SPECIFICATION

Apparatus for displaying position on tape

This invention relates to an apparatus for displaying a position along on a length of tape, used for indicating the amount of tape or photographic film run or used (or left unused) or the running of the tape or of the film in a tape recorder, a video tape recorder or an 8 mm projector using recording medium such as magnetic tape or photographic film.

It is convenient for the user to display the amount of recording medium run or used or left unused in an apparatus for recording and reproducing information by running such a recording medium as magnetic tape or the like. For example, in the case where a series of long-time information such as a speech or music is recorded in plural pieces of recording medium, the display of the amount of the medium run or left unused serves as an alarm of the time for the replacement of the recording medium on the apparatus by another desired one. This alarm leads to a quick replacement. Such a display can be also used as an alarm of the time for the replacement of one recording medium by another in the reproduction of the information recorded in plural recording media.

An example of the conventional display apparatus of the kind described above is an apparatus for predicting the end of recording medium in the shape of a tape by utilizing the fact that the rotation speed of a reel support varies with the radial thickness of the roll of the tape wound on a reel which radius changes as the tape is run forward. The principle of operation of this apparatus is as follows. The change in the period of the turn-on and-off of a switch whose alternating on and off states are repeatedly produced in accordance with the rotation of the reel support, is converted to the change in voltage and the changed voltage is compared with a predetermined voltage in a voltage comparator. When the voltage associated with the switch exceeds the reference voltage (the instant this phenomenon occurs is set a few minutes before the end of a tape), a display element is actuated.

The conventional display apparatuses have been intended only to predict the end of a tape but not to indicate the amount of the tape run or left unrun or the state of a tape being run.

It is therefore the object of this invention to provide an inexpensive apparatus for displaying the amount of recording medium run or used or left unused and the state of the recording medium being run, the display by the apparatus being discernible even at a distance.

According to a major aspect of this invention, use is made of the fact that the number of revolutions or the angle of revolution of the reel support per unit time varies with the radial thickness of the roll of the tape wound on a reel, the change in the angle of rotation per unit time is converted to the change in voltage, and the number of light emitting elements to be operated is controlled in accordance with the voltage obtained as a result of the above conversion. Further, at least one of the elements being operated is intermittently deenergized while the tape is being run. Thus, the amount of recording medium run or used or left unused is displayed by the number of the light emitting elements being operated and as the tape is run forward, the number of the elements operated increases while at least one of the operated elements is intermittently deenergized and therefore extinguished. The intermittent lighting of the element can therefore indicate that the tape is being run.

According to another aspect of this invention, there is provided a tape position displaying apparatus for use in an information recording/reproducing apparatus in which information recording medium is sent from one reel to another in the recording and reproduction of information, the apparatus comprising:

a converting means for converting the angular velocity of one of the reels to a corresponding voltage;

a display means having plural light emitting elements;

a first control means which receives the voltage as the output of the converting means and controls the number of the light emitting elements to be lit up according to the amplitudes of the voltage; and

a second control means which operates in response to the rotation of the reels and intermits the energization of at least one of the light emitting elements energized by the first control means.

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

Figure 1 shows in plan a part of the tape drive mechanism of a cassette type tape recorder;

Figure 2 shows in graphical representation the relationship between the passage of time since the start of tape winding and the number of revolutions per second of the supply reel support;

Figure 3 shows in graphical representation the relationship between the passage of time after the start of tape winding and the change per unit time in the angular position of the supply reel support;

Figures 4 and 5 show rotary disc bases used in and as embodiments of this invention; and

Figure 6 shows in block diagram the whole structure of a tape position indicating apparatus according to this invention.

This invention will be described as applied to a cassette tape recorder of a reel-to-reel type in which a length of tape is wound about a pair of reels and wound up from one reel onto another or reversely.

In Fig. 1, a magnetic tape 5 wound on a supply reel is moved at a constant speed by means of a capstan 8 and a pinch roller 7 and taken up on a take-up reel 3. Reference numeral 6 indicates guide rollers provided on a cassette (not shown for simplicity) and numeral 9 designates a magnetic head. As only partially shown, the take-up reel 3 is rotated by means of a take-up reel support 1 to take up the magnetic tape 5 thereon.

It should here be noted that the revolving velocities of the reels vary with time as the length of the portion of the tape wound on the take-up reel 3 or the length of the portion of the tape left on the supply reel 4 varies. In the state shown in Fig. 1, the more the tape is taken up on the take-up reel 3, the greater is the revolving speed of the supply reel 4.

Fig. 2 shows the relationship between the passage of time T after the start of winding (or taking-up) and the number N of revolutions per second of the supply reel support 2. When the times $T_0, T_1, T_2, \ldots, T_5$ are reached, the rps (abbreviated form of revolutions per second) N of the supply reel support 2 takes values $N_0, N_1, N_2, \ldots, N_5$, respectively, as shown in Fig. 2.

Fig. 3 shows the relationship between the passage of time T after the start of winding (or taking-up) and the angle (degree) through which the supply reel support 2 rotates during a unit time (second). When the time reaches the points $T_0, T_1, T_2, \ldots, T_5$, the angle θ in degree takes values $\theta_0, \theta_1, \theta_2, \ldots, \theta_5$, respectively. The angle θ can be related to the rps N such that

$$\theta = N \times 360^\circ.$$

In this invention, the change of the angular position of the supply reel support is converted to the change in the quantity of electricity and more particularly in voltage and the change in the voltage is detected for practical use.

An angle-to-voltage converting apparatus which is the essential part of this invention, will first be explained by the aid of Fig. 4. The angle-to-voltage converter is realized by a single rotary disc base 10. The rotary disc base 10 may be integrally formed on the supply reel support or may be provided separately in such a manner that it is counterclockwise rotated, being interlocked with the supply reel support .

Fig. 4 shows the detail of the angle-to-voltage converter, in which $P_1, P_2, \ldots, P_5$ designate arcuate conductor strips having the same radius of curvature; P_7 an arcuate conductor strip to start the operation of a time-controlleld switching circuit 13; and P_6 an arcuate conductor strip to serve as a lead conductor for power source. A wire switch 11 has its contact *b* so provided as to be brought into contact with the strips $P_1, P_2, \ldots, P_5$; its contact *c* with the strip P_7; and its contact *a* with the strip P_6. Resistors $R_1, R_2, \ldots, R_5$ are provided to connect the strip P_6 respectively with the strips $P_1, P_2, \ldots, P_5$. Accordingly, when a voltage is applied to the strip P_6 through the terminal contact *a* of the wire switch 11, voltages $V_1, V_2, \ldots, V_5$ appear respectively at the conductor strips $P_1, P_2, \ldots, P_5$, where $V_1 = iR_1$, $V_2 = iR_2, \ldots, V_5 = iR_5$ and *i* is the current flowing between each pair of the conductor strips. As the rotary disc base 10 rotates, different voltages $V_1, V_2, \ldots, V_5$ are delivered successively at the contact *b* of the wire switch 11.

Now, the operation of the apparatus according to this invention will be described with the aid of Figs. 4 and 6. In Fig. 6, reference numeral 15 indicates a display means having display elements $L_1, L_2, \ldots, L_5$ such as LED's. A control circuit 14 receives a voltage input through the contact *b* of the wire switch 11. It is in the form of, for example, an integrated circuit incorporating therein plural voltage comparators having different reference voltages. Accordingly, a voltage applied at the contact *b* of the wire switch 11 is compared with the reference voltages in the voltage comparators of the control circuit 14 and the number of the display elements to be lit up of the display means 15 is controlled by the input voltage. Such as control unit in the form of an IC device can be purchased in the market and therefore it is referred to simply as a control circuit 14 in Fig. 6.

Next, the operations of the rotary disc base 10 and the time-controlled switching circuit 13 will be explained. The conductor strip P_7 is electrically connected with the conductor strip P_6 connected with the power source via the contact *a* so that when the contact *c* of the wire switch 11 touches the strip P_7, a pulse having a constant height appears at the contact *c*. The constant-voltage pulse starts the operation of the time-controlled switching circuit 13. The circuit 13 continues to operate for a predetermined period of time. While the circuit 13 is being operated, a transistor Q is kept cut off so as not to prevent the voltage at the contact *b* of the wire switch 11 from being supplied to the control circuit 14. The time for which the switching circuit 13 continues to operate for a single shot, is chosen to be shorter than the time required for the rotary disc base 10 to rotated through 360° at the greatest speed. Accordingly, when the

operating time of the switching circuit 13 lapses, the switching circuit 13 causes the transistor Q to turn on so that the voltage at the contact *b* of the wire switch 11 is reduced to the ground level. As a result, the energization of the control circuit 14 to deenergize the display means 15 is interrupted.

The relationships among the voltages delivered at the contact *b*, the display elements to be lit up, and the passage of time after the start of tape winding, will be listed as follows.

voltage at contact *b*	display elements to be lit up	passage of time
V_1	L_1	T_0–T_1
V_2	L_1, L_2	T_1–T_2
V_3	L_1, L_2, L_3	T_2–T_3
V_4	L_1, L_2, L_3, L_4	T_3–T_4
V_5	L_1, L_2, L_3, L_4, L_5	T_4–T_5

As shown in the above list, the number of the display elements to be lit up increases stepwise as the time after the start of tape winding increases. This mechanism, therefore, can stepwise indicate how long the tape is in motion, that is, the length of the part of the tape wound up on the take-up reel. Also, the time in which the part of the tape left wound on the supply reel will be completely taken up, can be displayed if the resistance values of the resistors R_1, R_2, . . . , R_5 are so adjusted that by deriving the times left until the tape is completely taken up, on the basis of the passages T_1, T_2, . . . , T_5 of time, a time of 30 minutes left may be represented by the lit-up element L_1; a time of 20 minutes left by the lit-up element L_1 and L_2; a time of 12 min. left by the energization of L_1, L_2 and L_3; a time of 6 min. left by the energization of L_1, L_2, L_3 and L_4; and a time of 3 min. left by L_1, L_2, L_3, L_4 and L_5.

Since the switching circuit 13 is designed to operate continuously for one shot during the time shorter than the time required for a cycle of the rotary disc base 10, the display means 15 never fails to be completely deenergized during each cycle of the rotary disc base 10. Accordingly, the number of the display elements lit up will increase with alternate lighting of some or more elements and extinction of all the elements as the number of revolutions of the reel increases. The alternating lighting and extinction of the display elements indicates that the tape is in motion.

Fig. 5 shows an angle-to-voltage converter as another embodiment of this invention. In this embodiment, a magnet 17 is attached to a disc 16 rotated, being interlocked with the supply reel support 2. Switches S_1, S_2, . . . , S_6 which are magnetically turned on and off are disposed in proximity to the periphery of the disc 16. The switches S_1, S_2, . . . , S_5 are connected in series respectively with resistors R_1, R_2, . . . , R_5 and each of the series circuits S_1 and R_1, S_2 and R_2, . . . , S_5 and R_5 is connected between the contacts *a* and *b* of the wire switch 11. The switch S_6 is connected between the contacts *a* and *c*. As a result, a voltage is applied to the contact *a* and when the magnet 17 passes by one of the switches S_1 to S_5, the corresponding voltage appears at the contact *b*. Also, when the magnet 17 passes by the switch S_6, a pulse appears at the contact to be supplied to the switching circuit 13. This embodiment has a good performance since there is no sliding contact between the disc 16 and the contacts of the wire switch 11 and therefore no noise due to such sliding contact. Moreover, the contactless mechanism assures the long effective life.

In the above described embodiments, the display means 15 are shown as comprising 5 display elements. This by no means limits the scope of this invention, needless to say, but more elements may be employed to enhance the effect of this invention. Moreover, the prediction of the end of the tape may be more clarified by, for example, making the tones of the display elements lit up at different times different from one another.

Further, although in the above described embodiments the angle-to-voltage converter is disposed on the supply reel support, such a converter may be provided for the take-up reel if the dimensions of the conductor strips P_1–P_6 and the locations of the switches S_1–S_5 are suitably adjusted.

In the above embodiments, a single rotation of the disk forms a cycle but the single rotation may comprise several cycles by multiplying the numbers of the voltage lead-out strips P_1–P_5, the control signal strip P_7 and the switches S_1–S_5 etc.

The transistor Q, which is connected in the embodiment described above at the junction of the contact *b* of the wire switch 11 and the control circuit 14 so as to control the time for which the voltage is being applied to the control circuit 14, may also be connected anywhere in the signal path from the contact *b* of the wire switch 11 to the display means 15, that is, for example, it may be connected at the junction of the control circuit 14 and the display means

15.

The principle of this invention is (1) to control the number of the display elements to be lit up by obtaining voltages corresponding to the angular positions of the reel and (2) to control the lighting and the extinction of the display elements. And numerous other alterations, variations or modifications which meet the above two conditions may be said to be embodiments of this invention.

As described in detail above, according to this invention, the information about the length of the part of the tape taken up on the take-up reel or left wound on the supply reel can be easily obtained even at a distance by the number of the energized display elements since light emitting elements such as LED's are used for the display means. Moreover, since the display means is deenergized each time the supply reel support or a rotary body interlocked with the support performs a single rotation, the alternating lighting and extinction of the display elements indicates that the tape is running. Further, according to this invention, the supply reel support or the rotary body interlocked with the supply reel support is caused to actuate the switching mechanism; the angular positions of the supply reel support or the rotary body are related to the times corresponding to the amount of the tape run or used or left unused; the respective switching elements of the switching mechanism are connected in series with resistors; and the control circuit is driven by the voltages obtained through the stepwise conversion to voltage of the angles through which the supply reel support or the rotary body rotates per unit time at different speed, whereby an inexpensive apparatus for displaying the positions along on a tape can be provided and the present invention proves to be very useful.

CLAIMS

1. A tape position displaying apparatus for use in an information recording/reproducing apparatus in which information recording medium is sent from one reel to another in the recording and reproduction of information, said apparatus comprising:

a converting means for converting the angular velocity of one of said reels to a corresponding voltage;

a display means having plural light emitting elements;

a first control means which receives the voltage as the output of said converting means and controls the number of said light emitting elements to be lit up according to the amplitudes of said voltage; and

a second control means which operates in response to the rotation of said reels and intermits the energization of at least one of said light emitting elements energized by said first control means.

2. A tape position displaying apparatus for use in an information recording/reproducing apparatus in which information recording medium is sent from one reel to another in the recording and reproduction of information, said apparatus comprising:

a rotary body rotated in association with one of said reels;

a converting means for converting the angular velocity of said rotary body to a corresponding voltage, said converting means having an input section for receiving an input voltage and an output section for converting said input voltage to plural different voltages according to said angular velocity of said rotary body and for delivering said plural different voltages;

a control signal generating means for generating a control signal while said rotary body is being rotated;

a display means having plural light emitting elements;

a first control means which receives the voltages as the output of said output section of said converting means and controls the number of said light emitting elements to be lit up according to the amplitudes of said voltages; and

a second control means which operates in response to said control signal from said control signal generating means and intermits the energization of at least one of said light emitting elements energized by said first control means.

3. A tape position displaying apparatus for use in an information recording/reproducing apparatus in which information recording medium is sent from one reel to another in the recording and reproduction of information, said apparatus comprising:

a rotary body rotated in association with one of said reels;

a converting means attached to said rotary body for converting the angular velocity of said body to a corresponding voltage, said converting means having an annular conductor strip for the lead-in of power, arcuate conductor strips for the lead-out of voltage, each having a predetermined length subtending a predetermined angle with respect to the center of said rotary body, a control signal lead-out conductor strip projected from said annular conductor strip, and resistors having different resistance values and each connected between said annular conductor strip and one of said arcuate conductor strips;

an input/output means provided corresponding to said respective conductor strips, having an input section for supplying a voltage to said annular conductor strip, a first output section for

15.

The principle of this invention is (1) to control the number of the display elements to be lit up by obtaining voltages corresponding to the angular positions of the reel and (2) to control the lighting and the extinction of the display elements. And numerous other alterations, variations or modifications which meet the above two conditions may be said to be embodiments of this invention.

As described in detail above, according to this invention, the information about the length of the part of the tape taken up on the take-up reel or left wound on the supply reel can be easily obtained even at a distance by the number of the energized display elements since light emitting elements such as LED's are used for the display means. Moreover, since the display means is deenergized each time the supply reel support or a rotary body interlocked with the support performs a single rotation, the alternating lighting and extinction of the display elements indicates that the tape is running. Further, according to this invention, the supply reel support or the rotary body interlocked with the supply reel support is caused to actuate the switching mechanism; the angular positions of the supply reel support or the rotary body are related to the times corresponding to the amount of the tape run or used or left unused; the respective switching elements of the switching mechanism are connected in series with resistors; and the control circuit is driven by the voltages obtained through the stepwise conversion to voltage of the angles through which the supply reel support or the rotary body rotates per unit time at different speed, whereby an inexpensive apparatus for displaying the positions along on a tape can be provided and the present invention proves to be very useful.

CLAIMS

1. A tape position displaying apparatus for use in an information recording/reproducing apparatus in which information recording medium is sent from one reel to another in the recording and reproduction of information, said apparatus comprising:

a converting means for converting the angular velocity of one of said reels to a corresponding voltage;

a display means having plural light emitting elements;

a first control means which receives the voltage as the output of said converting means and controls the number of said light emitting elements to be lit up according to the amplitudes of said voltage; and

a second control means which operates in response to the rotation of said reels and intermits the energization of at least one of said light emitting elements energized by said first control means.

2. A tape position displaying apparatus for use in an information recording/reproducing apparatus in which information recording medium is sent from one reel to another in the recording and reproduction of information, said apparatus comprising:

a rotary body rotated in association with one of said reels;

a converting means for converting the angular velocity of said rotary body to a corresponding voltage, said converting means having an input section for receiving an input voltage and an output section for converting said input voltage to plural different voltages according to said angular velocity of said rotary body and for delivering said plural different voltages;

a control signal generating means for generating a control signal while said rotary body is being rotated;

a display means having plural light emitting elements;

a first control means which receives the voltages as the output of said output section of said converting means and controls the number of said light emitting elements to be lit up according to the amplitudes of said voltages; and

a second control means which operates in response to said control signal from said control signal generating means and intermits the energization of at least one of said light emitting elements energized by said first control means.

3. A tape position displaying apparatus for use in an information recording/reproducing apparatus in which information recording medium is sent from one reel to another in the recording and reproduction of information, said apparatus comprising:

a rotary body rotated in association with one of said reels;

a converting means attached to said rotary body for converting the angular velocity of said body to a corresponding voltage, said converting means having an annular conductor strip for the lead-in of power, arcuate conductor strips for the lead-out of voltage, each having a predetermined length subtending a predetermined angle with respect to the center of said rotary body, a control signal lead-out conductor strip projected from said annular conductor strip, and resistors having different resistance values and each connected between said annular conductor strip and one of said arcuate conductor strips;

an input/output means provided corresponding to said respective conductor strips, having an input section for supplying a voltage to said annular conductor strip, a first output section for

receiving voltage from said arcuate conductor strips, and a second output section for receiving a control signal from said control signal lead-out conductor strip;

a display means having plural light emitting elements;

a first control means which receives the voltages as the output of said first output section of said input/output means and controls the number of said light emitting elements to be lit up according to the amplitudes of said voltages; and

a second control means for controlling the time for which the signal path from said first output section via said first control means to said display means is broken, said second control means operating in response to the control signal from said second output section of said input/output means and intermitting the energization of at least one of said light emitting elements energized by said first control means.

4. A tape position displaying apparatus for use in an information recording/reproducing apparatus in which information recording medium is sent from one reel to another in the recording and reproduction of information, said apparatus comprising:

a rotary body rotated in association with one of said reels and having a magnet on its rotating surface;

a converting means for converting change in the angular velocity of said rotary body to a change in voltage, said converting means having a voltage input section for receiving a voltage, a converted voltage output section, a control signal output section, plural series circuits connected between said voltage input section and said converted voltage output section, each of said series circuits comprising a resistor and a switch which is turned on when said magnet passes by and being located near the periphery of said rotary body, the resistance values of said resistors being different from one another, and a switching means connected between said voltage input section and said control signal output section and turned on when said magnet passes by;

a display means having plural light emitting elements;

a first control means which receives the voltages as the output of said converted voltage output section of said converting means and controls the number of said light emitting elements to be lit up according to the amplitudes of said voltages; and

a second control means for controlling the time for which the signal path from said converted voltage output section of said converting means via said first control means to said display means is broken, said second control means operating in response to the control signal from said control signal output section of said converting means and intermitting the energization of at least one of said light emitting elements energized by said first control means.

5. A tape position displaying apparatus as claimed in any one of Claims 2 to 4, wherein the final output stage of said second control means is a transistor with its collector connected with the junction of said first control means and said first output section of said converting means and with its emitter grounded and the energization of said light emitting elements is controlled by cutting off or supplying a voltage to said first control means in the presence or absence of the bias to the base of said transistor.

6. A tape position displaying apparatus constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon) Ltd.—1982.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.