United States Patent

Whitlock

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[54] TEACHING MACHINE WITH SERVO-CONTROLLED TRACK SELECTOR

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[51] **Int. Cl.**.....**G11b 21/08,** G11b 25/02

[58] **Field of Search**.....274/4 J, 9 RA, 17, 20–22; 179/100.2 T; 340/174.1 C; 74/527

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[57] **ABSTRACT**

A teaching machine for selectively reproducing the respective audio tracks on a record drum lengthwise thereof has a servo-controlled track selector wherein a drive motor rotates the drum through a slip-clutch, and a series of ratchet wheels on the shaft of the drum are offset by fractional tooth differences and are engageable by respective pawls to stop the drum at as many different positions as the number of ratchet wheels times the number of teeth on each ratchet wheel. The pawls are actuated by respective solenoids controlled by a commutator operated by the drum shaft. The commutator has radially spaced brushes connected respectively to the solenoids, and has as many segments as the teeth on each ratchet wheel. Further, the portions of each segment engageable by the respective brushes are offset the same as are the teeth of the ratchet wheels. By selecting the circuits of the respective brushes and segments, the solenoids are actuated selectively to cause the drum to be indexed. By also selecting between one or another of two side-by-side heads spaced by an odd multiple of one-half the distance between successive index positions, the number of audio tracks which can be selected is doubled.

6 Claims, 6 Drawing Figures

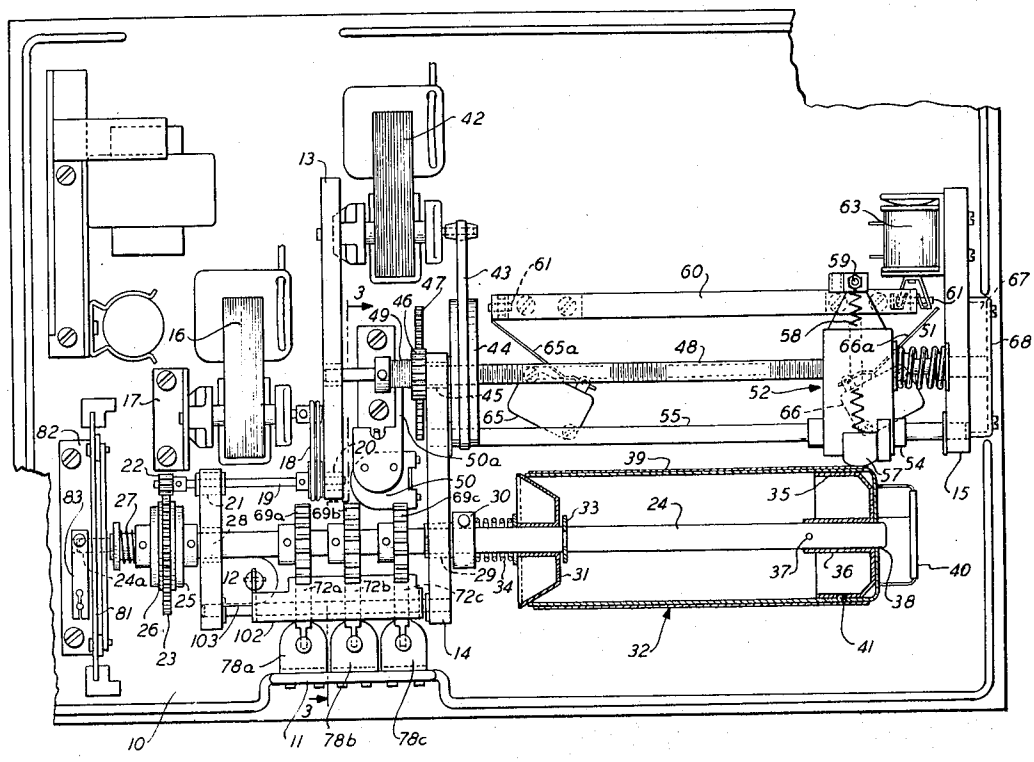
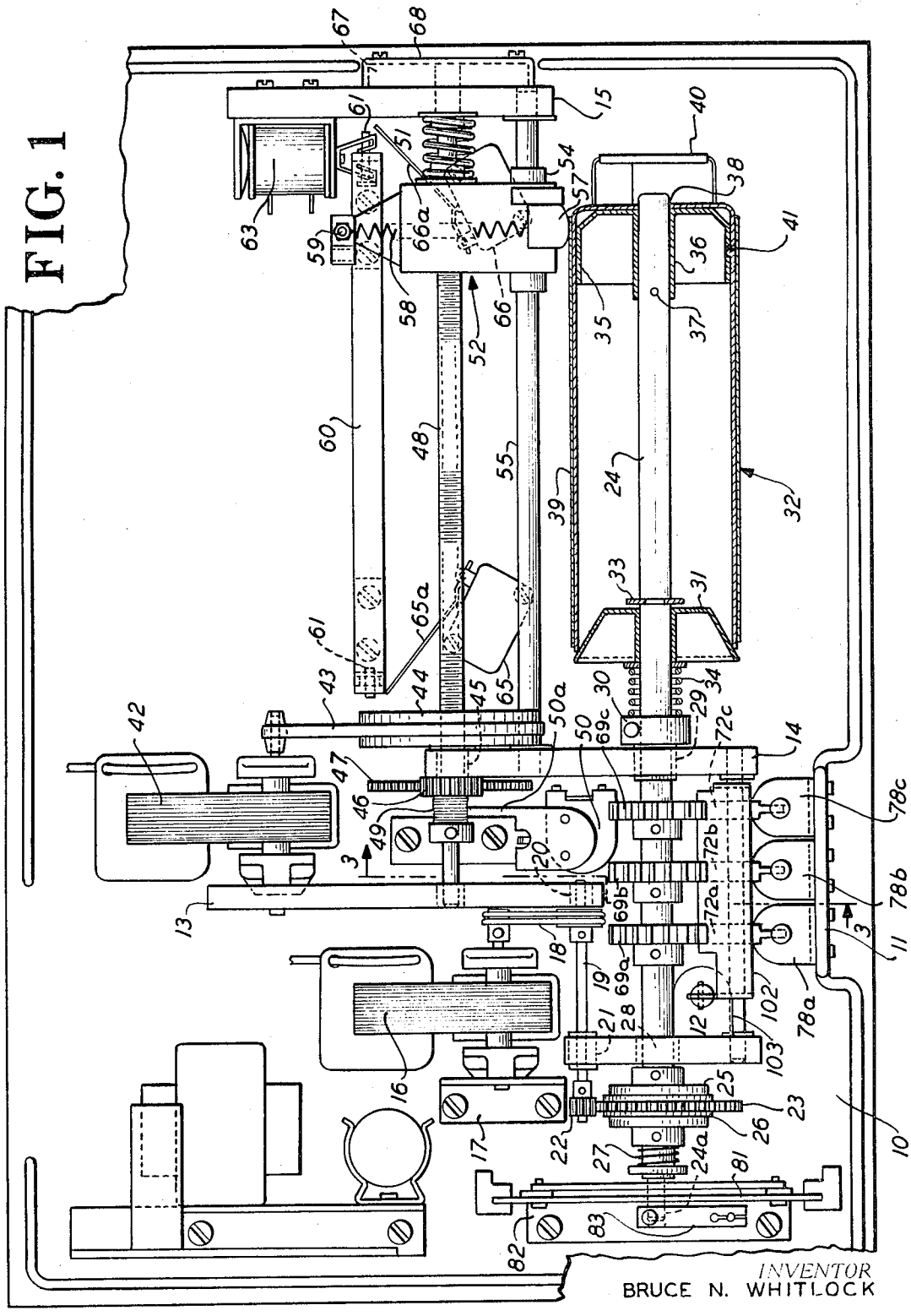


FIG. 1



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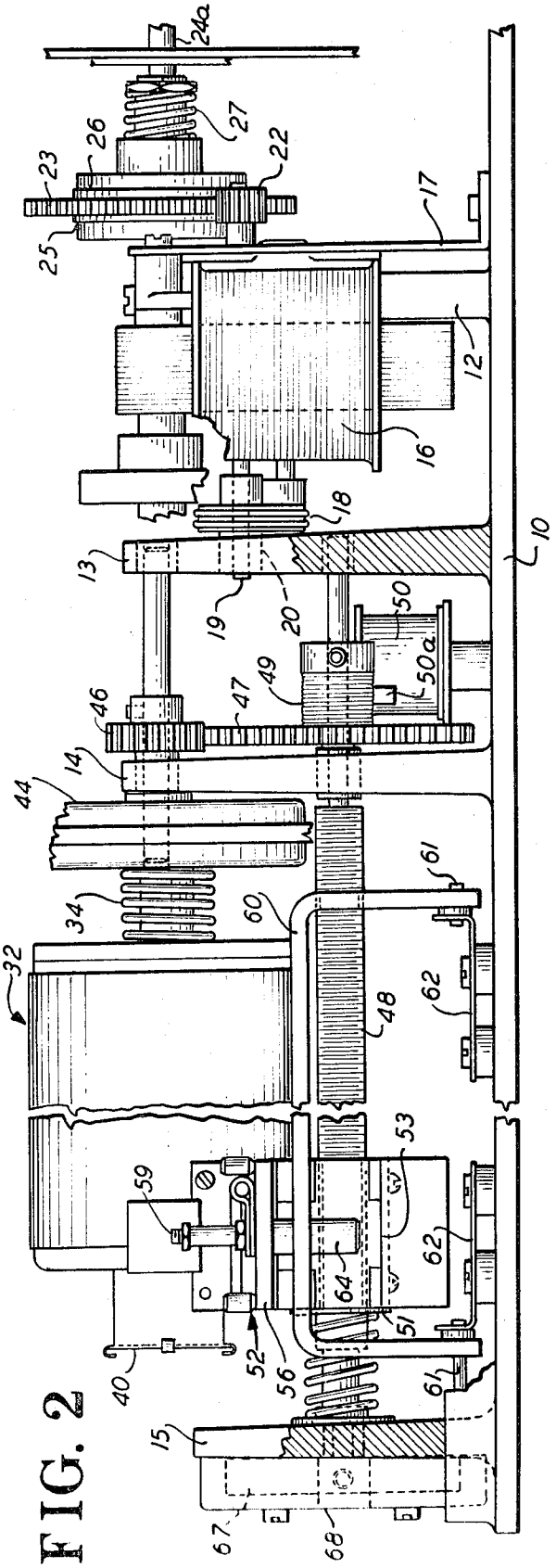
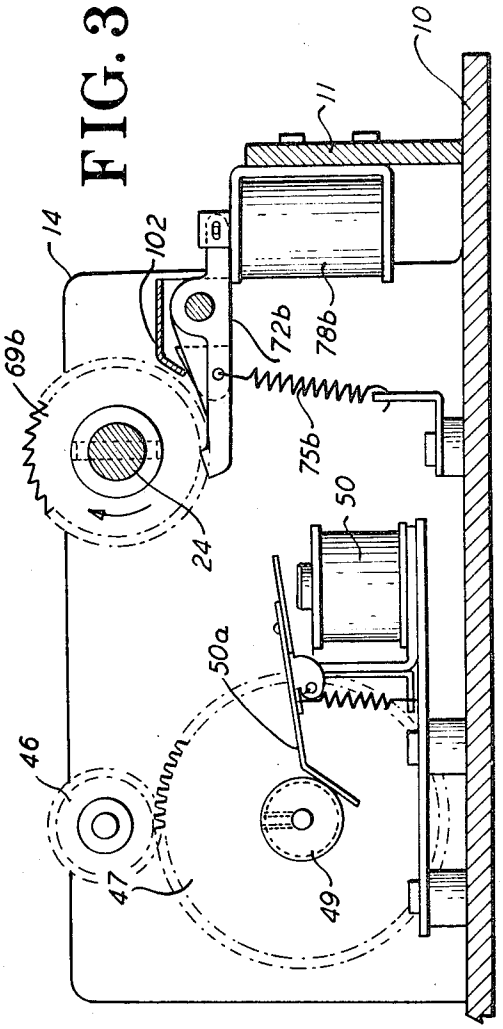


FIG. 2

FIG. 3

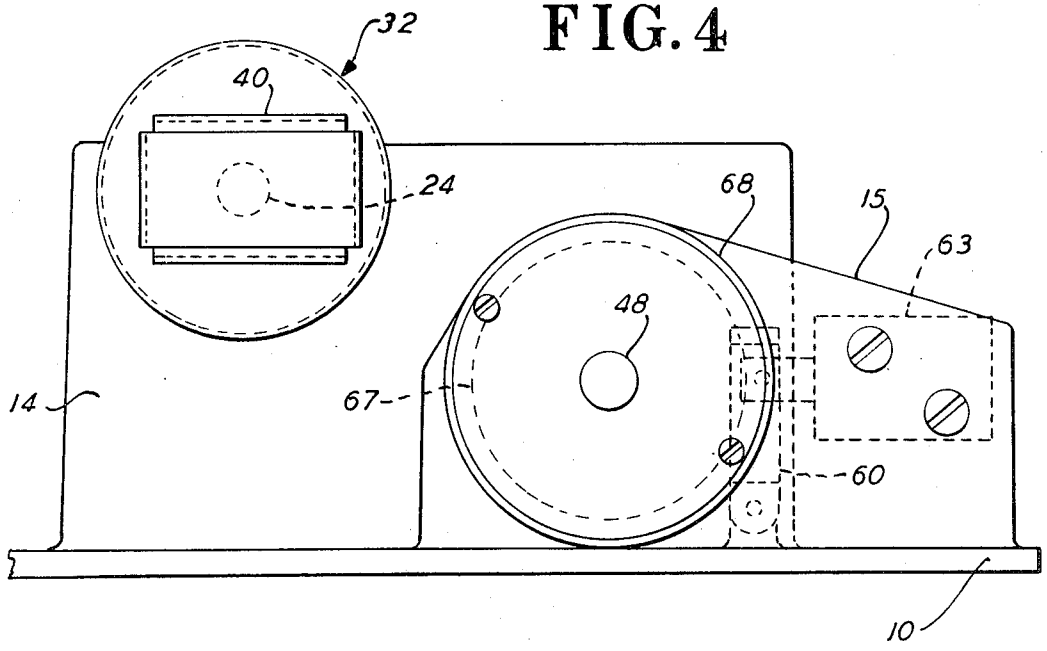


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FIG. 4



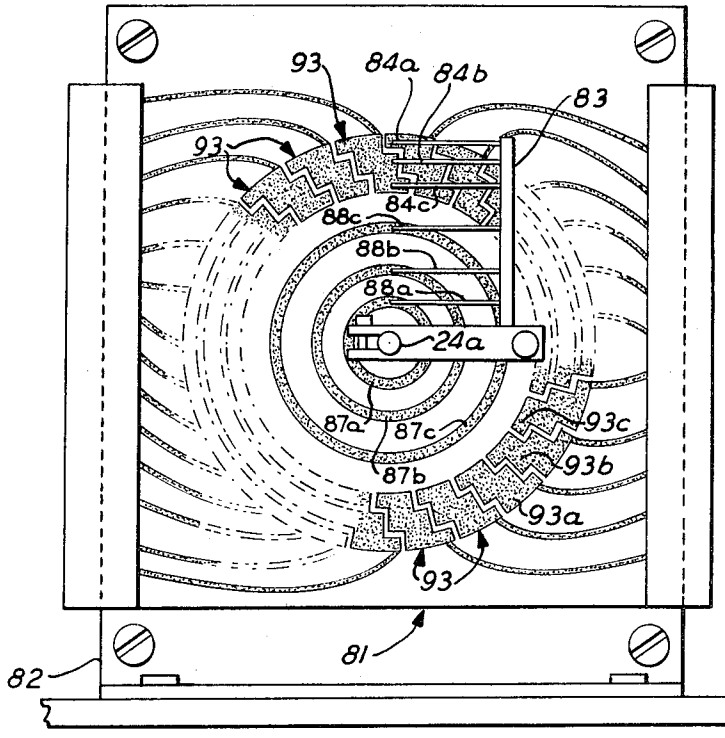
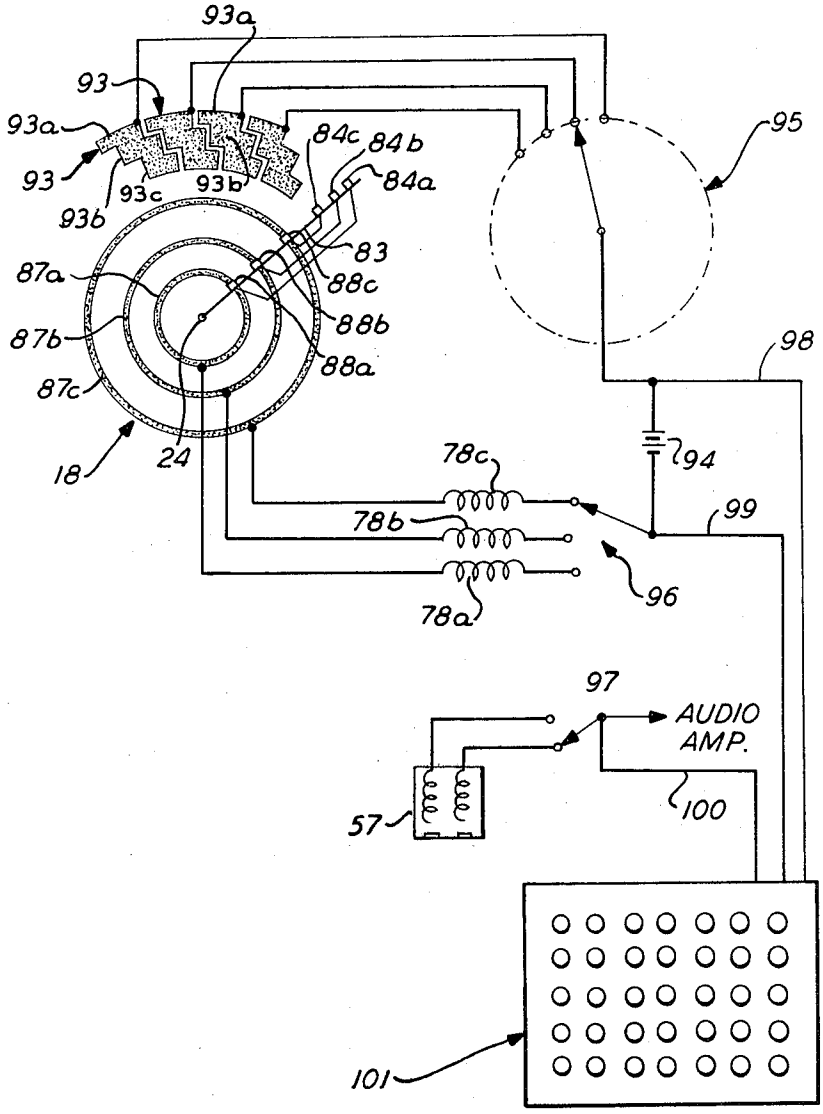


FIG. 5

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FIG. 6



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TEACHING MACHINE WITH SERVO-CONTROLLED TRACK SELECTOR

It is an object of my invention to provide a servo-controlled track selector which is of a simple and positive construction and which is more economical to produce than those of the prior art.

Another object is to provide such track selector which is operable dependably to select respective tracks responsive to a code machine.

Another object is to provide such track selector wherein a set of tracks on a rotating drum is scanned repeatedly 10 and the drum is stopped instantly when a selected track is reached.

Another object is to drive such drum through a slip-clutch and to latch the drum to a quick stop by a pawl and ratchet mechanism the instant a selected track is reached.

Another object is to provide a multiplicity of pawl and ratchet wheels each with relatively coarse teeth and with a durable pawl, and to provide a fine selection by staggering the ratchet wheels so that the teeth are offset by a fractional tooth distance depending on the number of the ratchet wheels.

Another object is to provide an easily mountable and removable drum for such machine wherein each drum is held accurately against eccentricity and is located always in the same angular position about the drum shaft.

These and other objects and features of the invention will be apparent from the following description and the appended claims.

In a description of my invention, reference is had to the accompanying drawings, of which:

FIG. 1 is a top plan view of a teaching machine construction including an audio drive and a servo-controlled track selector according to the invention;

FIG. 2 is a fractional rear view of the teaching machine;

FIG. 3 is a left-hand section on the line 3—3 of FIG. 1;

FIGS. 4 and 5 are right and left end views of the teaching machine; and

FIG. 6 is a circuit diagram of the servo-controlled system.

The present servo-controlled track selector has a frame including a rectangular base plate **10** provided with a front lateral standard **11** and with four parallel transverse standards of which there is a left standard **12**, two intermediate standards **13** and **14** and a right standard **15**. A motor **16** of a servo system is mounted on the base plate back of the standard **12** via a bracket **17** and is coupled through a pair of O-ring belts **18** to a lateral shaft **19**. This shaft is journaled at its right end in a bearing **20** mounted in the front portion of the standard **13** and is journaled **20** near its left end in a bearing **21** mounted in the back portion of the standard **12**. The shaft **19** has a drive gear **22** meshing with a gear **23** journaled on a lateral shaft **24** positioned ahead of the shaft **19** in parallel relation thereto. The gear **23** is retained frictionally between a disk **25** riveted to the shaft **24** and a second disk **26** splined to this shaft, the disks being under pressure of a spring **27** to provide a slip-clutch for coupling the servo motor **16** to the shaft **24**. The shaft **24** is journaled just to the right of the slip-clutch **25-27** in a bearing **28** mounted in the standard **12** and is journaled midway its length in a bearing **29** in

the standard **14**. The shaft **24** extends beyond the standard **14** to the right end of the base plate. A collar **30** on the shaft **24** to the right of the standard **14** serves in connection with the disk **25** at the left of the standard **12** to hold the shaft against end play.

Mounted slidably on the shaft **24** just to the right of a collar **30** is a frusto-conical locator cap **31** for a record cylinder or drum **32**. The locator cap is biased rightwardly against a stop ring **33** on the shaft **24** by a coil spring **34** bearing against the collar **30**. Secured to the right end of the shaft **24** is a cylindrical cup **35** having an internal bearing **36** secured by a pin **37** to the shaft. The record cylinder **32** is open at its inner end and has an end wall at its other end provided with a center hole **38** to receive the end post of the shaft **24** as the record cylinder is mounted. The periphery of the cylinder is covered with a magnetizable material **39** for receiving recorded signals thereon. Secured to the end wall of the cylinder is a U-shaped handle **40** to enable the cylinder to be pressed onto and removed from the shaft **24** without having to place the hand on the recording surface. The cylinder is mounted by sliding it over the cup **35** until the left end presses against a conical surface of the locator cap **31** and displaces the cap from the stop **33**. However, as the cylinder is slid onto the cup **35** it is also oriented about the cup until a spring detent **41** on the cup engages a locator hole in the cylinder to retain the cylinder releasably in a mounted position wherein it is always oriented in the same angular position about the shaft **24**. To remove the cylinder the user simply takes hold of the handle **40** and draws the cylinder outwardly to overcome the detent **41**.

The record cylinder has a teaching program recorded thereon along parallel tracks lengthwise thereof, which may be made by the present machine. The individual tracks bear respective items of information or instruction and are to be played back selectively. The audio drive for the machine may be in accordance with that described in Whitlock U.S. Pat. No. 3,354,557, dated Nov. 28, 1976. For example, a drive motor **42** as of the shaded pole type may be coupled through a belt reduction **43** to a flywheel **44**. This flywheel has a shaft journaled in a bearing **45** in the standard **14**. A pinion **46** on the shaft is in mesh with a larger gear **47** journaled on the left end of a long lead screw **48**. This lead screw is journaled in the standard **13** at its left end and in the standard **14** at its right end. A spring clutch **49** couples the gear **47** to the lead screw when a solenoid **50** is actuated. Meshing with the lead screw **48** is a nut **51** of a head carriage assembly **52**. The nut is secured to a carriage base structure **53** which has a bearing **54** slidably engaging a cross rod **55** supported at its ends by the standard **14—15**. Slidably mounted on the top face of the base structure **53** for movement from front-to-back is a plate **56** carrying a record-reproduce head **57** which is biased by a spring **58** against the record cylinder **39**. At the back end of the plate **56** is a screw **59** which depends past the back edge of an upright bail **60**. This bail is pivoted at its ends to studs **61** carried by respective brackets **62** secured to the base plate **10**. The bail is connected to a solenoid **63** which when energized rocks the bail rearwardly to move the record-reproduce head **57** away from the record drum **39**. When the head carriage

reaches its forward and rearward end positions a post **64** depending from the rearward portion of the head carriage moves against arms **65***a* and **66***a* of respective switches **65** and **66**, to perform respective control functions later described.

When the clutch solenoid **50** is energized its armature **50**a is drawn with pressure against the outer end of the clutch spring **49** causing the spring instantly to be drawn frictionally about the lead screw **48** to couple the gear **47** to the lead screw. This causes the head carriage assembly **52** to be moved from right to left along the record cylinder to either record on or reproduce from a track on the cylinder depending on whether the machine is in recording or reproducing condition. As the lead screw is turned it winds up a helical spring **67** at its outer end housed in a cylindrical case **68** on the standard **15**. When the head carriage reaches its left end of travel it closes the end switch **65** to energize the solenoid **63** and draw the head **57** out of contact with the record cylinder and to deenergize the clutch solenoid **50** whereby to release the clutch spring **49** and allow the return spring **67** to spin the lead screw **48** in a reverse direction to return the head carriage assembly quickly to home position. When the head carriage reaches its home position the end switch **66** allows the solenoid **63** to be deenergized and permit the spring **58** to return the head into engagement with the record cylinder. The drive clutch solenoid **50** is not again actuated until a start control (not shown) is operated. Thus, for any position of the record cylinder the machine can be operated to record on or to reproduce from a respective track on the cylinder.

The servo-controlled track selector with which the present invention is particularly concerned is adapted for indexing the record cylinder to any one of 78 different positions and to select one or another gaps of the head whereby to select the operation along any one of 156 tracks. This servo mechanism comprises three ratchet wheels **69***a*, **69***b* and **69***c* pinned to the portion of the shaft **24** between the standards **12** and **14**. The ratchet wheels are engageable by respective pawls **72***a*, **72***b* and **72***c* held normally disengaged by respective springs **75***a*, **75***b* and **75***c*. (See FIG. **3**). The pawls are engaged with the respective ratchet wheels by respective solenoids **78***a*, **78***b* and **78***c* mounted on the front standard **11**. Each ratchet wheel **69***a*, **69***b* and **69***c* has for example 26 teeth to enable each ratchet wheel and respective pawl to stop the record cylinder in any one of 26 equally spaced positions. However, the ratchet wheels are offset by one-third tooth distance from each other to render the three ratchet wheels operative to stop the record cylinder in any one of 78 equally spaced positions. In addition, the head **57** is provided with two gaps spaced circumferentially about the drum by one one hundred fifty-six revolution of the drum (one-half of the distance between the successive 78 indexing positions) to enable the machine by selection of one or the other of the two head gaps and by a selective time operation of the ratchet pawls to bring the 156 different tracks into selective engagement with the heads.

A selective activation of the solenoids **78***a*, **78***b* and **78***c* as well as a timing of the actuation of these solenoids comprises a circuit as shown in FIG. **5**. This circuit includes a commutator **81** (FIGS. **1**, **5** and **6**) mounted on a bracket **82** secured to the base **10**. The commutator includes a brush arm **83** mounted on the left end portion of the shaft **24**. This brush arm carries three individual brushes **84***a*, **84***b* and **84***c* equally radially spaced therealong. The brushes are connected respectively to individual stationary slip-rings **87***a*, **87***b* and **87***c* through individual brushes **88***a*, **88***b* and **88***c*. The slip-rings are connected respectively to the solenoids **78***a*, **78***b* and **78***c*. Further, the commutator includes **26** equally spaced segments **93** wherein each segment has three portions **93***a*, **93***b* and **93***c*, corresponding to the respective brushes **84***a*, **84***b* and **84***c*, which are stepped from each other by one-third the angular distance between the successive segments. With reference to FIG. **6**, a d. c. power source, say a battery **94**, is connected selectively by a switch **95** to the commutator segments **93**. The return circuit to the battery is completed via the brushes **84** and respective slip-rings through one or another of the solenoids **78***a*, **78***b* and **78***c* determined by a switch **96**. Another switch **97** connects one or the other of the gap coils of the head **57** to an audio amplifier. These switches **95**, **96** and **97** are connected by respective lines **98**, **99** and **100** as to a keyboard **101** (diagrammatically shown) having individual keys which may be operated to select the different combinations of the switches **95**, **96** and **97** which will index the record cylinder **39** and select one or the other of the gaps of the head **57** to record on or play back from any selected one of the 156 individual tracks on the record cylinder. At the end of playing or recording a track a common knock-out bail **102** for the pawls **72***a*, **72***b* and **72***c* is turned by a solenoid **103** to disengage whichever of the pawls was last actuated. This causes the motor **16** to start turning the record drum. In a subsequent indexing operation a selected segment and selected brush slip-ring are made active on the commutator so that when the selected brush reaches the selected segment current will flow through the respective pawl solenoid to engage its pawl with the selected tooth and bring the record drum to a sudden stop. At the end of the indexing operation the audio drive system is started by the solenoid **63** operating the bail **60** to engage the head **57** with the record drum and by the clutch solenoid **50** engaging the drive clutch **49** to start a progressive movement of the head **57** along the drum.

The embodiment of my invention herein particularly shown and described is intended to be illustrative and not necessarily limitative of my invention since the same is subject to changes and modifications without departure from the scope of my invention which I endeavor to express according to the following claims.

I claim:

1. A servo system comprising a record drum having individual tracks thereon parallel to the axis thereof, drive means including a slip clutch for rotating said drum, a plurality of ratchet wheels on said shaft and of corresponding pawls and solenoids, each of said ratchet wheels having a plurality of equally spaced teeth wherein the teeth of said respective ratchet wheels are shifted circumferentially from each other by a fractional tooth separation in inverse proportion to the number of said ratchet wheels, circuit means including a commutator on the shaft of said drum and switch means for selectively connecting to the segments of said commutator and to said solenoids for selectively

activating said solenoids to stop said drum with slippage of said clutch at preselected index positions, wherein said commutator includes a plurality of radially spaced brushes connected respectively to said solenoids, and wherein the portion of said segments engageable by said respective brushes are offset circumferentially by a fractional distance between successive segments in inverse proportion to the number of said ratchet wheels.

2. The servo system set forth in claim 1 including an audio system having a multiple track magnetic head engageable with said record drum along two side-by-side tracks spaced by an odd multiple of one-half the distance between successive index positions on said drum, and wherein said circuit means includes switch means for selectively connecting said dual head to said audio circuit upon each operation of said servo system.

3. In a servo system for selectively engaging parallel tracks of a record drum with a translating head: the combination of a rotatably mounted record drum bearing a plurality of said tracks equally spaced thereabout, a drive motor, a coupling including a slip-clutch between said motor and said drum, a plurality of ratchet wheels secured to said drum and of corresponding pawls, the number of tracks on said drum being an integral multiple of the number of teeth on each of said ratchet wheels, and said ratchet wheels being circumferentially displaced from each other by a fraction of a tooth distance in inverse proportion to the number of said ratchet wheels, said pawls being engageable with said ratchet wheels to stop said drum against the driving force of said motor transmitted via said slip-clutch, a commutator coupled to said drum having a brush and corresponding slip ring for each of said ratchet wheels and as many segments as the number of teeth on each of said ratchet wheels, each of said segments of said commutator having respective portions engageable by said brushes which are stepped circumferentially from each other by a fraction of the distance between successive segments in inverse proportion to the number of said ratchet wheels, respective solenoids for controlling said pawls, and circuit means for controlling said solenoids including a servomechanism for selecting one of said segments and concurrently one of said brushes whereby the selected solenoid is operated when a selected brush engages the respective portion of a selected segment.

4. The servo system set forth in claim 3 including an audio drive system for moving a magnetic head along a selected track, and means for activating said drive system upon selection of a given commutator segment and brush by said servo system.

5. The servo system set forth in claim 4 including a means for engaging the record-reproduce head with a selected track and for starting said drive system to advance the head along said track, and a bail and activating solenoid for disengaging whichever of said pawls is engaged with the respective ratchet wheel when the head reaches the end of said track.

6. The servo system set forth in claim 5 including two tracks on said drum for each index position thereof, a dual record-reproduce head for engaging both of said tracks in each of said index positions, and means controlled by said servo system during each operation thereof for selectively connecting one of said record-reproduce heads to said audio circuit.

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