SPECIFICATION

Apparatus for playing-back magnetic signals recorded in tracks on a magnetic tape

The invention relates to an apparatus for playing-back magnetic signals recorded in tracks on a magnetic tape, comprising a magnetic read head with a magnetic core having pole pieces between which a read gap is formed for scanning the magnetic signals on the magnetic tape, the magnetic head being carried on a head plate which is movably mounted on a frame of the apparatus, and an azimuth-angle correction device being provided for correcting an incorrect azimuth-angle position of the read gap relative to a track on the magnetic tape, which correction device comprises a pivoting plate on which the magnetic head is mounted and which is pivotably mounted on the head plate for influencing the azimuth-angle position of the read gap, and a pivoting member which cooperates with the pivoting plate for pivoting this plate.

When playing back magnetic signals recorded in tracks on a magnetic tape it is essential that during playback the correct angular position of the read gap of the read head relative to the selected track is maintained. An incorrect angular position of the read head results in higher frequencies of a signal recorded on the magnetic tape by means of a magnetic write head not being played back in an optimum manner. The write head also has a magnetic core with pole pieces. Between said pole pieces a write gap is formed. The position of the write gap determines the orientation of the magnetic signals recorded on the magnetic tape. The write gap and read gap should therefore have the same position as much as possible.

A deviation of only a few minutes of arc from the correct angular position of the read gap may lead to a degradation of a played-back audio signal at the high-frequency end of its spectrum. This problem may occur *inter alia* when the signals have been recorded on the magnetic tape with an apparatus other than that with which the magnetic tape is played back. In order to reduce the resulting interchangeability problems, it is therefore necessary that different apparatuses have a corresponding adjustment of the neutral position of the two magnetic heads.

It is obvious that in practice the accuracy of this neutral adjustment is limited by what is still feasible and efficient in the production of the apparatus. However, even in the case of correctly adjusted apparatus, optimum playback of signals which have been recorded by means of another apparatus, for example the playback of recordings in commercially available prerecorded Compact-Cassettes, particularly music cassettes, may not be achieved, because either the neutral adjustment of the write gap of the write head used during recording or the adjustment of the read gap of the read head of the apparatus used for playback is not optimal, for example because as a result of shocks or careless handling the write head, the read head or both heads does or do not have the correct position. In such a case a substantial improvement in playback quality can be obtained by slightly readjusting the read head of the apparatus used for playback, so as to ensure that the read gap of the read head is, as much as possible, parallel to the write gap of the write head used for recording the tracks and thus to the orientation of the tracks on the magnetic tape. This improved playback especially manifests itself in an audible improvement of the treble playback.

In several known apparatuses of the type mentioned in the preamble the read head, which serves for playing back the recorded magnetic signals, is mounted on the chassis of the apparatus so as to be adjustable. The read head is secured to a plate which is supported by the chassis is such as way that the azimuth angle can be changed with the aid of a set screw. During manufacture this set screw enables the neutral position of the read gap to be adjusted within the required tolerance range with the aid of a screwdriver. It is evident that such an azimuth angle correction device is less suitable for operation by a user during the playback of music, because in this situation the apparatus is connected to the mains voltage and, moreover, the relevant read head is covered by the front panel of the apparatus. Especially in the case of Compact-Cassette recorders provided with a higned cassette holder in which the cassette is inserted before it is swung into an operating position, there is not much room near the read head.

It is an object of the invention to provide an apparatus in which a user can readily operate the azimuth-angle correction device while listening to the music which is being played back.

According to the invention there is provided an apparatus for playing-back magnetic signals recorded in tracks on a magnetic tape, comprising a magnetic read head with a magnet core having pole pieces between which a read gap is formed for scanning the magnetic signals on the magnetic tape, the magnetic head being carried by a head plate which is movably mounted on a frame of the apparatus, and an azimuth-angle correction device being provided for correcting an incorrect azimuth-angle position of the read gap relative to a track on the magnetic tape, which correction device comprises a pivoting plate on which the magnetic head is mounted and which is pivotably mounted on the head plate for influencing the azimuth-angle position of the read gap, and a pivoting member which cooperates with the pivoting plate for pivoting this plate, wherein the pivoting member is pivoted by means of a manually rotatable correction knob which is connected to the pivoting member by flexible transmission means which comprise two flexible transmission members in the form of cords which are each connected at one end to the correction knob and at the other end to the pivoting member, resilient means being provided for tensioning each cord between its two ends so as to prevent slackening of the cords and consequent loss of motion in the azimuth-angle correction device, and wherein the pivoting member comprises a toothed segment which is rotatable about the pivotal axis of the pivoting member and which meshes with a pinion which is rotatable about an axis which is parallel to and spaced from said pivotal axis, and at

one end the two cords are each wound for at least part of a turn round a drum which is coaxially coupled to the correction knob for rotation therewith, the cords being wound in opposition directions, and at the other end the cords are each wound for at least part of a turn round a drum which is coaxially connected to the pinion for rotation therewith, the cords again being wound in opposite directions.

An apparatus according to the invention offers a number of advantages. First, the use of flexible transmission means provides a higher degree of freedom in the location of the correction knob, which can be mounted in a readily accessible position on the front panel of the apparatus. Second, the absence of lost motion in the transmission between the correction knob and the pivoting plate means that the neutral position of the read gap of the read head always corresponds to the neutral position of the correction knob. Third, the use of the toothed segment and pinion enables a suitable transmission ratio to be obtained between the rotation of the correction knob and the pivotal movement of the pivoting plate.

Preferably, the pivoting member comprises a pivoting cam which cooperates with the pivoting plate, resilient means being provided for urging the pivoting cam and the pivoting plate against each other.

In one embodiment of the invention the correction knob is fixed on a rotatable spindle which carries a disc which is rigidly connected to the spindle coaxially therewith, at said one end the two cords are each wound for at least part of a turn around an associated one of two drums which are coaxially coupled to the correction knob for rotation therewith and which are axially movable independently of one another along the spindle, one of these two drums has on one side a first face which cooperates with a face of said disk and on the other side a second face which cooperates with a face of the other of said two drums, the cooperating faces each being provided with radially extending ridges forming teeth for coupling these faces to one another in the direction of rotation, and resilient means being provided for urging the cooperating faces axially, against one another, and said two drums are rotatable relative to each other and to the disk for the purpose of obtaining a neutral setting of the correction knob after disengagement of the ridges on the cooperating faces of the drums and the disk from one another by axial movement of the drums relative to the disk and to one another.

An embodiment of the invention will now be described in more detail with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a magnetic tape cassette recorder with a correction knob for an azimuth angle correction device at the front panel,

Figure 2 is a front view of a part of the cassette recorder of Figure 1 at the location of a cassette holder and a write/read head, with the front panel removed,

Figure 3 is a perspective view partly in cross section, of a conventional magnetic write/read head,

Figure 4 shows a length of tape with an indication of the magnetic signals recorded in two tracks, the head face of the magnetic write/read head of Figure 3 being shown projected onto the magnetic tape,

Figure 5 is a sectional view taken on the line V-V in Figure 2,

Figure 6 is a sectional view taken on the line VI-VI in Figure 5,

Figure 7 is a view, partly in cross-section, of the correction knob and a number of associated components,

Figure 8 is a sectional view taken on the line VIII-VIII in Figure 7, and

Figure 9 is a block diagram of an electronic circuit for signalling an incorrect azimuth angle position of the read gap of the read head.

The cassette recorder shown in Figure 1, which is suitable for use with "Compact Cassettes", comprises a housing 1 having a front panel 2. At the front panel a number of keys 3 are located for the control of the tape transport of the cassette recorder, a number of push-buttons 4 for controlling electrical functions of the cassette recorder, two knobs 5 for actuating slide potentiometers 5 for adjusting the gain of the two channels of a built-in stereo amplifying unit, and two buttons 6 for the actuation of a counter 7. A magnetic-tape cassette 8 is inserted in a pivotable cassette holder 9, which in Figure 1 is in a closed position. For the insertion of a cassette into and its removal from the cassette holder 9, the holder can be swung into an open position, not shown.

Figure 2 shows the part of the frame 10 on which the cassette holder 9 is mounted. On the frame is movably mounted a head plate 11 which carries a combined write/read head 12 as well as an erase head 66. The cassette is of fully conventional construction, and components which are irrelevant to the present invention will not be discussed.

Figure 3 is a perspective view of the conventional magnetic write/read head 12 on an enlarged scale, some parts of the magnetic head being broken away so as to show its interior. Two magnetic circuits are embedded in a compound 13, each circuit comprising two magnetic cores 14 wound from electrically conducting wire and two C-shaped laminated pole pieces 15. In each of the magnetic circuits a gap 16 is formed between two such pole pieces, which gap during playback serves as a read gap. The actual magnetic head 17 is surrounded by a metal screen 18, to which on one side a tape guide member 19 is secured. The screen is connected to a resilient strip 20. The write/read head shown is of fully conventional construction and will not be described in more detail. The cassette 8 contains a magnetic tape 21 which during playback is brought into contact with the head face 22 of the magnetic head unit.

The magnetic signals recorded on the magnetic tape 21 and read with the aid of the magnetic head 12 consist of locally magnetized areas in the magnetic tape material which areas chiefly extend in the direction of the read gap 16, in two tracks. A deviation in the direction of these magnetized areas relative to the direction of the read gap is termed an "azimuth angle error". This is schematically shown in Figure 4. A length of magnetic tape 21 contains tracks 23. The orientation of said magnetized areas,

schematically represented by vertical lines in Figure 4, is indicated by a line 24. The head face 22 of the magnetic head *12* is shown projected onto a length of magnetic tape 21. A line 25 extends in line with the two head gaps 16. The lines 24 and 25 enclose an angle φ. This is the azimuth angle, which in ideal conditions should have the value zero for an optimum playback of the signals in the tracks 23, in particular in respect of signals of higher frequencies.

The azimuth angle correction device for correcting an incorrect azimuth angle position of the read gap 16 relative to the magnetic signals on the magnetic tape 21 comprises a pivoting plate 26 which carries the magnetic head 12 and which is pivotable relative to the frame 10, for influencing the azimuth angle position of the read gap 16. This can be effected by pivoting the pivoting plate. The azimuth angle correction device furthermore comprises a movable pivoting member 27 which cooperates with the pivoting plate 26 to cause the pivoting plate 26 to be pivoted when said member is moved.

On the front panel 2 of the cassette recorder at a readily accessible location a manually adjustable correction knob 28 is provided which is connected to the pivoting member 27. The pivoting member can be moved by moving the correction knob. In order to transmit the movements of the correction knob 28 over a certain distance to the pivoting member 27 and *via* the pivoting plate 26 to the read head *12*, the azimuth-angle correction device comprises two flexible transmission members in the form of two steel cords 29 and 30 between the pivoting member 27 and the correction knob 28.

The movable pivoting member 27 is provided with a pivoting cam 31 which cooperates with an inclined surface on the pivoting plate 26 (see Figure 5), the inclined surface being formed by a portion 37 of the plate which is bent obliquely from the plane of the plate. For urging the pivoting cam 31 and the pivoting plate 26 against each other and thus eliminating any clearance between them there is provided a compression spring 32. On the underside the pivoting plate 26 has two pivot pins 33 which bear with pointed ends on the head plate 11. Thus the pivoting plate is pivotable about a line 34 (see Figure 6) connecting the two points where the pivot pins 33 contact the head plate. A bolt 35 projects through a hole 36 in the pivoting plate 26 and is secured in the head plate 11. The spring 32 is fitted around the bolt 35 and exerts pressure on the pivoting plate 26 at a location which is situated to the left of the pivot pins 33, as viewed in Figures 5 and 6. As a result of this the pivoting plate 26 is urged against the pivoting cam 31 at a location to the right of the pivot pins 33, i.e. at the location of the bent portion 37 of the plate 26.

The correction knob 28 is rotatable about an axis of rotation 38 (Figure 7). The pivoting member 27 is rotatable to a limited extent about another axis, namely an axis 39 (Figure 5). It is provided with a toothed segment 40. The pivoting member 27 is journalled on a pin 41 on the head plate 11, which pin has a threaded portion at its free end onto which a nut 42 is fitted which *via* a ring 43 presses on the pivoting member 27. By means of the nut 42 the height of the pivoting member on the pin 41 can be adjusted to adjust the initial position of the pivoting plate 26. The toothed segment 40 meshes with a pinion 45 which is rotatable about an axis 44 which is parallel to and spaced from the axis 39. The pinion 45 is rotatably journalled on a pin 46 which is secured to the head plate 11. At one end the two cords 29 and 30 are fixedly attached to two coaxial drums 47 and 48 respectively and are wound in opposite directions round the drums 47 and 48 respectively for at least a part of a turn, the drums are coaxially coupled to the correction knob 28 for rotation therewith, as will be described. At their other ends the two cords are fixedly attached to one drum 49 and are wound round this drum in opposite directions for at least part of a turn. The drum 49 is coaxial and integral with the pinion 45. Thus, the two cords 29 and 30 are connected directly to the correction knob 28 and indirectly, namely *via* the pinion 45, to the pivoting member 27.

In order to prevent slackening of the cords 29 and 30 and thus the occurrence of lost motion in the azimuth-angle correction device, there is provided a tension spring 50 for tensioning the two cords between their two ends. The cords extend in flexible sheaths 51 and 52 over a part of their lengths. At their ends which are nearer the correction knob 28 the flexible sheaths 51 and 52 are inserted in a plastics holder 53, to which an end of the tension spring 50 is attached. The other end of the tension spring 50 is connected to a stationary part 54 of the cassette recorder frame. At their other ends the flexible sheaths 51 and 52 are secured to the head plate 11 with the aid of a bracket 55 and a screw 56.

The correction knob 28 is fixed on a spindle 57 which is rotatable about the axis 38. A disc 58 is rigidly connected to this spindle and is coaxial with the axis 38. The two drums 47 and 48 are movable axially along the spindle 57 independently of one another. The drum 47 has on one side a face which cooperates with a face of the disk 58 and on the other side a face which cooperates with a face of the drum 48. The disk 58 and the drums 47 and 48 are urged axially against each other by a leaf spring 59 which is secured to the spindle 57. The cooperating faces of the disk 58 and the drums 47 and 48 are provided with radially extending ridges 60 forming teeth for coupling these faces to each other in the direction of rotation (see Figure 8). In order to obtain a neutral setting of the correction knob 28 when the read gaps 16 of the read head 12 are in their neutral positions, the drums 47 and 48 can be rotated relative to each other and relative to the disc 58 after a slight axial displacement of the drums over a distance which is at least equal to the height of said ridges, against the force of the leaf spring 59.

In the embodiment shown, see Figure 5, the magnetic head 12 is mounted on a resilient strip 20 in the usual manner, which strip enables the azimuth angle of the magnetic head to be adjusted. At one end the resilient strip 20 is secured to a fixed post 61 on the pivoting plate 26 and near its other end it is adjustable relative to the plate 26 in the usual manner with the aid of a screw 62 and a compression spring 63. In the embodiment shown, a magnetic

ad is used which is in fact intended for conventional cassette recorders which are normally not provided with a manually adjustable azimuth-angle correction device. Thus, it is possible to mount a magnetic head on the pivoting plate 26 in a different manner, for example, by rigidly mounting the magnetic head directly on said plate.

Above the correction knob 28 two lamps 64 and 65 are located on the front panel, which lamps, for example, comprise so-called LED's (Light Emitting Diodes). If one of the two lamps 64 or 65 lights up, this means that the azimuth angle of the read head is not correct. The user of the apparatus can now correct the azimuth-angle error by turning the correction knob 28 in a direction which is opposite to the direction indicated by the lamp that is lit. The azimuth-angle error is within the permissible tolerance limits if neither of the two lamps lights up. Figure 9 shows a simplified block diagram of an electronic circuit for measuring the azimuth-angle and causing the lamps 64 or 65 to light up in the case of an excessive azimuth-angle error. For the use of the circuit shown it is necessary to employ a read head which per track, in contrast to the read head shown in Figure 3, has a split pole piece for separately scanning an upper half and a lower half of the track. The difference in time between two associated zero passages of the scanned signals is measured and is a measure of the angular position of the read gap. For a more comprehensive discussion of this method of measuring the angular position of a read head as well as the electronic circuits for correcting the angular position of the read head reference is made to the specification of the Applicant's co-pending United Kingdom Patent Application No. 7918351. Serial No. 2 022 874. A suitable read head also is described in the latter specification.

Figure 9 shows a phase detector to which signals A, obtained from the upper half of the track being scanned, as well as a signal B, obtained from the lower half of the track being scanned, are applied. The phase detector comprises two bistable multivibrators FF1 and FF2 with two inputs. The bistables are set by a falling edge of a signal on the one input and are reset or kept reset by a low level on the second input. The signal A is applied to the reset input *r* of the bistable FF1 and to the set input CK of the bistable FF2. The signal B is applied to the reset input *r* of the bistable FF1 and to the set input CK of the bistable FF2. If the zero passage of the signal from the upper half of the track arrives first, the bistable FF2 will be set and will subsequently be reset by the signal from the upper half of the track whose zero passage appears later. As the bistable FF1 is kept reset no pulse can appear on its output, whilst on the Q-output of the bistable FF2 a pulse does appear. However, if the zero passage of the signal B arrives sooner, the bistable FF1 is set and subsequently reset by the zero passage of the zero A from the upper half of the track, so that a pulse appears on the Q-output of bistable FF1. In this case no pulse can appear on the Q-output of bistable FF2. The pulse on the output of the bistable FF1 is utilized to make the lamp 64 light up and the signal on the output of the bistable FF2 is utilized to make the lamp 65 light up.

Obviously the write/read head 12 should be accurately restored to the neutral position during a recording. Around the correction knob 28 a readily visible graduated scale 67 is provided which gives an indication of the neutral position. The correction knob 28 itself has a pointed projection 68, which in the neutral position is situated against a central mark of the graduated scale.

CLAIMS

1. An apparatus for playing-back magnetic signals recorded in tracks on a magnetic tape, comprising a magnetic read head with a magnet core having pole pieces between which a read gap is formed for scanning the magnetic signals on the magnetic tape, the magnetic head being carried by a head plate which is movably mounted on a frame of the apparatus, and an azimuth-angle correction device being provided for correcting an incorrect azimuth-angle position of the read gap relative to a track on the magnetic tape, which correction device comprises a pivoting plate on which the magnetic head is mounted and which is pivotably mounted on the head plate for influencing the azimuth-angle position of the read gap, and a pivoting member which cooperates with the pivoting plate for pivoting this plate, wherein the pivoting member is pivoted by means of a manually rotatable correction knob which is connected to the pivoting member by flexible transmission means which comprise two flexible transmission members in the form of cords which are each connected at one end to the correction knob and at the other end to the pivoting member, resilient means being provided for tensioning each cord between its two ends so as to prevent slackening of the cords and consequent loss of motion in the azimuth-angle correction device, and wherein the pivoting member comprises a toothed segment which is rotatable about the pivotal axis of the pivoting member and which meshes with a pinion which is rotatable about an axis which is parallel to and spaced from said pivotal axis, and at one end the two cords are each wound for at least part of a turn round a drum which is coaxially coupled to the correction knob for rotation therewith, the cords being wound in opposite directions, and at the other end the cords are each wound for at least part of a turn round a drum which is coaxially connected to the pinion for rotation therewith, the cords again being wound in opposite directions.

2. An apparatus as claimed in Claim 1, wherein the pivoting member comprises a pivoting cam which cooperates with the pivoting plate, resilient means being provided for urging the pivoting cam and the pivoting plate against each other.

3. An apparatus as claimed in Claim 1 or 2, wherein the correction knob is fixed on a rotatable spindle which carries a disc which is rigidly connected to the spindle coaxially therewith, wherein at said one end the two cords are each wound for at least part of a turn around an associated one of two drums which are coaxially coupled to the correction knob for rotation therewith and which are axially movable independently of one another along the spindle, wherein one of these two drums has on one side a first face which cooperates with a face of said

ad is used which is in fact intended for conventional cassette recorders which are normally not provided with a manually adjustable azimuth-angle correction device. Thus, it is possible to mount a magnetic head on the pivoting plate 26 in a different manner, for example, by rigidly mounting the magnetic head directly on said plate.

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Obviously the write/read head 12 should be accurately restored to the neutral position during a recording. Around the correction knob 28 a readily visible graduated scale 67 is provided which gives an indication of the neutral position. The correction knob 28 itself has a pointed projection 68, which in the neutral position is situated against a central mark of the graduated scale.

CLAIMS

1. An apparatus for playing-back magnetic signals recorded in tracks on a magnetic tape, comprising a magnetic read head with a magnet core having pole pieces between which a read gap is formed for scanning the magnetic signals on the magnetic tape, the magnetic head being carried by a head plate which is movably mounted on a frame of the apparatus, and an azimuth-angle correction device being provided for correcting an incorrect azimuth-angle position of the read gap relative to a track on the magnetic tape, which correction device comprises a pivoting plate on which the magnetic head is mounted and which is pivotably mounted on the head plate for influencing the azimuth-angle position of the read gap, and a pivoting member which cooperates with the pivoting plate for pivoting this plate, wherein the pivoting member is pivoted by means of a manually rotatable correction knob which is connected to the pivoting member by flexible transmission means which comprise two flexible transmission members in the form of cords which are each connected at one end to the correction knob and at the other end to the pivoting member, resilient means being provided for tensioning each cord between its two ends so as to prevent slackening of the cords and consequent loss of motion in the azimuth-angle correction device, and wherein the pivoting member comprises a toothed segment which is rotatable about the pivotal axis of the pivoting member and which meshes with a pinion which is rotatable about an axis which is parallel to and spaced from said pivotal axis, and at one end the two cords are each wound for at least part of a turn round a drum which is coaxially coupled to the correction knob for rotation therewith, the cords being wound in opposite directions, and at the other end the cords are each wound for at least part of a turn round a drum which is coaxially connected to the pinion for rotation therewith, the cords again being wound in opposite directions.

2. An apparatus as claimed in Claim 1, wherein the pivoting member comprises a pivoting cam which cooperates with the pivoting plate, resilient means being provided for urging the pivoting cam and the pivoting plate against each other.

3. An apparatus as claimed in Claim 1 or 2, wherein the correction knob is fixed on a rotatable spindle which carries a disc which is rigidly connected to the spindle coaxially therewith, wherein at said one end the two cords are each wound for at least part of a turn around an associated one of two drums which are coaxially coupled to the correction knob for rotation therewith and which are axially movable independently of one another along the spindle, wherein one of these two drums has on one side a first face which cooperates with a face of said

disk and on the other side a second face which cooperates with a face of the other of said two drums, the cooperating faces each being provided with radially extending ridges forming teeth for coupling these faces to one another in the direction of rotation, and resilient means being provided for urging the cooperating faces axially against one another, and wherein said two drums and rotatable relative to each other and to the disc for the purpose of obtaining a neutral setting of the correction knob after disengagement of the ridges on the cooperating faces of the drums and the disk from one another by axial movement of the drums relative to the disk and to one another.

4. An apparatus for playing back magnetic signals recorded in tracks on 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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