Nov. 26, 1946. M. J. PIFER ET AL 2,411,754

SEQUENCE TUNER

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Fig. 1.

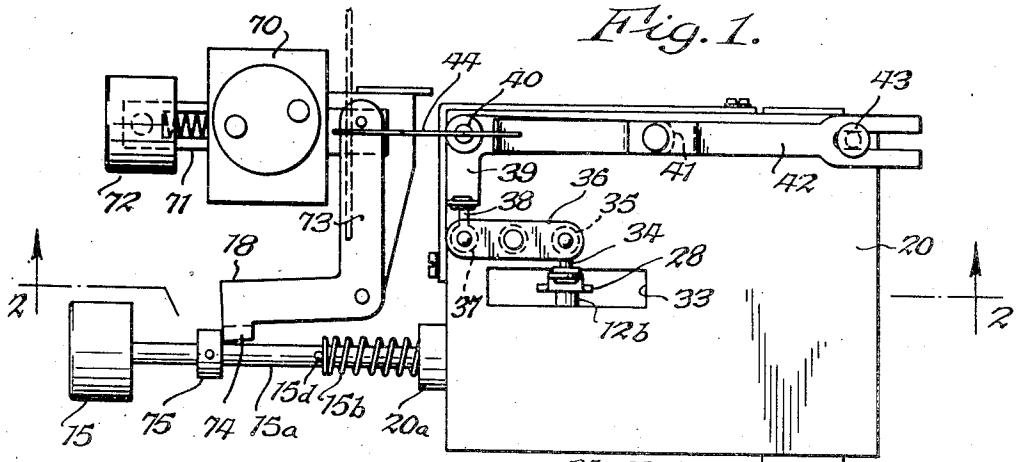


Fig. 2.

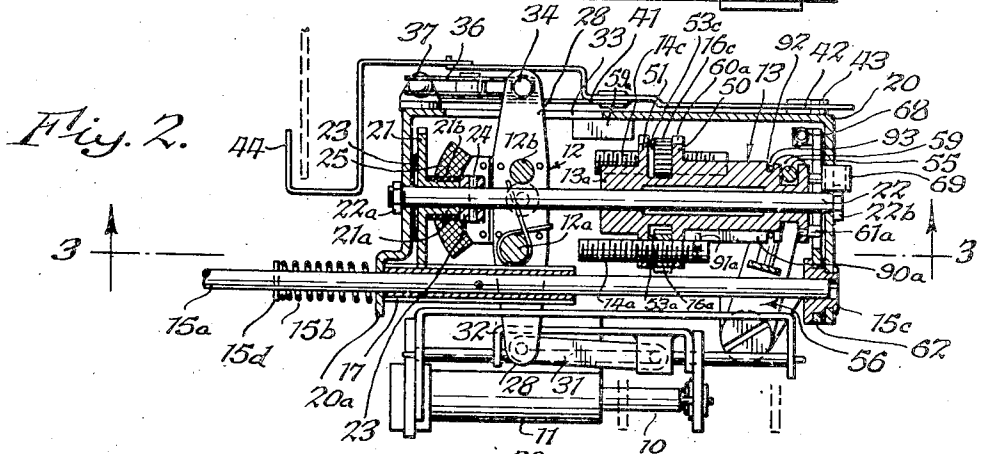
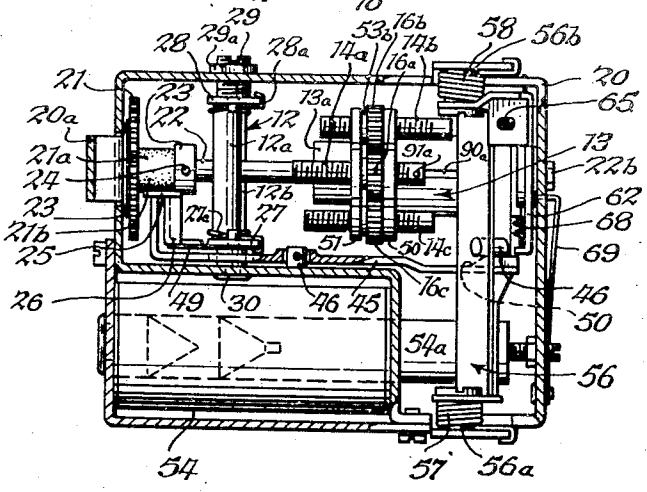


Fig. 3.



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SEQUENCE TUNER

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Fig. 4.

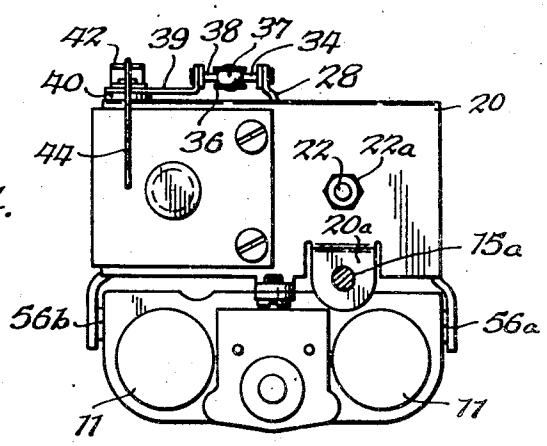


Fig. 5.

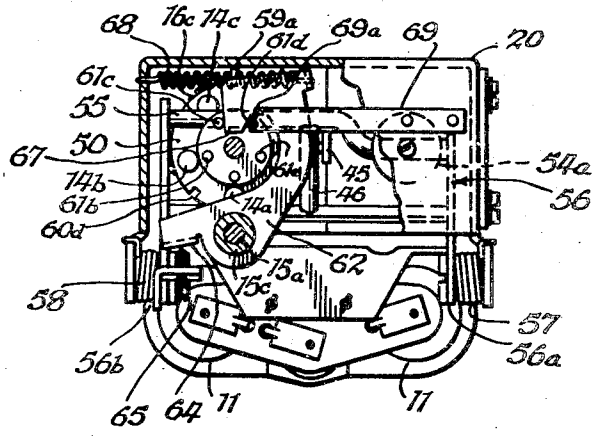
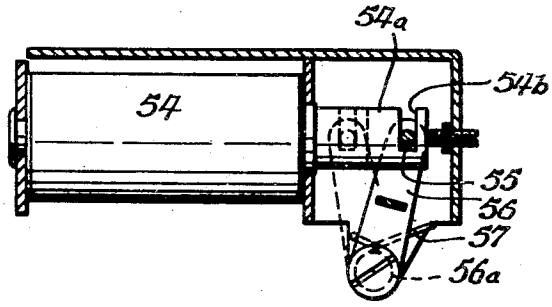


Fig. 6.



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Fig. 7.

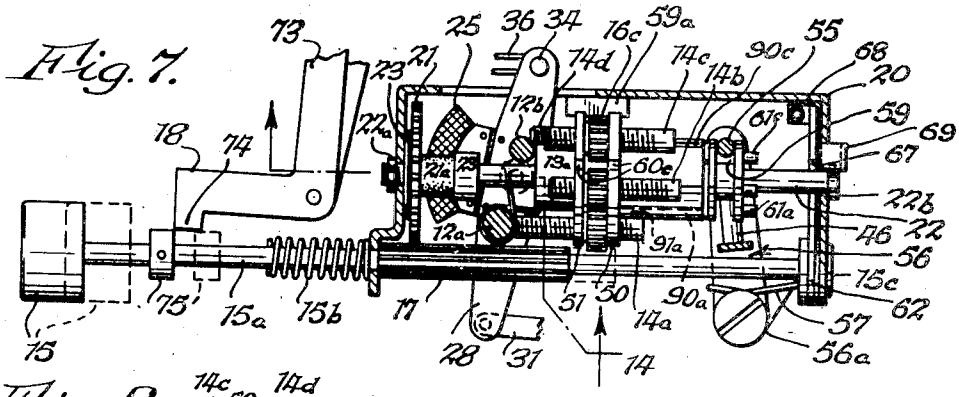


Fig. 8.

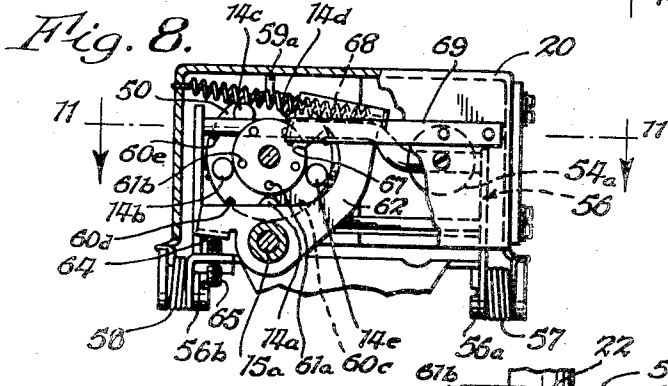


Fig. 9.

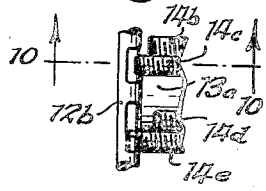


Fig. 10.



Fig. 11.

Fig. 15.



Fig. 12.

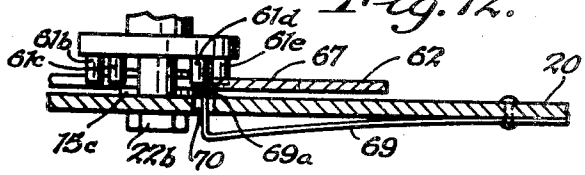


Fig. 13.

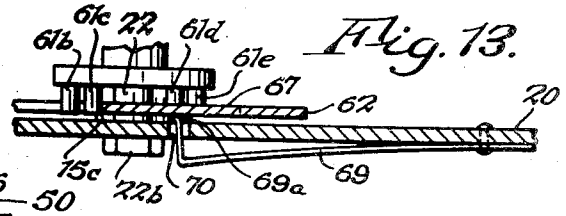
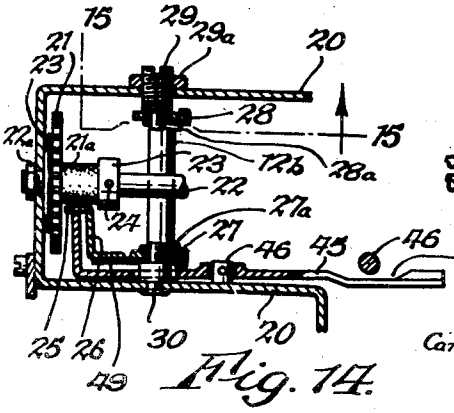


Fig. 14.



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Patented Nov. 26, 1946

2,411,754

UNITED STATES PATENT OFFICE

2,411,754

SEQUENCE TUNER

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Application July 4, 1945, Serial No. 603,130

11 Claims. (Cl. 74—10)

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This invention relates to a tuning unit for radio receivers, and more particularly to what is known as a "sequence tuner"; that is, one in which the apparatus may be pre-set or adjusted to operate, in response to the pushing of a single button, to tune successively, in a predetermined order, each station of a previously-selected group of stations.

Such tuners are particularly useful in automobile radios where the tuning may be controlled by a single push button mounted on the steering column or by a foot switch mounted on the floor. Each closure of the switch operates the tuning mechanism to change from one station to the next, in the order for which the apparatus has been previously pre-set. When the last station of the group has been tuned in, the next operation of the switch causes the mechanism to tune in the first station, and the station tuning cycle begins again.

Among the objects of our invention may be mentioned:

To provide a tuning unit in which the mechanical parts, the electrical components, and the dial indicator may be built complete as a single unit for installation in the receiver.

To provide such a mechanism capable of easy pre-setting or calibration to receive any one of a number of selected stations.

To provide such a unit including a manual tuning knob, the operation of which is not interfered with by the sequence tuning mechanism and which requires no preliminary operation, such as pushing in the knob, indexing to a special setting, pushing a special button, or the like, in order to tune manually.

To provide such a unit having a dial pointer formed as a part of the tuning unit.

To provide such a tuning unit which may be easily pre-set or adjusted to select desired stations without the use of tools of any kind, and which can be set up by anyone.

To provide a unit which is relatively small, compact, light in weight, and of high mechanical efficiency. To provide such a unit with interlocking safety features preventing the possibility of damage to the parts through incorrect operation.

To provide such a unit which will unfailingly tune closely to desired stations, without requiring excessive and unusually small tolerances in the mechanical parts.

To provide a unit of such design and construction that it is substantially free from backlash, and in which normal wear does not destroy the

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accuracy of settings or cause improper tuning of pre-set stations.

The features of novelty which we believe to be characteristic of our invention are set forth with particularity in the appended claims. Our invention itself, however, both as to its fundamental principles and as to its particular embodiments, will best be understood by reference to the specification and accompanying drawings, in which

Fig. 1 is a top plan view of the sequence tuner in accordance with our invention,

Fig. 2 is a vertical section on lines 2—2 of Fig. 1 with the tuner in normal position,

Fig. 3 is a section on lines 3—3 of Fig. 2,

Fig. 4 is a front elevation of the tuner,

Fig. 5 is a rear elevation with part of the housing broken away to show internal construction,

Fig. 6 is a detail view showing the solenoid, its core, and the bail which is operated thereby,

Fig. 7 is similar to Fig. 2, but showing the mechanism in the position it takes when the turret has just finished the forward half of its stroke and tuned a new station, with the latching part 14 distorted 90° about shaft 15a to bring it into view,

Fig. 8 is similar to Fig. 5, but showing the mechanism in the same position as the parts in Fig. 7,

Fig. 9 is a plan view of turret 13 similar to Fig. 3, showing the notched rocker bar 12,

Fig. 10 is a section on lines 10—10 of Fig. 9,

Figs. 11, 12, and 13 are horizontal sections on line 11—11 of Fig. 8,

Fig. 14 is a horizontal section through the rocker bar bearings showing clutching mechanism taken on line 14—14 of Fig. 7, and

Fig. 15 is a section on lines 15—15 of Fig. 14, showing shape of bearings.

The following brief summary of the construction and operation of our tuner, it is believed, will facilitate an understanding of the more detailed description appearing later.

In accordance with our invention, signal selection is accomplished preferably by what is known as permeability tuning; that is, the movement of iron cores 10 (Fig. 2) into and out of coils 11 of the tuning circuits; but it will be understood that other tuning instrumentalities may be employed, such, for instance, as the movement of copper slugs into and out of the coils. The movement of the tuning instrumentality is preferably linear, and such linear movement is derived from rotary movement of tilt or rocker bar 12.

The angular position to which tilt or rocker

bar 12 is set determines the position of the variable tuning instrumentality and, therefore, the frequency of the tuned circuits and the station to be received. The tilt or rocker bar is operated by selector turret 13 (Figs. 2, 3) mounted for both axial and rotary movement, and carrying a number of adjustable selector screws 14a, 14b, 14c, 14d, and 14e arranged with their axes parallel to the axis of rotation of the turret.

When the turret moves axially, driven, for example, by a solenoid energized by closure of the sequence tuning switch, one of these selector screws engages one rod 12a of the tilt bar, and the other rod 12b of the tilt bar is engaged by hub 13a of turret 13, adjusting the tilt bar, and by it, the tuner, to the position corresponding to the pre-set station. Rotation of turret 13 to bring different selector screws 14a, 14b, 14c, 14d, and 14e into position to engage the tilt bar provides for selection of different stations.

Turret 13 is normally out of engagement with tilt bar 12, during which time the manual tuning knob 15 is clutched to the tilt bar. When the turret moves forward to change the station tuning, the manual knob is de-clutched from the tilt bar, which is thereby left free to rotate to the position determined by turret 13; and when the turret reaches the end of its forward stroke, tilt bar 12 has been moved to the position corresponding to the new station, and that station is tuned.

Immediately afterward, turret 12 executes its return or indexing stroke and near the end thereof is given one step of rotation, preparing it to tune the next station in sequence. At the same time the manual knob is re-clutched to tilt bar 12 so that manual tuning may be accomplished without any preliminary operations, such as pushing in the knob, pushing a manual button, or the like.

Calibrating or pre-setting the apparatus for desired stations is accomplished by means of gears 16a, 16b, 16c, 16d, and 16e, one of which, in the forward position of the turret, meshes with gear 17 mounted on manual tuning shaft 15a. These gears are normally disengaged, but may be engaged in the forward position of the turret by pushing in the manual tuning knob against its spring bias. Turning the manual tuning knob under such conditions tunes in the desired station and pre-sets the selector, by adjusting the selector screw to the proper position to tune the station.

Mechanical interlock 18 is provided to prevent depression of the manual tuning knob except when the turret is in forward position where it can be adjusted to set up stations. This interlock 18 may be mechanically tied to the sequence tuning switch, if that switch is mounted on the receiver chassis, and it may be arranged to hold the manual knob out of pre-setting position so long as the sequence switch is not energized, and also to hold switch engaged while knob is depressed for station set-up.

Turning now to the more detailed description of the construction and operation of our tuner, the mechanism is housed within a suitable casing 20, preferably of metal, generally rectangular in shape, and of approximately the dimensions indicated on the drawings, which are actual size. Extending through the housing we provide manual tuning shaft 15a, the outer extremity of which carries manual tuning knob 15.

This shaft is preferably mounted so as to be rotatable and also slidable axially, and at its front

end may project through an opening in offset lip 20a on the front of the housing. At its rear end it may rest in bushing 15c carried by the rear face of housing 20. Adjacent to its front end, inside the housing, this shaft may carry tubular gear 17 pinned thereto.

Shaft 15a is biased to the forward extremity of its movement by means such as spring 15b surrounding shaft 15a and confined between offset face 20a of the housing and pin 15d extending through the shaft. The forward extremity of its motion is reached when the forward end of tubular gear 17 abuts against the inside face of offset shoulder 20a.

Gear 17 is at all times in mesh with gear 21. Gear 21, having sleeve 21a secured thereto, is mounted for rotation on carrier rod 22, which extends through housing 20, and is secured in position by nuts 22a and 22b engaging the threaded ends thereof. Spring washer 23 may be interposed between gear 21 and the forward face of the housing, and the position of gear 21 lengthwise of shaft 22 may be determined by collar 23 mounted on carrier rod 22 and secured thereto as by pin 24.

Collar or tube 21b of resilient friction material such as rubber may surround sleeve 21a. This collar 21b, secured on sleeve 21a, serves to drive tilt bar 12 upon manual tuning through sector-shaped plate 25 having a knurled face and carried by bracket 26 secured to end plate 27 of the tilt bar assembly.

Tilt bar 12 is preferably formed by two end plates 27 and 28, joined by the two contact rods 12a and 12b. These rods are not symmetrically placed with respect to the center of rotation of tilt bar 12, rod 12a being somewhat larger in diameter and placed further from the center of rotation of tilt bar 12 than rod 12b. The entire tilt bar assembly is mounted for rotation on bearings 29 and 30 (Fig. 3). Bearing 29 may be adjustably screw threaded into housing 20 and secured in adjusted position by nut 29a. V type bearings are preferably used in the end plates 27 and 28 with springs 27a and 28a to hold the bearing studs in the V's. This eliminates any possible play in bearings.

The lower end of end plate 28 of tilt bar 12 may extend below manual tuning shaft 15a and be connected by link 31 to slider 32 carrying permeability cores 10. From this it will be seen that as tilt bar 12 rocks in its bearing, it carries with it slider 32, moving cores 10 into and out of their respective coils to vary the receiver tuning.

The upper end of end plate 28 may project beyond housing 20 through opening 33 and carries pin 34 carrying ball 35 engaged by double link 36. The opposite end of link 36 may engage second ball 37 carried by pin 38 secured to bell crank lever 39 pivoted on the top of the housing, as at 40.

The other end 41 of bell crank lever 39 may be pivoted to an intermediate point of fork 42, the fork portion of which is arranged to slide in a groove on stud 43 mounted at the rear side of housing 20. Secured to the forward end of fork 42 there may be provided pointer 44, which cooperates with a dial indicated in dotted lines.

A clutching engagement between sleeve 21a and sector 25 is normally provided by means of a pivoted pressure bracket 45 (Fig. 3, Fig. 12) pivotally mounted on stud 46 for a slight rotary movement in the plane of the paper except when the solenoid is operating the tuning. Pressure plate 45 is maintained in the position shown in Fig. 3 by

means of pin 46, which normally presses on the outer extremity of pressure plate 45, holding sector 25 against rubber tubing 21a.

For the purpose of providing the small amount of motion necessary to permit clutching and declutching of sector 25 to collar 21a, the sector may be secured to tilt bar end plate 27 by means of the small spring plate 49. When the solenoid operates, pin 46 is moved forward, coming opposite depressed portion 50 of pressure arm 45. Pressure is no longer applied to sector 25, and the latter, moving slightly counter-clockwise, springs out of contact with sleeve 21a, permitting the tuning of the receiver without driving gear 21 and manual tuning shaft 15a.

At the same time, the constant clutching engagement between sector 25 and sleeve 21a, except when the solenoid is being operated, permits manual tuning at any time without the necessity of performing a special operation on the tuning shaft, or pressing a manual button as has heretofore been necessary in all such apparatus with which we are familiar, nor does manual tuning interfere with the sequence tuning operation, because, no matter what the initial position of the apparatus may be, operation of the turret to select a particular pre-set station will always set the apparatus to tune to that station.

The structure by which this is accomplished will now be described. Mounted on carrier rod 22 for both endwise sliding movement and rotation, we provide turret 13. This turret has central hub 13a and surrounding it with their axes parallel to carrier rod 22 we have provided a number of selector screws 14a, 14b, 14c, 14d, and 14e, spaced equiangularly around turret 13. In the embodiment shown there are five of these selector screws whereby the tuner may be pre-set or calibrated for five different stations.

It will be understood, however, that if desired, a larger or smaller number of selector screws may be provided to accommodate a larger or smaller number of stations.

Each of the screws passes through a suitable opening in flanges 50 and 51 of turret 13, and the longitudinal adjustment of each screw may be controlled by its particular adjusting gear nut 16a, 16b, 16c, 16d, and 16e, internally threaded to engage the threads of its respective screw, and positioned at an intermediate point on its respective screw, held against accidental disturbance by means of anti-friction washers 53a, 53b, 53c, 53d, and 53e.

The outer surfaces of gears 52a, 52b, 52c, 52d, and 52e have teeth of the pitch to engage with tubular gear 17 when the turret is in the forward extremity of its position and manual shaft 15a is pushed inwardly. When this occurs, rotation of shaft 15a rotates adjusting nut 16a, 16b, 16c, 16d, or 16e, as the case may be, and thereby moves the particular screw forward or backward in the turret.

To facilitate assembly and adjustment of the screws 14a, 14b, 14c, 14d, and 14e, each of the holes in flanges 50 and 51 are preferably reamed out, and the screws themselves are preferably ground to provide an accurate, smooth fit and prevent undue backlash or play of the screws in the turret. To prevent rotation of the screws when the adjusting nut is turned, we prefer to provide a series of longitudinal slots 90a, 90b, 90c, 90d, and 90e (Figs. 2, 8) extending from the rear of the turret to flange 50, and a corresponding key pin 91a, 91b, 91c, 91d, and 91e, in each selector screw 14a, 14b, 14c, 14d, 14e, each pin riding in its respective slot.

To limit the backward adjustment of each screw, we may provide a circumferential groove 92 at the rear end of the turret in which we may place spring retaining ring 93. To remove any screw, ring 93 is removed, after which rotation of the adjusting nut works the screw out of the holes in flanges 50 and 51.

It will be observed by reference to Fig. 7 that contact rod 12a of the tilt bar engages the bottom selector screw, whereas upper bar 12b does not engage any selector screw, but always engages the front or hub 13a of the turret. To prevent contact between the two top selecting screws and the top of rod 12b, which might otherwise occur if the selecting screws projected out too far, rod 12b may have notches formed in it to prevent contact and jamming, as shown in Figs. 9 and 10.

Mechanical power for the sequence tuning operation may be supplied by solenoid 54, having slidable core 54a. When the solenoid is energized, core 54a, normally in the full line position of Fig. 6, is drawn into the dotted line position. The core may have a slot cut near its end as at 54b for engaging cross member 55 of bail 56, pivoted as at 56a and 56b on housing 20, spring biased to full line position as by means of springs 57 and 58.

As will be observed from Figs. 2 and 5, the turret may have a groove 59 formed near its rear end and cross member 55 of bail 56, which is slightly offset at one end, passes through this groove. When the solenoid is energized and its core moves to the dotted position shown in Fig. 6, bail 56 is carried to the dotted position shown in Fig. 6, and the engagement of cross member 55, lying in groove 59 in the turret, carries the turret to the forward position shown in Fig. 7, whereby the tilt bar is swung to the position determined by the adjustment of the adjusting screw in contact with contact rod 12a of the tilt bar.

In order to prevent possible mistuning or jamming of the apparatus, which would result if the turret moved forward while out of position with respect to its rotation, we prefer to provide key 59a extending inwardly from the top of the housing and engaging corresponding key slots 60a, 60b, 60c, 60d, and 60e in the rim of flanges 50 and 51.

It was previously stated that on the return half of the turret stroke the turret is given one step of rotation to index it to the next station. In this particular embodiment, with provision for five stations, the amount of rotation introduced on each stroke will be 72°, but in any case it will be equal to 360° divided by the number of stations which the apparatus can handle.

The structure by which this rotation is accomplished will now be described. Referring particularly to Figs. 5 and 8, it will be observed that there are five pins, 61a, 61b, 61c, 61d, and 61e, projecting rearwardly from the rear face of the turret, these being spaced at the same radial distance from the center and spaced apart by equiangular distances, in this case 72°.

Positioning pawl 62 is mounted for oscillation on bushing 15c on the rear face of the housing. This is provided with pressure face 64 turned over in position to be engaged by actuating screw 65 carried by bail 56. The pawl 62 terminates at its outer extremity in a wedge-shaped nose portion 67 adapted to fit between any two adjacent pins such as 61c and 61d. This pawl is spring biased counter-clockwise by means of spring 68,

having one end secured to the housing and the other end secured to some part of the free end.

It will be observed that there is a slight clearance provided between adjusting screw 65 and pressure plate 64. This is provided so that as bail 56 swings, the turret will first be moved forwardly to clear pins 61c and 61d from pawl 62 before the latter is swung clockwise by the engagement of screw 65 with pressure plate 64. As the bail continues to swing under the pull of the solenoid, pawl 62 rotates clockwise to the position shown in Fig. 8 and is latched in this position by spring latch 69, the head of which may project inwardly through opening 70 in the housing.

Latch 69 is normally held in the position shown in Fig. 11 by engagement of one of the pins 61a, 61b, 61c, 61d, and 61e against its latch end, but as the turret moves forward the latch end moves in; and when lever 62 clears it, the latch takes the position shown in Fig. 11, holding lever 62 in the position shown in Fig. 8 until the turret again returns. When this occurs, the latch spring is pushed backwardly as in Fig. 12, and it will be noted that when the latch finally releases lever 62, its nose 69a is now in position to engage the next pin of sequence 61a, 61b, 61c, 61d, and 61e.

When the latch finally releases lever 62, the pressure of spring 68 restores lever 62 to the position shown in Fig. 5, rotating the turret through 72°. Thus, if the apparatus started in the position shown in Fig. 5 with pin 61a at the bottom, in the last portion of the return stroke lever 62 will rotate turret one step counter-clockwise, as seen in this figure, and 61b will now be at the bottom. Each successive operation of the solenoid will thus cause tuning to the station next on the tuning cycle and on the return stroke of the turret it is rotated by the amount necessary to index for the following station.

All that now remains to be described is the action of the interlock, which prevents pushing the manual tuning shaft into calibrating position except when the solenoid is energized. For this purpose the sequence switch indicated diagrammatically as 70 may have operating plunger 71 provided with knob or button 72. Plunger 71 may extend through the switch and project from the rear thereof, where it may be pivoted to bell crank lever 73 pivotally secured to any suitable mounting bracket.

The free end 74 of bell crank lever 73 may normally abut against manual tuning shaft 15a, and the latter may be provided with collar 75 secured thereto, which ordinarily engages end 74 of bell crank lever 73, and prevents inward displacement of the manual tuning knob.

When, however, the operator depresses knob 72 to close switch 70, bell crank lever 73 is rotated clockwise by an amount sufficient to clear collar 75, and manual tuning shaft 15a may now be pushed inwardly to engage tubular gear 17 with any one of the adjusting nuts. Upon release of the manual tuning knob and of the sequence switch knob, bell crank lever 73 and tuning shaft 15a return to the position shown in Fig. 1, locking the tuning shaft against inward displacement.

In the specification we have explained the principles of our invention and the best mode in which we have contemplated applying those principles, so as to distinguish our invention from other inventions; and we have particularly pointed out and distinctly claimed the part, improvement, or combination which we claim as our invention or discovery.

While we have shown and described certain preferred embodiments of our invention, it will be understood that modifications and changes may be made without departing from the spirit and scope thereof, as will be clear to those skilled in the art.

We claim:

1. In a sequence tuner, in combination, a positionable element, a tilt bar connected thereto for actuation thereof, a turret, mounted for rotation and axial translation, engaging said tilt bar on opposite sides of the tilt bar axis of rotation and setting it to one of a predetermined series of angular positions, and means for imparting a work and indexing stroke to said turret, said work stroke being an axial translatory movement, and said indexing stroke being a predetermined increment of rotation.

2. The combination claimed in claim 1, in which said turret carries a number of adjustable elements for engaging one side of said tilt bar, and a non-adjustable portion engaging the other side of said tilt bar.

3. The combination claimed in claim 1, in which said turret carries a number of adjustable elements adjacent its periphery for engaging one side of said tilt bar, and a non-adjustable portion closer to the center of rotation of said turret for engaging the other side of said tilt bar.

4. The combination claimed in claim 1, in which the tilt has two engageable portions at different distances from the center of rotation of the tilt bar, and in which said turret carries a number of adjustable elements for engaging one side of said tilt bar, and a non-adjustable portion for engaging the other side of said tilt bar.

5. The combination claimed in claim 1, in which said turret carries a number of adjustable elements for engaging said tilt bar, said elements being longitudinally adjustable, but fixed against rotation.

6. The combination claimed in claim 1, in which said turret carries a number of adjustable elements for engaging said tilt bar, said elements being longitudinally adjustable, but fixed against rotation, and each provided with an adjusting nut intermediate its ends arranged for rotation to effect longitudinal adjustment of its element.

7. The combination claimed in claim 1, in which said turret carries a number of adjustable elements for engaging said tilt bar, said elements being longitudinally adjustable, but fixed against rotation, and each provided with an adjusting nut intermediate its ends arranged for rotation to effect longitudinal adjustment of its element, said adjusting nuts being provided with external gear teeth, a manual tuning shaft carrying a driving gear, one of said adjusting nuts meshing with said driving gear when the turret is at the end of its work stroke.

8. The combination claimed in claim 1, in which said turret carries a number of adjustable elements for engaging said tilt bar, said elements being longitudinally adjustable, but fixed against rotation, and each provided with an adjusting nut intermediate its ends arranged for rotation to effect longitudinal adjustment of its element, said adjusting nuts being provided with external gear teeth, a manual tuning shaft carrying a driving gear, one of said adjusting nuts meshing with said driving gear when the turret is at the end of its work stroke, and said manual tuning shaft

being axially movable to mesh said driving gear and one of said adjusting nuts.

9. The combination claimed in claim 1 with a a manual shaft normally clutched to said tilt bar, and means for declutching said shaft when said turret is performing a work stroke.

10. The combination claimed in claim 1 with a manual shaft normally clutched to said tilt bar, a switch for controlling the work stroke of said turret, and an interlock preventing axial movement of said shaft except when said switch is in position to impart a work stroke to said turret.

11. The combination claimed in claim 1 in which the means for imparting an indexing stroke to said turret includes a spring-biased pawl engaging the turret, means for shifting said pawl after predetermined axial movement of said turret, means for latching said pawl in shifted position, and means for releasing said pawl as the turret returns to starting position to permit said pawl to rotate said turret to a new position.

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