

MAGNETIC TAPE CASSETTES

This invention relates to magnetic tape cassettes. Embodiments of the invention are particularly, but not exclusively, suitable for use for recording a digital signal, for example, a pulse code modulated (PCM) signal.

A recording and reproducing apparatus has been proposed in which an analog signal such as an audio signal is converted into a digital signal, for example, a PCM signal, and then recorded on (and subsequently reproduced from) a magnetic tape. Some known PCM recording and reproducing apparatus use a rotary head to provide a relatively high recording density. In such PCM recording and reproducing apparatus having a rotary head, upon recording or reproducing, a magnetic tape is drawn out from the tape cassette, wound around the rotary drum in which the rotary head is provided, and the recording and reproducing is carried out.

In a tape cassette incorporating such a magnetic tape, if an oily mark such as a fingerprint occurs on the magnetic tape, or dust adheres to the magnetic tape, a drop-out may be caused in the reproduced signal. Accordingly, in order to prevent such oily marks, and to discourage dust, the magnetic tape has to be enclosed as much as possible. Moreover, it is necessary to provide a space in front of the tape cassette through which a tape guide system is inserted into the tape cassette for drawing out the magnetic tape from the tape cassette for recording or reproducing.

Therefore, a tape cassette as shown in Figures 1 and 2 has been proposed. The tape cassette comprises a cassette casing 1 which comprises an upper half 2 and a lower half 3 which are connected by screws (not shown). A transparent window plate 2a is provided on the upper surface portion of the upper half 2. The inside of the cassette casing 1 can be seen through this transparent window plate 2a. A pair of reel hubs 4a and 4b are mounted in the cassette casing 1, and are rotatably engaged with a pair of reel shaft insertion apertures 5a and 5b which are formed through the lower half 3 at predetermined positions. A magnetic tape 6 is wound around the pair of reel hubs 4a and 4b.

Tape guide columns 7a and 7b are positioned on the lower half 3 facing the front portion of the tape cassette near the right and left side wall

portions. The magnetic tape 6 is stretched between and in contact with the tape guide columns 7a and 7b so as to run in a predetermined position relative to the front surface portion of the tape cassette. A rectangular cut-out portion 3a is formed through the lower half 3 over a predetermined width opposing the rear surface of the magnetic tape 6 stretched between the tape guide columns 7a and 7b. Upon recording and reproducing, a tape guide system is inserted into the cut-out portion 3a. The system is arranged to draw out the magnetic tape 6 and is provided in the recording and reproducing apparatus, not shown.

A front lid 8 is pivoted to the cassette front side of casing 1 through arm portions 8a and 8b which are formed at respective sides thereof. The front lid 8 is arranged to open and/or close the front surface portion of the cassette casing 1.

A sliding member 9 of substantially U-shape is provided such that it can be slidably moved back and forth in opposing relation to the lower surface and right and left side wall portions of the lower half 3. Reel shaft insertion apertures 9a and 9b are formed through the sliding member 9 at positions such that when the sliding member 9 is slidably moved backwards so as to expose the cut-out portion 3a, they correspond in position with the reel shaft insertion apertures 5a and 5b, respectively. Positioning holes 10a and 10b are formed from the lower surface portion of the lower half 3 in correspondence with the tape guide columns 7a and 7b.

As shown in Figure 3, the tape cassette is formed such that the front lid 8, the sliding member 9 and a reel brake member 11, which will be described later, are respectively assembled between the upper half 2 and the lower half 3 at predetermined positions, each being made of synthetic resin, for example, ABS resin.

The lower half 3 will now be further described with reference to Figure 3. The lower half 3 comprises a flat plate portion of substantially rectangular shape through which the reel shaft insertion apertures 5a and 5b are formed, and a frame portion which comprises right and left side wall portions, except the front surface portions at which the front lid 8 is disposed, and a rear surface wall portion. The right and left side wall portions and the lower surface portion of the lower half 3 other than the slidable range of the sliding member 9 are thinned by the thickness of the sliding member 9, whereby the right and left side wall portions and the

lower surface portion of the lower half 3 corresponding to the slidable range of the sliding member 9 are stepped. Thus, when the sliding member 9 is engaged with the lower half 3, there is no step between the lower half 3 and the sliding member 9. The right and left side wall portions of the lower half 3 near the front surface portion thereof are stepped inwardly to have steps corresponding to the thickness of the arm portions 8a and 8b of the front lid 8, thereby to form support walls 12, 12. Formed on the support walls 12, 12 are cut-out portions 12a, 12a which will form shaft apertures rotatably to pivot the shafts of the front lid 8, as will be described later.

On the support walls 12, 12 rearward of the cut-out portions and at their intermediate positions in the up and down direction are formed cut-out portions 12b, 12b of rectangular shape, and operating member insertion apertures 13, 13 of rectangular shape are formed through the support walls 12, 12 at the positions at which, when the front lid 8 is rotated upwards, the lower portions of the rear surface portions of the arm portions 8a and 8b of the front lid 8 cover the support walls 12, 12. Namely, at the positions of the front surface portions of the support walls 12, 12 near the lower ends thereof. When the lower half 3 and the upper half 2 are coupled to each other, the support walls 12, 12 and support walls of the upper half 2, which will be described later, abut against one another to permit the cut-out portions 12a, 12a and 12b, 12b respectively to form the shaft apertures and tape end sensing apertures.

Shield walls 14a, 14b and 14c are respectively formed at the right and left side portions and rear surface portion of the cut-out portion 3a, whereby the inside of the cassette casing 1 is shielded from the cut-out portion 3a. Formed on the upper edge portions of the right and left side wall portions of the lower half 3 are lateral grooves 15, 15 which are parallel to the front to back direction. Formed beneath the lateral grooves 15, 15 are slide guide grooves 16, 16 of rectangular shape in cross-section in correspondence with the slidable range of the sliding member 9. The depths of the lateral grooves 15 and the slidable guide grooves 16 are selected to be smaller than the thicknesses of the arm portions 8a, 8b of the front lid 8.

Collar or flange portions 17a and 17b of annular shape are formed around the pair of reel shaft insertion apertures 5a and 5b. A spring incorporating portion 18 of rectangular shape is formed at the intermediate position between the reel shaft insertion apertures 5a and 5b parallel to the

front and rear direction. A spring engaging column member 19 is positioned near the front surface portion side of the spring incorporating portion 18. Within the spring incorporating portion 18 is a coil spring 28 for biasing the sliding member 9 as will be described later. The coil spring 28 is engaged at one end with the spring engaging column member 19.

Next, the upper half 2 will be described with reference to Figures 3 and 4. Similar to the lower half 3, the upper half 2 comprises a flat plate portion of substantially rectangular shape through which the transparent window plate 2a is formed, and a frame portion which is formed of the right and left side wall portions and the rear surface wall portion except the front surface portion in which the front lid 8 is disposed. The outer dimension of the upper half 2 is selected to be substantially the same as the outer dimension of the lower half 3 when it is assembled with the sliding member 9, so that when they are assembled, there is no step between the upper half 2, the lower half 3 and the sliding member 9. Support walls 20, 20 are formed such that the portions of the right and left side wall portions near the front surface portion of the cassette casing are respectively stepped inwardly by the thicknesses of the arm portions 8a and 8b of the front lid 8 in correspondence with the support walls 12, 12 of the lower half 3. The shape of the abutting portions of the support walls 20, 20 and that of the abutting portions of the support walls 12, 12 of the lower half 3 are made complementary to each other. Tape end sensing apertures 20a, 20a are formed through the support walls 20, 20 at their rear and upper surface portions. Transparent prisms 21, 21 of substantially L-shape for detecting or sensing the tape end are located at the inside of the support walls 20, 20 in correspondence with the tape end sensing cut-out portions 12b, 12b and apertures 20a, 20a as shown in Figure 5. The prisms 21, 21 serve to form the optical paths for the tape end detecting light. A shield wall 14d is formed in correspondence with the shield wall 14c formed at the rear of the cut-out portion 3a of the lower half 3. When the upper half 2 and the lower half 3 are coupled to each other, the shield wall 14d of the upper half 2 and the shield wall 14c of the lower half 3 abut, thereby to shield the inside of the cassette casing 1 from the cut-out portion 3a.

Collar or flange portions 22a, 22b, 22c and 22d of arcuate shape are formed so as to correspond to the annular collar portions 17a and 17b formed on the lower half 3. By the cooperation of the collar portions 22a,



22b and 22c, 22d of the upper half 2 with the collar portions 17a and 17b of the lower half 3, the reel hubs 4a and 4b around which the magnetic tape 6 is wound are respectively supported so as to be able to rotate. In this case, the heights of the collar portions 22a, 22b, 22c and 22d are selected to be substantially the same as the thickness of the portions of the reel brake member 11, which will be described later, and which portions are along the upper half 2 so that the reel brake member 11 is prevented from protruding beyond the collar portions 22a, 22b, 22c and 22d. Thus the magnetic tape 6 wound around the pair of reel hubs 4a, 4b is protected.

A fixing boss 22e of U-shape is formed in correspondence with the spring engaging column member 19 formed on the lower half 3. When the upper half 2 and the lower half 3 are coupled to each other, the spring engaging column member 19 is located within the opening portion of the fixing boss 22e, and hence one end of a coil spring 28, to be described later, is fixed by the end portion of the fixing boss 22e. Concave and convex portions 23, 23 are formed on the right and left side wall portions near the rear surface portion for preventing any sliding of the cassette casing 1. Support pockets 24, 24 of substantially V-shape are formed substantially at the central portions of the right and left side wall portions. When the tape cassette is loaded on the recording and reproducing apparatus, the support portions 24, 24 are held by support projections (not shown) from both right and left directions.

The reel brake member 11 will be further described with reference to Figure 3. The reel brake member 11 comprises a slide guide plate 11a along the inner surface of the upper half 2, and arms 11b and 11c of L-shape which are respectively extended downwards and perpendicularly from end portions of the slide guide plate 11a. Brake projection members 11d and 11e corresponding to the pair of reel hubs 4a and 4b are formed at the rear surface portion side of the slide guide plate 11a. In correspondence with the brake members 11d and 11e, ratchet wheels are formed on the outer peripheral portions of the reel hubs 4a and 4b near the upper half 2.

A spring engaging portion 11f is provided at the central portion of the slide guide plate 11a and operating members 11g and 11h are respectively formed on the end portions of the arms 11b and 11c. A spring 25 which is used to bias the reel brake member 11 is engaged with the spring engaging portion 11f, and the free ends of the spring 25 urge the shield wall 14d of

the upper half 2 so that the brake members 11d and 11e are engaged with the ratchet wheels formed on the outer peripheral portions of the reel hubs 4a and 4b by the biasing force of the spring 25, whereby the pair of reel hubs 4a and 4b are locked so as not to be rotated. Moreover, when the reel brake member 11 is disposed within the cassette casing 1, the end portions of the operating members 11g and 11h are respectively protruded through the operating member insertion apertures 13, 13 of the lower half 3 to the outsides of the support walls 12, 12 by a predetermined amount, whereby when the front lid 8 is rotated upwards, the operating members 11g and 11h thus protruded are urged by the end portions of the arm portions 8a and 8b of the front lid 8, the reel brake member 11 is slid forward against the biasing force of the spring 25, and hence the brake members 11d and 11e are disengaged from the ratchet wheels of the reel hubs 4a and 4b, whereupon the pair of reel hubs 4a and 4b become rotatable.

The front lid 8 will now be further described with reference to Figure 3. The front lid 8 comprises a plate portion 8c which closes the front surface portion of the cassette casing 1 and arm portions 8a and 8b provided at the side end portions of the plate portion 8c so as to oppose each other and be of substantially U-shape viewed from above. When the front lid 8 is rotated to the position to close the front surface portion of the cassette casing 1, the arm portions 8a and 8b of the front lid 8 cover the right and left side support walls 20, 20 of the upper half 2, and when the front lid 8 is at this rotational position, the sliding member 9 can be located under the arm portions 8a and 8b. Rotary shafts 8d, 8d are provided at substantially the central positions on the inner surfaces of the arm portions 8a and 8b. Cut-away portions 8e and 8f are formed by cutting away the plate portion 8c to U-shape in correspondence with both the right and left sides of the cut-out portion 3a of the lower half 3.

The sliding member 9 will be described more fully with reference to Figures 3 and 6. The sliding member 9 comprises a flat plate portion 9c which lies along the lower surface portion of the lower half 3, and side plate portions 9d and 9e which are located at the right and left sides of the flat plate portion 9c and along the right and left side wall portions of the lower half 3 so as to be substantially U-shaped as seen from the front and rear direction. Bent portions 9f and 9g are provided by bending the upper end portions of the side plate portions 9d and 9e to a hook shape. The bent



portions 9f and 9g are located within the lateral grooves 15, 15 when the sliding member 9 is assembled with the cassette casing 1 as shown in Figure 6. In correspondence with the slide guide grooves 16, 16 of the lower half 3, projected portions 26, 26 are formed at the left and right side plate portions 9d and 9e at their predetermined positions which protrude to the side of the cassette casing 1. The cassette casing sides of the projected portions 26, 26 are formed as smooth curved surfaces so as to make the contact angles with the slide guide grooves 16, 16 obtuse angles as shown in Figure 6. Thus, the contact of the top surfaces of the projected portions 26, 26 with the bottom surfaces of the slide guide grooves 16, 16 position the sliding member 9 in the left and right direction of the cassette casing 1, while the contact of the upper and lower side portions of the top portions of the projected portions 26, 26 with the side surface portions of the slide guide grooves 16, 16 positions the sliding member 9 in the up and down direction of the cassette casing 1. Protruded portions 27, 27 are formed on the flat plate portion 9c near both the left and right sides thereof and parallel to the back and forth direction thereof. The protruded portions 27, 27 and the projected portions 26, 26 are slidably movable relative to the cassette casing 1. A spring engaging member 9h is formed on the flat plate portion 9c in correspondence with the spring incorporating portion 18 of the lower half 3.

A tension coil spring 28 biases the sliding member 9. One end of the tension coil spring 28 is engaged with the spring engaging column member 19 of the lower half 3 and the other end thereof is engaged with the spring engaging member 9h, with the result that the sliding member 9 is biased forward to close the cut-out portion 3a. Contact members 9i and 9j extend perpendicularly from the front end portion of the flat plate portion 9c so as to correspond with the cut-away portions 8e and 8f of the front lid 8.

The operation of the tape cassette thus made will be described with reference to Figures 7 to 10.

When not in operation, as shown in Figures 7 and 8, the front surface portion of the cassette casing 1 is closed by the front lid 8, and the sliding member 9 biased by the coil spring 28 is slid forward. At that time, the reel brake member 11 is biased in the backward direction by the spring 25, and hence the brake members 11d and 11e are engaged with the ratchet wheels of the reel hubs 4a and 4b, so that the reel hubs 4a and 4b are locked so as not to rotate. The reel shaft insertion apertures 5a and 5b of the casing 1,

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and the corresponding reel shaft insertion apertures 9a and 9b formed through the sliding member 9 are displaced in position from each other and the cut-out portion 3a of the cassette casing 1 is closed by the sliding member 9 so that the magnetic tape 6 is enclosed tightly against dust, which is prevented from entering through the reel shaft insertion apertures 5a and 5b and the cut-out portion 3a to adhere to the magnetic tape 6, and against fingers and the like touching the magnetic tape 6. Furthermore, the side plate portions 9d and 9e of the sliding member 9 are located beneath the arm portions 8a and 8b of the front lid 8 and the upper end surfaces of the side plate portions 9d and 9e of the sliding member 9 abut the lower end surfaces of the arm portions 8a and 8b of the front lid 8, whereby the front lid 8 can be locked so as not to rotate. As a result, when not in operation, the front lid 8 can be prevented from being rotated unintentionally to expose the magnetic tape 6 at the front surface portion of the cassette casing 1.

During operation, the tape cassette is loaded on the recording and reproducing apparatus. That is, when the tape cassette is inserted into the recording and reproducing apparatus, fixed projection members (not shown) of the recording and reproducing apparatus project through the cut-away portions 8e and 8f of the front lid 8 to contact members 9i and 9j of the sliding member 9. Then, when the tape cassette is further inserted to the predetermined position in the recording and reproducing apparatus in the above state, when the sliding member 9 is fixed by the fixed projection members of the recording and reproducing apparatus side, the cassette casing 1 is moved against the biasing force of the coil spring 28 and hence the sliding member 9 is slid backwards, relative to the cassette casing 1. In this case, since the projected portions 26, 26 having the smooth curved surfaces slidably engage with the slide guide grooves 16, 16 of the cassette casing 1, even if the sliding member 9 is slid along the cassette casing 1, the sliding guide grooves 16, 16 of the cassette casing 1 are not scarred. Moreover, since the sliding member 9 is slidably supported on the cassette casing 1 by the projected portions 26, 26 and the protruded portions 27, 27, the contact area of the cassette casing 1 with the sliding member 9 is relatively small, so that the sliding resistance of the sliding member 9 against the cassette casing 1 can be small.

As described above, since the sliding member 9 is slid backwards, the



cut-out portion 3a and the positioning apertures 10a and 10b are opened, and the reel shaft insertion corresponding apertures 9a and 9b of the sliding member 9 are made to correspond with the reel shaft insertion apertures 5a and 5b of the cassette casing 1 so that the reel shaft insertion apertures 5a and 5b are opened. In this state, the front lid 8 is rotated upwards by a lid rotating member (not shown) of the recording and reproducing apparatus and put into the state as shown in Figures 9 and 10. In this case, when the front lid 8 is rotated in the upward direction, the operating members 11g and 11h of the reel brake member 11 are pressed forward by the lower end portions of the arm portions 8a and 8b thereby to slide the reel brake member 11 forward against the biasing force of the spring 25. At that time, the engagements between the brake members 11d and 11e of the reel brake member 11 and the ratchet wheels of the reel hubs 4a and 4b are released to release the reel hubs 4a and 4b from the locked state, so that the reel hubs 4a and 4b can rotate.

In this state, positioning pins (not shown) and reel shafts (not shown) of the recording and reproducing apparatus are respectively inserted into the positioning apertures 10a and 10b and the reel shaft insertion apertures 5a and 5b, the magnetic tape 6 is exposed at the front surface portion of the cassette casing 1, and the tape guide system (not shown) is inserted into the cut-out portion 3a. Thus, by this guide system, the magnetic tape 6 is drawn out forwards and loaded on the rotary drum of the recording and reproducing apparatus, and then the predetermined recording and playback may be carried out.

When the mode of the magnetic tape cassette is changed from use-mode to non-use-mode, an operation opposite to the above operation will be carried out.

The portions inside the left and right support walls 12, 12 and 20, 20 of the tape cassette thus made are complicated in construction and restricted in space. Accordingly, the tape end sensing prisms 21, 21 which are respectively fixed to the insides of the left and right support walls 20, 20 have to be extremely small, and to attach these small prisms 21, 21 to the insides of the left and right support walls 20, 20 in corresponding with the tape end sensing apertures 20a, 20a is inevitably very difficult.

According to the present invention there is provided a magnetic tape cassette comprising:

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- a cassette casing having therein a pair of reel hubs around which a magnetic tape is wound;
- a transparent window plate formed on an upper surface of said cassette casing through which said pair of reel hubs can be seen;
- 5 an optical guide provided in a tape running path adjacent to a side wall of said cassette casing for detecting a tape end; and
- a coupling member for coupling said transparent window plate to said optical guide;
- 10 said transparent window plate, said optical guide and said coupling member being formed integrally of transparent synthetic resin.

The invention will now be described by way of example with reference to the accompanying drawings, throughout which like parts are referred to by like references, and in which:

15 Figure 1 is a perspective view showing an example of a prior art tape cassette having a rotatable front lid and a slider;

Figure 2 is a perspective view of the cassette of Figure 1 in which the front lid thereof is rotated in the upward direction and the slider is slid backwards;

Figure 3 is an exploded perspective view of the cassette of Figure 1;

20 Figure 4 is a perspective view showing the inside of the upper half of the cassette of Figure 1;

Figure 5 is a cross-sectional view for explaining a prism used in the cassette of Figure 1;

25 Figure 6 is a cross-sectional view for explaining the slider used in the cassette of Figure 1;

Figure 7 is a perspective view showing the cassette of Figure 1 in its non-use-mode;

Figure 8 is a schematic diagram for explaining Figure 7;

30 Figure 9 is a perspective view showing the cassette of Figure 1 in its use-mode;

Figure 10 is a schematic diagram for explaining Figure 9;

Figure 11 is a plan view showing part of an embodiment of magnetic tape cassette according to this invention; and

35 Figures 12 and 13 are respective cross-sectional views for explaining another embodiment of magnetic tape cassette according to this invention.

In the embodiment of Figure 11, a transparent window plate 2a' and

tape end sensing prism plates 21', 21' are formed integrally by a transparent synthetic resin, for example, acryl resin. The integrated transparent member 29 is so formed that the window plate 2a' and the prisms 21', 21' may be located relative to the upper half 2 in predetermined positions. Although not shown, the upper half 2, the lower half 3, the brake member 11, the front lid 8 and the sliding member 9 of this embodiment are formed similarly to those of the magnetic tape cassette as shown in Figures 1 to 10.

With this embodiment of tape cassette, upon assembly, if the integrated transparent member 29 is attached to the upper half 2 such that the transparent window plate 2a' is positioned at the predetermined position of the upper half 2, the extremely small prisms 21', 21' are automatically positioned at the insides of the support walls 20, 20 at their predetermined proper positions. Accordingly, since it becomes unnecessary that the very small prisms 21', 21' be individually attached to the upper half 2 at predetermined positions, assembly of this embodiment is much easier. Moreover, since the window plate 2a' and the prisms 21', 21' are formed integrally, it is possible to reduce the number of manufacturing steps, so the cassette can be produced at lower cost.

Figures 12 and 13 show part of another embodiment of magnetic tape cassette according to this invention.

In this embodiment, in manufacture, the integrated transparent member 29 and the upper half 2 are formed integrally. More specifically, as shown in Figure 12, into a cavity 32, which is formed by a first lower metal mould 30, and into an upper metal mould 31 in which the upper half 2 will be formed, a melted opaque resin is injected through a gate 31a, thereby to injection-mould the upper half 2. Thereafter, the first lower metal mould 30 is removed and then, as shown in Figure 13, a second lower metal mould 33 is coupled to the upper metal mould 31, and the upper half 2 is thus moulded. Then, into a cavity 34, which is formed by the second lower metal mould 33, the upper metal mould 31 and the upper half 2 and in which the integrated transparent member 29 will be formed, a melted transparent resin is injected through a gate 31b whereby the integrated transparent member 29 is injection-moulded. When the melted transparent resin is injected into the cavity 34, due to the heat and the injection pressure of the melted transparent resin, the contact area of the hardened upper half 2 with the melted transparent resin is put into a half-melted state. Then, when the

upper half 2 in the half-melted state is again hardened and the transparent resin is also hardened, the integrated transparent member 29 which is made of transparent resin is formed integrally with the upper half 2.

5 With this embodiment, in manufacture, since the integrated transparent member 29 and the upper half 2 are formed as a unitary body, it is possible to achieve a similar action and effect to those of the embodiment shown in Figure 11, and also considerably to simplify the manufacturing process of the magnetic tape cassette.

10 While in the above embodiments the tape end sensing prisms 21', 21' are used as the tape end detecting transparent member, it can easily be understood that other transparent optical guide members for detecting the kind of magnetic tape or the like can be used with a similar action and effect to those of the above embodiments.

CLAIMS

1. A magnetic tape cassette comprising:

a cassette casing having therein a pair of reel hubs around which a magnetic tape is wound;

5 a transparent window plate formed on an upper surface of said cassette casing through which said pair of reel hubs can be seen;

an optical guide provided in a tape running path adjacent to a side wall of said cassette casing for detecting a tape end; and

a coupling member for coupling said transparent window plate to said optical guide;

10 said transparent window plate, said optical guide and said coupling member being formed integrally of transparent synthetic resin.

2. A magnetic tape cassette according to claim 1 wherein a respective
15 said optical guide is provided in a said tape running path adjacent to each side wall of said cassette casing, and said optical guides are coupled to said transparent window plate by respective said coupling members which extend from each end portion of said transparent window plate.

3. A magnetic tape cassette substantially as hereinbefore described
20 with reference to Figures 1 to 10 as modified by Figure 11 of the accompanying drawings.

4. A magnetic tape cassette substantially as hereinbefore described
25 with reference to Figures 1 to 10 as modified by Figures 12 and 13 of the accompanying drawings.
