April 7, 1970 ITSUKI BAN 3,504,916

AUTOMATIC PLAYING APPARATUS

Filed Dec. 22, 1967 4 Sheets-Sheet 1

Fig. 1

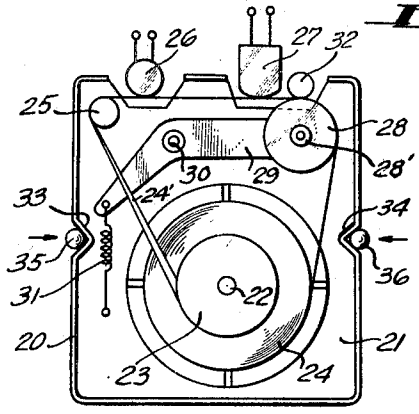


Fig. 2

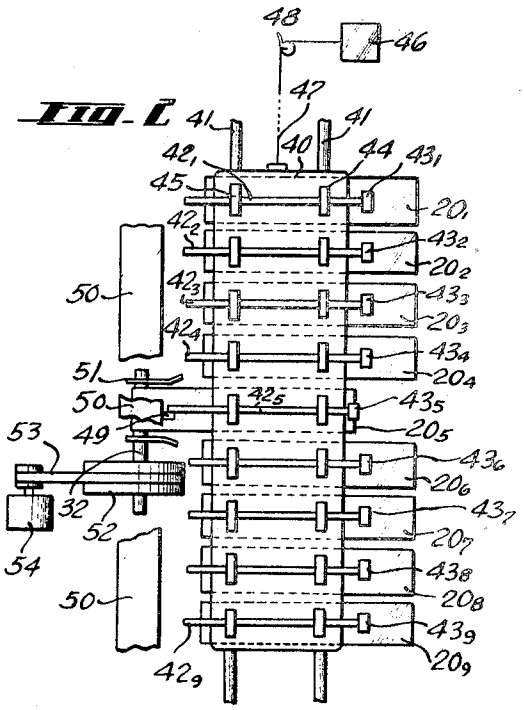


Fig. 4

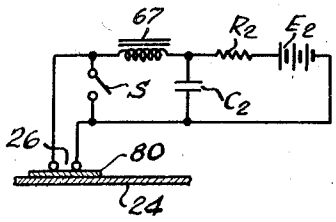


Fig. 5

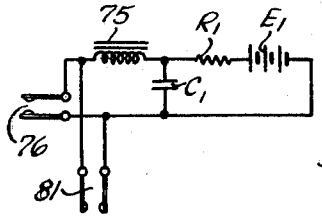


Fig. 6

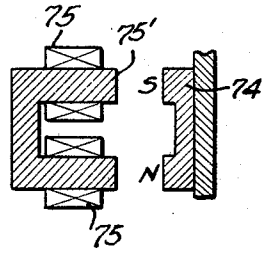
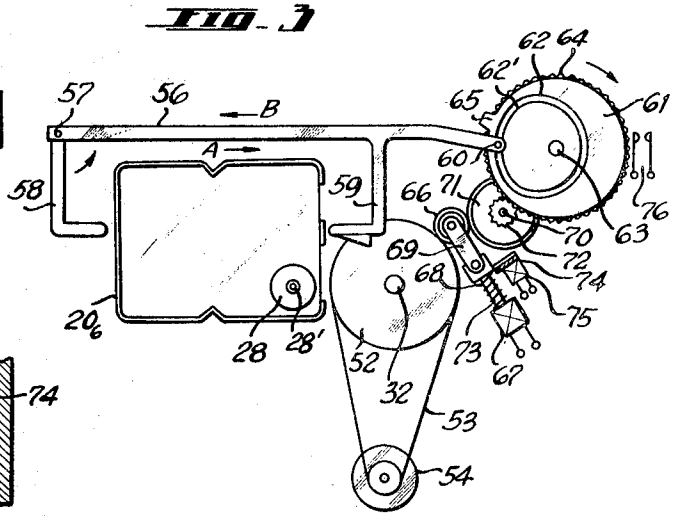


Fig. 3



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FIG. 7

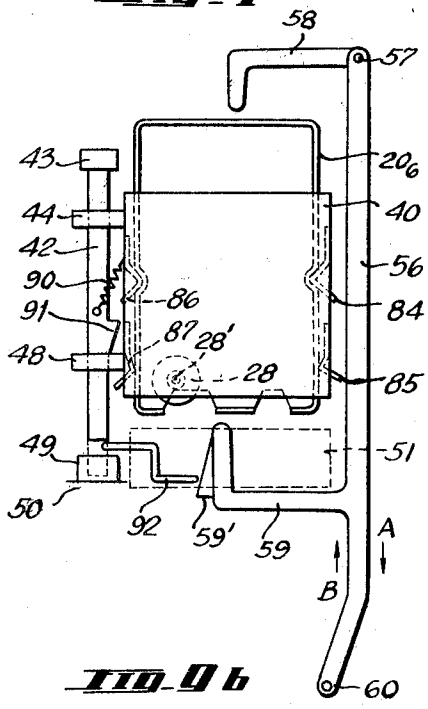


FIG. 8

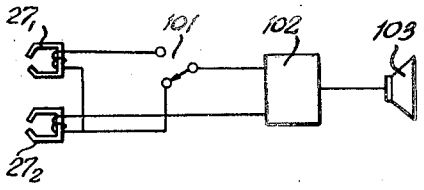


FIG. 8a

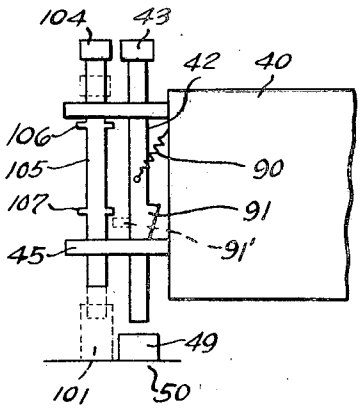


FIG. 8b

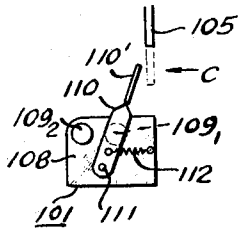


FIG. 10

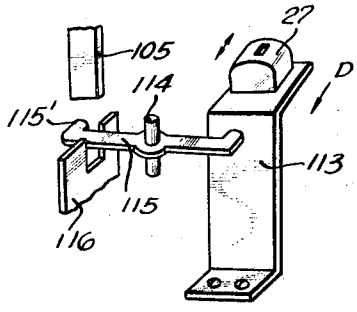
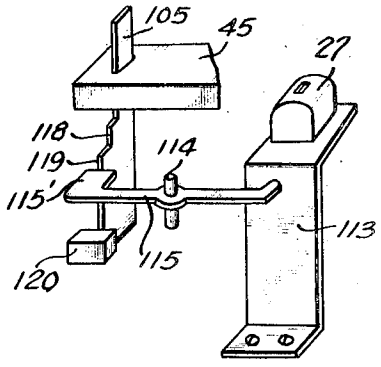


FIG. 11



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Fig. 1C

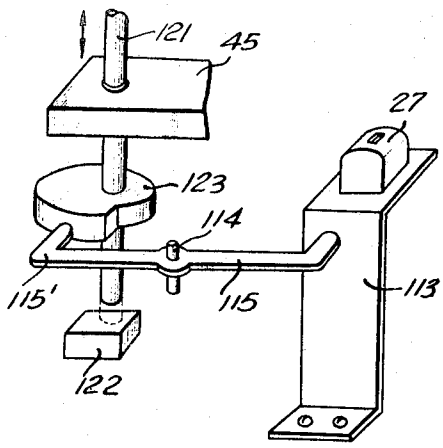


Fig. 1A

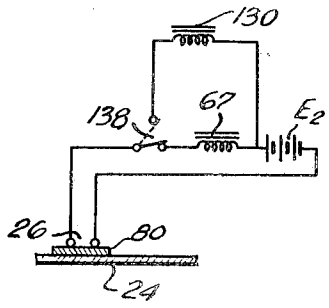


Fig 13a

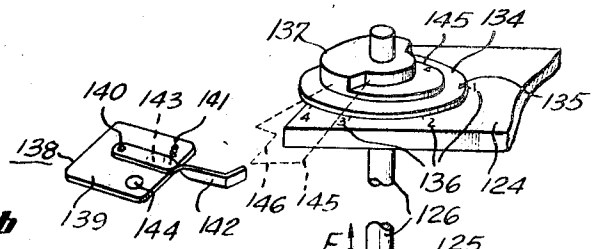
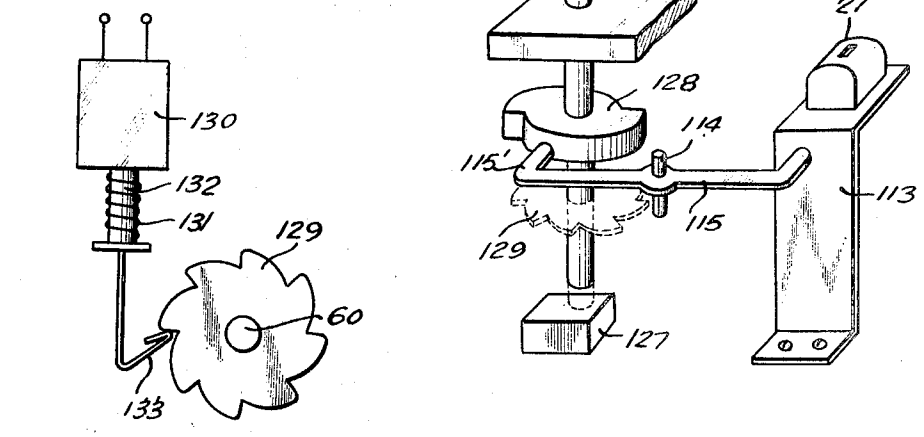


Fig. 13b



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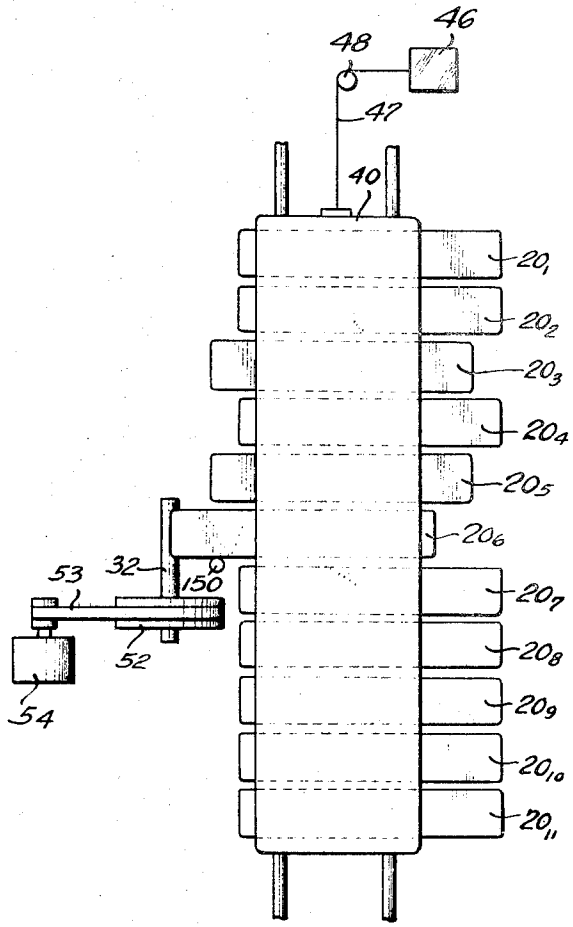


Fig. 13

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United States Patent Office 3,504,916 Patented Apr. 7, 1970

3,504,916

AUTOMATIC PLAYING APPARATUS

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Filed Dec. 22, 1967, Ser. No. 692,811
Int. Cl. G11b 5/78
U.S. Cl. 274—4 3 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for playing automatically in succession a plurality of endless tape cartridges according to a specific sequential program, wherein said cartridges are arranged in a stack within a casing for taking them up or down, a plurality of push button links are provided to correspond to each cartridge and adapted to be engaged with a raised portion to thereby limit the casing in its movement, a reciprocating lever is provided so that each cartridge is reciprocable between stand-by and play positions, a cam is actuated to terminate movement of the reciprocating lever when the cartridge is in the play position and to initiate movement thereof when the cartridge is in the stand-by position, and such movement of the reciprocating lever releases the push button link from its engagement with the raised portion to allow the casing to be moved.

BACKGROUND OF THE INVENTION

It is known to apply the concept of automatically playing a series of disc-shaped records in a juke box to the playing of a plurality of endless tape cartridges with a recording-reproducing apparatus. The disadvantages of such prior art are that dimension of the apparatus are so large and the cost is too high to make possible use by an individual.

The present invention contemplates the provision of means enabling the casing storing the cartridges to be lowered under the dead weight load to allow the cartridges to be placed in the play position as desired. The construction of the apparatus in accordance with the invention is very simple and compact to minimize consumption of electric current.

SUMMARY OF THE INVENTION

This invention relates to an automatic playing apparatus utilizing a plurality of endless tape cartridges, and more specifically to a new and improved mechanism for automatically indexing the cartridges in succession for automatic play.

Heretofore it has been proposed to use a currently available tape cartridge for the purposes as described above. Preferably, the cartridge is horizontally held in its position to facilitate the tape feed.

It is a principal object of the invention, accordingly, to provide an automatic playing apparatus which is capable of using a currently available tape cartridge without the necessity of modification thereof.

A further object of the invention is to provide an automatic playing apparatus having means to horizontally bring the cartridge into the stand-by or play position.

Another object of the invention is to provide an automatic playing apparatus in which a casing is provided for receiving a multiplicity of the cartridges in a stack therewithin and which is particularly adapted to be lifted or lowered to horizontally reciprocate the cartridge between two positions.

Another object of the invention is to provide an automatic playing apparatus having a plurality of push button links which are provided to correspond to each cartridge so that the cartridge is moved into the play position, at which time movement of a casing is arrested by engagement of a depressed push button link with a raised portion.

Another object of the invention is to provide an automatic playing apparatus which, when a casing is manually lifted or lowered under the deadweight load, does not require any complicated mechanism to accomplish this end.

Another object of the invention is to provide an automatic playing apparatus in which a cam is rotated by the output of an electric motor to operate a reciprocating lever carrying the cartridge, an electromagnetic device is actuated and deactuated by a switch and end mark search means to cause the cam to be connected and disconnected to the electric motor whereby each cartridge may be successively moved from the stand-by position to the play position, and vice versa.

Another object of the invention is to provide an automatic playing apparatus wherein the cartridge is adapted to be movable from the stand-by to neutral position by manually depressing the cartridge itself to allow the cartridge to be engaged with an engaging member for arresting movement of the casing whereby the cartridge may be brought to the play position.

Still another object of the invention is to provide an improved arrangement which, when the cartridges are in the play position, requires a pinch roller to be maintained in its position in relation to a capstan, and a head to secure the tape feed for obtaining excellent tone quality.

A still further object of the invention is to provide an automatic playing apparatus which is capable of indexing not only the cartridge but also one or more recorded tracks out of a plurality of tracks on the tape to allow tracks to be successively played.

Other objects, features and advantages of the invention will be understood from the following description and claims in conjunction with the accompanying drawing, wherein:

FIG. 1 is a plan view of a cartridge for use with an automatic playing apparatus according to the present invention;

FIG. 2 is a partial side elevational view of the automatic playing apparatus;

FIG. 3 is a schematic representation of a cartridge operating mechanism;

FIG. 4 is a circuit diagram for actuating an electromagnetic plunger;

FIG. 5 is a circuit diagram for actuating an electromagnetic coil;

FIG. 6 is a cross section of the electromagnetic coil of FIG. 5;

FIG. 7 is a schematic representation of a push button link for the cartridge;

FIG. 8 is a circuit diagram for indexing a track on the tape contained in the cartridge;

FIG. 9*a* shows schematically a track indexing mechanism adapted to actuate a switch.

FIG. 9*b* is partial plan view of a switch in a position to cooperate with the mechanism of FIG. 9*a*;

FIGS. 10, 11 and 12 are perspective views showing a track indexing mechanism adapted to cooperate with a magnetic head;

FIG. 13*a* is a perspective view of a mechanism for playing the tape in a manner such that tracks are successively indexed;

FIG. 13*b* shows schematically a ratchet wheel provided in the mechanism of FIG. 13*a*;

FIG. 14 shows a circuit diagram for actuating the mechanism of FIG. 13*a*;

FIG. 15 is a side elevational view of another embodiment of the present invention showing an arrangement

which is capable of indexing the cartridge by independent movement of the cartridge itself.

The structure of a currently available endless tape cartridge for use with an automatic playing apparatus according to the present invention will be described for an understanding of the function of such a cartridge.

Referring to the drawings, particularly, FIG. 1, a cartridge **20** comprises a rectangular container having a base **21** on which is mounted a post **22** on which is wound a spool of magnetic tape **24** loaded on a rotary disc **23** which is carried by the post **22**. A portion **24'** of the tape **24** passes around a tape guide **25**, past an end mark search device **26**, over a magnetic head **27**, and around a pinch roller **28** and terminates in the reeled tape. The pinch roller **28** is supported by a shaft **28'** on one end of a lever **29** which is rotatively supported by a pivot **30** fixed to the base **21**. The pinch roller is urged by a spring **31** in the direction of a capstan to press the capstan. In this manner, the tape **24** can be driven between the capstan and the pinch roller, and thus the spring **31** urges the pinch roller **28** against the capstan **32**.

Retainers **35**, **36** are provided so that the cartridge **20** may be snugly held in place when they are depressed in the direction of the arrow and are inserted into depressions **33**, **34** formed in both sides of the cartridge. In order to terminate the running of the tape **24**, the cartridge **20** is downwardly pulled from the play position against the pressure of the retainers **35**, **36** to release the capstan **32** from its engagement with the pinch roller **28**.

The same end can, however, be accomplished in a cartridge having no lever but having pinch roller which is pivoted to the base of the cartridge. Another type of a cartridge is that in which the pinch roller is provided in the cabinet to allow it to pass through a slot bored through the base of the cartridge when the cartridge is inserted into the opening of the cabinet so that the pinch roller cooperates with the capstan to effect the tape running. These cartridges as described above are commonly characterized in that the tape feed depends entirely upon movement of the cartridge which is reciprocable within the opening of the cabinet. Therefore, such a cartridge is advantageously available for the apparatus according to the present invention.

Referring now to FIG. 2, a vertically extending rectangular casing **40** is partitioned into a plurality of chambers and is slidably carried by guide posts **41**. A plurality of cartridges 20_1, 20_2, 20_3 . . . are removably inserted into the chambers and a plurality of push button links 42_1, 42_2, 42_3 . . . having push buttons 43_1, 43_2, 43_3 . . . at the end thereof are supported by respective keepers **44**, **45** secured to the casing **40** to correspond to the respective cartridges.

To the upper end of the casing **40** is tied a nylon string **47** which is wrapped around a reel in a governor member **46** having a spring motor therein. The governor member **46** is adapted to reel the string **47** therein by actuation of the spring motor when the casing is manually lifted. When the user's hand is removed from the casing after taking it up to the upper ends of the guide posts **41**, the casing **40** is automatically lowered under the deadweight load, at which time, the string **47** is reeled off little by little against returning force inherent in the spring motor, that is to say, the rate of descent of the casing **40** is subject to the influence of the governor member **46**. Numeral **48** indicates a string guide.

A raised portion **49** is formed on a cabinet **50** so as to engage a tip portion of the push button link **42** when the link is depressed. In this manner, movement of the casing **40** is arrested. A receptacle **51** is provided to receive the forward end of the casing **40** when it is brought into the play position to thereby secure engagement of the tape **24** with the head **27**, pinch roller **28**, and the capstan **32** so that excellent tone quality is obtained. A flywheel **52** having a capstan **32** as a shaft is rotated through a belt **53**.

For convenience of the users, as an index to an item on the program, a label or the like on which the contents of a tape is written or indicated may be atached to the rear end of each cartridge so that the cartridge to be indexed is identified.

Referring to FIG. 3, the cartridge operating mechanism will be described in greater detail hereinafter.

Pivoting about a pin **57** on an arm **58** is one end of a reciprocating lever **56** which has another arm **59** projecting from the mid portion thereof. The cartridge is securely engaged by the arms **58**, **59** against the respective ends thereof. The arm **58** is biased in the direction of the arrow by a spring (not shown) but inward movement of the arm **58** is limited by a stop (not shown). Rigidly fixed to the other end of the lever **56** is a crank pin **60** which is loosely received in an annular groove **62** eccentrically formed in a cam wheel **61**.

Rotation of the cam wheel **61** will cause the crank pin **60** carried by the groove **62** to reciprocate the lever **56** and the cartridge **20** in the direction of arrows A and B. The cam wheel **61** is provided with teeth **64** and a lug **65** on the circumference thereof.

Numeral **54** indicates a motor for imparting rotation through the medium of the belt **53** to the flywheel **52**. Positioned between the flywheel **52** and the roller **71** having a gear **72** meshing with the teeth **64** is an electromagnetic plunger **67** which has an actuator **68** pivotally mounted to one end of a lever **69** provided with a rotatable idler **66** at the other end thereof.

The actuator **68** around which a spring **73** is wound is adapted to be operated against the bias of the spring. A permanent magnet **74** of ferrite is rigidly fixed to the actuator **68** while the magnet circuit open end of a core **75'** of an electromagnetic coil **75'** is placed in a position where the permanent magnet **74** is moved when the electromagnetic plunger **67** is energized. The details of the permanent magnet and the electromagnetic coil will be described hereinafter with reference to FIG. 6.

Now once the plunger **67** is energized by an impulse thereto and hence the actuator **68** is retracted against the urging force of the spring **73**, the idler **66** is retracted to thereby impart rotation produced by the motor **54** to the cam wheel **61**. This will cause the permanent magnet **74** to be magnetically attracted to the core **75'** with the actuator remaining held in its position. For this reason, if energization of the plunger **67** is interrupted, the actuator **68** maintains its position against the bias of the spring **73** to thereby cause the cam wheel **61** to be continuously rotated.

At the periphery of the cam wheel **61** integrally formed therewith is the lug **65** which acts to close a normally open switch **76** adapted to be engaged by the lug when the cam wheel is rotated. Upon closing the switch **76**, the direction of the flow of current into the coil **75** is changed to cause the coil to produce a magnetic flux to counteract the magnetic flux of the permanent magnet **74**.

For the reason as set forth above, when the coil **75** is energized, the attractive force existing between the magnet **74** and the core **75'** decays allowing the spring **73** to push the actuator **68** back to its normal position. The idler **66** is, therefore, moved away from the flywheel **52** and the roller **71** to terminate rotation of the cam wheel **61**.

The electromagnetic plunger circuit to initiate rotation of the cam wheel **61** is illustrated in FIG. 4.

Current from the power mains E_2 flows through a high value resistor R_2 into a condenser C_2 to charge it. The tape feed causes an end mark **80** of aluminium foil on the tape to close the contacts of the end mark search device **26** so that the charge on the condenser R_2 which flows as a pulse into the plunger **67** cause the latter to be energized initiating rotation of the cam wheel **61**. At S is indicated a switch for manually actuating the plunger **67**. The condenser C_2 and the high value resistor R_2 are incorporated in the circuit to minimize current

consumption from the power mains E_2. A suitable modification of the present invention may be, however, used in which without the use of the condenser and the resistor the same end as described above is accomplished with a minimum amount of current. The end mark moves away from the search device to deenergize the plunger.

When the lug **65** acts to close the switch **76**, see FIG. 5, the charge through the high value resistor R_1 on the condenser C_1 flows as a pulse into the coil **75**. As previously described, at that moment the current flow direction to the coil **75** is also one which counteracts the magnetic flux yielded by the permanent magnet **74**. A switch **81** is provided in parallel with the switch **76** and is closed by the casing **40** when it is lowered to the fullest extent. The details of the switch **81** will be described later.

Once the permanent magnet **74** of ferrite, see FIG. 6, has approached the core **75'**, the magnetic circuit is closed to establish a powerful attractive force therebetween. The U shaped core **75'** is used in this arrangement, however, it is also possible to utilize a jar shaped core therein.

The electromagnetic device as described above provides advantages in minimizing power consumed by engagement of the idler with the flywheel and roller and in allowing the apparatus to be operated in a precise and non-frictional manner. The object of the electromagnetic device is to initiate rotation of the cam wheel when the end mark on the tape is engaged with the search device and to terminate rotation thereof when the cam wheel brings the lug into engagement with the switch, and the cartridge is brought to the play position. Another type of electromagnetic device may, of course, be employed.

The cartridge 20_6 in the stand-by position and the cartridge index mechanism including the push button link **43** are shown in FIG. 7. The cartridge indexing mechanism comprises the link **42** of which the top portion is the push button **43**, and a projection **91** which is integrally formed on the link. Keepers **44**, **45** which are rigidly secured to the casing **40** are provided with rectangular openings through which slidably extends the push button link **42**.

Two pairs of leaf springs **84**, **86** and **85**, **87** arranged in the opening of the casing **40** serve to hold the cartridge in the two positions, the stand-by position and the play position. When the cartridge is held in the stand-by position, one pair of springs **84**, **86** is in register with the depressed portions **33**, **34** while when the cartridge is held in the play position, the other pair of springs is in register with the depressed portions.

The receptacle **51** is provided to snugly, tightly receive the front end of the cartridge therein to thereby secure optimum engagement of the pinch roller **28** with the capstan **32** and of the tape **24** with the head **27** and the search device **26**. The pair of springs **85**, **87** may be disposed within the receptacle **51**.

The swingable and slidable link **42** is normally urged by the spring **90** extending thereto from the casing **40** and the push button **43** slightly projects beyond the outer edge of the casing. In order to index the cartridge to the play position, the push button **43** is depressed downwardly in the figure to bring the projection **91** into engagement with the keeper **45** so that the link is lowered and held in its position. At this point, a raised portion **49** is rigidly mounted on the cabinet **50** and is adapted to be engaged with the tip of the link **42**. In this manner, downward movement of the casing **40** is arrested by engagement of the link **42** with the raised portion **49**. The tip of the link **42** is preferably made of elastic sheet material to minimize a shock produced between the raised portion **49** and the link during engagement.

Slidably provided on the cabinet **50** is a release lever **92** which is adapted to push the link **42** outwardly to cause the projection **91** to move out of engagement with the keeper **45**. The lever **92** is normally urged in the direction of the arm **59** by the spring (not shown) but can be slidable in the direction of the link **42** when the lever is thrust away outwardly by a bevelled portion **59'** integrally formed on the arm **59** when the reciprocating lever **56** is moved to bring the cartridge to the stand-by position. Such movement of the lever **56** causes the link **42** to move out of engagement with the keeper **45**.

Operation of the apparatus according to the present invention should now be apparent.

Assuming that two of the cartridges which are desired to be played will be successively indexed, to this end the respective push buttons must be depressed. Downward movement of the casing under the deadweight load causes the tip of the link 42_6 to be engaged with the raised portion **49** so that movement of the casing is arrested allowing the cartridge to be in registry with the reciprocating lever **56**.

Now the switch S of FIG. 4 is closed, current is applied to the plunger **67** to cause the actuator **68** to be retracted compressing the spring **73**. At this point, the actuator is required to be maintained in its position even after the switch S is opened since the core **75'** is caused to draw the permanent magnet **74** by the attractive force therebetween. With retraction of the actuator **68**, the idler **66** is also retracted into engagement with the flywheel **52** and the roller **71** so that rotation is imparted through the gear **72** and teeth **64** to the cam wheel **61**.

Rotation of the cam wheel **61** causes the lever **56** to bring the cartridge 20_6, in the direction of arrow A, and the springs **85**, **87** are forced into depressions **34**, **35** while the forward end of the cartridge is moved into the receptacle **51**. At the same time, the lug **65** closes the switch **76** which energizes the coil **75** in a manner as previously described to erase the magnetic flux between the magnet **74** and the core **75'** so that the actuator **68** is returned to its initial position under the influence of the spring. When this occurs, the idler **66** is moved away from the flywheel **52** and the roller **71** to terminate rotation of the cam driven by the motor **54**. This also terminates reciprocation of the lever **56** and positions the cartridge in the proper location for playing in which the roller **28** engages the capstan **32** to drive the tape **24** which is reeled over the head **27** and the search device **26**.

In the play position, the cartridge is urged by the arm **58** in such a manner that engagement of the roller **28** with the capstan **32** and of the tape **24** with the head **27** is so effectively secured that tone quality is improved. In this embodiment, a spring (not shown) is provided for rotating the arm **58** about the pin **57** to tightly hold the cartridge in association with the other arm **59**. The arm **58**, may, however, be formed of a resilient material to make use of the inherent elastic force to urge it in the direction of the cartridge.

When the tape feed comes to an end, the end mark **80** provided on the end thereof contacts the search device **26**. This energizes the electromagnetic plunger **67** to bring the idler **66** into engagement with the flywheel **52** and the roller **71** allowing the cam wheel **61** to be rotated. Rotation of the cam wheel **61** at this time moves the reciprocating lever **56** in the direction of arrow B as the crank pin **60** is carried by the annular groove **62** is caused to cooperate with the cam wheel. With retraction of the cartridge to the stand-by position, engagement of the pinch roller with the capstan is ended so that the cartridge is in the stand-by position. When the cartridge is snugly received within the opening and the retainers **84**, **86** are urged toward the depressions **33**, **34** to be conformed therewith, the bevelled portion **59'** of the arm **59** is engaged by the release lever **92** for causing it to be moved leftwards as shown in FIG. 7 and the push button link **42** is also moved in the leftward direction by movement of the release lever **92**. The projection **91** thus is released from its engagement with the keeper **45** so that the spring

90 can urge the push button link 42 toward its normal position.

Upon disengagement of the push button link 42 from the raised portion 49, interference with movement of the casing 40 is ended so that the casing is lowered under its own weight until the next cartridge indexed by depression of the push button is aligned with the reciprocating lever 56.

In the time interval between the disengagement of the push button link from the raised portion and the interference with movement of the casing to permit the next cartridge to be indexed, the crank pin 60 is carried and guided by the groove 62 while the reciprocating lever 56 is kept at a standstill for a predetermining portion of the rotation of the cam wheel 61.

When movement of the lever 56 is again initiated, the cartridge 20 is brought into the play position to allow the tape 24 to be played and the end mark 80 on the last end of the tape 24 is searched by the search device 26. At this point, the cartridge 20 is moved to the stand-by position. In this manner, the cartridge is played in accordance with a specific sequential program.

An unexpected disadvantage derived from the depression of the push button is that after the cartridge is retained within the opening nothing interferes with movement of the casing so that the casing is lowered to the fullest extent so long as the cam wheel 61 is continuously rotated. The switch 81 is, however, provided, see FIG. 5, to apply current to the electromagnetic coil 75 when it is closed and the idler 66 is released from engagement with the flywheel 52 and the roller 71 so that rotation of the cam wheel 61 is terminated when the idler 66 moves away from the flywheel 52 and the roller 71. It is apparent that when the casing 40 is lowered to the fullest extent the lever 56 is not moved at all and so the disadvantage is not produced.

According to the arrangement as described above, the cartridges which are desired to be played may be successively indexed by depressing the push button links after the casing is manually lifted.

This invention also contemplates the provision of means enabling the cartridge indexing mechanism to serve for indexing a track on the tape when necessary. This may be accomplished by either of two arrangements, one providing a plurality of magnetic heads to be opposed to each track for allowing the head to be engaged by the track by changing over a switch, the other causing a single head to be movable across the tape to that end.

FIG. 8 shows a circuit in which a track is indexed by the former arrangement. This circuit comprises magnetic heads 27_1, 27_2 which are so arranged as to be opposed to two tracks on the tape, a change-over switch 101 connected to an amplifier 102 for selecting the output of one of said heads, and a speaker 103. With this arrangement, the output produced in the magnetic head 27_1 or 27_2 is applied to the amplifier by changing over the switch. The track indexing mechanism will be described below with reference to FIGS. 9*a* and 9*b*.

Slidably mounted in the keepers 44, 45 for carrying the push button link 42 is a push button link 105 which can also be engaged with these keepers when a push button 104 thereon is depressed. The push button link 105 is provided with lugs 106, 107 that are engageable with the keeper to arrest vertical movement of the link. The link 105 may be in the position shown by the broken or solid lines when the button 104 is depressed or not. The switch 101 is mounted on the cabinet 50 so as to be opposite to the link 105.

The details of the switch 101 are illustrated in FIG. 9*b* and it comprises terminals 109_1, 109_2 secured to an insulated base plate 108, and an arm 110 pivoted at a point 111 thereon and being urged clockwise by a spring 112 stretched between the arm and the plate. The rotation of the arm 110 is arrested by a stop (not shown) at the point where it engages the terminal 109_1. The free end 110′ of the arm 110 is made of a resilient material to absorb a shock produced when engagement is made with the push button link 105. When the push button link 105 is in the position shown by the solid lines the link is spaced away from the free end 110′ of the arm 110. The arm 110 connected to the amplifier 102 is maintained in engagement with the terminal 109_1 connected to the magnetic head 27_1 under influence of the spring 112. As a result, the track which is against the magnetic head 27_1 is played. When the push button 104 is depressed, the push button link 105 engages the free end 110′ of the arm 110 as the casing 40 is lowered in the direction of arrow C of FIG. 9*b* so that the arm 110 is rotated counterclockwise against the bias of the spring 112 and thus engages the terminal 109_2 connected to the magnetic head 27_2. This causes the switch 101 to be changed over to the contact with the magnetic head 27_2 and the track which is against head 27_2 is played.

It is apparent from the foregoing that with the arrangement shown in FIG. 9 the index of the track is effected independently for each cartridge. Any type of switch may be employed if it takes the form of one circuit and two contacts. The link 105 may take the form of the link 42 and vice versa.

The latter arrangement is shown in FIG. 10 and comprises a leaf spring 113 one end of which is mounted on the cabinet and carries the magnetic head 27 at the other end thereof, and a lever 115 rotatively pivoted on a shaft 114 fixed to the cabinet. The lever 115 is adapted to engage the leaf spring 113 at the one end thereof and to pass through a notched portion provided on one side of a stopping piece or member 116. Rotation of the lever 115 is effected by engagement of the push button link 105 therewith and is limited by the range of the notched portion of the member 116. The magnetic head 27 is reciprocated along the arrow D of FIG. 10 when the lever is rotated to thus allow the track to be indexed.

When the lever 115 is spaced from the pushbutton link 105, the one end thereof is purged inwardly by the bias of the leaf spring 113 while the other end is engaged by the notched portion of the member 116 to arrest rotation of the lever 115 so that the magentic head 27 carried by the leaf spring 113 is held in its position to allow it to engage the track during the time the tape is transported. When the pushbutton 104 is depressed the link 105 is moved into engagement with the end portion 115′ of the lever 115 after downward movement of the casing is arrested by the pushbutton 43 which is depressed. This causes the head 27 to be moved within the range of the notched portion of the member 116 and to engage the other track.

The pushbutton link 105 is preferably made of elastic material to use the returning force inherent in the elastic link for allowing the link to pass above the end portion 115′ due to its elasticity by movement of the casing upon finishing the play of the tape. In order to return the pushbutton link 105 to its normal position when the pushbutton link 42 is returned to its normal position, the latter link may be provided with a projection 91′ to engage a projection 107 integrally formed on the link 105.

A modified form of the pushbutton link for indexing for a number of tracks more than two on the tape is illustrated in FIG. 11, namely, a link is provided so that more than two tracks can be indexed. In this embodiment, there is provided a link 105 having a plurality of stepped portions 118, 119, . . . up to as many tracks as are on the tape, the stepped portions engaging the projection on end 115′ of the lever 115. With this link, the head 27 can travel a distance equal to the range of each stepped portion against the bias of the leaf spring 113 to index the track on the tape. Selection of the stepped portions 118, 119, . . . which engage the projection on end 115′ is determined by the amount of depression on the pushbutton 104. The pushbutton link 105 is preferably provided with a scale adjacent to the button 104 to indicate

which track is indexed. It is essential that a click stop means be disposed at the link **105** for facilitating engagement of the projection with the stepped portions. As will be seen from the drawing, a retaining member **120** is mounted on the cabinet to secure engagement of the projection with the stepped portions and to arrest movement of the casing when it engages the link **105**. This arrangement has the advantage that the pushbutton **43** and the link **42** as shown in FIG. 9 can be omitted. It is, however, necessary to provide means that are similar to the release lever **92**, the bevelled portion **59'** and cooperating with the lever **56** for pushing the link **105** to disengage it from the retaining member **120** when the lever **56** is moved. Instead of using the leaf spring **113**, the other prior means might be employed for carrying the magnetic head **27**.

An embodiment in which a rotary cam is substituted for the stepped portions is shown in FIG. 12. The pushbutton link **121** has a cam **123** secured to the mid-portion thereof. The cam **123** is so shaped as to allow the magnetic head **27** to selectively engage the track through movement of the lever **115**. When the pushbutton is depressed, the link **121** is engaged by a retaining member **122** to arrest movement of the casing **40** and the periphery of the cam engages the projection on the end of the lever **115**. The point where the cam is engaged by the projection on the end of the lever **115** can be adjustable by manually rotating the link **121** so that the magnetic head is movable in response to movement of the lever **115** as the projection is moved to conform to the configuration of the cam **123**.

Another arrangement illustrated in FIGS. 13 and 14 is such that any tracks desired can be indexed in succession out of a plurality of tracks on the tape. This arrangement comprises essentially a pushbutton link **126** having keepers **124**, **125** mounted on the casing **40** to rotate therewith, a cam **128** and a ratchet wheel **129**, respectively secured to the link underneath the keeper **125**. A retaining member **127** is disposed on the cabinet to engage and disengage the pushbutton link when it is depressed and pulled in directions of arrow F for arresting and initiating movement of the casing. The cam, the rotating lever, and the magnetic head shown in FIG. 13 are adapted to operate in the same manner as those shown in FIG. 12.

The cam **128** has symmetrical offset semicircular shapes to cause the head traversing the track to reciprocate twice whenever the cam revolves on its axis through an angle of 360°.

The ratchet wheel **129** is as shown in the broken lines of FIG. 13*a* and is rotated in a clockwise direction by a pawl **133** which engages teeth of the ratchet wheel when a plunger is energized to retract an actuator **132** against the bias of a spring **131**. Rotation of the ratchet wheel **129** causes the cam **128** to be rotated in the same direction so that the head **37** is moved to another track on the tape.

The arrangement as shown in FIG. 13*a*, is adapted to select one track out of four tracks on the tape. A disc **134** is secured to the link **126** above the keeper **124** to rotate with the cam **128**. The exterior of the keeper **124** is provided with an index scale **136** indicating four tracks, for example, by numerals **1**, **2**, **3** and **4**, and with a scale pointer engraved on the disc cooperates to indicate the adjustment of the cam **128** so that the track may be selected as desired. Numeral **138** is a cam plate which is frictionally mounted on the link **126** and is adapted to rest on the disc **134** by frictional force to freely be rotated around the link **126**.

A change-over switch **138** comprises an arm **142** pivotally mounted at a pivot **140** on an insulating plate **139**, and being urged in a counterclockwise direction by the bias of a spring **141**. This switch arrangement which is provided with two contact terminals **143**, **144** takes the form of a "one circuit and two contacts." Normally, the arm **142** is, under the influence of the spring, maintained in engagement with the contact terminal **143** but is engageable with the terminal **144** upon its disengagement from the other terminal **143** when it is pushed away. When movement of the casing is arrested by engagement of the link **126** with the retaining member **127**, the arm **142** is in the position shown by the broken lines of FIG. 13 and is engaged by the notched portion of the cam plate **137**. From the foregoing, it will be apparent that it depends upon the position in which of the notched portion is aligned with the arm which terminals **143**, **144** is engaged thereby.

A circuit including the switch arrangement **138** is shown in FIG. 14 wherein part or parts similar to those in FIG. 4 are represented by like reference numerals. When the switch **138** is held in the position shown by the solid lines of FIG. 14, that is to say, the circuit may operate the same as shown in FIG. 4. After the tape **24** has come to the end mark, the signal thereof causes the plunger **67** to be energized retracting the cartridge into its normal position by movement of the reciprocating lever **56** to terminate the play on the tape. At this moment, the arm **142** engages the notched portion of the cam plate **137**. On the other hand, if the arm **142** is caused to engage the periphery of the cam plate, the switch **138** is changed over and is in the position shown by the broken lines of FIG. 14. The current from the power mains E_2 is drained into the plunger **130** whenever the contact of the end mark search device **26** is short circuited by the end mark **80**. As a result, the ratchet wheel **129** is rotated by one tooth allowing the head **27** to traverse the tape by one track. In order to effect conversion from engagement of the head **27** with two tracks to engagement thereof with four tracks, there may be provided the pointer **145** disposed on the cam plate **137** and the scale (not shown) arranged on the disc **134** to indicate each track to be played so that an angle formed by the arm **142** engaging with the periphery of the cam plate **137** is adjustable by setting the pointer on the scale. As shown in FIG. 13*b*, one plunger **130** is mounted on the cabinet for operating the pawl **133** to mesh with the teeth of the ratchet wheel **129** when movement of the casing **40** is arrested.

The embodiment wherein the cartridge is adapted to be indexed by depressing the push button has been described above.

In FIG. 15, the other modified arrangement is provided so that the cartridge is indexed by the cartridge itself without the use of the push button or the like. Like figures are represented by like reference numerals.

In this embodiment, the cartridge is adapted to be movable from the stand-by through neutral to play position. Movement of the cartridge from the stand-by to neutral position is manually effected while movement thereof from the neutral to play and vice versa, is made by the reciprocating lever **56**. As seen from FIG. 15, the cartridge 20_6 is in the play position while the cartridge 20_3, 20_5 is in the neutral and the others in the stand-by position. Engaging member **150** is mounted on the cabinet **50** to engage the front end of the cartridge to be advanced. If the cartridge is caused to be moved to the neutral position, the engaging member is engageable with the cartridge to arrest downward movement of the casing. Arrest of movement of the casing advance is the cartridge engaging the engaging member **150** to the play position by means of the reciprocating lever (not shown). When the play of the cartridge is finished, the cartridge is moved to the stand-by position by the reciprocating lever to disengage the engaging member **150** from the cartridge 20_6. As a result, downward movement of the casing is again initiated until the next indexed cartridge 20_5 is engaged by the engaging member **150**. At the same time, the reciprocating lever moves the cartridge to the play position and moves the same back to the stand-by position after it is played. In this manner, the last indexed cartridge is moved back to the stand-by position after it

is played, and there is no further cartridge to be played so that the casing is lowered to the fullest extent. At this point a switch (not shown) which is similar to the switch 81 shown in FIG. 5 is closed by the casing to terminate successive movement of the reciprocating lever. It should be noted that the track indexing mechanism may be applicable to the arrangement in FIG. 15.

As seen from the description as in the above, it is apparent that the present invention provides not only an effective apparatus utilizing a plurality of cartridges which are successively played in accordance with a sequential program but also a simple construction by which automatic operation is effected without consumption of much current.

Since certain changes may be made in the above apparatus without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An apparatus for automatically playing a plurality of endless tape cartridges in succession according to a specific sequential program, comprising a casing for holding a plurality of cartridges for slidable movement transversely of the casing, guide means guiding said casing for movement past a reproducing station, a plurality of pushbutton links, one for each cartridge, slidably mounted on said casing for movement in the direction of sliding movement of the cartridges, latch means on said links and said cartridge for holding the pushbutton links in position, an abutment at said reproducing station with which the depressed pushbutton links are engageable for stopping movement of said casing, a cartridge moving lever at said reproducing station reciprocally movable in the direction of the sliding movement of said cartridges and engageable with successive cartridges at said reproducing station for moving the cartridge from the casing into a play position and back into the casing, a lever moving means coupled to said lever for moving said lever in one direction at the time when the casing brings the cartridge into position opposite the reproducing station and moving it in the other direction when the play of the tape is ended, said lever being engageable with said pushbutton link to release said latch means, a drive connecting means coupling said lever moving means with the drive of the tape recorder and reproducer for actuating the lever moving means to move the cartridge being played into the casing and after the casing has moved, moving the next cartridge in succession into the reproducing station and then disconnecting the lever moving means from the drive, and a sensing device for scanning the tape for sensing completion of play of the tape, said sensing device being coupled to said drive connecting means for actuating it when play of the tape has ended.

2. An apparatus as claimed in claim 1 further comprising magnetic head moving means at said reproducing station adapted to be coupled to the magnetic reproducing head of the reproducing apparatus for moving the tape head between tracks on a tape, and track indexing means on said cartridges engageable with said magnetic head moving means when said cartridge is at the reproducing station for indexing the magnetic head for playing a plurality of tracks on the tape in the cartridge.

3. An apparatus for automatically playing a plurality of endless tape cartridges in succession according to a specific sequential program, comprising a casing for holding a plurality of cartridges for slidable movement transversely of the casing, guide means guiding said casing for movement past a reproducing station, said cartridges being partially movable out of said casing to a projecting position, an abutment at said reproducing station with which the cartridges in the projecting position are engageable for stopping movement of said casing, a cartridge moving lever at said reproducing station reciprocally movable in the direction of the sliding movement of said cartridges and engageable with successive cartridges at said reproducing station for moving the cartridge from the projecting position into a play position and back into the casing, a lever moving means coupled to said lever from moving said lever in one direction at the time when the casing brings the cartridge into position opposite the reproducing station and moving it in the other direction when the play of the tape is ended, a drive connecting means coupling said lever moving means with the drive of the tape recorder and reproducer for actuating the lever moving means to move the cartridge being played into the casing and after the casing has moved, moving the next cartridge in succession into the reproducing station and then disconnecting the lever moving means from the drive, and a sensing device for scanning the tape for sensing completion of play of the tape, said sensing device being coupled to said drive connecting means for actuating it when play of the tape has ended.

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