

TAPE RECORDERBACKGROUND OF THE INVENTIONField of the Invention:

5 This invention relates to a tape recorder and concerns a tape recorder the magnetic head of which is turned over 180° upon each change-over of the running direction of a magnetic tape.

Description of the Prior Art:

10 In some conventional tape recorders equipped with an auto-reverse function, the magnetic head is turned over 180° upon each change-over of the running direction of a magnetic tape. Turning-over mechanisms of this sort are constructed as hereinafter described in detail but generally they include a turning shaft which carries the magnetic head and which is supported
15 in a bearing, the shaft being turned to turn-over the head. Mechanisms of this sort are however accompanied by the following drawbacks. Due to the existence of a clearance between the turning shaft and the bearing, the magnetic head is off-centered (i.e., deviated from
20 the center) or tilted. When such off-centering or inclination takes place, the optimum positional relation between the head and an associated magnetic tape is affected adversely so that the acoustic characteristics

are lowered significantly. It has hence been necessary to provide a tape guide on a side wall of the head in order to maintain the precise positional relation between the head and the tape.

5 Where the tape guide is fixed on the side wall of the head, it is necessary to cause the head to retract whenever it is desired to turn the head over 180° upon each change-over of the running direction of the tape. It is hence necessary to shift the head back and forth, to say nothing of turning over the head. This has
10 led to the need for a complex mechanism to shift the head. If the maximum turning radius of the head is greater than one half of the height of the usual window of a tape cassette in which the head is entered, it
15 is impossible to turn the head while it is positioned in the window of a cassette. In this case, it is indispensable to cause the head to retract from the interior of the cassette. This requirement has resulted in problems such that the reverse operation of the
20 tape running direction takes lots of time.

SUMMARY OF THE INVENTION

 With the foregoing in view, the present invention has as a principal object the provision of a tape recorder in which the magnetic head is allowed to turn over
25 180° without need for its retraction and as a consequence,

the shifting mechanism for the magnetic head can be simplified and the time required for the reversal of the running direction of the tape can be shortened.

It is the principal concept of this invention to avoid the need for a tape guide at a position close to a head by reducing the possibility of inclination and off-centering of the head.

In accordance with the present invention, there is thus provided a tape recorder in which a magnetic head is turned over 180° upon each change-over of the running direction of a magnetic tape so as to effect the change-over from one playback track to another or from one recording track to another and in which a tapered surface is formed on at least one of a turning member with the magnetic head mounted thereon and a bearing member with the turning member supported turnably thereon, and an urging means is provided to urge the turning member in the axial direction thereof so as to maintain the tapered surface in contact with the associated member.

Owing to the above construction, the turning member and bearing member are maintained in mutual contact at the tapered surface so that the turning member is held surely at a predetermined position. The magnetic head is thus substantially free from inclination or off-centering, whereby it is no longer

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necessary to provide a tape guide in the proximity of the head. It is therefore possible to turn the magnetic head, which is in the recording or playback mode, over 180° while maintaining the contact of the magnetic head with a magnetic tape, in other words, without need for causing the magnetic head to retract. It is hence possible to simplify the turning mechanism for the magnetic head and also to shorten the time required for the reversal of the running direction of the tape.

Specific embodiments of the present invention will hereinafter be described in detail by way of example with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a partly-fragmentary cross-sectional view of a magnetic head and its related members in a tape recorder according to one embodiment of this invention;

FIGURES 2(a) to 2(c) are schematic illustrations showing the manner of turning of a magnetic head, the dimensional relation between the magnetic head and its associated cassette window, and the maximum turning radius of the magnetic head respectively;

FIGURE 3 is a perspective view showing the manner of arrangement of tape guides by way of example;

FIGURES 4(a) to 4(d) schematically illustrate effects of the exemplified structure in comparison with a conventional structure;

FIGURES 5(a) to 5(d) are respectively partly-
5 fragmentary cross-sectional views of magnetic heads and their related members in tape recorders according to other embodiments of this invention;

FIGURE 6 is a partly-fragmentary cross-sectional view of a magnetic head and its related members in
10 a conventional tape recorder; and

FIGURES 7(a) and 7(b) schematically illustrate problems of the conventional structure of FIGURE 6.

DETAILED DESCRIPTION OF THE ILLUSTRATED CONSTRUCTIONS

With reference to the accompanying drawings
15 and first to Figs. 6, 7(a) and 7(b) a turning shaft 64 (see Fig. 6) is fixed on a head mount 62, which carries a magnetic head 61 thereon, with the central axis of turning of the turning shaft 64 being coincided with the central axis of turn-over of the head 61.
20 The turning shaft 64 is also supported turnably on a bearing 65. By turning a disk-shaped flange 66 secured fixedly on the lower extremity of the turning shaft 64, the head 61 is caused to turn about the central axis of its turning so that the head 61 is held at
25 a predetermined position (the position turned over 180°)

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by a stopper 63.

Due to the existence of a clearance between the turning shaft 64 and the bearing 65, the magnetic head 61 is off-centered (i.e., deviated from the center) or tilted. When such off-centering or inclination takes place, the optimum positional relation between the head 61 and an associated magnetic tape is affected adversely so that the acoustic characteristics are lowered significantly. It has hence been necessary to provide a tape guide 67 on a side wall of the head 61 in order to maintain the precise positional relation between the head 61 and the tape.

Where the tape guide 67 is fixed on the side wall of the head 61, it is necessary to cause the head 61 to retract whenever it is desired to turn the head 61 over 180° upon each change-over of the running direction of the tape. It is hence necessary to shift the head 61 back and forth, to say nothing of turning over the head 61. This has led to the need for a complex mechanism to shift the head 61. If the maximum turning radius of the head 61 is greater than one half of the height of the usual window 68 of a tape cassette in which the head is entered, it is impossible to turn the head 61 while it is positioned in the window of a cassette. In this case, it is indispensable to

cause the head 61 to retract from the interior of the cassette.

Referring now to Fig. 1, numeral 11 indicates a magnetic head which is mounted on a head mount 12.

5 A turning shaft (turning member) 14 is fixed along with a stopper 13 on the head mount 12. The stopper 13 serves as a member for controlling the position of the head 11 when the head has been turned over 180°. The turning shaft 14 is fixed on the head mount 12 with the

10 central axis of turning of the turning shaft 14 being coincided with the central axis of turn-over of the head 11. The turning shaft 14 is supported turnably by a bearing (bearing member) 15. The outer periphery of the turning shaft 14 is formed at an area near the upper end

15 thereof into a tapered surface 14a. The tapered surface 14a flares out toward the upper end of the turning shaft 14. Furthermore, the inner periphery of the bearing 15 is also formed at an area near the upper end thereof into a tapered surface 15a. The tapered surface 15a is

20 formed in opposition to the tapered surface 14a and flares out toward the upper end of the bearing 15.

A disk-shaped flange 16 with teeth 16a formed on the outer periphery thereof is secured fixedly on the lower end of the turning shaft 14. A turning drive force

25 is transmitted to the flange 16 so as to turn the

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head 11. A spring (push spring) 17 is arranged between the bearing 15 and the flange 16. The spring 17 serves to urge the turning shaft 14 in the downward direction as viewed in FIGURE 1.

5 Upon transmission of the turning force to the flange 16, the magnetic head 11 is turned over 180° as depicted in FIGURE 2(a). In the playback or recording mode, the head 11 is inserted in a window 18 of a tape cassette as shown in FIGURE 2(b) so that the head is
10 maintained in contact with the magnetic tape (not shown). Here, the head 11 has such dimensions that the maximum turning radius R of the head 11 is smaller than one half of the height (9.8 mm) of the window 18 [see, FIGURE 2(b) and 2(c)]. Unlike conventional structures,
15 no tape guide is fixed on the head 11. Instead, tape guides 19,19 are provided at locations spaced from the head 11.

 Since the turning shaft 14 is urged downwardly by the spring 17 in the above-described structure, the
20 tapered surface 14a of the turning shaft 14 and the tapered surface 15a of the bearing 15 are pressed against each other. The off-centering and inclination of the head 11 are therefore reduced to extremely small angles. A conventional structure and the structure of
25 the first embodiment of this invention are now compared

with reference to FIGURES 4(a) through 4(d). Let's now assume that as shown in FIGURES 4(a) and 4(b), the outer diameters of the turning shafts are d_1, d_2 , the inner diameters of the bearings D_1, D_2 , and the axial lengths of the bearings L_1, L_2 (note: $d_1 = d_2$, $D_1 = D_2$, and $L_1 = L_2$). The degree Δx_1 of off-centering in the conventional structure is expressed by the following equation.

$$\Delta x_1 = \frac{D_1 - d_1}{2}$$

On the other hand, the degree Δx_2 of off-centering in the structure of this embodiment is zero ($\Delta x_2 = 0$) because the tapered surfaces 14a and 15a are maintained in tight contact with each other by the spring force.

Regarding the inclination on the other hand, the inclination α_1 of the turning shaft in the conventional structure is expressed by the following equation as depicted in FIGURE 4(c).

$$\alpha_1 \approx \sin^{-1} \frac{D_1 - d_1}{L_1}$$

In the structure of the embodiment, the inclination α_2 of the turning shaft is expressed by the following equation as shown in FIGURE 4(d).

$$\alpha_2 \approx \sin^{-1} \frac{D_2/2 - d_2/2}{L_2}$$

Therefore, the inclination α_2 in the structure of the illustrated embodiment is one half of the inclination

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α_1 in the conventional structure. In addition, the center O_2 of the inclination is located at a point closer to the head in the structure of the illustrated embodiment compared with O_1 in the conventional structure.

5 The influence of the inclination on the deviation in height H of the head is extremely little in the structure of the illustrated embodiment. Namely, the deviation in height H of the head by the inclination is expressed by the following equation:

10 In the conventional structure:

$$h_1 = \tan \alpha_1 \times (L/2 + H)$$

In the structure of the illustrated embodiment:

$$h_2 = \tan \alpha_2 \times (H)$$

Even if α_1 is assumed to be equal to α_2 ($\alpha_1 = \alpha_2$),

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$$h_1 : h_2 = (L/2 + H) : (H)$$

Even at the same inclination, the deviation in height H is smaller in the case of h_2 . Since $\alpha_2 = \alpha/2$, the deviation in the case of h_2 in height of the head in the structure of the illustrated embodiment should
20 be extremely small.

In the illustrated embodiment, the tapered surfaces 14a, 15a are provided respectively with the turning shaft 14 and bearing 15 and the tapered surfaces 14a, 15a are maintained in tight contact by the
25 urging force of the spring 17. It is hence possible to make the off-centering and inclination of the magnetic



head 11 extremely small. Since the off-centering and inclination of the magnetic head 11 have been eliminated substantially, it is no longer required to provide a tape guide on a side wall of the head 11. Namely,
5 the tape guides 19,19 are provided at the locations spaced from the head 11. It is hence possible to cause the magnetic head 11 to turn while maintaining same in contact with the associated magnetic tape. By choosing the dimensions of the head 11 as shown in FIGURE 2(b),
10 it is also possible to allow the head 11 to turn while maintaining the head 11 in a position inserted in the window 18.

According to this embodiment, it is therefore possible to cause the magnetic head 11 to turn over
15 180° while maintaining the head 11 in contact with the magnetic tape in both recording and playback modes. It is hence possible to obviate any mechanism which is otherwise required to cause the magnetic head to retreat and advance upon each reversal of the running
20 direction of magnetic tape, leading to significant simplification to the turn-over and drive mechanism of the head 11 and hence a reduction to the manufacturing cost. Since it is no longer required to cause the head 11 to retreat and then to advance, another advantage
25 has also been brought about that the time required for the reversal of the head 11 can be shortened.

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FIGURES 5(a) to 5(d) are respectively partly-fragmentary cross-sectional views of magnetic heads and their related members in tape recorders according to other embodiments of this invention. In FIGURE 5(a), the tapered surfaces are enlarged, namely, the axial dimensions of the tapered surfaces are long. In FIGURE 5(b), tapered surfaces are formed at two locations, namely, at upper and lower end portions by way of example. In FIGURE 5(c), two tapered surfaces are formed at both upper and lower end portions of the bearing 15 and a resiliently yieldable skirt 27 is formed integrally with the turning shaft 14. The resiliently yieldable skirt 27 is maintained in contact with the lower tapered surface of the bearing 15. In FIGURE 5(d), a short resiliently yieldable cylinder 37 which is formed as an integral member with the disk-shaped flange 16 is in abutment with the lower end surface of the bearing 15. Needless to say, all of these modified structures can bring about the same advantageous effects as the above-described first embodiment of this invention.

It should be borne in mind that the present invention is not necessarily limited to or by the above-described embodiments. For example, it is not essential to provide tapered surfaces on both turning



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member and bearing member. It is still acceptable to form a tapered surface on either one of the turning member and bearing member. It is also feasible to use a solenoid as a means for urging the turning member.

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CLAIMS:

1. A tape recorder in which a magnetic head is turned over 180° upon each change-over of the running direction of a magnetic tape so as to effect the change-over from one playback track to another or from one recording track to another and in which a tapered surface is formed on at least one of a turning member with the magnetic head mounted thereon and a bearing member with the turning member supported turnably thereon, and an urging means is provided to urge the turning member in the axial direction thereof so as to maintain the tapered surface in contact with the associated member.
2. A tape recorder as claimed in claim 1, wherein said urging means is a spring.
3. A tape recorder as claimed in claim 1, wherein said urging means is a solenoid.
4. A tape recorder as claimed in claim 1, wherein a resiliently yieldable portion is formed on either one of the turning member and bearing member and the resiliently yieldable portion is maintained in contact with the associated member by the resiliency thereof acting as said urging means.
5. A tape recorder as claimed in Claim 4, wherein the resiliently yieldable portion is formed



on the turning member.

6. A tape recorder in which a magnetic head is turned over 180° upon each change-over of the running direction of a magnetic tape so as to effect the change-over from one playback track to another or from one recording track to another, substantially as hereinbefore described with reference to, and as shown in Figs. 1 to 3 or Fig. 4(b) or Fig. 5(a) or Fig. 5(b) or Fig. 5(c) or Fig. 5(d) of the accompanying drawings.

