United States Patent

[11] 3,633,804

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[32] Priorities June 27, 1969
[33] Japan
[31] 44/50767;
Dec. 29, 1969, Japan, No. 45/135; June 27, 1969, Japan, No. 44/50768

[54] **TAPE-DETECTING DEVICE FOR TAPE RECORDERS**
13 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **226/11,** 226/43, 340/259
[51] **Int. Cl.** **B65h 25/32,** G11b 15/16
[50] **Field of Search** 226/11, 43, 34; 340/259; 192/127

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Primary Examiner—Allen N. Knowles
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ABSTRACT: A tape-detecting device having a discontinuous conductive member, a conductive member making contact therewith, and a power source for supplying a voltage between the discontinuous conductive member and the conductive member. In this case an electric signal is derived from between the discontinuous conductive member and the conductive member both rotating according to the travel of a tape.

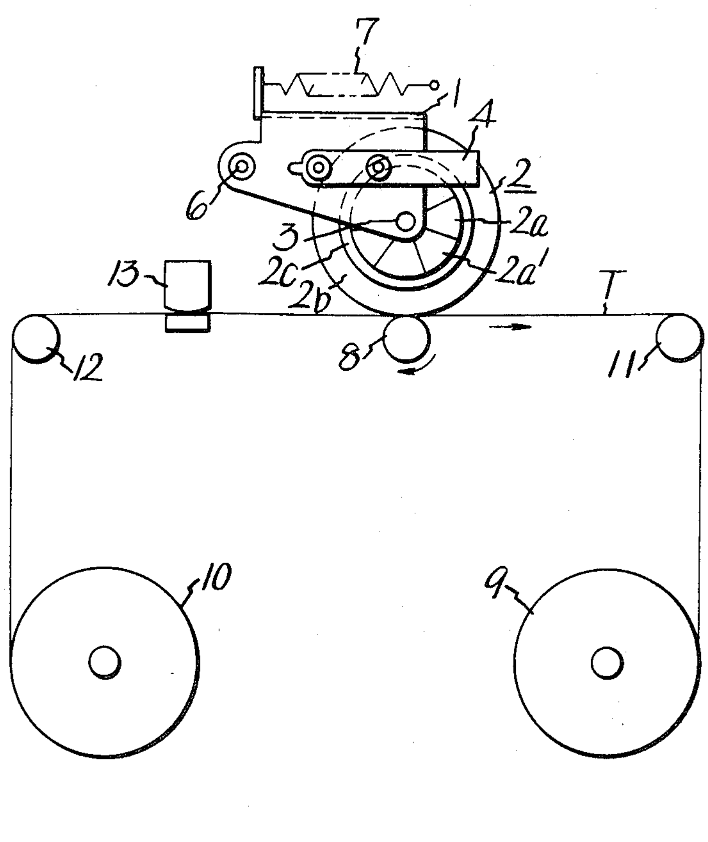

Fig. 1

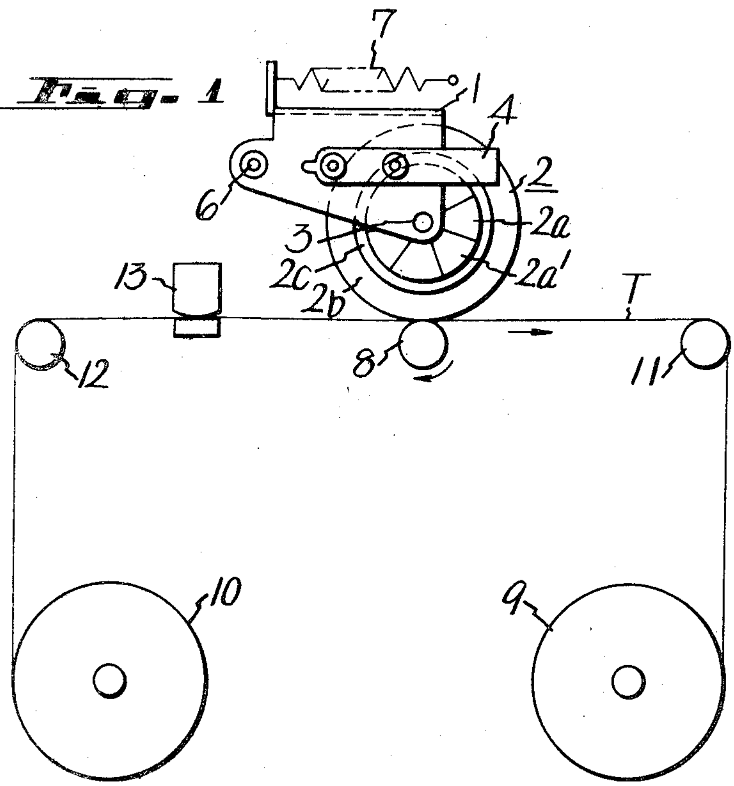

Fig. 2

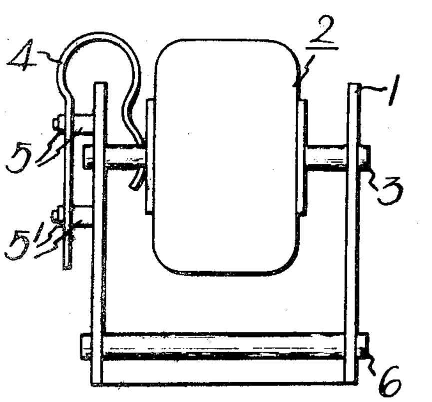

Fig. 3

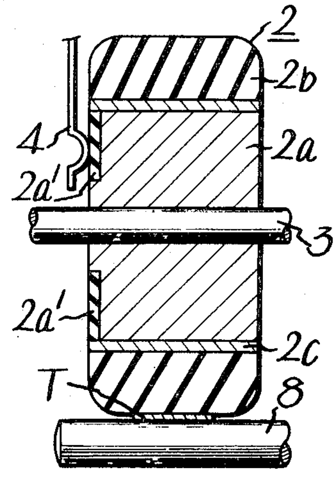

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Fig. 4

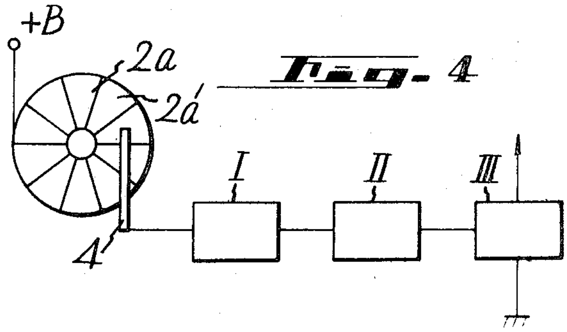

Fig. 5A

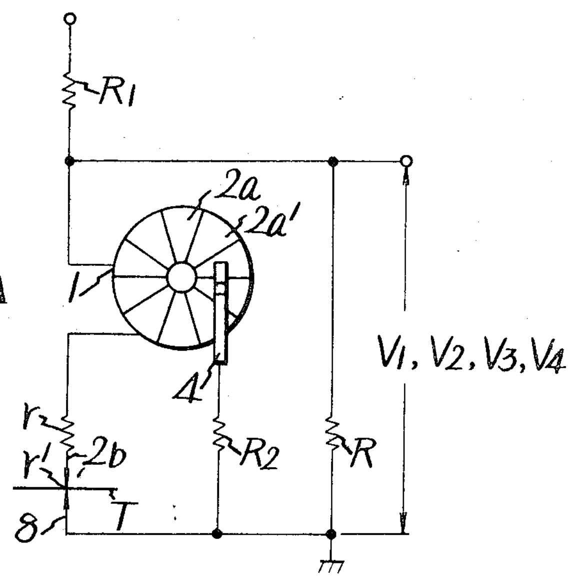

Fig. 5B

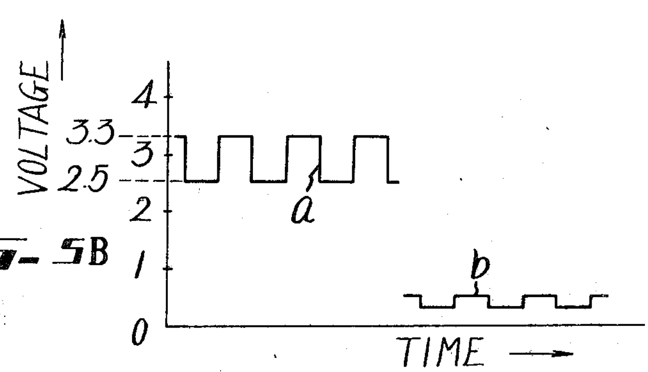

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Fig. 6A

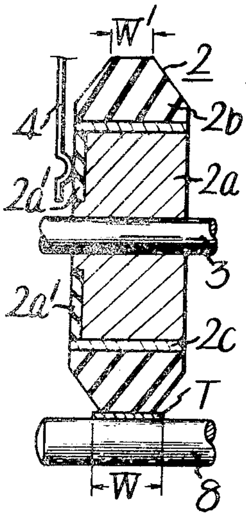

Fig. 6B

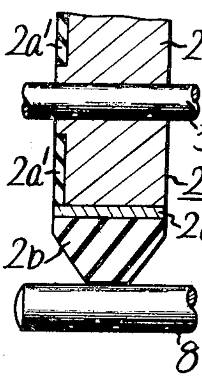

Fig. 7A

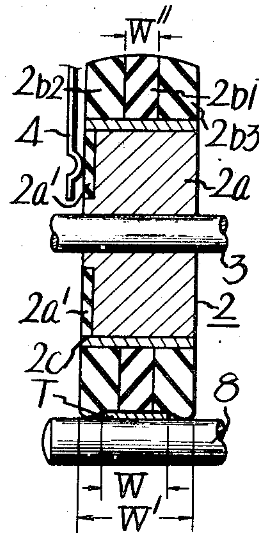

Fig. 7B

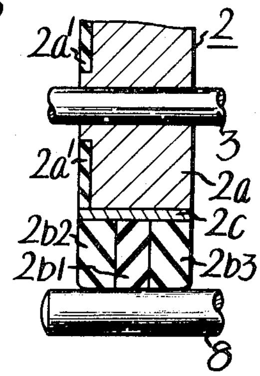

Fig. 8A

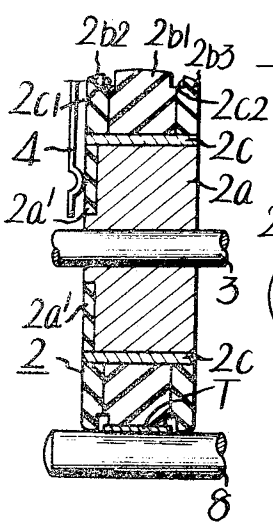

Fig. 8B

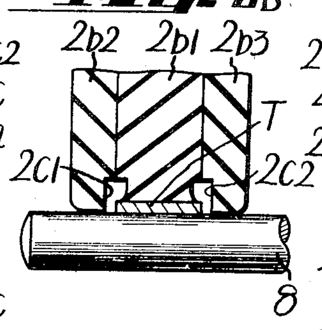

Fig. 9A

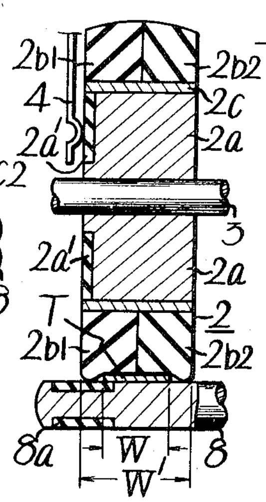

Fig. 9B

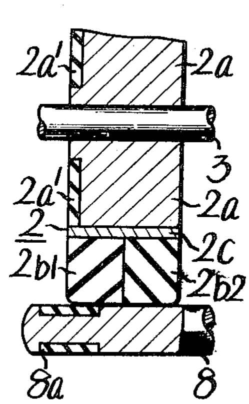

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Fig. 10A

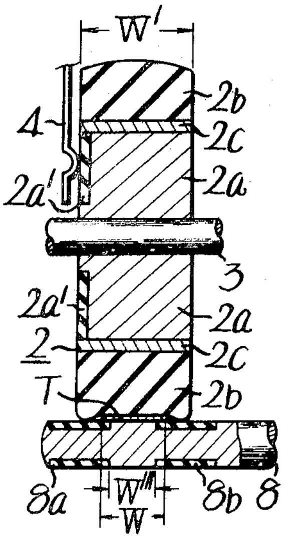

Fig. 10B

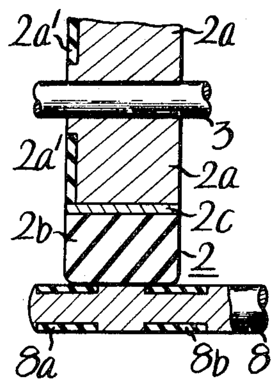

Fig. 11

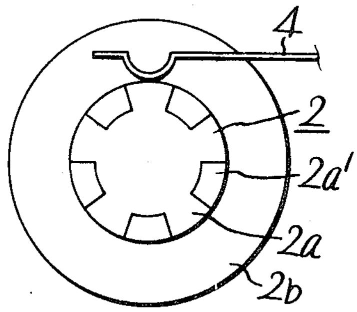

Fig. 12

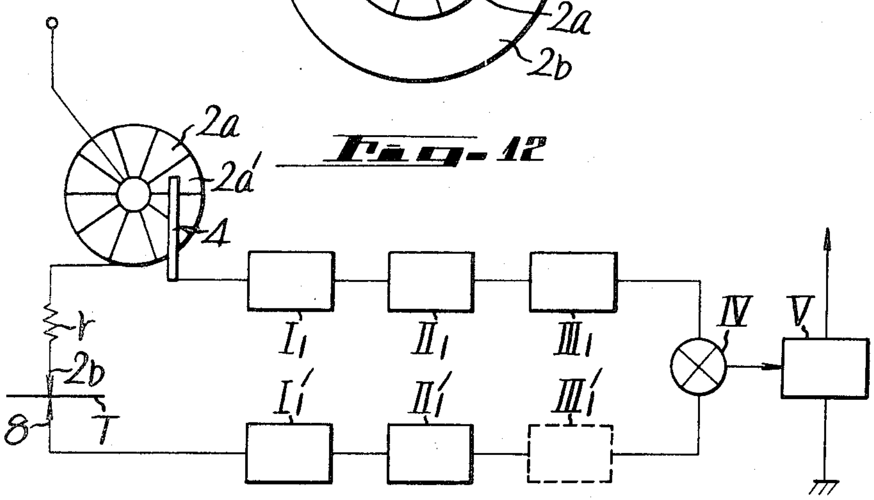

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Fig. 13

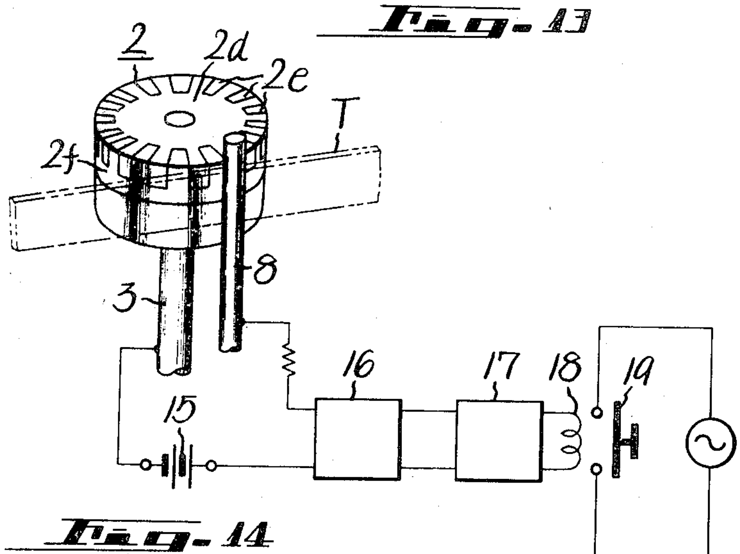


Fig. 14

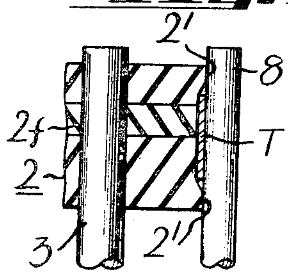


Fig. 15

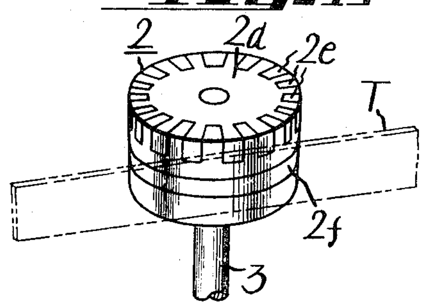


Fig. 16

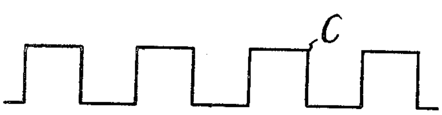
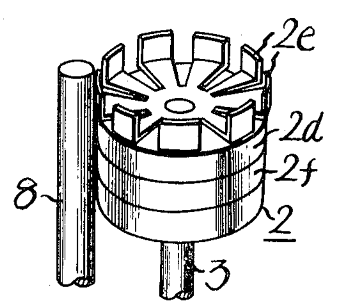


Fig. 17



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TAPE-DETECTING DEVICE FOR TAPE RECORDERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a tape-detecting device for magnetic tape recorders, and more particularly to a tape-detecting device for detecting the travelling or standstill condition or the presence of the tape or combination thereof.

2. Description of the Prior Art

Heretofore, various types of signal-detecting devices for automatic control of tape recorders have been proposed but none of them are satisfactory. For use with a magnetic tape cartridge (cassette) having two reels an automatic control signal detecting device has been proposed in which a rotary switch is provided in association with, for example, one of the reel shafts to detect the rotation and stoppage of the reel and a control relay is actuated by an electric signal to open a power source circuit or bring the operation of the cartridge to the next step. However, the device of this kind has a disadvantage such that it is readily actuated even when the reel is stopped for a very short time due to slight slack of the tape. Further, the frequency generated by the rotation of the reel varies with the radius of the tape convolution on the reel shaft, so that the frequency band of the detector circuit is required to be wide and this introduces defects such as mixing of noise signals.

SUMMARY OF THE INVENTION

The primary object of this invention is to provide a tape-detecting device of simple construction for detecting travel and standstill of the tape.

Another object of this invention is to provide a tape-detecting device for detecting the presence of the tape.

Still another object of this invention is to provide a tape-detecting device for detecting the combination of the travel, standstill and presence of the tape.

Other objects, features and advantages of this invention will become apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram showing a tape-detecting device of this invention and its general arrangement, for explaining the invention;

FIG. 2 is a side view of the principal part of the tape-detecting device;

FIG. 3 is an enlarged cross-sectional view of an assembly of a pinch roller and a capstan illustrated in FIGS. 1 and 2;

FIG. 4 is a schematic diagram of one example of an electric circuit including the tape-detecting device of this invention;

FIG. 5A is a schematic diagram of a modified form of the electric circuit in accordance with another example of this invention;

FIG. 5B is a graph for explaining the operation of the example depicted in FIG. 5A;

FIGS. 6A and 6B to 10A and 10B are enlarged cross-sectional views of other modified forms of the assembly of the pinch roller and capstan of this invention;

FIG. 11 is a schematic diagram showing a modification of the contact of a brush with the pinch roller;

FIG. 12 is a schematic diagram, similar to FIG. 5A, showing the electric circuit in accordance with another example of this invention;

FIG. 13 is a schematic diagram showing another example of this invention;

FIGS. 14 and 15 are schematic diagrams showing other examples of this invention;

FIG. 16 is a waveform diagram, for explaining the operation of the device depicted in FIG. 13; and

FIG. 17 is a schematic diagram showing another example of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1 to 4, one example of the tape-detecting device of this invention will hereinafter be described in detail. Reference numeral 1 indicates a bracket formed of a conductive material and 2 a pinch roller which is rotatably mounted on the bracket 1 by a conductive pin or shaft 3. The pinch roller 2 is made up of a columnar conductive metal member 2a rotatably mounted on the pin 3 an a roller member 2b formed of a resilient material such as rubber and fixedly mounted on the periphery of the columnar metal member 2a, as depicted in FIG. 3. If necessary, a bushing 2c may be interposed between the columnar member 2a and the roller member 2b. With the above arrangement, the bracket 1, the shaft 3 and the columnar member 2a may be regarded as constituting an electrically connected circuit. Further, insulating members 2a' as of Bakelite or a plastic material are separately embedded in one end face of the columnar member 2a of the pinch roller 2 (in FIG. 1 in the face lying on the sheet of the drawings or in FIG. 3 in the left-hand face) in such a manner that the conductive material of the columnar member and the insulating material are alternately arranged on that end face of the columnar member 2a. The insulating members 2a' are need not always be embedded in that end face but may be deposited thereon. Further, it is also possible to form void areas in that end face at those places corresponding to the insulating members 2a' without specially providing them. A brush 4, whose one end is always in contact with the aforementioned end face of the columnar member 2a, is secured at the other end to the bracket 1 through insulating spacers 5 and 5'. Reference numeral 6 indicates a pin by means of which the bracket 1 is pivoted to a fixed portion, though not shown. Reference numeral 7 designates a spring stretched between the fixed portion (not shown) and the bracket 1 for suitably biasing the latter, by which the pinch roller 2 supported by the bracket 1 is caused to press a magnetic tape T against a capstan 8 at a suitable pressure. Reference numerals 9 and 10 respectively represent a take-up and a rewinding reel for the magnetic tape T, 11 and 12 guide rollers and 13 a magnetic head.

Turning now to FIG. 4, the operation of the above tape-detecting device will hereinbelow be described. Reference numeral I in the figure indicates an electronic circuit block for AC amplification or eliminating a DC component and its input side is connected to the brush 4. Reference numeral II designates a circuit for rectifying the output of the electronic circuit block I and III a switching circuit by means of which an output circuit having a load such as a relay or the like is switchingly controlled with the signal derived from the rectifier circuit II.

1. In the event that the tape T exists and is running between the capstan 8 and the pinch roller 2, the columnar conductive member 2a is biased relative to a reference potential (for example, the earth potential), so that a rectangular wave or an AC signal and a DC component superimposed on each other are supplied from the brush 4 to the electronic circuit block I to remove the DC component and only the AC component is rectified by the rectifier circuit II to derive therefrom a DC output.

2. When the tape T exists between the capstan 8 and the pinch roller 2 but stands still, no signal or only a DC signal is derived from the brush 4 and the DC signal is removed by the electronic circuit block I, so that the output of the rectifier circuit II is zero.

The arrangements of the circuits I, II and III shown in FIG. 4 need not always be limited specifically thereto and may be suitably changed with the scope of attainment of the above-described object and, further, the circuit elements may also be increased or decreased in number as desired.

A description will be given of a modified form of this invention, which is exactly identical with the foregoing example except in that the roller member 2b of the pinch roller 2 depicted in FIG. 1 is formed of a conductive rubber in such a shape as shown in FIGS. 6A and 6B and in that both the capstan 8 and the bushing 2c are made of a conductive material. In the tape-detecting device exemplified in FIG. 6 the bracket 1, the shaft 3, the columnar member 2a and the roller member 2b may be regarded as constituting an electrically connected circuit.

FIG. 5A shows an electrically equivalent circuit, for explaining the tape-detecting operation of the tape-detecting device having the pinch roller assembly shown in FIG. 6. In FIG. 5A the same reference numerals as those in FIGS. 1 and 6 indicate similar elements and in the figure reference character r represents the internal resistance of the roller member 2b, r' the contact resistance between the capstan 8 and the roller member 2b and R, R_1 and R_2 suitable resistors and a voltage V is impressed between the bracket 1 and the conductive capstan 8. With reference to FIG. 5 the operation of the tape-detecting device of this invention will hereinbelow be described.

1. The tape T runs between the roller member 2b and the capstan 8 and this implies that the roller member 2b and the capstan 8 are electrically cut away from each other. (a) Under such condition, when the brush 4 is in contact with the insulating member 2a' the voltage V is applied only to the resistors R_1 and R. Accordingly, the voltage V_1 across the resistor R is given by the following equation.

$$V_1 = Vx\frac{R}{R_1+R}$$

(b) when the brush 4 is in contact with the columnar conductive member 2a the resistors R_2 and R are connected in parallel with each other and the resistor R_1 is connected to the parallel circuit in series, so that the voltage V_2 across the resistor R is given as follows.

$$V_2 = V\left\{\frac{1}{1+\left(\frac{1}{R_2}+\frac{1}{R}\right)R_1}\right\}$$

Namely, while the tape T runs between the capstan 8 and the pinch roller 2 the voltages V_1 and V_2 alternately appear across the resistor R.

2. While, when the tape T is present between the capstan 8 and the pinch roller 2 but stands still, the brush 4 is in contact with (a) the insulating member 2a' or (b) the columnar conductive member 2a. Consequently, the voltage across the resistor R is either V_1 and V_2.

3. Further, when the tape T does not exist between the capstan 8 and the pinch roller 2, they are electrically connected to each other. (c) Accordingly, if the brush 4 is in contact with the insulating member 2a', the resistor R and $(r+r')$ are connected in parallel with each other and the resistor R_1 is connected to the parallel connection in series, thereby to impress the voltage V across the circuit. As a result of this, the voltage V_3 across the resistor R is given by the following equation.

$$V_3 = V\left\{\frac{1}{R_1\left(\frac{1}{R}+\frac{1}{r+r'}\right)+1}\right\}$$

(d) While, if the brush 4 is in contact with the columnar conductive member 2a under the same conditions, the resistors R, R_2 and $(r+r')$ are connected in parallel relation and the resistor R_1 is connected in series to the parallel connection, thereby to apply the voltage V across the circuit. Accordingly, the voltage V_4 across the resistor R is expressed as follows.

$$V_4 = V\left\{\frac{1}{R_1\left(\frac{1}{R}+\frac{1}{R_2}+\frac{1}{r+r'}\right)+1}\right\}$$

Assuming that the resistance values of the aforementioned elements are selected as follows.

$R_1 = 200$ kilohms (kΩ) $r+r' = 10$ kilohms (kΩ)
$R_2 = 200$ kilohms (kΩ)
$R = 100$ kilohms (kΩ)

the following relationships are resulted.

$V_1 = (1/3)\,V$
$V_2 = (1/4)\,V$
$V_3 = (1/23)\,V$
$V_4 = (1/24)\,V$

If $V = 10$ volts, it follows that

$V_1 \approx 3.3$ volts
$V_2 \approx 2.5$ volts
$V_3 \approx 0.435$ volts
$V_4 \approx 0.416$ volts

Accordingly, under the above-described condition (1), namely when the tape T exists between the capstan 8 and the pinch roller 2 and runs, the voltage across the resistor R is a kind of rectangular wave or an alternating current such that 3.3 and 2.5 volts alternate as indicated by the curve a in FIG. 5B. Further, under the condition (2), namely when the tape T exists between the capstan 8 and the pinch roller 2 but stands still, the voltage appearing across the resistor R is either 3.3 or 2.5 volts, that is, a constant DC voltage. Under the condition (3), namely when the tape T does not exist between the capstan 8 and the pinch roller 2, the voltage across the resistor R is a kind of rectangular wave or an alternating current such that 0.435 and 0.416 volts alternate as indicated by the curve b in FIG. 5B.

In the case of the rectangular wave a, the difference between its crest and trough is 3.3–2.5=0.8 (volts) and this difference is appreciably great, while under the condition (3) the difference is 0.435–0.416=0.019 (volts) and this is extremely small and is approximately 1/40 of the former. Accordingly, distinction of the cases (1) and (3) can be readily achieved by applying the voltages across the resistor R to an AC amplifier or a voltage level discriminator including DC component to detect the difference in amplitude therebetween.

As above described, this invention employs as signal-detecting means the combination of the capstan and the pinch roller rotating irrespective of the condition of the tape, instead of deriving a signal output from the reel shaft or the like as in the prior art, so that the device of this invention is free from the influences of slackness or winding condition of the tape on the reel shaft. Further, since no variation is caused in the revolving speed of the reel which results from a difference in diameter of the tape winding at the outer and inner convolutions thereof, an output signal of a constant frequency can be produced at all times, and accordingly the rising time constant of the control operation can be extremely reduced without fail.

FIGS. 7A and 7B illustrate another modification of the tape-detecting device of this invention. In the present example the width W' of the contact area of the pinch roller 2 with the capstan 8 or the tape T is selected greater than that W of the tape T and the roller member 2b of the pinch roller 2 is made up of a ring-shaped conductive rubber member $2b_1$ and ring-shaped nonconductive rubber members $2b_2$ and $2b_3$ griping therebetween the member $2b_1$. In this case the width W'' of the conductive rubber member $2b_1$ is selected smaller than that W of the tape T so that when the tape T exists between the pinch roller 2 and the capstan 8 the conductive rubber member $2b_1$ does not make direct contact with the capstan 8 (refer to FIG. 7A). In such a case, the pinch roller 2 makes contact with the capstan 8 at its nonconductive rubber members $2b_2$ and $2b_3$, namely outside of the marginal edges of the tape T, thereby to further stabilize the travel of the tape T. In this example, when the tape T does not lie between the capstan 8 and the pinch roller 2, the latter is electrically connected through its conductive rubber member $2b_1$ as illustrated in FIG. 7B.

In FIGS. 8A and 8B ring-shaped recesses or grooves $2c_1$ and $2c_2$ are formed between the conductive rubber member $2b_1$ and the nonconductive rubber members $2b_2$ and $2b_3$ to ensure insulation between the capstan 8 and the pinch roller 2 (in the presence of the tape T therebetween). The other arrangements are the same as those in the example of FIGS. 7A and 7B.

In FIG. 9 the roller member 2b of the pinch roller 2 is formed with a ring-shaped conductive rubber member $2b_1$ and a nonconductive rubber member $2b_2$ and the entire surface of one portion of that area of the capstan 8 contacting the conductive rubber member $2b_1$ is coated with an insulating material 8*a* such as ceramics, plastics or the like. In this case the width W' of the contact area of the pinch roller 2 with the capstan 8 or the tape T is selected greater than that W of the tape T to stabilize the travel of the tape T. With such an arrangement, when the tape T exists between the pinch roller 2 and the capstan 8 they are electrically disconnected from each other (refer to FIG. 9A) and when the tape T does not exist the pinch roller 2 and the capstan 8 are electrically connected to each other (refer to FIG. 9B).

In FIG. 10 the roller member 2*b* of the pinch roller 2 is formed of a conductive rubber but the width W' of its contact area with the capstan 8 and the tape T is selected greater than that W of the tape T to stabilize the travel of the tape T. While, the roller member 2*b* of the pinch roller 2 makes contact with the capstan 8 outside of the both marginal edges of the tape T but ring-shaped insulating members 8*a* and 8*b* are formed on the corresponding peripheral surfaces of the capstan 8. In this case the distance (or width) W''' between the both insulating members 8*a* and 8*b* is selected shorter than the width W of the tape T. With such an arrangement, when the tape T exists between the pinch roller 2 and the capstan 8, they are electrically insulated from each other as depicted in FIG. 10A and when the tape T does not lie therebetween they are electrically connected to each other as shown in FIG. 10B.

FIG. 11 illustrates another example of this invention in which the brush 4 and the columnar member 2*a* make contact with each other in a different manner from those in the foregoing examples. In the illustrated example the brush 4 makes contact with the columnar member 2*a* not at its end face but at the periphery thereof. Further, in this case, too, the insulating members 2*a*' are discontinuously embedded in or deposited on the end face of the columnar member 2*a* in the same manner as in the foregoing examples, so that the brush 4 makes alternate contact with the columnar member 2*a* and the insulating members 2*a*'. Accordingly, this example is exactly the same in operation as the foregoing ones.

The bracket 1 described above may be formed by molding from an insulating material such as plastic or like material, in which case the shaft 3 may be used as one terminal and the spacers 5 and 5' may be thereby left out.

The foregoing example of FIG. 5 utilizes for detection of the presence of the tape the effect of a parallel resistance due to the continuous contact of the conductive pinch roller with the capstan. With reference to the block diagram of FIG. 12 a description will be given of another modification of this invention. In the figure reference numeral I_1 indicates an electronic circuit block for AC amplification or eliminating a DC component, II_1 a rectifier circuit block for rectifying the output of the electronic circuit block I_1, I_1' an amplifier circuit block which is actuated by a potential produced by the contact of the pinch roller with the capstan, II_1' a rectifier circuit block for rectifying the output of the amplifier circuit block I_1', and III_1 a signal converter which is incorporated in such a manner that the output signals of the rectifier circuit block II_1 or II_1' representative of the standstill and absence of the tape are in phase with each other. The signal converter III_1 is of the type which blocks a DC signal supplied from the rectifier circuit block II_1 but produces a DC signal in the absence of the DC signal derived from the rectifier circuit block II_1. Further, the signal converter III_1 may be placed at a stage following the rectifier circuit block II_1 or II_1'. Reference numeral IV designates a signal mixer circuit block for mixing the signals derived from the signal converter III_1 and the rectifier circuit block II_1', and V a switching circuit block for switchingly controlling an output circuit having a relay and the like as loads with a signal derived from the signal mixer circuit block IV.

The operation of this example will hereinbelow be described.

1. In the event that the tape T exists and is running between the capstan 8 and the pinch roller 2, the conductive columnar member 2*a* and the roller member 2*b* are biased relative to a reference potential (for example, the earth potential), so that a rectangular wave or AC signal and a DC component superimposed on each other are supplied from the brush 4 to the electronic circuit block I_1 to remove the DC component and only the AC component is rectified by the rectifier circuit block II_1 to derive therefrom a DC output.

2. When the tape T exists between the capstan 8 and the pinch roller 2 but stands still, no signal or only a DC signal is derived from the brush 4 but this DC signal is removed by the electronic circuit block I_1, so that the output of the rectifier circuit block II_1 is zero.

3. In the presence of the tape T between the capstan 8 and the pinch roller 2 as in the cases (1) and (2), the input of the amplifier circuit block I_1' is zero, and consequently the output of the rectifier circuit block II_1' is also zero.

4. In the absence of the tape T between the capstan 8 and the pinch roller 2, the roller member 2*b* and the capstan 8 are continuously or intermittently engaged with each other. In this case a DC- or AC-like signal is supplied to the amplifier circuit block I_1' to be amplified and then rectified by the rectifier circuit block II_1' and, in either case, a DC output is derived from the rectifier circuit block II_1'. It is a matter of course that the rectifier circuit block II_1' is designed to have a phase permitting the passage therethrough of the input DC signal.

In the control of a tape recorder the same control is required in the both cases (2) and (4) above mentioned. This requires the output signals in the both cases to be of the same kind. To this end, the signal converter circuit III_1 is provided at the stage following the rectifier circuit block II_1 and the control switching circuit is actuated through the signal mixer circuit or "OR-gate" circuit IV in a manner to achieve the same operation in either case.

In the latter case, even if the pinch roller member 2*b* and the capstan 8 make slight contact with each other in the absence of the tape T therebetween, control operation can be achieved by increasing the amplification degree of the amplifier circuit block I_1', thus ensuring stable and highly sensitive control operation.

Further, the rising time constant of the rectified output of the rectifier circuit block II_1 can be diminished relative to that of the rectifier circuit block II_1', so that in the absence of the tape T the control circuit can be actuated in a moment irrespective of the numbers of the conductive members and the insulating members 2*a* and 2*a*', thereby the ensure rapid operation.

The arrangements of the circuit blocks I_1, II_1, III_1, I_1', II_1', III_1', IV and V shown in FIG. 12 need not always be limited specifically thereto and may be suitably changed within the scope of attainment of the above-described objects and, further, the circuit elements may also be increased or decreased in number as desired.

FIG. 13 illustrates a further modification of this invention, in which similar elements to those in the foregoing examples are identified by the same reference numerals. In the present example the pinch roller 2 consists of a pinch roller proper 2*d* formed of an insulating material such as a nonconductive rubber, a discontinuous conductive member 2*e* consisting of a plurality of tabs formed of conductive rubber embedded in the peripheral surface of the pinch roller proper 2*d* on its upper marginal portion at regular intervals, each tab being wider than the width of the contact area of the pinch roller 2 with the capstan 8, and a belt-shaped continuous conductive member 2*f* embedded in the pinch roller proper 2*d* contiguously to the discontinuous conductive member 2*e*. The belt-shaped continuous conductive member 2*f* is positioned at such a location as to be out of contact with the capstan 8 in the presence of the tape T between the pinch roller 2 and the capstan 8 as shown in FIGS. 13 and 14 and to be in contact with the capstan 8 in the absence of the tape T therebetween.

FIG. 15 shows still a further modified form of this invention which is identical in construction with that of FIG. 13 except in that the continuous and discontinuous members 2*f* and 2*e* are respectively embedded in the pinch roller proper *2d* so that they interconnect and connect with the pin 3 in the body of the pinch roller proper *2d* but do not interconnect at the surface thereof. In FIG. 13 reference numeral **15** indicates a DC power source inserted between the pinch roller **2** and the capstan **8**. The circuit constituted by the pinch roller **2**, the capstan **8** and the DC power source **15** is connected to an AC amplifier **16**, which is, in turn, connected to a rectifier circuit **17**. Reference numeral **18** designates a relay coil connected to the rectifier circuit **17**. A movable contact piece **19** of the relay coil **18** is to open and close the power source of a deck.

The operation of the tape-detecting devices depicted in FIGS. 13 to 15 will hereinbelow be described.

1. In the event that the tape T housed in, for example, a tape cassette or cartridge runs gripped between the capstan **8** and the pinch roller **2**, portions **2′** and **2′** (in FIG. 14) of the pinch roller **2** which are out of contact with the magnetic tape T make direct and rotary contact with the capstan **8** due to elasticity of rubber but the continuous conductive member *2f* does not contact the capstan **8**, since the tape T serving as an insulating member lies between the continuous conductive member *2f* and the capstan **8**. With the rotation of the pinch roller **2** the discontinuous member *2e* made of the conductive rubber rotates into and out of contact with the capstan **8**. Namely, the capstan **8** and the pinch roller **2** are electrically connected to each other intermittently, with the result that the AC amplifier **16** produces an electric signal such as indicated by C in FIG. **16** whose waveform is similar to a rectangular wave. The resulting electric signal is amplified by the AC amplifier **16**, whose output is rectified by the rectifier circuit **17** into a direct current, which is then fed to the relay coil **18** to close its movable contact piece **19**, thus maintaining, for example, recording or playback of the tape.

2. In the event that the tape T is retained at one end to, for example, a supply reel, when the tape T has been wound up onto a takeup reel from the supply reel, the capstan **8** races or runs idle and the pinch roller **2** stops rotation, in which case either one or both of the pinch roller proper *2d* and the discontinuous conductive member *2e* of the pinch roller **2** make contact with the capstan **8**, so that such a rectangular wave as depicted in FIG. **16** is not generated. Consequently, the rectifier circuit **17** produces no output and the contact piece **19** of the relay coil **18** is opened to actuate a tape control device.

3. When the winding end of the tape T has been drawn out from, for example, the supply reel or the tape T has been broken and, as a result of this, the tape T has been slipped out from between the capstan **8** and the pinch roller **2**, the continuous conductive member *2f* always makes contact with the capstan **8**. Consequently, even if the pinch roller **1** continues rotation, the aforementioned rectangular wave C is not produced, and accordingly no output is derived from the rectifier circuit **17**. Thus, the contact piece **19** is opened to control the tape T.

Although the present invention has been described in connection with the cases where the rotary member is a pinch roller and the conductive member is a capstan, it is also possible to achieve similar automatic tape control by separately providing on the deck plate of a tape recorder a conductive member and a rotary member having provided thereon the aforementioned discontinuous and continuous conductive members and driving the tape gripped between the rotary and conductive members to produce the aforementioned rectangular wave.

The discontinuous and continuous members may be provided in various shapes other than those depicted in FIGS. **13** and **15**. As shown in FIG. **17**, the discontinuous member *2e* may be provided in the form of a resilient conductive piece, which gets into or out of contact with the conductive member to produce the rectangular wave. Further, it is also possible, of course, to actuate the device by providing only the discontinuous conductive member on the rotary member or to detect the presence of the tape by providing only the continuous conductive member on the rotary member though not shown.

As has been described in the foregoing, the tape-detecting device of this invention does not derive any signal output from the reel shaft or the like as practised in the prior art but instead employs as signal-detecting means the combination of the rotary member such as a pinch roller with the conductive member such as a capstan which rotate irrespective of the condition of the tape, so that the device of this invention is not affected by the slackness of the tape or its winding condition on the reel shaft or variations in the revolving speed of the reels due to the difference in the diameter of the tape winding at the inner and outer convolutions thereof. This provides an output signal of substantially constant frequency at all times, and hence greatly reduces the riding time constant of the control operation and ensures the operation. Further, this shortens the time for detecting the condition of the tape and, at the same time, ensures automatic control of the tape travelling in the cases where the tape is retained at the winding end to the reel or not retained, where the tape is broken and where no cassette is used with a cassette automatic continuous player.

Thus, the present invention provides a tape-detecting device which is relatively simple and compact in construction, reliable in operation and inexpensive.

It will be apparent that many modifications and variations may be effected without departing from the scope of the novel concepts of this invention.

I claim as my invention:

1. A tape-detecting device comprising a discontinuous conductive member, a conductive member making contact therewith, both said members mounted for rotation on opposite sides of the tape in accordance with the travel of a tape and a power source for applying a voltage between the discontinuous conductive member and the conductive member, in which an electric signal is derived from between the discontinuous conductive member and the conductive member when they are both rotating in accordance with the travel of a tape.

2. A tape-detecting device as claimed in claim **1** wherein the discontinuous conductive member is formed on one end face of a rotary member rotating in relation to the travel of a tape and the conductive member making contact with the discontinuous conductive member is a brush.

3. A tape-detecting device as claimed in claim **1** wherein the discontinuous conductive member is formed on the peripheral surface of a rotary member rotating in relation to the travel of a tape.

4. A tape-detecting device as claimed in claim **1** wherein the discontinuous conductive member is formed on one end face of a pinch roller.

5. A tape-detecting device as claimed in claim **1** wherein the discontinuous conductive member is formed on the peripheral surface of a pinch roller.

6. A tape-detecting device comprising a pinch roller consisting of an outer cylindrical member formed of an elastic material and an inner cylindrical member formed of a conductive material, in which a conductive piece is provided in a manner to make intermittent contact with one end face of the inner cylindrical member and a voltage impressed between the inner cylindrical member formed of the conductive material and the conductive piece making intermittent contact therewith, thereby to derive from therebetween an electric signal corresponding to their intermittent contact.

7. A tape-detecting device as claimed in claim **1** which includes a tape contact portion formed of a conductive material and provided on the outer peripheral surface of the discontinuous conductive member and a conductive contact portion placed opposite to the tape contact portion.

8. A tape-detecting device as claimed in claim **7** wherein the tape contact portion is made up of an area formed of a conductive material and a pair of areas formed of an insulating material on both side of the conductive area and the conductive area is narrower than a tape.

9. A tape-detecting device as claimed in claim **8** wherein ring-shaped grooves are formed along the boundaries between the conductive area and the areas formed of the insulating material.

10. A tape-detecting device as claimed in claim 7 wherein the tape contact portion is made up of an area formed of a conductive material and an area formed of an insulating material and an insulating material is provided on the conductive tape contact area of the tape contact portion placed opposite to the tape contact member.

11. A tape-detecting device as claimed in claim 7 wherein the tape contact portion is wider than a tape, two insulating members are provided on the conductive tape contact portion placed opposite to the tape contact portion and the distance between the two insulating members is smaller than the width of the tape.

12. A tape-detecting device as claimed in claim 1 wherein the discontinuous conductive member is formed on the peripheral surface of a rotary member rotating in relation with the tape travel and the continuous conductive member is formed to partially exposed at the peripheral surface of the rotary member.

13. A tape-detecting device comprising a discontinuous conductive member mounted on a conductive shaft, a resilient member placed on the outer peripheral surface of the discontinuous conductive member, a conductive member disposed to make contact with the discontinuous conductive member, means for supporting the conductive shaft, the supporting means further supporting the conductive member, means for impressing a voltage between the conductive member and the conductive shaft, and means for deriving from therebetween an electric signal in accordance with the relative rotation between the discontinuous conductive member and the conductive member.

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