

A TAPE END DETECTING DEVICE

The present invention relates to a device for
5 detecting the end of a tape, for example in an analog or
digital video or audio cassette tape player and/or recorder
or tape deck.

In a conventional cassette tape for use in video or
audio cassette tape players and/or recorders, the magnetic
10 tape enclosed in a cassette housing has transparent
portions at both ends thereof, which are used to detect the
end of the tape by means of a tape end detecting device
comprising a pair of light emitting and receiving elements.
The light emitting element of the tape end detecting device
15 is usually supported by a holder positioned on a circuit
board in such a way as to be at the same height as the
running tape, while the light receiving elements are fitted
to the tape deck chassis.

In such arrangement, it has been found that the
20 holder projecting from the surface of the circuit board is
susceptible to being damaged upon building up of the
circuit board. In addition, each of the light receiving
elements must be connected by wire to a tape end signal
generating circuit formed on the circuit board, resulting
25 in a complex construction and assembly operation.

Furthermore, a conventional tape end detecting device
has the disadvantage that it may generate a detecting

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signal when the housing of the tape deck is opened for various services including repair, because the receiving element would be energized by outside light.

An aim of the present invention and/or the preferred
5 embodiment thereof is to provide a tape end detecting device which can operate to detect the end of the magnetic tape with a good response. Another such aim is to provide a tape end detecting device with a simple construction which enables reduction of manufacturing costs due to
10 simplification of the assembling of the circuit board and wiring.

According to the present invention, there is provided a tape end detecting device for detecting the end of the tape of a tape cassette, comprising:

15 light emitting means for generating a light pulse signal; and

a tape end signal generating circuit comprising light receiving means to receive said light pulse signal after its passage through the tape of the tape cassette, a high
20 pass filter, and a comparator for comparing an output of the light receiving means with a reference voltage.

By arranging the tape end signal generating circuit to operate only when a light pulse signal having a predetermined frequency is received, the tape end detecting
25 device may be prevented from being operated by light received from outside.

In a preferred embodiment of the present invention,

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the central prism has an inlet surface disposed above the light emitting element and first and second reflecting surfaces disposed within the cassette, the first reflecting surface being formed to direct the light beam from the
5 light emitting element to the inlet surface of the first side prism, and the second reflecting surface being formed to direct the light beam from the light emitting element to the inlet surface of the second side prism.

The first and second reflecting surfaces may be
10 formed in an X- or V-shaped cut-out portion formed on top of the central prism.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

15 Fig. 1 is a plan view of a portion of a VHS video tape deck equipped with a first embodiment of a tape end detecting device in accordance with the present invention;

Fig. 2 is a plan view of the driving mechanism of the tape deck shown in Fig. 1;

20 Fig. 3 shows a geometrical arrangement of the prisms of the tape end detecting device of Fig. 1;

Figs. 4 and 5 show the relationship between the cassette and the prisms;

Fig. 6 shows the relationship between the central and
25 side prisms;

Fig. 7 is a top plan view of the central prism;

Fig. 8 shows a preferred angular arrangement of the



central prism;

Fig. 9 shows the relationship between the central and side prisms of another embodiment of a device in accordance with the present invention; and

5 Fig. 10 is a circuit diagram of a tape end signal generating circuit of an embodiment of device in accordance with the present invention.

 The tape deck of Figs. 1-5 includes a deck chassis 1 of substantially rectangular shape in plan view, and a
10 rotatable head cylinder 2 bearing recording and playback heads. Tape loading pins 3 and 4 are supported by the slidable members 7 and 8 respectively. The members 7 and 8 are movable along the rails 5 and 6 respectively, for use in guiding a magnetic tape 9a enclosed in a cassette 9
15 between the predetermined loaded position and unloaded position. A pair of tape reels of the cassette are engaged with supply and wind up shafts 10 and 11, respectively. Numeral 13 depicts an erase head, 14 a capstan, and 15 a pinch roller.

20 A cassette holder 16 is provided for receiving the cassette 9 inserted through a port (not shown) and for transporting the cassette to a predetermined loaded position for playback or recordal. The movement of the cassette holder is guided by guide plates 17, 18. After
25 the cassette has been transported to its loaded position, a loading mechanism, including a loading motor 20 and a tape loading lever 21, brings the magnetic tape into a

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prescribed position in which the tape is ready to run. The loading motor 20 also acts to drive the cassette holder 16 to move it. The specific construction and operation of the loading mechanism is well known to those skilled in the art.

A recording/playing circuit and a motor controlling circuit are formed on a circuit board 23 secured to the chassis 1 by means of screws 24.

As best shown in Figs. 4 and 5, a light emitting element, such as a light emitting diode (LED) 25, and a pair of light-receiving elements, such as phototransistors 26A and 26B, of a tape end generating circuit (which will be described below) are disposed on the circuit board 23.

The illustrated tape end detecting device also comprises a central prism 27 and a pair of side prisms 31 and 32. The central prism 27 is an elongated rod having an inlet surface 27a and two reflecting surfaces 27b, 27c, and is securely fitted to the circuit board 1 by means of a hook 28 secured to the prism 27 near to the inlet surface. The side prisms 31 and 32 may be securely supported by the guide plate 17 and 18 by any suitable means, such as hooks 33.

The first reflecting surfaces 27b of the central prism 27 is placed to intersect the axis of the prism 27 at an angle of about 45 degrees in one direction, so as to direct the light beam from the LED 25 to the inlet end of the first side prism 31 through ports 33A, 34A formed in

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the side walls of the cassette. The second reflecting surface 27c intersects the prism axis at the same angle, but in the opposite direction to surface 27a, to direct the light beam to the inlet end of the second side prism 32 through ports 33B, 34B.

In the illustrated embodiment, the first side prism 31 is in the form of a rod having a substantially rectangular cross section, with a reflecting surface 31a at one end and an outlet end 31b at the other end. The reflecting end 31a is disposed in a plane with an angle of about 45 degrees to the axis of the prism so as to direct the light beams coming from the central prism to the outlet end 31b. The second side prism 32, on the other hand, is of crank-like configuration having inlet surface 32a and outlet surface 32b at its opposite ends, with two reflecting surfaces 32c, 32d being disposed between the inlet and outlet surfaces to direct the light beam received from the second outlet surface 27c, via the ports 33B, 34B, to the second phototransistor 26B.

Referring again to Fig. 4, which illustrates the tape deck in its operating condition with the tape cassette 9 being loaded in position, the light beam emitted from the light emitting diode (LED) 25 enters into the body of the central prism 27 through the inlet surface 27a and is divided into two beams at the reflecting surfaces 27b and 27c. The light beam reflected at the first reflecting surface 27b enters into the cassette 9 through the port 33A

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and then reaches to the tape 35. When this portion of the tape is opaque, the light beam is interrupted. However, if this portion of tape is one of the transparent portions of tape connected to either end of the magnetic tape, then the
5 light beam passes through the tape and reaches the inlet surface 31a of the first side prism 31. The first phototransistor 26A detects the light beam coming from the first side prism 31 and produces a tape end detecting signal.

10 Similarly, the light beam reflected at the second reflecting surface 27c enters into the cassette 9 through the port 33B and then reaches the tape 35. If it encounters a transparent portion of the tape, the light beam will pass through the tape, to reach the inlet surface
15 32a of the second side prism 32 and then reach the second phototransistor 26B to produce a tape end detecting signal.

Fig. 6 illustrates a geometric arrangement of the central and side prisms of the tape deck embodying the present invention designed under the JIS standards, wherein
20 the lines L1 and L2 connecting the center of the central prism 27 and the centers of the first and second side prisms 31 and 32 respectively, are inclined by 7 degrees with respect to the line X which intersects the center line of the central prism and lies in parallel with the line
25 connecting the axes of the reels of the cassette. Preferably, in order to direct the reflected light beams from the central prism to both the side prisms, the

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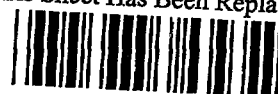
opposite side walls of the central prism are disposed in planes parallel to the lines L1 and L2, respectively. Namely, the cross section of the central prism forms a trapezoid of which both side lines are inclined at 7
5 degrees to the base line, as clearly shown in Fig. 7.

For the most efficient transmission of the light beams from the central prism to the side prisms, it is preferable that the central prism 27 be fixed in such a manner that the side line position above the line X is
10 inclined by about 6.2 degrees to the line X, and to the other side line by about 7.8 degrees, as illustrated in Fig. 8. This arrangement ensures that the light beams reflected at the reflecting surfaces 27b and 27c can be directed to the center of the receiving surface of each of
15 the side prisms.

Fig. 9 illustrates an alternative form for the central prism 27. In this embodiment, the central prism 27 has a V-shaped end for forming reflecting surfaces 27b and 27c. In this arrangement, the reflecting surfaces 27b, 27c
20 are arranged to face the inlet surfaces of the side prisms to eliminate delicate angle adjustment of the central prism as required in the arrangement shown in Fig. 5.

Fig. 10 illustrates a circuit diagram of a tape end signal generating circuit for a tape end detecting device
25 embodying the present invention, which includes a light emitting circuit having the LED 25 and a light sensing circuit having a light receiving element or phototransistor

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44 which corresponds to the phototransistor 26A or 26B shown in Fig. 4.

The light emitting circuit further comprises a transistor 41 of which the collector is connected to a DC line through a resistor 42 and the LED 25. The base of the transistor is connected to a pulse generator 43 which generates a pulse train having a desired frequency to energize the transistor 41 in a reciprocal ON and OFF operation, resulting in the generation of a light pulse signal from the LED 25.

The phototransistor 44 of the light sensing circuit is positioned to receive the light pulse signal from the LED 25 through the tape 35. The collector of the phototransistor 41 is connected to the DC power supply line, while the emitter is connected to ground via a load 46 and to the input of a comparator 45 through a high pass filter comprising a capacitor 47 and a resistor 48. The other input of the comparator 42 is connected to a reference voltage generating circuit which comprises a capacitor 49 and dividing resistors 50, 51 to generate a reference voltage at a point (a). The reference voltage is also impressed to the other input via a resistor 52. The reference voltage generating circuit sets a hysteresis-added type threshold level. The output of the comparator 45 is connected to the DC line through a resistor 53 and to an output terminal 54.

When the transparent portion of the tape of the

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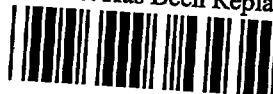
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cassette reaches a position at which the light beam from the central prism 27 can pass to one of the side prisms 31 and 32, the light beam (which is shown in Fig. 10 by the numeral L) enters the phototransistor 26A or 26B. The
5 light beam L, which is a light pulse signal from the LED 25, is directed to the base of the phototransistor 44 to energize it, thereby to generate a pulse signal at the emitter. This pulse signal passes through the high pass filter, where direct current and low frequency components
10 in the signal are cut off, and then to the input of the comparator 45. The time constant of the high pass filter should be selected in accordance with the frequency of the pulse signal. The comparator 45 functions to compare the voltage level of the input signal with the reference
15 voltage at the point (a).

When the level of the input pulse signal at a point (b) is higher than the reference voltage or a threshold level at the point (a), the output of the comparator 45 is kept at high level, so that a pulse signal is obtained at
20 the terminal 54. This signal may be used as a tape end detecting signal in a control circuit formed on the circuit board 23.

As has been stated above, the light signal used is a light pulse signal having a proper frequency, so that the
25 current value at each peak of the pulse can be double that when the LED 25 is energized by a DC current. Therefore, even when the phototransistor 44 is brought into an ON

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condition by noise caused by light entering from outside,
the wrong signal is cut off, when the parameters such as
the threshold level corresponding to the difference in
voltage between the points (a) and (b), or the time
5 constant of the high pass filter are properly selected.
Moreover, should a wrong signal reach the input of the
comparator 45, it will be suppressed by the set voltage
between the points (a) and (b). Thus, the tape end signal
generating circuit can generate a tape end detecting signal
10 only when the light pulse signal from the LED 25 is
supplied to the phototransistor 44.

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CLAIMS

1. A tape end detecting device for detecting the end of the tape of a tape cassette, comprising:

5 light emitting means for generating a light pulse signal: and

a tape end signal generating circuit comprising light receiving means to receive said light pulse signal after its passage through the tape of the tape cassette, a high
10 pass filter, and a comparator for comparing an output of the light receiving means with a reference voltage.

2. A device as claimed in claim 1, further comprising a pair of side prisms arranged to be positioned at sides of a loaded tape cassette; and

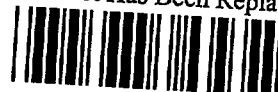
15 prism means for directing the beam of the light pulse signal from said light emitting means to said first and second side prisms;

said light receiving means comprising a pair of light receiving elements each arranged to receive said light
20 signal from said light emitting means via a respective said side prism.

3. A device as claimed in claim 2, wherein said prism means comprises a central prism having an inlet surface disposed above said light emitting element and
25 first and second surfaces arranged to be disposed within the tape cassette, said first surface being arranged to direct the beam of the light pulse signal from said light



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emitting element to an inlet surface of said first side prism, and said second surface being arranged to direct the beam of the light pulse signal from said light emitting element to an inlet surface of said second side prism.

5 4. A device as claimed in claim 3, wherein the top of said central prism is generally V-shaped and forms said first and second surfaces.

 5. A device as claimed in any of the preceding claims, wherein said light emitting means comprises a light
10 emitting diode, a transistor for controlling said light emitting diode, and a pulse generating circuit for energizing said transistor at a desired frequency.

 6. A device as claimed in any of the preceding claims, wherein said comparator is arranged to generate an
15 output when the voltage output of the light receiving means is higher than the reference voltage.

 7. A device as claimed in any of the preceding claims, wherein the time constant of the high pass filter is selected in accordance with the frequency of the light
20 pulse signal.

 8. A tape end detecting device substantially as described herein with reference to the accompanying drawings.

 9. A tape player and/or recorder including a
25 device as claimed in any of the preceding claims.



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