Feb. 1, 1944. LE ROY J. LEISHMAN 2,340,393

AUTOMATIC TUNING MECHANISM

Filed May 13, 1940 3 Sheets-Sheet 1

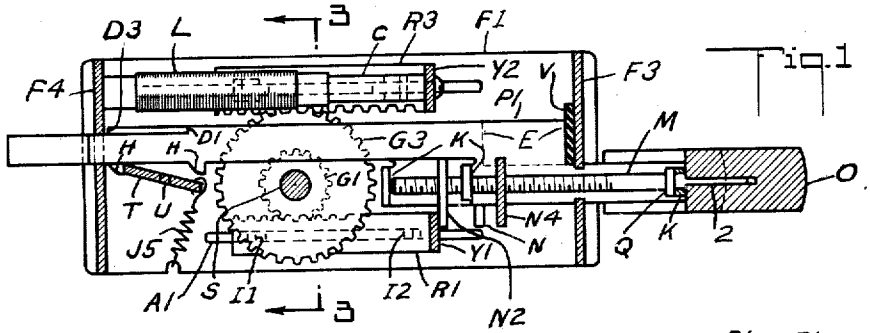


Fig. 1

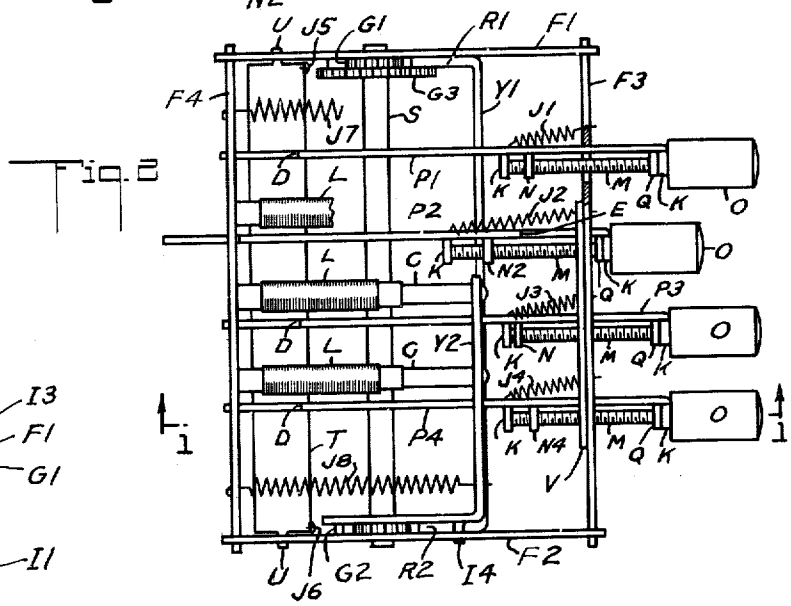


Fig. 2

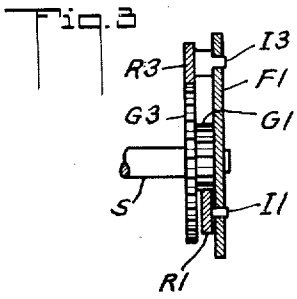


Fig. 3

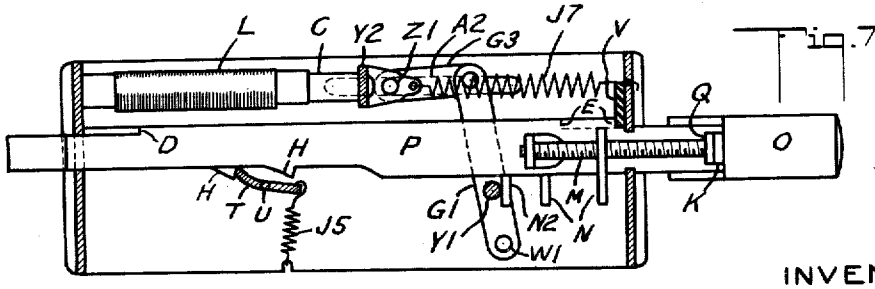


Fig. 7

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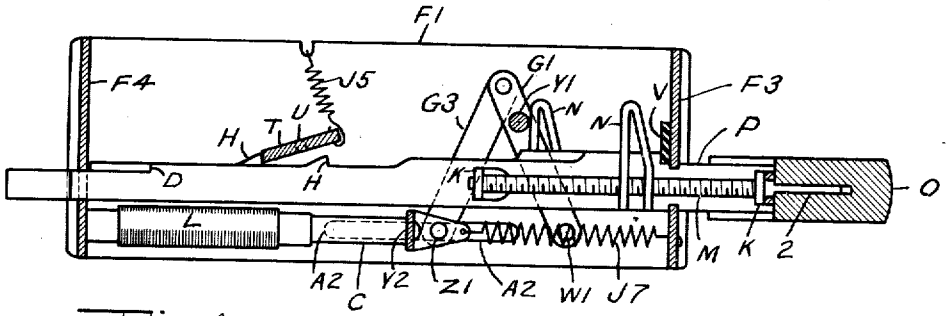


Fig. 4

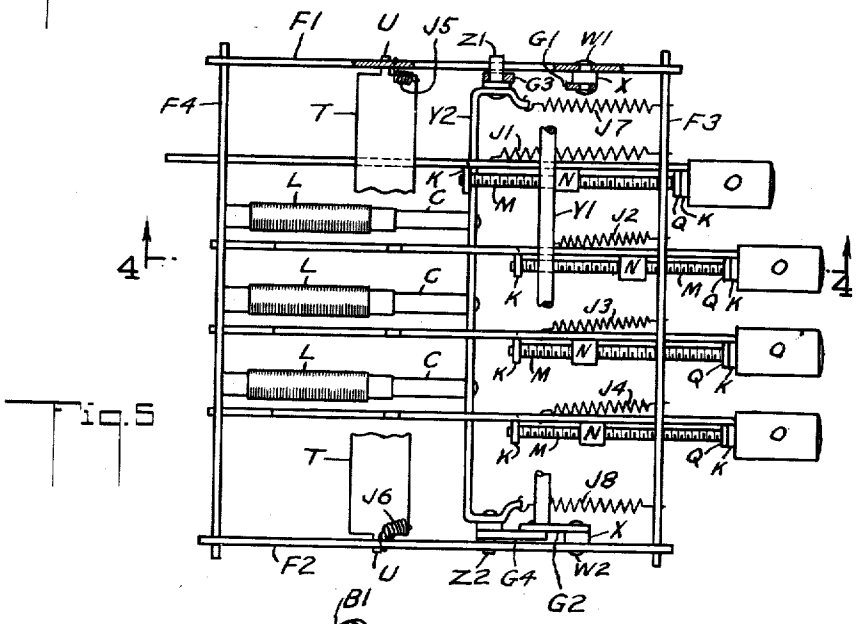


Fig. 5

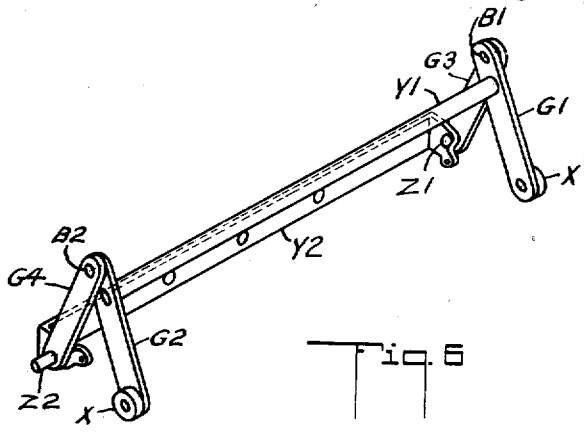


Fig. 6

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Fig. 8

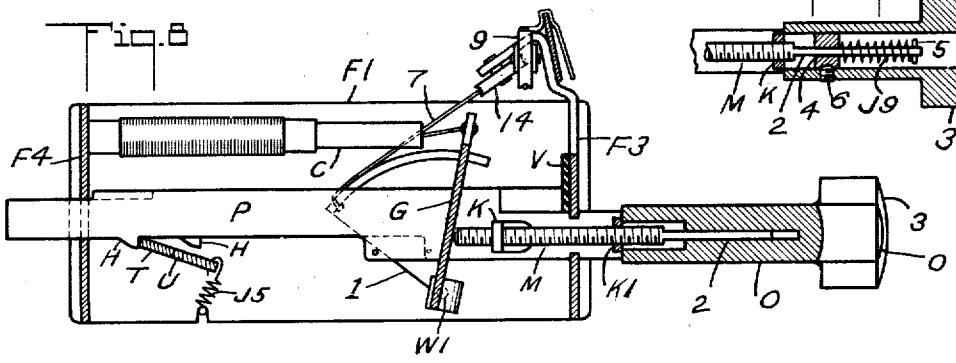
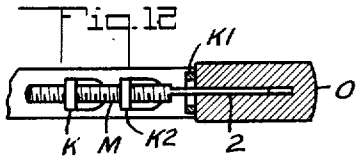


Fig. 11

Fig. 12



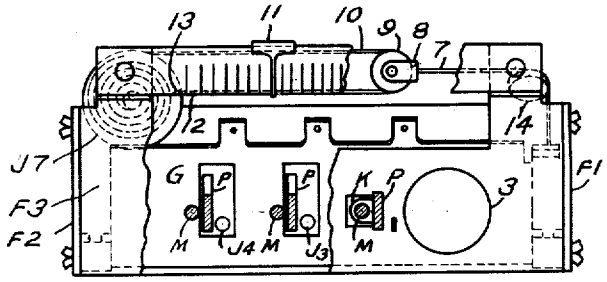


Fig. 13

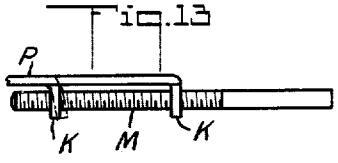


Fig. 9

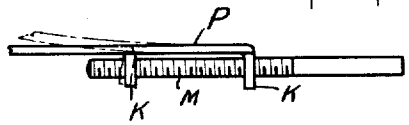


Fig. 14

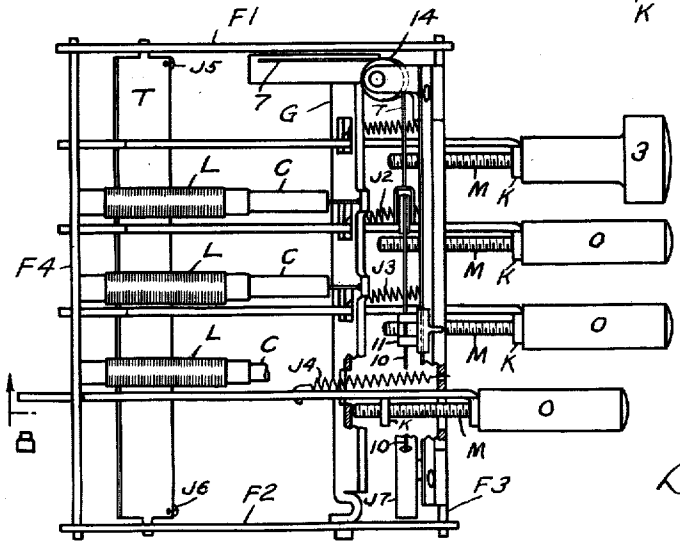


Fig. 10

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Patented Feb. 1, 1944 2,340,393

UNITED STATES PATENT OFFICE

2,340,393

AUTOMATIC TUNING MECHANISM

Le Roy J. Leishman, Los Angeles, Calif.

Application May 13, 1940, Serial No. 334,685

8 Claims. (Cl. 74—10)

My invention, as described herein, relates to automatic tuning mechanisms, including devices of this class used in radio receivers, and more particularly to that type of automatic tuning apparatus in which the movable control of the resonance-varying device is urged in one direction by a loading spring and moved predetermined distances in the opposite direction by means of individually operable selectors, and in which an adjusting means for preselecting the position in which the control will come to rest is provided for each selector. Tuners of this general class are exemplified by the devices of the following designated patents: Marvin, No. 1,704,754; Faas, No. 1,928,200; Bast, No. 1,687,420; and British Patent No. 405,716, issued to Freytag et al.

My invention may be used with any type of resonance-varying apparatus having a movable control, including variable condensers, but it is especially adaptable for variable permeability tuning.

None of the embodiments shown in the above identified patents have come into use in the United States because of complicated construction, inconvenient operation, inaccurate tuning, or some combination of two or all of these defects, nor are any of these tuners well suited for use with variable permeability tuning, in which the actual control member moves in a straight line.

Because of the latching means, however, tuners of the general class of the Marvin and Freytag structures are ideal for adaptations in which it is desirable for the operating button to remain depressed as a means of indicating the station to which the set is tuned, or for use in sets that must be used under conditions in which vibration is apt to jar the control from its adjusted position, as in an automobile receiver.

It is one of the objects of the present invention to remove the defects that have been inherent in past devices of the spring-loaded variety in order to realize the full benefits of the desirable features just set forth.

More specifically, as far as these objectives are concerned, the present invention aims to increase accuracy by reducing the number of parts interposed between the adjustable position-determining means associated with each selector and the movable control that must be accurately positioned for proper tuning; to provide means for removing play from the mechanism; to produce a device that will be sturdy and dependable; and to make easy operation possible.

Only one of the patents mentioned discloses a tuner that can be set from the button, but the structure is too complicated and costly for receivers that are low enough in price for the average purchaser. It is therefore an object of the present invention to simplify the button adjusting arrangement.

Another object is to make it possible for all the buttons to be in alignment in their rest positions regardless of the adjustment of the associated adjusting means without resorting to complex or unnecessarily costly expedients to attain this result.

In the device for the Freytag patent, any one of the buttons may be used as a manual knob for tuning the receiver through its entire range of frequencies. The pressing of any other button for returning the tuning control to a predetermined position will automatically declutch the plunger being used for manual tuning, and such manual knob regardless of its high ratio therefore does not increase the button pressure. The structure of the Freytag button and plunger, however, is unnecessarily complicated for this purpose, and the present invention therefore aims to simplify the construction and reduce the number of required parts.

Another object of my invention is to provide means in certain of the embodiments for removing play between the threads of the adjusting screw and the screw-threaded parts of the supporting member, and to do this in an inexpensive manner.

Another object is the reduction of the button pressure required to operate the device.

Further objects of my invention are to reduce the torque of the dial or indicating means, and to make it possible to have a relatively long pointer travel without gears or a large driving pulley.

At the present time, the cores of permeability tuners must move approximately 1¼ inch to cover the entire broadcast band if the tuning is not to be too critical. The button stroke, however, should not be more than half of this core travel, as buttons that protrude very far from the panel of the set are unsightly. It is desirable to have the shortest possible button stroke consistent with reasonable button pressure. It is therefore an important object of my invention to provide simple, cheap and efficient motion-multiplying means for stepping up the short button stroke sufficiently to move the core through its required range of travel.

Additional objects will appear as the specification proceeds.

In the accompanying drawings:

Fig. 1 is a section taken on line 1—1 of Fig. 2, showing one form of my invention.

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

Fig. 3 is a section taken on line 3—3 of Fig. 1, showing the guiding means for keeping the racks in mesh.

Fig. 4 is a section taken on line 4—4 of Fig. 5, and shows another modification of my invention.

Fig. 5 is a top plan view, partly in section, of the embodiment shown in Fig. 4.

Fig. 6 is an isometric view of the motion-multiplying means and core mounting rack of the embodiment illustrated also in Figs. 4 and 5.

Fig. 7, on the first page of the drawings, illustrates a variant of the device of Figs. 8, 9 and 10, and corresponds to the sectional views of Figs. 1 and 4.

Fig. 8 illustrates the form of the invention that I prefer, and is a section taken on line 8—8 of Fig. 10.

Fig. 9 is a front elevation, partly in section, of the device shown in Figs. 8 and 10.

Fig. 10 is a top plan view of the embodiment illustrated in Figs. 8 and 9.

Fig. 11 is a cross section of the manual knob and associated parts, showing the means for keeping the knob in the same longitudinal position with respect to the plunger assembly regardless of the relative longitudinal position of its adjusting screw.

Fig. 12 is a sectional view of a modification of the button structure shown in Fig. 8.

Fig. 13 illustrates one method of removing play between the threads of the screw and the associated screw-threaded portions of the plunger.

Fig. 14 illustrates another method of removing play between the threads so that the screw will fit snugly in its bearings and resist accidental turning.

In the embodiment of my invention shown in Figs. 1, 2 and 3, the mechanism is supported by a frame consisting of side plates F1 and F2 and front and back plates F3 and F4, respectively. A shaft S is journaled in the side plates F1 and F2. Rigidly attached to this are two small gears G1 and G2, each located at one end and adjoining the inner surface of the end plates. Two larger gears, of identical size, are rigidly mounted on shaft S next to the small gears G1 and G2. One of these large gears, G3, is shown in Figs. 1, 2 and 3, but its mate is concealed beneath rack R4 in Fig. 2.

A U-shaped carriage, comprising parallel racks R1 and R2, has a front portion Y1 yoking the side racks R1 and R2, which mesh respectively with the small gears G1 and G2. Each of these racks is provided with two outwardly extending lugs, preferably sheared and formed from the stock, and these lugs slide in slots in the end plates to support the racks and keep the teeth in mesh. Lugs I1 and I2 are shown in dotted lines in Fig. 1, sliding in slot A1 in end plate F1. Another view of lug I1 appears in Fig. 3.

A similar U-shaped member, disposed with the teeth at the bottom, comprises racks R3 and R4, and a connecting yoke portion Y2. Racks R3 and R4 mesh with the two large gears, as indicated clearly in Figs. 1 and 3, in which rack R3 is shown in mesh with gear G3. These racks are guided in a straight path by lugs I3 and I4, as shown in Figs. 2 and 3. These lugs are shaped with a shoulder as shown in Fig. 3 to take up the space between the racks and the end plates, but the same purpose may be served by using a lug of the same width throughout and taking up the space with washers.

The yoke Y2 supports a plurality of permeability cores C arranged to move in and out of the tuning coils L. The art affords a variety of ways for mounting the cores and coils, but none is shown in detail in any of the figures of the drawings, as such mounting means are not a part of this invention.

A series of plunger devices are mounted in the front and back plates F3 and F4 for longitudinal movement, but as these are alike, a description of one will serve for the group. Each plunger comprises a flat bar P, provided with front and rear motion-limiting shoulders E and D, a latching lug H, and a pair of lugs K in which is journaled an adjusting screw M, having a flat or keyed end 2 on which is mounted button O which has a recess to fit the end 2 so that the turning of the button will rotate the screw. Each screw is provided with a collar or similar means Q for preventing longitudinal movement of the screw, its longitudinal movement in the other direction being prevented by the journal itself. Each screw carries a travelling nut N constrained against rotation by a flat side fitting against the adjacent side of bar P. The plungers are held in operative positions against bumper V by retaining springs J1, J2, J3 and J4.

A latch bar T is journalled in the side plates F1 and F2 by means of integral lugs U, and held against the plungers by springs J5 and J6, attached to the latch bar and the side plates.

Two loading springs J7 and J8 pull the upper U-shaped member back, and, through the medium of the gears, force the lower U-shaped member toward the front of the mechanism.

When any plunger is pressed in, the lug H passes over the end of latch bar T, and is locked in operated position by means of the latch bar, the end of which is held behind the shoulder of the lug by means of springs J5 and J6. The travelling or position-determining nut, N2 on the depressed plunger of Figs. 1 and 2, receives the outward thrust of yoke or abutment Y1, and by its adjustment determines the position of both carriages, which, in turn, determine how far the cores are positioned inside the tuning coils.

When another plunger is pressed in, its rounded or cammed shoulder H moves the latch bar to release the previously locked plunger, and the travelling nut of the newly depressed plunger now acts to position the cores through the instrumentality of the racks and gears.

It will be evident that the turning of the button on any depressed plunger will move the position-determining nut along the screw and that, since the depressed plunger is latched in operated position, the nut will move the lower carriage backward or forward, inasmuch as abutment Y1 is constantly urged forward under action of the loading springs.

From the foregoing description it will be clear that the operation of any button will position the cores and tune the set according to the previous adjustment of the position-determining nut.

No manual tuning means is shown in the figures for this species, nor in Figs. 4, 5 and 6 for the species that they illustrate, because such manual tuning means is illustrated in detail in Figs. 8, 9 and 10 and described in following parts of this specification. However, all embodiments require some provision for manual tuning, and

it may be assumed that the forms of my invention for which no manual arrangement is shown in the figures, are nevertheless provided with some such means, either of a type old in the art or of the form illustrated in Figs. 8, 9 and 10 and described in connection therewith.

An important feature of my invention resides in the interposition of motion-multiplying means between the plungers and the cores, whereby the short stroke of the plungers controls the longer stroke of the cores. In the embodiment just described, such means is provided by the carriages, gears and the shaft.

The species illustrated in Figs. 4, 5 and 6 employs an entirely different motion-multiplying arrangement than that in the species just described. As the operation and most of the features of this modification are essentially the same as in the embodiment of Figs. 1, 2 and 3, none of the substantially identical parts will be described, and the description of this species will be confined to the elements that are different.

Links G1 and G2 are pivoted by means of studs or bolts W1 and W2 respectively on side plates F1 and F2 respectively. These links are rigidly connected by rod Y1. Links G1 and G3 are rotatably connected by pin B1, and the corresponding links on the other side of the motion-multiplying device are similarly connected by pin B2. The lower or free ends of links G3 and G4 are provided with pins Z1 and Z2 respectively, each of which protrudes on both sides of the link. On the inner ends of these pins a bracket Y2 is pivoted. The outer ends of these pins are constrained to move in a straight line by slots in which they move in the side plates. One such slot, A2, is shown in Fig. 4. Loading springs J1 and J8 serve not only to pull bracket Y2 toward the front of the tuner, but also, because of the position at which they are connected, to keep the face of the main yoke portion in a vertical plane.

The cores C are connected to this yoke by any suitable means.

The position-determining means in this modification are shaped in the manner shown because they need to be reinforced on account of their extra height, which is required to enable them to engage rod Y1 in all its possible positions.

In this embodiment, bracket Y2 has more than twice the horizontal travel of rod Y1, and the difference can be made even greater by attaching rod Y1 nearer to the pivots of links G1 and G2. If the ratio of travel must be very great, additional links may be interposed between links G1 and G3, and between G2 and G4, with all the lower connecting pins of the links in each train moving in a slot.

In the device of Fig. 7, the coils are mounted at the top, and bracket Y2, carrying the cores, is constrained to move in a straight line by the pins that move in the slots in the side plates. The figure shows one such pin, Z1, moving in slot C. Link G3 serves in this embodiment not as part of the motion-multiplying means, but to convert the arcuate motion of pivoted link G1, to which it is rotatably attached, into the rectilinear motion required by bracket Y2. Corresponding links, not shown in the figure, are of course used on the other side of the device; and rod Y1, shown connected to link G1, is connected at the other end to a corresponding link to form a motion-multiplying means consisting of a single integral assembly which moves as a unit.

The remaining parts of this embodiment are substantially the same and function the same as the corresponding parts in the form previously described which bear the same reference characters.

In the device of Figs. 8, 9 and 10, the integral pivoted structure of Fig. 7, which comprises three rigidly connected parts, is replaced by a one piece member G which functions the same and multiplies the motion imparted by the plungers in the same way. This part, however, may be stamped and formed. A pulley segment I is attached to bar G at one end thereof, and the entire structure is pivoted on the end plates F1 and F2. The link G3 of Fig. 7 is replaced by a flexible wire, which method of connecting a core to a rotatable member is not original with me.

The plunger structure shown in Figs. 8 to 14 inclusive embodies important improvements and simplifications over the prior art.

The position-determining means proper consists of a single rod or screw M with threads that engage in corresponding threads in the holes in lugs K through which the rod is threaded. If these holes are tapped in the conventional way in a single operation with a single tap and if neither the bar P nor the lugs are distorted in any manner, screw M will fit so loosely in the lugs that it will not maintain its adjustment. This may be prevented to some degree by providing no clearance between the male and female threads, but Figs. 13 and 14 illustrate a simple preferred method. The lugs may be threaded with the bar very slightly distorted as shown in exaggerated form in broken lines in Fig. 14, and when the bar assumes its normal shape after the threading operation, the threads of one lug are displaced with relation to the threads in the other lug. The amount of distortion may be controlled by a fixture so that the distortion will not be so great that the screw will not engage the threads in the second lug, but so that the screw will nevertheless encounter enough friction on the sides of the threads to keep the screw from turning when it is not rotated deliberately.

A similar result may be achieved by holding the lug in distorted position during the tapping operation, as indicated in exaggerated form in dotted lines in Fig. 13, or both lugs may be tapped in their formed position and at least one of them bent afterward to displace the threads sufficiently for the required result.

As shown in Fig. 8, the outer end 2 of the rod or screw is flat, but any shape other than round with no interruptions in the curved periphery will answer the purpose. A key-way or a single flat side will suffice. The term "keyed portion" in the claims is intended to cover any of these equivalent shapes. The button O shown in cross-section in Fig. 8 has a longitudinal recess enlarged at the open end to pass over the end of the threaded portion of the screw in any of its adjusted positions, and the recess is shaped for the remainder of its depth to fit over the keyed end of the rod or screw in any of its longitudinal positions. When the button is turned to the right to adjust the screw inwardly, the external end of the screw will move out of the button, which is prevented from following the screw by the abutment or formed lug K1 on the plunger bar. When the button is turned in the opposite direction to adjust the screw outwardly, the button will of course move away from lug K1, but on account of the length of the recess, the button will move back against lug K the first time the button is pressed to operate the plunger.

Fig. 12 shows a modification of the button and

screw structure. In this form, the outer lug K1 has a hole large enough to clear the keyed end of the rod or screw, and an extra lug K2 with a threaded hole is provided to afford the second threaded bearing required. The button O of this variant may have a recess of uniform cross section throughout the length of the recess. The operation of this arrangement is the same as that shown in Fig. 8.

In Figs. 8, 9, 10 and 11, a manual tuning knob is shown, which may also be used in any of the other embodiments. Such tuning knob must be capable of rotation in a direction to move the screw outwardly without moving the button away from abutment or lug K. I have met these requirements in a simple and inexpensive way. The keyed end 2 of screw M carries a keyed collar 4 which turns with the screw but which permits the screw to move longitudinally therethrough. In assembly, a compression spring J9 is placed over the keyed portion 2 after the collar has been placed thereon, and a pin or other abutting means 5 is then placed in position at the end of the screw. The knob 3 has a longitudinal recess wide enough to clear the spring J9 and pin 5, but of proper diameter or shape to fit the collar 4 to which it is secured by means of a set screw 6 or suitable keying means. Spring J9, pressing on collar 4, keeps the end of the knob tight against abutment K under all operating conditions.

In the embodiment shown in Figs. 8, 9 and 10, a single loading spring device J7, illustrated in spiral form, not only acts to urge the movable parts of the tuner each in one operative direction, but to operate the indicating device which is connected to the segment pulley 1 by a single cord 7. The particular part of the device to which cord 7 is attached, is the movable or floating pulley-support 8, carrying the pulley 9. One end of a second cord 10 is attached to the frame at point 13 behind the scale 12, as indicated in Fig. 9. It passes around pulley 9 and is attached at the other end to the spring-actuated reel or loading spring J7. This device may reel up the cord as a tape measure or flexible steel tape is wound into the case in numerous familiar devices that are on the market. An indicator 11 is attached to cord 10 between the spring device and the pulley 9. The spring device acts to hold this indicator at the left end of the scale 12 and to pull the floating pulley 9 to a position about half way across the back of the scale. As pulley 12 pulls on its supporting bracket 8, it pulls on cord 7, which passes over pulley 14 and pulls on the segment pulley 1 to which it is connected, tending to hold pivoted member G in its extreme forward position.

Motion-multiplying member G is moved in the opposite direction against the action of the loading spring J7 by the end of screws M, each plunger operating to position member G and the connected cores C according to the particular adjustment of its associated screw. The latching device T and the bumper V operate as in the devices of the preceding figures, and thus do not need description. The bumper V, in fact, is not essential, and is therefore omitted from some of the figures illustrating the various forms of my device.

The forms of my invention that I have illustrated and described, are but illustrative embodiments, and many equivalents for the essential elements will readily suggest themselves to those skilled in the art. Various rearrangements, additions, substitutions and transpositions are also possible within the broad scope of my invention; and the essential parts or their equivalents may also, of course, be disposed to move in different planes and directions than those represented.

My claims are:

1. In a radio tuning mechanism, a combination including: a supporting frame comprising a front plate and a back plate; a rectilinearly movable control for said mechanism; an operating device for said control disposed between said plates; resilient means for actuating said device and moving said control in one direction; a plurality of plunger members each slidably mounted in both of said plates; a plurality of adjustable position-determining means each carried by one of said members and adapted to engage and actuate said device to move said control in the opposite direction, said position-determining means also comprising a rotatable male screw extending substantially longitudinally of the associated member, and means on the external end of said screw and free from engagement with either of said plates for imparting rectilinear motion to said screw; and latching means common to all of said members for locking any of said members in a fixed position.

2. In a radio tuning mechanism, a combination including: resonance-varying means; a movable control for said resonance-varying means; a pair of relatively large gears connected to turn with equal angular velocity; a pair of relatively small gears each connected to turn as a unit with one of said large gears; a first carriage comprising a pair of racks meshing with said large gears; means connecting said first carriage and said control; a second carriage comprising a pair of racks meshing with said small gears and including an abutment extending transverse to the direction of motion thereof; resilient means for urging said racks each in a single direction respectively; and a plurality of operating devices each comprising adjustable means for engaging said abutment and moving said racks against the action of said resilient means to position said control.

3. In a radio tuning mechanism, a combination including: a resonance-varying means; a movable control for said resonance-varying means; a pair of relatively large gears connected to turn with equal angular velocity; a pair of relatively small gears each connected to turn as a unit with one of said large gears; a first carriage comprising a pair of racks meshing with said large gears; means connecting said first carriage and said small gears and including an abutment extending transverse to the direction of motion thereof; resilient means for urging said racks each in a single direction respectively; a plurality of operating devices each comprising adjustable means for engaging said abutment and moving said racks against the action of said resilient means to position said control; and latching means for immobilizing any of said devices to maintain said control in a stationary position.

4. In a control-positioning mechanism having a movable control element and a plurality of selectors each comprising adjustable means for operating said mechanism to move said control each to a preselected position, motion-multiplying means interposed between said selectors and said control and including: a pair of substantially identical linkage devices each comprising a plurality of movably connected links one of which is pivoted at a fixed point; a rod connect-

ing one of the links in one pair with the corresponding link in the other pair; said rod arranged and disposed for engagement by the adjustable means of any of said selectors; a pin near the end of the link in each pair that is furthest from said fixed point; a guide for each of said pins to constrain its movement in a straight line; a bracket movably connected to said furthest link in each of said pairs; and means connecting said bracket and said control.

5. In a radio tuning mechanism having a positionable control, a plunger device including: a supporting element comprising an abutment; a rotatable position-determining member carried by said supporting element and extending on both sides of said abutment and having a keyed outer end and externally threaded portions engaging in corresponding screw-threaded portions of said element; and a button member having a forward end adapted to engage said abutment and a recess extending longitudinally of said button member from the forward end thereof, at least a portion of said recess keyed to fit the outer end of said position-determining member.

6. In a plunger device for positioning a spring-loaded control of a radio tuning mechanism, a combination including: a supporting element comprising an abutment; a rotatable control-engaging and position-determining first member disposed longitudinally of said element and having a keyed outer end and external screw-threaded portions extending on both sides of said abutment and engaging in corresponding screw-threaded portions of said element; and a button member having a longitudinal recess shaped at its forward end to clear the threads of said first member, at least a portion of the remainder of said recess comprising a keyed portion adapted to receive the keyed end of said first member.

7. In a device for positioning a spring-loaded control of a radio tuning mechanism, a combination including: a supporting element comprising an abutment; a rotatable control-engaging and position-determining first member disposed substantially longitudinally of said element and having externally screw-threaded portions engaging in corresponding screw-threaded portions of said element and having a keyed portion at its outer end; a keyed collar slidably mounted on said keyed portion; abutting means near the outer end of said keyed portion; an operating member rigidly mounted on said collar and having a recess adapted to receive and permit the free longitudinal movement of said keyed portion and abutting means; and a compression spring surrounding said keyed portion between said collar and said abutting means and acting through said collar to urge the forward end of said operating member toward the abutment on said element regardless of the longitudinal position of said first member.

8. In a radio tuning mechanism having a positionable control, a plunger device for positioning said control, said device including: adjustable means for determining the position that said control will occupy upon operation of said plunger, said means comprising a rotatable adjusting screw having a keyed portion, an operating member slidably keyed to said portion whereby said screw may be rotated, and a spring for urging said member along said portion in one longitudinal direction.

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