read/write head. In preferred embodiments, this platen is circular in shape. In one embodiment, the read head is incrementally moved through an arc across the surface of the recordable media to record, and read a series of tracks thereon. In another preferred embodiment, a single magnetic head is positioned over the card and is incrementally stepped along the longitudinal axis of the reader to read and/or write a plurality of spaced circular tracks covering the recordable material. In further embodiments, the head may be an optical device such as a laser, for use in recording and reading optically recordable media. In other embodiments a servo control precisely positions the head or the card to compensate for manufacturing tolerances while maintaining high density recording capability.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] **FIG. 1** is a top plan view of a card reader constructed in accordance with this invention;

[0007] **FIG. 2** is a top plan view of another embodiment of a card reader constructed in accordance with this invention; and

[0008] **FIG. 3** is a top plan view of yet another embodiment of a card reader constructed in accordance with this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] One embodiment of a card read/write apparatus constructed in accordance with one preferred embodiment of the invention is shown in **FIG. 1**. High-density memory card reader **100** is particularly adapted for reading high-density memory cards. Generally reader **100** includes a housing **10**, platen **25** for rotation of the inserted memory card **20**, and read/write head **30** for interface with the card.

[0010] In the preferred embodiment of **FIG. 1**, platen **25** is a circular disc, having a thickness, diameter, outer edge, top and bottom surfaces, with a recessed channel **30** in its upper surface, and radial notch **70** in the outer edge. Recessed channel **30** has a depth below the top surface of platen **25**, and is preferably designed to accommodate the insertion of a high-density memory card **20** which, in preferred embodiments, is substantially the size of a credit card. In the embodiments shown, channel **30** extends from the edge of platen **25**, and terminates in such a fashion as to locate the geometric center of the memory card **20** concentrically with the axis of rotation of platen **25**. A plurality of projecting ears **43** extend from the upper surface of platen **25**, over recessed channel **30**. In the specific embodiment shown, the platen includes a card retainer apparatus in the form of projection ears **43** which are semi-circular in shape, but may be another shape or form that will prevent the memory card from moving from the plane of channel **30**, especially during operation.

[0011] Housing **10** includes a front wall **11** provided with a slot **37** through which can pass a card carrier (not shown) in which the high-memory card **20** is initially placed. This carrier then transfers the card **20** to the recessed channel **30** and card **20** is moved longitudinally until the leading edge **41** of high-memory card **20** is firmly lodged against the rear wall **42** of the recessed channel **30** and clamped in place against the projecting ears **43**.

[0012] During card entry, platen **25** is maintained in an appropriate position vis-a-vis slot **37** by platen lock apparatus **45**. This apparatus includes a pivoting arm **50** having a platen engageable projection **51** at or proximate to the distal end **52** of arm **50** remote from its pivot axis **55**. Control system **60** senses a card entry **61** or a card withdrawal **62** command to energize solenoid **65**. Solenoid plunger **66** then engages the distal end of the arm **50** so that the projection **51** engages a radial notch **70** of platen **25**. Platen is then "locked" into a stationary position in which the front edge of recess is juxtaposed slot **37** for card insertion or card withdrawal.

[0013] Typically, the card **20** will have the approximate size of a credit card or business card supporting a layer of recordable medium. The preferred embodiments of card **20** include cards in which substantially all of one face of the card is comprised of a recordable medium **71** or both faces of the card are composed of a recordable medium. In still

other embodiments, card **20** is, substantially in its entirety, formed of a suitable recording medium. Specific examples of recordable medium are magnetizeable or optically recordable mediums.

[**0014**] A head actuating mechanism **80** is mounted to reader **100** in proximity to platen **25**. A cantilevered control arm **75** is mounted to actuating mechanism **80**, and extends from mechanism **80** towards the geometric center **27** of platen **25**. In the embodiment of **FIG. 1**, arm **75** extends along the diameter of platen **25**. The read/write head **30** is mounted near the distal end of control arm **75**, adjacent to geometric center **27** of platen **25**. Actuator **80** is free to rotate on reader **100**, for example along a limited arc **90** whose axis of rotation is at **81**, when engaged to move read/write head **30** to different positions above the inserted high-density memory card between center line segment **84** and either line segments **82** or **83**. In other embodiments such as shown in **FIG. 3** and described below, the read/write head may move radially by way of a linear actuator such as a stepper motor.

[**0015**] Another preferred embodiment of the present invention shown in **FIG. 2** includes shows a reader comprising a housing **10**, having a slot **12**, a platen **125**, an actuator **180**, a linear control arm **175**, and a read/write head **30**. Cantilever control arm **175** extends over platen **125** toward the center of platen **127**, but is located off set from center line **21** of platen **125**. Read/write head **30** is located near the distal end of arm **175**, in proximity to the location of the recordable media. Actuator **180** allows control arm **175**, and read/write head **30** to move along arc **19**.

[**0016**] During card entry into platen **125**, platen **125** is maintained in its appropriate position for card entry by notch **145** on its bottom surface. A locator pin **142**, and solenoid actuator **149** are also located below platen **125**. Pin **142** is located at the radial location **191** of notch **145**. Locator pin **142**, when engaged with notch **145**, stop platen **125** in such a position as to align recessed channel **30**, and slot **12** for card insertion, and removal. In other embodiments of this invention, the notch **145** may alternatively be a groove, castellation, or any other structure that can interface with a locating device, to locate the platen in a desired position to receive or remove card **20** from platen **125**.

[**0017**] A significant feature of the embodiment of **FIG. 2** is the placement by the axis of control arm **175** off-center of the axis **27** of rotation of platen **125**. The length of control arm **175** is such that the read/write head **30**, when at the mid-point of its arc of motion **19**, is centered midway over the radius of the recording area **240**, and positioned such that throughout its arc of motion **19**, the average signal strength is optimized for all recording tracks in the recording area **240** of the magnetizable medium of card **20**. In other embodiments, control arm actuator may include a cam or other mechanism to convert the rotational motion of the read/write head to a linear motion illustrated in **FIG. 2** by straight line **18**. As the platen rotates, the head can record, or read information from the recordable media present on the card.

[**0018**] In the embodiment of **FIG. 3**, control arm **275** is fixed to a linear actuator **295**. Actuator **295** is typically a stepper motor or similar motor actuating mechanic to move the read/write head **30** linearly across its recording area **240** of card **20** in the direction of various **200**, **200**.

[**0019**] In the preferred embodiments shown the platen **25** or **125** is a disk shaped member rotated by a motor (not shown) below this platen for rotating the platen in a direction indicated by arrow **90**. The platen thus rotates relative to a fixed reference to rotate storage card **20** symmetrically with the axis of rotation of the platen under the read/write head **30**.

[**0020**] By way of specific example the platen drive motor (not shown) is advantageously a brushless D.C. motor.

[**0021**] In the preferred embodiments shown in the Figures, the recorded area of card **20** is shown as an approximate ring shaped area **240** in the center of the card and the read/write head **30** is continuously proximate to the recording surface of its card **20**.

[**0022**] In further embodiments of this invention, the head actuators **80** and **295** may be located directly above or below the platen in the plane of the reader. For example, a linear actuator located below the platen such as in a compact disc player, or similarly above the platen, to drive the read/write head across the rotating recordable media.

[**0023**] Other embodiments of this invention may advantageously include a second read/write head below the platen. The second read/write head will allow for the double-sided use of the inserted card, increasing the amount of data capable of being stored on the memory card.

[**0024**] The platen illustrated in FIGS. **1-3** is shown as a circular disc. In other embodiments of this invention, the platen may have a non-circular configuration that is preferably rotationally balanced.

[**0025**] Embodiments of this invention may advantageously include a conventional motor driven apparatus (not shown) to move the storage card along channel **30** longitudinally until the leading edge of card **20** is firmly lodged against the rear wall of the channel **30**.

[**0026**] In the specific embodiments shown, the platen includes a card retainer apparatus in the form of projection ears **43** which extend over channel **2** surface to leave a space between the bottom of each ear and the surface of channel **2** which is slightly larger than the thickness of the card. This allows the card to be slid onto channel **2** while retaining the card on platen **25** during its rotation. In some preferred embodiments of the invention, the upper surface of the card will be retained substantially level with the upper surface of platen **25**. In these embodiments, other card retainer apparatus, such as an air suction applied through apertures in the floor of channel **30**, can be used to retain the card within channel **30**. In further embodiments, channel **30** may include multiple depths extending into the thickness of the platen. For example, the memory card may, when properly inserted to the reader, rest in a deeper recess than the initial length of the channel. In other embodiments, the channel may further comprise a mechanism for securing the memory card in place, such as a spring-mounted locking device.

[**0027**] As described above, during card insertion and removal of the card from the reader, the platen is maintained in an appropriate position to locate channel **30** in alignment with an insertion slot **12** on the outside surface of reader housing **10**. In further embodiments, the platen lock apparatus may be located on the top surface of the platen. In other preferred embodiments, the location of the platen via locator pin and notch, and the read/write head actuation may be combined into the same structure. It will be apparent that

many other platen locating devices and control systems may be used to locate channel **30** for card entry. For example, the platen drive motor (not shown) may be controlled by a servo loop that includes a sensor responsive to the rotational position of the platen relative to the slot. The platen drive motor would thus be used to rotate the platen recess to the desired position. In further embodiments, the motor may be mounted above, or to the side of the platen in a configuration which will allow the motor to control the rotation of the platen.

[**0028**] Further embodiments of this invention may advantageously locate substantially only that portion of card **20** containing the recordable media concentrically on the platen, rather than the entire card on which the media is supported. Thus, in certain applications, it may be advantageous to locate the card off-center on the platen. In such embodiments, it may be advantageous to counter balance the weight of the card as the platen spins.

What is claimed is:

1. A high density card reader apparatus comprising:

a housing having a card slot;

a thin high density recording card approximately the size of a credit or business card;

a driven rotatable platen having a recess in its surface approximately the length and width of said card and large enough to accept the card into said recess, said recess being located substantially symmetrical to the axis of rotation of said platen;

card retainer apparatus;

a movable read/write head located continuously proximate the surface of said card without crossing an interface between the recording surface of the card and the surface of the platen;

head actuator apparatus coupled to drive said head incrementally across the surface of said card;

a card slot in said housing; and

platen locating apparatus responsive to card entry or card withdrawal to position said recess in juxtaposition with said card slot.

2. A high density card reader apparatus comprising:

a housing having a card slot;

a thin high density recording card approximately the size of a credit or business card;

a driven rotatable platen having a recess in its surface approximately the length and width of said card and large enough to accept the card into said recess;

card retainer apparatus;

a movable read head located proximate the surface of said card;

head actuator apparatus coupled to drive said head incrementally across the surface of said card; and

a card slot in said housing; and

platen locating apparatus responsive to card entry or card withdrawal to position said recess in juxtaposition with said card slot.

3. A high density card reader apparatus comprising:

a thin high density recording card;

a rotatable platen having a recess approximately the length and width of said card;

card retainer apparatus;

an incrementally movable read head located proximate the surface of said card; and

platen locating apparatus responsive to card entry or card withdrawal.

4. The card reader apparatus of claim 3, wherein said card is approximately the size of a credit or business card.

5. The card reader apparatus of claim 3, wherein said card retainer apparatus includes one or more projection ears about the surface of said recess.

6. The card reader apparatus of claim 3, including an actuator for incrementally moving said head through an arc across the surface of said card.

7. The card reader apparatus of claim 3, including an actuator for radially moving said head across the surface of said card.

8. The card reader apparatus of claim 4, including a pivotal actuator for moving said head across the surface of said card, the pivot axis of said actuator being located substantially aligned with the center axis of said platen.

9. The card reader apparatus of claim 4 including a pivotal actuator for moving said head in an arc across the surface of said card, the pivot axis of said actuator being located off-center from the center axis of said platen so that when at the mid-point of its movement, said arcuate path of said head is centered substantially midway over the radius of the recording area of said card.

10. The card reader apparatus of claim 3, wherein said platen locating apparatus includes an electro-mechanical actuator.

11. The card reader apparatus of claim 10, wherein said actuator includes a solenoid driving an actuator.

12. The card reader apparatus of claim 10, wherein said actuator is a movable projection engaging notch in the periphery of said platen.

13. The card reader apparatus of claim 11, wherein said actuator is a moveable projection engaging the underside of said platen.

14. The card reader apparatus of claim 3, wherein said card is located substantially symmetrical to the axis of rotation of said platen while data is stored or read from said card.

15. The card reader apparatus of claim 3, wherein said recess for said card is located off-center from the axis of rotation of said platen and said platen is counterbalanced to compensate for the off-center location of said recess and card.

16. A method for recording and/or reading on a recordable medium provided on a rectangular card similar in size to a credit card, comprising:

placing said card on a rotatable platen substantially symmetrical to the axis of rotation of said platen and adjacent to a read and/or write head;

rotating said platen and incrementally moving said head with respect to said card without crossing an interface between the recording surface of the card and the surface of the platen.

17. A method for recording and/or reading on a recordable medium provided on a rectangular card similar in size to a credit card, comprising:

placing said card on a platen adjacent to a read and/or write head;

rotating said platen and incrementally moving said head with respect to said card.

18. A method for recording and/or reading on a recordable medium provided on a rectangular card similar in size to a credit card, comprising:

placing said card on a platen adjacent to a read and/or write head;

rotating said platen and incrementally moving said head along a path radial with respect to the geometric center of said platen.

19. A high density card reader apparatus comprising:

a housing having a card slot;

a driven rotatable platen having a channel in its surface approximately the width of said card and large enough to accept the card into said channel;

card retainer apparatus;

a movable read head located proximate the surface of said platen;

head actuator apparatus coupled to drive said head incrementally across the surface of said card; and

platen locating apparatus responsive to card entry or card withdrawal to position said channel in juxtaposition with said card slot.

20. The actuator of claim 19, wherein said actuator is located inline with a diameter of said platen.

21. The actuator of claim 20, wherein said actuator is located offset from a diameter of the platen.

22. The card reader of claim 20, wherein said locating platen apparatus is located below said platen.

23. The card reader of claim 20 further comprising a second read head located proximate to the opposite surface of said first read head.

24. The card reader of claim 23 further comprising a head actuator apparatus coupled to drive said second head incrementally across the surface of said card.

25. The card reader of claim 24, wherein said actuator drives said head in a linear fashion.

26. A high density card reader apparatus comprising:

a rotatable platen having a channel having approximately the correct length and width to locate a memory card concentrically with said platen;

card retainer apparatus;

an incrementally movable read head located proximate the surface of said platen; and

platen locating apparatus responsive to card entry or card withdrawal.

27. The card reader apparatus of claim 26, wherein said card is approximately the size of a credit or business card.

28. The card reader apparatus of claim 26, wherein said card is the size of a credit card, adhering to ISO standard 2894.

29. The card reader apparatus of claim 26, wherein said card retainer apparatus includes one or more projection ears about the surface of said channel.

30. The card reader apparatus of claim 26, including an actuator for incrementally moving said head through an arc across the surface of said card.

31. The card reader apparatus of claim 26, including an actuator for radially moving said head across the surface of said card.

32. A high density card reader apparatus comprising:

a rotatable platen having a channel having approximately the correct length and width to locate a memory card concentrically with said platen;

card retainer apparatus;

an incrementally movable read head located proximate the surface of said platen;

head actuator apparatus located off set from a diameter of said platen and coupled to drive said head incrementally in an arc across the surface of said card; and

a platen locating apparatus responsive to card entry or card withdrawal.

33. A high density card reader apparatus comprising:

a housing having a card slot;

a rotatable platen having a channel having approximately the correct length and width to locate a memory card concentrically with said platen;

card retainer apparatus;

an incrementally movable read head located proximate the surface of said platen; and

a platen locating apparatus responsive to card entry or card withdrawal.

34. The card reader of claim 33 further comprising a linear actuator coupled to said read head allowing said head to move radially from the geometric center of said platen.

35. The card reader of claim 33 further comprising a second read head located proximate to the opposite surface of said first read head.

36. The card reader of claim 35 further comprising a head actuator apparatus coupled to drive said second head incrementally across the surface of said card.

37. The card reader of claim 33, wherein said locating device is located beneath said platen on said housing.

38. The card reader of claim 33, wherein said channel will locate said card in such a fashion as to locate the recordable media present on said card concentrically with said platen.

39. A high density card reader apparatus comprising:

a housing having a card slot;

a rotatable platen having a channel having approximately the correct length and width to locate a memory card concentrically with said platen;

card retainer apparatus;

a multiplicity of incrementally movable read heads, coupled to an actuator, located proximate the surface of said platen; and

a platen locating apparatus responsive to card entry or card withdrawal.

40. The card reader of claim 39, further comprising a second set of multiple read heads coupled to a second

actuator, located proximate to the opposite surface of said surface of said platen.

41. The card reader of claim 39 or claim 40, wherein said actuator enables said multiplicity of head to be moved in an arc across aid surface of said platen.

42. The card reader of claim 39 or claim 40, wherein said actuator enables said multiplicity of said heads to be moved linearly across said surface of said platen.

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