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 [21] Appl. No. **713,655**
 [22] Filed **Mar. 18, 1968**
 [45] Patented **June 15, 1971**
 [32] Priority **Mar. 18, 1967, Apr. 14, 1967**
 [33] **Japan**
 [31] **42/16625 and 42/23425**

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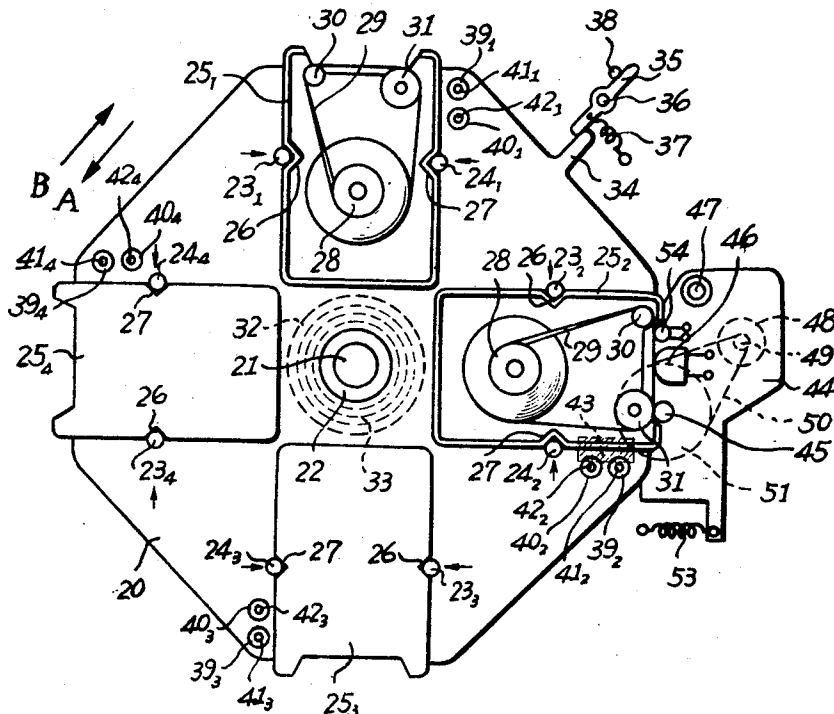
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[54] **MEANS FOR BRINGING CAPSTAN INTO ENGAGEMENT AND DISENGAGEMENT FOR AUTOMATIC PLAYING APPARATUS UTILIZING A PLURALITY OF ENDLESS TAPE CARTRIDGES**
 8 Claims, 15 Drawing Figs.

[52] U.S. Cl..... 274/4,
 179/100.2, 352/123
 [51] Int. Cl..... **B65h 19/00,**
 G11b 15/66, G03b 21/04
 [50] Field of Search..... 242/55.19;
 226/177, 178, 179; 179/100.2; 274/4 A-E;
 352/123

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ABSTRACT: In an automatic playing apparatus utilizing a plurality of endless tape cartridges a housing designed to bring a cartridge as indexed into the play position by movement thereof after effecting thereinto insertion of plurality of endless tape cartridges each having a pinch-roller therein, a swingable deck including a capstan, driving means therefor, and a magnetic head, said capstan feeding said endless tape stored in the cartridge in the play position in relation to said housing, said magnetic head playing the running endless tape, a deck driving means retracting said deck from the cartridge in the play position, time lag means automatically returning said deck in the original position after a certain time of period for driving endless tape stored in the cartridge as next indexed positioned in the play position, said deck driving means adapted to be actuated by searching an end mark on the tape during play, and said time lag means preventing said deck from returning automatically until after the cartridge as next indexed is positioned in the play position.



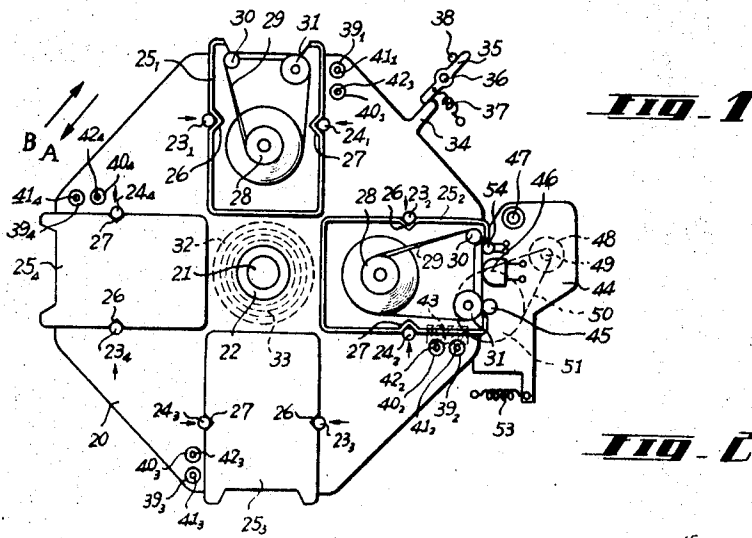


FIG. 1

FIG. 2

FIG. 3a

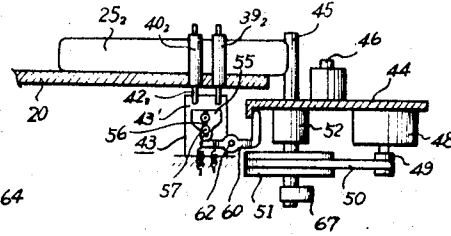


FIG. 3b

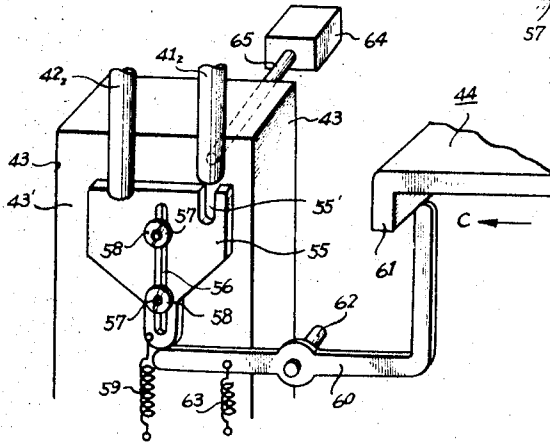
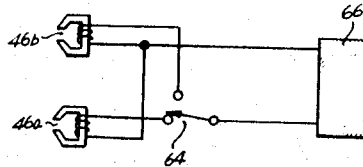
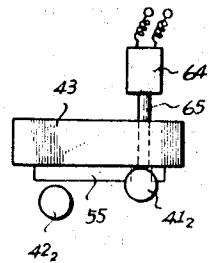


FIG. 4



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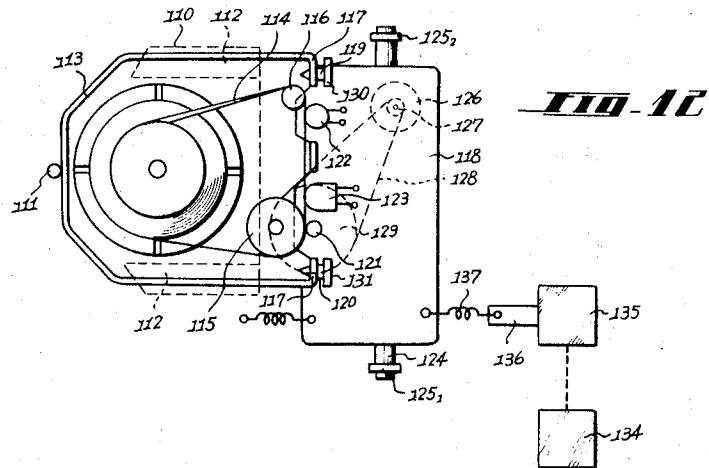


FIG. 13

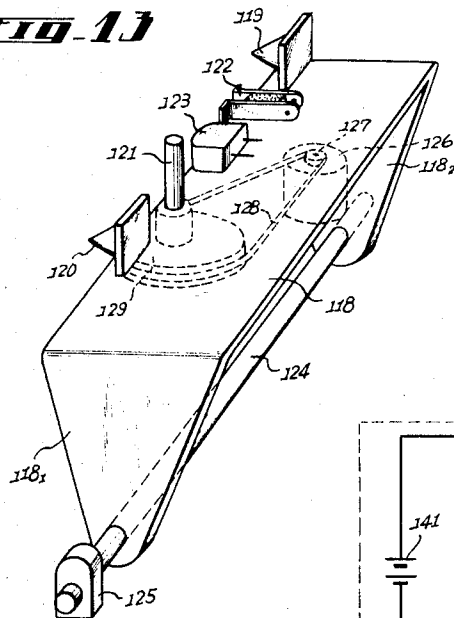
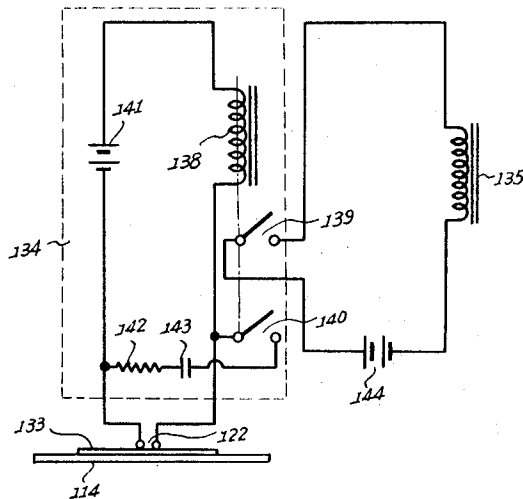


FIG. 14



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MEANS FOR BRINGING CAPSTAN INTO ENGAGEMENT AND DISENGAGEMENT FOR AUTOMATIC PLAYING APPARATUS UTILIZING A PLURALITY OF ENDLESS TAPE CARTRIDGES

BACKGROUND OF THE INVENTION

This invention relates to means for automatically bringing a capstan into engagement and disengagement for an automatic playing apparatus utilizing a plurality of endless tape cartridges, more specifically to means for automatically approaching or spacing a capstan to and from a pinch roller for a magnetic reproducing apparatus wherein a multiplicity of endless tape cartridges rested in a housing are indexed in accordance with a sequential program to thereby index a magnetic track to be played automatically.

As well known, the cartridge is generally provided with an endless magnetic tape, a guide portion guiding said tape along the forward edge of the cartridge, and a pinch roller feeding said tape in association with a capstan disposed on a cabinet.

According to a prior art construction of the playing apparatus, the cartridge of this class as described is inserted into a slot of the apparatus to cause the pinch roller to abut against the capstan and the tape to be fed and played by a play circuit provided within the apparatus. In these days such an automatic playing apparatus has been provided wherein a plurality of cartridges provided therewithin is to be successively indexed as program. One recently developed automatic playing apparatus of this type, as for example, comprises a plurality of cartridges stacked therein, an elongated pinch roller in common with the cartridges, a plurality of magnetic heads in opposition to each cartridge and for reproducing the tape, cartridge driving means forwarding the cartridge to be indexed to abut the capstan against the pinch roller to thereby feed the tape for its reproducing; an end mark on the tape for actuating said driving means to reverse the cartridge for terminating reproduction by the tape. According to the apparatus of this class, a multiplicity of magnetic heads and considerable elongated capstans are required to associate with at least a number of cartridges to be received so that manufacture of the apparatus is expensive in proportion as the number of the cartridges is increased. On the other hand, the length of the capstan and the number of the cartridges are limited to a certain extent.

In order to overcome the disadvantage as set forth in the above, such apparatus has been proposed as that by movement of the cartridge containing a plurality of cartridges, the indexed cartridge is caused to be moved to the position where the tape is opposite to the capstan and the magnetic head, that is, the play position and thereafter the cartridge as positioned in that position is forwarded by the cartridge driving mechanism to effect its reproduction.

According to such the proposed apparatus, the length of the capstan is shortened to convenient one for use and a multiplicity of magnetic heads is reduced to a single head so that advantages are derived from the use of this kind of the apparatus.

In principle, the tape feed is effected by the bias abutment upon the tape between the pinch roller and the capstan, variation in such the abutment force brings about variation in speed of the tape feed to cause wow-flutter so that good tone quality is not possible during reproduction.

Therefore, in order to secure stable abutment of the pinch roller and capstan on the tape, the cartridge should be held in position when reproducing, that is to say, lateral, transversal vibration must be eliminated.

For this reason, an improved and novel playing apparatus construction is provided so that the pinch roller is brought into and out of engagement with the capstan in response to the reciprocal movement of the cartridge to minimize waste of energy for vibration as mentioned whereby good tone quality may be obtained.

The present invention contemplates the provision of an automatic playing apparatus which, when used in conjunction with means for bring a capstan into engagement and disengagement with a pinch roller, does not waste of electric power and also does not require a complicated mechanism.

SUMMARY OF THE INVENTION

It is a principal object of the invention to provide means for bringing a capstan into engagement and disengagement for an automatic playing apparatus utilizing a plurality of endless tape cartridges with the use of a simple mechanism while requiring a minimum of energy for operation.

An object of the invention is, second, to provide means for bringing a pinch roller into engagement and disengagement with a capstan for an automatic playing apparatus utilizing a plurality of endless tape cartridges with the swingable movement of a deck in which the capstan, rotatable drive mechanism, and a magnetic head are included.

An object of the present invention is, third, to provide means for bringing a capstan into engagement and disengagement for an automatic playing apparatus utilizing a plurality of endless tape cartridges wherein a deck is moved away from the cartridge by a drive member which is actuated in response to the searching of an end mark on the tape and time lag means is provided to return the deck to its original position after positioning the next indexed cartridge in the play position.

An object of the present invention is, fourth, to provide means for bringing a capstan into engagement and disengagement for an automatic playing apparatus utilizing a plurality of endless tape cartridges wherein a deck is swingably moved by rotation of a drive member for a capstan and the deck is automatically returned to its normal position by means of a mechanical time delay element whereby the apparatus is operated with a minimum of electric current.

An object of the present invention is, fifth, to provide means for bringing a capstan into engagement and disengagement for an automatic playing apparatus utilizing a plurality of endless tape cartridges wherein a deck which has been swung by an electromagnetic plunger, is retained by a magnetic attractive force and the deck is returned to its original position by reducing the attractive force with the use of an electric time delay element.

The present invention has particular usefulness in conjunction with a tape having a multiplicity of sound tracks, that is to say, a switchover member for each track is operated by lever means which is actuated by the swingable movement of a deck to change over a track.

Still another object of the invention to provide means for bringing a capstan into engagement and disengagement for an automatic playing apparatus utilizing a plurality of endless tape cartridges wherein a casing containing the plurality of cartridges is released when a deck is away from the cartridge to allow the next indexed cartridge to be moved and positioned in the play position.

In order that the invention may be fully understood, embodiments thereof will now be described by way of example, by reference to the accompanying diagrammatic drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view showing the form of an automatic playing apparatus utilizing a plurality of endless tape cartridges for used with the present invention;

FIG. 2 is a reduced fragmentary side view showing a portion of embodiment shown in FIG. 1;

FIG. 3a is a perspective view showing a mechanism for indexing a cartridge and a track;

FIG. 3b is a side view of the mechanism for indexing the cartridge and the track shown in FIG. 3a;

FIG. 4 is a circuit diagram for changing over a track;

FIG. 5 is a perspective view of the deck shown in FIG. 1 used in connection with the capstan;

FIG. 6 is a plan view showing deck driving means for use with the deck shown in FIG. 1;

FIG. 7 is a schematic view of an electromagnetic mechanism circuit for use with deck driving means shown in FIG. 6;

FIG. 8 is a side view of a modified deck driving means;

FIG. 9 is a circuit diagram for energizing an electromagnet for use with the modification illustrated in FIG. 8;

FIG. 10 is a schematic view of a permanent magnet and an electromagnet for use with the modification in FIG. 8;

FIG. 11 is a sectional view showing a form of means for magnetically attracting the deck;

FIG. 12 is a plan view showing a portion of modified form of an automatic playing apparatus utilizing a plurality of endless tape cartridges for used with the present invention;

FIG. 13 is a perspective view of the deck for use with the modification shown in FIG. 12;

FIG. 14 is an electrical diagram schematically showing the electromagnetic plunger and the circuit for actuating the same.

DESCRIPTION OF SPECIFIC EMBODIMENT

Referring to the drawings, particularly to FIG. 1, a cartridge mounting plate 20, as a housing for the cartridge, is of planar and rotatively mounted to a pivot disposed on a cabinet (not shown) through a central bearing 22. Pairs of retaining members 23₁, 24₁, 23₂, 24₂; 23₃, 24₃; and 23₄, 24₄; are urged against depressions 26, 27 on the sidewalls of each four cartridges 25₁, 25₂, 25₃, and 25₄, having an endless tape 29 on a rotary disc 29, a tape guide 30, and a pinch roller 31 in order to hold the cartridges in position. Since each cartridge is identical, it is deemed sufficient to describe only two 25₁, 25₂ of them. One pair of cartridges are arranged on the plate 20 at a right angle to the other pair of cartridges. The forward edge portion of each cartridge is positioned above the edges of the plate 20. The cartridge is drawn against the urged force of the retaining members to free it from the mounting plate 20 so that there may be an interchangeability with each other.

A column 32 is provided downwardly of the plate 20 to interpose a spiral coil spring 33 between the column and the bearing 22. The cartridge mounting plate 20 is manually rotated in the direction of arrow B, and energy is stored in the spring 33 to impart rotation in the direction of arrow A to the plate 20. A projection 34 is integrally formed at the edge of the plate 20 and a lever 35 is pivoted by a shaft 36. Such rotation of the plate 20 is thus arrested by engagement of the projection 34 with the lever 35. The above-mentioned arrest force applied to this rotation is derived from a spring 37 extending between the cabinet and the lever 35. A stopper pin 38 is provided to prevent the lever 35 from being rotated. When the lever 35 is manually rotated against the urged force of the spring 37, it is disengaged from the projection and rotation of the plate 20 is initiated by energy stored in the spring 33. Adjacent to one side of each cartridge rigidly secured to the plate are pairs of hollow shafts 39₁, 39₂, 39₃, 39₄, 40₁, 40₂, 40₃, and 40₄, within which pairs of associated push rods 41₁, 41₂, 41₃, 41₄, 42₁, 42₂, 42₃, and 42₄ are provided, the latter being slidably and frictionally carried within by each hollow shaft. Normally, the upper end of the push rod is projected from the hollow shaft while the lower end thereof is restrained within the hollow shaft. When the push rod is manually depressed, the lower end thereof is caused to be projected from the hollow shaft. As rotation of the mounting plate 20, these push rods are accordingly rotated to cause the pair of rods to be engaged with a raised portion secured to the cabinet. This causes the rotation of the plate to be terminated. FIG. 2 shows the state wherein the cartridge has been positioned in the play position after the push rod had been depressed to be engaged with the raised portion to thereby terminate rotation of the plate 20. Numeral 44 indicates a deck comprising a pinch roller 31 within the cartridge to be positioned in the play position, a capstan 45 engaging the tape 29, and a magnetic head 46 and which is swingably journaled by a

shaft 47 to the cabinet. At the lower end of the capstan 45 there is provided a flywheel 51 which is carried by a bearing 52 and is rotated by a belt 50 imparting rotation of a motor 48 through a motor shaft 49. A spring 53 extends between the deck and the cabinet to urge the deck 44 toward the cartridge to allow the capstan 45 to be urged against the pinch roller 31 and to cause the magnetic head 46 to be engaged by the tape 29 when the tape is reproduced. Numeral 54 indicates an end mark search head which searches an end mark (not shown) of a conductive material such as aluminum foil on the tape 29 and can be urged against the tape 29 in the same manner of the magnetic head 46 when the tape is reproduced.

In FIG. 2, like parts are represented by like numerals. On the face 43' of the raised position 43 engaging the depressed push rods 41₁, 42₁, a lever plate 55 is slidably supported by two guide pins 57 having a flange 58 passing through a vertically elongated slot 56. Springs wound to the guide pins 57 are interposed to provide a space between the flange 58 and the lever plate 55. Abutment of the plate 55 with the face 43' is secured by the urged force of such the springs. A spring 59 also extends between the lever plate 55 and the cabinet to normally urge the lever plate 55 downwardly. This will cause the lever plate 55 to be downwardly positioned below the push rod 41₁, 42₁, which is engaged by the raised portion 43. The line linked between the two push rods 41₁, 42₁ is not always parallel to the face 43' of the raised portion 43. That is, the push rod 41₁ is firstly depressed to engaged the raised portion 43 at which time, the other push rod 42₁ is free from engagement with the raised portion and a certain space more than the thickness of the lever plate 55 is formed between the push rod 42₁ and the raised portion 43. However, the other push rod 42₁ can, of course, be depressed to engage the raised portion 43 when the push rod 41₁ is not depressed.

Numeral 60 is a link lever having the opposite ends one of which is positioned adjacent to the lever plate 55 and the other is engaged with a deck limb 61. The link lever 60 is rotatably supported by a shaft 62. Details of the functional operation of the lever plate 55 and the link lever 60 will be described hereinafter. When the deck 44 is swingably moved in the direction of arrow C after the tape is reproduced in a manner as described later, as the deck limb 61 depresses the other end of the link lever 60 is then clockwise rotated about the axis of the shaft 62 against the urged force of the spring 59. As a result, the lever plate 55 moves the push rod 41₁ upwardly to be released from engagement with the raised portion 43. When the deck 44 is returned to its normal position in a manner as described later, the lower plate is also returned by the springs 59, 63 to its normal position. The push rod 42₁ is engaged by the raised portion 43 by upward movement of the push rod 41₁ to maintain the cartridge mounting plate 20 in a position for arresting its rotation. Next, the engagement of the push rod 42₁ with the raised portion 43 is released by upward movement of the push rod 42₁ due to the swingable rotation of the deck 44. If the push rod 41₁, 42₁ is depressed together, they are upwardly moved by the swingable rotation of the deck 44 twice to release their engagement from the raised portion 43 and the plate 20 initiates its rotation.

It should be noted that the push rod 41₁ provided not only the functional operation to arrest rotation of the mounting plate 20 but also such a function to index a magnetic head on the tape. The depressed push rod 41₁ engaged with the raised portion 43 is caused to depress a microswitch actuating rod 65 passing through the raised portion 43 and projecting from the face 43'.

As shown in FIG. 4, the microswitch 64 is arranged between a tape reproducing amplifier 66 and two magnetic heads 46a, 46b which are provided to be opposed to each magnetic head. When the actuating rod 65 is depressed by the push rod 41₁, the output of the magnetic head 46b is applied to the amplifier 66. It is the time when the actuating rod 65 is not depressed that the output of the magnetic head 46a is applied thereto. The modified form of the magnetic heads 46a, 46b illustrated in FIG. 4 is shown in FIG. 1 as a magnetic head 46 for which

function of both magnetic heads provides. In order to prevent the lever plate 55 from being engaged with the actuating rod 65 of the microswitch 64 when axial movement of the lever plate 55 is effected, a slit 55' may be provided thereon.

To the lower end of the capstan 45 is mounted a cam 67, see FIG. 2, which forms a part of the swingable movement mechanism of the deck 44 and will be fully described hereinafter.

The detail of the deck and related parts is shown in FIGS. 5 and 6. The flywheel 51 is provided with such an arrangement at read side thereof as shown in FIG. 6. This arrangement is provided for the purpose that the deck 44 is swung to disengage the capstan 45 from the pinch roller 31 to terminate the tape feed. Slidably mounted to the capstan 45 as the shaft for the flywheel 51 is the cam 67 between which and the flywheel 51 a leaf spring 68 is interposed through a pin 69. On the other hand, an electromagnet 71 with an actuator 73 is secured to the cabinet 70 of the apparatus.

When an end mark 74 on the tape 29, see FIG. 7, closes the end mark search head 54 and the current from a power supply 75 is applied to the excitation coil of the electromagnet 71, the magnetic circuit is closed through the yoke 72 of the electromagnet 71 to attract the actuator 73 from the position shown by the dotted line to the position shown by the solid line. At this point, the cam 67 rotates in the direction of arrow D, see FIG. 7, to allow the cam 67 to engage the end of the actuator 73 and then such engagement reacts on the capstan 45 to urge it in the direction of arrow F. As a result, counterclockwise rotation (FIG. 5) is imparted to the deck 44 allowing it to initiate rotation thereof. The capstan 45 is away from the pinch roller 31. The leaf spring 68 rotates the cam 67 in association with rotation of the flywheel 51 while avoiding a collision between the cam 67 and the actuator 73. With such an arrangement as set forth in the above, current flow (pulse current) to be drained to the excitation coil of the electromagnet 71 may be minimized. In other words, the deck 44 gains a considerably swingable movement due to the force of inertia of the flywheel 51 even though electric power economized.

Referring again to FIG. 5, when the deck 44 is rotated in the direction of arrow E against urged force of the spring 53 upon searching the end mark on the tape, a ratchet wheel 76 and the detent 77 are engaged with each other so that the deck is caused to terminate its rotation. The detent 77 is pivotally mounted to the portion of the deck 44 and a spring 78 extends between the apparatus and the detent to normally effect engagement of the detent with the tooth of the ratchet wheel 76. The ratchet wheel 76 subject to governor effect is associated with a governor claw 82 through multiplying gear trains 79, 80 and 1 and is rotated by the urged force of the spring 53 after predetermined interval. This causes the deck 44 to be returned to its original position and the capstan 45 is urged against the pinch roller 31 so that the tape is fed and is reproduced.

If the time lag is set to be over the period (time for rotation of the cartridge at one revolution of 20°) at which the cartridge mounting plate, it is apparent that the cartridge is substantially indexed by pressing the push rod whereby each tape is successively reproduced.

The other embodiments of the present invention are illustrated in FIGS. 8, 9, and 10.

Suffice it to say that means are provided for engagement and disengagement of the capstan with the pinch roller placed within the cartridge in the play position since means to bring a desired cartridge out of a plurality thereof into the play position does not form a substantial part of the present invention.

A deck 83, see FIG. 8, is pivoted by a shaft 84 passing through the lower portion thereof to the apparatus and which is urged by a spring 85 in the counterclockwise direction. Numeral 86 indicates a capstan which is rotatably supported at the opposite sides thereof by bearings 87, 88 secured to the deck 83. The capstan 86 takes the form of the spindle for a flywheel 9. A belt 92 is stretched between the flywheel 89 and a rotary shaft of a motor 90 mounted to the deck 83. The cap-

stan 86 is urged against the pinch roller (not shown) disposed on the cartridge under influence of the spring 85 to drive the tape for its feed.

Now, end mark searching means (not shown) detect the end mark on the tape under reproduction, an electromagnetic plunger 93 is actuated by the output of the end mark searching means to swing the deck 83 against the force of the spring 85. The instant end mark may take such a form as conductive foil used for embodiment as described, particular frequency signal, a predetermined number of continuous pulse signal, recorded on the tape, or nonsignal (nonrecorded) zone thereon. If recorded or nonrecorded signal is used as the end mark for end mark searching means, it includes the magnetic head and electronic switching means for controlling current to the electromagnetic plunger by means of the output of the magnetic head. The magnetic head included in end mark searching means may be provided independently of the magnetic head (not shown) for reproducing recorded information or may serve as the latter. In the latter case, a filter is provided for the output of the recorded information reproducing magnetic head to filtrate only the end mark signal so that electronic switching means is actuated by the output of the filter. If the end mark takes the form of nonsignal zone, no filter is needed and electronic switching means capable of switching for a certain period of no input is employed instead.

A permanent magnet 94 is secured to the deck 83 and is caused to be attracted to a yoke 96 of an electromagnet mounted to the apparatus when the deck 83 is away from the cartridge by function of an electromagnetic plunger 93. It should be noted that the permanent magnet 94 prevents the deck 83 from returning to its original position when the plunger 93 has finished its function. An exciting coil 97, see FIG. 9, for the electromagnet 95 is connected through a switch 98 and a resistor 99 to a supply source 100. A condenser is also connected in parallel with the supply source. A switch 98 is adapted to be manipulated by the deck 83 which is away from the cartridge. When the deck 83 is clockwise rotated in response to the end mark signal on the tape and the capstan 86 is away from the pinch roller (not shown) in the cartridge, the switch 98 is closed to allow the current from the supply source 100 to be drained through the resistor 99 to the condenser 101 for increasing electric potential thereof. The current applied to the exciting coil 97 is gradually increased in response to the time constant defined by the condenser. Current value exceeding the predetermined value causes the flux generated by the exciting coil 97 to erase the flux of the permanent magnet 94 so that attractive force between the permanent magnet and the electromagnet 95 is eliminated and the deck 83 is returned by the urged force of the spring 85 to its normal position. At this point, the switch 98 is opened and the electric charge applied to the condenser 101 is discharged through the exciting coil 97. On the other hand, potential is maintained at zero point until the switch 98 is again closed.

FIG. 10 shows the electromagnet 95 and the permanent magnet 94 in section for the purpose to illustrate the relationship between the two.

The exciting coil 97 is wound to the core of the cylindrical yoke 96. The permanent magnet is made of ferrite magnet. The magnet circuit ends thereof close to the yoke 96, its circuit is closed due to the polarization to cause the permanent magnet 94 and the yoke 96 to be attracted to each other. As described in the foregoing, once the exciting coil 97 is energized, attractive force between the two is erased since the direction of the magnetic flux generated is such that it enables the magnetic flux of the ferrite magnet to be erased. This causes the deck 83 to be released from the engagement.

FIG. 11 shows alternative forms of the magnetic members, that is, a magnetic substance 102 made of mild steel plate and the electromagnet 103. In this modification, the magnetic substance 102 is secured deck and the electromagnet 103 includes the yoke 106 which is provided with the exciting coil 104 preliminary charged with DC current, and the exciting coil 105 to be charged with the current when the deck is

returned to its original position. When the magnetic substance 102 closes to the yoke 106, the electromagnet 103 is attracted by the charged exciting coil 104 to the yoke 106 and the deck is brought into engagement. Disengagement of the deck is effected by the circuit as shown in FIG. 9 in a manner that the magnetic flux generated by the charged exciting coil 105 functions to erase the magnetic flux generated by the exciting coil 104 so that both generated fluxes are offset and attractive force between the electromagnet 103 and the magnetic substance 102 decays.

Referring to FIG. 9, again, the time constant determined by the resistor 99 and the condenser 101 is time lag returning the deck 83 to its normal position. It should be noted that such the time is longer than any of the longest period for indexing one out of a plurality of cartridges to the play position.

Another embodiments of the present invention are shown in FIGS. 12, 13, and 14.

Numerical 110 indicates a cartridge mounting plate, see FIG. 12 with the major portions abridged, which serves as the cartridge casing to receive a plurality of cartridges and having a mechanism for bringing the cartridge to be indexed into its play position. A pin 111 is mounted to the plate 110 not only to control movement of the cartridge 113 which is inserted by cartridge guides 112 into the plate 110 but also to position the cartridge guides in a manner that the forward end of the cartridge at least projects from the periphery of the plate 110. The cartridge 113 as shown is such that it is out of a plurality of the cartridges received within the plate and is positioned in its play position. The cartridge 113 is provided with the tape 114, pinch roller 115, and the tape guide 116 therewithin. Provided on the forward end 117 of the cartridge is an opening (not shown) through which passes guide pins 119, 120 mounted to the deck 118 as will be described hereinafter. The tape 114 runs through the pinch roller 115 and the capstan 121 mounted to the deck 118. When the tape comes to the forward end 117 of the cartridge, it is slidable in an end mark search head 122 and the magnetic head 123 to allow the magnetic surface of the tape to be brought in contact with these heads.

The deck 118, see FIG. 13, is integrally provided with supports 118₁, 118₂ at the opposite ends thereof. A rotatable shaft 124 passes through the supports 118₁, 118₂ and is supported at the ends thereof by bearings 125₁, 125₂ secured to the apparatus.

A motor 126 as drive source for the capstan 121 and a flywheel 129 connected through a belt 128 to the shaft 127 of the motor are disposed under the other side of the deck 118. The shaft for the flywheel 129 serves as the capstan 121. Supports 130, 131 is provided to carry the guide pins 119, 120.

FIG. 12 shows the stage in which the deck 118 is swingably urged by the bias of the spring 132 against the cartridge 113 and the capstan 121 abuts on the pinch roller 115 to feed the tape 114. At this point, the guide pins 119, 120 project into the opening (not shown) through the forward end 117 to define the relative position in respect to the cartridge 113 and the deck 118. This also defines the relative position in respect to the tape 114 and the magnetic head 122 so that a proper reproduction is effected.

When the end mark 133, see FIG. 14, on the tape 114 closes the contacts of the end mark search head 54, an electric controller 134 functions to apply the current to the electromagnetic plunger 135. An actuator 136 for the electromagnetic plunger 135 is connected through a spring 137 to the deck 118 so that when the plunger 135 is energized and the actuator 136 is attractively moves in the rightward direction, the deck 118 is swingable about the rotatable shaft 124 against the bias of the spring 132. While the capstan 121 is away from the pinch roller 115 by the deck 118 which is swingable in the above manner, the magnetic head 123 is also away from the tape 114 to thereby terminate the reproduction of the tape 114.

The electric controller 134 constitute a circuit as shown by the dotted line of FIG. 14 and comprises an electromagnetic

relay 138 with its contacts incorporating in series into the conductive circuit for the electromagnetic plunger 134, a power supply 141 for actuating the relay 138, a relay contact 140 constituting the self-preserve circuit for the electromagnetic relay 138, a resistor 142, and a condenser 143. When the end mark 133 on the tape 114 short circuits the contacts of the end mark search head 122, the current from the power supply 141 is applied to the electromagnetic relay 138 whereby two normally open type relay contacts 139, 140 are closed and operated. As a result, the electromagnetic relay constitutes a self-preserve circuit through the relay contact, the condenser 143, and the resistor 142 and the electromagnetic plunger 135 is connected through the relay contact 139 to the power supply 144. By energization of the electromagnetic plunger 135, the deck 118 is away from the cartridge 113 and the capstan 121 is in turn away from the pinch roller 115 and then simultaneously the end mark search head 122 is also away from the end mark 133 whereby the conductive circuit for the electromagnetic relay 138 by the end mark 133 is opened but the electromagnetic relay is maintained in the stage of energization by the self-preserve circuit as previously mentioned. Therefore, the electromagnetic plunger 135 is also maintained in the stage of energization to allow the deck 118 to be held in the position being away from the cartridge 113. Since the resistor 142 and the condenser 142 are in series incorporated in the self-preserve circuit for the electromagnetic relay 138, the current applied to the electromagnetic relay 138 decays in response to the charge on the condenser 143 and then the current is such that it is less level thereof for the electromagnetic relay 138, the two relay contacts 139, 140 are opened. Opening of the relay contact 140 causes the self-preserve circuit for the electromagnetic relay 138 to be completely broken while opening of the other relay contact 139 causes the conductive circuit for the electromagnetic plunger 135 to be broken to deactuate the plunger so that the deck 118 is returned to its original position under influence of the spring 132. In other words, the deck 118 which is moved away from the cartridge 113 in response to the end mark 133 on the tape 114 is again returned to its original position after the time lag which is determined by the resistor 142 and the condenser 143. Such the time lag should be longer than that necessary for functioning to position the next indexed cartridge in the play position.

In the case of the apparatus as shown in FIGS. 12 to 14, as well as the apparatus as illustrated in FIGS. other than those, it may be necessary to provide means for indexing not only the tape but also the cartridge to respond to the swingable operation of the deck 118.

While only the preferred forms of the invention have been described, it should be understood that various changes or modifications may be made within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. In an automatic tape playing apparatus having a plurality of endless tape cartridges mounted on a casing, the casing being rotatable to bring the cartridges into playing position in a predetermined sequence, means for bringing a capstan into engagement with and disengagement from a tape cartridge in the play position comprising a pivotally movable deck, a capstan and a capstan driving means on said deck, the capstan being adapted to forcibly abut on a pinch roller in one of the tape cartridges held in the play position in response to movement and location of the casing supporting the plurality of endless tape cartridges; a magnetic head on said deck; bias means for normally urging said deck in the direction of a cartridge in the play position; deck driving means for pivotally moving said deck against the bias of said bias means and retracting said capstan and said magnetic head from the tape and said pinch roller in the cartridge in the play position; end mark search means for searching an end mark on the tape, means responsive to said end mark search means for actuating said deck driving means when the end mark is sensed, said responsive means including an electromagnet adapted to be energized when said end mark is sensed, and said deck driving

means including an actuator movable by said energized electromagnet for causing the deck to move against said bias means when said electromagnet is energized; and delay means operative to lock said deck after it has been retracted from the cartridge in the play position by said deck driving means, to retain said deck in the retracted position against the bias of said bias means for a delay period longer than the period for positioning the next indexed cartridge in the play position, and to release the deck at the end of said delay period, said bias means being operative when said deck is released from the delay means to automatically swing the deck toward and into engagement with a cartridge in the play position.

2. In an automatic tape playing apparatus having a plurality of endless tape cartridges mounted on a casing, the casing being rotatable to bring the cartridges into playing position in a predetermined sequence, means for bringing a capstan into engagement with and disengagement from a tape cartridge in the play position comprising a pivotally movable deck, a capstan and a capstan driving means on said deck, the capstan being adapted to forcedly abut on a pinch roller in one of the tape cartridges held in the play position in response to movement and location of the casing supporting the plurality of endless tape cartridges; a magnetic head on said deck; bias means for normally urging said deck in the direction of a cartridge in the play position; deck driving means for pivotally moving said deck against the bias of said bias means and retracting said capstan and said magnetic head from the tape and said pinch roller in the cartridge in the play position; end mark search means for searching an end mark on the tape, means responsive to said end mark search means for actuating said deck driving means when the end mark is sensed, said responsive means including an electromagnet adapted to be energized when said end mark is sensed, and said deck driving means comprising an actuator movable by said energized electromagnet and a cam coupled to a flywheel for said capstan driving means, said electromagnet when energized by the output of said end mark search means being adapted to magnetically attract said actuator into the range of rotation of said cam, said deck being swingably moved by the reaction of said cam when it impinges on said actuator, and delay means operative to lock said deck after it has been retracted from the cartridge in the play position by said deck driving means, to retain said deck in the retracted position against the bias of said bias means for a delay period longer than the period for positioning the next indexed cartridge in the play position, and to release the deck at the end of the delay period, said bias means being operative when said deck is released from the delay means to automatically swing the deck toward and into engagement with a cartridge in the play position.

3 Means in accordance with claim 1 wherein said delay means comprises a ratchet claw mounted on said deck, a ratchet wheel mounted adjacent said deck, and a governor claw coupled through gear trains to said ratchet wheel, said deck being adapted to be swung by said deck driving means and to interfere with the engagement of said ratchet claw and said ratchet wheel such that the deck cannot be restored to its original position even under influence of said bias means, and a mechanical governor for gradually returning the deck to its original position.

4. In an automatic tape playing apparatus having a plurality of endless tape cartridges mounted on a casing, the casing being rotatable to bring the cartridges into playing position in a predetermined sequence, means for bringing a capstan into engagement with and disengagement from a tape cartridge in the play position comprising a pivotally movable deck, a capstan and a capstan driving means on said deck, the capstan being adapted to forcedly abut on a pinch roller in one of the tape cartridges held in the play position in response to movement and location of the casing supporting the plurality of endless tape cartridges; a magnetic head on said deck; bias means for normally urging said deck in the direction of a cartridge in the play position; deck driving means for pivotally moving said deck against the bias of said bias means and

retracting said capstan and said magnetic head from the tape and said pinch roller in the cartridge in the play position; end mark search means for searching an end mark on the tape, means responsive to said end mark search means for actuating said deck driving means when the end mark is sensed, said responsive means including an electromagnet adapted to be energized when said end mark is sensed, and said deck driving means including an actuator movable by said energized electromagnet for causing the deck to move against said bias means when said electromagnet is energized; and magnetic delay means including means for magnetically locking said deck after it has been retracted from the cartridge in the play position by said deck driving means and for magnetically retaining said deck in the retracted position against the bias of said bias means for a period longer than the period for positioning the next indexed cartridge in the play position, and means for deactivating said magnetic locking means at the end of the delay period to release said deck, said bias means being operative when said deck is released from the delay means to automatically swing the deck toward and into engagement with a cartridge in the play position.

5. Means in accordance with claim 4, wherein said actuator is an electromagnetic plunger for swinging said deck against the bias of said bias means when said plunger is energized to move the deck away from the cartridge in the play position.

6. Means in accordance with claim 5 wherein said delay means comprises a permanent magnet secured to the deck, said permanent magnet having a magnetically attractive yoke, a second electromagnet secured adjacent the deck, said permanent magnet and said second electromagnet being so located that they are adjacent when the deck is fully retracted, an exciting coil disposed on said second electromagnet in a manner such that its current direction is able to erase the magnetic flux of said permanent magnet, a supply source for energizing said exciting coil for said second electromagnet, a resistor connected in series between said supply source and said exciting coil for said second electromagnet, a condenser coupled in parallel with said exciting coil, and a switch provided between said supply source and said exciting coil and positioned to be closed by said deck when the deck is retracted from a cartridge in the play position, whereby said deck is retained in the retracted position by magnetic attraction between said permanent magnet and said second electromagnet, and said attraction between said permanent magnet and said second electromagnet is demagnetized by the magnetic flux generated in said second electromagnet after time lag defined by said resistor and said condenser, whereby said deck is automatically returned to its original position by the bias of said bias means.

7. Means in accordance with claim 5 wherein said delay means comprises a magnetizable plate secured to the deck, a second electromagnet being secured adjacent the deck and having a yoke including a first normally energized exciting coil and a second exciting coil, said second electromagnet attracting said plate thereto by the flux generated in said first normally energized exciting coil and retaining said deck in the retracted position where said deck is away from the cartridge, a supply source for applying current to the second exciting coil in a direction to demagnetize the flux generated in the first exciting coil, a switch provided between said supply source and said second exciting coil and adapted to be closed by said deck for the period that said deck is retained by magnetic attraction between said plate and said yoke, and a time constant circuit provided between said supply source and said second exciting coil and having a condenser and a resistor generating in said second exciting coil the flux to demagnetize the flux generated in first exciting coil after a predetermined time lag when said switch is closed, whereby magnetic attraction between said electromagnet and said plate is demagnetized after time lag defined by said time constant circuit while said deck is automatically returned to its normal position by the bias of said bias means.

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8. Means in accordance with claim 5, wherein the magnetic delay means includes an electromagnetic relay energized and defined by the end mark search means when searching the end mark on the endless tape, and a self-preserve circuit for said electromagnetic relay constituted through a resistor, a condenser, and a contact which is closed when said electromagnetic relay is energized, the electromagnetic plunger being energized by the other contact of said electromagnetic relay,

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whereby the electromagnetic plunger is held in energizing condition for the time lag which is defined by the resistor and condenser incorporated in said self-preserve circuit for said electromagnetic relay so that said deck is moved and held in the position being away from the cartridge and is automatically returned to its normal position by the bias of said bias means after said time lag.

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