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SHAFT POSITION CONTROL MECHANISM

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FIG. 1

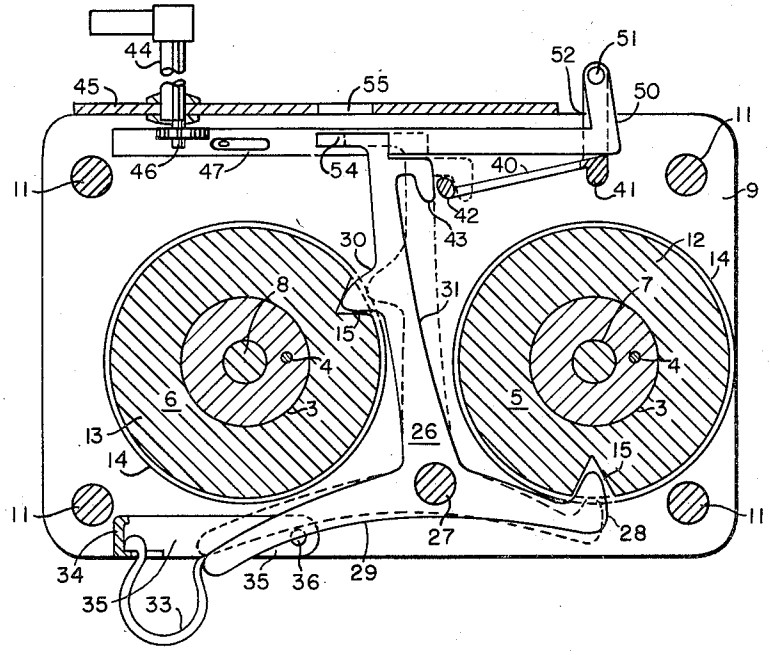
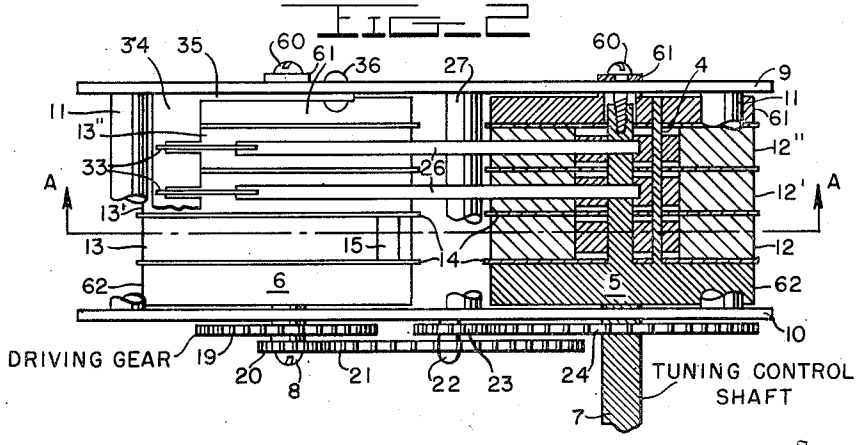


FIG. 2



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SHAFT POSITION CONTROL MECHANISM

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1

This invention relates to a shaft position control mechanism, and more particularly to a mechanism for selectively controlling the angular position of a shaft with a high degree of accuracy.

While the present invention has wide application, as will be readily apparent, it is particularly intended for use in controlling the position of a tuning shaft such as employed in electronic apparatus, and specifically designed to be employed with a vernier tuning control mechanism.

Another object of the present invention is to provide a new and improved shaft position control mechanism, and more particularly to provide a mechanism for selectively controlling the angular position of a shaft with a high degree of accuracy.

A further object of the present invention is to provide an improved shaft position control mechanism adapted for use in conjunction with a vernier shaft.

Other objects and advantages of the present invention will be apparent from the following detailed description taken in conjunction with the drawings, wherein:

Fig. 1 is a sectional view of the shaft control mechanism, taken along the line A—A of Fig. 2.

Fig. 2 is a bottom plan view, partially cut away, of the shaft control mechanism.

Briefly, this invention provides a means for exactly positioning a control shaft in any one of a number of positions without the aid of expensive machinery. A first drum may be mounted on or connected to the control shaft. A second drum is rotably mounted adjacent the first drum and geared to the first drum so that rotation of the second drum will produce a slower rotation of the first drum and the associated control shaft. A mechanical stopping means is cooperatively associated with the first and second drums operative to arrest their rotation whenever any of a number of predetermined angular relations between the two drums have been reached. Additional means are associated with the drums for predetermining the angular relations of the two drums selected by the stopping means. Indicating means are associated with the stopping means for identifying each predetermined angular relation as it is reached.

Referring now to the drawings, wherein a preferred embodiment of the invention is illustrated, it will be seen that the shaft control mechanism of this invention includes two drums 5 and 6 which are mounted on suitably spaced, parallel shafts 7 and 8, respectively, journalled between

2

a pair of spaced, parallel, side plates 9 and 10 which form a generally rectangular housing for the mechanism. Spacer rods 11 are located at the four corners of the housing and extend between the side plates, their ends being suitably secured to the side plates to provide a rigid structure.

Each of the drums 5 and 6 consists of a plurality of disks 12, 12', and 12'' and 13, 13' and 13'', respectively, assembled between end plates 61 and 62. As shown in Fig. 2, one end plate 62 may be made integral with the shaft and the other end plate 61, may be attached thereto by a screw 60. The disks are separated from each adjacent disk by spacer rings 14. Each disk has a large axial bore containing a washer 3, each washer 3 and spacer ring 14 is keyed to the shafts 7 and 8 by a key 4. The washers 3 slidably mount their respective disks and are employed to prevent the keys 4 which lock the spacer rings 14 to the shafts 7 and 8 from also locking the disks to the shafts. Said washers are preferably constructed somewhat thinner than the disks in order not to interfere with the lateral frictional engagement of the disks and the spacer rings. Said lateral frictional engagement is provided by tightening screws 60 thus drawing the end plates 61 and 62 together and pressing the disks tightly against their respective adjacent spacer rings. Thus, when end plates 61 and 62 are tightened the disks will rotate as a unit with their corresponding shafts, and when they are loosened the angular relation of each disk with respect to its shaft may be individually adjusted without disturbing the other disks. Each disk has formed in the periphery thereof of V-shaped notch 15.

Only three disks with their associated mechanism have been illustrated for the purpose of simplifying the drawing; it should be understood that the invention is not limited to that number.

Referring now to Fig. 2, it will be seen that the mechanism below the drums 5 and 6 in Fig. 1 has been cut away from the lowest disks 12 and 13 in Fig. 2 to illustrate their exteriors in plan view and the apparatus comprising drum 5 has been taken in cross-section through the center of tuning shaft 7 to show the association of the component parts of said drums. A gear train is provided whereby the shafts 7 and 8 may be rotated in timed relation, comprising a small pinion gear 20 keyed to the lower end of the shaft 8, as viewed in Fig. 2, which drives a large spur gear 21 mounted on an idler shaft 22, suitably

mounted on the side plate 10. The idler shaft 22 has also keyed thereto a second small pinion gear 23 which engages a second large spur gear 24 keyed to the end of the shaft 7. Thus it will be apparent that rotation of shaft 8 will cause rotation of shaft 7, the amount of rotation of shaft 7 with respect to that of shaft 8 depending on the gear ratio provided by the gear train described. It will be obvious, however, that to mount the gears so that the higher speed shaft is shaft 7 instead of shaft 8 would not be departing from the present invention. Another gear 19 may be keyed to shaft 8 whereby the tuning mechanism may be driven from an external source.

Since the shaft 7 and associated drum 5 rotate at a substantially slower speed than the shaft 8 in the embodiment shown, the notches in the periphery of the disks forming the drum 5 will pass a given point only once for a number of revolutions of the shaft 8 depending on the gear ratio selected. For example, if the gear ratio provides a 15 to 1 reduction, then the shaft 8 must be rotated up to 15 times in order to cause a notch on a given disk of the drum 6 to be aligned with any predetermined point at the same time that a notch on a corresponding disk of the drum 5 is aligned with a preselected point.

This condition is utilized in accordance with the present invention to provide a highly accurate and precise shaft control mechanism by employing in conjunction with the drums a number of pawls 26, shown in Fig. 1, corresponding to the number of disks on either drum. These pawls 26 are pivotally mounted on a shaft 27 journalled between the side plates 9 and 10 and located between the drums. Said pawls are adapted to rotate between the positions indicated in solid and dotted lines. The pawls are substantially T-shaped, each having a detent 28 integrally formed with the underside of one end of the cross portion 29 and extending toward the drum 5, and a second detent 30 integrally formed in a side of the mid-portion 31 of the pawl and extending toward the drum 6, as viewed in these drawings. The opposite end of the cross portion 29 has bearing thereagainst one end of a small spring 33 so mounted as to urge the double pawl 26 to move as shown in Fig. 1, in a counterclockwise direction. The springs 33 are substantially semi-circular in shape, with their opposite ends mounted on a comb member 34 pivotally supported at 36 between the side plates 9 and 10 by arms 35 (only one of which is shown) to permit adjustment of the springs relative to pawls 26. Referring again to Fig. 2, by pivoting the comb member 34 in or out of the plane of the paper on its pivot arms 35 and pivot 36, the springs 33 are centered so that a minimum torque is applied to the pawls when the pawls are in a disengaged position relative to the disks. However, when a pawl begins to enter a notch, the associated spring is moved from its minimum torque position and a correspondingly increased torque is applied to the pawl to urge the pawl firmly into the notch and thereby establish most accurate positioning.

The pawls are so mounted and shaped that when a notch on an associated disk 12 is aligned with the corresponding pawl detent 28 and when a notch on a disk 13 of the drum 6 is aligned with its corresponding detent 30, then the pawl may rotate about shaft 27 to cause the detents to enter the respective notches as shown in solid lines in Fig. 1, and thereby to arrest rotation of

the drums. Since the drum 5 rotates only once for every 15 revolutions of the drum 6, this condition will not obtain except once for every 15 revolutions of the drum 6. Thus, it will be apparent that if the drum 5 be connected to a tuning control shaft, or be a part of the shaft to be controlled as shown, a highly accurate position control is effected.

The pawls 26 may be so shaped that when not detented, only the detent 28 slides along its respective disk 12 while the other detent 30 does not quite touch its disk 13. This provides a minimum of friction between detent and disk since only the detent 28 rides against its slow disk 12. In order that each detent will penetrate equally its respective notch 15, detent 30 will then have to move further than detent 28; accordingly, it is located further from the pivot shaft 27.

In order to facilitate the adjustment of the disks and also to permit free rotation of the disks without detenting the pawls when desired, a latching mechanism is provided comprising an open rectangular frame 40, shown in Fig. 1, pivotally mounted along its rear edge on a shaft 41 which is journalled between the spaced side plates 9 and 10. The frame is shown pivoted in a clockwise direction causing the transverse portion 42 thereof to engage lugs 43 shown at the upper right end of the center arm portions 31 of the pawls 26. When engaged by the frame, the pawls are prevented from rotating in either direction. Pivoting of the frame 40 is accomplished by rotating a shaft 44 journalled in a cover plate 45, mounted on the spaced plates 9 and 10. The shaft 44 has an eccentric pin 46 fixed to the inner end thereof which rides in a transverse slot formed on one end of a reciprocably mounted link arm 47, the link arm 47 being slidably supported on the side plate 9. The other end of the link arm 47 has integrally formed therewith a member 50 which extends upwards at right angles, and the outer end of which is journalled to a short pin 51 which engages the outer ends of a short pivot arm 52 rigidly secured to the rear end of the frame 40. Rotation of the shaft 44 then causes the link 47 to move longitudinally and to pivot the frame 40 about the supporting shaft 41 into locking position or disengaged position with the lugs 43 in accordance with the direction of rotation of the control shaft 44. The dimensions of the lips of lugs 43 and the degree of rotation of pawls 26 are adjusted so that rotation of the transverse portion 42 of frame 40 into engagement with the lugs of pawls 26 operates to lock all the pawls in their current position.

The latching mechanism may be engaged when all pawls are free and prevent detenting when the shafts 7 and 8 are rotated. It may be used in the following manner to set up a shaft position for future selection:

Any pawl desired for making this selection is chosen, the shafts are then rotated until this pawl detents. The latching mechanism is then engaged locking this pawl down and preventing the others from detenting. The screws 60 are then loosened thereby permitting slippage of the disks with respect to their shafts as described above. With the desired pawl locked in, the shafts are turned to their new selection position, thereby sliding the appropriate pair of disks to a corresponding position. Now after tightening the screws 60, the new detent position will be set up for the desired pawl and the

detent positions of the other pawls will not have been changed.

The position of the drums **5** and **6** is conveniently indicated as shown in Fig. 1 by affixing or forming small suitably numbered plates **54** to the ends of the midportions of the pawls **26** and providing a window **55** in the cover plate **44** so that when a pawl engages the disks, the associated numbered plate **54** will move into exposed position under the window **55**.

The mechanism may be rotated by hand, at each selected position a pawl will detent stopping the shafts and indicating the number of that position. The shafts are securely held but not locked by detenting of the pawls and may be rotated through any number of detent positions to any desired detent position, the pawls being designed to rise out of the notches upon further rotation of the shafts. The final positioning of the shaft at each detent position is reached automatically by the action of the springs **33** thus providing much more positive positioning than could be obtained by an entirely manual approach to each position.

Whether the mechanism is rotated by a motor or by hand, the rotating force may be removed as soon as the pawl starts entering the associated notches. The springs **33** will complete the positioning of the shafts and the possibility of hunting is thereby eliminated from the mechanism.

While but one embodiment of this invention has been shown and described, it will be understood that many changes and modifications may be made therein without departing from the spirit and scope of the present invention.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. In a shaft position control device, a pair of juxtaposed rotatable drums each having a plurality of notches formed in the periphery thereof, means mechanically connecting said drums whereby rotation of one drum causes the other to rotate at a speed different from that of the first drum, and pawl means positioned in intimate relation with the notches of each of said drums and operative upon its simultaneous engagement with a notch in each of said drums to arrest the rotation of said drums.

2. In a shaft position control device, a pair of juxtaposed rotatable drums each having a plurality of notches formed in the periphery thereof, said notches being positioned at selectable angular points along the length of said drums, means mechanically connecting said drums whereby rotation of one drum causes the other to rotate at a speed different from that of the first drum, and pawl means positioned in intimate relation with the notches of each of said drums and operative upon its simultaneous engagement with a notch in each of said drums to arrest the rotation of said drums.

3. In a shaft position control device, a pair of juxtaposed rotatable drums each having a plurality of notches formed in the periphery thereof, means mechanically connecting said drums whereby rotation of one drum causes the other to rotate at a speed different from that of the first drum, a plurality of pawls each having a first detent operative to engage a notch of one of said drums and a second detent operative to engage a notch of the other of said drums, said pawls being pivotably mounted and operative upon the simultaneous engagement of the two detents of any single pawl with a notch in each of the drums to arrest the rotation of the drums.

4. In a shaft position control device, a pair of juxtaposed rotatable drums each having a plurality of notches formed in the periphery thereof, means mechanically connecting said drums whereby rotation of one drum causes the other to rotate at a speed different from that of the first drum, a plurality of pawls each having a first detent operative to engage a notch of one of said drums and a second detent operative to engage a notch of the other of said drums, said pawls being pivotably mounted and operative upon the simultaneous engagement of the two detents of any single pawl with a notch in each of the drums to arrest the rotation of the drums, and latching means operable to prevent the pivoting of said pawls in or out of their associated notches.

5. In a shaft position control device, a pair of juxtaposed rotatable drums each having a plurality of notches formed in the periphery thereof, means mechanically connecting said drums whereby rotation of one drum causes the other to rotate at a speed different from that of the first drum, a plurality of pawls each having a first detent operative to engage a notch of one of said drums and a second detent operative to engage a notch of the other of said drums, said pawls being pivotably mounted and operative upon the simultaneous engagement of the two detents of any single pawl with a notch in each of the drums to arrest the rotation of the drums, latching means operable to prevent the pivoting of said pawls in or out of their associated notches, and indicating means associated with said pawls for indicating the relative position of said disks in accordance with the entry of a pawl into a pair of notches.

6. In ashaft position control device, a pair of juxtaposed rotatable shafts, a plurality of disks assembled on each of said shafts, a notch formed in the periphery of each of said disks, means mechanically connecting said shafts whereby rotation of one shaft causes the other to rotate at a speed different from that of the first shaft, a plurality of pawls equal in number to the number of disks on each shaft, each of said pawls having a first and second detent associated respectively with a disk of one of said shafts and a disk of the other of said shafts, each pawl being pivotable whereby its detents may simultaneously enter the notches of their associated disks in accordance with the position of the disks so as to arrest the rotation of the shafts.

7. In a shaft position control device, a pair of juxtaposed rotatable shafts, a plurality of disks assembled on each of said shafts, a notch formed in the periphery of each of said disks, means mechanically connecting said shafts whereby rotation of one shaft causes the other to rotate at a speed different from that of the first shaft, a plurality of pawls equal in number to the number of disks on each shaft, each of said pawls having a first and second detent associated respectively with a disk of one of said shafts and a disk of the other of said shafts, each pawl being pivotable whereby its detents may simultaneously enter the notches of their associated disks in accordance with the position of the disks so as to arrest the rotation of the shafts, resilient means associated with each of

said pawls operable to cause one detent of each pawl to press on the periphery of its associated disks and to increase said pressure as a pawl moves into its associated notches.

8. In a shaft position control device, a pair of juxtaposed rotatable shafts, a plurality of disks assembled on each of said shafts, spacer means interposed between each of said disks and arranged to rotate with the shafts to permit individual adjustment of the angular position of each of said disks, a notch formed in the periphery of each of said disks, means mechanically connecting said shafts whereby rotation of one shaft causes the other to rotate at a speed different from that of the first shaft, a plurality of pawls corresponding in number to the number of disks on each shaft, each of said pawls having detent means positioned in intimate relation to the corresponding disks of each shaft, each pawl being pivotable so as to simultaneously enter the notches of its corresponding disks in accordance with the position of the disks so as to arrest the rotation of the shafts, resilient means associated with each of said pawls operable to cause one detent of each pawl to press on the periphery of its corresponding disk and to increase said pressure as a detent moves into its associated notches, and latching means operable to prevent the pivoting of said pawls in or out of their respective notches.

9. In a shaft position control device, a pair of juxtaposed rotatable shafts, a plurality of disks assembled on each of said shafts, spacer means interposed between each of said disks and arranged to rotate with the shafts to permit individual adjustment of the angular position of each of said disks, a notch formed in the periphery of each of said disks, a gear train interconnecting said pair of shafts whereby the rotation of one shaft will cause rotation of the other shaft at a lower rate, a plurality of pawls corresponding in number to the number of disks on each shaft, each of said pawls having detent means positioned in intimate relation to the corresponding disks of each shaft, each pawl being pivotable so as to simultaneously enter the notches of its corresponding disks in accordance with the position of the disks so as to arrest the rotation of the shafts, resilient means associated with each of said pawls operable to cause one detent of each pawl to press on the periphery of its corresponding disk and to increase said pressure as a detent moves into its associated notches, and latching means operable to prevent the pivoting of said pawls in or out of their respective notches.

10. In a shaft position control device, a pair of spaced parallel, rotatable shafts, a plurality of disks assembled on each of said shafts, spacer means interposed between each of said disks and arranged to rotate with the shafts to permit individual adjustment of the angular position of each of said disks, a notch formed in the periphery of each of said disks, a gear train interconnecting said pair of shafts whereby the rotation of one shaft will cause rotation of the other shaft at a lower rate, a plurality of pawls each having a pair of detents, said pawls being associated with said disks and being pivotable so that when suitable rotational relation of the shafts occur one detent of one pawl enters the notch of a disk on one shaft and the other detent of the same pawl enters the notch of a disk on the other shaft, resilient means associated with each of said pawls operable to cause one detent of each pawl to press on the periphery of its associated disk and to increase said pressure as a pawl moves into its associated notches, latching means operable to prevent the pivoting of said pawls in and out of their associated notches, and indicating means associated with said pawls for indicating the relative position of said disks in accordance with the entry of a pawl into a pair of notches.

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