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(54) **MINI-CARTRIDGE ADAPTER FOR ADAPTING A MINI-CARTRIDGE TO AN INDUSTRY STANDARD TAPE CARTRIDGE FORMAT**

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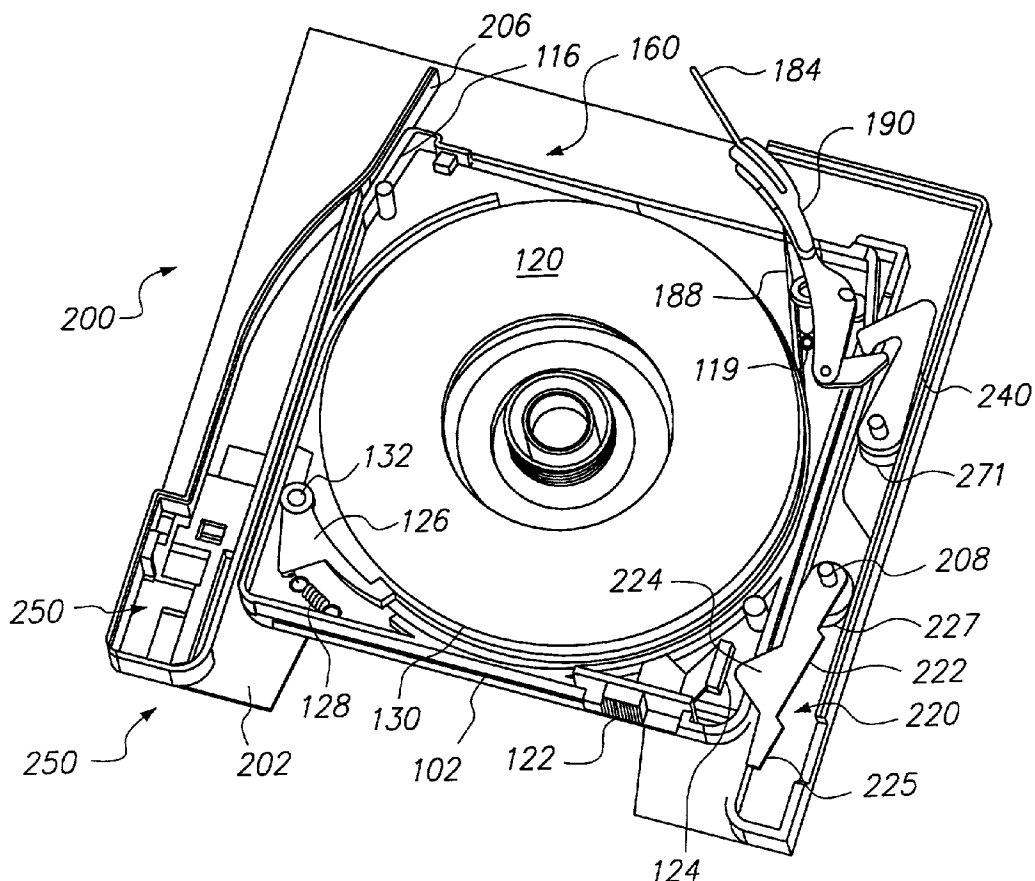
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(52) **U.S. Cl.** **360/94; 360/132**

(57) **ABSTRACT**

A tape mini-cartridge is functionally compatible with a larger industry standard tape cartridge. A mini-cartridge adapter adapts the mini-cartridge to be compatible with a standard tape drive by presenting the standard structural and functional appearances to the tape drive as presented by the larger standard tape cartridge. Since the standard cartridge has a plurality of structural elements including reel locks, leader buckle guide, and write protect flag engaged by the standard drive, the cartridge adapter effectively transfers these engagements and forces to and from the mini-cartridge in a manner providing full structural interchangeability with the standard tape cartridge.



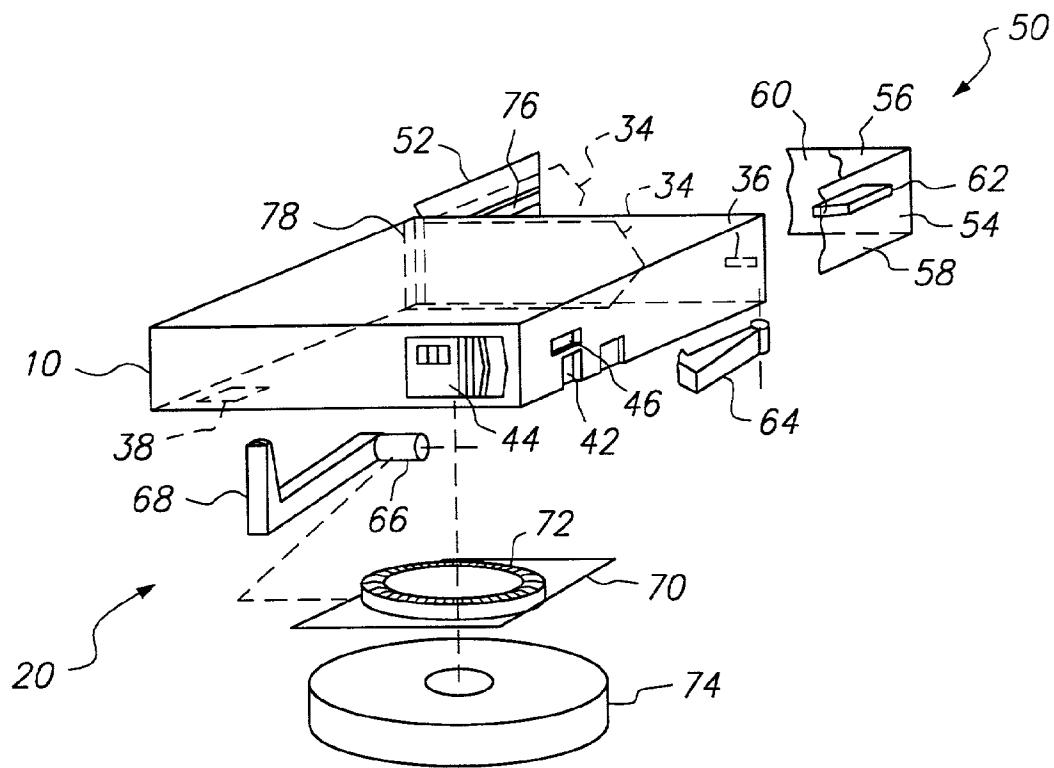


FIG. 1
(PRIOR ART)

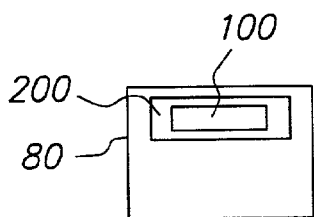


FIG. 4A

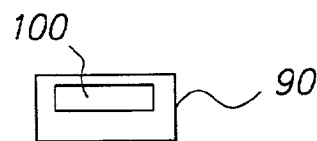


FIG. 4B

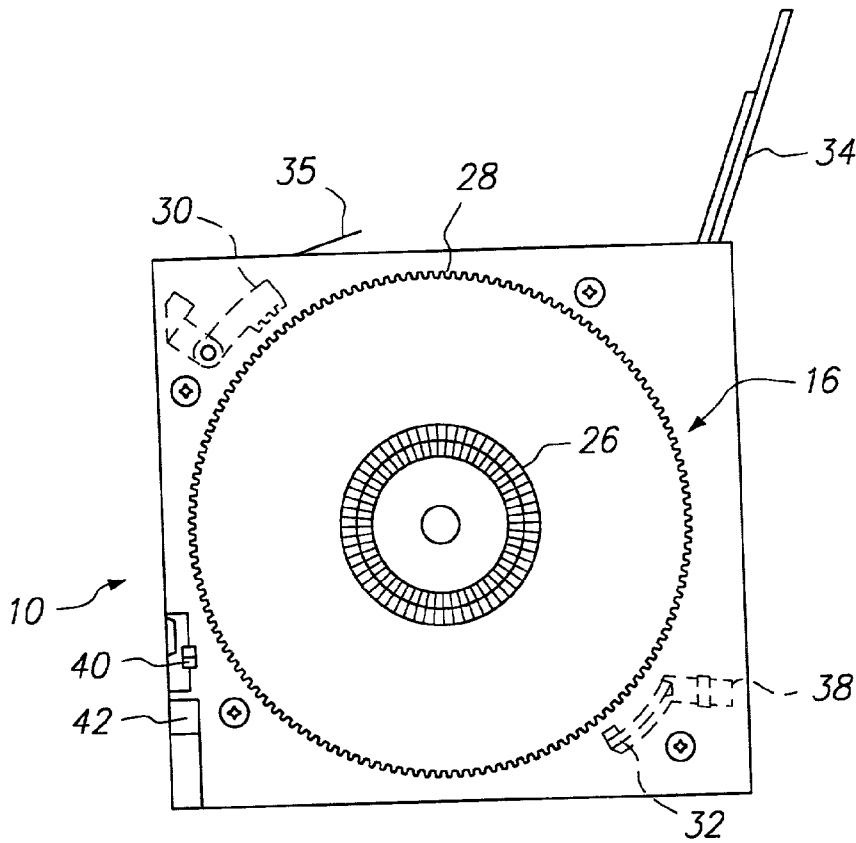


FIG. 2
(PRIOR ART)

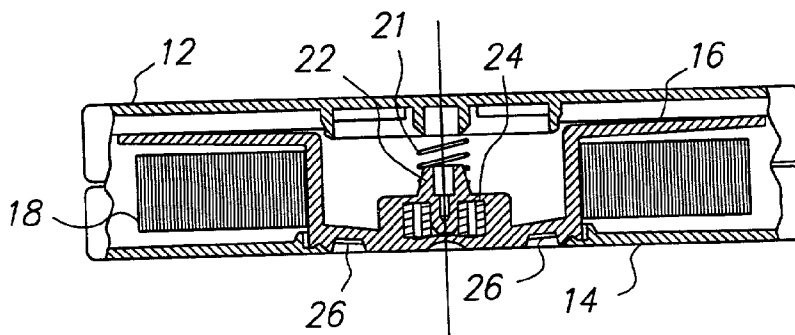
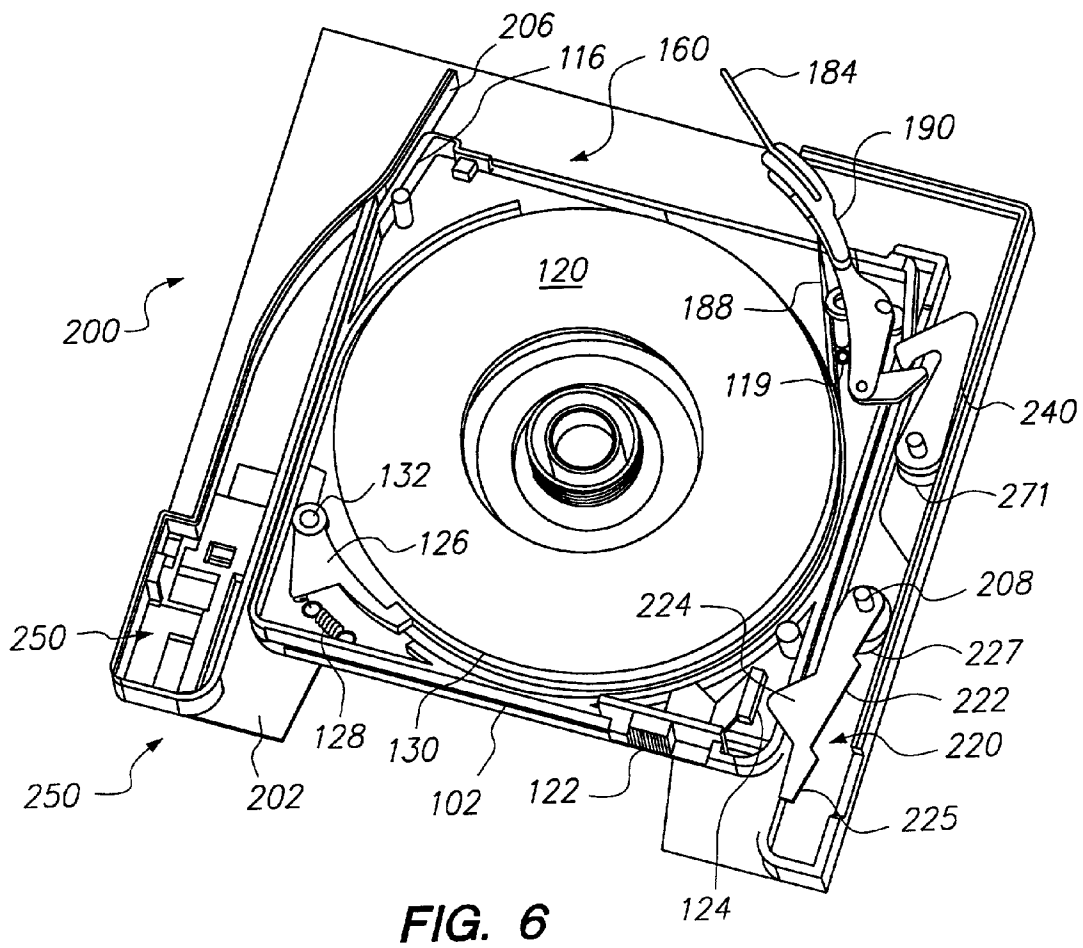
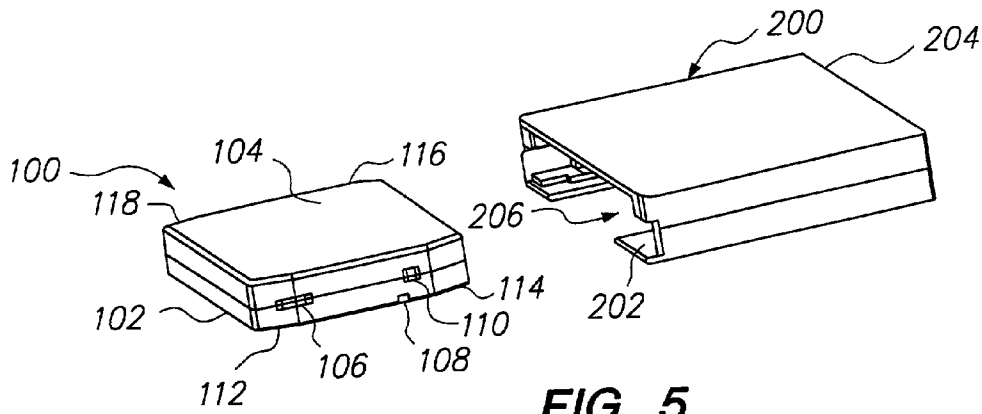


FIG. 3
(PRIOR ART)



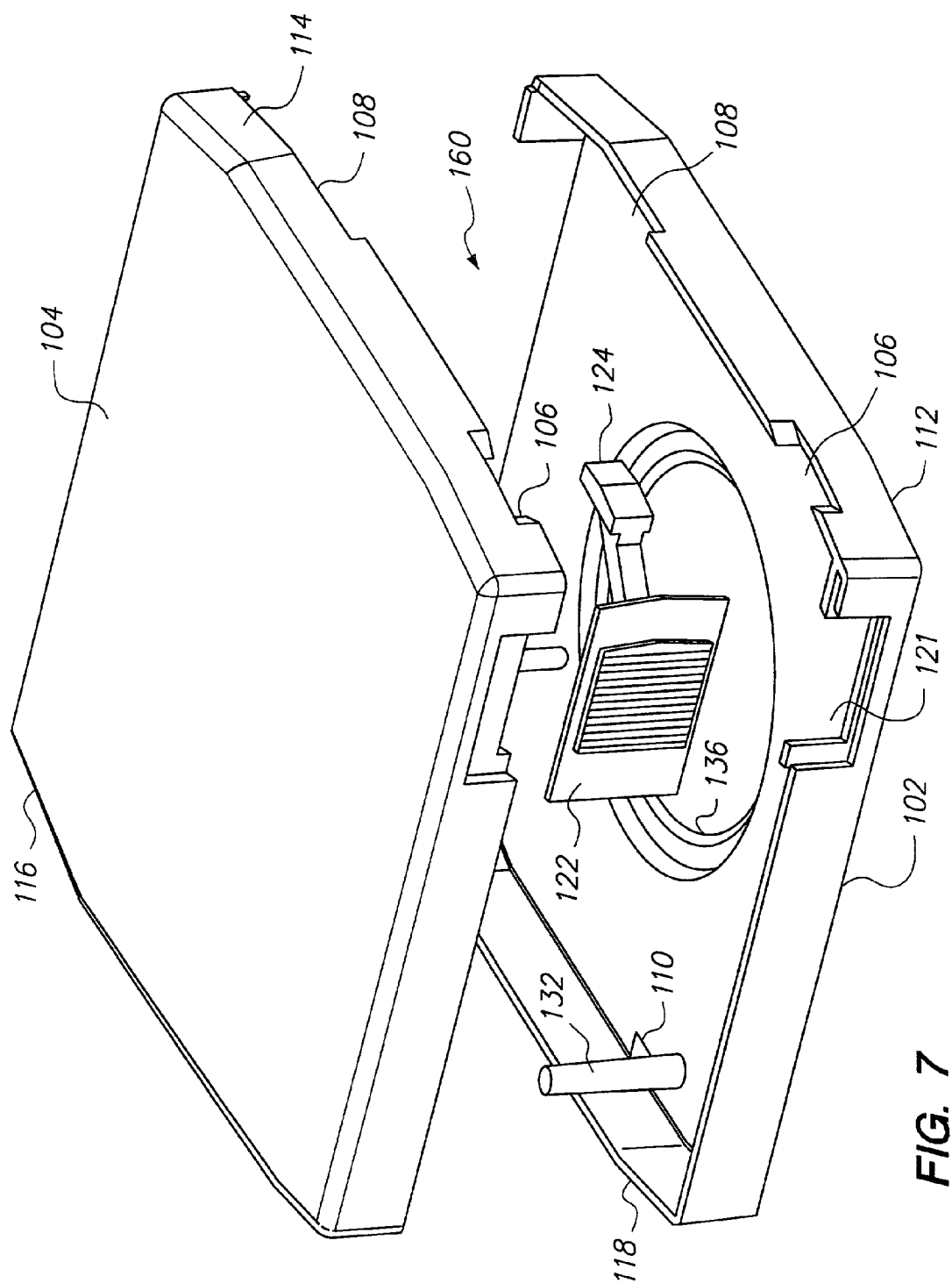


FIG. 7

FIG. 8A

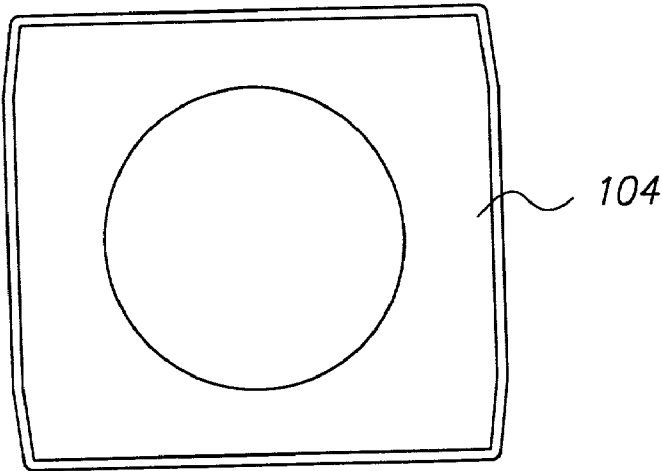


FIG. 8B

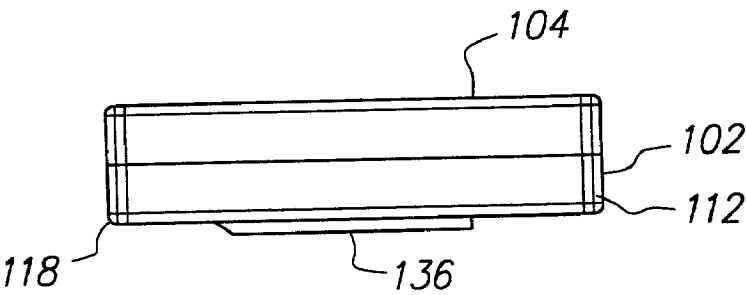
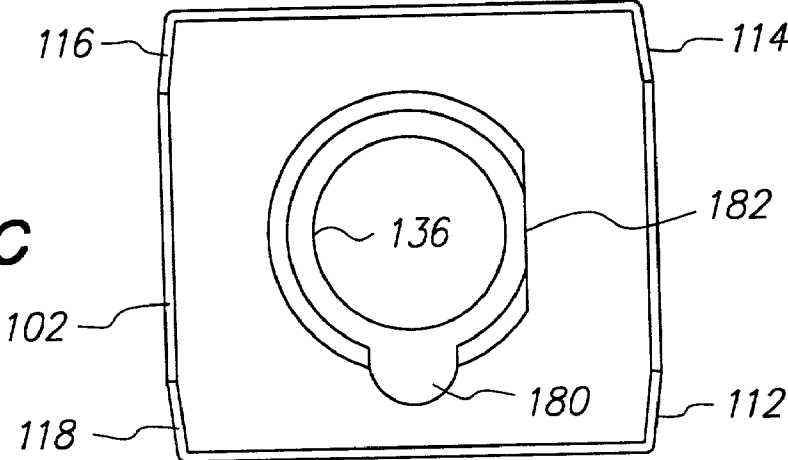


FIG. 8C



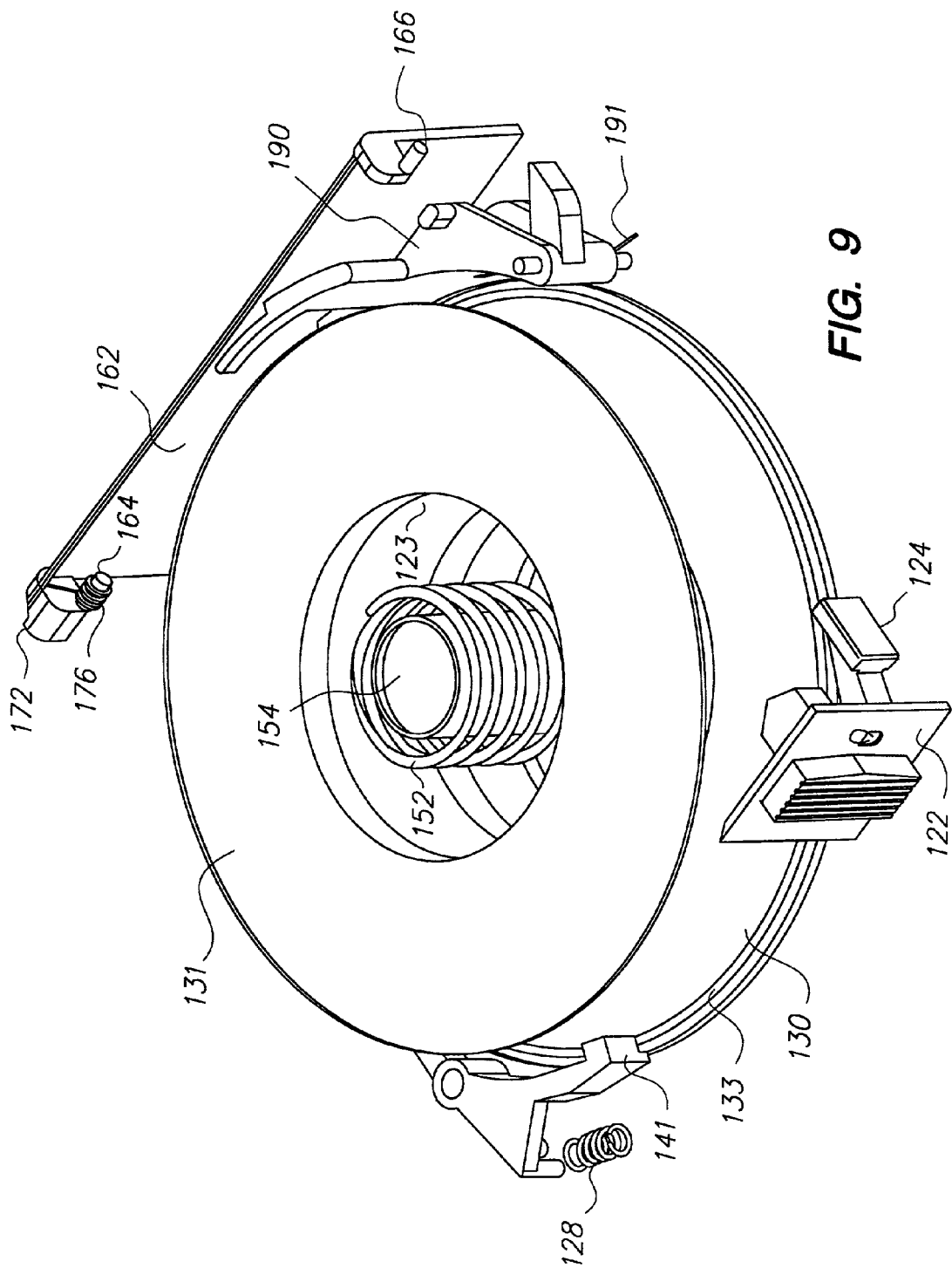


FIG. 9

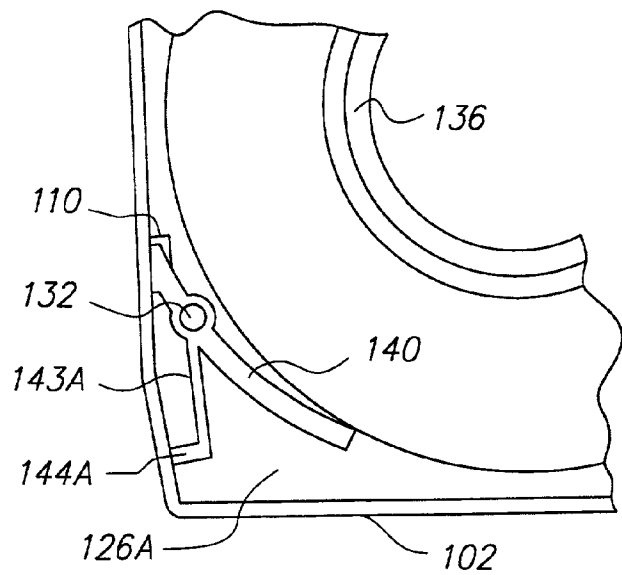


FIG. 10

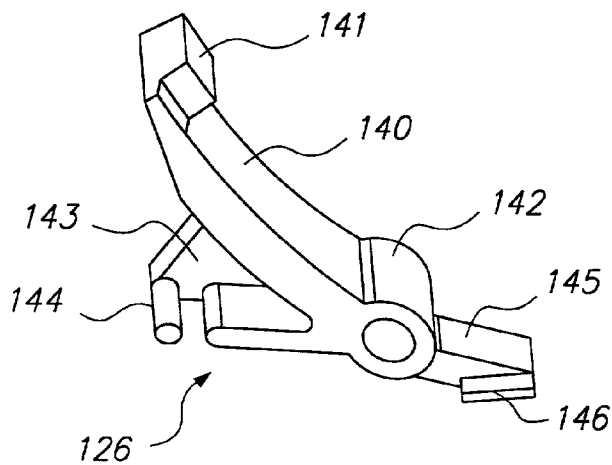


FIG. 9A

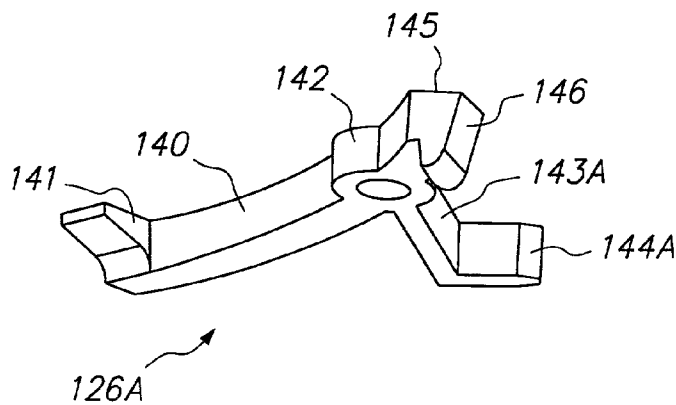
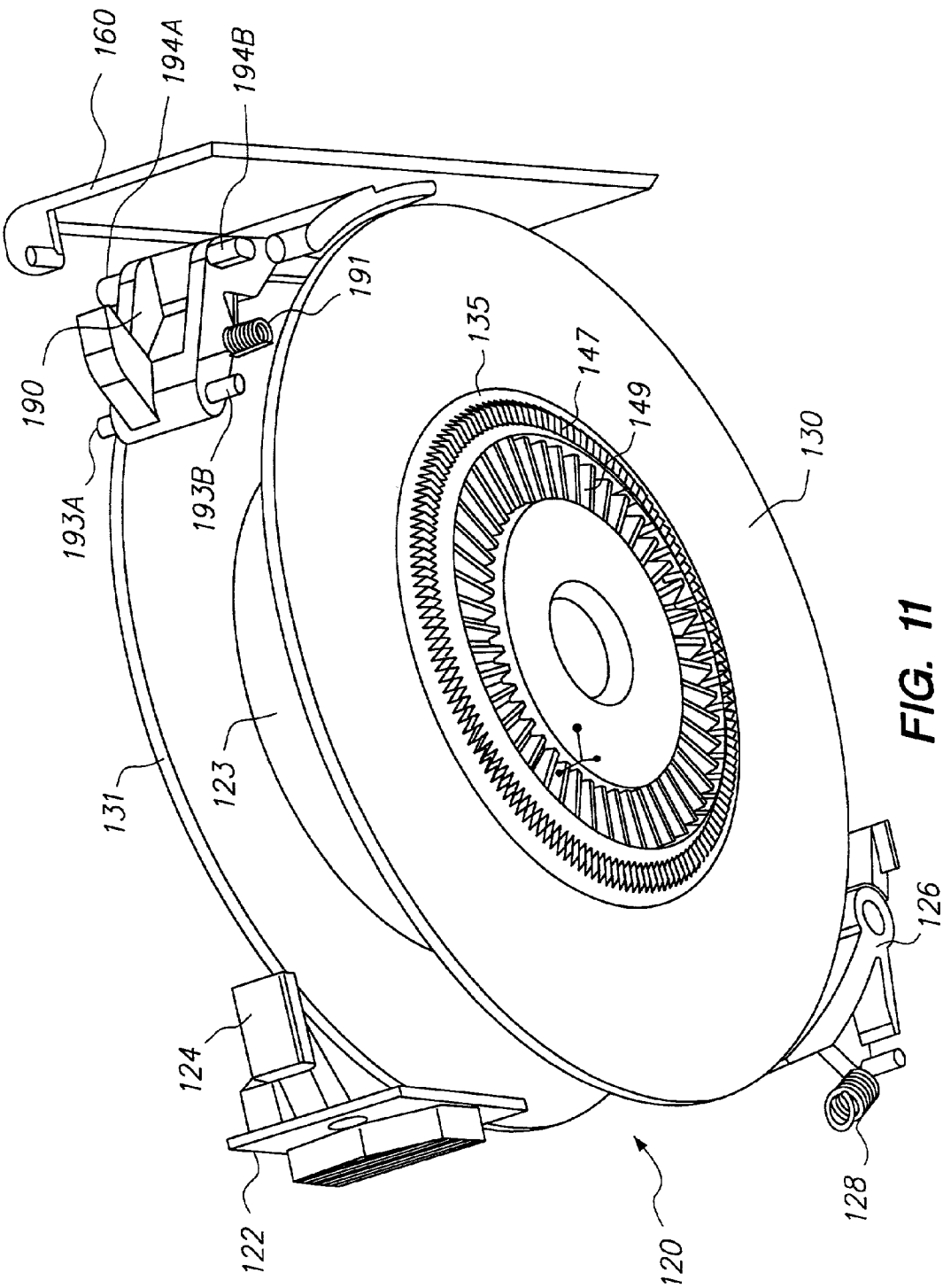
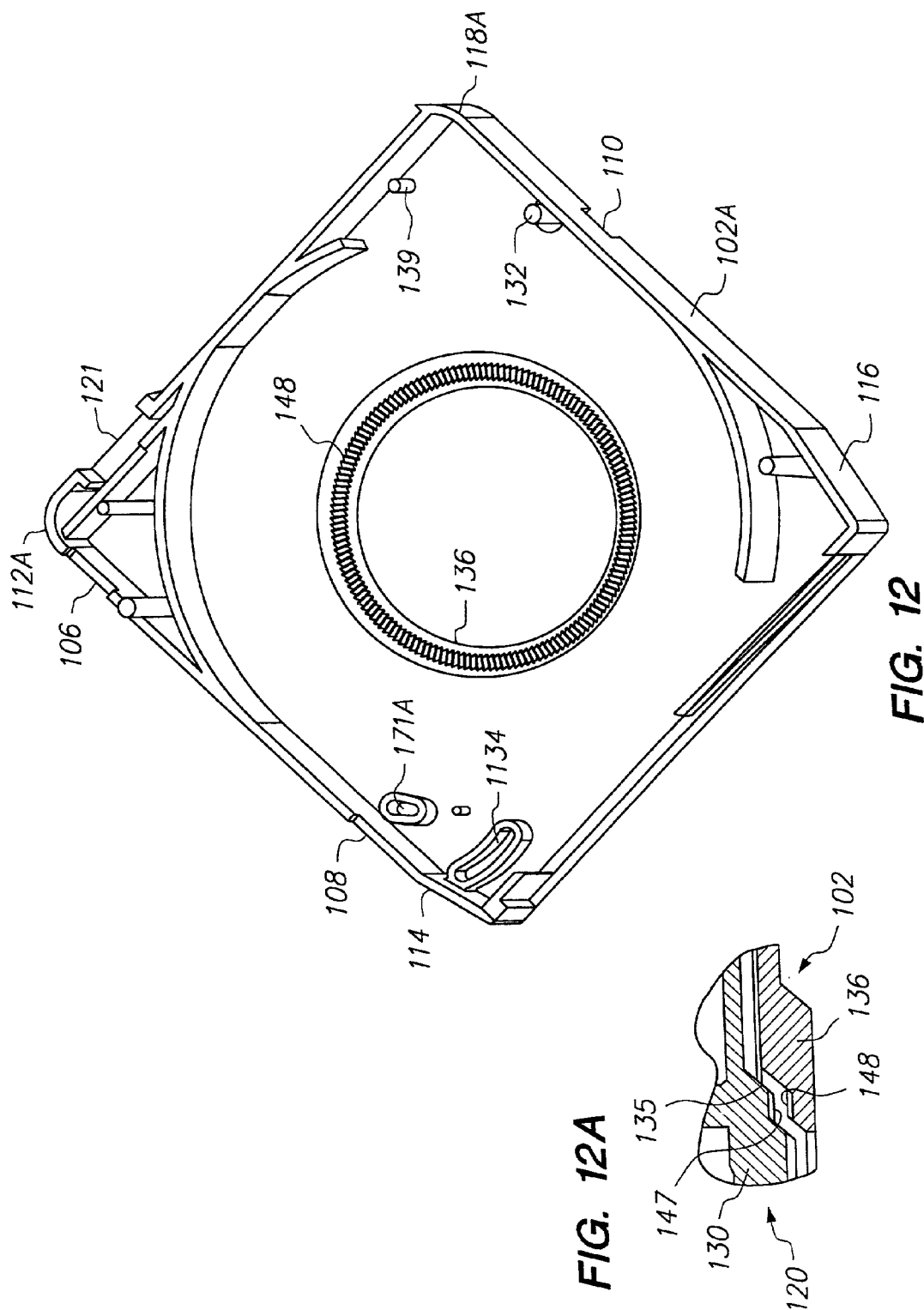


FIG. 10A





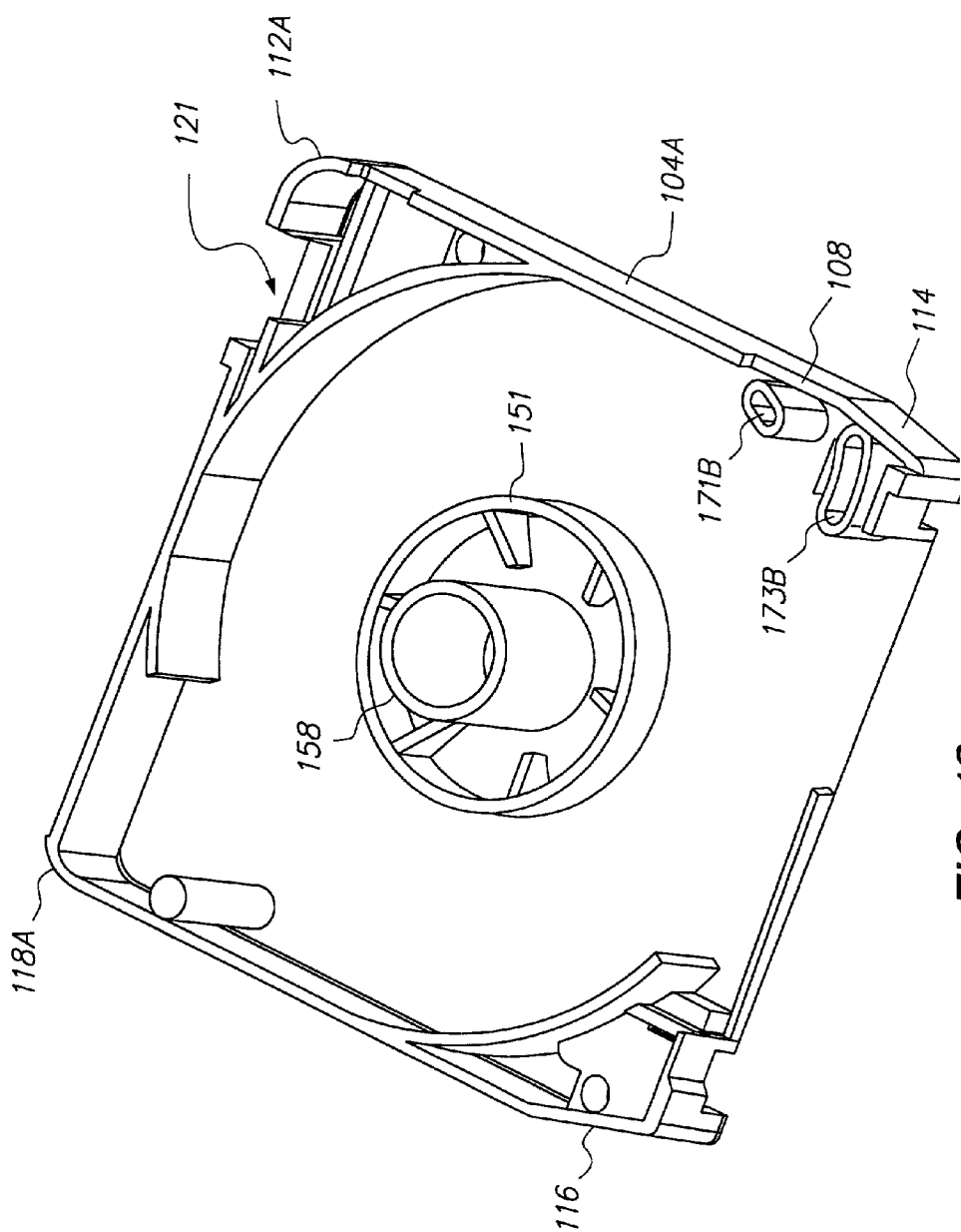


FIG. 13

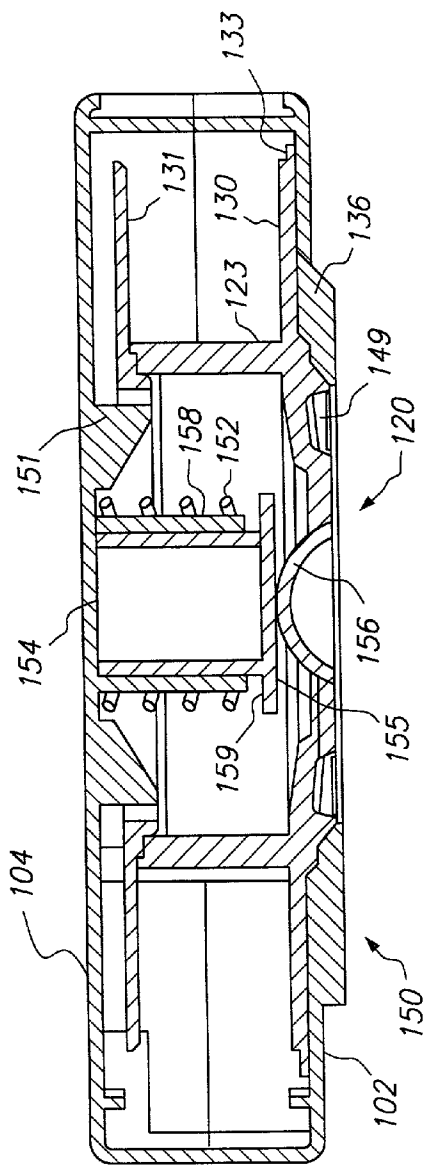


FIG. 14

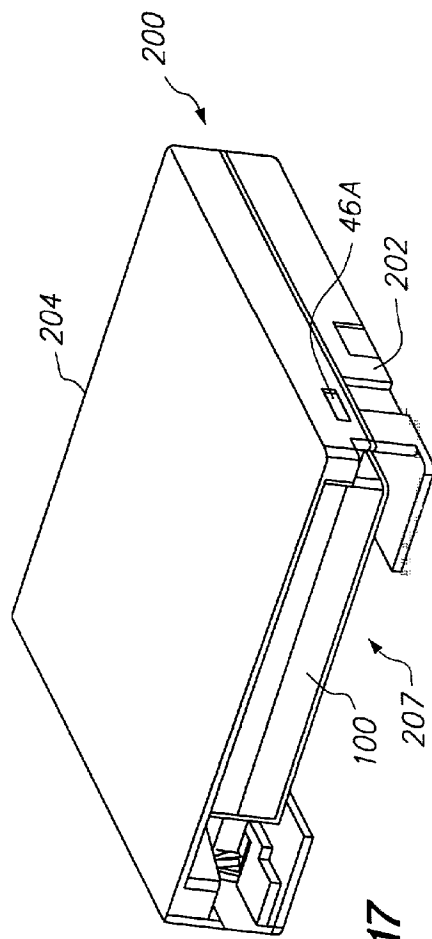


FIG. 17

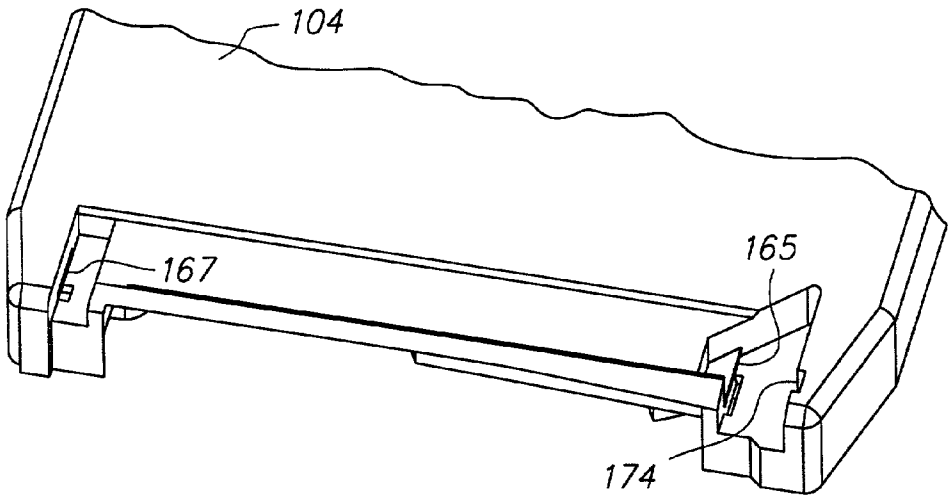


FIG. 15A

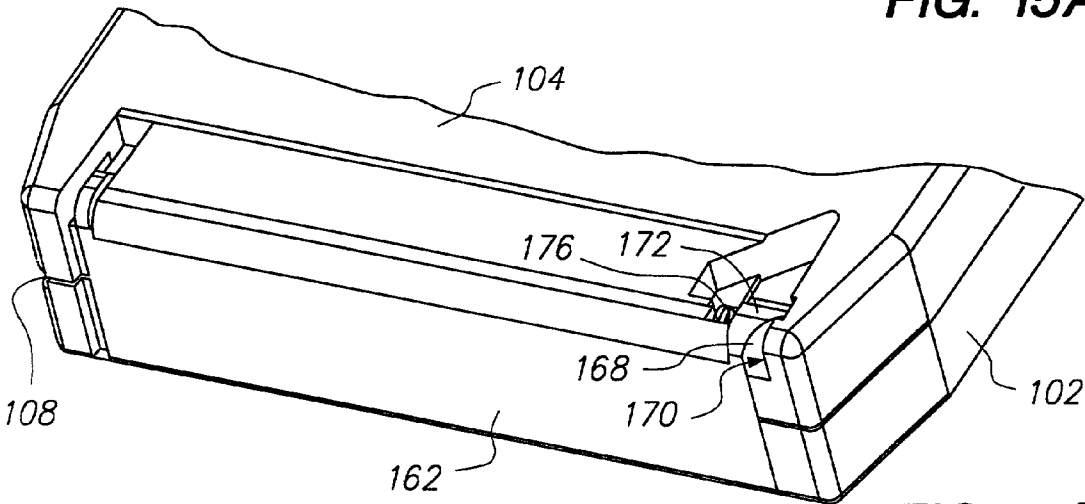


FIG. 15B

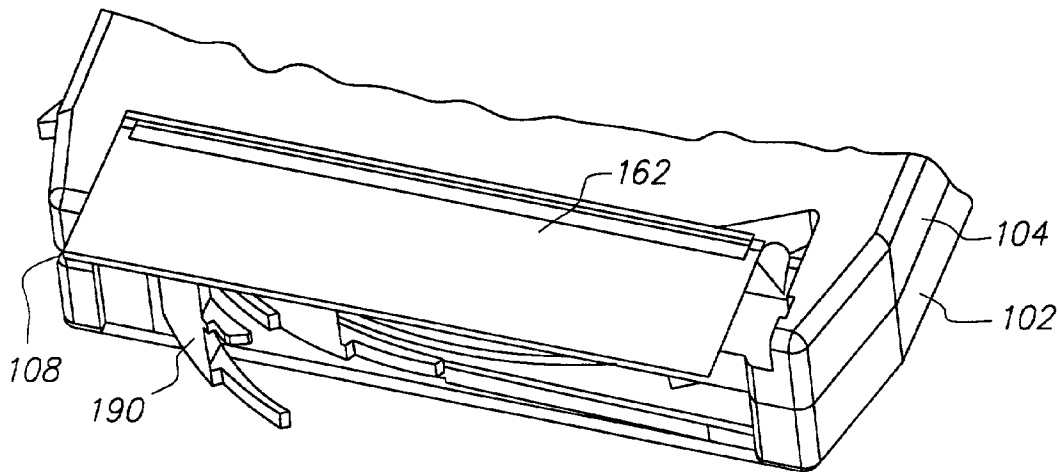


FIG. 15C

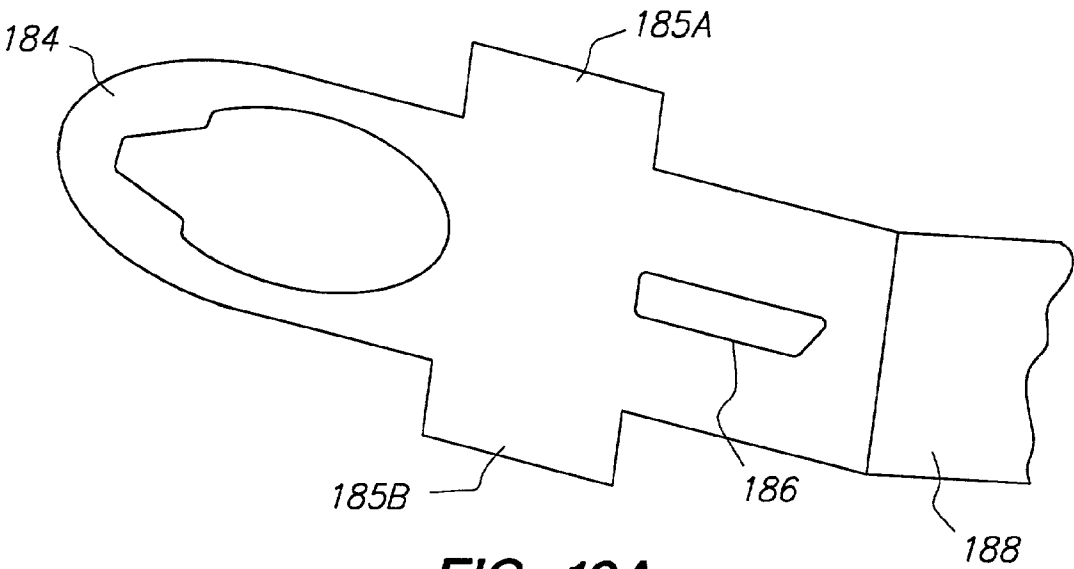


FIG. 16A

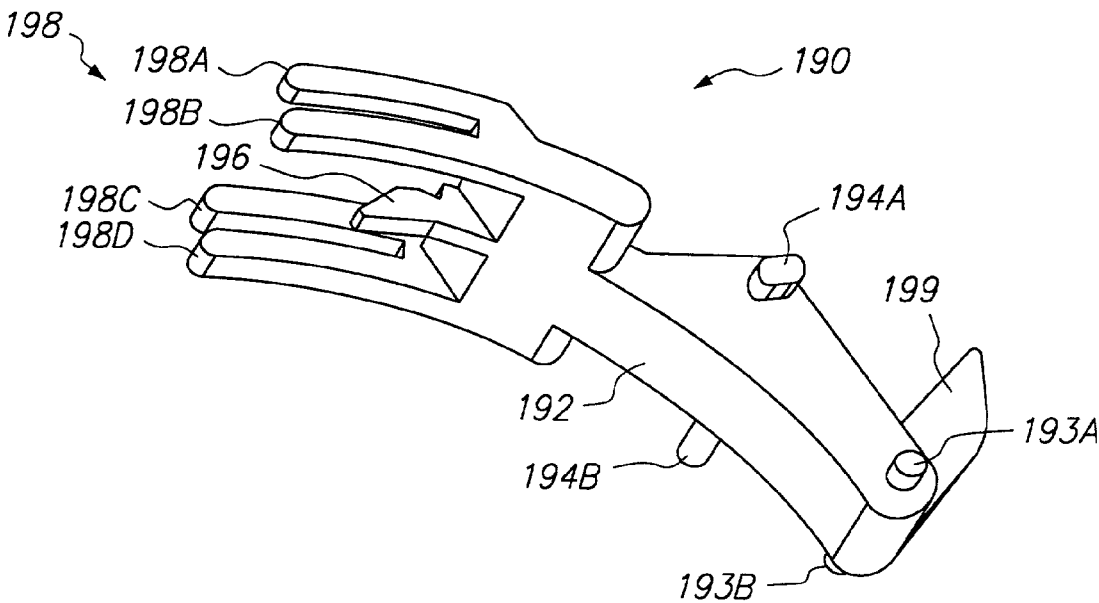
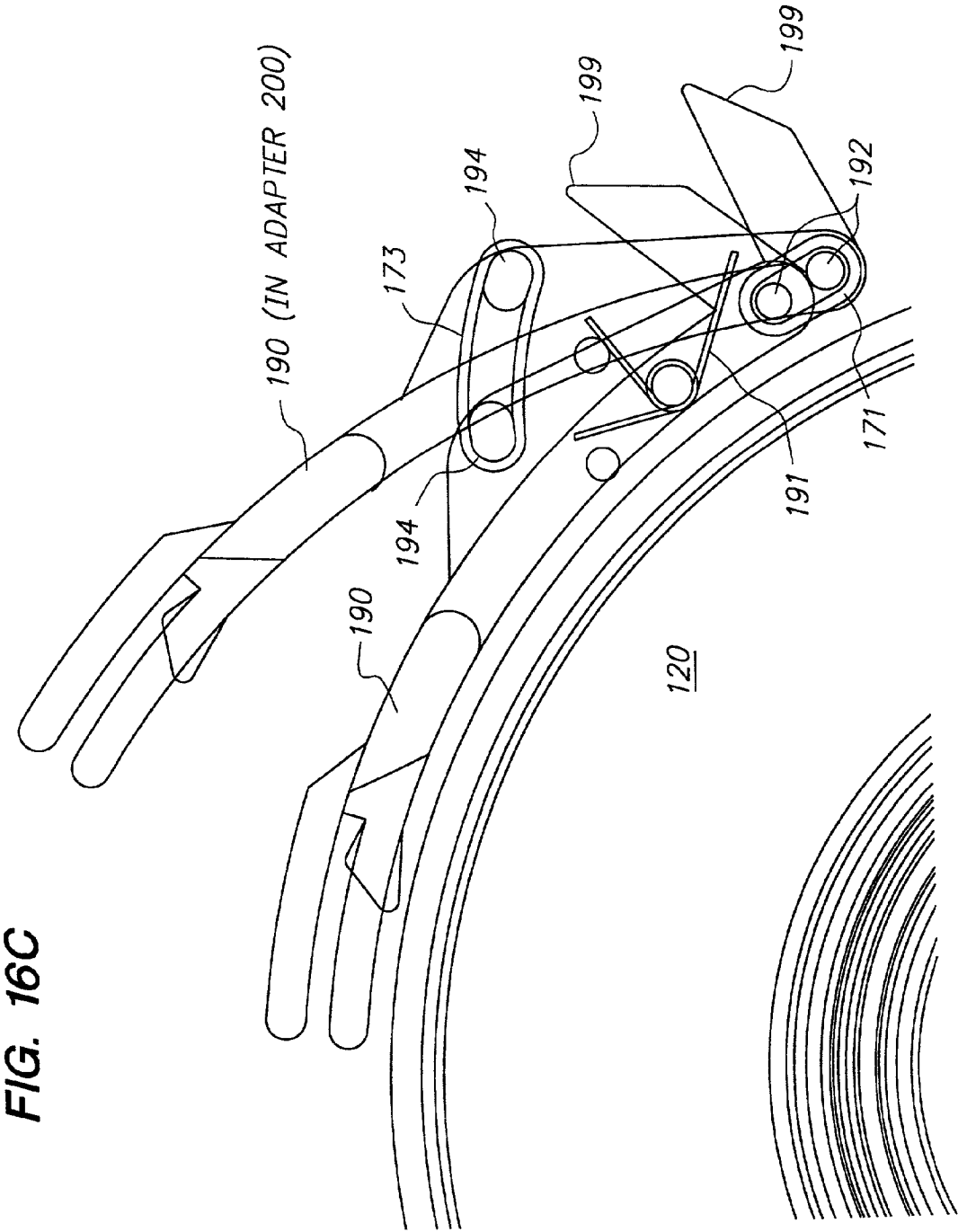


FIG. 16B



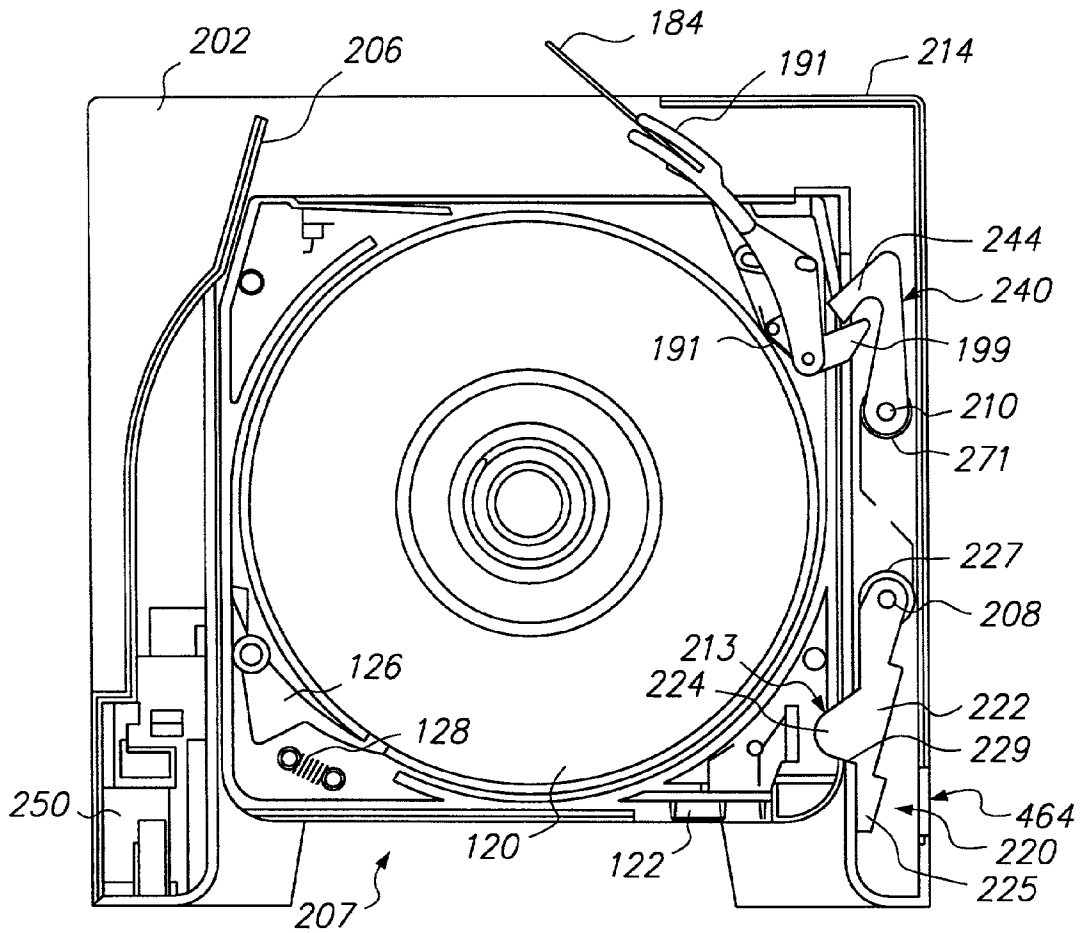


FIG. 18

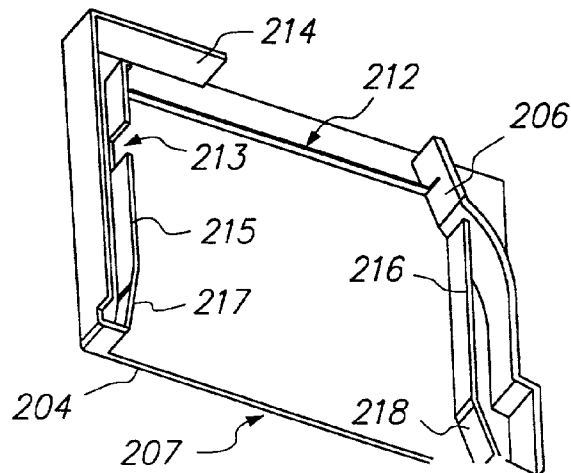


FIG. 19

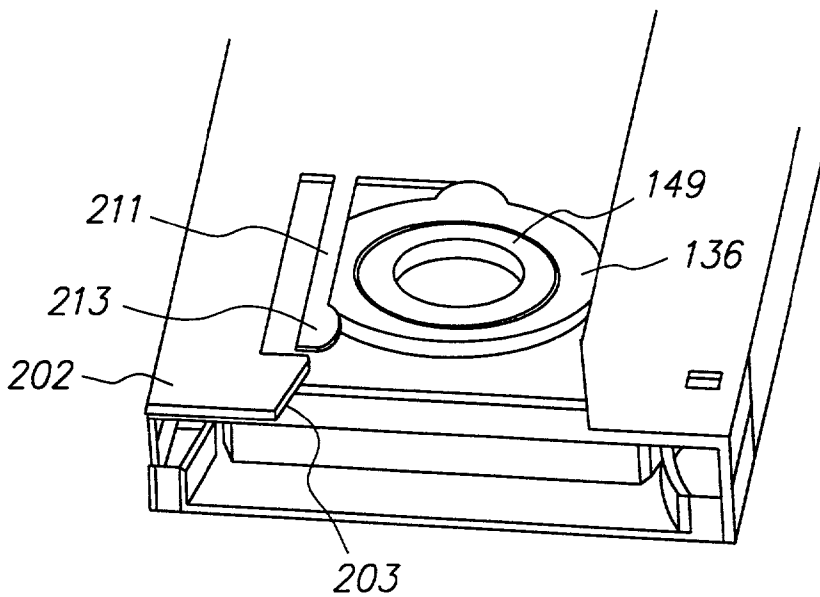


FIG. 20B

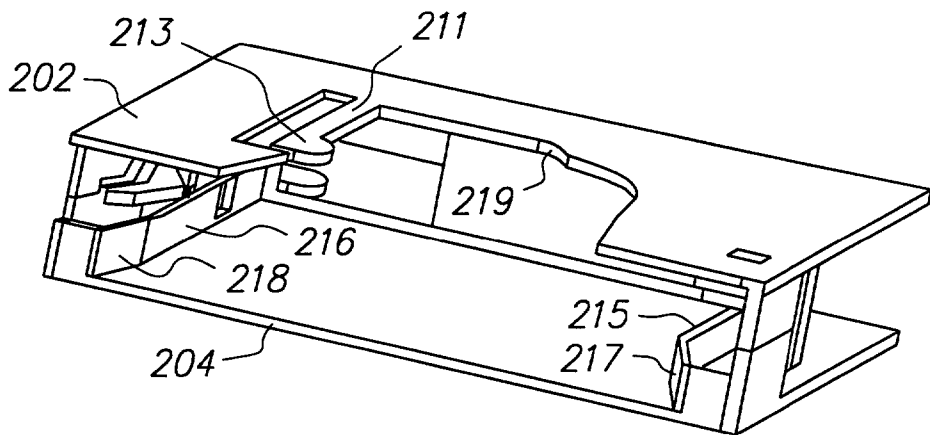
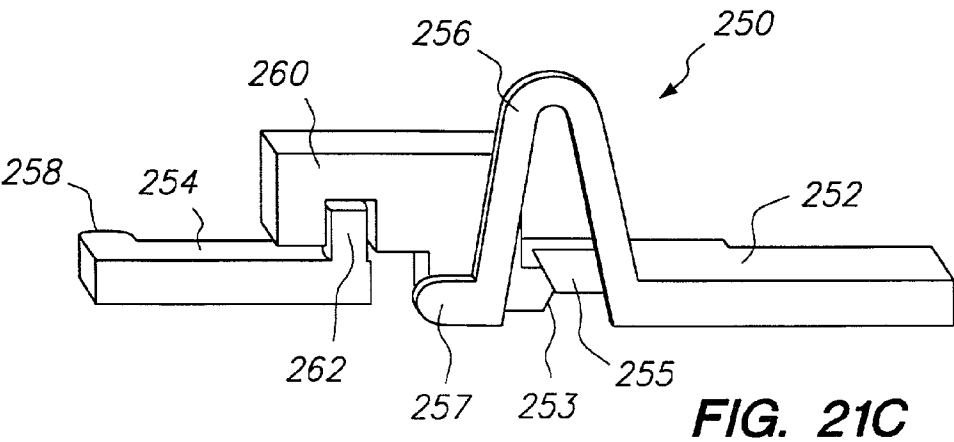
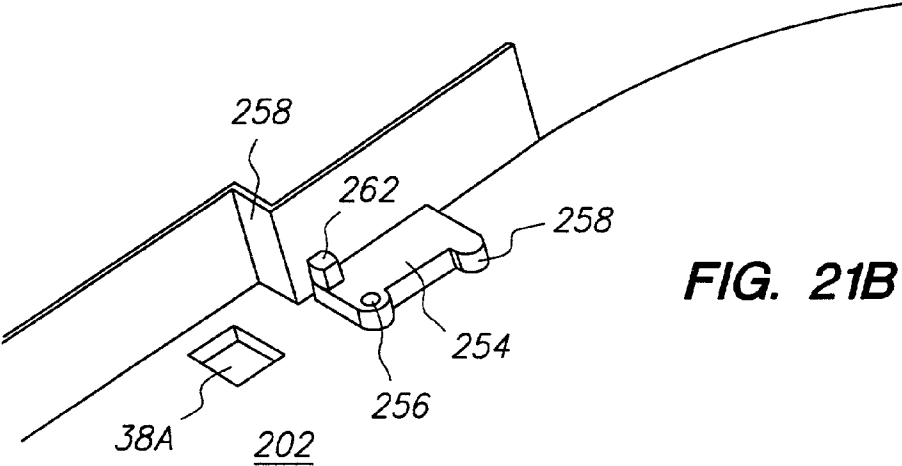
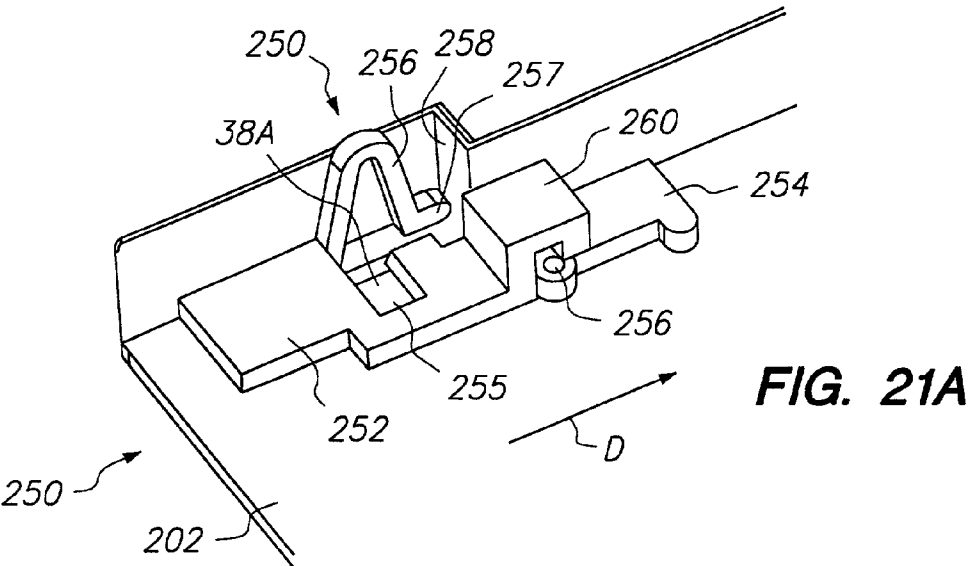


FIG. 20A



MINI-CARTRIDGE ADAPTER FOR ADAPTING A MINI-CARTRIDGE TO AN INDUSTRY STANDARD TAPE CARTRIDGE FORMAT

FIELD OF THE INVENTION

[0001] The present invention relates to size-reduced data storage media cartridges and cartridge adapters which are compatible with each other and with a standardized full size media cartridge. The present invention provides an adapter for holding a smaller tape cartridge in a housing such that the smaller cartridge may be used in a tape drive which accepts a larger, industry standardized tape cartridge.

BACKGROUND OF THE INVENTION

[0002] Cartridge tape drives are extensively used for archival backup of computerized user digital information, and are increasingly used as an information library tool, particularly on the so-called "world-wide web" or "internet". The information is typically written onto the tape as a linear track (or tracks) of magnetic flux transitions as the tape is drawn or "streamed" past a write head element. Typically, blocks of tape are successively streamed to the tape as it moves at high speed from a "beginning of tape" or "BOT" indicator, to an "end-of-tape" or "EOT" indicator. Alternatively, the digital information may be written in transverse tracks as the tape is drawn past a helical scan, rotating head array of the type employed in video cassette recording technology.

[0003] Since magnetic recording tape is a very thin, flexible plastic strip coated on one side with a magnetic storage material, it is susceptible to damage. The tape may become stretched or warped, and its edges may become damaged or frayed. Accordingly, tape cartridges have been developed in order to minimize physical damage to the tape during loading and unloading of the tape onto the tape drive. There are two basic types of tape cartridge: the self-contained feed and take-up reel cartridge, and the single, feed reel cartridge which includes a coupling or buckling mechanism at a leader end of the tape supply coiled on the single cartridge.

[0004] In order to achieve commercial success, it has been necessary for the industry to standardize tape cartridges and tape within the cartridges, so that cartridges following a particular standard may be received and used by tape drives designed to handle the standard cartridge design. Standardization has imposed a second and even more severe design restraint, and that is that newer tape cartridge designs should be backward-compatible with older tape drives (and newer tape drives should likewise be backward-compatible with older tape cartridges), in order to maintain the agreed-to cartridge standards. The present invention provides an improvement to a standardized cartridge design for a single-reel tape cartridge presently marketed by the assignee of this application under the DLT™ Compactape™ brand. This cartridge is standardized e.g. by American National Standards Institute standard ANSI X3.197-1991 standard entitled "Unrecorded Magnetic Tape and Cartridge for Information Interchange— $\frac{1}{2}$ inch (12.65 mm), Serial Serpentine, 22-Track, 6 667 ftpi (262 ft/mm) and 48-Track, 10 000 ftpi (394 ft/mm)". This industry standard cartridge specification is incorporated by reference herein as relevant background material.

[0005] The standardized cartridge **10** (shown diagrammatically in **FIG. 1** and in greater structural detail in **FIGS. 2 and 3**) is a two-part, generally rectangular box structure containing a single feed reel **16** of tape with five rigid walls

and at least a portion of a sixth wall having a door or shutter **34** which opens as the cartridge **10** is inserted into a compatible tape drive in order to enable tape drive access to a coupling end of a tape supply coiled on the reel **16**. The cartridge **10** includes e.g. two defined openings **36** and **38** leading to two internal reel locks **30** and **32**. The reel locks **30** and **32** are located to act on a diameter of the reel **16** and the locks prevent the feed reel from rotating and the tape pancake from unraveling during cartridge handling outside of the standard tape drive. A tape leader includes a buckling mechanism, and the cartridge **10** typically includes features to restrain the buckling mechanism at a defined position adjacent the opening.

[0006] A cartridge-handling portion **20** of the standard tape drive is shown functionally in **FIG. 1**. The compatible tape drive for the standardized cartridge **10** has a base casting (not shown) to which a molded-plastic cartridge receiver **50** is secured. As viewed from a front opening, the receiver **50** is adapted to receive a standard single reel tape cartridge **10**. The receiver **50** is a generally U-shaped channel structure having a left side **52**, a right side **54** and a top **56**, and defines openings at front and back. A metal plate floor **58** has a spindle opening and is attached to the channel structure to form a box. A molded plastic drive cover (not shown in **FIG. 1**) attaches to the receiver and to a front wall of the base casting. The receiver **50** includes a front opening for receiving the cartridge, and provides journals for a rotatable handle mechanism **66** (shown diagrammatically in **FIG. 1**).

[0007] The handle mechanism **66** rotates two levers, a first one of which (not shown in **FIG. 1**) has a first finger which enters a standardized locating hole in the bottom of the cartridge when the handle is pushed flush with the front cover after the cartridge **10** is inserted. The other lever **66** has a second finger **68** which is also brought into engagement with the cartridge **10**. While this second finger **68** may have a secondary locating function, a primary function of the second finger **68** is to release one of the feed reel locks within the cartridge **10**.

[0008] Suspended between the two levers is a plate **70** with a slight rotational degree of freedom, and with a central opening. When the handle is in the open position, admitting the tape cartridge, the levers are pushed downwardly away from the receiver, and the plate engages a spring-loaded clutch mechanism on the feed reel motor fixed to the drive base. This action pushes the tape spindle assembly downwardly and out of the path of the cartridge **10**. Conversely, when the handle mechanism is returned to its engaged, flush-against-the-front-panel position, the clutch plate **70** releases the spindle, and the plate **70** elevates the spindle into a nominal operating engagement with the single reel within the cartridge **10**.

[0009] An annular toothed ring **72** of the spindle engages a complementary annular toothed plate of the feed reel within the cartridge. A feed reel motor **74** is directly coupled to rotate the drive ring **72** and thereby rotate the reel within the standard cartridge **10**. A spring mechanism within the cartridge **10** provides a bias force to the feed reel, and this force is overcome when the spindle ring engages the feed reel toothed plate. Beveling of the ring and plate facilitate centering of the reel on the spindle when the spindle is engaged. One example of a tape cartridge including a

spring-biased feed reel in accordance with the published standard is described in U.S. Pat. No. 5,027,249 to Johnson et al., entitled: "Tape Cartridge Bearing", the disclosure thereof being incorporated herein by reference.

[0010] A fixed cartridge door actuation structure **76** on the left sidewall **52** of the receiver **50** cooperates with a door opening structure **78** of the cartridge **10**, so that as the cartridge **10** is pushed into the receiver **50** engagement of the fixed structure **76** with the cartridge door release structure **78** automatically opens the door **34** of the cartridge to expose the tape buckling mechanism. On the right sidewall of the receiver a solenoid-actuated, hinged locking dog **64** extends into a third standardized opening **42** defined in the cartridge **10**. This third opening **42** comprises a notch in the right sidewall of the cartridge **10**. Rotation of the locking dog **64** by the solenoid unlatches the handle mechanism **66** and allows the handle to be opened. Otherwise, once the cartridge **10** is loaded into the receiver **50** the cartridge locking dog **64** prevents the cartridge from coming out. The locking dog structure also carries a second micro switch which senses a user-activated write protect mechanism **44** which selectively opens and blocks a write protect window **46** formed in the sidewall of the cartridge adjacent the notch **42**.

[0011] When the cartridge **10** is properly loaded into the receiver **50**, the cartridge's right sidewall and opening **38** become precisely registered with reference datum planes of the receiver **50** and thereby with the feed reel spindle ring **72** of the tape drive. At the same time, the cartridge tape-protection features including the door and the two diametrically opposed reel locks become respectively opened and disengaged, thereby enabling the tape drive mechanism to buckle to the tape buckling mechanism and to draw the tape along a defined tape path within the drive, with tape tension controlled by the feed reel motor **74** as well as by a counter-torque applied by a take up reel motor to a take-up reel within the tape drive.

[0012] In the present example shown in **FIGS. 2 and 3**, the standardized cartridge **10** includes a two-part molded plastic housing including a top cover **12**, and a bottom cover **14**. The tape reel **16** is wound with a spool **18** of magnetic recording tape **18**. The reel **16** may include only a top flange as shown in **FIG. 3**, or it may preferably include a top and a bottom flange.

[0013] The flanges may provide a tape-wedging function be in accordance with the teachings of commonly assigned U.S. Pat. No. 5,474,253, entitled:

[0014] "Wedge Reels in Streaming Tape Drives and Tape Cartridges", the disclosure thereof being incorporated herein by reference.

[0015] A center of rotation of the reel **16** is biased toward the bottom cover **14** and away from the top cover **12** by a coiled spring **21**. A spring-loaded hub structure **22** engages a ball bearing assembly **24**, the outer races of which engage a cylindrical flange of the plastic reel **16**. Reel engagement teeth formed as an annulus **26** about the center of rotation of the reel **16** enable the reel to be rotated by the spindle ring **72** and spindle motor **74**, once the cartridge **10** is loaded into the receiver mechanism **20** of a compatible tape drive **50**. One reel flange of the reel **16** has outer peripheral teeth **28** which are engaged by toothed pawls of reel locks **30** and **32**. The reel locks **30** and **32** are spring biased toward the reel periphery to lock the reel in place.

[0016] The cartridge **10** includes the hinged door **34** which is automatically opened by the structural features **76** of the compatible receiver **20** as the cartridge **10** is received therein, so that a buckle **35** of a tape leader of the tape **18** becomes exposed and thereupon may be engaged by an automatic tape buckling mechanism for bucking a drive leader to the tape leader. A suitable two-part tape buckling mechanism is shown in commonly assigned U.S. Pat. No. 4,572,460 to Hertrich, entitled: "Means for Pulling Tape From a Reel". Engagement and disengagement of the two parts of the tape buckling mechanism within the standard drive is more particularly described in commonly assigned, copending U.S. patent application Ser. No. 08/666,854 filed on Jun. 19, 1996, and entitled: "Improved Tape Buckling Mechanism for Single Reel Cartridge Tape Recording", the disclosure thereof being incorporated herein by reference.

[0017] The industry-standard cartridge **10** is provided with several cartridge-locating features, including an end wall slot **36**, two bottom wall slots **38** and **40**, and a side recess **42**. In addition, a write-protect mechanism **44** alternatively blocks and exposes a window **46** in the sidewall of the cartridge **10**. End wall slot **36** provides access for releasing reel lock **30**, while bottom wall slot **38** provides access for releasing reel lock **32**.

[0018] With reference again to **FIG. 1**, the receiver mechanism **52** includes a reference side wall **54**, top wall **56**, bottom wall **58** and end wall **60**. These surfaces serve as datum planes to locate the cartridge **10** within the receiver **50**. The end wall **60** includes a fixed pin **62** which passes through end wall slot **36** and engages reel lock **30**, thereby rotating it away from the toothed periphery **28** of reel **16**. A spring-biased latching pawl **64** includes a toothed portion which enters the side recess **42** and thereby locks the cartridge **10** inside of the receiver. A rotational latch mechanism **66** includes a locating/release pin **68** which passes through end wall opening **38** to release the other reel lock **32**. A registration pin (not shown) may be provided as part of the rotational latch mechanism for entering the other end wall opening **40** and further register the cartridge **10** within the receiver. Accurate registration is needed to ensure that the toothed engagement ring **26** will precisely center with, and be engaged by, a reel motor drive mechanism. In addition, accurate registration is also needed to ensure accurate mating between a take up leader nose and a supply leader hoop.

[0019] The described combination of standard tape cartridge **10** and standard tape drive **50** has worked well for many years, with one principal drawback that the "form factor" of the cartridge and the "form factor" of the tape drive have remained substantially invariant over the years. This combination has occupied either a full-height 5.25 inch drive bay or a half-height 5.25 inch drive bay of a computer. A recent trend has been to provide disk and tape drives in smaller "form factors". One prevalent form factor is the so-called 3.5 inch form factor, because many computer designers specify, and computer cabinets provide, 3.5 inch drive bays, rather than 5.25 inch drive bays.

[0020] The need to reduce tape drive form factor to serve physically smaller computing systems has been recognized. A similar trend has been experienced in the hard (non-removable) disk drive art, and in the optical disk art. For removable media drives, particularly those performing backup or archival data storage service, backward compat-

ibility becomes a critical and limiting condition. Cartridge adapters have been proposed for adapting smaller media units for compatible handling by larger media drives.

[0021] One example is the ubiquitous VHS-C cartridge used in many hand held video cassette recorder products and the surprisingly complex VHS-C adapter unit which adapts the small VHS tape video camera cartridge to a standard-size VHS cartridge and VCR playback unit. In at least one form, the VHS-C cartridge adapter carries a dry cell and includes a battery-operated DC motor for loading and unloading the VHS-C cartridge within the adapter before it is able to be handled within a conventional set-top VHS video recording/playback device. While this cartridge adapter is widely used, it is also quite complicated, and relatively expensive.

[0022] Another example is provided in U.S. Pat. No. 5,402,95, entitled "Videotape Adapter for Use With A Cartridge", and U.S. Pat. No. 5,082,196, entitled: "Video Cartridge Adapter Interlock System". A further example of a cartridge adapter is described in U.S. Pat. No. 5,331,627, entitled: "Cartridge Adapter". The '627 patent describes an optical disk cartridge adapter for holding a 90 mm optical disk cartridge within a drive adapted to receive a 130 mm optical disk cartridge. A "pseudo-spindle" was provided to interconnect the drive spindle with the smaller disk spindle opening. In addition, a rotating permanent magnet was provided directly above a shutter opening of the smaller cartridge in order to present a bias field to enable writing of the 90 mm magneto-optical media in the smaller cartridge.

[0023] Each of these prior, vastly different, cartridge approaches suggests that providing a workable miniaturized cartridge and a compatible cartridge adapter can be a daunting engineering challenge. This challenge is largely dependent upon the particular characteristics and requirements of the standard cartridge to which the miniaturized cartridge of different design will be adapted for handling by a drive or cartridge loader designed to handle the larger-sized standard cartridge. As a standard cartridge becomes imbued with many unique features for locating, reel-locking and releasing, write protecting, etc., the difficulty in adapting the defined standard for compatible use with a smaller form-factor cartridge becomes manifestly complex.

[0024] Thus, a hitherto unsolved need has remained for a form-factor reduced single reel tape mini-cartridge and cartridge adapter enabling a standard form-factor tape drive to handle and access tape stored in the mini-cartridge.

SUMMARY OF THE INVENTION WITH OBJECTS

[0025] A general object of the present invention is to provide a tape mini-cartridge having standardized features and a mini-cartridge adapter for adapting the standardized features of the mini-cartridge to be functionally interchangeable with a larger form factor industry standard tape cartridge in a manner overcoming limitations and drawbacks of the prior art.

[0026] Another general object is to provide a tape cartridge adapter for transferring a plurality of functional forces applied by force imparting elements to features of a standard tape cartridge to structurally and functionally equivalent features of a mini-cartridge which is smaller than the standard tape cartridge and which is carried in the cartridge adapter.

[0027] A further object is to provide a size-reduced single reel tape cartridge with functional features and structural characteristics such that, with the aid of a tape cartridge adapter, the size-reduced tape cartridge achieves functional interchangeability with a larger industry standard tape cartridge within a tape drive mechanism.

[0028] One more object of the present invention is to provide a size-reduced single reel tape cartridge with a spindle hub having a spindle engagement portion sized and positioned to be compatible with a hub spindle engagement portion of a larger standardized tape cartridge such that a standard tape drive handling the larger standardized tape cartridge may be used with the size-reduced tape cartridge when carried within a compatible cartridge adapter.

[0029] Yet another object of the present invention is to provide a single reel tape cartridge with a reel locking mechanism overcoming limitations and drawbacks of the prior art.

[0030] A further object of the present invention is to provide a single reel tape cartridge with an improved spring bias force mechanism for biasing the reel into a locking engagement with a cartridge housing when the reel is not engaged by a tape drive spindle.

[0031] One more object of the present invention is to provide a size-reduced single reel tape cartridge with a pivoting tape leader guide for presenting a tape buckle in two operative engagement positions, one position being for engagement by a buckler when the size-reduced tape cartridge is loaded into a size-reduced tape drive, and the other position being for engagement by a buckler when the size-reduced tape cartridge while being carried within a cartridge adapter is loaded into a full size standard tape drive.

[0032] Accordingly, in one aspect of the present invention a tape mini-cartridge adapter is provided for adapting a tape mini-cartridge to a larger industry standard tape cartridge standardized appearance. The standard cartridge is of a single-reel type and has an internal reel and a standard dimension toothed hub for engagement by a toothed spindle ring of a standard tape drive. The tape mini-cartridge includes a cartridge housing containing a tape reel within the housing wound with a supply of standard dimension tape. The mini-cartridge housing includes a generally annular plateau region extending outwardly from a major face of the mini-cartridge housing and a standard-dimension toothed hub is exposed through and is substantially co-planar with the generally annular plateau region. The mini-cartridge adapter has an adapter housing for receiving the mini-cartridge therewithin. The adapter housing has a major wall surface which defines a slot for receiving the plateau region in substantial coplanar alignment with the major surface such that the mini-cartridge and mini-cartridge adapter present the standard dimension toothed hub of the mini-cartridge reel to a standard tape drive at standardized position and elevation relative to the drive's feed reel spindle. Desirably, the mini-cartridge plateau region and the adapter include complementary keying features for restricting insertion of the mini-cartridge into the adapter in one intended engagement orientation.

[0033] In a related aspect of the present invention the tape mini-cartridge adapter adapts the mini-cartridge to standardized cartridge features for receiving mechanical force imparting elements of a tape drive. The force imparting

elements are applied to the standard cartridge through standardized openings of the standard cartridge housing and come from a plurality of different directions. The tape mini-cartridge adapter includes a plurality of internal structural mechanisms which receive the force imparting elements through standardized openings in the adapter housing of the mini-cartridge adapter and transfer the forces to functionally equivalent structural elements of the mini-cartridge. The mechanisms may include a rocker arm member, and coupled link-pivot members for achieving the desired force translations from the standard tape drive to the mini-cartridge, so that the mini-cartridge may be handled by the conventional tape drive without any structural modification thereto.

[0034] In another related aspect of the present invention, the standard cartridge includes a standard tape leader and a buckle mechanism, and a fixed structure for restraining the buckle mechanism at a standard position relative to a front opening of the standard cartridge. In this aspect of the invention the mini-cartridge has an internal reel and a pivoting leader buckle guide member for engaging and restraining the leader buckle. The guide member normally presents the buckle at a first position adjacent a front opening of the mini-cartridge, but is displaceable to present the buckle at the standard tape cartridge position relative to a front opening of the standard cartridge in a manner avoiding stretching or breaking a tape leader. The mini-cartridge adapter includes a spring loaded pawl for causing the leader buckle guide member to displace from the first position to present the buckle at the standard position when the mini-cartridge is inserted into the mini-cartridge adapter.

[0035] In one more related aspect of the present invention a tape cartridge has a box-shaped housing with at least two major walls. A tape reel within the housing contains a supply of coiled recording tape. The reel has at least one flange located adjacent to one major wall. A toothed spindle ring is sized and positioned to be engaged by a standardized spindle ring of a tape drive. The one major housing wall defines a generally annular plateau region adjacent an opening for receiving the toothed spindle ring generally flush therewith. A spring bias mechanism applies a force from the other major wall to urge the reel toward the one wall. A pair of adjacently-facing rings of locking teeth are formed on an inner surface of the annular plateau region and on an adjacently facing surface of the flange adjacent the toothed spindle ring. The spring force urges the teeth of the reel into locking engagement with the teeth of the plateau region to lock the reel. A tape drive spindle engages the toothed spindle ring and displaces the reel to clear the pair of respective locking teeth, thereby enabling the reel to be rotated freely within the housing during tape drive operations.

[0036] In yet another aspect of the present invention, an improved reel preload arrangement is provided for a tape media cartridge. In this aspect the tape media cartridge includes a generally box-shaped housing with at least two major walls. A single reel contains a coil of recording tape thereon, the reel being formed of a plastic material and it defines a bearing dimple having a contact point aligned with an axis of rotation of the reel. A plunger is formed of plastic material and has a flat face portion facing the bearing dimple. A coil compression spring bears between one of the two major walls and the plunger and thereby transfers a bias

force to the reel through the plunger at the contact point. This arrangement enables a plastic-on-plastic bearing arrangement with minimized wear, and thereby reduces the cost of the media cartridge.

[0037] These and other objects, advantages, aspects and features of the present invention will be more fully understood and appreciated by those skilled in the art upon consideration of the following detailed description of preferred embodiments, presented in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] In the Drawings:

[0039] **FIG. 1** is an exploded isometric view of an industry-standard tape cartridge and relevant functional portions of a tape receiver mechanism of a tape drive adapted to handle the standard cartridge.

[0040] **FIG. 2** is a bottom plan view of the **FIG. 1** industry-standard tape cartridge showing the reel engagement teeth and reel locks in hidden outline view and showing the door open, exposing a tape buckle.

[0041] **FIG. 3** is a view in elevation and section of the **FIG. 1** cartridge showing the spring-loaded reel and tape.

[0042] **FIG. 4A** is a diagrammatic front view of a conventional tape drive for receiving and using the **FIG. 1** industry-standard tape cartridge, and a mini-cartridge and adapter in accordance with principles of the present invention.

[0043] **FIG. 4B** is a diagrammatic front view of a mini-cartridge tape drive for receiving and using the **FIG. 4A** mini-cartridge without the adapter, in accordance with principles of the present invention.

[0044] **FIG. 5** illustrates a mini-cartridge and an adapter for receiving the mini-cartridge to a size compatible with the conventional single-reel cartridge described above, the mini-cartridge and adapter being in accordance with principles of the present invention.

[0045] **FIG. 6** is an isometric diagrammatic view of the **FIG. 5** mini-cartridge and adapter shown in a fully engaged relationship, and with respective cover portions of the mini-cartridge and the adapter removed to facilitate illustration and understanding of the various components and elements thereof.

[0046] **FIG. 7** is an enlarged, exploded isometric view of the **FIG. 5** cartridge housing, illustrating a write-protect feature.

[0047] **FIGS. 8A, 8B** and **8C** are respectively top plan, side elevation, and bottom plan views of the **FIG. 5** two-piece mini-cartridge exterior housing.

[0048] **FIG. 9** is an enlarged, isometric, diagrammatic top view showing the reel lock, write protect mechanism, tape reel, leader guide and door of the **FIG. 5** mini-cartridge in their respective positions with respect to the two-piece housing which has been removed in this view.

[0049] **FIG. 9A** is an enlarged bottom isometric view of the **FIG. 9** reel lock.

[0050] FIG. 10 is a plan view of a portion of the FIG. 5 mini-cartridge illustrating an alternative preferred embodiment of a reel lock having a live spring bias section in accordance with aspects of the present invention.

[0051] FIG. 10A is an enlarged bottom isometric view of the FIG. 10 reel lock.

[0052] FIG. 11 is an enlarged, isometric, diagrammatic bottom view showing the tape reel with an outer annular region forming reel locking teeth and an inner annular region forming spindle engagement teeth, the reel lock, the write protect mechanism, and the leader guide and door of the FIG. 5 mini-cartridge in assembly position with respect to the two-piece housing (which has been removed in this view).

[0053] FIG. 12 is an isometric view of an interior of the bottom shell of the FIG. 5 mini-cartridge.

[0054] FIGS. 12A is a detail view in section and elevation showing meshing relationship of the locking teeth of the lower reel flange with the lower shell wall, in accordance with aspects of the present invention.

[0055] FIG. 13 is an isometric view of an interior of the top shell of the FIG. 5 mini-cartridge showing a central cylindrical chimney structure for supporting a tape reel preload mechanism.

[0056] FIG. 14 is a view in side elevation and section of a spring-biased tape reel preload mechanism for biasing the tape reel of the FIG. 5 mini-cartridge toward the lower shell wall, thereby promoting meshing engagement of the oppositely facing reel locking teeth in accordance with aspects of the present invention.

[0057] FIGS. 15A, 15B, and 15C are three views pertinent to an access door arrangement of the FIG. 5 mini-cartridge; the FIG. 15A isometric view showing door features of the top shell of the mini-cartridge housing; the FIG. 15B isometric view showing the door installed on the top shell and in a closed position; and, the 15C isometric view showing the door in an open, and rearwardly displaced position relative to the top shell of the mini-cartridge housing.

[0058] FIGS. 16A, 16B, and 16C are respective views of a leader buckle, a pivoting leader guide, and the two operating positions of the leader guide within the FIG. 5 mini-cartridge in accordance with aspects of the present invention. FIG. 16A is an enlarged view of a tape guide leader buckle engaged by the FIG. 16B leader guide. FIG. 16B presents an enlarged isometric view of the pivoting leader guide itself. And, FIG. 16C presents an enlarged diagrammatic plan view of the leader guide in a normal position, and in an extended position when the FIG. 5 mini-cartridge is within the cartridge adapter, in accordance with aspects of the present invention.

[0059] FIG. 17 is an isometric view of the FIG. 5 tape cartridge adapter viewed with the cartridge in place from a cartridge-insertion end of the adapter.

[0060] FIG. 18 is a top plan view of the FIG. 5 cartridge adapter and cartridge with upper shells of the adapter and cartridge removed to illustrate mechanical relationships between elements of the cartridge and adapter.

[0061] FIG. 19 is an isometric view of an upper shell of the cartridge adapter of FIG. 17. FIGS. 20A and 20B are respectively a bottom isometric view of the cartridge adapter without the cartridge, and a bottom view of the cartridge adapter and cartridge illustrating several keying and snap-locking features to ensure proper relationship between the cartridge and the adapter in accordance with aspects of the present invention.

[0062] FIGS. 21A, 21B and 21C are respectively an enlarged diagrammatic isometric view of a second reel lock transfer mechanism for transferring a reel lock release force applied to a bottom wall of the cartridge adapter to a side wall opening of the mini-cartridge to release a second reel lock within the mini-cartridge in accordance with aspects of the present invention; an enlarged diagrammatic isometric view of a pivot lever element of the FIG. 21A transfer mechanism; and, an enlarged diagrammatic isometric view of a link member of the FIG. 21 A transfer mechanism.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0063] In accordance with principles and aspects of the present invention, and as one example of a preferred embodiment, a tape mini-cartridge 100 and a mini-cartridge adapter 200 may be physically combined in a nested relationship to provide functional compatibility in place of a larger, industry standardized tape cartridge 10 described above. In the FIG. 4A diagram, the mini-cartridge 100 and adapter 200 are inserted as a combined unit into a receiver 50 of a conventional tape drive, such as the drive 80 shown in FIG. 4A. The conventional tape drive 80 follows an established form factor of a full height or half height 5.25 inch drive and fits into a drive bay of a computer or storage array housing dimensioned to receive this particular drive form factor.

[0064] Alternatively and equally satisfactorily, the mini-cartridge 100 may be used within a tape drive specifically adapted to receive and handle the smaller tape cartridge 100. FIG. 4B shows a small form factor tape drive 90 which receives and handles the mini-cartridge 100 directly, without need or requirement for the adapter 200. Of course, the smaller tape drive 90 cannot receive or handle the conventional, full size cartridge 10.

[0065] Information may be recorded on the tape within the mini-cartridge 100 on either the larger drive 80 or the smaller drive 90, and played back on a drive of the other size, it being understood that the larger drive 80 requires the mini-cartridge 100 to be installed within the cartridge adapter 200. Further, in order for the mini-cartridge 100 to be used on the standard drive 80, it is necessary that the cartridge adapter 200 present the same structural and functional appearance to the standard drive 80 as would the conventional cartridge 10. Since the conventional cartridge 10 has a plurality of structural elements engaged by the standard drive 80, it is necessary for the cartridge adapter 200 to transfer effectively those engagements and forces to the mini-cartridge in a manner providing compatible functionality. Just how this daunting task is accomplished is explained hereinafter, first by considering the structural details of the mini-cartridge 100, and then by considering the structural and functional details of the cartridge adapter 200.

Mini-Cartridge 100

[0066] In FIG. 5 the mini-cartridge 100 is seen to include e.g. a molded plastic lower shell 102 to which e.g. a molded plastic upper shell 104 is secured e.g. by threaded screws or ultrasonic welding. While molded plastic is presently preferred to form the two-shell housing, other materials, such as die-stamped sheet metal, may be used. The mini-cartridge 100 includes a single reel 120 upon which a supply of e.g. ½ inch magnetic recording tape 121 is spooled, to form a tape “pancake”. An inner end of the tape 121 is secured to a reel hub 122. The reel 120 includes a lower reel flange 130 which is preferably formed integrally with the reel 120, and may include a top flange 131 which is typically formed as a separate disk and secured to the reel hub 123 by e.g. a suitable adhesive or plastic solvent.

[0067] As shown in FIG. 7, the mini-cartridge two-piece 102, 104 housing defines a series of functional openings. A first right side window opening 106 exposes a write-protect flag 124. A second right side window opening 108 is provided to admit a pawl 240 of the cartridge adapter 200 for rotating a tape leader guide 190 from a retracted position to an extended position. An opening 110 on the left side of the mini-cartridge 100 receives a finger for releasing a spring-biased reel lock mechanism 126. An opening 121 in the rear side-wall and related structure receives a write-protect slide mechanism 122 including the write protect flag 124 which alternatively blocks and unblocks the write-protect window 106, depending upon the setting of the operator-actuated write-protect slide mechanism 122. An elongated front opening 160 enables access to the tape and tape buckling mechanism held by a leader guide 190. A door 162 hinged to the housing covers the opening 160 when the mini-cartridge 100 is located or being handled outside of a tape drive cartridge receiver or a cartridge adapter 200 in order fully to enclose and thereby protect the tape pancake 121.

[0068] The two-part housing 102, 104 of the mini-cartridge 100 is attractively shaped by providing beveled side wall segments 112, 114, 116 and 118, as shown in FIG. 7. The beveled surfaces 112-118 functionally guide the mini-cartridge 100 into a cartridge receiver of the smaller tape drive 90, or into the cartridge adapter 200. The cartridge adapter 200 includes guiding and centering walls, e.g. wall 206, which are contacted by the beveled forward wall segments 114, 116 of the mini-cartridge 100.

[0069] As shown in FIGS. 8A, 8B and 8C a central annular ring 136 which extends outwardly from the lower shell 102 includes two unique keying features 180 and 182. Tab 180 serves as a centering feature, whereas notched edge feature 182 ensures that the mini-cartridge 100 can be received by a compatible receiver, such as the adapter 200 or the small tape drive 90 in one orientation/insertion direction only.

[0070] As shown in FIG. 7, the mini-cartridge lower shell 102 includes a molded vertical journal post 132. The post 132 receives the molded plastic reel lock 126. As shown in FIGS. 6, 7, 9 and 9A, a first preferred embodiment of the mini-cartridge reel lock 126 includes a hub portion 142 which has a transverse cylindrical opening for receiving the journal post 132. A somewhat curved portion 140 extends from the hub 142 in a first direction and ends at the locking dog end 141. Another portion 146 extends from the hub 142 in a different direction and ends at the flag portion 146. A

generally triangular web portion 143 extends to a boss 144 which engages one end of coil spring 128. Another end of the coil spring 128 is secured to a boss 139 extending upwardly from a floor of bottom shell 102, as shown in FIG. 12, for example.

[0071] In this preferred embodiment, the locking dog end 141 of lock 126 is spring-biased by coil spring 128 toward, and normally engages, a notched outer peripheral edge 133 of lower reel flange 130 of the tape reel 120. A reel lock releasing force applied through the window 110 to a release flag portion 146 of the reel lock 126 overcomes the bias force applied by spring 128 and rotates the reel lock 126 about the post 132 to cause the lock dog portion 141 to move outwardly and away from locking engagement with the reel flange 130. This action releases the tape reel 120 from being locked against rotation relative to the cartridge housing. Upon release, the reel 120 may become elevated by upward engagement of a spindle ring, such as spindle ring 72, of e.g. the conventional disk drive 80 and become freely rotatable the drive's feed reel spindle motor 74, for example. A similarly configured spindle ring mechanism and a spindle motor are included in the small form factor tape drive 90 of FIG. 4B.

[0072] FIGS. 10 and 10A illustrate an alternative preferred embodiment of reel lock 126A which is substantially interchangeable with the lock 126. In this alternative preferred embodiment, the reel lock 126A is also formed as a single unitary plastic molding, and it includes the slightly curved lever arm 140 terminating in the locking dog end 141 at a distal end. A hub 142 has a transverse cylindrical opening for receiving the journal post 132 at the other end of the lever arm 140. In this embodiment the metal coil spring 128 is replaced by a thin elongated live spring section 143A which is formed integrally with the other elements of the plastic reel lock structure 126A. The live spring section 143A extends from the hub 142 in a direction different from the arms 140 and 145 and has a suitable spring length, and includes a protrusion 144 for contacting e.g. the inside of angled side wall 114 of the lower shell 102 of the mini-cartridge 100, as shown in FIG. 10.

[0073] In order to work satisfactorily in both the large, conventional tape drive 80 and the smaller drive 90, the mini-cartridge 100 includes a spring-biased, slidably pivoting leader guide 190 which engages and restrains a leader buckle 184. The leader guide 190 is shown in FIG. 6 in its extended position when the mini-cartridge 100 is seated and locked into the cartridge adapter 200, for example. The leader guide 190 is shown in its normally retracted position in the FIG. 9 view. When the mini-cartridge 100 is used in the smaller tape drive 90, the leader guide is rotationally biased toward the periphery of the tape reel 120, by a bias spring 191, as in a position shown in the FIG. 9 diagrammatic view. The leader guide 190 is explained in greater detail hereinafter.

[0074] The reel lock 126 and lower flange 130 form one part of a two-part reel locking mechanism. The other part is formed by two mating teeth rings: a rotating reel flange teeth ring 147 formed on an annular plateau 135 of the reel lower flange 130 as shown in FIG. 11, and a ring of fixed teeth 148 formed on an upper wall of the housing annular flange 136 as shown in FIG. 12. The bottom of the lower flange 130 also defines an inner toothed spindle ring 149 having teeth

sized and pitched to be engaged by a standard spindle ring, such as the spindle ring **72** of conventional drive **80** shown in **FIGS. 1 and 4**.

[0075] The rotating reel flange teeth ring **147** and the fixed complementary teeth ring **148** are normally meshed in a locking engagement by virtue of a reel preload bias force. The teeth rings **147** and **148** become released from mutual locking engagement by upward movement of the reel **120** relative to the base **102** after the reel lock **126** is retracted and the toothed spindle ring **149** is engaged by a mating standardized spindle ring, such as the conventional spindle ring **72** of drive **80** shown in **FIGS. 1 and 4**. Engagement by the spindle ring also involves moving the reel slightly upwardly to the clearance position as shown in **FIG. 12A**.

[0076] An internal reel preload mechanism **150** implements a plastic-on-plastic bearing and applies a bias force between the upper shell **104** and the reel **120**. As shown in **FIG. 14**, the preload mechanism **150** includes a helical coil spring **152** which transfers a force to a molded plastic cylindrical plunger **154**. The plunger **154** includes a flat disk face **155** which faces an upwardly curving dimple bearing **156** formed in the plastic reel **120**. A cylindrical chimney **158** is formed as part of the top shell **104**. The plunger **154** is slideably seated inside of the chimney **158**, while the coil spring **152** is mounted outwardly surrounding the chimney **158**. A flange extension **159** of the plunger disk face **155** is engaged by a free end of the coil spring **152** while a fixed end of the spring **152** seats against an inside surface of the top shell **104** outwardly adjacent the chimney **158**. A finned annular reinforcing structure **151** is formed as a part of the top shell **104** and surrounds the chimney **158**.

[0077] The spring-loaded plunger **154** bears down upon the dimple bearing **156** of the plastic reel, in response to the preload force applied by the spring **152** between the top shell **104** and the plunger **154**. The dimple bearing **156** is generally hemispherical and contacts the flat disk face **155** of the plunger such that when the reel is engaged by a spindle and rotating, a contact point of the dimple bearing **156** is always substantially aligned with a center of rotation of the reel **120** relative to the mini-cartridge housing and plunger **154** (shown as the dashed line in **FIG. 14**). Most preferably, the dimple bearing **156** and the plunger **154** are formed of wear resistant and/or lubricated plastic material. The dimple bearing **156** establishes a minimal-radius contact point with the flat surface **155** of the plunger in a manner resulting in minimal wear between these plastic elements at the contact point, and enable the contact point to move relatively along the flat disk face **155** in order to accommodate high volume manufacturing and usage tolerances. The dimple bearing **156** may be molded as an integral part of the reel **120**, or it may be a separate part and suitably secured in an opening molded into the reel **120**. Similarly, the flat disk face **155** may be integrally molded within the plunger **154**, or it may be a separate part to which the cylindrical plunger body is suitably bonded or secured.

[0078] Advantages of the preload mechanism **150** include the dimple bearing **156** being formed with the rotating mass, i.e. reel **120**, while the flat surface **155** of the plunger **154** is formed with the non-rotating mass, i.e. the plunger. Specifically, locating the dimple on the rotating half of the bearing interface reduces the relative velocity of the wear surfaces with respect to each other when the two surfaces are in a

misaligned condition. As a result, bearing wear is reduced. In addition, the flat surface **155** enables the dimple bearing surface to move laterally, relative thereto. This enables the preload force to remain normal to reel **120**, thereby not inducing any lateral vector to lift one side of the reel hub off the reel driver. Consequently lateral tape movement (LTM) may be avoided.

[0079] Alternatively, the dimple bearing **156** may be replaced by a steel ball secured to the reel **120**. All the functional aspects and advantages discussed herein above, with respect to the plastic dimple bearing **156**, would similarly apply.

[0080] The bottom shell **102A** and top shell **104A** shown in **FIGS. 12 and 13** differ slightly from the shells **102** and **104** shown in **FIG. 7**. In the **FIGS. 12 and 13** embodiment of the mini-cartridge housing, the beveled surfaces **112** and **118** have been changed to rounded corners **112A** and **118A**, respectively. The modified shells **12** and **13** provide a mini-cartridge housing which is less likely to be inserted into a cartridge receiver in an incorrect orientation.

[0081] As shown in **FIGS. 15A-C**, the front wall of the mini-cartridge **100** defines the elongated opening **160**. As shown in **FIG. 9**, the door **162** includes two pivot pins **164** and **166** at opposite ends. The pivot pins engage journals **165** and **167** defined in the upper shell **104** of the cartridge **100**. An angled corner surface **168** of the door **162** is contacted by a door opening pin (not shown) positioned at a location **170** as the cartridge enters the adapter **200**. As shown in **FIG. 15B** a release force at position **170** pushes the door **162** first to the left to move a door lock boss **172** out of a notch **174** formed in the upper shell **104** thereby to release the door **162** and permit it to rotate upwardly to an opened position shown in **FIG. 15C**. A helical compression spring **176** shown in **FIGS. 9 and 15B** is placed on pin **166** with one end engaging the door **162** and the other end engaging the upper shell **104** such that the spring **176** simultaneously urges the boss **172** into the groove **174** and the door **162** into the closed position shown in **FIG. 15B**. The journals **165** and **167** are slotted, and permit the pins **164** and **166** to slide rearwardly in the door-open position by a predetermined small amount, such as 0.150 inch, so that the door **162** fits entirely within an interior space defined by the cartridge adapter **200**.

[0082] **FIG. 16A** illustrates the leader buckle **184** used for buckling the mini-cartridge tape leader **188** to a complementary drive leader in accordance e.g. with the standardized buckling arrangement illustrated in commonly assigned U.S. Pat. No. 4,572,460 discussed above. The buckle **184** includes two laterally extending buckle ears or tab extensions **185A** and **185B**, and a longitudinally central detent slot **186**. The leader buckle **184** is designed to be engaged and captured by the pivoting leader guide **190** as shown in **FIGS. 6, 9, and 11**.

[0083] The pivoting tape leader guide **190** is shown in greater detail in **FIG. 16B** and includes a main body portion **192**. The main body portion **192** includes two axially aligned cylindrical rear bosses **193A** and **193B**, and two axially aligned oblong forward bosses **194A** and **194B**. These two pairs of bosses **193** and **194** respectively cooperate with boss guides **171** and **173** formed respectively in the bottom shell **102** and top shell **104**, as shown in **FIGS. 12 and 13**. Oblong boss guides **171A** and **173A** are formed in the bottom shell

102, and curved slot boss guides **171B** and **173B** are formed in the top shell. The boss guide **171A** is aligned with the boss guide **171B**, and the boss guide **173A** is aligned with the boss guide **173B** when the shells **102** and **104** are connected together. The coil spring **191**, best seen in the **FIG. 11** view, biases the leader guide **190** to the retracted position shown in **FIGS. 9** and **11**. The boss guides **171A,B** and **173A,B** guide the leader guide to the extended position shown in **FIG. 6** which is required when the mini-cartridge **100** is installed within the cartridge adapter **200**.

[0084] The boss guides **171A** and **171B** enable the bosses **193A** and **193B** to move generally longitudinally in the mini-cartridge, while the boss guides **173A** and **173B** enable the bosses **194A** and **194B** to move generally transversely in the mini-cartridge. This forward and sideways movement enables the leader guide **190** to pivot to the extended position shown in **FIG. 16C** required by the cartridge adapter **200** without stretching the tape, since a true center of rotation of the leader guide **190** lies underneath (and above) the reel **120**. In other words, without the longitudinal and transverse degrees of limited relative displacement, an attempt to rotate the leader guide **190** at a pivot point outside the periphery of the reel **120** without first releasing the reel locking mechanisms could result in stretching or tearing of the tape leader **188**. While other mechanisms are known to achieve the displacement positions shown in **FIG. 16C**, such as a three-link mechanism, the present leader guide **190** is preferred because of its simplicity and reliability in operation.

[0085] A buckle engagement portion **198** of the tape leader guide **190** includes two slotted engagement fingers: an upper finger formed of tines **198A** and **198B**, and a lower finger formed of tines **198C** and **198D**. While single-tine fingers are shown in the **FIG. 9** and **FIG. 11** views, the double-tine fingers shown in **FIG. 16B** are most preferred. These two double-tine fingers respectively receive the buckle extensions **185A** and **185B** of the tape buckle as the tape is completely wound onto the supply reel **120**. A detent hook **196** extends from a central web portion of the leader guide body **192** and is dimensioned to receive the buckle detent **186**. An opposing lever portion **199** extends from the leader guide body **192** adjacent the bosses **193A** and **193B** and can be engaged by a pivoting pawl of the cartridge adapter **200** in order to pivot the leader guide outwardly and place the buckle **184** in position to be engaged by a complementary buckle of the conventional large form factor tape drive **80**. Otherwise, the coil spring **191** causes the pivoted leader guide to remain at a position adjacent the outer periphery of supply reel **120** of the mini-cartridge. The opposing lever portion **199** is engageable through the elongated slot **108** in the right side wall of the mini-cartridge, see e.g. **FIGS. 7, 12** and **13**.

Mini-Cartridge Adapter **200**

[0086] Referring now to **FIG. 17**, the mini-cartridge adapter **200** includes e.g. a molded plastic lower shell **202** to which a molded plastic upper shell **204** is secured e.g. by threaded screws. As assembled, the mini-cartridge adapter **200** includes all of the specified dimensions and openings of the full-size standardized tape cartridge **10** depicted in **FIGS. 1-3**, for example. The lower shell **202** includes a central opening **207** sized to admit the cartridge flange **136** of the mini-cartridge **100**. **FIG. 17** shows the mini-cartridge **100**

inserted into and locked within the cartridge adapter **200**. In order to emulate the full-sized standardized cartridge **10**, the cartridge adapter **200** must present the equivalent functional appearance to the tape drive receiver or tape handling mechanism. Accordingly, in addition to standardized external appearance, a plurality of transfer mechanisms are required to transfer external forces applied to the adapter **200** to appropriate functional locations of the mini-cartridge **100**.

[0087] **FIG. 18** shows e.g. three cartridge adapter transfer mechanisms: a write protect transfer mechanism **220**, a leader guide actuator pawl mechanism **240**, and a corner reel lock transfer mechanism **250**. Two cartridge adapter journal posts **208** and **210** extend upwardly from a bottom wall of the lower shell **202**. The write-protect transfer mechanism **220** is journaled to the post **208**, and the leader guide actuator lever mechanism **240** is journaled to the post **210**.

[0088] **FIG. 19** shows the inside of the upper shell **204** of the cartridge adapter **200**. The angled surface **206** is shown in opposite orientational sense of the orientation of **FIGS. 6** and **18**. A hard stop transverse lip **212** at the front end of the adapter **200** stops the mini-cartridge **100** at its intended position within the adapter **200**, while the angled surface **206** forces the cartridge to rest against an opposite guide rail **215**. An opening **213** in the rail **215** admits the leader guide actuator pawl mechanism **240**. A front end wall **214** has a major opening therein to permit the leader guide **190** to position the buckle **184** outwardly therethrough. A guide rail **216** on the same side of the shell **204** as the angled wall **206** also guides the mini-cartridge **100** to its desired position. The wall **215** has a flared section **217** extending to the rear opening **207**, while the wall **216** has a flared section **218**, also extending to the rear opening **207**.

[0089] With reference to **FIGS. 20A** and **20B**, the lower shell **202** of the cartridge adapter **200** defines a slot in the major bottom wall for receiving the cartridge ring **136** of the mini-cartridge **100**. One edge **203** of the slotted opening is dimensioned to pass the notched edge alignment feature **182** of the ring **136**. This arrangement prohibits the mini-cartridge **100** from being inserted into the cartridge adapter **200** backwards. A cantilevered leaf spring **211** extends adjacently to the notched edge feature **182** and includes a detent ball portion **213** which snap-locks the mini-cartridge **100** into the cartridge adapter **200** around the ring **136**, as shown in **FIG. 20B**, for example. A curved edge **219** of the bottom wall **202** is adapted to be engaged by the alignment tab feature **180** which also extends from the mini-cartridge lower ring **136**.

[0090] As shown in **FIGS. 6** and **18**, the write-protect transfer mechanism **220** preferably comprises a molded plastic part having a rigid lever body portion **222** which extends from a hub forming a journal at post **208** and has an intermediate angled sensor extension **224** for sensing the position of the write-protect flag **124** of the mini-cartridge (see e.g. **FIG. 7**). A write protect indicator flag portion **225** is formed at the distal end of the lever body portion **222** and mimics the position of the mini-cartridge write protect mechanism **122** at an external write-protect window **46A** in the same position as the window **46** of the standardized conventional cartridge **10**. The write-protect transfer mechanism **220** is biased toward the mini-cartridge write-protect window by a coil spring **227** which bears against the

sidewall of the lower adapter shell **202** as shown in **FIGS. 6 and 18**. The rigid lever body **222** has an angled surface **229** between the sensor extension **224** and the flag portion **225** which angles away from the mini-cartridge housing in order to permit the mini-cartridge **100** to be received and withdrawn from the cartridge adapter **200** without presenting an insurmountable obstruction.

[0091] The leader guide actuator pawl mechanism **240** functions substantially as a hook which is spring biased by a spring **242** toward the elongated slot **108** of the mini-cartridge **100**. The pawl **240** includes a dog-leg hook portion **244** which hooks the arm **199** of the leader guide **190** as the mini-cartridge **100** is inserted into the cartridge adapter **200**. Since the location of the pawl **240** is fixed by the location of pivot pin **210**, as the cartridge **100** moves into the adapter **200**, the pawl **240** causes the leader guide to rotate to the position shown in **FIG. 18**. The dog-leg hook portion **244** is angled relative to the cartridge **100** such that the cartridge may be inserted and withdrawn from the adapter **200** without obstruction.

[0092] The reel-lock transfer mechanism **250** is shown in detail in **FIGS. 21A, 21B and 21C**. Therein, the mechanism **250** is seen as including two separate structural elements: a longitudinally displaced link member **252** and a pivot lever **254**. Both elements are most preferably formed of a suitable plastic material. The link member **252** has a beveled engagement face in a notch **255** which is located to cover partially the opening **38A** formed in the cartridge adapter **200** in the same position as the opening **38** of the standard tape cartridge **10**. As was the case with the standard cartridge **10**, a release arm **68** enters the opening **38A** and moves the link member **252** in a linear motion toward the front of the adapter **200**, in the direction indicated by the bold arrow **D** in **FIG. 21A**. This displacement is resisted by a horseshoe-shaped live spring **256** having a distal end bearing against a narrow transverse side wall face **258** of the lower shell **202** of the adapter **200**.

[0093] As shown in **FIGS. 21B and 21C**, the link member **252** includes a U-shaped portion **260** which engages a crank-pin **262** of the pivot lever **254**. The pivot lever **254** is journaled to the base **202** at a journal post **256**, and the crank pin **262** is laterally offset from the journal post **256**, such that a reel-lock release cam **258** rotates into engagement with the face **146** of rear reel lock **128** via opening **109** in the cartridge lower shell **102** as arm **68** passes through opening **38A**, enters notch **255**, engages a beveled surface **253** of link member, and drives link member **252** forward.

[0094] To those skilled in the art, many changes and modifications will be readily apparent from consideration of the foregoing description of a preferred embodiment without departure from the spirit of the present invention, the scope thereof being more particularly pointed out by the following claims. For example, some aspects and features of the present invention may readily be adapted and applied to storage disk cartridges and storage disk cartridge adapters, and the like. The descriptions herein and the disclosures hereof are by way of illustration only and should not be construed as limiting the scope of the present invention which is more particularly pointed out by the following claims.

What is claimed is:

1. A tape mini-cartridge adapter for adapting a tape mini-cartridge to a larger industry standard tape cartridge box-shaped appearance, the standard cartridge being of a single-reel type having an internal reel and a standardized dimension toothed hub,

the tape mini-cartridge including a cartridge housing and a tape reel within the housing,

the cartridge housing including a generally annular plateau region extending outwardly from a major face of the cartridge housing, the tape reel having a standardized dimension toothed hub exposed through and substantially co-planar with the generally annular plateau region,

the mini-cartridge adapter having an adapter housing for receiving the mini-cartridge therewithin, the adapter housing having a major wall surface defining a slot for receiving the plateau region in substantial coplanar alignment with the major surface,

such that the mini-cartridge and mini-cartridge adapter present the standardized dimension toothed hub of the mini-cartridge reel to a tape drive at a standard position and elevation relative to a feed reel spindle of a tape drive for receiving the mini-cartridge and mini-cartridge adapter.

2. The tape mini-cartridge adapter set forth in claim 1 wherein the generally annular plateau region defines at least one keying feature and wherein the slot for receiving the plateau region includes structure for keying with the keying feature such that the mini-cartridge can be placed into the mini-cartridge adapter in a single position of engagement.

3. The tape mini-cartridge adapter set forth in claim 2 wherein the at least one keying feature comprises a longitudinally extending notch truncating one side of the plateau region.

4. The tape mini-cartridge adapter set forth in claim 3 wherein the major wall surface structure for keying with the keying feature comprises a snap-lock mechanism for locking the mini-cartridge into the adapter at a desired position.

5. The tape mini-cartridge adapter set forth in claim 4 wherein the major wall surface structure is formed of a resilient plastic material and wherein the snap-lock mechanism comprises a cantilevered plastic leaf spring segment having an edge adjacently facing the longitudinally extending notch and a detent ball at a distal end of the leaf spring for engaging a portion of the plateau region rearwardly adjacent to the longitudinally extending notch.

6. The tape mini-cartridge adapter set forth in claim 4 wherein the tape mini-cartridge reel includes a tape reel leader having a reel buckle and a pivoting tape guide leader for engaging the buckle at a front end of the tape mini-cartridge, and wherein the tape mini-cartridge adapter includes an opening adjacent the pivoting tape guide leader for enabling a buckle of a tape drive leader to be buckled to the reel buckle of the tape reel leader.

7. The tape mini-cartridge adapter set forth in claim 6 wherein the tape mini-cartridge includes a pivoting door cover for covering the opening adjacent to the pivoting tape guide leader, and wherein the tape mini-cartridge adapter includes structural features for pivoting the door cover to an open position incident to insertion of the tape mini-cartridge into the tape mini-cartridge adapter.

8. The tape mini-cartridge adapter set forth in claim 6 further comprising a pivoting force applying mechanism for engaging the pivoting tape guide leader incident to insertion of the tape mini-cartridge into the tape mini-cartridge adapter in order to pivot the tape guide leader to present the reel buckle adjacent an exterior face of the tape mini-cartridge adapter.

9. The tape mini-cartridge adapter set forth in claim 1 wherein the tape mini-cartridge has a releasable reel lock, and further comprising a reel lock release force transfer mechanism for transferring a reel lock release force supplied by a tape drive at an exterior standard wall location of the tape mini-cartridge adapter to the releasable reel lock of the tape mini-cartridge.

10. A mini-cartridge adapter for adapting a mini-cartridge containing a storage medium to a larger industry standard media cartridge appearance, the standard cartridge appearance having standardized features receiving a plurality of mechanical force-imparting elements of a media drive applied through a plurality of standard openings of a housing of a standard cartridge from a plurality of different directions, the mini-cartridge adapter including at least one internal force transfer mechanism for receiving a predetermined one of the force imparting elements through a standardized opening in a housing of the mini-cartridge adapter and for transferring a force from the predetermined one through a mini-cartridge housing to a structural element inside of the mini-cartridge which is functionally equivalent to a structural element of the standard cartridge.

11. The mini-cartridge adapter set forth in claim 10 wherein the storage medium comprises magnetic recording tape spooled on a single reel within the mini-cartridge.

12. The mini-cartridge adapter set forth in claim 10 wherein the standard openings are formed on at least three different wall surfaces of the standard cartridge and the cartridge adapter.

13. The mini-cartridge adapter set forth in claim 10 wherein the at least one internal force transfer mechanism of the mini-cartridge adapter converts a force applied by a mechanical force imparting element of the tape drive in a first direction into a force applied to the mini-cartridge in a second direction different than the first direction.

14. The mini-cartridge adapter set forth in claim 10 wherein the at least one internal force transfer mechanism of the mini-cartridge adapter comprises a pivoting rocker-arm mechanism for transferring a write-protect indication from the mini-cartridge to a write protect sensor exteriorly of the cartridge adapter.

15. The mini-cartridge adapter set forth in claim 14 wherein the pivoting rocker-arm mechanism includes a bias spring for biasing the rocker-arm mechanism into engagement with the mini-cartridge in absence of the force applied by the mechanical force imparting element.

16. The mini-cartridge adapter set forth in claim 14 wherein the pivoting rocker-arm mechanism and bias spring are formed as a single unitary molded plastic member and the bias spring is a live-spring portion of the member.

17. The mini-cartridge adapter set forth in claim 14 wherein the bias spring is a metal coil spring.

18. The mini-cartridge adapter set forth in claim 10 wherein the at least one internal force transfer mechanism of the mini-cartridge adapter comprises a mechanism having a link member for translating the force applied by the mechanical force imparting element into a linear displacement,

and a second member pivoted to the adapter and having an off-center crank pin responsive to the linear displacement of the link member and a cam rotating into the mini-cartridge in response to the linear displacement of the link member.

19. The mini-cartridge adapter set forth in claim 18 wherein the mechanical force imparting element enters an opening defined in a major surface wall of the adapter and the structural feature transfers the force through a side wall opening of the mini-cartridge.

20. The mini-cartridge adapter set forth in claim 18 wherein the force applied by the mechanical force imparting element is for releasing a lock within the standard cartridge, and wherein the mini-cartridge adapter transfers the force to release a mini-cartridge lock within the mini-cartridge.

21. The mini-cartridge adapter set forth in claim 20 wherein the storage medium comprises magnetic recording tape spooled on a single reel within the mini-cartridge and wherein the mini-cartridge lock locks the reel from free rotation within the mini-cartridge.

22. The mini-cartridge adapter set forth in claim 21 wherein the mini-cartridge reel lock includes a locking dog portion for forcing a reel flange of the single reel toward a first major wall of a housing of the mini-cartridge.

23. The mini-cartridge adapter set forth in claim 22 wherein the reel and first major wall of the mini-cartridge housing include complementary facing annular locking teeth, and further comprising spring means for urging the single reel towards the first major wall to maintain the complementary facing annular locking teeth in an enmeshed position, the reel lock locking dog portion for securing the reel in locked engagement with the mini-cartridge housing.

24. A tape mini-cartridge adapter for adapting a tape mini-cartridge to a larger industry standard tape cartridge appearance, the standard cartridge being of a single-reel type having a standard internal reel and a standard tape leader and buckle mechanism, the standard cartridge having fixed structure for restraining the buckle mechanism at a standard position relative to a front opening of the standard cartridge, the mini-cartridge having an internal reel and a pivoting leader buckle guide member for engaging and restraining the buckle, the guide member normally presenting the buckle at a retracted position adjacent a front opening of the mini-cartridge, and displaceable to present the buckle at the standard position relative to a front opening of the standard cartridge, and the mini-cartridge adapter including pawl means for causing the guide member to displace from the retracted position to the standard position when the mini-cartridge is in the mini-cartridge adapter.

25. The tape mini-cartridge adapter set forth in claim 24 wherein the camming means comprises a pawl means for engaging a portion of the leader buckle guide as the mini-cartridge is inserted into the mini-cartridge adapter.

26. A tape media cartridge having a generally box-shaped housing with at least two major walls, a single reel for containing a coil of recording tape thereon, the reel being formed of plastic material and defining a bearing dimple having a contact point aligned with an axis of rotation of the reel, a plunger being formed of plastic material and having a flat face portion facing the bearing dimple, and a coil compression spring bearing between one of said two major walls and the plunger for transferring a bias force to the reel through the plunger at the contact point.

27. The tape media cartridge set forth in claim 26 wherein said one of said two major walls defines a hollow chimney, wherein the plunger has a body which is slideably nested inside said hollow chimney, and said coil compression spring outwardly surrounds said hollow chimney.

28. The tape media cartridge set forth in claim 26 wherein the plunger includes a flange adjacent to the flat face portion, and wherein the coil compression spring bears against said flange.

29. The tape media cartridge set forth in claim 27 wherein said one of said two major walls defines a reinforcement structure surrounding said hollow structure.

30. The tape media cartridge set forth in claim 26 wherein the reel comprises a toothed spindle ring sized and positioned for engagement by a standardized spindle ring of a tape drive, the other one of said two major walls defining a generally annular plateau region adjacent an opening for receiving the toothed spindle ring generally flush therewith, and adjacently-facing arrays of locking teeth formed on an inner surface of the annular plateau region and on an adjacently facing surface of the flange adjacent the toothed spindle ring.

31. The tape cartridge set forth in claim 30 further comprising at least one reel flange lock mechanism for locking an outer periphery of the reel toward the said other wall of said two major walls, thereby maintaining engagement of the adjacently-facing arrays of locking teeth.

32. The tape cartridge set forth in claim 31 wherein the reel flange lock mechanism comprises a spring biased locking arm having a curved locking dog portion for forcing a peripheral edge region of the lower flange toward an adjacently facing portion of the said other one of said two major walls.

33. The tape cartridge set forth in claim 32 wherein the spring biased locking arm is biased by a metal coil spring.

34. The tape cartridge set forth in claim 32 wherein the spring biased locking arm is formed as a unitary plastic structure including a live spring section which bears against a side wall of the cartridge housing to apply a bias force to a locking arm and the locking dog portion.

35. The tape cartridge set forth in claim 30 wherein the generally annular plateau region defines at least one keying feature for keying the tape cartridge to a tape cartridge receiver mechanism.

36. The tape cartridge set forth in claim 35 wherein the at least one keying feature comprises a longitudinally-extending notched edge along the generally annular plateau region.

37. The tape cartridge set forth in claim 35 wherein the at least one keying feature comprises a curved tab extending from the generally annular plateau region along a radius extending from an axis of rotation of the reel directly to a tape-engagement endwall of the tape cartridge.

38. The tape cartridge set forth in claim 35 comprising two keying features, one of the said features comprising a longitudinally-extending notched edge along the generally annular plateau region, and another of the said features comprising a curved tab extending from the generally annular plateau region along a radius extending from an axis of rotation of the reel directly to a tape-engagement endwall of the tape cartridge.

39. The tape cartridge set forth in claim 26 wherein the recording tape includes a leader and a tape buckle, and the tape cartridge includes a pivoting tape leader guide for engaging and restraining the tape buckle when the tape is fully wound on the reel.

40. The tape cartridge set forth in claim 39 wherein the tape buckle includes two lateral tab extensions, and wherein the tape leader guide includes two engagement fingers for contacting the two lateral tab extensions of the tape buckle as the tape is fully wound onto the reel.

41. The tape cartridge set forth in claim 40 wherein the two engagement fingers comprise slotted fingers for receiving the two lateral tab extensions of the tape buckle.

42. The tape cartridge set forth in claim 39 wherein the tape buckle includes central detent slot, and wherein the tape leader guide includes a detent boss extending outwardly from a web portion of the tape leader guide for engaging the detent slot.

43. The tape cartridge set forth in claim 26 wherein the cartridge housing includes a tape-engagement endwall having an elongated opening, and further comprising hinged rotational door means for covering the elongated opening.

44. The tape cartridge set forth in claim 43 wherein the hinged rotational door means comprises an elongated door sized to cover the elongated opening, the door having axially-aligned hinge pins at opposite ends for engaging journals defined by the cartridge housing, spring means between the cartridge housing and the door for biasing the door to a position closing the opening, and door opening means for causing the door to rotate to an open position unblocking the elongated opening upon being contacted by a door release feature of a tape cartridge receiver.

45. The tape cartridge set forth in claim 44 wherein the door opening means comprises an engagement structure displaced away from an axis of rotation of the door such that a release pin of the tape cartridge receiver contacts the engagement structure and rotates the door to the open position.

46. The tape cartridge set forth in claim 45 wherein the engagement structure further comprises a ramped surface and a locking boss for engaging a notch defined in the cartridge housing, such that engagement by the release pin causes the door to be displaced longitudinally as well as rotationally, thereby moving the locking boss out of the notch and enabling the door to be rotated.

47. The tape cartridge set forth in claim 44 wherein the journals are slotted such that the door is displaceable longitudinally as well as rotationally.

48. The tape cartridge set forth in claim 26 further comprising a write protect slide lever accessible at an end wall of the cartridge housing for selectively exposing and blocking a write protect window in a sidewall of the cartridge housing at a location adjacent to the slide lever.

49. The tape cartridge set forth in claim 26 wherein the cartridge housing comprises a molded plastic upper shell and a molded plastic lower shell.

50. The tape cartridge set forth in claim 26 wherein the cartridge housing includes sidewalls having tapered segments.

51. A tape cartridge having a box-shaped housing with at least two major walls, a reel containing a supply of recording tape coiled thereon, the reel having at least one flange adjacent one wall of the two major walls and a toothed spindle ring sized and positioned for engagement by a

standardized spindle ring of a tape drive, the said one wall defining an annular region of housing locking teeth adjacent an opening for receiving the toothed spindle ring generally flush therewith, bias spring means for applying a bias force from an other wall of the two major walls to the reel, the reel including an annular region of locking teeth engaging the housing locking teeth when the reel is spring biased into contact with the said one wall.

52. The tape cartridge set forth in claim 51 further comprising at least one reel flange lock mechanism for locking an outer periphery of a reel flange of the reel toward said one wall of said two major walls, thereby maintaining engagement of the adjacently-facing annular locking teeth.

53. The tape cartridge set forth in claim 52 wherein the reel flange lock mechanism comprises a spring biased locking arm having a curved locking dog portion for forcing a peripheral edge region of the lower flange toward an adjacently facing portion of the said other one of said two major walls.

54. The tape cartridge set forth in claim 53 wherein the spring biased locking arm is biased by a metal coil spring.

55. The tape cartridge set forth in claim 53 wherein the spring biased locking arm is formed as a unitary plastic structure including a live spring section which bears against a side wall of the cartridge housing to apply a bias force to a locking arm and the locking dog portion.

56. The tape cartridge set forth in claim 52 wherein the at least one reel flange lock mechanism is released by application of a external release force through an opening defined in a wall of the cartridge.

57. A tape cartridge having a box-shaped housing with at least two major walls, a single reel containing a supply of recording tape coiled thereon, the reel having at least one flange adjacent a said one wall of the two major walls and a toothed spindle ring sized and positioned for engagement

by a standardized spindle ring of a tape drive, the tape housing having an elongated tape-access opening along a sidewall, the recording tape including a leader and a tape buckle, and the tape cartridge including a pivoting tape leader guide for engaging and restraining the tape buckle when the tape is fully wound on the reel, the pivoting tape leader guide for presenting the tape buckle in at least two different positions relative to the housing.

58. The tape cartridge set forth in claim 57 wherein the tape buckle includes two lateral tab extensions, and wherein the pivoting tape leader guide includes two engagement fingers for engaging the two lateral tab extensions of the tape buckle as the tape is fully wound onto the reel.

59. The tape cartridge set forth in claim 57 wherein the tape buckle includes central detent slot, and wherein the pivoting tape leader guide includes a detent boss extending outwardly from a web portion of the tape leader guide for engaging the detent slot.

60. The tape cartridge set forth in claim 57 wherein the pivoting pivoting tape leader guide is spring-biased toward a first position.

61. The tape cartridge set forth in claim 57 wherein the pivoting tape leader guide is displaced along two axes is moving from one position to another position.

62. The tape cartridge set forth in claim 61 wherein the pivoting tape leader guide includes at least two pivot bosses, one boss for engaging a first fixed guide slot aligned generally along one of the two axes, and another boss for engaging a second fixed guide slot aligned generally along another of the two axes.

63. The tape media cartridge set forth in claim 26 wherein the bearing dimple comprises a steel ball.

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