Description

Technical Field

The present invention relates to magnetic tape recorders and to subassemblies utilised therein, particularly with respect to recorders adapted for multiple track recording using a single track head which is transversely movable with respect to the recording tape.

Background Art

In known cartridges, a magnetic recording tape is preloaded in a reel-to-reel type enclosure together with an endless flexible belt in frictional contact with the tape on both reel hubs for bidirectionally driving the tape, including rapid accelerations and decelerations, such as are encountered in digital data recording and playback. Recorders adapted to use such data cartridges originally employed fixed, multitrack heads which were complex, expensive and difficult to maintain in proper alignment.

To eliminate the multitrack heads, U.S. Patent No. 4,313,143 (Zarr) disclosed a head positioning mechanism by which a single track head could be transversely positioned with respect to the width of the recording tape to enable recording and playback of any of a plurality of parallel tracks. This U.S.A. Patent discloses a head positioning mechanism having a linear support means secured proximate to and generally perpendicular to the direction of the tape, head mounting means slidably mounted on said support and receiving said head, first biasing means for biasing said mounting means along said support means and a stepper motor for incrementally driving the mounting means against the biasing means. The stepping motor is secured relative to this transport path and has a drive shaft with a lead screw coupled by a thread. while such a system operates entirely satisfactorily, it has recently been thought advantageous to reduce the size of the data recording cartridge and accordingly the recorder in which the cartridge is used. Simple miniaturisation of the head positioning mechanism of the Zarr Patent has not proven feasible, and so the head positioning mechanism has been redesigned for use with the smaller data cartridge recorder.

In EP-A-18646 there is disclosed a head positioning mechanism having a lead screw coupled with a triangularly shaped linear follower and a biasing means is provided for urging an apex of the follower into engagement with the lead screw thread.

It is an object of this invention to provide a head positioning mechanism for a data cartridge recorder which is more compact than the known prior art positioning mechanisms and which provides reliable engagement between the head mounting means and the lead screw.

Disclosure of Invention

The present invention provides a simplified head positioning mechanism, in comparison to that of the Zarr Patent, which variably positions a recording head transversely with respect to the width of the recording tape to enable recording and playback of any of a plurality of parallel tracks.

According to this invention there is provided a head positioning mechanism for a tape recorder adapted for incremental recording and playback of data from a multiplicity of parallel tracks extending the length of a magnetic recording tape and in which at least one recording/playback head is adapted to interface with the tape along a tape transport path and to be variably positioned transversely with respect to the tape, said head positioning mechanism comprising:

(a) linear support means secured proximate to a said transport path and generally perpendicular to the direction of motion of a said tape,

(b) head mounting means slideably mounted on said support means and adapted to receive a said at least one head for linear travel of a said at least one head across a said tape,

(c) first biasing means for directing said mounting means to move said at least one head toward one edge of a said tape,

(d) means for incrementally driving said mounting means against said biasing means, thereby enabling incremental movement of said at least one head toward the opposite edge of a said tape, and for biasing means, thereby controlling the incremental movement of a said head toward said one edge, said means for driving including:

(i) a stepper motor secured relative to a said transport path and having a drive shaft rotatably mounted therein,

(ii) lead screw means mounted to said drive shaft of said stepper motor for converting rotary motion of said shaft into corresponding linear movement, and characterised by:

said mounting means being pivotally located about a longitudinal axis of said linear support means,

a plurality of partial female threads attached to said mounting means for coupling said mounting means to said lead screw, said partial female threads contacting said lead screw for between about 60 degrees to 180 degrees of the circumference of said lead screw, and

second biasing means arranged between a

fixed point and said mounting means for pivotally moving said mounting means about said linear support means to urge said partial female threads into engagement with said lead screw.

Alternatively, the first and second biasing means may be replaced by a single coil spring oriented at a preferred angle of 45 degrees with respect to the cylindrical linear support means.

Preferably the linear support means is a cylindrical shaft and the axis of said shaft is substantially parallel to that of said lead screw and closely adjacent thereto.

Brief Description of the Drawings

The present invention will be more thoroughly described with reference to the accompanying drawings, wherein like numbers refer to like parts in the several views, and wherein:

FIGURE 1 is an exploded perspective view of a head positioning mechanism according to the present invention;

FIGURE 2 is a top plan view of a data cartridge and data cartridge recorder employing the head positioning mechanism of FIGURE 1, with portions broken away to show details; and

FIGURE 3 is a rear elevational view of the data cartridge recorder of FIGURE 2, with portions broken away to illustrate details of the head positioning mechanism.

Detailed Description

FIGURE 1 illustrates a head positioning mechanism, generally indicated as 10, which primarily includes a head mounting slide 12 and a stepper motor 14 for driving the head mounting slide 12. The head mounting slide 12 includes a bore 16 which is slideably mounted on a cylindrical shaft 18 extending from a mounting cover 20 of the stepper motor 14.

The head mounting slide 12 is biased toward the stepper motor cover 20 by a coil spring 22 which attaches, at one end, to a recess 24 in the head mounting slide and at the other end to a hole 26 in a bracket 28 suitable attached to the stepper motor cover 20. In the absence of a countervailing force, the coil spring 22 would move the head mounting slide 12 downwardly toward the stepper motor cover 20.

The head mounting slide 12 is preferably molded of a polymeric material as a single unit and further includes a rectangular recess 30 into which is mounted a single channel recording (and playback) head 32 for incremental transverse motion with respect to a recording tape.

Movement of the recording head 32 is caused by movement of the head mounting slide 12 along the mounting shaft 18, this movement of the head mounting slide 12 in turn being caused by operation of the stepper motor 14.

Incremental electrical pulses supplied to the stepper motor 14 cause rotation of a shaft 34 to which is fixed a male lead screw 36. The lead screw 36 is coupled to the head mounting slide 12 by means of a partial female thread 38 which is integrally molded as a part of the head mounting slide 12. Since the partial female thread 38 does not completely surround the lead screw 36, a second coil spring 40 is provided which biases the head mounting slide 12, and the female thread 38, into engagement with the lead screw 36. The coil spring 40 is connected between the head mounting slide 12 at a molded or drilled hole 42 and a second hole 44 formed in the stepper motor bracket 28. Rotation of the lead screw 36, in one direction, forces the head mounting slide 12 away from the stepper motor 14 against the bias of the coil spring 22, and opposite rotation of the lead screw 36 allows the coil spring 22 to urge the head mounting slide 12 toward the stepper motor 14.

The head mounting slide 12 is provided with a partial female thread 38 because accurate parallel alignment of the lead screw drive shaft 34 and the mounting shaft 18 cannot be guaranteed in a production setting. If the female thread 38 completely surrounded the lead screw 36, and the shafts 18 and 34 were not parallel, binding between the lead screw 36 and the female thread 38 could occur and the stepper motor 14 would possibly stall. The partial female thread 38 accommodates misalignment of the drive shaft 34 relative to the mounting shaft 18 so long as the circumferential extent of the female thread 38 is less than 180 degrees and, therefore, does not capture the lead screw 36. The minimum circumferential wrap of the female thread 38 relative to the lead screw 36 is that which provides reliable engagement between the female 38 and the lead screw 36 and is capable of transmitting a force sufficient to lift the head mounting slide 12 against the bias of the coil spring 22. As a practical matter, it is believed that a circumferential wrap of 60 degrees minimum is required for reliable engagement between the female thread 38 and the lead screw 36. The preferred circumferential engagement is between approximately 90 degrees and 120 degrees.

FIGURES 2 and 3 illustrate a data cartridge tape recorder 46 (with electrical connections, electronic control circuitry and tape drive mechanism omitted) which mounts the head positioning mechanism 10 and which accepts a data cartridge 48. The stepper motor 14 is mounted to an internal plate 50 within the tape recorder 46 by mounting ears 52 such that the lead screw 36 and mounting shaft 18 are oriented perpendicular to the direction

of movement of a recording tape 54 extending from the data cartridge 48. This orientation allows the recording head 32, and the head mounting slide 12, to move across the width of the recording tape 42, transversely to the direction of tape 54 travel. This transverse movement of the recording head 32 allows a multiplicity of parallel and separate tracks to be recorded along the length of the recording tape 54. Incremental movement of the recording head 32 across the width of the recording tape 54 is achieved, as explained above, by incremental rotation of the lead screw 36 of the stepper motor 14.

Although the present invention has been described with respect to only a single embodiment, it is understood that many modifications will be apparent to those skilled in the art. For example, the present invention includes two coil springs 22 and 40 which bias the head mounting slide 12 toward the stepper motor 14 and the head mounting slide 12 into engagement with the lead screw 36, respectively. These coil springs 22 and 40 are oriented at approximately 90 degrees with repect to each other for maximum efficiency, but it should be recognized that the two springs 22 and 40 could be replaced by a single coil spring mounted between the head mounting slide 12 and the stepper motor bracket 28 at an angle of approximately 45 degrees. Such a coil spring, and such an orientation, would provide vectored forces which would at once accomplish the purposes of the springs 22 and 40. Two springs, however, are preferred for simplicity and efficiency.

Also, while the present invention has been particularly described with respect to a data cartridge, the head positioning mechanism 10 could be used with any moving tape, such as reel-to-reel, audio tape cassettes or video tape cassettes.

Finally, the invention should not be limited for use with only a single recording/playback head. While the head positioning mechanism 10 has been presented as an alternative to multitrack heads, a hybrid is possible. The head positioning mechanism 10 could support more than one head while still moving these heads relative to the tape. Access time between tracks could thereby be reduced by electronically switching between heads.

All such modifications falling within the spirit and scope of the appended claims are intended to be included in the present invention.

Claims

1. A head positioning mechanism for a tape recorder adapted for incremental recording and playback of data from a multiplicity of parallel tracks extending the length of a magnetic recording tape and in which at least one recording/playback head (32) is adapted to interface with the tape along a tape transport path and to be variably positioned transversely with respect to the tape, said head positioning mechanism (10) comprising:

   (a) linear support means (18) secured proximate to a said transport path and generally perpendicular to the direction of motion of a said tape,

   (b) head mounting means (12) slideably mounted on said support means (18) and adapted to receive a said at least one head (32) for linear travel of a said at least one head (32) across a said tape,

   (c) first biasing means (22) for directing said mounting means (12) to move said at least one head (32) toward one edge of a said tape,

   (d) means for incrementally driving said mounting means (12) against said biasing means (22), thereby enabling incremental movement of said at least one head (32) toward the opposite edge of a said tape, and for controlling the motion of said mounting means (12) as directed by said biasing means (22), thereby controlling the incremental movement of a said head (32) toward said one edge, said means for driving including:

      (i) a stepper motor (14) secured relative to a said transport path and having a drive shaft (34) rotatably mounted therein,

      (ii) lead screw means (36) mounted to said drive shaft (34) of said stepper motor (14) for converting rotary motion of said shaft (34) into corresponding linear movement, and characterised by:

   said mounting means (12) being pivotally located about a longitudinal axis of said linear support means (18),

   a plurality of partial female threads (38) attached to said mounting means (12) for coupling said mounting means (12) to said lead screw (36), said partial female threads (38) contacting said lead screw (36) for between about 60 degrees to 180 degrees of the circumference of said lead screw (36), and

   second biasing means (40) arranged between a fixed point (44) and said mounting means (12) for pivotally moving said mounting means about said linear support means to urge said partial female threads (38) into engagement with said lead screw (36).

2. A head positioning mechanism (10) according to claim 1 wherein said linear support means (18) is a cylindrical shaft and the axis of said

of movement of a recording tape 54 extending from the data cartridge 48. This orientation allows the recording head 32, and the head mounting slide 12, to move across the width of the recording tape 42, transversely to the direction of tape 54 travel. This transverse movement of the recording head 32 allows a multiplicity of parallel and separate tracks to be recorded along the length of the recording tape 54. Incremental movement of the recording head 32 across the width of the recording tape 54 is achieved, as explained above, by incremental rotation of the lead screw 36 of the stepper motor 14.

Although the present invention has been described with respect to only a single embodiment, it is understood that many modifications will be apparent to those skilled in the art. For example, the present invention includes two coil springs 22 and 40 which bias the head mounting slide 12 toward the stepper motor 14 and the head mounting slide 12 into engagement with the lead screw 36, respectively. These coil springs 22 and 40 are oriented at approximately 90 degrees with repect to each other for maximum efficiency, but it should be recognized that the two springs 22 and 40 could be replaced by a single coil spring mounted between the head mounting slide 12 and the stepper motor bracket 28 at an angle of approximately 45 degrees. Such a coil spring, and such an orientation, would provide vectored forces which would at once accomplish the purposes of the springs 22 and 40. Two springs, however, are preferred for simplicity and efficiency.

Also, while the present invention has been particularly described with respect to a data cartridge, the head positioning mechanism 10 could be used with any moving tape, such as reel-to-reel, audio tape cassettes or video tape cassettes.

Finally, the invention should not be limited for use with only a single recording/playback head. While the head positioning mechanism 10 has been presented as an alternative to multitrack heads, a hybrid is possible. The head positioning mechanism 10 could support more than one head while still moving these heads relative to the tape. Access time between tracks could thereby be reduced by electronically switching between heads.

All such modifications falling within the spirit and scope of the appended claims are intended to be included in the present invention.

Claims

1. A head positioning mechanism for a tape recorder adapted for incremental recording and playback of data from a multiplicity of parallel tracks extending the length of a magnetic recording tape and in which at least one recording/playback head (32) is adapted to interface with the tape along a tape transport path and to be variably positioned transversely with respect to the tape, said head positioning mechanism (10) comprising:

(a) linear support means (18) secured proximate to a said transport path and generally perpendicular to the direction of motion of a said tape,

(b) head mounting means (12) slideably mounted on said support means (18) and adapted to receive a said at least one head (32) for linear travel of a said at least one head (32) across a said tape,

(c) first biasing means (22) for directing said mounting means (12) to move said at least one head (32) toward one edge of a said tape,

(d) means for incrementally driving said mounting means (12) against said biasing means (22), thereby enabling incremental movement of said at least one head (32) toward the opposite edge of a said tape, and for controlling the motion of said mounting means (12) as directed by said biasing means (22), thereby controlling the incremental movement of a said head (32) toward said one edge, said means for driving including:

(i) a stepper motor (14) secured relative to a said transport path and having a drive shaft (34) rotatably mounted therein,

(ii) lead screw means (36) mounted to said drive shaft (34) of said stepper motor (14) for converting rotary motion of said shaft (34) into corresponding linear movement, and characterised by:

said mounting means (12) being pivotally located about a longitudinal axis of said linear support means (18),

a plurality of partial female threads (38) attached to said mounting means (12) for coupling said mounting means (12) to said lead screw (36), said partial female threads (38) contacting said lead screw (36) for between about 60 degrees to 180 degrees of the circumference of said lead screw (36), and

second biasing means (40) arranged between a fixed point (44) and said mounting means (12) for pivotally moving said mounting means about said linear support means to urge said partial female threads (38) into engagement with said lead screw (36).

2. A head positioning mechanism (10) according to claim 1 wherein said linear support means (18) is a cylindrical shaft and the axis of said

shaft is substantially parallel to that of said lead screw (36) and closely adjacent thereto.

3. A head positioning mechanism (10) according to claim 1 or 2 wherein said first (22) and said second (40) biasing means are combined into a single biasing element oriented at an angle to said linear support means (18) and operating in a direction which simultaneously urges said head mounting means (12) toward said one edge of said tape and said female thread (38) into engagement with said lead screw (36).

4. A head positioning mechanism (10) according to claim 3 wherein said single biasing element is a coil spring.

5. A head positioning mechanism (10) according to claim 4 wherein said spring is disposed at approximately 45 degrees with respect to said axis of said cylindrical shaft (18).

6. A head positioning mechanism as claimed in claim 2 wherein the head mounting means (12) is of unitary, molded, construction, having a bore (16) for sliding movement along said cylindrical shaft and positioned to be parallel with said bore is the longitudinal axis of said partial female thread (38).

Revendications

1. Mécanisme de positionnement de tête pour un enregistreur à bande prévu pour l'enregistrement et la reproduction par incrément de données à partir d'une pluralité de pistes parallèles s'étendant le long d'une bande d'enregistrement magnétique, et dans lequel au moins une tête d'enregistrement/reproduction (32) est prévue en interface avec la bande, le long d'un chemin de déplacement de bande, et elle peut être positionnée de façon variable transversalement à la bande, ledit mécanisme de positionnement de tête (10) comprenant :
   (a) un support linéaire (18) fixé près d'undit chemin de déplacement et sensiblement perpendiculaire à la direction de déplacement d'unedite bande,
   (b) une monture de tête (12) montée de façon coulissante sur ledit support (18) et prévue pour porter au moins unedite, tête (32) afin de déplacer linéairement ladite au moins une tête (32) transversalement à une dite bande.
   (c) des premiers moyens de rappel (22) pour tendre à déplacer ladite monture (12) de manière à déplacer ladite au moins une tête (32) vers un premier bord d'une dite bande,
   (d) des moyens d'entraînement incrémentiels de la dite monture (12) contre lesdits moyens de rappel (22), permettant ainsi un mouvement incrémentiel de ladite au moins une tête (32) vers le bord opposé d'une dite bande, et pour commander le mouvement de ladite monture (12) dirigée par lesdits moyens de rappel (22), contrôlant ainsi lé mouvement incrémentiel d'une,dite tête (32) vers ledit, premier bord, lesdits moyens d'entraînement comportant :
      i- un moteur pas-à-pas (14) fixe par rapport à undit chemin de déplacement et dans lequel un arbre d'entraînement (34) est monté de façon tournante,
      ii- une vis-mère (36) montée sur ledit arbre d'entraînement (34) dudit moteur pas-à-pas (14) pour convertir le mouvement rotatif dudit arbre (34) en un mouvement linéaire correspondant,

   caractérisé en ce que :

   ladite monture (12) est placée de façon pivotante autour d'un axe longitudinal dudit support linéaire (18),

   une pluralité de filets femelles partiels (38) sont prévus sur ladite monture (12) pour accoupler ladite monture (12) à ladite vis-mère (36), lesdits filets femelles partiels (38) étant en contact avec ladite vis-mère (36) sur 60 degrés à 180 degrés environ de la circonférence de ladite vis-mère (36), et

   des deuxièmes moyens de rappel (40) sont disposés entre un point fixe (44) et ladite monture (12) pour faire pivoter ladite monture autour dudit support linéaire afin d'appliquer lesdits filets femelles partiels (38) en prise avec ladite vis-mère (36).

2. Mécanisme de positionnement de tête (10) suivant la revendication 1, dans lequel ledit support linéaire (18) est un arbre cylindrique et l'axe de cet arbre est sensiblement parallèle et étroitement adjacent à celui de ladite vis-mère (36).

3. Mécanisme de positionnement de tête (10) suivant la revendication 1 ou 2, dans lequel lesdits premiers (22) et lesdits deuxièmes (40) moyens de rappel sont combinés en un élément de rappel unique incliné par rapport audit support linéaire (18) et agissant dans une direction telle qu'il rappelle simultanément ladite monture (12) vers ledit premier bord de ladite bande et le dit filetage femelle (38) en prise avec ladite vis-mère (36).

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4. Mécanisme de positionnement de tête (10) suivant le revendication 3,dans lequel ledit élément de rappel unique est un ressort hélicoïdal.

5. Mécanisme de positionnement de tête (10) suivant la revendication 4, dans lequel ledit ressort est disposé à 45 degrés environ par rapport audit axe dudit arbre cylindrique(18).

6. Mécanisme de positionnement de tête suivant la revendication 2, dans lequel la monture de tête (12) est de construction moulée unitaire, comportant un alésage (16) pour le mouvement coulissant le long dudit arbre cylindrique, et l'axe longitudinal dudit filetage femelle partiel (38) est placé parallèlement au dit alésage.

Patentansprüche

1. Kopfpasitioniermechanismus für ein Bandaufnahmegerät, das zum inkrementalen Aufnehmen und Wiedergehen in Form von Daten auf bzw. von einer Vielzahl von parallelen Spuren geeignet ist, die sich in der Längsrichtung eines Magnetspeicherbandes erstrecken, wobei mindestens ein Aufnahme- und Wiedergabekopf (32) geeignet ist, längs einer Bandlaufbahn mit dem Band eine Schnittstelle zu bilden, und quer zu dem Band in verschiedenen Stellungen positionierbar ist, wobei der Kopfpasitioniermechanismus (10) umfaßt:

   (a) eine lineare Stützeinrichtung (18), die in der Nähe einer der genannten Laufbahnen befestigt ist und die allgemein rechtwinklig zu der Bewegungsrichtung eines solchen Bandes ist,

   (b) eine Kopfhalterung (12), die auf der Stützeinrichtung (10) verschiebbar gelagert ist und die geeignet ist, mindestens einen derartigen Kopf (32) aufzunehmen und linear quer über ein solches Rand zu bewegen,

   (c) eine erste Vorbelastungseinrichtung (22), die trachtet, die Halterung (12) zu veranlassen, den mindestens einen Kopf (32) zu einem Rand eines derartigen Bandes hin zu bewegen,

   (d) eine Einrichtung zum inkrementalen Antrieb der Halterung (12) gegen die Wirkung der Vorbelastungseinrichtung (22) derart, daß der mindestens eine Kopf (32) inkremental zu dem entgegengesetzten Rand eines derartigen Bandes hin bewegbar ist, und zur Steuerung der der Halterung (12) durch die Vorbelastungseinrichtung (22) erteilten Bewegung und dadurch zur Steuerung der Bewegung eines derartigen Kopfes (32) zu dem genannten einen Rand hin, wobei die Antriebseinrichtung umfaßt:

   (i) einen gegenüber einer derartigen Laufbahn festgelegten Schrittmotor (14) mit einer darin drehbar gelagerten Antriebswelle (34) und

   (ii) einer mit der Antriebswelle (34) des Schrittmotors (14) verbundenen Leitspindeleinrichtung (36) zum Umwandeln einer Drehbewegung der Welle (34) in eine entsprechende lineare Bewegung, dadurch gekennzeichnet, daß

   die Halterung (12) um eine Längsachse der linearen Stützeinrichtung (18) schwenkbar gelagert ist,

   an der Halterung (12) eine Mehrzahl von Innengewindeteilen (38) vorgesehen ist, die zum Kuppeln der Halterung (12) mit der Leitspindel (36) dienen und die die Leitspindel (35) über etwa 60 bis 180 Grad des Umfanges der Leitspindel (36) berühren, und

   zwischen einem Festpunkt (44) und der Halterung (12) eine zweite Vorbelastungseinrichtung (40) angeordnet ist, die die Halterung (12) derart um die lineare Stützeinrichtung zu verschwenken trachtet, daß die Innengewindeteile (38) an der Leitspindel (36) angreifen.

2. Kopfpositioniermechanismus (10) nach Anspruch 1, dadurch gekennzeichnet, daß die lineare Stützeinrichtung (18) eine zylindrische Welle ist, deren Achse zu der der Leitspindel (36) im wesentlichen parallel und deren Achse nahe benachbart ist.

3. Kopfpositioniermechanismus (10) nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die erste (22) und die zweite (40) Vorbelastungseinrichtung zu einem einzigen Vorbelastungselement vereinigt sind, das unter einem Winkel zu der linearen Stützeinrichtung (18) orientiert ist und das in einer solchen Richtung wirksam ist, daß es trachtet, gleichzeitig die Kopfhalterung (12) zu dem genannten einen Rand des Bandes hin zu bewegen und das Innengewinde (38) zum Angriff an der Leitspindel (36) zu bewegen.

4. Kopfpositioniermechanismus (10) nach Anspruch 3, dadurch gekennzeichnet, daß das

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einzige Vorbelastungselement eine Schraubenfeder ist.

5. Kopfpositioniermechanismus (10) nach Anspruch 4, dadurch gekennzeichnet, daß die Feder unter einem Winkel von etwa 45 Gard zu der Achse der zylindrischen Welle (18) angeordnet ist.

6. Kopfpositioniermechanismus nach Anspruch 2, dadurch gekennzeichnet, daß die Kopfhalterung (12) ein einstückiger Formpreßteil ist und eine Bohrung (16) zur längsverschiebbaren Lagerung auf der zylindrischen Welle hat und so angeordnet ist, daß die Längsachse des Innengewindeteils (38) zu der genannten Bohrung parallel ist.

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