PATENT SPECIFICATION (11) 1 593 307

1 593 307

(21) Application No. 42006/77 (22) Filed 10 Oct. 1977 (19)

(31) Convention Application No. 738674 (32) Filed 4 Nov. 1976 in

(33) United States of America (US)

(44) Complete Specification Published 15 Jul. 1981

(51) INT. CL.[3] G11B 21/02 // 5/012 21/08 21/12

(52) Index at Acceptance
G5R B264 B346 B361 B36Y B421 B443 B452 B55X B68X B789 KC

(54) TRANSDUCER CARRIAGE TRANSPORT ARRANGEMENTS FOR DISC RECORDERS, AND DISC RECORDERS INCORPORATING THE SAME

(71) We, ARVIN INDUSTRIES, INC. a corporation organized and existing under the laws of the State of Indiana, United States of America, of 1531 East Thirteenth Street, Columbus, Indiana 47201, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to disc recorders and more specifically but not exclusively, to recorders in which video information is recorded on a rapidly rotating magnetic disc. The disc used in such a recorder may be constructed of either rigid or flexible material. The recording disc is rapidly rotated and one or more transducer heads are positioned adjacent the recording surface to record and reproduce the video information. If desired, transducers may be provided for recording and playback on both sides of the recording disc.

Recording of video signals on a disc recorder may be accomplished in a number of ways. In one format, the video signal is stored in a number of circular concentric recording tracks and the transducer is moved only intermittently to the desired track for recording or playback. Generally one field of video information will be stored in each of the tracks. The disc will be rotated, therefore, at a rate equivalent to the field rate of the video signal.

A second recording format for disc recorders is shown in U.S. Patent No. 3,509,274. The transducer head is moved radially during disc rotation such that a continuous spiral track is defined. While such a recording format permits a slower transport mechanism to be utilized, this format is disadvantageous in that continuous high quality reproduction of a single video field, or series of fields, is not easily obtained.

Regardless of the format used, however, it is clear that a controlled, dimensionally precise transport must be provided for each transducer. One type of prior art transducer transport is shown in U.S. Patents Nos. 3,770,905 and 3,814,441. These patents show transport mechanisms in which a radially disposed, threaded rod engages the transducer carriage and is rotated by a stepping motor to move the transducer radially with respect to the disc. Since the carriage mechanism and the threaded rod it engages are both moving, the inertia of the transport is significant and a rapid stepping motion is difficult to obtain.

A second type of prior art transducer transport mechanism is shown in U.S. Patent No. 3,539,716. In this type of transport mechanism, a transducer carriage is moved radially by means of a carriage belt. The belt forms a loop around an idler pulley which is adjacent the center of the recording disc. Both ends of the belt are positively attached to the drive pulley, with each end being wrapped around the drive pulley a number of times. Positive engagement of the belt by the drive pulley is required since a frictional drive arrangement would always be subject to slippage and the resulting misalignment of the transducer with respect to the recording tracks. Since it is necessary to attach positively both ends of the drive belt to the drive pulley, with each end being wrapped around the drive pulley a number of times, the belt ends must be attached to the drive pulley at different levels. As shown in the latter U.S. patent, the idler pulley must therefore be skewed with respect to the drive pulley to compensate for the fact that the drive belt must change levels as it extends around the idler pulley. An arrangement of this type is somewhat disadvantageous in that there will always be a certain amount of friction between the drive belt and the idler pulley. Additionally, each

section of the drive belt extending from the idler pulley to the drive pulley will be twisted along its length and will exert an undesirable torque on the transducer carriage.

It is an object of the present invention to provide a transducer carriage transport arrangement in which twisting forces on said carriage are substantially reduced or effectively eliminated.

From one aspect, the present invention provides a disc recorder for use with a rotatable recording disc, comprising: a transducer assembly including a transducer cooperable with a disc when operatively assembled with respect to the recorder; carriage means mounting said transducer assembly; an idler pulley and a drive pulley, one of said pulleys being positioned inward from the periphery of an operatively assembled disc and the other pulley being positioned further from the rotational axis of said disc than said one pulley; carriage belt means attached to said carriage means and to said drive pulley extending around said idler pulley, said belt means being supported along a path extending generally parallel to said disc; and stepping motor means connected to rotate said drive pulley such that said transducer is moved generally radially of said disc; wherein:

said idler and drive pulleys have mutually parallel axes,

the path of movement of the carriage belt means intermediate the pulleys is perpendicular to the axes of the pulleys, and

said carriage belt means comprises first and second carriage belts each attached at one end to said carriage means and attached at its other end to said drive pulley, and a third carriage belt attached to said carriage means, extending therefrom in the opposite direction from said first and second belts, and attached to said drive pulley intermediate said first and second carriage belts.

From another aspect, the invention provides a disc recorder for use with a rotatable recording disc, provided with a transport arrangement for moving a transducer generally radially along the surface of a rotating disc when operatively assembled with respect to the recorder, comprising:

carriage means mounting a transducer assembly including a transducer,

an idler pulley and a drive pulley, one of said pulleys being positioned inward of the periphery of an operatively assembled disc, and the other of said pulleys being positioned further from the rotational axis of the disc than said one pulley, the axes of rotation of said idler pulley and said drive pulley being substantially parallel,

carriage belt means comprising first and second carriage belts each attached to said carriage means and to said drive pulley, and a third carriage belt attached to said carriage means, said third carriage belt being attached to said drive pulley intermediate said first and second carriage belts and extending around said idler pulley, and

means for rotating said drive pulley such that said carriage means is movable in a path generally parallel to an operatively assembled disc and said transducer is movable generally radially along the surface of said disc, and the path of movement of the carriage belt means intermediate the drive and idler pulleys is perpendicular to the axes of the pulleys.

A linkage arrangement may be used to attach the first and second carriage belts to the carriage means such that the force applied to the carriage means by the third belt is counterbalanced.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings, in which:-

Figure 1 is a plan view of a portion of a recorder embodying the present invention showing a mechanism incorporating transducer carriage mounting and transport arrangement, and a transducer mounting arrangement;

Figure 2 is a front view of the mechanism of Figure 1 showing, in section, a cartridge containing a magnetic recording disc operatively inserted into the mechanism;

Figure 3 is a side view of a portion of the mechanism as seen looking from left to right in Figure 2, the transducer assemblies of the mechanism, and the disc cartridge, being removed;

Figure 4 is an enlarged sectional view taken generally along line 4-4 in Figure 2;

Figure 5 is an enlarged front view showing the details of the mechanism; and

Figure 6 is a plan view of the portion of the mechanism shown in Figure 5.

Referring now to Figures 1, 2 and 3, there is shown a portion of a disc recorder embodying the present invention. While disc recorders for recording video signals may use either rotatable rigid magnetic disc or flexible discs, those recorders using flexible discs offer greater versatility while reducing the possibility of damage to the disc during operation of the recorder. As seen in Figure 2, a cartridge 11 is provided in which a flexible magnetic recording disc 12 is housed. Radially extending slots 13 and 14, one in each side of the disc cartridge 11, permit access to the disc by transducers 15 and 20.

The recording disc 12 extends between a pair of guide members 38 and 40, one above and one below the disc as shown in Figure 2. The transducer assemblies 45 and 50 are moved along guide members 38 and 40, respectively, by stepping motor 53. A com-

mon drive pulley 57 is used to move both transducer assemblies with the result that they are stepped simultaneously to corresponding positions on opposite sides of the disc. Carriage belt means, including a first carriage belt 60, second carriage belt 62, and third carriage belt 65 move transducer assembly 45 when drive pulley 57 is rotated. Idler pulley 67 at the opposite end of the guide member 38 positions belt 65 as assembly 45 is moved. In like manner, belts 70, 72 and 74 and idler pulley 75 move transducer assembly 50 along guide member 40.

The extent of travel of transducer assemblies 45 and 50 is limited by photo sensors 76, 77, 78 and 79. Sensor 78 is used as a reset to detect when the transducers have been moved to an initial position. The sensors 76, 77 and 79 are provided to protect against overtravel and are not actuated during normal recorder operation.

Running parallel to guide members 38 and 40 are locating members 85 and 87 (Figures 1 and 3). Loading means 90 and 93, mounted on transducer assemblies 45 and 50, interact with locating members 85 and 87 to assure the positional stability of the transducer assemblies, as is more fully explained below. The transports for the upper and lower transducers 15 and 20 are identical.

The guide members 38 and 40 form part of a transducer carriage mounting arrangement. In this respect, each of the guide members 38 and 40 is generally U-shaped in cross section, as seen in Figure 4 and provides a guide surface 97 extending transversely of the disc 12 and including a groove 99 extending parallel to the disc. Figure 4, an enlarged sectional view of guide member 40, shows a transducer carriage 105 having a tab 106 which interacts with the photosensors as explained above. Carriage 107 likewise includes a tab 108 for actuating the appropriate photosensors.

The transducer carriage mounting arrangement also includes a friction reducing bearing pad 110 which is attached to carriage 105 and slides along guide surface 97. A pair of cylindrical bearing means 113 and 114 in the form of pads are mounted on the carriage 105 in spaced relation to bearing pad 110 and are positioned to be slidable in groove 99. Loading means 93 includes leaf spring 133, and roller 135 which engages locating surface 130 of locating members 87, the loading means 93 biasing carriage 105 toward guide surface 97. Groove 99 and bearing means 113 and 114 prevent relative vertical motion between carriage 105 and guide member 40 as the transducer assembly is moved along the guide member.

Details of the transducer carriage mounting arrangement are shown in Figures 5 and 6. Guide member 40 extends between drive pulley 57 and idler pulley 75. The friction reducing cylindrical bearing means 113 and 114 and bearing pad 110 allow the carriage 105 to slide along guide member 40 on guide surface 97. As shown in Figure 4, groove 99 is engaged by the cylindrical bearing pads on the carriage as a result of the interaction between loading means 93 and locating surface 130.

Details of the transducer carriage transport arrangement are also shown in Figures 5 and 6. The carriage 105 is moved along guide member 40 such that the transducer head 20 moves radially with respect to flexible recording disc 12. First and second carriage belts 70 and 72 are each attached at one end to carriage 105 and at the other end to drive pulley 57. Belts 70 and 72 will typically be pinned to drive pulley 57 and will be wrapped around the pulley a number of times. Also pinned to pulley 57 and wrapped around it is third carriage belt 74. Belt 74 is attached to carriage 105 and extends in the opposite direction from the first and second belts 70 and 72. It should be noted that the third belt 74 is attached to drive pulley 57 intermediate belts 70 and 72. As seen in Figure 4, belt 74 extends from idler pulley 75 to drive pulley 57 through cavity 138.

Belt 74 is pivotally attached by bolt 152 to carriage 105. On the opposite side of the carriage, a "T" - shaped linkage arrangement is connected to belts 70 and 72. A first linkage means 155 is pivotally attached to belts 70 and 72 at pivot points 158 and 161. A second linkage means 165, attached to the first linkage means 155 intermediate the first and second carriage belts 70 and 72, is pivotally secured to carriage 105 by bolt 167. The opposing forces applied to the carriage 105 by the first, second, and third belts are therefore aligned. Since the axes of the drive and idler pulleys are parallel, and the latter pulleys support each belt for movement along a path extending parallel to the disc, and since the path of movement of the belts intermediate the drive and idler pulleys is perpendicular to the axes of these pulleys, the friction between the belts and the pulleys is reduced and transducer movement may therefore be effectuated very rapidly. Additionally, the carriage belts are not twisted, i.e. the movement of the belts between the pulleys is planar or in two dimensions only, so that there is no twisting moment applied to the carriage.

The mechanism also includes a transducer mounting arrangement which mounts each transducer from its associated transducer carriage. In this respect, transducer carriage 105 includes a mounting surface 170 which is substantially perpendicular to the plane of the recording disc 12 and substantially parallel to the direction of movement of carriage

105. A transducer holding plate 175 is positioned adjacent and parallel to mounting surface 170, and is movable relative thereto. Bearing pads 176 are disposed between the holding plate 175 and mounting surface 170, The transducer holding plate 175 is attached to the carriage 105 via the parallel motion linkage means 177 including a generally U-shaped wire. The parallel motion linkage means confines the motion of the transducer holding plate 175 relative to the mounting surface 170 in a plane parallel to the mounting surface 170 to motion which is substantially perpendicular to rotating recording disc 12. Parallel linkage means 177 is attached to holding plate 175 by potting the wire along the side of flange 180. The ends of the wire are rigidly secured between bar 183 and backing blocks 185. It should be understood that two separate parallel wires could be used as the parallel linkage means with the first ends of the wires attached to the mounting surface 170 and the other ends attached to holding plate 175.

Spring means, including wire spring arm 187, biases the transducer holding plate 175 towards mounting surface 170 and also biases plate 175 toward rotating recording disc 12. Transducer 20 is rigidly attached to holding plate 175 and thus moves toward disc 12 with a biasing force determined by spring 187. Spring 187 extends through a bearing in the form of a glass bead 191 set in flange 180. The other end of spring 187 is adjustably secured by mounting 194 to bar 183. Glass bead 191 prevents twisting forces from being applied to holding plate 175 by spring 187.

The mechanism described and illustrated is particularly useful where rapid transducer movement is required due to its low inertial mass. Additionally, the force exerted on the recording disc by the transducer head may be easily and precisely adjusted.

Bale 200 is provided adjacent the upper edge of flange 180 and extends along the length of travel of transducer 20. A similar bale is provided for transducer assembly 45. As seen in Figure 1 these bales extend to pivots 205 and 210 and are linked to rotary solenoid 215 and dashpot 220. When solenoid 215 is actuated, the bales contact the transducer holding plates and move transducer head 15 and 20 away from flexible disc 12. The motion of the recording heads is sufficient to allow disc 12 and cartridge 11 to be withdrawn from the recorder.

Other features of the mechanism hereinbefore described and illustrated form the subject of copending applications Nos: 41917/77 and 41918/77 (Serial Nos: 1593304, 1593305).

WHAT WE CLAIM IS:

1. A disc recorder for use with a rotatable recording disc, comprising: a transducer assembly including a transducer cooperable with a disc when operatively assembled with respect to the recorder; carriage means mounting said transducer assembly; an idler pulley and a drive pulley, one of said pulleys being positioned inward from the periphery of an operatively assembled disc and the other pulley being positioned further from the rotational axis of said disc than said one pulley; carriage belt means attached to said carriage means and to said drive pulley and extending around said idler pulley, said belt means being supported along a path extending generally parallel to said disc; and stepping motor means connected to rotate said drive pulley such that said transducer is moved generally radially of said disc; wherein:

said idler and drive pulleys have mutually parallel axes,

the path of movement of the carriage belt means intermediate the pulleys is perpendicular to the axes of the pulleys, and

said carriage belt means comprises first and second carriage belts each attached at one end to said carriage means and attached at its other end to said drive pulley, and a third carriage belt attached to said carriage means, extending therefrom in the opposite direction from said first and second belts, and attached to said drive pulley intermediate said first and second carriage belts.

2. A rotating disc recorder for use with a rotatable recording disc, provided with a transport arrangement for moving a transducer generally radially along the surface of a rotating disc when operatively assembled with respect to the recorder, comprising:

carriage means mounting a transducer assembly including the transducer,

an idler pulley and a drive pulley, one of said pulleys being positioned inward of the periphery of an operatively assembled disc, and the other of said pulleys being positioned further from the rotational axis of the disc than said one pulley, the axes of rotation of said idler pulley and said drive pulley being substantially parallel,

carriage belt means comprising first and second carriage belts each attached to said carriage means and to said drive pulley, and a third carriage belt attached to said carriage means, said third carriage belt being attached to said drive pulley intermediate said first and second carriage belt and extending around said idler pulley, and

means for rotating said drive pulley such that said carriage means is movable in a path generally parallel to an operatively assembled disc and said transducer is movable generally radially along the surface of said disc, and the path of movement of the carriage belt means intermediate the drive and idler pulleys is perpendicular to the axes

of the pulleys.

3. A disc recorder as claimed in claim 1 or 2, in which said carriage means comprises:

means pivotally attaching said third carriage belt to said carriage means,

first linkage means attached to said first and second carriage belts, and

second linkage means, attached to said first linkage means intermediate said first and second carriage belts, and pivotally securing said first and second carriage belts to said carriage means such that the opposing forces applied to said carriage means by said first and second carriage belts and by said third carriage belt, respectively, are aligned.

4. A disc recorder as claimed in claim 1, 2 or 3, in which said drive pulley is positioned further from the rotational axis of an operatively assembled disc than is said idler pulley.

5. A transducer carriage transport arrangement for a disc recorder, constructed substantially as hereinbefore described with reference to the accompanying drawings.

6. A disc recorder provided with a transducer carriage transport arrangement as claimed in claim 5.

BARON & WARREN,
16, Kensington Square,
London, W.8.
Chartered Patent Agents.

Printed for Her Majesty's Stationery Office,
by Croydon Printing Company Limited, Croydon, Surrey, 1981.
Published by The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.

1593307 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG-1

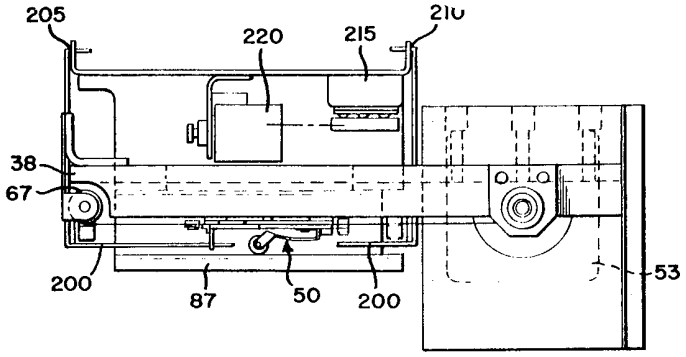


FIG-2

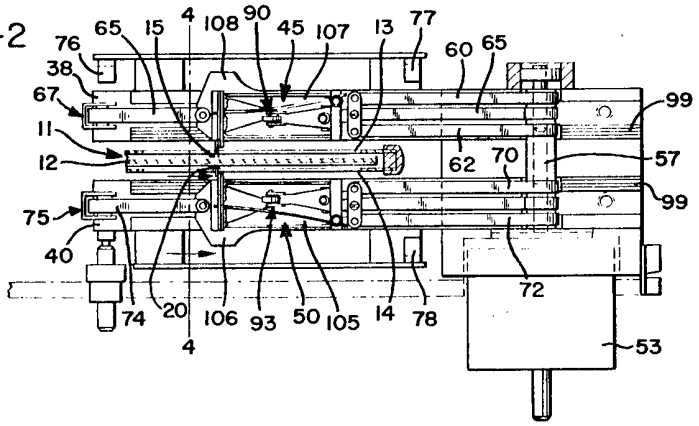


FIG-3

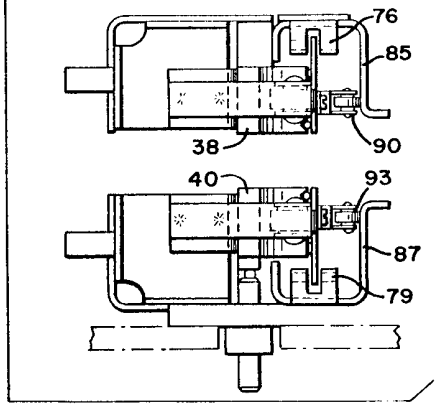
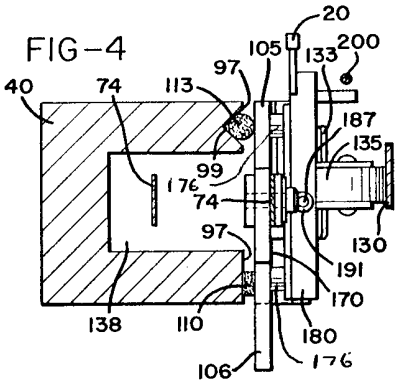


FIG-4



1593307 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

FIG-5

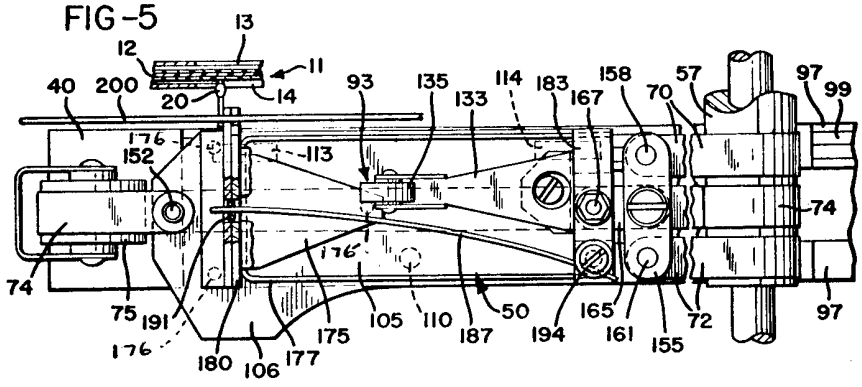


FIG-6