Sept. 13, 1938. A. W. PLENSLER 2,130,153

TUNING DEVICE FOR RADIO RECEIVERS

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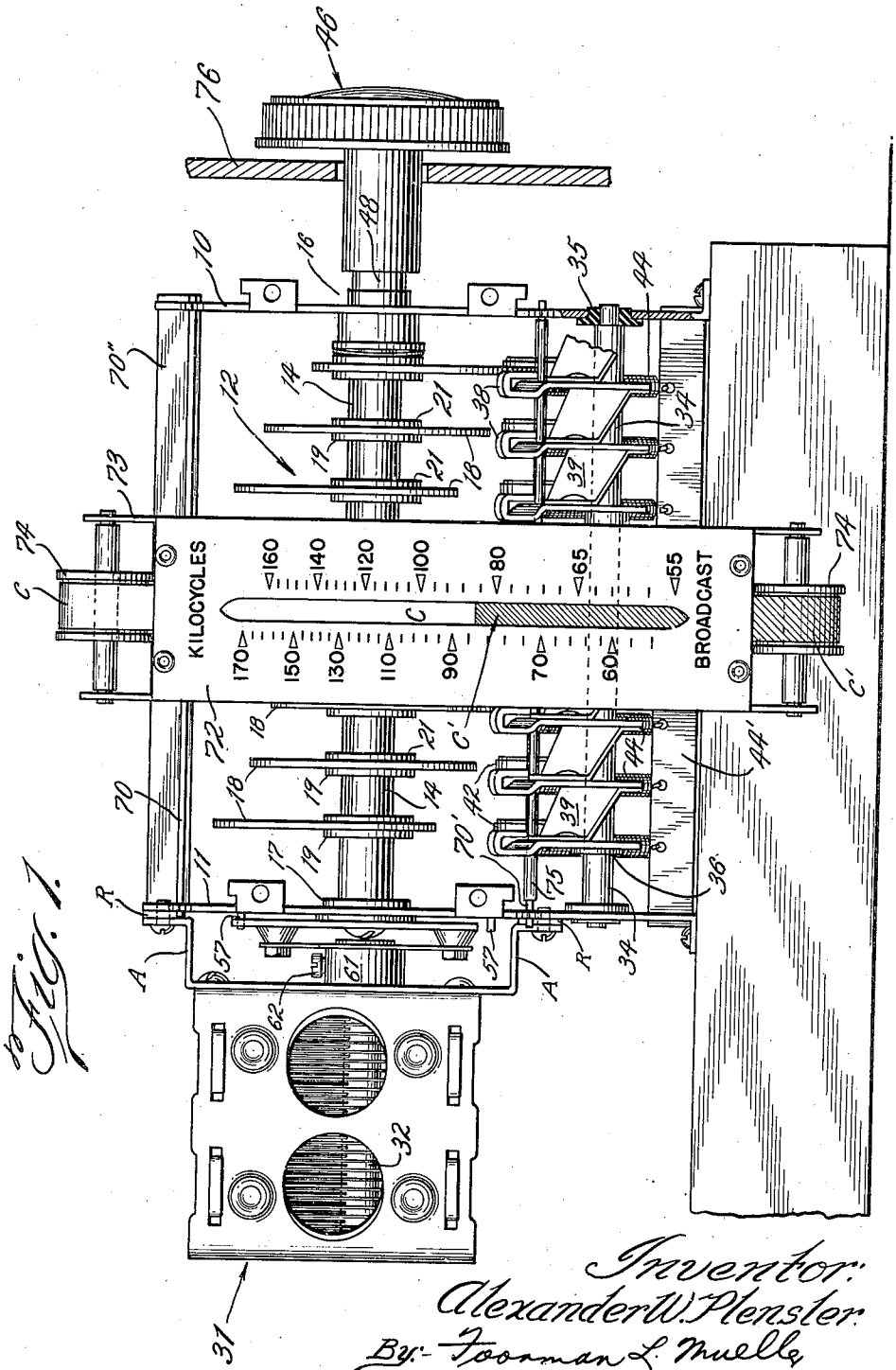

Fig. 1.

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Fig. 2.

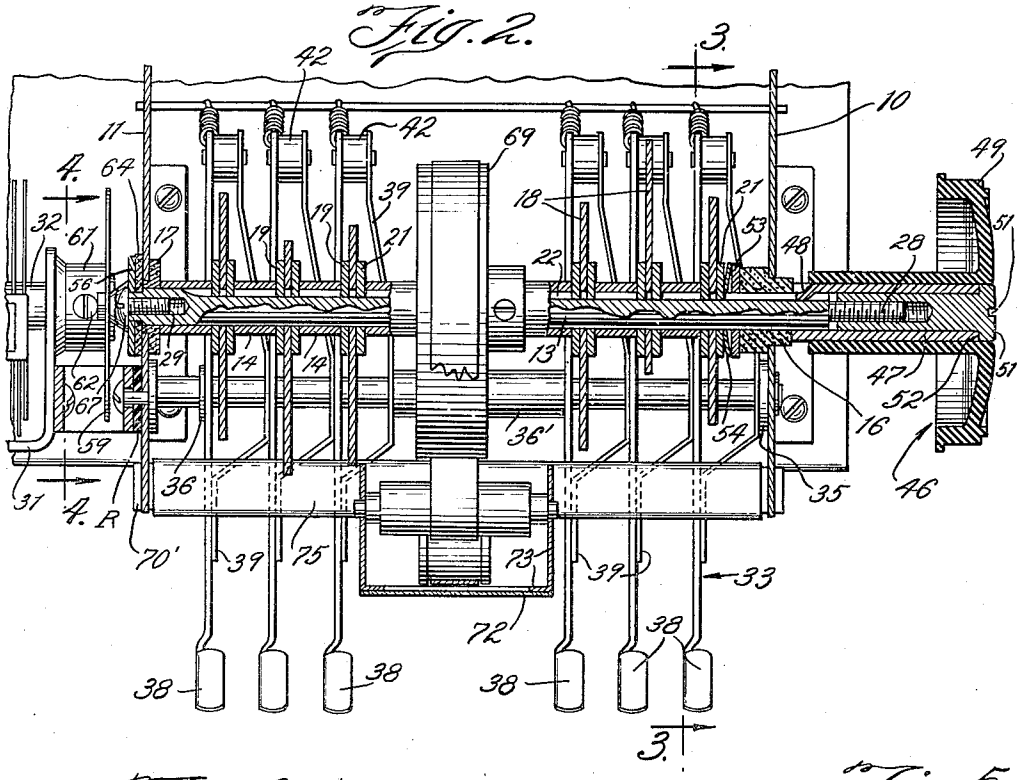


Fig. 3.

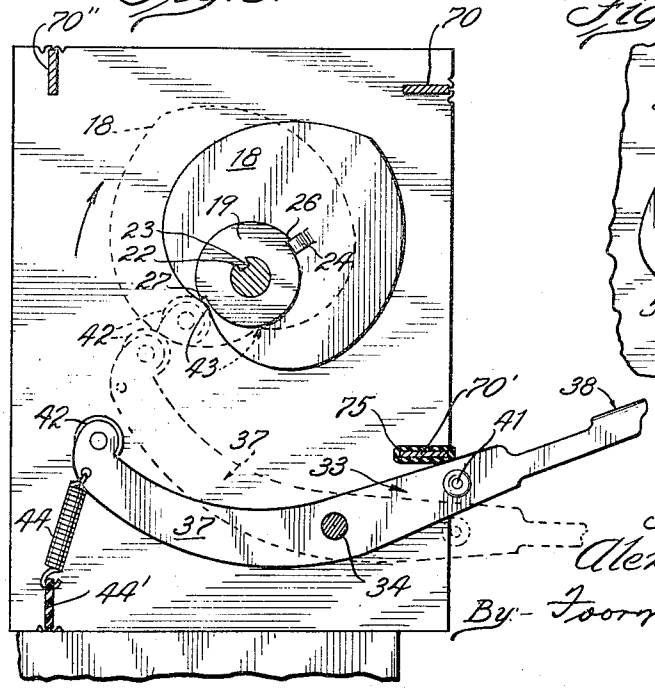


Fig. 4.

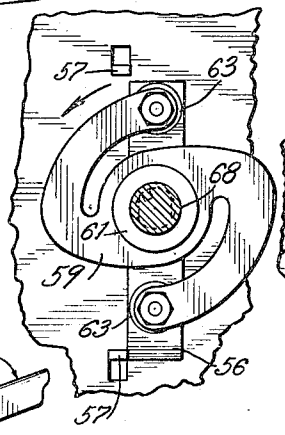
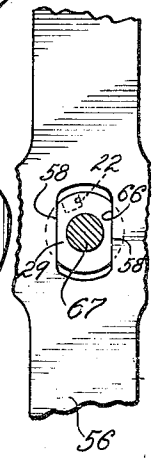


Fig. 5.



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TUNING DEVICE FOR RADIO RECEIVERS

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Fig. 6.

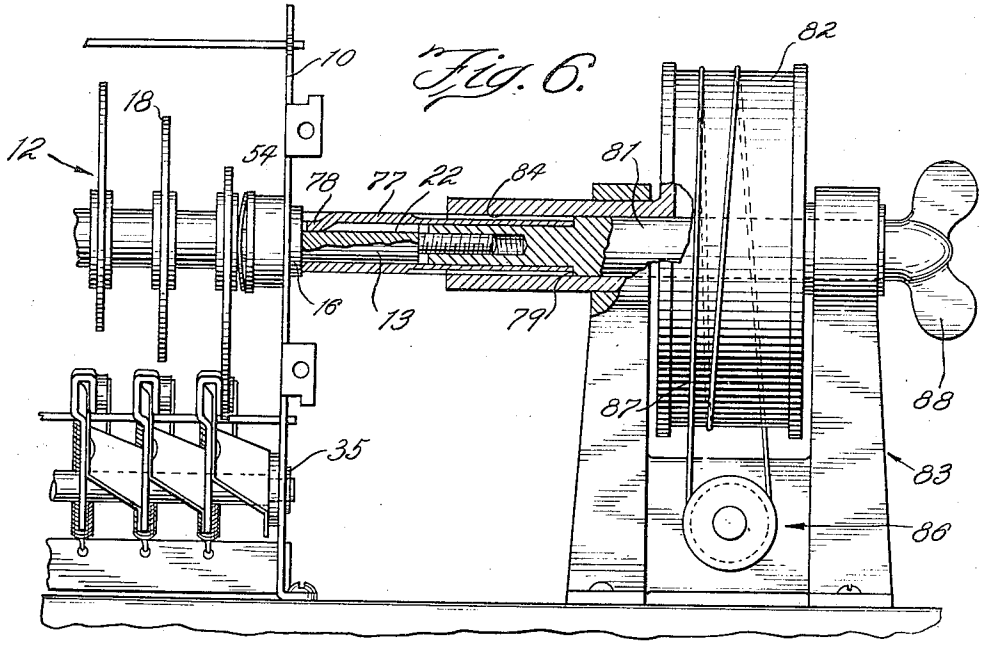

Fig. 7.

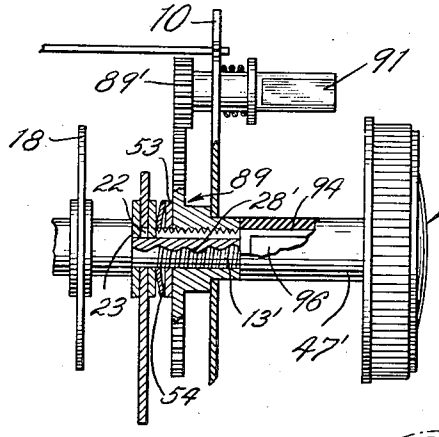

Fig. 8.

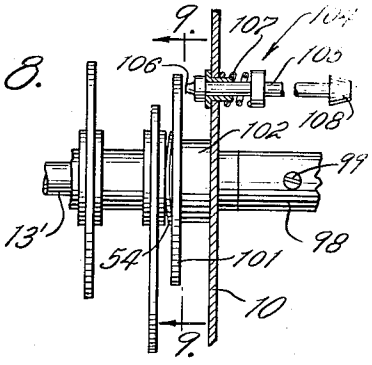

Fig. 9.

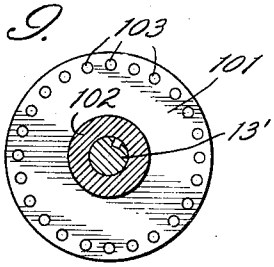

Fig. 10.

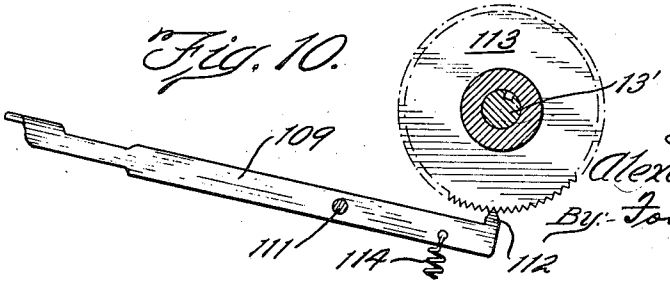

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Fig. 12.

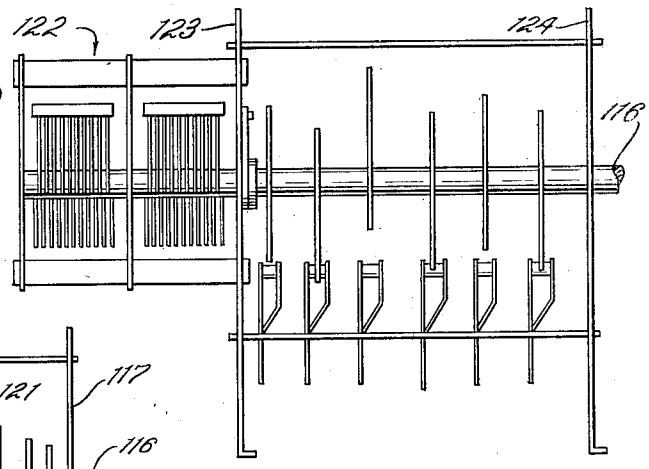

Fig. 11.

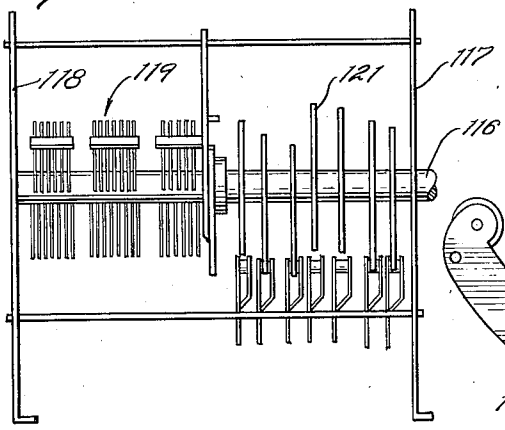

Fig. 14.

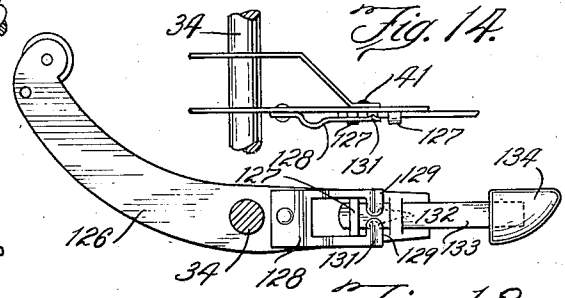

Fig. 13.

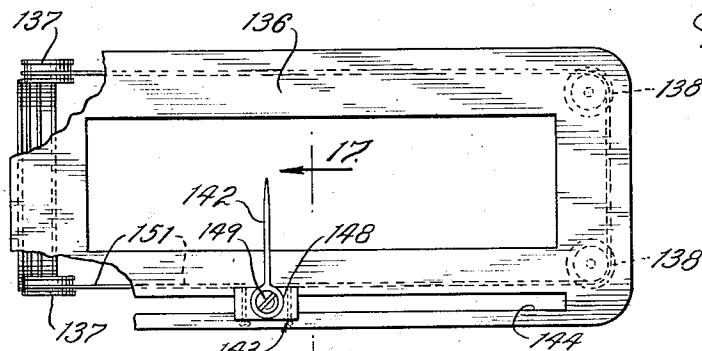

Fig. 17.

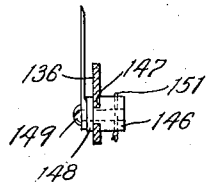

Fig. 15.

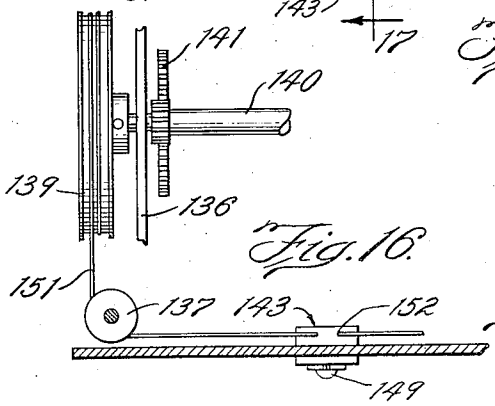

Fig. 16.

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UNITED STATES PATENT OFFICE

2,130,153

TUNING DEVICE FOR RADIO RECEIVERS

Alexander W. Plensler, Chicago, Ill., assignor to Belmont Radio Corporation, a corporation of Illinois

Application October 20, 1937, Serial No. 170,070

17 Claims. (Cl. 74—10)

My invention relates in general to so-called automatic tuning devices for radio receivers and particularly to a mechanically operated device for connection with the tuning mechanism for a radio receiver to accomplish rapid tuning of the receiver to a predetermined broadcast station.

Mechanical tuning of a radio receiver to a predetermined station setting has been accomplished in the prior art by means of a rotatable cam and movable lever structure, but there have been certain disadvantages to the structure heretofore employed which have prevented or at least handicapped the commercial exploitation of such devices. These disadvantages were primarily related to unsatisfactory structure for securing a cam to its corresponding shaft, yet permitting rotation thereon for original setting or resetting of said cam to a desired tuning position, and further were related to the complexity and relatively high costs for the structure without producing comparable operating advantages.

It is an object of the present invention to provide an improved automatic tuning device for a radio receiver.

A still further object is to provide a simplified, mechanically operated tuning device which will operate smoothly and efficiently, yet of such simple construction that it may be produced at a very low cost for use with any radio receiver, and particularly the inexpensive table models or so-called midget radio receivers.

One of the features of my invention is the provision of locking means for the rotatable cams on their corresponding shaft to positively prevent movement of the cam with respect to the shaft during the tuning operation so that after the cam is once positioned on the shaft for a desired station setting, such position will be retained during subsequent tuning operations. These tuning operations are, in effect, somewhat violent, by virtue of the fact that the operator in pressing the operating lever for the cam downwardly will apply a substantial force against the cam surface.

A still further feature of my invention is the provision of novel and simple means for varying the locking pressure on the individual cams so as to permit the setting or angular positioning of such cam with respect to the shaft to provide a desired predetermined station setting for the tuning device. With respect to this locking pressure, there is sufficient frictional pressure on each cam even when ready for resetting, so that all cams may be reset individually while the locking pressure is off, and then retain the set position until all others are similarly acted upon, after which the locking pressure may be applied to all cams simultaneously with a single operation.

A further feature of my invention is the provision of coupling means between the tuning condenser and cam shaft to prevent misalignment of the condenser elements and to prevent undesirable microphonics to arise as between the condenser and automatic tuning device.

In practicing my invention I may also provide the tuning cams, and tuning condenser rotors on the same shaft, eliminating the necessity for coupling a cam shaft to a tuning shaft and thus simplifying the complete assembly.

In the commercial embodiments of my invention I also provide various stopping means to limit the movement of the cam on its carrying shaft to substantially 180° or the degree of rotation of the variable condenser for the radio receiver. I also provide stopping means acting upon the rotatable carrying shaft mechanism for my tuning device to cooperate with the normal stopping means on the variable condenser for the receiver to reduce jarring and consequently the possibility of misalignment of the variable condenser elements to a minimum.

Other objects and features of my invention will be apparent in the following description taken with the drawings, of which:

Fig. 1 is a front elevation of the complete automatic tuning device of my invention.

Fig. 2 is a top plan view, partly in section, of the tuning device of a portion of the variable condenser shown in Fig. 1.

Fig. 3 is a detailed sectional view along the line 3—3 of Fig. 2.

Fig. 4 is a detailed view, partly in section, of the coupling mechanism between the rotatable cam shaft and the variable condenser for the radio receiver.

Fig. 5 is an enlarged view of a portion of the coupling mechanism.

Fig. 6 is a fragmentary view, partly in section, of a modification of the manual tuning structure, and friction tensioning means for the tuning cams.

Fig. 7 is a fragmentary view, partly in section, of a further modification of the tuning and tensioning means.

Fig. 8 is a front elevation of a modification of the friction pressure adjusting means.

Fig. 9 is a side elevation of an element thereof.

Fig. 10 illustrates a still further modification of the friction adjusting means.

Fig. 11 illustrates a modification of the tuner and condenser structure in which a common shaft is provided for both members.

Fig. 12 is a modification of the structure of Fig. 11.

Fig. 13 is a modification of the selector lever structure of Fig. 1.

Fig. 14 is a fragmentary top plan view of the selector lever.

Fig. 15 is a modification of the indicator structure of Fig. 1.

Fig. 16 is a fragmentary plan view of the indicator of Fig. 15; and

Fig. 17 is a fragmentary sectional view of the pointer unit for this indicator.

Referring to Fig. 1, my tuning device is illustrated with a frame comprising a pair of side members 10 and 11 for rotatably supporting a cam shaft structure 12 including a central shaft 13 (Fig. 2) with a plurality of independent sleeves 14 surrounding the shaft. A bushing 16 slidable with respect to said shaft supports the same in the frame member 10, while a corresponding bushing 17 supports the shaft 13 in the opposite frame member 11. A plurality of cams 18 are supported on the shaft and spaced apart by means of a spacing sleeve or collar 14, and washers 19 and 21, with said washers positioned on the left-hand and the right-hand side, respectively of each cam as viewed in Figs. 1 and 2. A detail of this cam assembly on the shaft is shown in Fig. 3, illustrating the key way 22 in the shaft for receiving the key lug 23 on the washer 19 to prevent the rotation of the washer on said shaft. The cam 18 will rotate on the shaft when the friction pressure is reduced as will be hereinafter explained, but this rotary movement is limited to substantially 180° by means of the integral stop lug 24 on the cam, engaging shoulder 26 or 27 on the washer 19, the particular shoulder engaged depending on the angular position of the cam with respect to the shaft 13. Washer 21 may be identical with washer 19 and non-rotatable on the shaft 13, but a stop lug is provided on only one side of the cam 18. The key way 22 is shown in Fig. 2 of the drawings, and extends from the threaded end portion 28 of the shaft substantially to the opposite condenser coupling end 29.

The tuning of the radio receiver to a particular broadcast station is accomplished by moving the rotors of the tuning condenser 31 secured to a shaft 32 to a particular position with respect to the condenser stators to provide a particular capacity therebetween. The rotary movement of the rotors is limited to 180°, and suitable stops are provided on the condenser structure. By virtue of the lug 24 on a cam 18, and the shoulders 26 and 27 on a fixed washer 19, the movement of each cam is limited to the same 180° arc travelled by the rotors of the variable condenser 31. To provide a predetermined station setting within this path a cam 18 is set to an angular position with respect to the shaft 13 corresponding to the position of the rotors of the variable condenser 31 for that station. So far as the positioning of a cam on a shaft to correspond with the tuning condenser is concerned, this has been previously accomplished in the art. However, locking the cams in the desired position and then resetting those cams for a predetermined station setting is accomplished in the present invention by much more positive yet simpler means than anything provided in the prior art.

The cams frictionally retained against rotary movement on the shaft 13 when in operating position, are selectively moved to provide a predetermined station setting for the variable condenser by means of selector levers 33 pivoted on a fixed rod or shaft 34 secured in the frame plates 10 and 11. The selector levers act as their own spacers, but are retained on a limited length of the rod as shown by means of split locking washers 36 pressed into corresponding grooves at that point in the rod. A sleeve 36' separates the two groups of levers at the dial portion of the assembly. Bushings 35 of insulating material support the shaft 34 at each end in the frame members to electrically insulate said shaft from said frame members. Each selector lever comprises a one-piece key and lever member 37 having a finger portion 38 formed at one end, and apertured intermediate the ends to fit over the rod 34. The member 37 is reinforced and supported against undesirable play on the shaft by means of a lever frame bar 39 riveted or otherwise secured to the lever member 37 at 41 and extending rearwardly in an offset position substantially parallel to the member 37 to cooperate therewith at its outer end in carrying a rotatably mounted roller 42. The two members 37 and 39 act as their own spacers on the rod. Pivoted about the rod 34 as a center, the selector lever 33 is depressed until it engages the cam surface as shown in the first dotted position in the illustration of Fig. 3 when it causes the cam 18 itself to move by virtue of the rounded surface of its edge until the roller is in the depression 43 formed by the two halves of the substantially heart-shaped cam. This position of the cam is shown in full lines in Fig. 3 and the corresponding position of the roller 42 is shown in the upper dotted line position. After the lever has been depressed to rotate the cam to this position, the spring 44 fastened to an insulating strip 44' acts to pull it back to the normal non-operating position shown in Fig. 1. As is apparent, in Fig. 3 one side of the cam from tip to depression 43 is longer than the other side, and the tip is off-center with respect to the aperture for the shaft 13. The cam and lever structure described above compensates for any wear on any of the engaging portions of the complete assembly and the roller 42 always seats in the depression 43 so that the latter is always in the same angular position and consequently the same station will always be tuned in for a particular setting of a cam. The angular position of the condenser rotors of course corresponds to the position of the cam in the set position described.

The frictional pressure or tension on the cams 18 is adjusted by structure as shown in one embodiment in Fig. 2, which includes a knob unit 46 comprising an inner sleeve 47 having an integral downwardly extending lug 48 for fitting in the key-way 22 of the shaft 13 as heretofore described. A knob 49 molded or provided in other material and rigidly secured to the sleeve 47, is left open at the end to receive a cap screw 51 which fits into the sleeve 47 and is apertured and tapped at one end to screw onto the corresponding thread section 28 of the shaft 13. It is noted in Fig. 2 that shoulders 52 are provided on the under side of the head of the cap screw 51 to bear against the end of the sleeve 47 which sleeve at its other end presses against the bushing 16 slidably carried on the shaft 13. The bushing 16, in turn bears against a washer 53, which with

the washer 21 carries therebetween a spring washer 54 bowed over its body portion as shown clearly in Fig. 2. In the position of these members as illustrated in Fig. 2, the screw 51 has been turned outwardly enough to reduce the tension in the spring washer 54, to in turn reduce the friction tension on the individual cam-washer-and-collar units over the length of the shaft 13 so that such shaft 13 may be moved relative to the cam 18. Such movement of the shaft 13 is accomplished while holding a cam 18 in fixed position by means of a roller 42 on the lever 33 engaging the depression 43. This holding position is illustrated in the full-line position of the cam 18 in Fig. 3, and the uppermost dotted line position of the roller 42. Meanwhile the tuning knob 49 is rotated to rotate the shaft 13 and in turn the shaft 32 coupled thereto, of the condenser 31. Even in the position of Fig. 2 the spring washer 54 exerts sufficient force on the movable assembly on the shaft to provide such frictional engagement on the cams as to keep them from rotating freely. As a result each cam may be reset while the locking pressure is off, and then with them all in the desired positions the locking pressure is applied in a single operation as will be explained.

After a particular setting of the cam 18 is accomplished, the screw 51 is tightened on the threaded portion 28 to pull the threaded portion 29 into the threaded cavity of the cap screw 51, and thereby cause the collar 47 on the tuning knob to press against the bushing 16 which in turn presses the washer 53 against the spring washer 54 to gradually flatten the same against the washer 21 and thus increase the friction pressure between each member of the complete assembly. This causes sufficient frictional pressure between the washers 19 and 21 and the adjacent surfaces of the cam 18 to securely lock the cam 18 against rotation with respect to the shaft 13. The slot 51' in the head of the cap screw is of such size that it will accommodate a relatively thin coin for turning the same so that no screwdriver is required.

In order to prevent rotation of the shaft 13 as the screw 51 is being threaded onto the section 28, the shaft is turned by means of the turning knob 49 until a stop bar 56 keyed to the flattened portion 29 of the shaft 13 engages a lug 57 punched out of the end wall 11 of the tuner frame. Inasmuch as the bar is keyed to the shaft, this engagement prevents further rotation of the shaft. The stop bar 56 is an element in the coupling structure between the shaft 32 of the tuning condenser and the shaft 13 of the automatic tuning device. As shown in the enlarged illustration of Fig. 5, the end portion 29 of the shaft 13 is flattened on each side at 58. These flattened sides correspond in angular position to the key-way 22 in such a manner that all of the elements making up the tensioning and locking means for the tuner can be aligned in the original assembly thereof to permit a rapid alignment with the rotor sections of the tuning condenser 31. In this manner the arcuate path of 180° for the tuning condenser and the cams on the tuner will exactly correspond when the device is in operation. This will be more readily apparent in the following description.

In the structure of Figs. 1 to 5 particularly an indirect coupling between the shaft 32 and shaft 13 is provided. This is accomplished by a spring spider 59 rigidly secured to a bushing 61 which may be slipped over the end of the shaft 32 and secured thereto by the set screw 62. The spring spider 59 in turn is mounted on a pair of bosses 63 formed in the bar 56 in the original stamping thereof. In the original assembly of the tuner and after the shaft 13 with the cam units and cooperating mechanism thereon is mounted in the frame members 10 and 11, the shaft 13 may be pushed in a left-hand direction as viewed in Fig. 2 to cause the flattened portions 58 to extend through the end member 11. A fibre washer 62 is slipped over the end of the shaft to lay against the outside surface of the wall 11 and the spider collar and stop bar assembly is then slipped over the end of the shaft with the flattened sides 66 of the slot or aperture in the stop bar 56 snugly engaging the flattened portions 58 of the shaft 13 to cause the stop bar to be keyed thereon in the position shown in Figs. 4 and 5. This assembly is then rigidly secured on the end of the shaft by means of a screw 67 fitting in a threaded cavity in the end portion 29 of the shaft 13 and accessible through the opening 68 of the collar 61. With this assembly completed, the shaft 13 is then turned until the stop bar 56 butts a lug 57 as shown in Fig. 4. This, of course, represents one of the extreme positions in the 180° arc travelled by rotors of the condenser 31 and the shaft 13. In originally setting or resetting a cam 18, the cam, as stated above, remains stationary while the shaft 13 is rotated by the knob 49. Because of the lug 24 on the cam 18 and the abutting shoulder 26 limiting rotation of the shaft, such shaft must be turned in a counter-clockwise direction as viewed in Figs. 3 and 4, and this, of course, is also true because of the fact that the stop bar 56 abuts the lower lug or projection 57. With the condenser 31 mounted in the position on the end of the tuner frame shown in Fig. 1, the rotors of such condenser will be entirely fitted into the stators thereof at maximum capacity position when the cam and coupling structure is in the position shown in Figs. 3 and 4. Therefore, rotating the shaft 13 in a counter-clockwise direction by means of the tuning knob 49 will move the rotors of the condenser outwardly to the position of minimum capacity 180° from the initial position. This operation is utilized in coupling the condenser shaft to the shaft 13 by means of the collar 61, inasmuch as alignment between the tuner and condenser may be accomplished with each at one of the extreme positions on the 180° arc. After the set screw 62 is turned tightly against the shaft 32 to secure the coupling device onto said shaft, the mounting arms A on the condenser frame are secured by means of screws or the like to a rubber mounting member or grommet R on the end member 11 of the tuning frame to cushion the condenser with respect to the tuning device.

Tuning indication is provided in a dial assembly including a drum 69 on the bushing 71 which in turn is secured to a movable sleeve on the shaft 13 as heretofore described. The dial scale is printed on a plate or the like 72 transparent at the figures themselves to transmit light from dial light to the rear thereof. The plate 72 is secured on a box-like frame 73 which in turn is supported on the bars 70 and 70', and then the edge of the frame adjacent the slots is peened to spread the frame and rigidly secure the bar in the frame. This same securing means is employed for fastening the bars 70 and 70', as well as the bar 70'', onto the frame members 10 and 11, and is illustrated particularly in Fig. 3. The bar 70' is covered, over the greater portion of its length, by a rubber covering 75 as shown in Fig. 3, to cushion the bar and prevent jarring from the levers 33 when they are pulled against the same by the spring 44. The

covering 75 also insulates the bar. To indicate the tuned station on the scale a colored ribbon having one color at C, for instance, and another color at C', is rotated over the drum 69 and two rollers 74 at each end of the frame 73, so that the dividing line between the two colors C and C' corresponds to the tuned position of the condenser 31 and indicates such position on the dial scale on the plate 72.

The embodiment of the invention illustrated in Figs. 1 and 2 is primarily employed with a small table model or so-called midget radio receiver. The entire cabinet and receiver chassis is, of course, compact and relatively small, and the knob 49 is adapted to extend through an end wall 76 of the cabinet. No other manual tuning knob is employed for the condenser 31, and setting or resetting of the cams as well as tuning to stations other than those provided for on the automatic tuning device, is accomplished by such knob. In the case of a larger console model or the like where the large chassis and large cabinet is employed, it is not convenient from the standpoint of operation to have the manual tuning knob on the side of the cabinet nor desirable in that it necessitates an extremely long tuning shaft reaching through the side wall of the cabinet. To overcome this difficulty a modification of the invention is illustrated in Fig. 6 in which is provided a right-angled drive with the usual tuning knob at the front of the cabinet rather than on the side of the cabinet as is provided for the structure of Fig. 1. The shaft 13 in the Fig. 6 embodiment extends through the side wall 10 of the tuning device and is encircled by a collar 77 having a downwardly projecting lug 78 keyed in the key-way 22 of the shaft 13, and bearing against the bushing 16 at one end, and against the shoulder 79 of a screw 81 at the other end. A drum 82 suitably journalled in a frame 83 is splined to the collar 77 at 84. A pulley and shaft assembly 86 carries a belt or cord 87, and upon rotation of the shaft and pulley 86 by means of a knob on the front of the radio cabinet, the pulley 82 is rotated to in turn rotate the shaft 13, and consequently the condenser shaft 32 as heretofore described.

The frictional pressure on the individual cams 18 is varied in the manner substantially as previously described by turning the screw 81 to the right or left in the same manner as described with the cap screw 51. A wing nut 88 is provided on the end of the screw and is large enough to provide sufficient leverage for finger movement of said screw. In turning the cap screw, the collar 77, and consequently all of the axially movable cam unit elements on the shaft 13 in the tuning unit, are moved into tight frictional engagement with one another, and the spring washer 54 is compressed to maintain this frictional pressure as heretofore described. After the frictional pressure has been removed, the selector lever 33 may be employed to engage the depression 43 in the substantially heart-shaped cam, to hold such cam against rotation while the shaft 13 is turned by means of the tuning knob on the shaft and pulley assembly 86. The cams are reset in this manner to vary the tuning position thereof.

A still further modification of the manual tuning tensioning means for the cam units is illustrated in Fig. 7. With this structure it is possible to eliminate the internal cap screw of the structures of Figs. 1 to 6 and utilize merely a single tuning knob 46' for varying the frictional pressure on the elements on the shaft. In the position illustrated in Fig. 7, the frictional pressure on the cam units is reduced to permit resetting of a cam 18, and for the purpose of illustration, this structure and the operation thereof will be described in connection with the step of increasing the frictional pressure on the individual cams. Axial movement of the washer 53 to the left on the shaft 13', as viewed in Fig. 7, to increase the frictional pressure, is accomplished by an internally threaded gear or toothed wheel 89 threadably secured on the thread portion 28' of the shaft 13'. A pinion gear 89' is provided, having a stub shaft 90 with a flattened side or sides 91 at the end thereof. A rim or collar 92 on the shaft 90 cooperates with the wall 10 to retain a coiled spring 93 on the shaft. The spring is shown in its compressed position in Fig. 7, but when the inward pressure on the shaft 90 is removed, as will be explained, the spring presses the shaft to the right to disengage the gear 89' from the gear 89.

In the structure of Fig. 7 the knob 46' is provided with an integral or rigid collar 47' having a cavity 94 therein corresponding in shape to the end of the shaft 90 including the flattened portion 91. A corresponding flattened portion 96 is provided on the end of the tuning shaft 13' to receive the knob and hold it against rotation thereon. The internally threaded gear or toothed wheel 89 corresponds to a nut threaded on the shaft 13' and a gear rigid with respect thereto. The shaft 13' is turned by the knob 46' until the stop bar 56 (Fig. 4) on the end thereof, as heretofore described, engages a stop lug 57. This prevents further rotation of the shaft. The knob 46' is then removed from the shaft 13' and is slipped onto the end of the stub shaft 90 to push the shaft and gear 89' into the position illustrated, and then by turning the latter shaft in a direction to move the gear 89 axially to the left on the thread portion 28' of the shaft 13', the washer 53 is likewise moved to the left and the friction pressure is increased on the individual cam units over the entire length of the shaft 13'. The knob 46' may then be removed from the stub shaft 90 and placed onto the shaft 13' and again utilized for manual tuning in the manner described above.

It is understood that the modification of Fig. 7 is employed primarily on midget sets and the knob 46' is positioned on the outside of the end wall of the cabinet as described with respect to Fig. 1. It is further understood, of course, that the loosening operation for the gear 89 is just the opposite of that for increasing the frictional pressure on the slidable elements carried on the shaft 13'.

Although the adjusting means for the embodiments of my invention illustrated in Figs. 1 to 7 include removable elements such as the cap screws and knobs, the invention is successfully practiced with adjusting means for the friction pressure on the cam by structure including non-removable elements. One such embodiment, representing a modification of the previously described structure, is illustrated in Figs. 8 and 9. In the illustration of Fig. 8, a sleeve 98 for a knob member such as that shown in Figs. 1 and 7 is rigidly secured to a shaft 13' by means of a set screw 99 or the like. An apertured wheel 101 internally threaded or rigidly secured to a collar as 102 is threadably carried on the shaft 13' as heretofore described. The apertures 103 are spaced apart and provided adjacent the outer

rim of the wheel 101 to be engaged by a spring detent 104, including a movable pin 105 having a pointed end 106 and having suitable stop collars and spring collars to retain the pin in the wall 10 of the frame member for the tuner device. A coiled spring 107 on the pin 105 normally holds the same in the position shown in Fig. 8 out of engagement with the apertures 103 of the wheel 101. When it is desired to change the axial position of the wheel 101 on the shaft 13' in order to vary the frictional pressure on the cam units supported on the shaft, the shaft is first turned by means of the knob until the stop bar 56 on the end of the shaft engages a lug 57 as previously described. This stopped position for the shaft will be dependent upon whether or not it is desired to increase or decrease the frictional pressure on the cam units as has been explained. With the shaft 13' retained against rotation in one direction, the button 108 is pressed to cause the projection 106 to engage a corresponding aperture 103 in the wheel and while holding this engagement, the shaft 13' is turned in a direction away from the stop lug 57 by the tuning knob on the collar 98. This structure will permit the shaft to turn 180° and the threads on the shaft 13' and corresponding threads on the wheel unit are provided in such a manner that the 180° of movement will be sufficient to compress the spring washer 54, or permit the expansion thereof a sufficient amount to lock, or loosen, the cam units on such shaft, and in the latter case permit adjustment thereof. After the adjusting operation is completed the spring 107 will move the projection 106 out of engagement with the wheel 101.

A still further modification of the adjusting means is illustrated in Fig. 10. This includes a one-piece lever 109 pivotally secured on a pin 111, normally mounted on the wall 10 of the tuner frame. The lever 109 is provided with a dog or projection 112 for engagement with a tooth of a toothed wheel 113 similar to, or identical with, the gear 89 of Fig. 7. When it is desired to adjust the frictional pressure on the elements on the shaft 13', the shaft 13' is turned by means of a knob (not shown) rigidly secured, if desired, to the end of the shaft 13' to a stop position with the stop bar 56 engaging a lug 57. Instead of a detent such as unit 104 of Fig. 8, the lever 109 is depressed to cause the engagement of the dog 112 on a tooth at the stopped position of the wheel and the knob on the shaft 13' is then turned to move the shaft 180° as heretofore described. The spring 114 pulls the dog 112 out of engagement with the toothed wheel when the operator's finger is removed from the lever. This lever may extend out of the rear of the cabinet or could extend from the front of the cabinet in a manner to correspond with the selector levers 33.

Modifications of the cam and condenser assembly are illustrated in Figs. 11 and 12. In Fig. 11, a one-piece shaft 116 is rotatably mounted in a frame including a pair of end plates 117 and 118 corresponding in general to frame plates 10 and 11 of the structure of Fig. 1. The rotor members of the tuning condenser 119 are rigidly secured to the shaft 116 in the usual manner, and the cams 121 are supported on such shaft in the identical manner as described with respect to the structure of Fig. 1. The selector lever mechanism is likewise similar to that previously described. In fact, the illustrations of Figs. 11 and 12 are primarily schematic.

A slight modification of the one-piece rotatable shaft is illustrated in Fig. 12 with the condenser frame 122 being substantially identical with the frame of the condenser 31 except that the wall 123 of the tuning unit frame is common to the condenser frame as well as the tuning frame. The shaft 116, however, is journalled in the frame member 123 and 124 and carries both the rotors of the condenser and the cams for the tuning unit. The coupling structure shown in Figs. 2 and 4 particularly, is, of course, eliminated in the devices of Figs. 11 and 12. This structure necessitates such a correlation between the condenser unit and the tuning unit that the entire assembly is completed in a single continuous operation rather than assembling each unit independently as is the case with the preferred embodiment in Fig. 1. However, where large production is attained on one particular structure of the tuning device, it is profitable to design the tuning and condenser units for assembly on a single shaft as shown in Figs. 11 and 12 to eliminate the extra parts and labor of the coupling device in the preferred embodiment. With the variations in sizes for a number of models, as is the usual practice with radio manufacturers, the two-unit assembly of Fig. 1 is ordinarily preferred.

The usual stops are provided in the rotor and stator assembly of Figs. 11 and 12, and a stop bar performing in the same manner as bar 54 is provided on the one-piece rotatable shaft intermediate the condenser unit and the cam unit, for engagement with a lug on the wall or frame member intermediate these two units in the manner previously described.

When utilizing the tuning device of my invention with a midget set having a one-piece molded cabinet, with a decorative front wall and no supplementary escutcheon plates, the slots in the wall for receiving a finger portion as 38 would ordinarily have to be too wide to be acceptable from a decorative standpoint. In order to overcome this difficulty, a multi-part lever (Figs. 13 and 14) is provided having a stub end which may be conveniently inserted in a relatively narrow slot and having a supplementary finger portion for attachment to the main body of the selector lever. A lever member 126 similar to the lever 37 without the key portion 38, is provided with a pair of bumped out straps 127 at the forward portion thereof. A spring member 128 is riveted to the lever 126 and includes a pair of spring fingers 129 having detents 131 thereon to engage corresponding notches 132 in a removable pin 133 for insertion through the front wall of the cabinet. A molded finger portion 134 is molded directly onto the pin 133. When the pin is inserted through the straps 127, the detents 131 on the fingers 129 snap into the notches 132, and cooperate with the straps 127 to rigidly, but removably, retain the pin 133 therein.

In the event that a longitudinal rather than a vertical indicating scale is desired with the tuning structure previously described, a stamped-out frame 136 is mounted on the tuner frame, preferably to one side or the other of the selector levers. Frame 136 is adapted to support thereon a plurality of pulleys, including two longitudinally mounted pulleys 137 at one end and two vertically mounted pulleys 138 at the end end. A drive pulley 139 is secured to either the condenser shaft 32 or the cam shaft 13, and in this illustration such one or the other shaft will be designated generally by reference character 140. Any de-

sired gear reduction may be provided at 141. With the tuning scale (not shown) carried on the front of the frame 136, tuning indication is accomplished by a pointer 142 supported on a movable carriage 143, which in turn is slidable in a slot 144 in the frame member 136. The carriage is illustrated in section in Fig. 17 and includes a block 146 having shoulder portions 147 engaging one side of the frame 136. The block 146 is retained in this position by a plate 148 secured to the front of the block by a bolt or screw 149 also utilized to secure the pointer 142 to the plate 148. A cord 151 extends around the drive pulley 139 and over the two sets of pulleys 137 and 138, and each end of such cord is inserted through apertures 152 in the block 146 to be knotted at the under surface thereof and retained against removal. This is shown more particularly in Fig. 17. Upon rotary movement of the shaft 140, the carriage 143 travels longitudinally in the slot 144 with the pointer 142 indicating the changed position of the radio receiver.

From the foregoing description and the drawings it is apparent that I have provided a simple and compact tuning device, which will quickly and accurately tune the radio receiver to a desired predetermined station setting. The cams are so rigidly retained in position on the tuning shaft when they are set thereon that they will withstand any normal amount of pressure on the selector keys without varying in angular position. This makes it possible to obtain the same peak-tuning for a predetermined station upon continued operations. Yet the friction tensioning means for the cam is such that it may be very quickly and easily adjusted.

Although my invention has been described and illustrated in its preferred embodiments, it is undersood that I do not limit my invention thereby but the invention is limited only by the scope of the appended claims.

I claim:

1. Radio tuning apparatus for movement through no more than 180°, including in combination, a rotatable shaft, a pair of spaced apart parallel frame members supporting said shaft, with the latter extending through each frame member, rotating means for said shaft on one end thereof, and a stop member keyed to said shaft at the other end thereof for engagement with corresponding stops on the adjacent frame member positioned in a manner to limit the rotation of the shaft to substantially 180°, and station selecting means on said shaft intermediate the frame members.

2. Radio tuning apparatus including a rotatable shaft, a plurality of cams supported on said shaft and rotatable relative to said shaft, a plurality of washers on said shaft with at least one washer adjacent each cam and non-rotatable with respect to said shaft, and means for limiting the rotational movement of each cam with respect to said shaft, said means including a rigid stop lug on one side of each cam, with said adjacent washer having a pair of integral shoulders spaced apart circumferentially thereon for engaging said lug on said cam to limit the rotary movement of the cam to the distance between said shoulders on said washer.

3. Selector tuning mechanism for a radio receiver for mounting in a housing for the receiver, said mechanism including in combination, a rotary shaft threaded at one end, a plurality of control members on said shaft, spacing and friction means intermediate the control members and axially slidable therewith on said shaft substantially as an assembly, means at one end of the assembly for limiting axial movement of the assembly on the shaft at that end, tuning and adjusting means at the other end of the assembly directly on the threaded end of the rotary shaft and operable adjacent an end wall of the housing for varying the frictional pressure on the control members and adapted for rotation of the shaft directly at the shaft for tuning, said means including threaded means on the threaded end of the rotary shaft, and with said means movable and operatively connected with the slidable assembly to cause relative movement between the slidable assembly on the shaft and the limiting means at the one end of the assembly for applying sufficient frictional pressure on the control members in the assembly to prevent rotation of said control members with respect to the rotary shaft.

4. Selector tuning mechanism for a radio receiver having a housing including in combination, a rotary shaft threaded at one end, a plurality of control members on said shaft, axially slidable means intermediate the control members for normally frictionally retaining said members against rotation relative to said shaft, said members and said slidable means movable axially together substantially as an assembly on said shaft, means at one end of the assembly for limiting axial movement of the assembly on the shaft at that end, and tuning and friction adjusting means at the other end of the assembly directly on the threaded end of the rotary shaft including a knob on the outside of the receiver housing having a central bore and carried axially slidable on said shaft but non-rotatable thereon, a cap screw rotatable in said knob bore adjustably secured on the threaded end of the rotary shaft having an enlarged head at the outer end thereof for engagement against the knob, with said tuning and adjusting means operatively connected with said slidable assembly to cause relative movement between said assembly and said limiting means at the one end of the assembly upon rotation of said cap screw in said knob to apply frictional pressure on the control members.

5. Selector tuning mechanism for a radio receiver including in combination, a rotary shaft threaded at one end, a plurality of control members on said shaft, spacing and friction means intermediate the control members and axially slidable therewith on said shaft substantially as an assembly, means at one end of the assembly for limiting axial movement of the assembly on the shaft at that end, tuning and friction adjusting means at the other end of the assembly directly on the threaded end of the rotary shaft including a tuning and friction adjusting device having a central bore and carried axially slidable but non-rotatable on said shaft, an adjusting member within the device bore having an internally threaded cavity at one end for threaded engagement with the end of the rotary shaft and having an enlarged head at the other end engaging a corresponding shoulder on the device at the bore, with said tuning and friction adjusting means operatively connected with said slidable assembly to cause relative movement between said assembly and the limiting means at the one end of said assembly upon rotation of said adjusting member on said device to apply frictional pressure on the control members.

6. Selector tuning mechanism for a radio receiver having a housing with a front and side walls including in combination, a rotary shaft threaded at one end portion, a plurality of control members on said shaft, spacing and friction means intermediate the control members and axially slidable therewith on said shaft substantially as an assembly, means at one end of the assembly for limiting axial movement of the assembly on the shaft at that end, tuning and friction adjusting means at the other end of the assembly on the rotary shaft directly on said threaded end thereof including a tuning member for operation outside an end wall of the housing non-rotatably supported on said rotary shaft, and an adjusting unit operable outside said end wall of the housing at the tuning member having a threaded portion threadably secured on the threaded end of the rotary shaft, a relatively rigid washer and a resilient washer adjacent one another on said shaft intermediate the tuning and friction adjusting means and the slidable assembly, and with said tuning and friction adjusting means acting on said washers and slidable assembly upon rotation of said adjusting unit from the outside of the end wall of the housing to provide relative movement between the slidable assembly on the shaft and the limiting means at one end of the assembly for applying frictional pressure on the control members.

7. Selector tuning mechanism for a radio receiver having a housing including in combination, a rotary shaft threaded at one end thereof, a plurality of control members on said shaft, spacing and friction means intermediate the control members and axially slidable therewith on said shaft substantially as an assembly, means at one end of the assembly for limiting axial movement of the assembly on the shaft at that end, and tuning and friction adjusting means at the other end of the assembly directly on the threaded end, said means including an elongated member threadably secured at one end of the threaded end of the rotary shaft extending outwardly toward a side wall of the housing for adjusting the frictional pressure on the control members and adapted for direct engagement to turn the rotary shaft for tuning, structure axially slidable but non-rotatable relative to said shaft on said shaft intermediate said assembly and the elongated member acting upon said assembly upon threadable adjustment of said elongated member on said shaft to provide relative movement between said assembly and said limiting means at the one end of said assembly to apply frictional pressure on the control members.

8. Radio tuning apparatus for mounting in the housing for a radio receiver including in combination, a rotary shaft threaded at one end, a plurality of control members on said shaft, spacing and friction means intermediate the control members and axially slidable therewith on said shaft substantially as an assembly, means at one end of the assembly for limiting axial movement of the assembly on the shaft at that end, a tuning and friction adjusting unit at the other end of the assembly directly on the threaded end of the rotary shaft and operable outside an end wall of the housing for the receiver, said unit having a threaded portion on the threaded end of the shaft, axially slidable means intermediate said unit and said slidable assembly, with said unit rotatable relative to said rotary shaft at the end thereof for threaded adjustment to provide relative movement between said slidable means and said assembly acting together and said limiting means at one end of said assembly to apply frictional pressure on the control members.

9. Radio tuning apparatus for movement through no more than 180°, including in combination a rotatable shaft, a pair of spaced apart parallel frame portions supporting said shaft, station selecting means on said shaft intermediate the frame portions with said shaft extending at each end through the corresponding frame portion, rotating means for said shaft on one end thereof, outside the corresponding frame portion, and a stop bar secured to said shaft against rotation relative thereto at the other end of said shaft outside the other frame portion, stop lugs extending laterally from such other frame portion on the outside thereof and positioned in the path of movement of said stop bar in a manner to limit the degree of rotation of said bar to not more than 180°.

10. Radio tuning apparatus including a rotary shaft, a plurality of control members spaced apart on said shaft and rotatable relative to said shaft, a washer on at least one side of each control member, non-rotatable relative to said shaft, means for maintaining each of said washers substantially in abutting relationship to the corresponding side of said control member, and means for limiting the rotational movement of each control member relative to said shaft, said means including a rigid lateral projection on the side of each control member with the corresponding washer for each member having a pair of integral abutments spaced apart circumferentially thereon for engaging the lateral projection on the control member to limit the relative rotary movement between the control member and the shaft to the distance between the abutments on the washer.

11. Radio tuning apparatus including a rotary tuning shaft, a plurality of control members spaced apart on said shaft for selective rotation relative to said shaft to vary the control position of each of said members, a rotational limiting member on said shaft on at least one side of each control member non-rotatable relative to said shaft, means for limiting the angular rotational movement of each control member with respect to said shaft to a degree no more than the normal tuning movement of the rotary tuning shaft, said means comprising engaging abutments on a limiting member and its corresponding control member, with a single abutment on one of said members and a pair of angularly spaced apart abutments on the other of said members, said abutments being on adjacent portions and said pair of abutments defining the limit of relative movement between said two members.

12. Radio tuning apparatus including in combination, a rotary shaft, supporting means for said shaft, a plurality of control members normally frictionally retained against rotation relative to said shaft, spacing and friction means on at least one side of each of said control members axially slidable therewith as an assembly on said shaft, friction adjusting means at one end of said shaft bearing against one end of said assembly for axially adjusted movement to vary the friction on each control member in accordance with the adjusted position of said friction adjusting means, said spacing and friction means for each control member including a washer member adjacent said control member and keyed on said shaft with means on said two members

to limit the relative rotation for one with respect to the other, said means including an abutment on one member and a pair of spaced apart abutments on the other member for engagement by the one abutment to limit the degree of rotation of said control member relative to said shaft when the friction adjusting means is in a reduced friction position.

13. Radio tuning apparatus including in combination, a rotary shaft, supporting means for said shaft, a plurality of control members normally frictionally retained against rotation relative to said shaft and each control member having a projection extending laterally from one side thereof, spacing and friction means on each side of each of said control members axially slidable therewith as an assembly on said shaft, friction adjusting means on one end of said shaft bearing against one end of said assembly for axially adjusting movement to vary the friction on each control member in accordance with the adjusted position of said friction adjusting means, said spacing and friction means including a washer against the extending projection side of each control member, each of said washers having a pair of circumferentially spaced abutments for engagement by the lateral projection of said control member to limit the degree of rotation of said control member relative to said shaft when the friction adjusting means is in a reduced friction position.

14. Radio tuning apparatus including in combination a rotary shaft, a pair of frame portions spaced apart and supporting said rotary shaft, rotating means for the shaft on one end thereof, a plurality of control members rotatable on said shaft intermediate the frame portions, means for limiting the angular rotation of said shaft to less than 360° comprising a stop bar on said shaft keyed against rotation thereon and a pair of laterally projecting abutments spaced apart on a frame portion adjacent said stop bar for limiting the movement of said stop bar and thereby limiting said shaft to angular movement corresponding to the space between said abutments, and means for limiting the angular rotation of each of said control members on said shaft to less than 360°, said latter means comprising a washer for each control member keyed against rotation on the shaft and positioned adjacent one side of the control member, with one of said elements as between a washer and a control member having an abutment thereon and the other of said elements having a pair of abutments thereon spaced apart angularly less than 360° for engagement by the single abutment to limit relative movement between the two elements.

15. Radio tuning apparatus including in combination, a rotary shaft, a frame for supporting said shaft, rotating means for said shaft at one end portion thereof, a plurality of control members on said shaft within said frame, means for limiting the angular rotation of said shaft to less than 360°, and means for limiting the angular rotation of each control member on said shaft relative to said shaft to a similar amount less than 360°, said latter means comprising a washer member for each control member keyed against rotation on the shaft and positioned adjacent one side of the control member, with one of said two members having a pair of abutments spaced apart less than 360° corresponding to the limitation of movement of said shaft and the other of said two members having a single abutment thereon for engagement with the pair of abutments and for angular movement within the limits of the corresponding distance between said pair of abutments whereby to maintain each of said control members in an angular position within the limits of angular movement of said shaft.

16. Radio tuning mechanism for mounting in a housing, said mechanism including in combination a rotary shaft having a threaded portion at one end, tuning control means on said shaft including a plurality of spaced apart control members for controlling the angular rotation of said shaft and spacing and friction means therefor, tuning and adjusting means at one end of the tuning control means directly on the threaded-portion end of the rotary shaft for operation at an end wall of the housing for varying the frictional pressure on the control members and for rotation of the shaft directly at said shaft for tuning purposes, said tuning and adjusting means including a finger engaging tuning member axially movable on said shaft and an adjusting member therewith having a securing portion for adjustable securing engagement with the threaded portion end of the rotary shaft, with said adjusting member operatively connected with said finger engaging member, and with said finger engaging member operatively connected with the tuning control means to cause relative axial movement between the tuning control means and the shaft upon adjustable movement of said adjusting member for causing a variation in the frictional pressure between the control members and the spacing and friction means therefor to prevent or to permit rotation of the control members relative to the rotary shaft depending upon whether the frictional pressure is applied to, or removed from, said control members.

17. Radio tuning mechanism for mounting in a housing, said mechanism including in combination a rotary shaft having a threaded portion at one end, tuning control means on said shaft including a plurality of spaced apart control members for controlling the angular rotation of said shaft and spacing and friction means therefor, tuning and adjusting means at one end of the tuning control means directly on the threaded portion end of the rotary shaft for operation at an end wall of the housing for varying the frictional pressure on the control members and for rotation of the shaft directly at said shaft for tuning purposes, said tuning and adjusting means including a finger-engaging-shaft-rotating member on said shaft adapted for relative axial movement with respect to said shaft and a threaded adjusting member operatively connected with said finger-engaging member for threadable engagement with the threaded portion of said shaft to govern such relative axial movement of the finger-engaging member, with said finger-engaging member operatively connected with the tuning control means to cause relative axial movement between the tuning control means and the shaft upon said relative axial movement between the finger-engaging member and said shaft to vary the frictional pressure between the control members and the spacing and friction means therefor.

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