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(54) APPARATUS FOR RECORDING AND OR PLAYING BACK
 SIGNALS ON AND/OR FROM A MAGNETIC TAPE

- (71) We, PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED, of Abacus House, 33 Gutter Lane, London, E.C.2., a British Company, 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:—
- 5 The invention relates to an apparatus for magnetically recording and/or playing back signals on and/or from a magnetic tape and comprising a capstan for driving the tape, a pressure roller for pressing the tape against the capstan, an assembly of electromagnetic recording and/or playback means with associated erase means, the assembly comprising a rotatable head disc on which are disposed electromagnetic heads which are spaced at equal radial distances from the axis of rotation of the disc and which are uniformly spaced around the circumference of the disc, a support for the rotatable head disc, a tape guide device which comprises concave guide members having equal radii of curvature for guiding the magnetic tape in a locally transversely curved condition past a part of the circular path of said electromagnetic heads in a direction extending transversely of the plane of rotation of the head disc whereby said heads scan transverse tracks on the tape in the operation of the apparatus, two winding spindles for driving first and second tape spools, tape guide members for guiding the magnetic tape from the first spool to the assembly of electromagnetic means and thence to the second spool, and actuating means for effecting relative movement between the head disc and the concave guide members in a direction extending transversely of the axis of rotation of the head disc, between an inoperative position in which the concave guide members are at a distance from the head disc sufficient to allow the magnetic tape to assume a substantially flat shape at the location where in operation the tape is transversely curved, and an operating position in which the magnetic tape is guided in said locally curved condition past the circular path of the heads.
- 10 The invention is very suitable for recording and/or playing back video or wide-band audio signals.
- 15 In known apparatuses of this type, for obtaining the transversely curved shape of the magnetic tape, a partial vacuum is produced between two concave guide members in a vacuum chamber provided for this purpose, so that the tape is drawn into the curvature of the guide members. Therefore, it is necessary to provide such apparatuses with a vacuum pump, which is connected to said vacuum chamber by suitable means.
- 20 Although the provision of a vacuum pump presents fewer problems for larger professional apparatuses, which are used in broadcasting studios for example the situation is different in the case of apparatuses intended for domestic use. Apparatuses for domestic use are mass-produced and are equipped with a different system for guiding the magnetic tape past the head disc. In such apparatuses the magnetic tape is locally moved helically round a two-part cylindrical drum in which the head disc is rotatably mounted and in which a slot is provided between the two drum sections to allow the heads of the head disc, which pass through the slot, to write obliquely extending tracks on the magnetic tape. However, a drawback of this type of apparatus is that the amount of information which can be stored on the magnetic tape is smaller for a number of
- 25 45 50 55 60 65 70 75 80 85

reasons than the amount that can be stored with an apparatus of the first type, in which the tracks are written transversely of the magnetic tape. Another drawback is that bringing the magnetic tape into contact, and maintaining it in contact, with the drum demands a fairly intricate loop-shaped lace-up, as well as fairly intricate means for moving the tape from the inoperative position to the operating position and *vice versa*.

According to the invention there is provided an apparatus for magnetically recording and/or playing back signals on and/or from a magnetic tape and comprising a capstan for driving the tape, a pressure roller for pressing the tape against the capstan, an assembly of electromagnetic recording and/or playback means with associated erase means, the assembly comprising a rotatable head disc on which are disposed electromagnetic heads which are spaced at equal radial distances from the axis of rotation of the disc and which are uniformly spaced around the circumference of the disc, a support for the rotatable head disc, a tape guide device which comprises concavely curved guide members having equal radii of curvature for guiding the tape in a locally transversely curved condition past a part of the circular path of said electromagnetic heads in a direction extending transversely of the plane of rotation of the head disc whereby said heads scan transverse tracks on the tape in the operation of the apparatus, two winding spindles for driving first and second tape spools, tape guide members for guiding the tape from the first spool to the assembly of electromagnetic means and thence to the second spool, and actuating means for effecting relative movement between the head disc and the concave guide members in a direction extending transversely of the axis of rotation of the head disc, between an inoperative position in which the concave guide members are disposed at a distance from the head disc sufficient to allow the magnetic tape to assume a substantially flat shape at the location where in operation the tape is transversely curved, and an operating position in which the magnetic tape is guided past the circular path of the heads in said locally curved condition, wherein the tape guide device further comprises two convexly curved guide members which are disposed on opposite sides to one another of the head disc in the axial direction thereof and which have a radius of curvature which substantially equals that of the concave guide members, the concave guide members and the convex guide members being supported so as to permit relative movement between the concave

guide members on the one hand and the convex guide members on the other hand in a direction extending transversely of the axis of rotation of the head disc, and wherein the concave guide members each form a part of a pressure piece which, in the operating position, presses the locally transversely curved part of the magnetic tape against the convex guide members.

In one embodiment of the invention there are two of said concave guide members forming parts of a single pressure piece, and the distance between the convex guide members in a direction parallel to the axis of rotation of the head disc is greater than the distance between said two concave guide members in this direction and these convex and concave guide members are arranged relative to each other in such a way that in the operating position of the actuating means the two concave guide members are located between the two convex guide members in the axial direction of the head disc and a gap exists between each convex guide member and the nearer of the concave guide members, at which gaps the tape is not in contact with any part of the apparatus. The main advantage of this embodiment is that the engagement of the magnetic tape with the concave and convex guide members is well-defined and, moreover, the pressure between the magnetic tape and the guide members is completely independent of the force with which the pressure piece is pressed into position. It is exclusively the position which the concave and convex guide members occupy relative to each other in the operating position which determines the pressure which is exerted on the magnetic tape.

In view of the desirability of obtaining an exact and reproducible alignment of the concave and convex guide members relative to each other, which alignment is of great importance for the results to be attained and in particular for the tape pressure, the pressure piece may comprise, in addition to said concave guide members, concave adjustment members which have equal radii of curvature and are formed by extensions at the ends of the concave guide members, corresponding convex abutment members being provided which have substantially the same radius of curvature as the concave abutment members and on which the latter members bear in the operating position of the actuating means, and resilient means being provided for resiliently pressing the concave and convex abutment members against each other in the operating position.

For the dimensional stability of the guide members it is beneficial if the pressure piece, the convex guide members and the

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convex abutment members are made of the same non-magnetic material.

5 The convex abutment members may be integral with the convex guide members. The convex guide members and the convex abutment members may be formed by accurately machined parts of the cylindrical outer surfaces of two drums which are arranged coaxially with the head disc on opposite sides thereof to one another. At least one of the drums may also serve as a housing for a bearing of a rotatable shaft carrying the head disc.

10 It is preferable that the magnetic tape makes contact with the drums only at the location of the convex guide members and elsewhere runs entirely clear thereof. This is achieved in an embodiment of the invention in which the cylindrical outer surface of each of the drums comprises a first part which provides the convex supporting and guide members and a second part of smaller diameter than the first part, at least said first part being accurately machined.

15 The drums may also serve for accommodating a synchronizing head for the synchronization of the transport speed of the magnetic tape, and for accommodating a device for transferring signals from stationary parts of the apparatus to and from the heads which are mounted on the rotatable head disc.

20 To ensure correct engagement of the pressure piece with the convex abutment members, the pressure piece may be mounted on a pressure-piece support for limited omni-directional movability relative thereto.

25 A pressure-piece support may be employed which comprises a supporting pin, which is disposed in a bore in the pressure-piece with clearance so that the pressure-piece is capable of play relative to the pin in the radial direction thereof, the supporting pin and the pressure-piece being resiliently loaded in opposite radial directions by said resilient means, and stop means being provided for limiting the movements of the pressure-piece relative to the supporting pin in the axial direction.

30 The resilient means may comprise two coil springs which are mounted in blind bores in the pressure piece, the blind bores extending transversely of the bore for the supporting pin and each spring bearing at one end against the supporting pin and at the other end against the end wall of the respective blind bore.

35 An exact alignment of the two convex guide members which are disposed on opposite sides of the head disc is achieved if the two drums are disposed on a mounting block which has two accurately machined faces formed by the walls of a V-shaped

groove in the block, and the accurately machined parts of the cylindrical outer surfaces of the drums are held against said walls of the V-shaped groove by fixing means.

70 A motor for driving the head disc may have a housing of which the outer surface has an accurately machine cylindrical part which has a diameter equal to the diameter of the accurately machined parts of the cylindrical outer surfaces of the two previously mentioned drums and which is also held against the walls of the V-shaped groove by fixing means. The output shaft of the motor may be connected to the shaft of the head disc by a flexible shaft coupling.

75 The mounting block may have faces on which an electromagnetic audio recording and/or playback head and an audio erase head respectively are mounted.

80 When the tape is being threaded in the apparatus it should be easy to manipulate the tape and there should be a sufficient distance for this purpose between the concave guide members and the convex guide members. Preferably, the movement of the tape from the inoperative position to the operating position should be minimal. For this reason both the concave guide members and the convex guide members preferably are movably mounted on the deck of the apparatus, the concave guide members on the one hand and the convex guide members on the other hand being movable relative to the deck simultaneously and in opposite directions to one another by the actuating means. The mounting block may be disposed on a first carriage of the actuating means and the pressure-piece support with the pressure-piece on a second carriage of the actuating means, one of said carriages being slidably drivable and the two carriages being coupled to one another in such a manner that as said one carriage is driven in one direction the other carriage performs a corresponding sliding movement in the opposite direction.

85 For an accurate guidance of the magnetic tape past the rotating heads of the head disc it is important that the tape is at the correct height. In an embodiment of the invention which employs a mounting block as defined above this may be achieved by means of two cylindrical tape guide members of which one is arranged to be the last guide member to be passed by the tape before it reaches the convex and concave guide members and the other is arranged to be the first guide to be passed by the tape after it has left the convex and concave guide members, said two cylindrical guide members being supported for limited axial and radial movability, and the mounting block being provided with faces on which

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are mounted means which are engageable with said cylindrical tape guide members for accurately determining the positions thereof transversely of their axes relative to the axis of rotation of the head disc in the operating position of the disc, which means comprise two pairs of tongues, the two tongues of each pair being spaced from one another in a direction parallel with the axes of the cylindrical tape guide members by a distance which substantially equals the width of the magnetic tape. The tongues may be identical and at their ends may be formed with recesses to receive said cylindrical tape guide members.

In an embodiment of the invention in which the apparatus is equipped with a rectangular cassette containing a magnetic tape and having two parallel major walls and two pairs of parallel peripheral walls, two locating pins are provided on the deck of the apparatus for positioning the cassette and one of the major walls of the cassette has corresponding openings for receiving the locating pins, the cassette is provided with two flanged winding spools which are mounted in the cassette so as to be capable of radial and axial play therein and are resiliently loaded towards said one major wall of the cassette by resilient means in the cassette so that when the cassette is removed from the apparatus the winding spools are pressed against said one major wall of the cassette so that rotation of the spools and unwinding of the tape are inhibited, the winding spindles are spaced from each other on the deck of the apparatus and extend parallel to one another, turntables are provided on the winding spindles, the cassette has openings in said one major wall to receive the turntables, the turntables are arranged to support the winding spools against the pressure of the resilient means in the cassette in positions in which the spools are clear of the major walls of the cassette, the cassette contains the two cylindrical tape guide members, these members being disposed near one of the peripheral walls of the cassette in a manner such as to be capable of both radial and axial play relative to the cassette and being resiliently loaded towards said one peripheral wall by corresponding springs in the cassette, the capstan is parallel to the winding spindles, said one major wall of the cassette has an opening for the passage of the capstan, said one peripheral wall of the cassette has openings for the entry of the means for determining the positions of the cylindrical tape guide members transversely of their axes and openings for the entry of the convex guide members, said various electromagnetic heads and the pressure roller, and said one major wall of the

cassette has an opening for the passage of the pressure piece.

In the operating condition of this apparatus the mounting block and the cassette should be accurately positioned relative to each other. This can be achieved in an embodiment in which said locating pins form parts of locating members which are mounted on the deck and of which parts which are more remote from the deck form said locating pins and parts nearer the deck co-operate in the operating condition of the apparatus with corresponding locating stops for positioning said mounting block relative to the cassette. In this embodiment the first carriage may comprise a sliding plate, said locating members may also act as guide members for guiding the first carriage in its sliding movement and be provided with grooves which co-operate with edges of the sliding plate and have a width which is slightly greater than the thickness of the sliding plate, the sliding plate may also be guided by a guide pin which is rigidly connected to the deck of the apparatus and which extends through a corresponding guide slot in the sliding plate, the locating stops may be formed on the sliding plate and include a first stop comprising a straight surface and a second stop comprising a V-shaped surface, and the guide slot may be locally enlarged at the region where the guide pin is located in the operating position of the actuating means so that at all sides the guide pin is clear of the sliding plate.

A video cassette recorder constructed in accordance with the invention will now be described in more detail with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of the part of the video cassette recorder which is relevant to the invention, the actuating means being shown in the inoperative position and the recorder being shown without a cassette on it,

Figure 2 is a view similar to Figure 1 but with the actuating means in the operating position,

Figure 3 is a plan view of the video cassette recorder of Figures 1 and 2 with a cassette, shown partly in section, inserted in the recorder and with the actuating means in the inoperative position,

Figure 4 is a view similar to Figure 3 but with the actuating means in the operating position,

Figure 5 is a scaled-up detail of the recorder shown in Figures 1 to 4, showing the head disc and the adjoining drums in plan view and the pressure piece and the transversely curved portion of the magnetic tape in section,

Figure 6 is a view similar to Figure 5 but

with the pressure piece and the magnetic tape shown in full plan view,

Figure 7 is a sectional view taken on the line VII—VII in Figure 4, and

5 Figure 8 is an underneath perspective view of a cassette for use in conjunction with the video cassette recorder shown in Figures 1 to 7.

10 In the various figures corresponding parts are denoted by corresponding reference numerals. A substantial part of the video cassette recorder shown in the drawing is of a conventional construction similar to that found in audio cassette recorders. For a description of these known audio recorders reference is made to the relevant comprehensive literature.

15 In the drawings the deck of the video cassette recorder is designated by the reference numeral 1, the capstan by 2 and the pressure roller for pressing the magnetic tape against the capstan by 3. The assembly of electromagnetic recording and/or playback means with the associated erase means comprises a head disc 5 which is rotatable by a motor 4 and on which are disposed electromagnetic video recording and/or playback heads 6 which are spaced at equal radial distances from the axis of rotation of the disc and which are uniformly distributed around the circumference of the disc. The assembly also comprises a video synchronizing/erase head 7 as well as an audio erase head 8 and an audio recording and/or playback head 9 for the audio signal. The head disc 5 and also the video heads 6, the audio erase head 8 and the audio recording and/or playback head 9 are of conventional design and will not be discussed in more detail. For a further description of the video synchronizing/erase head 7 reference is made to our prior United Kingdom Patent Specification No. 1,499,370.

45 The tape guide device of the apparatus shown comprises concavely curved guide members 10a and 10b (Figures 1, 5 and 7) for guiding a magnetic tape in a locally transversely curved condition past a part of the circular path of the video recording and/or playback heads 6 in a direction extending transversely of the plane of rotation of the head disc 5.

50 Two winding spindles are designated by the reference numerals 11 and 12.

55 The tape guide device further comprises convexly curved guide members 13 and 14 which are arranged on opposite sides of the head disc 5 in the axial direction. These guide members have a radius of curvature which substantially equals that of the concavely curved guide members 10a and 10b. As will be described later herein, the guide members 10a, 10b and the guide members 13, 14 are so supported as to

60 permit relative movement between the guide members 10a, 10b and the guide members 13, 14 in a direction extending transversely of the axis of rotation of the head disc 5. In the operating position the concave guide members 10a and 10b, which form parts of a pressure piece 15, press a locally transversely curved part of the tape against the convex guide members 13 and 14 (see in particular Figures 5 and 6). In the inoperative position the concave guide members are disposed at a distance from the convex guide members sufficient to allow the tape to assume a substantially flat shape.

70 The axial distance between the convex guide members 13 and 14 is greater than the width of the pressure piece 15, and thus also, in the embodiment shown, than the axial distance between the concave guide members 10a and 10b, whilst the convex guide members and the pressure piece are so arranged relative to each other that, in the operating position, between each convex guide member 13 and 14 and the pressure piece 15 a gap is obtained where the magnetic tape is not in contact with any part of the recorder. This can be seen in Figures 5 and 6, in which the magnetic tape has the reference numeral 16.

80 The pressure piece 15 comprises four concave abutment members 17 which are formed by extensions at the ends of each of the concave guide members 10a and b. Two of these abutment members, designated 17a and 17b, can be seen in Figures 1 and 7. In the operating position (see Figures 2, 4, 5, 6 and 7) the concave abutment members 17 bear on corresponding convex abutment members having the same radius of curvature as the concave abutment members. The convex abutment members are integral with the convex guide members 13 and 14. In the operating position the concave and convex abutment members are elastically pressed against each other by two coil springs 18 and 19. These springs press against a supporting pin 20, which is disposed in a bore 21 in the pressure piece 15 with clearance so that the pressure piece is capable of play relative to the pin in both the radial and axial directions thereof. In the axial direction the movements of the pressure piece along the supporting pin are limited by stop means which are constituted by a circular clip 22 and a cylindrical fixing member 23 which secures the supporting pin 20 to actuating means for moving the pressure piece, which means will be described hereinafter. The coil springs 18 and 19 are accommodated in corresponding blind bores 24 and 25 extending transversely of the bore 21. The springs bear at one end against the end walls of the

bores 24 and 25 and at the other end against the supporting pin 20.

In the operating position the springs 18 and 19 press the concave abutment members 17 against the corresponding convex abutment members. The convex abutment members and the convex guide members 13 and 14 form portions of accurately machined parts of the cylindrical outer surfaces of two drums 28 and 29 which are arranged coaxially with the head disc 5 on opposite sides thereof. The drum 28 also serves as a housing for a bearing for a rotatable shaft 30 carrying the head disc 5. As this bearing is a plain bearing of conventional construction, it is not illustrated in the drawings.

The cylindrical outer surface of each of the drums 28 and 29 comprises an accurately machined first part 26, 27 which provides the respective convex abutment and guide members, and a second part 31, 32 of smaller diameter than the first part. The drum 28, in addition to serving as a bearing housing, also serves for accommodating the video synchronizing head 7. The drum 29 serves to accommodate the stationary parts of a number of rotary transformers for transferring the video signals to and from the video heads 6. The rotary parts of these transformers are driven simultaneously with the head disc 5 by the motor 4 via the shaft 30. Since such rotary transformers are known *per se* in the field of video recording and playback equipment, these will not be described in further detail.

The pressure piece 15 and the drums 28 and 29 are made of the same non-magnetic material.

The two drums 28 and 29 are mounted on a mounting block 33. This block has a number of accurately machined faces, two of which are formed by the walls 34 and 35 of a V-shaped groove 36 in the block (see in particular Figure 7), against which walls the accurately machined parts 26 and 27 of the cylindrical outer surfaces of the drums 28 and 29 are held by fixing means, not shown. Alternatively, the drums may be held in the V-shaped groove by gluing the surface parts 26, 27 to the walls of the groove 36.

The motor 4 for driving the head disc 5 is provided with a housing 37 (Figures 1 and 2) having an outer surface which comprises a cylindrical part 38 which is also accurately machined and which has a diameter equal to the diameter of the parts 26 and 27 of the cylindrical outer surfaces of the two drums 28 and 29. The cylindrical surface part 38, which surrounds a part of the housing 37 that accommodates a tachogenerator which forms a unitary assembly with the motor 4 and controls the speed of the motor, is also held against the

walls 34 and 35 of the V-shaped groove 36 by suitable means, not shown. Consequently, an accurate alignment of the motor shaft, which is designated 39, and the shaft 30 of the head disc 5 is ensured.

The motor shaft 39 is connected to the drive shaft 30 by means of a flexible shaft coupling 40. Several shaft couplings which are suitable for this purpose are commercially available. For example, bellows couplings are suitable.

On the mounting block 33, faces 41 and 42 (Figures 1 and 2) are provided on which the audio erase head 8 and the audio recording and/or playback head 9 are mounted.

The pressure piece 15 and the mounting block 33 are movable relative to the deck 1 simultaneously and in opposite directions by the aforesaid actuating means. For this purpose the mounting block 33 is disposed on a first carriage 43 of the actuating means, and the pressure-piece support, constituted by the cylindrical fixing member 23, is mounted with the pressure-piece 15 on a second carriage 44. The carriage 43 is driven by a special motor 45. This motor is situated on the deck 1 on a bracket 46, and via a worm 47 the motor drives a wormwheel 48 which is rotatable about a shaft 49 fixed on the deck 1. A toothed rack 50 (Figures 1 to 4) mounted on a lever 108 co-operates with a gear wheel, not shown, which is integral with the wormwheel 48. When the lever 108 is moved by the motor 45 the two carriages 43 and 44 perform sliding movements in opposite directions. This will be further explained hereinafter.

Two tape guide pins 51 and 52 are mounted in a cassette 53 (see Figures 3 and 4) in a manner such as to be capable of limited axial and radial movement therein. Means for accurately determining the positions of the tape guide pins transversely of their axes relative to the axis of rotation of the head disc 5 in the operating condition are mounted on suitable faces provided for this purpose on the mounting block 33. These means comprise two pairs of spaced tongues 55a and b and 56a and b (Figures 1 and 2), the two tongues of each pair being disposed one above the other at a distance which corresponds to the axial dimension of corresponding parts of the corresponding guide pins 51 and 52 and is substantially equal to the width of the tape. The ends 57a, b and 58a, b respectively of the two tongues of each pair are slightly bent away from each other and are formed with recesses to receive a corresponding one of the guide pins 51 and 52.

In Figures 3 and 4 the cassette 53 is shown inserted in the recorder. The cassette is accurately positioned relative to

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the deck 1 of the recorder with the aid of two locating pins 59 and 60, which are rigidly connected to the deck 1 and which are engageable in corresponding locating openings 106 and 107 (Figure 8) in the cassette. In the cassette two winding spools 61 and 62 are disposed which are provided with flanges 63a, 63b and 64a, 64b. The winding spools are mounted in the cassette so as to be capable of some radial and axial play therein. As shown in Figure 7, the winding spools are resiliently loaded towards the lower wall of the cassette in order that when the cassette is removed from the recorder the winding spools are pressed against this wall to prevent them turning and the tape being unwound. For each winding spool a coil spring 65 is mounted in the cassette. Each spring is accommodated in a respective tubular portion 66 which projects from the inner surface of the upper wall of the cassette and on which is slidably mounted a tubular cap 67. On the end of each cap 67 is a domed protrusion 68 which bears on a pressure face 69 of the respective winding spool. Two turntables 70 and 71 are provided on the recorder for co-operation with the two winding spools. These two turntables are integral with two pulleys 72 and 73 made of plastic. Each of the pulleys is driven by a separate motor *via* a belt. This drive system is not essential to the apparatus according to the invention and for the sake of clarity it is not shown in the Figures.

The cassette 53 in known manner comprises two separate sections 74 and 75 which will be referred to as the "lid" and the "bottom" respectively of the cassette. In the cassette bottom openings 76 and 77 are formed to receive the turntables 70 and 71. The turntables, against the pressure of the springs 65, support the winding spools 70 and 71 at a height at which the spools are clear of the upper and lower walls of the cassette. The two tape guide pins 51 and 52 are mounted in the cassette so as to be capable of both radial and axial play and are resiliently loaded towards the front of the cassette by springs 78 and 79 disposed in the cassette. The recessed ends 57a, b and 58a, b of the tongues 55a, b and 56a, b can be inserted into the cassette through corresponding slots 81a, b and 82a, b in the front wall thereof to determine the positions of the tape guide pins 51 and 52 transversely of their axes. Also, openings 83 and 84 are formed in the front wall of the cassette for the entry of the convex guide members 13 and 14, the various previously mentioned electromagnetic heads 6, 7, 8 and 9 and the pressure roller 3. In the bottom 75 of the cassette an opening 80 is formed for the passage of the capstan 2, which extends parallel to the winding

spindles 11 and 12, and an opening 105 for the passage of the pressure piece 15.

The locating pins 59 and 60 form parts of two locating members 85 and 86 (Figures 1 and 2) mounted on the deck 1. The parts of these members which are remote from the deck form the locating pins and the parts which are nearer the deck, and which are designated by the reference numerals 87 and 88, co-operate in the operating condition of the recorder with two corresponding locating stops 89 and 90 on the carriage 43 to accurately position the mounting block 33 relative to the cassette 53. The locating members 85 and 86 also act as guide members for the carriage 43, which consists of a sliding plate. For this purpose the two locating members are provided with grooves 91 and 92 which have a width which is slightly greater than the thickness of the sliding plate so that the grooves can receive the edges of the sliding plate. The sliding plate 43 is also guided by a guide pin 93 which is rigidly connected to the deck 1 and which extends through a corresponding guide slot 94 in the sliding plate. This guide slot is locally widened at the region, designated 95, where the guide pin 93 is located in the operating position of the actuating means, so that in the operating position the pin 93 is clear of the sliding plate 43 at all sides. This is of great importance for the centring of the sliding plate, which is effected exclusively with the aid of the locating stops 89 and 90. The locating stop 89 has a V-shaped surface and the locating stop 90 a straight surface. Thus, an extremely accurate centring of the sliding plate 43 relative to the two locating members 85 and 86 can be obtained in the operating position. The stop 90 only prevents movement of the plate 43 in a direction perpendicular to the straight surface of this stop, whilst the stop 89 also prevents movements of the plate transversely of that direction.

The actuating means for moving the head disc 5 and the pressure piece 15 relative to each other operates as follows. The motor 45, upon energization and in the previously described manner, moves the sliding plate 43 *via* the wormwheel 48, the gear wheel (not shown) which is integral with the wormwheel, the toothed rack 50 and the lever 108, which is pivotally mounted on the deck 1 and co-operates with the plate 43. A lever 54 is pivoted to the deck 1. In Figure 1 the axis of rotation of said lever is indicated by the reference number 96. The sliding plate 43 has two guide strips 97 and 98 which slide in the grooves 91 and 92 in the locating members 85 and 86. The strip 98 moreover serves for moving the lever 54 at one end. For this purpose the lever 54 is provided with an end tab 99 which co-

operates with the distal end of the strip 98. At its other end the lever 54 has a portion 100 which co-operates with a tongue 101 bent upwardly from the second carriage 44, which also consists of a sliding plate. A tension spring 102 is connected at one end to the sliding plate 43 and at its other end to the lever 54. By moving the sliding plate 43 from the position shown in Figure 1 to the position shown in Figure 2, the strip 98 presses against the end tab 99 of the lever 54 so that the lever rotates about the axis of rotation 96. The sliding plate 44 is continuously loaded in the direction towards the mounting block 33 by elastic means, not shown, so that the tongue 101 is urged continuously into contact with the end portion 100 of lever 54. The sliding plate 44 has a downwardly bent tongue 103 which, during the movement of the plate 44, moves in a corresponding slot 104 in the deck 1. At the end of said slot 104 further sliding movement of the sliding plate 44 is blocked by the engagement of the tongue 103 with said end of the slot, so that the tongue 101 and the end portion 100 of lever 54 become disengaged due to the fact that the sliding plate 43 moves slightly further and the lever 54 is consequently rotated slightly further. In the operating position thus obtained there is consequently no longer any direct contact between the sliding plate 44 and the lever 54. The sliding plate 43 is positioned relative to the deck 1 in the previously described manner by means of the stops 89 and 90, whilst the pressure piece 15, which is secured to the carriage 44, is pressed against the cylindrical parts 26 and 27 of the two drums 28 and 29 by means of the coil springs 18 and 19 and is then fully clear of the supporting pin 20. Thus, the pressure piece 15 is capable of freely locating itself relative to the cylindrical outer surfaces of the parts 26 and 27 of the drums 28 and 29. This always ensures an excellent engagement of the pressure piece against the drums. The force with which the pressure piece is pressed against the drums has no effect on the friction between the magnetic tape 16 and the concave and convex guide members.

Although the above embodiment relates to a video cassette recorder, the scope of the invention is not limited thereto. For example, the use of convexly curved guide members in conjunction with concavely curved guide members, between which members the tape is passed so as to obtain the required transverse curvature, is equally applicable to an apparatus which employs loose tape spools, i.e., tape spools which are not housed in a cassette and which may be manipulated individually by the user. Various modifications may be

made in the apparatus described above and illustrated in the drawings without departing from the scope of the invention as defined in the following claims. For example, two tape guide rollers corresponding to the guide pins 51 and 52 may be located directly before and after the convex and concave guide members with respect to the direction of movement of the tape, the rollers being mounted with limited omnidirectional play on pins which are rigidly connected to the deck, and being resiliently loaded towards the mounting block 33 and being engageable by the tongues 55a, b and 56a, b when the mounting block is moved to the operating position.

WHAT WE CLAIM IS:—

1. An apparatus for magnetically recording and/or playing back signals on and/or from a magnetic tape and comprising a capstan for driving the tape, a pressure roller for pressing the tape against the capstan, an assembly of electromagnetic recording and/or playback means with associated erase means, the assembly comprising a rotatable head disc on which are disposed electromagnetic heads which are spaced at equal radial distances from the axis of rotation of the disc and which are uniformly spaced around the circumference of the disc, a support for the rotatable head disc, a tape guide device which comprises concavely curved guide members having equal radii of curvature for guiding the tape in a locally transversely curved condition past a part of the circular path of said electromagnetic heads in a direction extending transversely of the plane of rotation of the head disc whereby said heads scan transverse tracks on the tape in the operation of the apparatus, two winding spindles for driving first and second tape spools, tape guide members for guiding the tape from the first spool to the assembly of electromagnetic means and thence to the second spool, and actuating means for effecting relative movement between the head disc and the concave guide members in a direction extending transversely of the axis of rotation of the head disc, between an inoperative position in which the concave guide members are disposed at a distance from the head disc sufficient to allow the magnetic tape to assume a substantially flat shape at the location where in operation the tape is transversely curved, and an operating position in which the magnetic tape is guided past the circular path of the heads in said locally curved condition, wherein the tape guide device further comprises two convexly curved guide members which are disposed on opposite



operates with the distal end of the strip 98. At its other end the lever 54 has a portion 100 which co-operates with a tongue 101 bent upwardly from the second carriage 44, which also consists of a sliding plate. A tension spring 102 is connected at one end to the sliding plate 43 and at its other end to the lever 54. By moving the sliding plate 43 from the position shown in Figure 1 to the position shown in Figure 2, the strip 98 presses against the end tab 99 of the lever 54 so that the lever rotates about the axis of rotation 96. The sliding plate 44 is continuously loaded in the direction towards the mounting block 33 by elastic means, not shown, so that the tongue 101 is urged continuously into contact with the end portion 100 of lever 54. The sliding plate 44 has a downwardly bent tongue 103 which, during the movement of the plate 44, moves in a corresponding slot 104 in the deck 1. At the end of said slot 104 further sliding movement of the sliding plate 44 is blocked by the engagement of the tongue 103 with said end of the slot, so that the tongue 101 and the end portion 100 of lever 54 become disengaged due to the fact that the sliding plate 43 moves slightly further and the lever 54 is consequently rotated slightly further. In the operating position thus obtained there is consequently no longer any direct contact between the sliding plate 44 and the lever 54. The sliding plate 43 is positioned relative to the deck 1 in the previously described manner by means of the stops 89 and 90, whilst the pressure piece 15, which is secured to the carriage 44, is pressed against the cylindrical parts 26 and 27 of the two drums 28 and 29 by means of the coil springs 18 and 19 and is then fully clear of the supporting pin 20. Thus, the pressure piece 15 is capable of freely locating itself relative to the cylindrical outer surfaces of the parts 26 and 27 of the drums 28 and 29. This always ensures an excellent engagement of the pressure piece against the drums. The force with which the pressure piece is pressed against the drums has no effect on the friction between the magnetic tape 16 and the concave and convex guide members.

Although the above embodiment relates to a video cassette recorder, the scope of the invention is not limited thereto. For example, the use of convexly curved guide members in conjunction with concavely curved guide members, between which members the tape is passed so as to obtain the required transverse curvature, is equally applicable to an apparatus which employs loose tape spools, i.e., tape spools which are not housed in a cassette and which may be manipulated individually by the user. Various modifications may be

made in the apparatus described above and illustrated in the drawings without departing from the scope of the invention as defined in the following claims. For example, two tape guide rollers corresponding to the guide pins 51 and 52 may be located directly before and after the convex and concave guide members with respect to the direction of movement of the tape, the rollers being mounted with limited omnidirectional play on pins which are rigidly connected to the deck, and being resiliently loaded towards the mounting block 33 and being engageable by the tongues 55a, b and 56a, b when the mounting block is moved to the operating position.

WHAT WE CLAIM IS:—

1. An apparatus for magnetically recording and/or playing back signals on and/or from a magnetic tape and comprising a capstan for driving the tape, a pressure roller for pressing the tape against the capstan, an assembly of electromagnetic recording and/or playback means with associated erase means, the assembly comprising a rotatable head disc on which are disposed electromagnetic heads which are spaced at equal radial distances from the axis of rotation of the disc and which are uniformly spaced around the circumference of the disc, a support for the rotatable head disc, a tape guide device which comprises concavely curved guide members having equal radii of curvature for guiding the tape in a locally transversely curved condition past a part of the circular path of said electromagnetic heads in a direction extending transversely of the plane of rotation of the head disc whereby said heads scan transverse tracks on the tape in the operation of the apparatus, two winding spindles for driving first and second tape spools, tape guide members for guiding the tape from the first spool to the assembly of electromagnetic means and thence to the second spool, and actuating means for effecting relative movement between the head disc and the concave guide members in a direction extending transversely of the axis of rotation of the head disc, between an inoperative position in which the concave guide members are disposed at a distance from the head disc sufficient to allow the magnetic tape to assume a substantially flat shape at the location where in operation the tape is transversely curved, and an operating position in which the magnetic tape is guided past the circular path of the heads in said locally curved condition, wherein the tape guide device further comprises two convexly curved guide members which are disposed on opposite



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- sides to one another of the head disc in the axial direction thereof and which have a radius of curvature which substantially equals that of the concave guide members, the concave guide members and the convex guide members being supported so as to permit relative movement between the concave guide members on the one hand and the convex guide members on the other hand in a direction extending transversely of the axis of rotation of the head disc, and wherein the concave guide members each form part of a pressure piece which, in the operating position, presses the locally transversely curved part of the magnetic tape against the convex guide members.
2. An apparatus as claimed in Claim 1, wherein there are two of said concave guide members forming parts of a single pressure piece, and wherein the distance between the convex guide members in a direction parallel to the axis of rotation of the head disc is greater than the distance between said two concave guide members in this direction and these convex and concave guide members are arranged relative to each other in such a way that in the operating position of the actuating means the two concave guide members are located between the two convex guide members in the axial direction of the head disc and a gap is obtained between each convex guide member and the nearer of the concave guide members, at which gaps the magnetic tape is not in contact with any part of the apparatus.
3. An apparatus as claimed in Claim 2, wherein the pressure piece comprises concave abutment members which have equal radii of curvature and are formed by extensions at the ends of each of the concave guide members, and wherein corresponding convex abutment members are provided which have the same radius of curvature as the concave abutment members and on which the latter members bear in the operating position of the actuating means, resilient means being provided for resiliently pressing the concave and convex abutment members against each other in the operating position.
4. An apparatus as claimed in Claim 3, wherein the pressure piece, and the convex guide members and the convex abutment members are made of the same non-magnetic material.
5. An apparatus as claimed in Claim 3 or 4, wherein the convex abutment members are integral with the convex guide members.
6. An apparatus as claimed in Claim 5, wherein the convex guide members and the convex abutment members are formed by accurately machined parts of the cylindrical outer surfaces of two drums which are arranged coaxially with the head disc on opposite sides thereof to one another.
7. An apparatus as claimed in Claim 6, wherein at least one of the drums also serves as a housing for a bearing for a rotatable shaft carrying the head disc.
8. An apparatus as claimed in Claim 6 or 7, wherein the cylindrical outer surface of each of the drums comprises a first part which provides the respective convex abutment and guide members and a second part of smaller diameter than the first part, at least said first part being accurately machined.
9. A machine as claimed in Claim 6, 7 or 8, wherein the drums serve for accommodating a synchronizing head for synchronizing the translational speed of the magnetic tape, and for accommodating a device for transferring signals from stationary parts of the apparatus to and from the heads which are mounted on the rotatable head disc.
10. An apparatus as claimed in any of Claims 3 to 9, wherein the pressure piece is mounted on a pressure-piece support for limited omnidirectional movability relative thereto.
11. An apparatus as claimed in Claim 10, wherein the pressure-piece support comprises a supporting pin which is disposed in a bore in the pressure piece with clearance so that the pressure piece is capable of play relative to the pin in the radial direction thereof, the supporting pin and the pressure piece being resiliently loaded in opposite radial directions by said resilient means, and stop means being provided for limiting the movements of the pressure piece relative to the supporting pin in the axial direction.
12. An apparatus as claimed in Claim 11, wherein the resilient means comprise two coil springs which are mounted in blind bores in the pressure piece, the blind bores extending transversely of the bore for the supporting pin and each spring bearing at one end against the supporting pin and at the other end against the end wall of the respective blind bore.
13. An apparatus as claimed in any of Claims 6 to 9 or in Claims 10, 11 or 12 when read as appendant to Claim 6, wherein the two drums are mounted on a mounting block which has two accurately machined faces formed by the walls of a V-shaped groove in the block, and wherein the accurately machined parts of the cylindrical outer surfaces of the drums are held against said walls of the V-shaped groove by fixing means.
14. An apparatus as claimed in Claim 13, comprising a motor for driving the head



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- disc, the motor having a housing of which the outer surface has an accurately machined cylindrical part which has a diameter equal to the diameter of the accurately machined parts of the cylindrical outer surfaces of the two drums and which is also held against the walls of the V-shaped groove by fixing means.
15. An apparatus as claimed in Claims 7 and 14, wherein the output shaft of the motor is connected to the shaft of the head disc by a flexible shaft coupling.
16. An apparatus as claimed in Claim 13, 14 or 15, wherein the mounting block has faces on which an electromagnetic audio recording and/or playback head and an audio erase head respectively are mounted.
17. An apparatus as claimed in any preceding claim and comprising a deck on which both the concave guide members and the convex guide members are movably mounted, the concave guide members on the one hand and the convex guide members on the other hand being movable relative to the deck simultaneously and in opposite directions to one another by the actuating means.
18. An apparatus as claimed in Claim 10, 11 or 12 in combination with any of Claims 13 to 16 and Claim 17, wherein the mounting block is disposed on a first carriage of the actuating means and the pressure-piece support with the pressure piece on a second carriage of the actuating means, one of said carriages being slidably drivable and the two carriages being coupled to one another in such a manner that as said one carriage is driven in one direction the other carriage performs a corresponding sliding movement in the opposite direction.
19. An apparatus as claimed in Claim 18, comprising two cylindrical tape guide members of which one is arranged to be the last guide member to be passed by the magnetic tape before it reaches the convex and concave guide members and the other is arranged to be the first guide member to be passed by the magnetic tape after it has left the convex and concave guide members, said two cylindrical guide members being supported for limited axial and radial movability and the mounting block being provided with faces on which are mounted means which are engageable with said cylindrical tape guide members for accurately determining the positions thereof transversely of their axes relative to the axis of rotation of the head disc in the operating position of the disc, which means comprise two pairs of tongues, the two tongues of each pair being spaced from one another in a direction parallel with the axes of the cylindrical tape guide members by a distance which substantially equals the width of the magnetic tape.
20. An apparatus as claimed in Claim 19, wherein said tongues are identical and at their ends are formed with recesses to receive said cylindrical tape guide members.
21. An apparatus as claimed in Claim 19 or 20 and which is equipped with a rectangular cassette containing a magnetic tape and having two parallel major walls and two pairs of parallel peripheral walls, wherein two locating pins are provided on the deck of the apparatus for positioning the cassette and one of the major walls of the cassette is provided with corresponding openings for receiving the locating pins, the cassette is provided with two flanged winding spools which are mounted in the cassette so as to be capable of radial and axial play therein and are resiliently loaded towards said one major wall of the cassette by resilient means in the cassette so that when the cassette is removed from the apparatus the winding spools are pressed against said one major wall of the cassette so that rotation of the spools and unwinding of the tape are inhibited, the winding spindles are spaced from one another on the deck of the apparatus and extending parallel to one another, turntables are provided on the winding spindles, the cassette has openings in said one major wall to receive the turntables, the turntables are arranged to support the winding spools against the pressure of the resilient means in the cassette in positions in which the spools are clear of the major walls of the cassette, the cassette contains the two cylindrical tape guide members, these members being mounted near one of the peripheral walls of the cassette in a manner such as to be capable of both radial and axial play relative to the cassette and being resiliently loaded towards said one peripheral wall by corresponding springs in the cassette, the capstan is parallel to the winding spindles, said one major wall of the cassette has an opening for the passage of the capstan, said one peripheral wall of the cassette has openings for the entry of the means for determining the positions of the cylindrical tape guide members transversely of their axes and openings for the entry of the convex guide members, said various electromagnetic heads and the pressure roller, and said one major wall of the cassette has an opening for the passage of the pressure piece.
22. An apparatus as claimed in Claim 21, wherein said locating pins form parts of locating members which are mounted on the deck and of which parts which are remote from the deck form said locating pins and parts nearer the deck co-operate



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in the operating condition of the apparatus with corresponding locating stops for positioning said mounting block relative to the cassette.

- 5 23. An apparatus as claimed in Claim 22, wherein the first carriage comprises a sliding plate, said locating members also act as guide members for guiding the first carriage in its sliding movement and are
- 10 provided with grooves which co-operate with edges of the sliding plate and have a width which is slightly greater than the thickness of the sliding plate, the sliding plate is also guided by a guide pin which is
- 15 rigidly connected to the deck of the apparatus and which extends through a corresponding guide slot in the sliding plate, the locating stops are formed on the sliding plate and include a first stop
- 20 comprising a straight surface and a second

stop comprising a V-shaped surface, and the guide slot is locally enlarged at the region where the guide pin is located in the operating position of the actuating means so that at all sides the guide pin is clear of the sliding plate.

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24. An apparatus for magnetically recording and/or playing back signals on and/or from a magnetic tape, the apparatus being constructed and arranged to operate substantially as herein described with reference to the accompanying drawings.

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C. A. CLARK,
Chartered Patent Agent,
Berkshire House,
168—173, High Holborn,
London, WC1V 7AQ,
Agent for the Applicants.

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