Sept. 20, 1971 KATSUHIKO OKABE 3,606,346

AUTOMATIC TAPE CARTRIDGE PLAYER

Filed March 17, 1969 6 Sheets-Sheet 1

Fig. 1

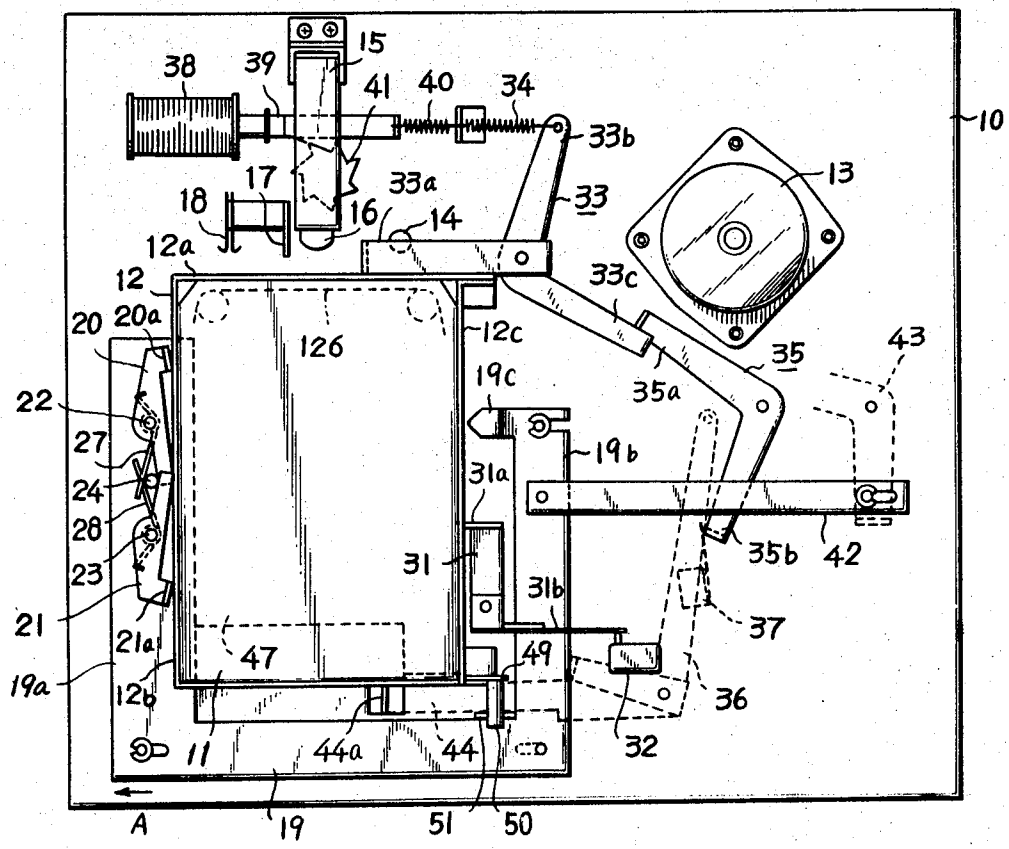
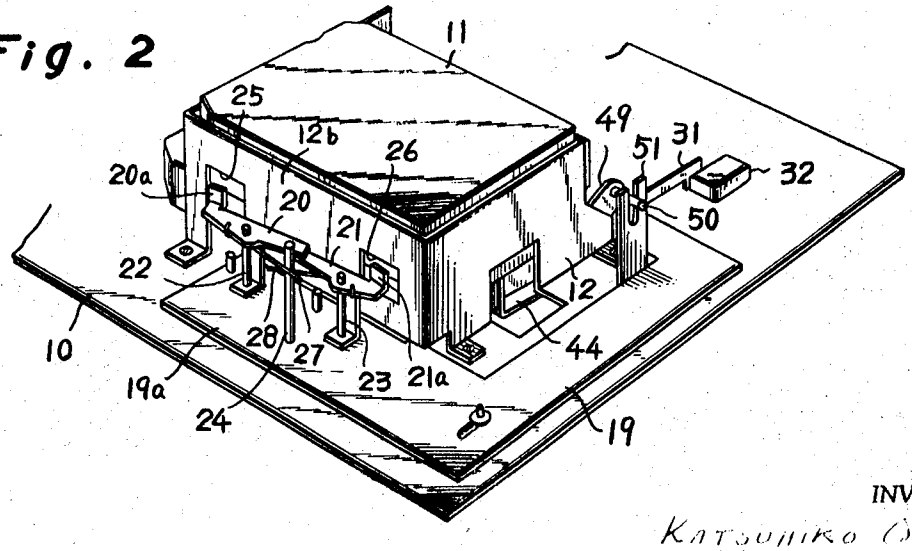


Fig. 2



INVENTOR

KATSUHIKO OKABE

BY Holman, Glascock, Downing & Seebold

ATTORNEYS

Sept. 20, 1971 KATSUHIKO OKABE 3,606,346

AUTOMATIC TAPE CARTRIDGE PLAYER

Filed March 17, 1969 6 Sheets-Sheet 2

Fig. 3

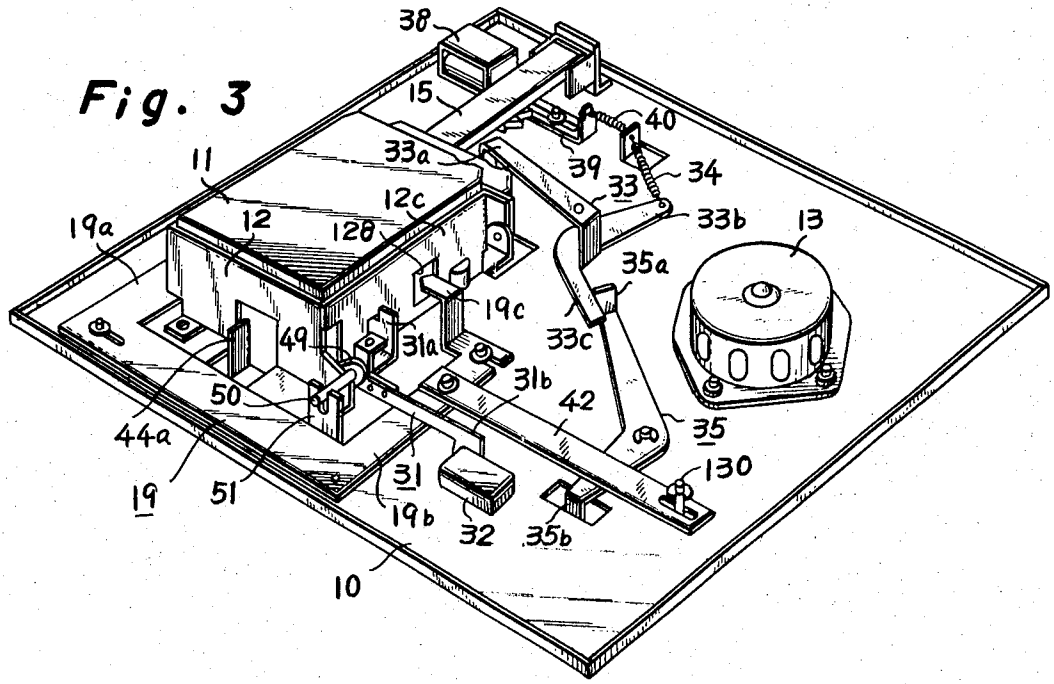


Fig. 5

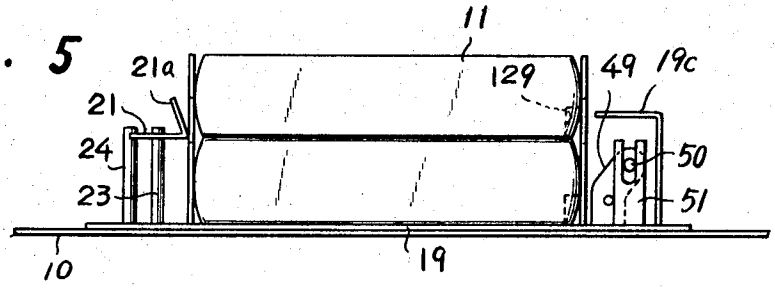
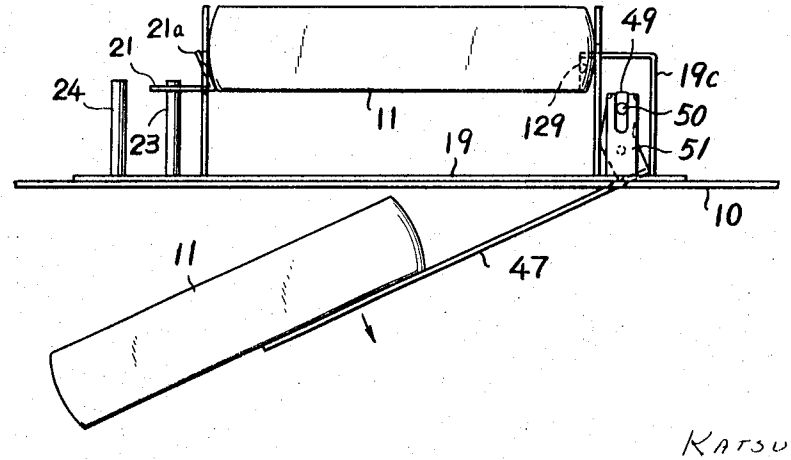


Fig. 6



INVENTOR

KATSUHIKO OKABE

BY Wolman, Hazcock, Conway & Sichtel

ATTORNEYS

Sept. 20, 1971 KATSUHIKO OKABE 3,606,346

AUTOMATIC TAPE CARTRIDGE PLAYER

Filed March 17, 1969 6 Sheets-Sheet 3

Fig. 4

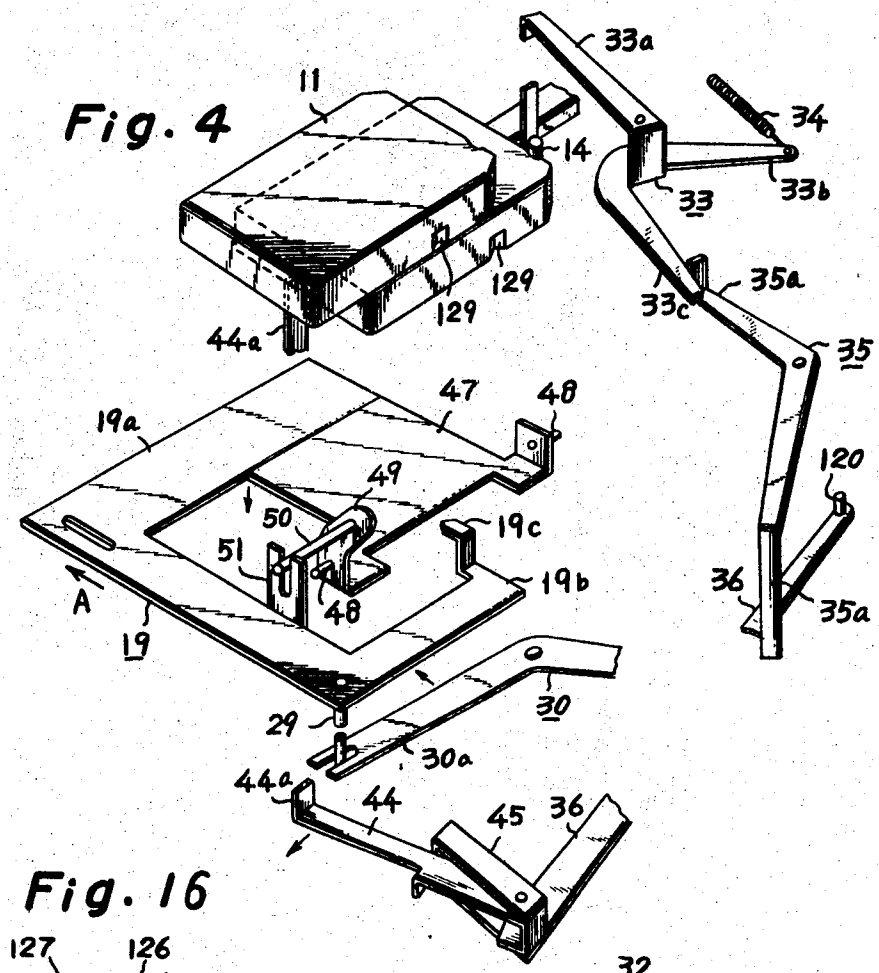
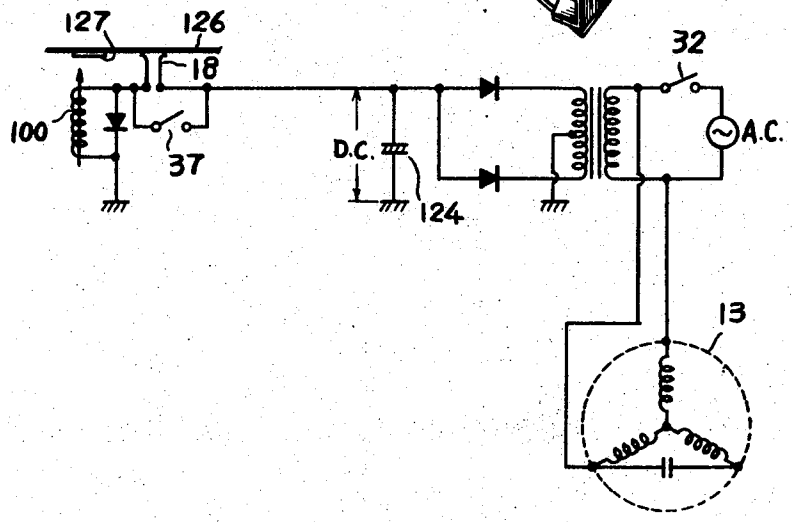


Fig. 16



INVENTOR

KATSUHIKO OKABE

BY Holman, Glascock, Downing & Seibold

ATTORNEYS

Sept. 20, 1971 KATSUHIKO OKABE 3,606,346

AUTOMATIC TAPE CARTRIDGE PLAYER

Filed March 17, 1969 6 Sheets-Sheet 4

Fig. 7

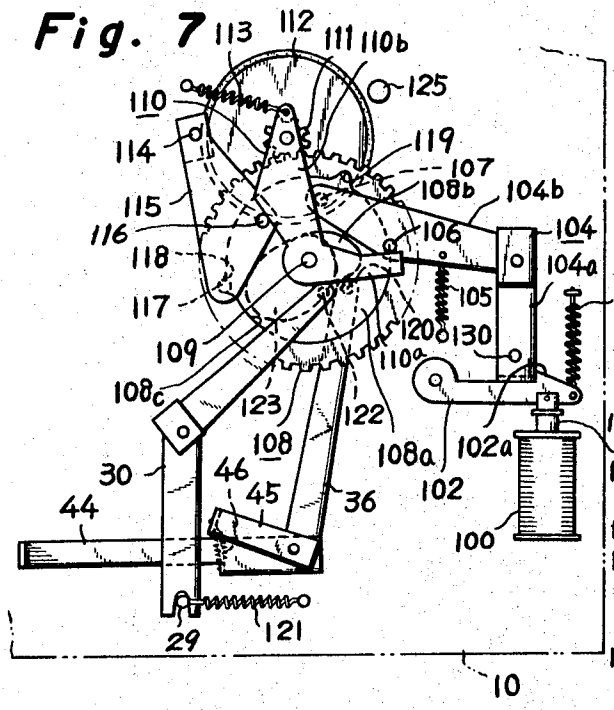


Fig. 8

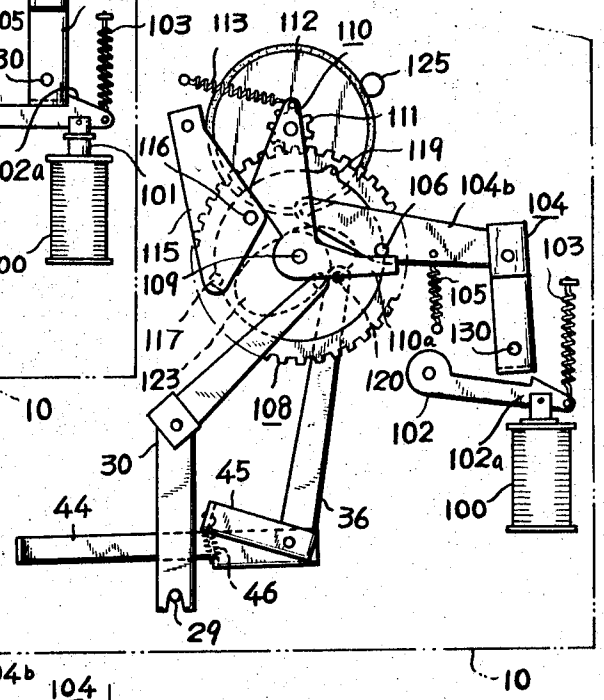
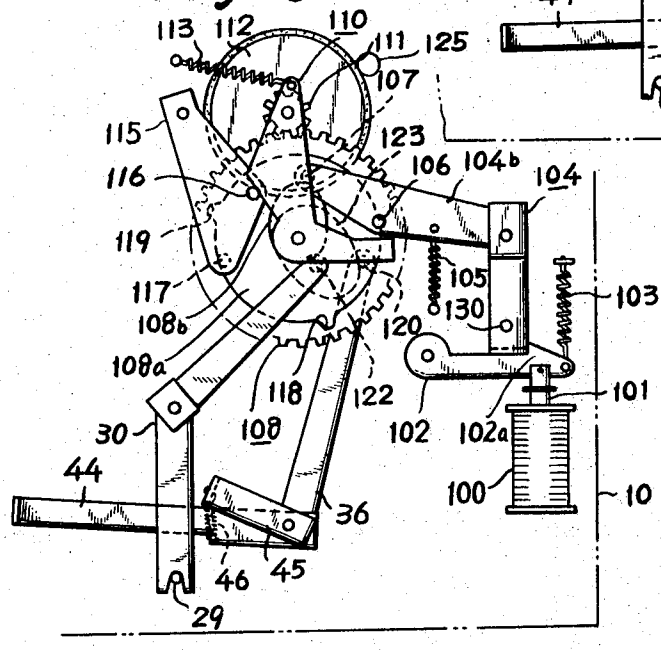


Fig. 9



INVENTOR
KATSUHIKO OKABE

BY Holman, Glascock, Downing & Seibold
ATTORNEYS

Sept. 20, 1971 KATSUHIKO OKABE 3,606,346

AUTOMATIC TAPE CARTRIDGE PLAYER

Filed March 17, 1969 6 Sheets-Sheet 5

Fig. 10

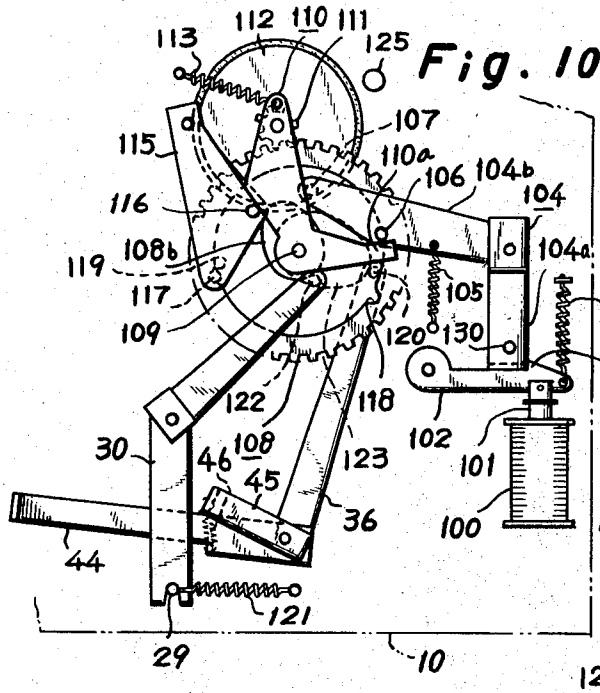


Fig. 11

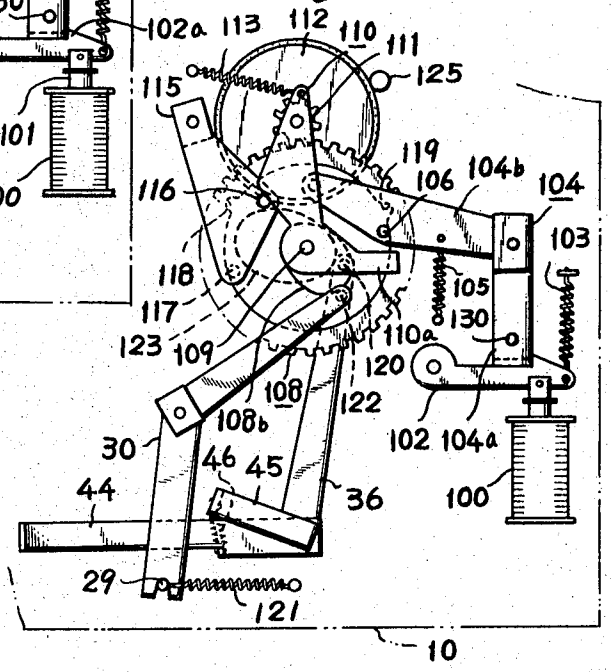
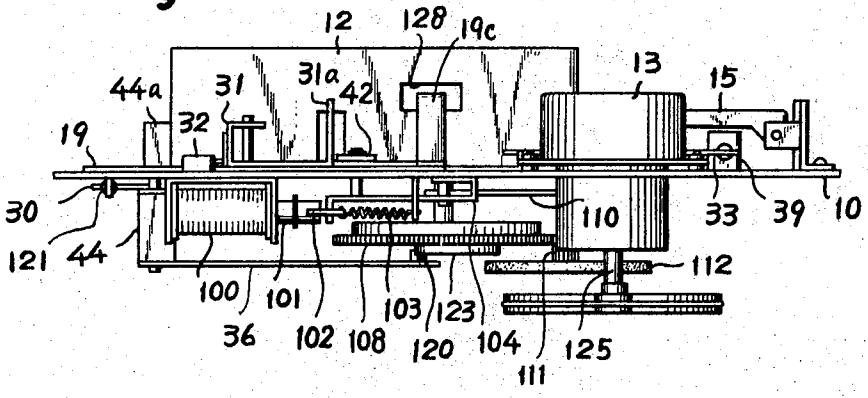


Fig. 12



INVENTOR
KATSUHIKO OKABE

BY Holman, Glascock, Downing & Seebold

ATTORNEYS

AUTOMATIC TAPE CARTRIDGE PLAYER

Filed March 17, 1969 6 Sheets-Sheet 6

Fig. 13

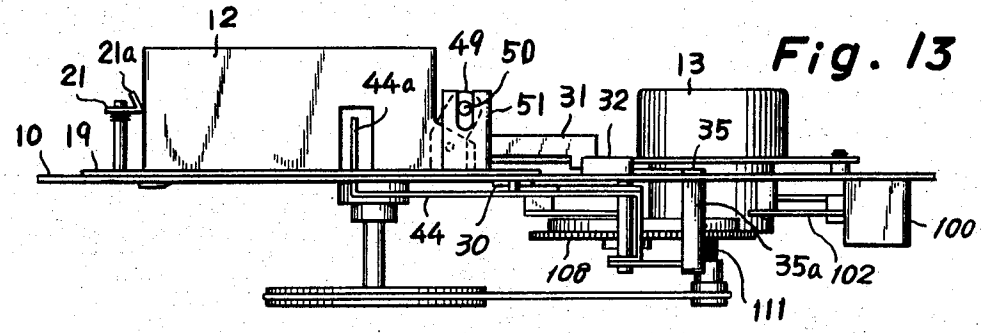


Fig. 14A

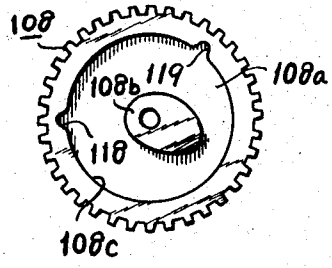


Fig. 14B

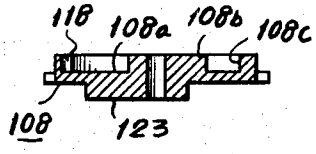


Fig. 14C

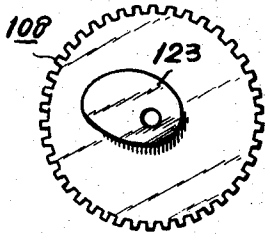
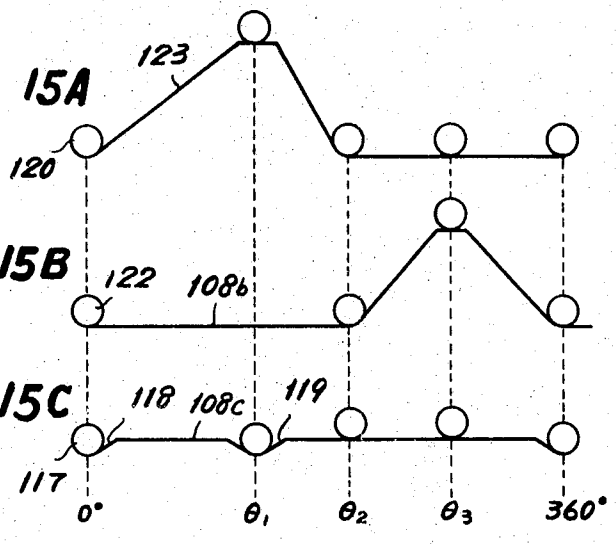


Fig. 15A

Fig. 15B

Fig. 15C



INVENTOR
KATSUHIKO OKABE

BY Holman, Glascock, Downing & Seibold
ATTORNEYS

United States Patent Office 3,606,346 Patented Sept. 20, 1971

3,606,346

AUTOMATIC TAPE CARTRIDGE PLAYER

Katsuhiko Okabe, Tokorozawa, Japan, assignor to Victor Company of Japan Limited, Yokohama, Japan

Filed Mar. 17, 1969, Ser. No. 807,617
Claims priority, application Japan, Mar. 15, 1967 (utility model), 42/22,330; Apr. 12, 1967 (utility model), 42/31,269; Mar. 19, 1968, 43/17,524 (utility model), 43/21,108; Dec. 13, 1968, 43/90,997; Dec. 31, 1968 (utility model), 44/1,662
Int. Cl. G11b 5/00
U.S. Cl. 274—4F 4 Claims

ABSTRACT OF THE DISCLOSURE

An automatic tape cartridge player comprising a magnetic head for reproducing and playing a lowermost tape cartridge out of a plurality of tape cartridges loaded in layers in a casing, a cam-operated lever means for dropping and discharging or releasing said lowermost tape cartridge after termination of playing from its loaded position, and cam-operated lever means for supporting the loaded cartridges other than the discharged one during operation of the discharging means. One of said loaded cartridges immediately above the discharged one is then dropped to the lowermost position in the casing after operation of said discharge means.

The present invention relates to an automatic tape cartridge player, and more particularly to a device for automatically and consecutively playing a plurality of tape cartridges loaded in layers in a casing of a player.

The invention concerns a new and useful contrivance designed for automatic and successive playing of a plurality of tape cartridges in the same manner as in record autochangers for continuously playing a gramophone.

One object of the present invention is to provide an automatic tape cartridge player which is capable of playing consecutively and automatically a plurality of tape cartridges loaded in layers in a casing of a player.

Another object of the present invention is to provide an automatic tape cartridge player for automatically continuously playing which is designed for discharging downwardly a tape cartridge finished playing out of the player and positioning a subsequent cartridge to be played to a predetermined location.

Still another object of the present invention is to provide an automatic tape cartridge player having a change cycle mechanism which periodically pushes forth and back, separates and drops a tape cartridge by a cam mechanism.

A further object of the present invention is to provide an automatic tape cartridge player which operates a change cycle mechanism in cooperation with a sensing tape adhered to a magnetic tape and automatically and continuously carries out playing of a tape cartridge.

Still other objects and features of the invention will be apparent from the following description with reference to the accompanying drawings, in which:

FIG. 1 is a plan view of an embodiment of this invention;

FIG. 2 and FIG. 3 are perspective views of the player according to the invention respectively viewed from the right and left sides;

FIG. 4 is an exploded perspective view of a portion of the player showing a relationship of the principal levers;

FIG. 5 and FIG. 6 are diagrammatic front views of principal parts respectively illustrating the excluding and dropping operations of a tape cartridge;

FIG. 7 through FIG. 11 are plan views respectively

showing successive stages of operation of the principal parts of a change cycle mechanism;

FIG. 12 and FIG. 13 are respectively a side view and a front view of the player shown in FIG. 1;

FIGS. 14A through 14C are respectively a plan view, a vertically sectional side view, and a bottom view of a cam gear;

FIGS. 15A through 15C are respectively developed views of a cam surface illustrating the operation of the cam mechanism;

FIG. 16 is a circuit diagram showing an embodiment of an electric circuit according to this invention.

In FIG. 1 through FIG. 4, a chassis **10** is provided with a casing **12** for loading a plurality of tape cartridges **11** stacked in layers. A front plate **12***a* of the casing **12** has an opening through which is pushed outward a front part of a tape cartridge of the lowermost stage or layer. At a distance from said front plate **12***a* are provided a capstan **14** being transmitted a rotational force and driven by a motor **13** through a suitable non-illustrated belt, a magnetic head **16** held by a head holder **15**, a tape guide **17** and a sensor **18** of detection contacts. A generally U-shaped slide lever **19** has opposed arms **19***a* and **19***b*. The forward end of the arm **19***b* has a bent portion **19***c*. Also, a pair of supporting levers **20**, **21** are provided having respectively bent portions **20***a*, **21***a* and are pivotally rotated on respective shafts **22**, **23** by the pushing of a pin **24** fixed on the arm **19***a*. The levers **20**, **21** are urged to turn by springs **27**, **28** so that the bent portions **20***a*, **21***a* may enter into the casing **12** through openings **25**, **26** of the side plate **12***b*. The slide lever **19** is slidably moved by rotation of a rotary lever **30** which has a lever arm **30***a* engaging with a downwardly extending pin **29** secured to the lower surface of the slide lever **19**. When a contact portion **31***a* of the forward end of a switch lever **31** is pushed by contacting with a side of the cartridge **11**, the other end **31***b* of the lever **31** pushes a microswitch **32** for closing and energizing the power circuit. A rotary lever **33** has an arm **33***a* for pushing back a cartridge, a second arm **33***b* which is pulled by a spring **34** and a third arm **33***c* which engages with an end **35***a* of the rotary lever **35**, which in turn engages with a lever **36** swingable by a cam means which will be later described. Thus the rotational force of the lever **36** is transmitted to the lever **33** by the lever **35**. Further in rotation of the lever **35**, by an end **35***b* of the lever **35** there is opened or closed a microswitch **37** which is connected in parallel with a sensor **18**. A solenoid **38** moves a slidable plunger or rod **39** at each operation against the force of a spring **40** and intermittently urges rotatably a stepped cam **41** for changing over the height of the head **16** to thereby change tracks. There is further provided a lever **42** secured to the slide lever **19** so as to reset a lever **43** later described. A lever **44** is connected to a small lever **45** secured to the lever **36** by spring **46** and has an upstanding arm **44***a* for pushing the tape cartridge forward. The small lever **45** and spring **46** control the pushing strokes when the length of a tape cartridge is different. There is provided a bottom plate **47** for carrying the bottom surface of a tape cartridge in the lowermost stage or layer out of the cartridge stacked one upon another, such bottom plate being capable of rotating downwardly about a pair of pivots **48**. Said bottom plate **47** has a crooked arm **49**. A pin **50** fixed to the arm **49** engages with a vertical slot in projection **51** of the lever **19**. The bottom plate **47** turns over about the pivots **48** by sliding of the lever **19**.

Operations of the components of the above described structure of this invention will now be illustrated with reference to FIG. 5 through FIG. 16.

When a plurality of cartridges **11** are loaded in a stack of layers in the casing **12** the microswitch **32** is closed by

a switch lever **31**. By closing of the microswitch **32** the motor **13** is made to be connected to an AC power source as shown in FIG. 16 and starts it revolving. Before a cartridge starts playing, the lever **33** is moved by the spring **34** to a position as indicated in FIG. 1 so that the lever **35** is in the position shown and the microswitch **37** is closed. Accordingly, by closing of the microswitch **37** a solenoid **100** shown in FIG. 7 to FIG. 11 is supplied a DC current through the switch **37** and starts operation.

FIG. 7 to FIG. 11 show the principal parts of the change cycle mechanism in which the chassis **10** has been removed for clarity. FIGS. 12 and 13 are respectively side and front views showing the principal parts of the player of FIG. 1 including a change cycle mechanism. FIG. 7 shows the state of the parts before the plunger **100** operates. An engaging lever **102** in association with an operating lever **101** of the solenoid **100** is moved by a spring **103** and stays in the position shown in FIG. 7. A rotary lever **104** is pulled by a spring **105**, one lever arm **104***a* of which engages with an engaging portion **102***a* of the lever **102**, while the other lever arm **104***b* has a stud **106** on its upper surface intermediate its ends and a stud **107** on its lower surface at its free end. A lever **110** pivoted on a shaft **109** and having mounted thereon a rotatable cam gear **108** has a lever arm **110***a* in engagement with stud **106**. The other lever arm **110***b* of lever **110** has mounted thereon a rotatable idler **112** having secured thereto a small gear **111** meshing with the cam gear **108**, and is biased in the counterclockwise direction by a spring **113**. A lever **115** pivoted on a shaft **114** has a stud **116** on its upper surface engaging with the lever **110** and a stud **117** on its lower surface. The cam gear **108** has, as shown in FIG. 14, a groove **108***a* which partitions an inner eccentric cam surface **108***b* from an outer circular cam surface **108***c*. On the circular cam surface **108***c* are provided recesses **118**, **119** for engaging with the stud **117**. The lever **36** can swing along the inner eccentric cam surface **108***b* while the stud **120** at the forward end of the lever **36** is in contact with the outer circular cam surface **108***b*. The lever **30** is tensioned by a spring **121** and engages the surface of an eccentric cam **123**, while a stud **122** is in contact with the surface of the eccentric cam **123** on the lower surface of the cam gear **108**.

Thus, by loading a cartridge **11** in the casing **12**, the solenoid **100** operates for a short period of time while the condenser **124** (FIG. 16) is discharged, and pulls the operating lever **101** whereby the lever **102** moves to rotate in the clockwise direction. As shown in FIG. 8, the lever **102** releases the lever **104** from engagement with the engaging portion **102***a*. After being released the lever **104** swings in the counterclockwise direction by tension of the spring **105**. By rotation of the lever **104** the lever arm **110***a* rotates in the clockwise direction around the shaft **109** by the stud **106** on the lever arm **104***b*. The lever arm **110***b* swings in the state that the small gear **111** gears with the cam gear **108** and the idler **112** is pressed in contact with a motor shaft **125**. Further, by rotation of the lever **110** the lever arm **110***b* is released from engagement with the stud **116** so that the lever **115** becomes free for rotation.

At the above described position in FIG. 8, the idler **112** is imparted a force of rotation by the rotating motor shaft **125** and the cam gear **108** geared with the small gear **111** starts rotation in the counterclockwise direction. By rotation of the cam gear **108** the stud **117** is disengaged from the recess **118** and is sliding along the cam surface **108***c*. In the rotation of the cam gear **108**, the lever **104** having the stud **107** in contact with the cam surface **108***b* turns in the clockwise direction following the contour of the cam surface. As shown in FIG. 9 the lever arm **104***a* is again engaged with an engaging portion **102***a* of the lever **102** which has returned to its original position by the spring **103** after the solenoid **100** has operated for a short period of time. At the same time the lever **36**, having the stud **120** which contacts with the cam surface of the cam

123, turns in the clockwise direction corresponding to the contour of the cam surface. Thus, by rotation of the lever **36**, the lever arm **44***a* of the lever **44** pushes the rear portion of the cartridge **11** at the lowermost stage or layer to a forward position so that a tape within the cartridge contacts with the capstan **14**, the head **16**, and the sensor **18** to start playing. Therefore, when the cam gear **108** starts rotation and the stud **117** shown in FIG. 10 engages with a subsequent recess **119**, the cartridge is then in a reproducing and playing state.

In this operation, the lever **33** is pushed forward by the front surface of the tape cartridge **11** which has been pushed and swings in the clockwise direction. The lever **35** engaging with the lever **36** in rotation turns in the counterclockwise direction and thereby the microswitch **37** is opened. When the stud **117** engages with the recess **119**, the lever **115** slightly turns and the lever **110** is urged to turn by spring **113**. And the idler **112** is released from the motor shaft **125** and the cam gear **108** stops its rotation.

FIG. 15A through FIG. 15C are exploded diagrams of the cam surfaces. FIG. 15A shows the relation of the cam **123** and the stud **120**, FIG. 15B of the cam surface **108***b* and the stud **122**, FIG. 15C of the cam surface **108***c*, recesses **118**, **119** and the stud **117** respectively. As described above, when the stud **117** is disengaged from the recess **118** and the cam gear **108** turns in an angle θ_1 for engagement with the recess **119**, the stud **120** reaches the top of the cam **123** and the lever **44** is in a position of being fully turned, while the stud **122** is not turned.

With the progress of playing of the cartridge **11**, an electroconductive sensing tape **127** at a position of termination of playing on the tape **126** runs into contact with the sensor **18**, the sensor **18** is electrically closed and the solenoid **100** starts its operation again for a short period of time. By starting of operation of the solenoid **100** the cam gear **108** again starts rotation and the stud **117** is disengaged from the recess **119**. During rotation of the cam gear **108** in an angle θ_2 the stud **120** moves along the cam **123** and the levers **36**, **44** turn in the counterclockwise direction. The lever **33** which has been released from engagement by the levers **36**, **35** moves in the counterclockwise direction by the spring **34**, pushing the cartridge again into the casing **12** by pushing arm **33***a*.

While the cam gear **108** turns in an angle θ_3 as shown in FIG. 15, the levers **36**, **44** stay in the same position and the stud **122** moves along the cam surface **108***b* and the lever **30** turns in the clockwise direction fully in an angle θ_3. By said rotation of the lever **30** the slide lever **19** is slidingly moved through the pin **29** in the direction indicated by an arrow A. Upon the lever **19** being moved in sliding the bent portion **19***c* advances into the casing **12** from an opening **128** on the side wall **12***c* of the casing **12**. As shown in FIG. 6 said portion **19***c* engages with a recess **129** on the cartridge **11** and supports one side thereof. On the other hand, the bent portions **20***a*, **21***a* of the levers **20**, **21** released from engagement with the pin **24** are pushed into the casing **12** by force of springs **27**, **28**, and support the other side of the cartridge **11**. Said bent portion **19***c* and levers **20**, **21** are provided so as to support a cartridge in the second stage from bottom. While the lever **19** slides, the crooked arm **49** turns counterclockwise about the pivot **48** through the pin **50** engaging with the portion **51**, and the bottom plate **47** turns downward as shown in FIG. 6 and the cartridge **11** in the lowermost stage slides from the bottom plate **47** and falls by its own weight to be discharged. When the cartridge in the lowermost stage is so discharged, the switch **32** is opened. As the lever **19** slides, the lever **104** turns clockwise by the lever **42** which engages with stud **130** secured to the lever **104** and again engages with the portion **102***a* of the lever **102**.

As the cam gear **108** further turns beyond the angle θ_3 to the angle position of 360° corresponding to one cycle of rotation while the lever **30** turns counterclockwise, the

lever **19** slides in the opposite direction from arrow A and the bottom plate **47** turns upward and closes. Simultaneously the bent portions **19***c* and **20***a*, **21***a* retract from the cartridge **11** and let the cartridge which has supported by said portions fall onto the bottom plate **47** being closed. When the cartridge **11** drops on the bottom plate the microswitch **32** again is closed. And then the solenoid **100** operates and the change cycle mechanism repeats its change cycle operation as above described from the state shown in FIG. 7. After the cartridges are all played and dropped for release, the switch **32** remains open and the power source is automatically interrupted.

It is to be noted that in the above described embodiment the cartridge after being played is discharged by opening of the bottom plate, but it may also be released by any other way for example by sliding in a horizontal direction.

The invention is not restricted only to the above described embodiment but it may anyway be modified without departing from the spirit and scope of the invention.

What I claim is:

1. An automatic tape cartridge player comprising a casing housing a plurality of tape cartridges in a vertical stack and including a bottom plate, said bottom plate being mounted for selective pivotal movement between a first, substantially horizontal position wherein it defines a bottom support for the lowermost cartridge of the stack of cartridges and a second, downwardly inclined position wherein said lowermost cartridge is free to slide downwardly and outwardly of the player under its own weight, said bottom plate normally being retained in said first position; playing means adjacent to said casing for playing successive tape cartridges; means for slidably moving said lowermost cartridge from an original position at the bottom of the stack to a playing position in juxtaposition to said playing means; means for slidably moving said lowermost cartridge from the playing position back to said original position following playing of said lowermost cartridge; means for engaging and supporting the next higher cartridge immediately above said lowermost cartridge when said lowermost cartridge has been returned to said original position; and pivoting means for pivoting said bottom plate downwardly to said second position following engagement of said engaging and supporting means with said next higher cartridge whereby said lowermost cartridge will be ejected downwardly and outwardly under its own weight, and for thereafter pivoting said bottom plate upwardly to said second position, said pivoting means being interconnected with said supporting and engaging means to disengage said engaging and supporting means from said next higher cartridge following return of said bottom plate to said second position, whereby said next higher cartridge will be released to drop onto said bottom plate.

2. A tape cartridge player comprising a casing housing a plurality of tape cartridges in a vertical stack and having a bottom plate, said bottom plate being mounted for selective pivotal movement between a first, substantially horizontal position wherein it defines a bottom support for the lowermost cartridge of the stack of cartridges and a second, downwardly inclined position wherein said lowermost cartridge is free to slide downwardly and outwardly of the player under its own weight; means for slidably moving said lowermost tape cartridge from an original position at the bottom of the stack to a playing position in juxtaposition with a playing head in response to positioning of said lowermost cartridge on said bottom plate; a generally U-shaped side lever having a pair of opposed arms on the opposite ends thereof and a projection portion; a first pin fixed on one of said opposing arms; at least one fixed shaft; at least one supporting lever pivotally mounted on said fixed shaft and engaging with said first pin at one end thereof; said bottom plate having a second pin engaged with said projection portion of said slide lever and being swingable about a horizontal pivot by movement of said slide lever in a direction transverse to said horizontal pivot; means for slidably moving said lowermost tape cartridge from said playing position to said original position following playing of the tape cartridge; means for moving said slide lever horizontally in a direction transverse to said horizontal pivot in one reciprocal motion to engage the opposite end of said supporting lever and the other of said opposing arms of said sliding lever with the next higher tape cartridge immediately above said lowermost cartridge to thereby engage and support said next higher cartridge, to pivot said bottom plate downwardly to said second position to thereby discharge said lowermost cartridge under its own gravity and to thereafter return said bottom plate to said first position, and thereafter to release said supporting lever and said other of said opposed arms from said next higher tape cartridge to thereby drop the stack of cartridges onto said bottom plate.

3. An automatic tape cartridge player as defined in claim **2**, further comprising means for connecting the player to a power supply responsive to positioning said lowermost tape cartridge on said bottom plate, and for disconnecting the player from said power supply responsive to the ejecting of said lowermost cartridge from said bottom plate.

4. An automatic tape cartridge player as defined in claim **3**, further comprising a rotatable cam disk having a plurality of coaxially disposed cam surfaces, said cam surfaces respectively controlling said means for slidably moving said lowermost cartridge from said original position to said playing position, said means for slidably moving said lowermost tape cartridge from playing position back to said original position, and said means for moving said slide lever.

References Cited

UNITED STATES PATENTS

3,197,150	7/1965	Camras	274—4(F)X
3,289,962	12/1966	Gellenthin	274—4(F)X
3,353,443	11/1967	Hall	274—4(F)X
3,477,726	11/1969	Laschenski	274—4(F)
3,504,916	4/1970	Ban	274—4(F)
3,359,665	12/1965	Gerry	274—4(F)X

OTHER REFERENCES

Hanson, North American Philips Comany, Inc., Audio Engineering Society Preprint No. 584, available for sale to public, Apr. 30, 1968.

LEONARD FORMAN, Primary Examiner

D. A. DEARING, Assistant Examiner

U.S. Cl. X.R.

179—100.2Z