June 17, 1969 J. G. PITZER 3,450,409

INDEXING MECHANISM

Filed July 18, 1966

FIG.1

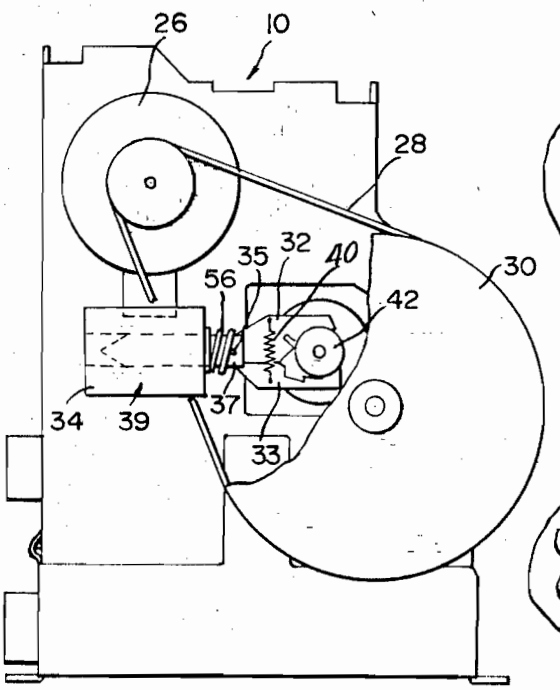


FIG.3

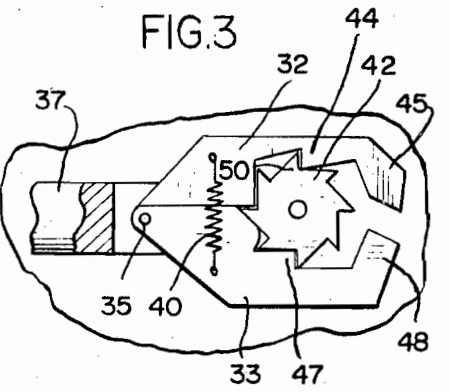


FIG.4

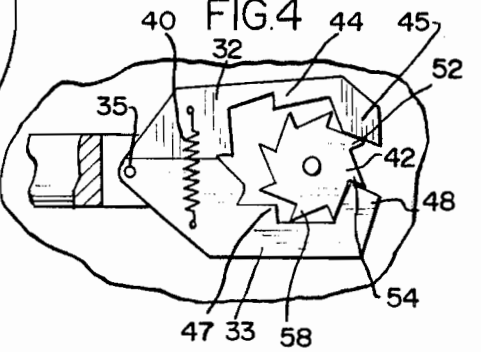


FIG.5

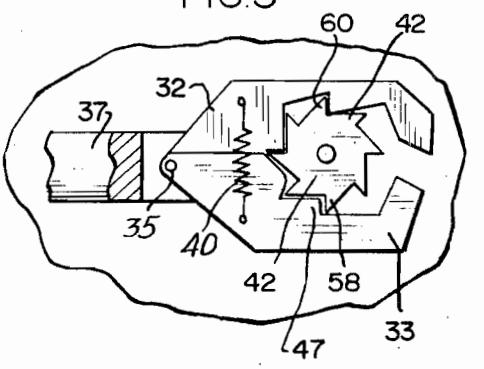
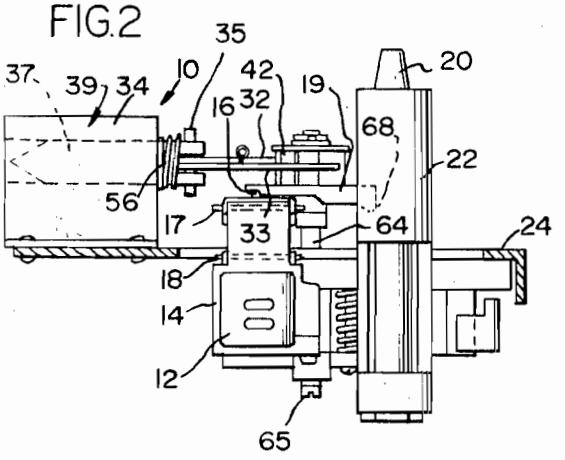


FIG.2



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United States Patent Office 3,450,409
Patented June 17, 1969

3,450,409

INDEXING MECHANISM

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Filed July 18, 1966, Ser. No. 565,965
Int. Cl. G11b 5/56
U.S. Cl. 274—4 3 Claims

ABSTRACT OF THE DISCLOSURE

A pawl and ratchet device actuated by a solenoid for rotating the cam of a cartridge-type tape player to position the magnetic tape head between the different tracks of the tape, which includes first and second pawl members pivotally mounted to the armature of the solenoid and joined by a spring which biases them into connection with the ratchet. The pivotal mounting of the pawl members to the armature permits misalignment of the armature axes with the center of rotation of the ratchet thereby providing wide tolerances during assembly of the tape player. Each of the pawl members has actuating projections and a locking portion that cooperate to prevent counter-rotation of the ratchet at the limits of movement of the armature in both directions. Each pawl is made from thin sheet material so that it may be moved in a plane normal to the ratchet along the axis of rotation thereof and still be maintained in engagement with the same.

This invention pertains generally to a device for transforming linear motion into rotary motion and more particularly to a pawl and ratchet mechanism for positioning a magnetic tape head of a cartridge type tape player to the different tracks of the magnetic tape.

In many installations in which a pawl and ratchet is used to transform linear motion into rotary motion, the pawl and actuating mechanism therefor and the ratchet may be parts of separate pieces of the installation. In the past, when assembling such installations it was usually necessary to carefully align the pawl drive mechanism with the ratchet to prevent binding of the device.

It is an object of this application to provide an improved pawl and ratchet mechanism for transforming linear motion into rotary motion.

It is another object of this invention to provide a pawl and drive mechanism therefor and a ratchet that are separate pieces of an installation but which may be assembled in an operating installation with a substantial tolerance in the alignment of drive mechanism with the ratchet thereby reducing production costs.

Many cartridge-type tape players capable of reproducing multi-track tape use a cam and cam follower arrangement for positioning the magnetic tape head. Generally, the arrangement includes a cam having a plurality of different cam surfaces each of which is associated with a different track on the tape. A solenoid is used to drive a pawl which is coupled to the ratchet to move the different cam surfaces into contact with the cam follower thereby positioning the tape head. In the past, however, certain cam surfaces when in contact with the cam follower have caused auto-rotation of the cam thereby misaligning the tape head with the track. Furthermore, the cam generally has to bev aried in elevation to index each of the cam surfaces to its associated tracks on the tape. In the past, this has caused problems in maintaining the pawl in engagement with the ratchet since the ratchet is usually coupled to the cam and moves with it in elevation when the cam surfaces are indexed to the tracks.

It is another object of this invention to provide a pawl and ratchet device for use with a cartridge-type tape player which positively locks the cam into position after

it has been rotated at the end of one set of tracks, to position the tape head to different tracks thereby eliminating auto-rotation.

It is a further object of this invention to provide a pawl and ratchet device for use with a cartridge-type tape player that allows the cam for positioning the tape head to be varied in elevation while maintaining the pawl in engagement with the ratchet.

One feature of this invention is a device for transforming linear motion into rotary motion having first and second pawl members pivotally connected to the armature of a solenoid, and a spring biasing the pawl members together and into engagement with a ratchet wheel. Because the pawls are pivotally connected to the armature and the spring biases the pawls into engagement with the ratchet, a tolerance is permitted in aligning the solenoid and armature with the ratchet.

Another feature of this invention is a device for transforming linear motion into rotary motion having actuating portions on each pawl and the teeth of the ratchet cooperating to positively lock the ratchet against counter-rotation with the solenoid being de-energized, and the spring biasing locking portions of each pawl into engagement with the ratchet teeth with the solenoid being energized thereby preventing counter-rotation of the ratchet.

A further feature of this invention is a device for transforming linear motion into rotary motion having the pawls formed from relatively thin sheet material, so that the position of the ratchet can be varied in elevation along the axis of rotation while the pawl members remain biased by the spring in engagement with the ratchet in a plane substantially normal to the axis of rotation.

In the drawings:

FIG. 1 is a top plan view of the pawl and ratchet device in accordance with this invention;

FIG. 2 is a side elevation view of the pawl and ratchet mechanism in accordance with this invention; and

FIGS. 3, 4 and 5 are bottom plan views illustrating the operation of the pawl and ratchet device in accordance with this invention.

In one embodiment of this device, first and second pawl members are pivotally coupled to an armature of a solenoid. A spring is coupled between the pawl members and biases the pawls together into engagement with a ratchet wheel. When the solenoid is energized, the armature and pawl members are moved in one direction to rotate the ratchet through a portion of the desired movement. In this position, the spring pressure biases locking portions of the pawl members into engagement with the ratchet wheel, thereby preventing the ratchet from being counter rotated. When the solenoid is de-energized the armature and pawl members are returned to the rest position by the solenoid spring thereby rotating the ratchet to complete the desired movement thereof. With the solenoid being de-energized, actuating projections of the pawl members engage the ratchet wheel to positively lock the ratchet against counter rotation. The pawls are formed from thin sheet material. Because they are biased into engagement with the ratchet wheel by the spring in a plane substantially normal to the axis of rotation of the wheel, the ratchet may be varied in elevation along the axis of rotation with the pawl members remaining engaged. Furthermore, because the pawl members are pivotally coupled to the armature and biased by the spring into engagement with the ratchet, a substantial tolerance is permitted in the alignment of the center line of the solenoid and armature with the axis of rotation of the ratchet.

Referring to the figures of the drawings, FIGS. 1 and 2 show a portion **10** of a cartridge-type tape player adapted to receive and play tape cartridges having multi-track tapes therein. The player **10** includes a magnetic tape head **12** which is mounted in head bracket **14**. Integral with the

head bracket **14** is a cam follower **16**. The head bracket **14** is mounted to a pantograph, a portion of which includes the pivot rods **17** and **18**. A spring that is not shown biases the pantograph, and hence the head mounting **14** and the cam follower **16** into contact with the cam **19**. The cam **19** has a plurality of different cam surfaces each of which is associated with different tracks on the magnetic tape. By rotating the cam **19** at the end of one set of tracks on the tape, the cam follower **16** moves the magnetic tape head **12** against the spring bias of the pantograph to position the magnetic tape head to a different set of tracks on the tape.

Tape player **10** also includes a capstan shaft **20** mounted within a capstan housing **22** that is supported by the tape deck **24**. A motor **26** is coupled by a belt **28** to the flywheel **30** which is connected to capstan shaft **20** and drives the shaft to move the magnetic tape through the cartridge and past the magnetic tape head **12**.

Generally in the past, upon completion of one pair of tracks in a stereo tape player such as shown at **10**, a solenoid is actuated to operate a linkage which rotates a cam similar to cam **19** to position the tape head **12** to a new set of tracks on the magnetic tape. It is improvements in the device for rotating the cam **19** to which this invention is primarily directed.

The device includes first and second pawl members **32** and **33** which are pivotally coupled at **35** to the armature **37** of a solenoid **39**. A spring **40** is connected to each of the pawl members **32** and **33** and biases them together about the pivot point **35** and into engagement with the toothed wheel or ratchet **42**. The pawl member **32** has an actuating projection **44** and a locking portion **45**, as does the pawl **33**, and they are numbered **47** and **48** respectively.

Operation of the device can be best understood by referring to FIGS. 3–5. When the solenoid **39** is energized, the armature **37** and pawl members **32** and **33** are pulled into the coil **34** causing the actuating projection **44** on pawl **32** to engage the tooth **50** of ratchet **42**. This causes movement of the ratchet 22½°, in this example, to the position shown in FIG. 4. With the armature **37** pulled into the coil **34**, as shown in FIG. 4, the locking portions **45** and **48** engage the teeth **52** and **54** of the ratchet and are held in this engagement by the bias of spring **40**. The tension on spring **40** is selected so that it is great enough to withstand any tendencies of the ratchet **42** to counter-rotate in a clockwise direction by forcing the pawls apart. When the solenoid **39** is de-activated, the solenoid spring **56** returns the pawls to the rest position as shown in FIG. 5. During this movement, the actuating projection **47** of the pawl **33** engages the tooth **58** of ratchet **42** to move the ratchet through 22½ more degrees of rotation thereby completing the desired 45° of rotation of the ratchet wheel **42**. It should be clear, of course, that by varying the angles of the teeth on the ratchet **42** is would be possible to vary the amount of rotation of the ratchet. When the armature **37** has been returned to the rest position with the solenoid **39** de-energized, the actuating projections **44** and **47** engage the teeth **58** and **60** of the ratchet **42** to positively lock the ratchet into position thereby preventing any counter rotation of the ratchet wheel in a clockwise direction.

The significance of the pawl and ratchet mechanism as described in combination with the tape player may be understood by once again referring to FIGS. 1 and 2 of the drawing. In the tape player **10**, the ratchet wheel **42** is connected to the cam **19** and rotates with it. The cam **19** is mounted to a shaft **64** which may be varied in altitude along the axis of rotation of the cam **19** by adjusting screw **65**. The solenoid **39** is assembled and mounted to the tape deck **24** as a separate unit from the ratchet **42** and cam **19**. If the pawls **32** and **33** were not pivotally connected to the armature **37** at pivot point **35**, it would be necessary for the longitudinal center line of the armature **37** and solenoid **39** to be aligned accurately with the axis of rotation of the ratchet **42**. Otherwise, the armature and pawls would bind and be prevented from moving in and out of the solenoid **39**. By having the pawls pivoted, however, a tolerance is permitted in aligning the solenoid with the rachet **42** so that the pieces may be easily assembled at different times in the production of the tape player without paying special attention to positive alignment of the two pieces thereby reducing production costs. Should the alignment of the solenoid and ratchet wheel be off slightly the pawls will pivot about the armature **37**, and the spring bias will insure that they will at all times engage the ratchet **42**.

As has been described, the ratchet and cam **19** are moved in altitude along the axis of rotation of the two pieces by screw **65**. This permits the indexing of each of the different cam surfaces of the cam **19** to their respective tracks on the magnetic tape in order to properly position the magnetic tape head with the cam follower. Problems have existed in engaging the pawls with the ratchet and maintaining the engagement when the ratchet and cam are moved in elevation along the axis of rotation of the cam **19**. To overcome this, I have formed the pawls in the embodiment from thin sheet metal (they could be made from other materials such as plastic or hard rubber), such that they are considerably thinner than the periphery of the ratchet **42**. When the ratchet **42** and cam **19** are moved in elevation along the axis of rotation, the spring **40** maintains the pawls **33** and **32** in engagement with the ratchet **42** and in a plane substantially normal to the axis of rotation of the ratchet and cam. Because the pawls are relatively thin in comparison to the periphery of the ratchet **42** considerable adjustments in altitude may be made with the pawls remaining in engagement with the ratchet **42**.

In operation of the player **10**, when the end of a particular set of tape tracks is reached on the tape, an aluminum strip moves across a set of contacts, which are not shown, to energize the solenoid **39**. With the solenoid **39** energized, the armature is rapidly pulled into the coil **34** to rotate the ratchet **42** 22½°. This in turn rotates the cam **19** the same amount. Because the armature **37** is moved backward with considerable force, rotating the ratchet **42** equally fast, there is a tendency towards backlash of the ratchet **42** when it hits the portions **45** and **48** of the pawls **32** and **33**, respectively. This backlash tends to drive the ratchet in a clockwise direction. To counter this, the locking portions **45** and **48** engage the teeth **52** and **54** as shown in FIG. 4, and the bias of spring **40** prevents this counter rotation from taking place. When the solenoid is de-energized the spring **56** returns the armature **37** and pawls to the rest position. On this return stroke, the ratchet **42** is turned the remaining 22½° so that the total rotation of the wheel is 45°. Of course, this also rotates the cam **19** 45° to position a different cam surface in contact with the cam follower **16** thereby positioning the magnetic tape head to a new set of tracks on the magnetic tape. When the cam has been rotated such that some of the higher surfaces of the different cam surfaces on cam **19** such as shown at **68** are in engagement with the cam follower **16**, there is a tendency for the spring bias mounting of the head **12** to push the cam follower **16** against the cam surface **68**, for instance, and to auto-rotate the cam in a clockwise direction. The positive locking engagement, however, of the actuating projections **47** and **44** with the teeth **58** and **60** of the ratchet **42** prevents this auto-rotation.

What has been described, therefore, is an improved pawl and ratchet mechanism for transforming linear motion into rotary motion. The alignment of the actuating mechanism for the pawl with the center of rotation of the ratchet is not critical and considerable tolerance is permissible in assembling the pieces. When the pawl and ratchet mechanism is used with a cartridge-type tape player, the pawl and ratchet cooperate to lock the cam, for positioning the tape head in place, once the cam has

been rotated to position the tape head to a different set of tracks, and it further permits the cam to be varied in elevation along its axis of rotation without interfering with the engagement of the pawl with the ratchet.

I claim:

1. A cartridge-type tape player adapted to receive and play tape cartridges having a multi-track tape therein, and including a cam having a plurality of different cam surfaces each one of which is associated with a different track on the tape and a cam follower in engagement with the cam for positioning the magnetic tape head, the combination including a device for rotating the cam to position a different cam surface in a contact with a cam follower with the playing of one of the different tracks on the tape thereby automatically positioning the magnetic tape head to play a different track of the multitrack tape, said device including in combination, a solenoid having an armature, first and second pawl members in spaced relation to one another each having an actuating portion and a locking portion, said pawl members being movably coupled to said armature, a ratchet wheel rotatingly positioned between said pawl members and coupled to the cam, spring means coupled between said pawl members for biasing the same into engagement with said ratchet wheel, said solenoid being energized upon a completion of one of the different tracks on the tape to move said pawl members in one linear direction with said first pawl member in driving engagement with said ratchet wheel and said second pawl member in sliding relation thereto to rotate said cam through a portion of the desired rotation, said spring means biasing said locking portions of said pawl members into engagement with the teeth of said ratchet wheel to prevent counter-rotation of the same with said pawl members being moved to the limit in said one linear direction by said solenoid, and said solenoid being de-energized to move said pawl members in a linear direction opposite to said one direction with said second pawl member in driving engagement with said ratchet wheel and said first pawl member in sliding relation thereto to complete the desired rotation of the cam, and said teeth of said ratchet wheel and said actuating projections of said pawl members cooperating to positively lock said ratchet wheel against counter-rotation with said pawl members being moved to the limit in a linear direction opposite to the one direction.

2. The cartridge-type tape player of claim 1 further including indexing screw means coupled to the cam for providing an adjustment for indexing the magneitc tape head to the different tracks on the tape, and wherein said device of the tape player includes said pawl members being formed from relatively thin sheet material, so that said pawl members are thin in the plane normal to the axis of rotation of the ratchet and thin relative to that portion of the ratchet normal to said plane, thereby permitting the position of said cam and ratchet coupled thereto to be varied along the axis of rotation of the cam with the spring means maintaining said pawl members in engagement with said ratchet substantially in the plane normal to the axis of rotation of the cam.

3. A device for transforming linear motion into rotary motion including in combination, first and second rigid pawl members in spaced relation to one another each having an actuating portion and a locking portion, electromechanical means including a solenoid and an armature pivotally coupled to said pawl members for imparting linear motion thereto, a toothed wheel rotatingly positioned between said pawl members, said pivotal connection between said pawl members and said armature permitting a tolerance in the alignment of the center line of said solenoid and said armature with the center of rotation of said toothed wheel, spring means coupled between said pawl members for biasing the same into engagement with said toothed wheel, said electromechanical means being energized to move said pawl members in one linear direction with said first pawl member in driving engagement with said toothed wheel and said second pawl member in sliding relation thereto to rotate the same through a portion of the desired rotation, with said spring means biasing said locking portions of said pawl members into engagement with the teeth of said toothed wheel to prevent counter-rotation of the same with said pawl members being moved to the limit in said one linear direction, and said electromechanical means being de-energized to move said pawl members in a linear direction opposite to said one direction with said second pawl member in driving engagement with said toothed wheel and said first pawl member in sliding relation thereto to complete the desirable rotation, with said actuating portions of said pawl members cooperating to positively lock said toothed wheel against counter-rotation with said pawl members being moved to the limit in said direction opposite to the one linear direction.

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U.S. Cl. X.R.

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