Aug. 31, 1965 H. T. LYMAN ETAL 3,204,208

TUNER DRIVING MECHANISM

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FIG. 2

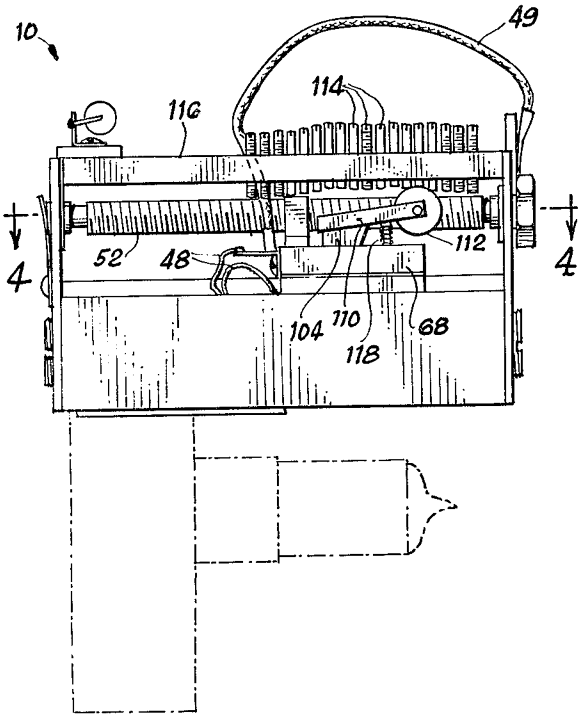

FIG. 1

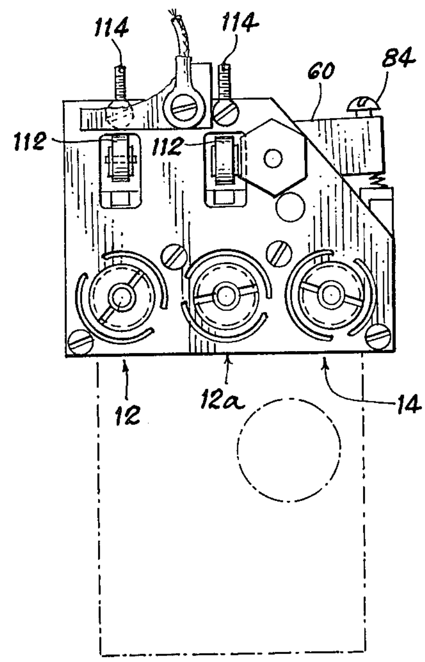

FIG. 3

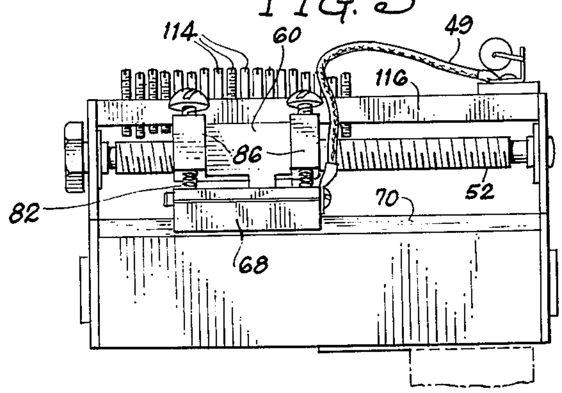

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FIG. 4

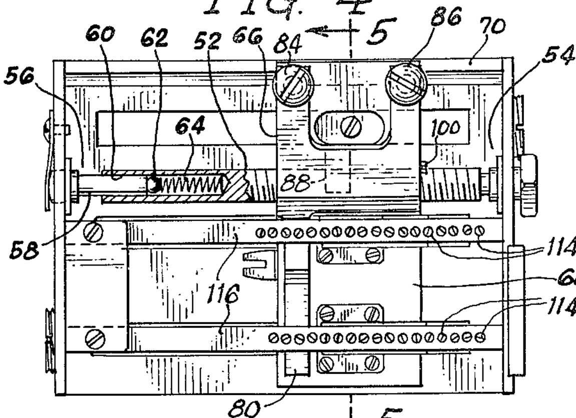

FIG. 6

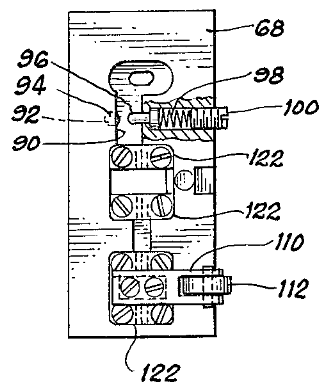

FIG. 5

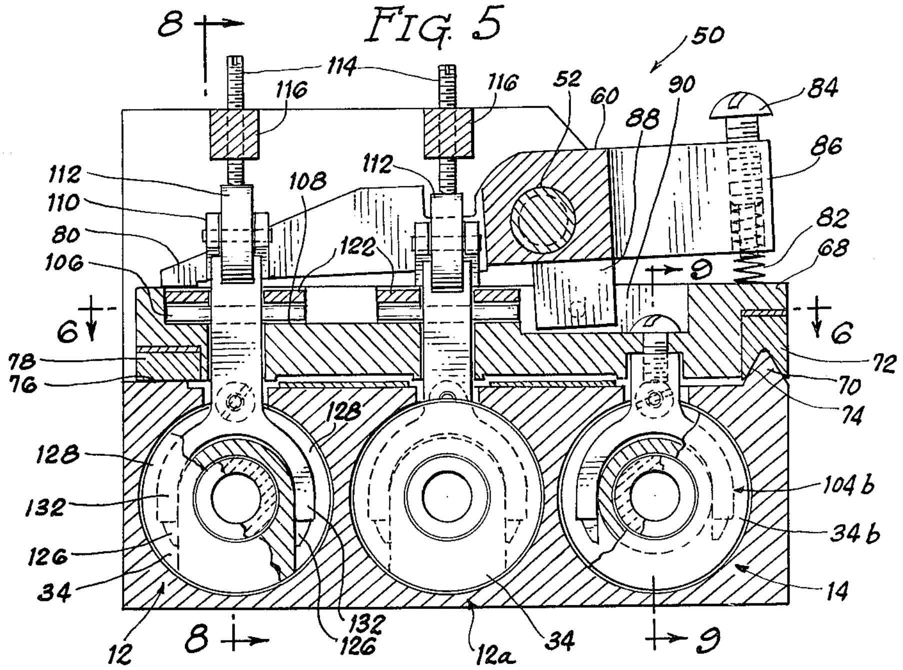

FIG. 7

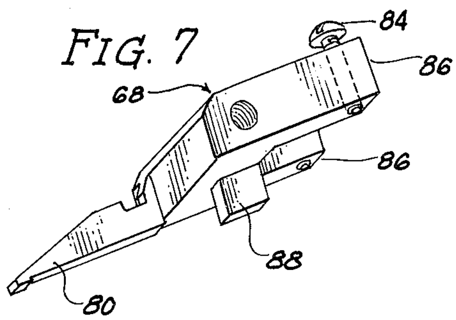

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FIG. 8

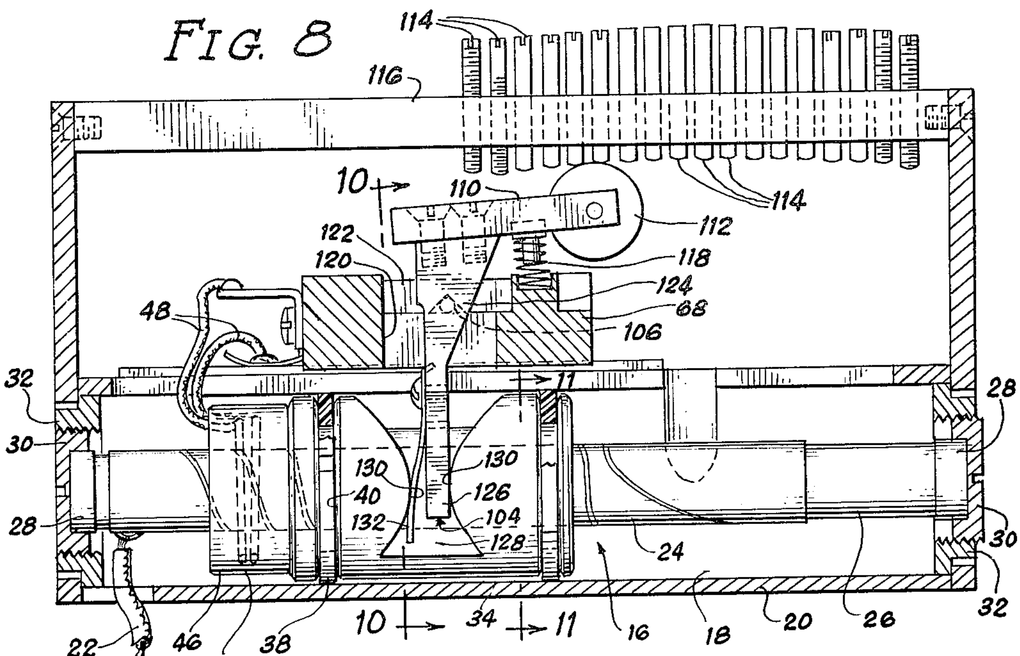
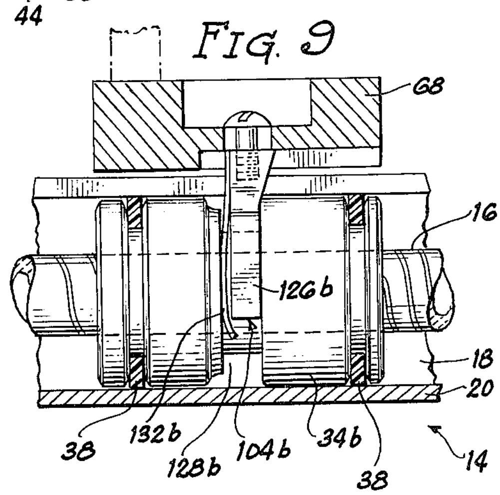


FIG. 9



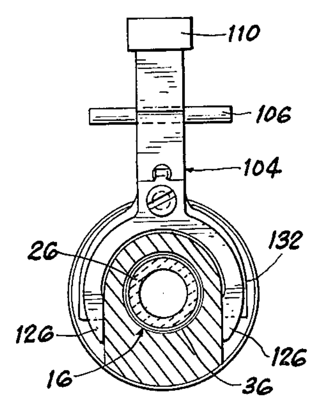
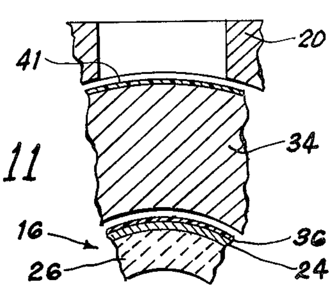


FIG. 10

FIG. 11



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United States Patent Office 3,204,208
Patented Aug. 31, 1965

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TUNER DRIVING MECHANISM

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Filed Oct. 12, 1961, Ser. No. 144,638
3 Claims. (Cl. 334—73)

This invention relates to a driving mechanism which is particularly applicable to tuners for use in radio, television or other similar apparatus.

One object of the present invention is to provide a new and improved tuner drive which will operate a plurality of tuning elements, while virtually eliminating all backlash, binding, play, and other mechanical defects.

Another object is to provide a new and improved tuner drive which may be reset to a predetermined position with a high degree of precision.

A further object is to provide a new and improved tuner drive having means for driving a plurality of tuning sleeves or other similar elements, together with means whereby the tuning of each sleeve may be tracked accurately to a predetermined tuning curve.

It is another object to provide a new and improved tuner drive of the foregoing character, in which each sleeve is driven substantially at its center of frictional resistance, so that rocking and twisting movement of the sleeve will be substantially eliminated.

A further object is to provide a new and improved tuner drive of the foregoing character in which all of the tuning sleeves are driven by means of a movable carriage which, in turn, is driven at a single point, disposed substantially at its center of frictional resistance, so that the carriage will move smoothly, with virtually no twisting or turning movement.

Another object is to provide a new and improved tuner drive of the foregoing character in which the carriage is provided with a plurality of swingable yokes, engaged with the tuning sleeves, and in which tracking movement is imparted to the yokes by means of a plurality of stationary but adjustable tracking screws or other similar elements.

Further objects and advantages of the present invention will appear from the following description, taken with the accompanying drawings, in which:

FIG. 1 is a front elevational view of a tuner having a driving mechanism to be described as an illustrative embodiment of the present invention.

FIG. 2 is a left side elevational view of the tuner.

FIG. 3 is a right side elevational view thereof.

FIG. 4 is a top view of the tuner, partly in section along a line 4—4 in FIG. 2.

FIG. 5 is a vertical section, taken generally along a line 5—5 in FIG. 4.

FIG. 6 is a top view of a carriage, forming part of the tuner, the view being partly in section along a line 6—6 in FIG. 5.

FIG. 7 is a perspective view showing a traveling nut which is one of the components of the tuner.

FIG. 8 is a longitudinal section, taken generally along a broken line 8—8 in FIG. 5.

FIG. 9 is a fragmentary section, taken generally along a line 9—9 in FIG. 5.

FIG. 10 is a fragmentary cross-sectional view, taken generally along a line 10—10 in FIG. 8.

FIG. 11 is a greatly enlarged fragmentary cross-section, taken generally along a line 11—11 in FIG. 8.

It will be seen that the drawings illustrate a three-stage tuner **10**. The illustrated tuner is intended to provide the initial stages of a superheterodyne radio receiver. However, the tuner driving mechanism of the present invention may be employed in connection with various types of tuners, for use with radio, television, or other similar apparatus.

The illustrated tuner **10** comprises two radio frequency preselector stages **12** and **12***a*, and an oscillator stage **14**. Unless otherwise specifically described, the various details of the three stages **12**, **12***a* and **14** may be regarded as being the same. Thus, for the most part, the present description will be directed to the first stage **12**, and to a lesser extent to the oscillator stage **14**.

The first tuner stage **12** comprises a coil **16** (FIG. 8) which is mounted along the axis of a cylindrical cavity or chamber **18**, formed with a conductive housing or shield **20**. A terminal lead **22** may be soldered or otherwise connected directly to one end of the coil **16**. No direct conductive connection is made to any other point on the coil **16**.

The illustrated coil **16** takes the form of a generally helical conductive ribbon **24**, supported on the outside of an insulated cylindrical form **26**. The conductive ribbon **24** may be applied to or formed on the insulated support **26** by any known or suitable circuit printing techniques. The width of the ribbon **24** may be varied along the length of the coil, to obtain a desired tuning curve.

In this case, the ends of the insulated form **26** are fitted with caps **28** which are secured to threaded plugs **30**. Bushings **32** are mounted in the ends of the cylindrical cavity **18** to receive the plugs **30**. The bushings **32** are internally threaded to mate with the external threads on the plugs **30**. With this arrangement, it is easy to make a precise adjustment of the longitudinal position of the coil **16**.

The tuning of the tuner stage **12** is adapted to be varied by means of a tuning electrode or sleeve **34** which is movable along the coil **16**, within the housing **20**. While the sleeve **34** could be in direct conductive engagement with the ribbon conductor **24** of the coil **16**, it is preferred to maintain capacitive coupling between the sleeve **34** and the coil. To this end, an insulating space or member is preferably provided between the inside of the sleeve **34** and the outside of the coil **16**. In this case, an insulating coating **36** (FIG. 11) is applied to the outside of the coil **16**. An alternative arrangement would be to apply the coating to the inside of the sleeve **34**.

As already indicated, the lead **22** serves as one terminal of the coil **16**. The movable sleeve **34** is capacitively coupled to the coil **16** and thus serves as a second, adjustable terminal.

In this case, the sleeve **34** is connected or coupled to the housing **20**. While the sleeve might be in direct conductive engagement with the inside of the housing **20**, it is preferred to maintain capacitive coupling between the sleeve and the housing. To this end, suitable means are provided to insulate the sleeve **34** from the housing **20**. In the illustrated construction, the sleeve **34** is provided with two insulating rings **38**, similar to piston rings, mounted in external grooves **40** formed in the sleeve. In addition, the sleeve may be covered with a thin insulating coating **41**. The rings **38** may be made of Teflon, or any other suitable insulating material. The rings **38** may be split so that they may readily be mounted in the groove **40**. As shown, the rings **38** project outwardly to a slight extent beyond the cylindrical outer surface of the sleeve **34**. The rings **38** are snugly received within the cylindrical bore **18** in the housing **20**. Thus, the rings **38** serve to center the sleeve **34** within the housing **20** and to maintain a slight space between the sleeve and the housing. However, the spacing is only a matter of a few thousandths of an inch, so that a substantial amount of capacitive coupling is provided between the sleeve **34** and the housing 20. Thus, the coil 16 is effectively connected between the lead 22 and the housing 20.

To provide coupling to the coil 16, the sleeve 34 is provided with a coupling coil 44 which is wound on an insulated bobbin or other support 46 secured to one end of the sleeve 34. Thus, the coil 44 is movable along the coil 16 with the sleeve 34. Connections may be made to the pick-up coil 44 by means of flexible leads 48 and 49.

It will be understood that the three tuner sections 12, 12*a* and 14 have individual tuning elements or sleeves 34. To vary the setting of the tuner 10, all three tuning sleeves 34 must be moved simultaneously along their respective coils 16. Moreover, the tuning of all three stages 12, 12*a* and 14 must be tracked to a predetermined tuning curve. In the case of the illustrated superheterodyne tuner, the stages 12, 12*a* and 14 are tracked so that the difference between the resonant frequency of the oscillator stage 14 and the resonant frequency of the radio frequency preselector stages 12 and 12*a* is maintained constant, at the desired intermediate frequency.

In the illustrated tuner 10, all three sleeves 34 are operated by means of a drive 50 (FIGS. 4 and 5). A rotatable lead screw 52 constitutes the primary or initial driving element of the drive 50. The lead screw 52 may be rotated manually, or by means of a suitable motor or other source of power (not shown). It will be seen that the lead screw 52 extends parallel to the coils 16, along which the tuning sleeves 34 are slidable.

Front and rear bearings 54 and 56 are provided to support the rotatable lead screw 52. The rear bearing 56 is arranged to take up any end play that might otherwise exist in the mounting of the lead screw. Thus, the rear bearing 56 comprises a rotatable shaft 58 which extends into an axial bore 60 formed in the lead screw 52. A ball 62 is disposed in the bore 60 and is biased against the pin 58 by means of a spring 64 which is compressed between the ball and the end of the bore 60. The spring 64 urges the lead screw 52 longitudinally to the right, as seen in FIG. 4, so as to take up any end play.

The lead screw 52 is adapted to operate a traveling nut 66 which is threaded onto the lead screw. The nut 66, in turn, operates a slidable carriage 68. Means are provided on the carriage 68 to move the three tuning sleeves 34.

The carriage 68 is guided for linear sliding movement by means of a stationary, upwardly projecting V-shaped way or block 70. The carriage 68 is fitted with a guide plate or block 72 which is formed with a V-shaped groove 74 adapted to engage the V-block 70. To minimize friction, the V-block 70 may be chromium plated, while the guide member 72 may be made of bronze. The V-block 70 is disposed adjacent the oscillator stage 14 so that the tuning of the oscillator will be controlled with a high degree of precision. The V-block 70 extends parallel to the coils 16 on which the tuning sleeves 34 are slidable.

At the opposite side of the carriage 68, adjacent the initial stage 12, the carriage is guided by a flat, stationary, upwardly facing surface or way 76. A downwardly facing guide plate or block 78 is mounted on the carriage 68 to engage and slide along the flat surface 76. To minimize friction, the surface 76 may be chromium plated, while the block 78 may be made of bronze. The combination of the V-guide 70 and the flat guide 76 enables the carriage to be moved freely and easily without any tendency to bind upon its supporting surfaces.

The traveling nut 60 has an elongated laterally extending arm 80 which engages the upper side of the carriage 68, on the side thereof adjacent the block 78. The arm 80 engages the carriage 68 at a point which overlies the block 78.

At the opposite side of the carriage 68, two springs 82 are compressed between the carriage 68 and adjusting screws 84 mounted on the traveling nut 60. The springs 82 extend generally in a vertical direction between the traveling nut 60 and the carriage 68 and are compressed to a sufficient extent to press the carriage 68 downwardly against the guides 70 and 76. At the same time, the springs 82 press the nut 60 upwardly against the lead screw 52. The action of the springs 82 causes downward pressure between the arm 80 and the carriage 68. It will be seen that the nut 60 is formed with two short, laterally extending arms 86 to support the screws 84.

The traveling nut 60 is arranged to drive the carriage 68 at a single point, substantially at the center of resistance of the carriage. This arrangement eliminates any binding between the nut and the carriage, and virtually eliminates any tendency for the carriage to rock or turn. The connection between the nut 60 and the carriage 68 is formed by a tongue or lug 88, which projects downwardly from the nut 60. It will be seen that the lug 88 extends into a groove or recess 90 formed in the upper side of the carriage 68. A ball 92 (FIG. 6) is disposed between one side of the recess 90 and the adjacent side of the lug 88. It will be seen from FIG. 6 that the ball 92 is set into a socket 94 formed in one side of the recess 90. The other side of the lug 88 is engaged by a pin 96 which is slidably mounted in the carriage 68. A spring 98 biases the pin 96 against the lug 88. It will be seen that the spring 98 is compressed between the pin 96 and an adjusting screw 100, threaded into the carriage 68. The spring-pressed pin 96 eliminates any play or backlash between the nut 60 and the carriage 68. The pin 96 and the ball 92 are aligned with each other and are disposed substantially at the center of resistance of the carriage 68. It will be noted that the center of resistance is closer to the V-guide 70 than to the flat guide 76, because the friction between the carriage and the V-guide 70 is greater than the friction between the carriage and the flat guide 76. The single point drive provided by the ball 92 and the pin 96 virtually eliminates the transmission of twisting or turning moments between the nut 60 and the carriage 68.

As shown to advantage in FIGS. 5 and 8, the tuning sleeve 34 of the tuner stage 12 is engaged by a yoke 104 which is pivotally mounted on the carriage 68. This is also true as to the second tuner stage 12*a*. In the case of the oscillator stage 14, the tuning sleeve 34 is engaged by a yoke 104*b* which is rigidly secured to the carriage 68.

It will be seen that the yoke 104 is fitted with a pivot pin 106 which is seated in a bearing groove 108 formed in the carriage 68. Thus, the yoke 104 is swingably mounted on the carriage 68. To move the yoke 104, a generally horizontal arm 110 is secured to the upper end of the yoke and is fitted with a cam follower roller 112. As shown to advantage in FIG. 8, the roller 112 is adapted to engage a series of stationary but adjustable cams in the form of adjustable tracking screws 114 threaded through a stationary bar 116. Any desired number of the tracking screws 114 may be provided, in accordance with the desired number of tracking points. The arm 110 is biased upwardly by means of a spring 118 which is compressed between the arm and the carriage 68. Thus, the spring 118 presses the roller 112 against the tracking screws 114.

It will be seen that the yoke 104 extends downwardly through a slot 120 formed in the carriage 68. The pivot pin 106 is retained in the bearing groove 108 by means of retainer plates 122 mounted on the carriage 68. Each of the retainer plates 122 is formed with a downwardly facing V-shaped groove 124 for engaging the upper side portion of the pivot pin 106.

At its lower end, the yoke 104 has two arms 126 which straddle the tuning sleeve 34 and are received in lateral grooves 128 formed in the tuning sleeve. As shown to advantage in FIG. 8, each of the grooves 128 is generally in the shape of an hour glass. Thus, the opposite sides of the groove 128 are formed with opposed rocker portions 130 which are aligned with the center line of the tuning sleeve 34. It will be seen that the right-hand rocker portion **130** engages the corresponding yoke arm **126** along a single line of contact. The left-hand rocker portion **130** engages a biasing spring **132** which is mounted on the yoke **104**. As illustrated, the spring **132** is of the leaf type. The spring **132** presses against the left-hand rocker **130** and causes the right-hand rocker to press against the yoke **104**. It will be noted that the spring **132** takes up any slack or backlash between the yoke **104** and the tuning sleeve **34**. It will be apparent that the yoke **104** acts upon the sleeve **34** substantially at its center of frictional resistance, so that the action of the yoke imparts virtually no turning or twisting movement to the sleeve **34**.

In the case of the tuning sleeve **34*b*** for the oscillator stage **16**, an annular groove **128*b*** (FIG. 9) is provided to receive the yoke **104*b***. The yoke arms **126*b*** engage one side of the groove **128*b***, while the yoke-biasing spring **132*b*** engages the other side of the groove. The groove **128*b***, in this case, may have flat radial sides, because the yoke **104*b*** is rigidly secured to the carriage **68**, so that no provision need be made for accommodating the rocking movement of the yoke.

As the carriage **68** is moved along the guides **70** and **76**, the roller **112** travels along the lower ends of the tracking screws **114**. The yokes **104** cause the tuning sleeves **34** to move along with the carriage **68**. If the tracking screws **114** are adjusted to a single horizontal plane, there is very little movement of the arm **110** and the yoke **104** relative to the carriage **68**. If the lower ends of the screws are adjusted to different positions, the roller **112** moves up and down as it travels along the screws. This causes the yoke **104** to swing back and forth relative to the carriage **68**. In this way, the exact position of each tuning sleeve **34** may be varied at any point along the tuning curve corresponding to the position of any of the tracking screws **114**. Thus, the tuning curve of the tuner stages **12** may be varied. A separate set of tracking screws **114** is provided to vary the tuning curve of the second stage **12*a***. Thus, both initial stages **12** and **12*a*** may be tracked to the oscillator stage **14**. In this case, the tracking mechanism is omitted from the oscillator stage in order to achieve the highest degree of precision in the operation of the oscillator. However, the oscillator could be provided with a similar tracking mechanism to track the oscillator stage to a tuning dial or the like.

The illustrated driving mechanism provides a considerable range of tracking adjustment. It is an easy matter to make the necessary tracking adjustments, simply by adjusting the positions of the screws **114**.

Various modifications, alternative constructions and equivalents may be employed without departing from the true spirit and scope of the invention, as exemplified in the foregoing description and defined in the following claims.

We claim:

1. In a tuner, the combination comprising a coil, a tuning sleeve movable along said coil, a carriage movable parallel to the path of movement of said tuning sleeve, a V-guide and a flat guide for guiding said carriage, said carriage having complementary elements slidably engaging said V-guide and said flat guide, a rotatable lead screw disposed generally parallel to the path of movement of said carriage, a nut having a threaded hole threaded onto said lead screw, spring means acting between said nut and said carriage and pressing said carriage against said V-guide and said flat guide, a lug on said nut and engaging said carriage at the center of resistance between said flat guide and said V-guide, said carriage having thrust bearing elements engaging said lug, spring means biasing at least one of said thrust bearing elements against said lug, said

tuning sleave having grooves formed in side portions thereof, each of said grooves having oppositely facing rocker portions, a yoke received in said grooves and pivotally mounted on said carriage, said yoke engaging one of said rocker portions of each groove, a spring on said yoke engaging the other of said rocker portions of each groove, said yoke constituting the sole connection between said tuning sleeve and said carriage, an arm connected to said yoke, a cam follower roller mounted on said arm, and a plurality of adjustable camming screws disposed along the path of movement of said carriage and engageable successively with said roller for making minor adjustments in the position of said tuning sleeve at various positions of said carriage, said carriage having spring means thereon for biasing said roller against said screws.

2. In a tuner, the combination comprising a movable tuning element, a movable carriage having means thereon engaging said tuning element for propelling it along its path of movement, a V-guide and a flat guide for guiding said carriage, said carriage having elements slidably engaging said V-guide and said flat guide, a lead screw extending generally parallel to the path of movement of said carriage, a traveling nut having a threaded bore therein screwed onto said lead screw, a thrust member on said nut and engaging said carriage between said V-guide and said flat guide, said nut having first and second oppositely extending lateral arms, said first arm engaging said carriage, and spring means acting between said second arm and said carriage for biasing said carriage and urging said second arm and said carriage away from each other against said guides while biasing said nut against said lead screw, said spring means biasing said first arm against said carriage, said spring means and said arms preventing rotation of said nut on said screw.

3. In a tuner, the combination comprising a movable tuning element, a movable carriage having means thereon engaging said tuning element for propelling it along its path of movement, guide means guiding said carriage along a path parallel to the path of said tuning element, a lead screw extending generally parallel to the path of movement of said carriage, a traveling nut having a threaded bore therein screwed onto said lead screw, said nut and said carriage having interengaging thrust members thereon for transmitting thrust therebetween, said nut having first and second oppositely extending lateral arms, and spring means acting between said second arm and said carriage and urging said second arm and said carriage away from each other for biasing said first arm against said carriage while biasing said nut against said lead screw, said spring means biasing said carriage against said guide means, said spring means and said arms preventing rotation of said nut on said screw.

References Cited by the Examiner

UNITED STATES PATENTS

1,879,294	9/32	Jones et al.	74—568
2,163,644	6/39	Ware	334—72 XR
2,669,699	2/54	Shapiro	74—568
2,674,706	4/54	Koosp et al.	74—424.8 XR
2,999,156	9/61	Mason et al.	334—73
3,020,500	2/62	Beiser	333—97
3,026,624	3/62	Clay	33—191

OTHER REFERENCES

Strong: Procedures in Experimental Physics, Prentice-Hall, Inc., New York, copyright 1946, pages 588 and 589 relied on.

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