

March 9, 1943.

H. J. LYMAN ET AL

2,313,653

TUNING MECHANISM

Filed Jan. 19, 1942

5 Sheets-Sheet 1

FIG. 1.

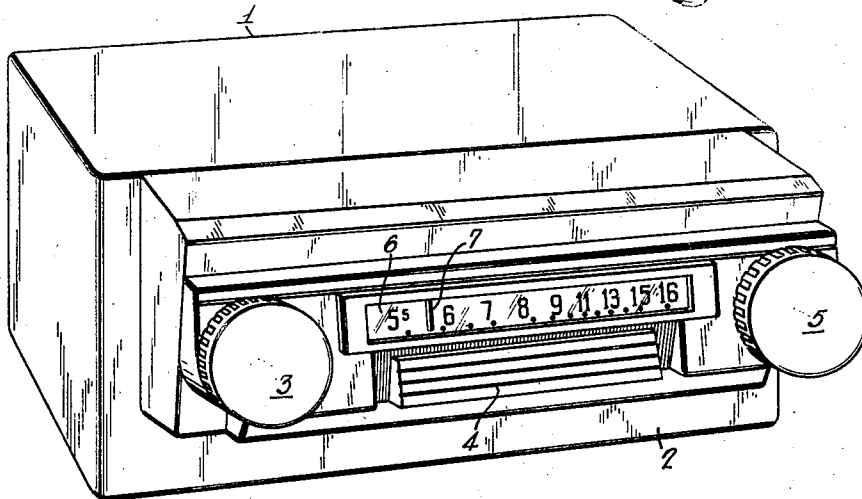
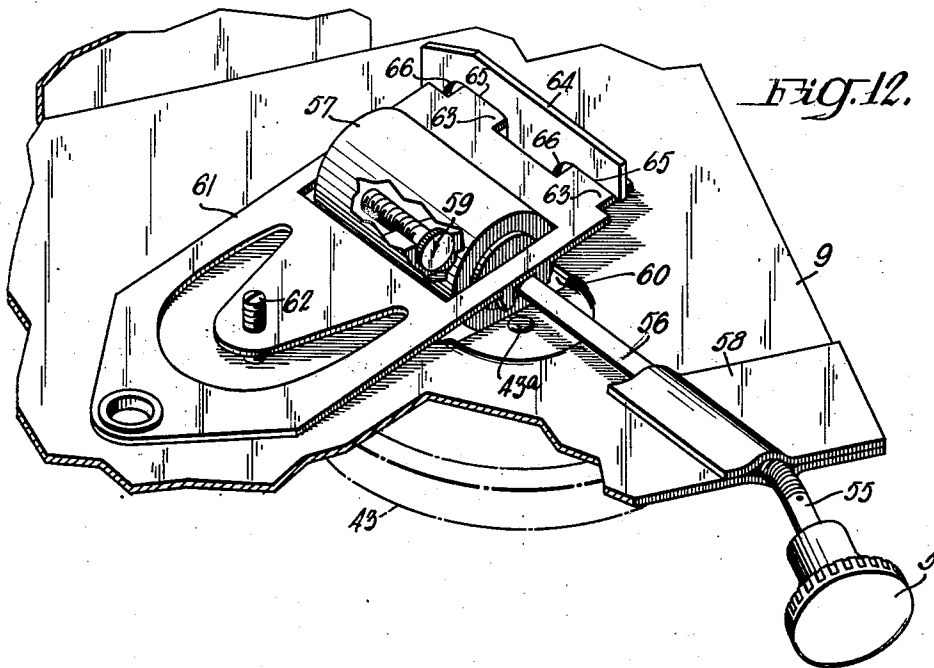


FIG. 12.



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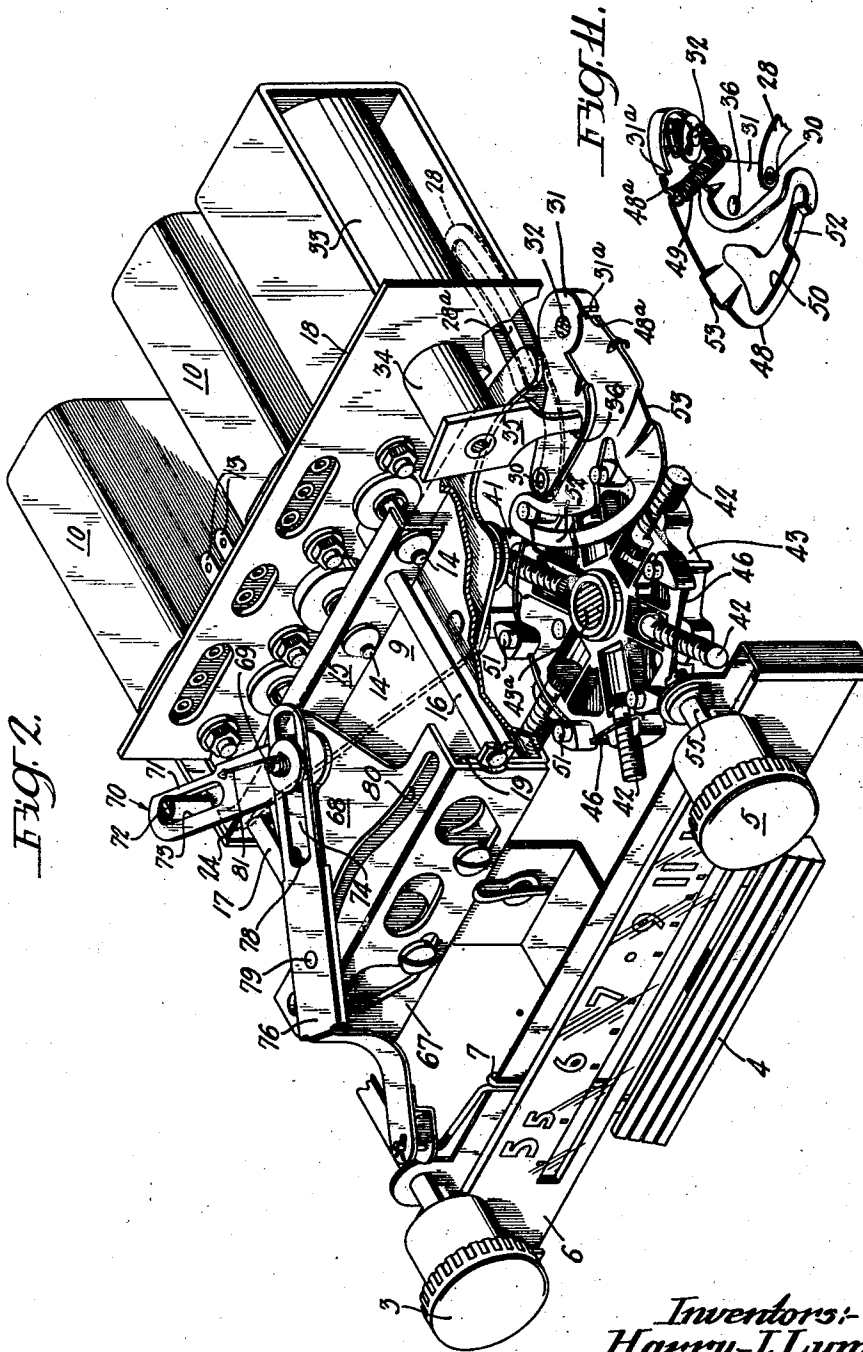
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5 Sheets-Sheet 2



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Fig. 3.

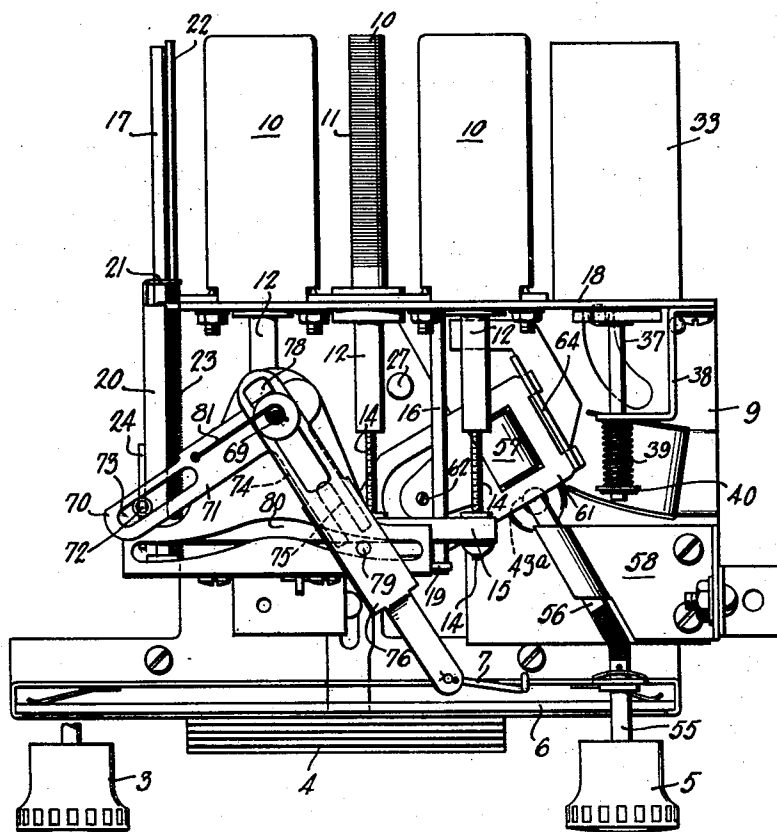
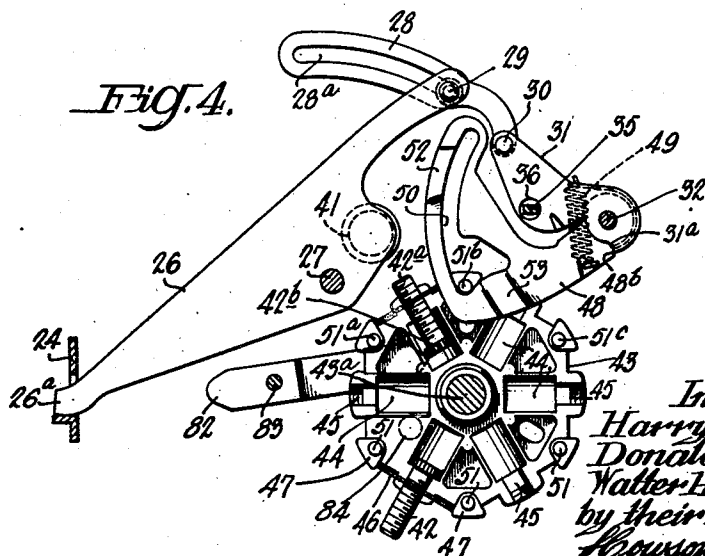


Fig. 4.



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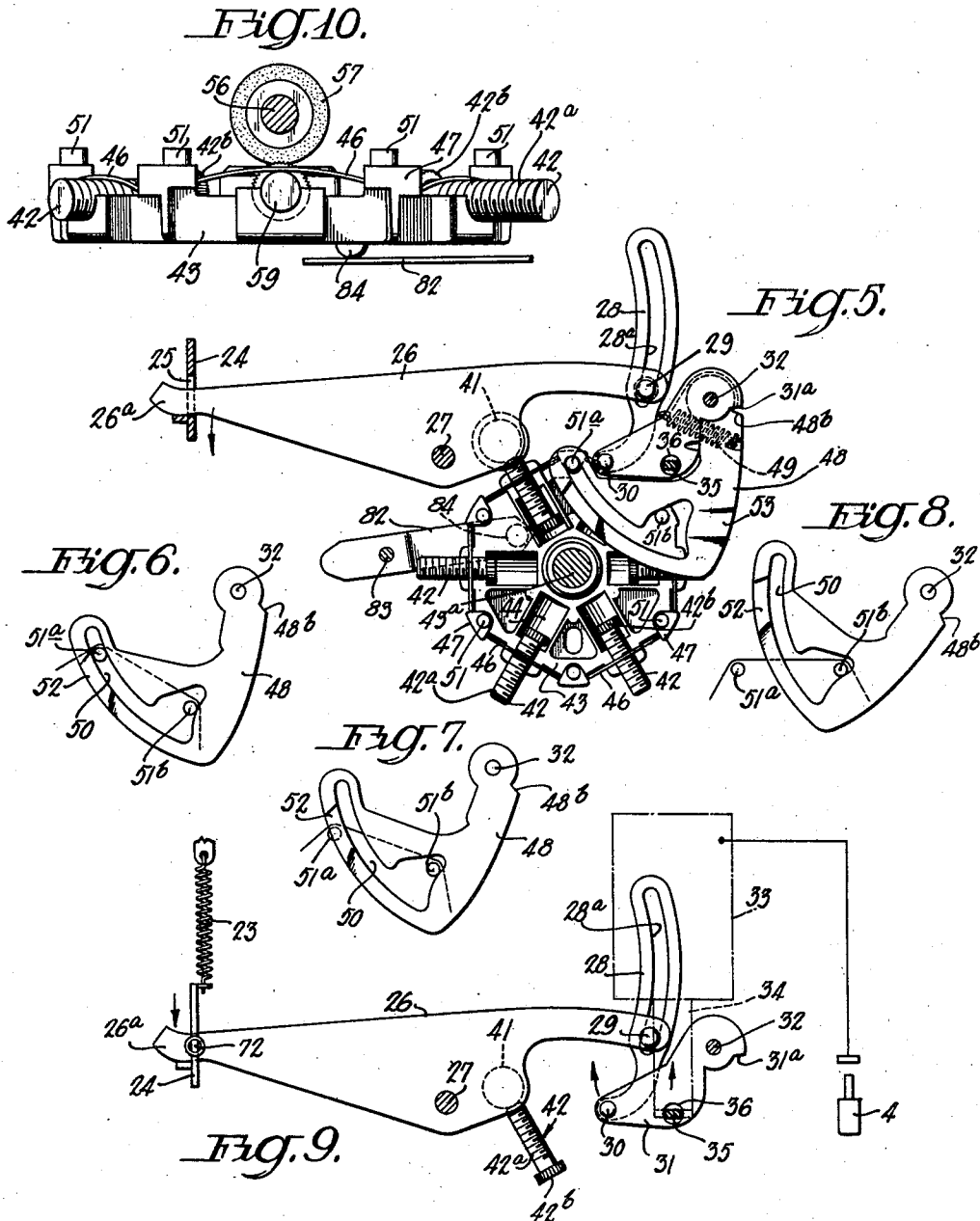
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TUNING MECHANISM

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5 Sheets-Sheet 4



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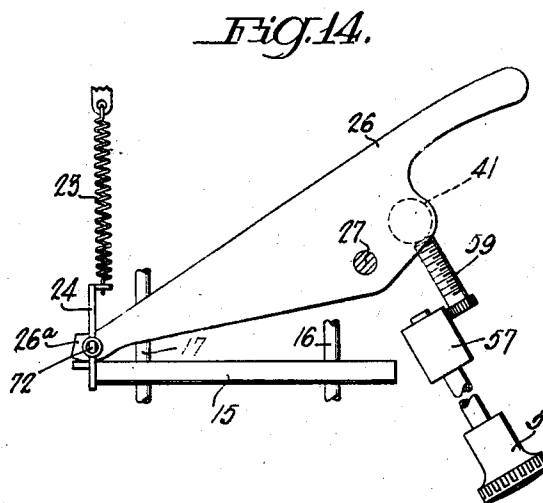
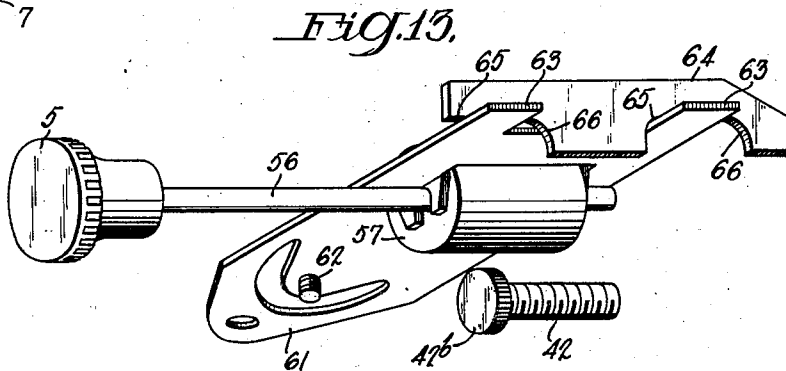
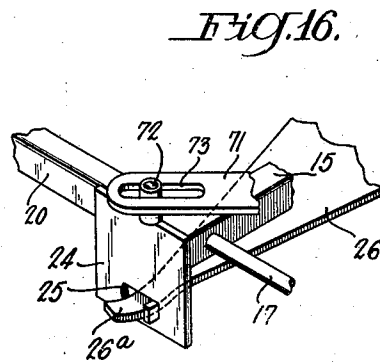
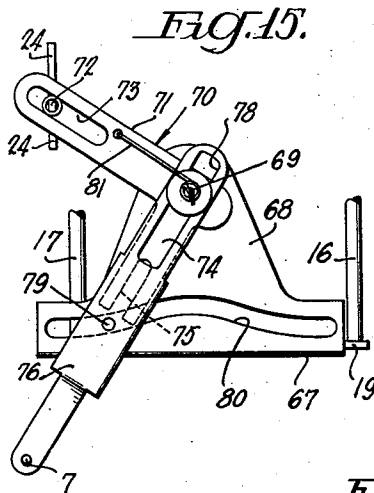
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TUNING MECHANISM

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,313,653

TUNING MECHANISM

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Application January 19, 1942, Serial No. 427,366

34 Claims. (Cl. 74-10)

This invention relates to new and useful tuning devices for radio receiving sets and the like, and relates especially to tuning devices that are selectively operable to effect both manual and automatic tuning of the receiver. More particularly, the invention is concerned with tuning devices that are operable by the controlled mechanical movement of one or more tuning elements to effect a change in the frequency to which the radio receiver will respond.

Mechanical tuning devices afford certain advantages over tuning mechanisms of the electrical type that involve, for example, the substitution of circuit elements. In general, tuners of the mechanical type are less expensive to manufacture for they do not require the numerous costly coils, condensers and switches that are employed in electrical tuners. Too, tuners of the electrical type are customarily employed with circuits employing but two tuned stages, whereas mechanical tuners generally may be used to tune as many stages as desired.

With the foregoing in mind, the principal object of the present invention is to provide a compact and unitary tuning mechanism of the mechanical type that overcomes the difficulties and disadvantages presented by prior devices of this general type, and is operable to tune as many stages as desired without materially adding to the cost or complexity of the device.

Another object of the invention is to provide a radio tuner that is capable of both manual and automatic operation with a minimum of effort and attention on the part of the operator; and wherein the change-over from one mode of operation to the other is very readily effected.

Another object of the present invention is to provide a tuning device of the character set forth that is capable of the extremely accurate and simultaneous tuning of a number of circuit elements.

Still another object of the invention is to provide a tuning device of the stated type wherein backlash is eliminated under conditions of both manual and automatic tuning.

Yet another object of the invention is to provide a tuning device as set forth wherein complete tuning accuracy is obtained without the use of costly, carefully machined parts.

A further object of the invention is to provide a tuning mechanism of the stated type wherein the automatic tuning controls are readily adjustable by the user to condition the apparatus to select a certain set of desired stations without

requiring the services of an expert serviceman, or the use of aligning instruments.

A still further object of the invention is to provide a tuning device embodying a novel stop-carrying member that is mounted for step-by-step rotation thereby to successively position the stops to vary the carrier frequency to which the radio set will respond.

These and other objects of the invention and the various features and details of the construction and operation thereof are hereinafter fully set forth and described and shown in the accompanying drawings, in which:

Figure 1 is a view in perspective of a radio receiving set incorporating a tuner of the present invention;

Figure 2 is a view in perspective of a tuning mechanism embodying the present invention, a portion of the base or mounting plate thereof being broken away to better illustrate certain details of the construction and operation thereof.

Figure 3 is a plan view of the mechanism shown in Figure 2.

Figure 4 is a plan view of a novel, rotary stop member and its associated linkage;

Figure 5 is a view similar to Figure 4, showing the relative positions of the several parts at the completion of an actuating stroke;

Figures 6 to 8 inclusive, illustrate successive positions of a portion of the operating linkage;

Figure 9 is a diagrammatic view in plan illustrating operation of the essential parts of the mechanism for effecting automatic tuning;

Figure 10 is a view in side elevation (enlarged) of the rotary stop member;

Figure 11 is a view in perspective looking upward at the lower face of the pivoted sector or linkage members shown in Figures 4 and 5;

Figure 12 is a diagrammatic view in perspective of a portion of the manual operating mechanism, a portion of which has been cut away to better illustrate certain features thereof;

Figure 13 is a diagrammatic perspective view looking upward at the underside of the mechanism illustrated in Figure 12;

Figure 14 is a diagrammatic operational view in plan illustrating the essential parts of the mechanism for effecting manual tuning; and

Figures 15 and 16 are plan and perspective views respectively, of parts of the mechanism for indicating the station to which the receiving set is tuned by the mechanism of the present invention.

The illustrated embodiment of the invention comprises, in general, a three coil inductance

tuner having a single movable carriage to which the core members of said tuner are secured. This carriage is moved by a lever pivoted intermediate its ends and one end of said lever is in driving relation with the carriage while the other end is arranged to be actuated by any suitable means, for example, a solenoid as in the present case. It will be clear that the lever may be actuated by other means, for example, by force applied directly by a manual control. For the purpose of determining the extent of movement of the carriage, there is provided a rotatable member or turret which carries a series of adjustable stops arranged in equally spaced radial relation around its periphery, and the arrangement is such that actuation of the aforesaid lever by the solenoid serves both to move the carriage and lever to one limit of their movement and also to rotate the turret member so as to bring its radial stops successively into position for engagement by said lever to predeterminedly position the same, suitable means being provided for urging the lever, from the limit position to which actuated, back into engagement with the particular stop then in operative position. Thus a different tuning position of the carriage is effected for each actuation of the pivoted lever.

In addition to the foregoing, the device comprises a manually operable member for effecting a simple manual control of the carriage tuning position by varying the position of a particular stop provided for the purpose on the rotary turret member. This manually operable member may also be employed to adjust any or all of the other radial stops on said rotary turret member to condition or set-up the apparatus for the automatic selection of predetermined desired stations. Provision is also made for indicating the station to which the set may be tuned by both automatic or manual operation.

Referring now particularly to the drawings, there is illustrated in Figure 1 an automobile radio receiving set 1 employing a tuning device or mechanism embodying the present invention mounted as a unit in the lower central portion of the casing 2, with the various control elements disposed as shown. In the particular embodiment shown, the controls comprise a conventional "off-on" volume control element 3, a pivoted switch-bar 4 for effecting automatic tuning of the set, and a manual tuning knob 5. A tuning indicator dial is shown at 6, and associated therewith is a pointer 7 which is caused to move transversely of the dial 6 in response to the tuning operations in a manner hereinafter more fully described.

The dial 6 is arranged to indicate the tuning position of the set under both manual and automatic conditions of operation, and to this end is provided with suitable indicia, such as, for example, the frequency designations shown thereon. It is a well recognized characteristic of inductance tuning devices that the rate of change of frequency is not uniform for equal increments of core movement and in the present embodiment this is compensated for by the use of a non-linear scale. It should be borne in mind that such compensation may be effected in other ways, for example, by varying the design of one or more of the operating parts of the device. If desired, the dial 6 may be of the novel edge and back lighted type shown and described in copending application of Burton and Nichol, Serial No. 434,952, filed March 16,

1942, and the device may be equipped with a suitable switch for energizing the back light only when the set is conditioned for manual operation.

Referring now to the tuning mechanism per se, and particularly to Figures 2 and 3 of the drawings, it will be observed that the entire mechanism is quite compact and easily handled, being mounted on a base or plate 9 which makes it possible to secure the mechanism as a unit within the radio receiver casing 2 simply by providing one or more suitable brackets to which the base or plate 9 may be secured.

The mechanism comprises a plurality of tuning devices 10 for tuning the circuits of the receiving set to select signals of different carrier frequencies. By way of example only, as it will be obvious that other tuning devices could be employed, the tuning devices 10 are of the variable inductance type, each comprising a coil 11 and a powdered iron slug or core 12 adapted to move into and out of its coil and thereby vary its inductance. In the particular mechanism shown, three such tuning devices 10 are provided and of these, the central one is shown without a casing (Figure 3). The tuning devices 10 constitute components of a radio receiving circuit (terminals 13) and as this general type of radio tuning is well known, it is neither necessary to illustrate the radio circuit in detail nor to show the connection of said tuning devices thereto.

The core 12 of each tuning device 10 is connected at its forward or outer end, by means of a screw or other suitable connector element 14, to a carriage 15 which is mounted upon a pair of spaced bars 16 and 17 for sliding movement toward and away from the tuning devices 10. These bars extend through suitable openings in said carriage and have their opposite ends suitably fastened to upstanding flanges 18 and 19 formed on the base plate 9.

As best shown in Figure 3 of the drawings, the carriage 15 is provided (at its lefthand end) with a rearwardly extending leg 20 having at its extremity a flange portion 21 which is apertured to slidably receive the aforesaid bar 17. Disposed adjacent and parallel to the bar 17 is a rod 22 of smaller diameter supported at spaced points along its length by the flange 19 of the base plate 9 and by the carriage flange 21. An expansible spring 23 is mounted upon the rod 22 and this spring reacts between the fixed upstanding flange 19 and the carriage flange 21 constantly to urge the carriage 15 in the direction of or toward the tuning devices 10 and the cores 12 thereof into their coils 11.

Mechanism is provided for moving the carriage 15 outwardly against the action of its spring 23, and also for effecting a step-by-step selection of various stop elements which serve to fix the position to which the carriage 15 and the connected cores 12 are actuated with respect to the coils 11 of the tuning devices 10 for each tuning position of the device. Thus, as best illustrated in Figure 16, there is secured to the side of the leg 20 of the carriage 15 a depending plate or block 24 having an opening 25 therein which is engaged by the outer end 26a of a lever 26. This lever 26 is pivoted intermediate its ends as at 27 (see Figure 9), and has its other or opposite end slidably connected by a pin and slot connection to a yoke member 28, the said yoke 28 having a slot 28a therein within which moves a pin 29 carried by the said lever 26. The base end of this yoke 28 is pivotally connected by means of a

pin 30 to a link 31 and this link 31 in turn is pivoted as at 32 to the underside of the base plate 9 of the device.

In the present case, actuation of the link 31 is effected by means of a solenoid 33 having a core 34 which is drawn into the solenoid upon energization thereof. This core 34 at its outer end carries a depending finger 35 which extends through an opening in the base plate 9 and is engaged with the link 31 through an opening 36 therein (Figure 2). The core 34 is fixedly mounted upon a rod or bar 37 which is slidably supported by a bracket 38, and a spring 39, mounted on said rod 37 and acting between said bracket 38 and a washer 40 at the outer end of the rod, operates to return the core 34 to its extended position upon deenergization of the solenoid 33.

In this connection, Figure 9 of the drawings illustrates the relative positions of the lever 26, yoke 28, link 31 and finger 35 when the solenoid 33 is deenergized, whereas the relative positions of these same parts when said solenoid 33 is energized are shown in Figure 4 of the drawings.

Thus, with the parts in their rest positions shown in Figure 9, energization of the solenoid 33 by depression of the switch bar 4 actuates the solenoid core 34 in the direction of the arrow with the result that its finger 35 causes the link 31 to move in a clockwise direction about its pivot 32 to the position shown in Figure 4 thereby simultaneously actuating the yoke 28 rearwardly and in turn the lever 26 in a counterclockwise direction about its pivot 27 into the relative positions shown in said Figure 4. This counterclockwise movement of the lever 26 in turn actuates the block 24 forwardly in the direction indicated by the arrow in Figure 9 thus moving the carriage 15 to its extreme forward limit of movement against the force of the spring 33. On the other hand, upon deenergization of the solenoid 33 the spring 39 operates to return the core 34 to its extended position and said core 34, at the same time, operates through its finger 35 to return the link 31 and yoke 28 to their rest positions shown in Figure 9, while the spring 23 operates to move the carriage 15 and its cores 12 inwardly and also to move lever 26 in a clockwise direction until an abutment 41 on the latter engages one of a plurality of stop members 42 thereby predeterminedly limiting clockwise movement of said lever 26 as well as inward movement of the carriage 15 and the cores 12 with the result that the devices 10 are adjusted to correspond with a particular carrier frequency.

The several stops 42 are carried by a member or turret 43 which is rotatably mounted at the underside of the base plate 9 by means of a central pin 43a. These stops 42 are in the form of screw elements each comprising threaded stem and knurled head portions 42a and 42b, respectively. The turret 43 is provided with a series of radially extending equally spaced apart recesses in which the stops 42 are positioned, and these each have an inner portion 44 of a size sufficient to permit of longitudinal movement therein of the head portions 42b of the stops, and also have a threaded outer portion 45 (see Figure 4) of reduced size to receive the threaded stem portions 42a of said stops, the threads on the recess portions 45 being arranged to mesh with the threads on the said stems of the stops so that the latter may be adjusted radially with respect to the turret 43 merely by turning the heads 42b of said stops in the appropriate direction. In order to hold the stops 42 in the recesses of the turret with the

threads on their stems 42a properly meshed with the threaded recess portions 45, there are provided relatively short lengths or spans of spring wire 46 (see Figure 10) which overlie the stems of the stops 42 and have their opposite ends engaged under suitable projections 47 spaced peripherally of the turret at points midway between the adjacent stop elements. As will be clear from any one of Figures 4, 5 and 9, each of the screws is intended to be adjusted to project a different distance from the turret, and thereby select a different station by varying the ultimate position of lever 26, and thence carriage 15.

The turret 43 is rotated step-by-step in a counterclockwise direction with respect to Figure 2 of the drawings so as to bring the stops 42 successively into position for engagement by the aforesaid abutment 41 on the lever 26. Rotation of the turret in this manner is effected likewise through actuation of the solenoid core 34 when the solenoid 33 is energized as aforesaid. To this end there is provided what may be termed a sector plate 48 and this plate 48 is mounted for pivotal movement about the aforesaid pin 32 which serves also as the pivot for the link 31. The sector plate 48 is resiliently coupled to said link 31 by means of a spring 49 of sufficient strength so that said plate 48 is actuated by movement of said link 31.

The sector plate 48 has a generally arcuate slot 50 formed therein and this slot is constructed and arranged to engage successively a series of upstanding pins 51 formed on each of the aforesaid turret projections 47 and thereby rotate the turret 43 in a step-by-step manner as herein-after more fully set forth and described.

Referring now to Figures 4 to 8 of the drawings, Figure 5 shows the relation of the mechanism, including sector plate 48 and turret 43, in their rest or deenergized solenoid position (cf. Figure 9), and Figure 4 shows said parts in the position to which actuated upon energization of the solenoid 33 (but before return of lever 26 against stop 42), while Figures 6, 7 and 8 illustrate diagrammatically the movements that take place as the sector plate 48 moves from the rest position in Figure 5 to the position in Figure 4.

In the rest position of sector plate 48 just prior to energization of the solenoid 33 shown in Figure 5, it will be observed that two of the pins 51 reside within the slot 50 and, to avoid confusion in describing the operation thereof upon energization of the solenoid 33, these two pins will be referred to as pin 51a and pin 51b, respectively, as indicated in Figures 4 to 8 of the drawings.

Referring now to Figure 6, the sector plate 48 has started to move in a clockwise direction about its pivot 32 in response to the pull of the solenoid 33 which is transmitted through the resilient coupling 49. At this stage of movement of the plate 48 the turret 43 has not yet moved as the slot 50 has merely moved a short distance relative to the pin 51a without moving the latter. Also at this stage (Figure 6) it will be seen that the other or succeeding pin 51b has been engaged by the base portion of the slot 50, and as rotation of the plate 48 continues it carries with it the said pin 51b thereby causing the turret to begin its rotary movement in a counterclockwise direction as shown in Figure 7. At this same stage (Figure 7), rotation of the turret 43, as aforesaid, causes the pin 51a to move outwardly from the slot 50 of plate 48 through an elevated or bridge portion 52 formed therein outwardly adjacent

said slot. This bridge 52 is most clearly illustrated in Figure 11 of the drawings.

In Figure 8, continued rotation of the plate 48 has moved the pin 51b and turret 43 approximately one-half of the distance from the initial position shown in Figure 5 toward the position thereof at the completion of the operation shown in Figure 4. Also, it will be observed that the pin 51a has now moved substantially away from the plate 48. In Figure 4 it will be observed that the sector plate 48 has carried the pin 51b into the position occupied by pin 51a prior to energization of the solenoid 33 thereby positioning the turret 43 and another of its stop elements 42 for cooperative engagement by the lever 26 which, at the same time, has been actuated to the extreme limit of its counterclockwise movement by the link 31 and yoke 28 as aforesaid. This cycle of operation, of course, is completed substantially instantaneously upon energization of the solenoid 33, and the result is a rapid step-by-step successive selection of the various stations that the radio set is conditioned to receive.

Upon completion of the aforesaid operation cycle and deenergization of the solenoid 33, the sector plate 48 is returned in a counterclockwise direction to the position shown in Figure 5 and in the course of this return movement the said plate 48 passes over the next of the pins 51 and engages the latter within its slot 50. To enable the plate 48 to pass over succeeding pins 51 upon its return movement, there is formed in the portion of the plate traversed by the pins an upwardly offset outwardly inclined ramp portion 53. This will be seen by reference to Figure 4 wherein the succeeding pin is designated 51c.

Referring again to the spring 49 that serves to resiliently couple the sector plate 48 to the link 31, as previously described, it is pointed out that, in addition merely to providing an actuating connection for the plate 48, this spring 49 serves three added useful purposes in the device. Thus spring 49 operates not only to reduce stresses that would otherwise occur due to the speed of movement of the solenoid core 34 and the inertia of the turret 43, and to permit the link 31 to continue its movement after the plate 48 has reached the limit of its movement until a stop 31a on said link moves into engagement with the edge 48b of said sector plate 48 as shown in Figures 4 and 11, but functions also to permit the sector plate 48 to be raised somewhat out of the plane of its rotary movement to facilitate and permit the ramp portion 53 of said plate 48 to pass over the next pin 51c and engage the latter in its slot 50 upon return movement of plate 48 in the manner previously described.

By permitting the link 31 to continue its rotation after the plate 48 has reached the limit of its travel as aforesaid, the turret and its particular stop element 42 is brought to and held in the proper operative position a moment prior to the time that the link 31 reaches its limit position and the solenoid is deenergized.

Summarizing the foregoing operation, upon energization of the solenoid 33 its core 34 is actuated inwardly and the finger 35 carried thereby moves the link 31 in a clockwise direction thereby actuating yoke 28 to move lever 26 in a clockwise direction and actuate the carriage 15 and its cores 12 to the limit of their outward movement. This same movement of link 31 serves also to actuate sector plate 48 in a counterclockwise direction, and the slot 50 therein

cooperates with one of the pins 51 to move the turret 43 and one of its stops 42 in a clockwise direction into a definite position with respect to the lever 26, so that upon deenergization of the solenoid 33 and the return of the link 31, yoke 28 and sector 48 to their rest positions, the said turret stop 42 will be engaged by the lug 41 on the lever 26 and thereby predeterminedly limit return movement of said lever 26. Engagement of stop 42 with lug 41 also limits inward movement of the carriage 15 and its cores 12 with respect to their coils 11 under the action of the carriage spring 23; with the result that the radio set is tuned to a signal of a particular carrier frequency.

Preferably a suitable switch (not shown) is interposed between the switch bar 4 and solenoid 33 and it is desirable that this switch be of the type that operates to mute the receiver while it is being tuned. This may be done, for example, by momentarily short-circuiting the loudspeaker and, as switches of this type are well known in the art, it is not necessary to illustrate or describe the same.

As previously stated, in addition to the automatic tuning mechanism, there is provided a manual control knob 5 operable to permit of continuous manual adjustment of the tuning devices 10 through the whole of the frequency band of the radio receiving set.

To this end the knob 5 is secured upon the outer end of a shaft 55 which is in turn flexibly connected to a shaft 56 that extends inwardly of the tuning mechanism and has a friction roller 57 of rubber or similar material secured on the inner end thereof as shown in Figures 3 and 12 of the drawings, the said shaft being journaled upon the base plate 9 by means of a suitably formed plate 58.

This friction roller 57 is adapted to engage the knurled head of a particular screw stop element 59 that is arranged upon and carried by the turret 43 in the same manner as the previously mentioned stop elements 42 except that the stop element 59 is disposed at an elevation slightly above that of the said stops 42 (see Figure 10). Provision also is made for engaging the roller 57 with the heads of the stops 42 as hereinafter set forth.

In order that the head of the screw stops 42 and 59 may be engaged by the friction roller 57, an opening 60 is provided in the base plate 9 overlying the turret 43 and the said roller 57 extends through this opening 60 as shown in Figure 12. Secured at one of its ends to the base plate 9 is a spring plate 61 the free end portion of which supports the shaft 56 and normally holds it at an elevation so that the friction roller 57 thereon is held in spaced relation above, and free from engagement with, the heads of the screw stops 42 but at an elevation that will permit said roller 57 to engage the head of the special stop 59 with the required amount of pressure to enable said stop 59 to be rotated and adjusted merely by rotating the knob 5. Adjustment of the plate 61 to this end, as well as to correct for manufacturing tolerances, may be accomplished by an adjusting screw 62 which is threaded through said plate 61 and arranged to bear against the underlying base plate 9.

From the foregoing it will be seen that after the turret 43 has been stepped (by energizing solenoid 33) to the position shown in Figure 5 with the special screw top 59 disposed beneath the friction roller 57 and in operative relation to

the abutment 41 of lever 26, the set may be tuned manually throughout its entire frequency band by manually rotating the knob 5 in the appropriate direction. This is shown diagrammatically in Figure 14 from which it will be observed that rotation of the friction roller 57 by means of the knob 5 will operate to advance or retract the special stop 59 thus imparting a corresponding movement to the lever 26 and thereby vary the setting of the carriage 15 and the cores 12 with respect to the coils 11 of the tuning devices 10.

Under both manual and automatic conditions of operation backlash is eliminated, as all parts are always maintained in firm contact with each other, under the influence of the various springs. This is possible because the device is of the abutment type throughout, i. e., the final position of the parts is always determined by each part abutting against another under the positive pressure of the springs.

As previously stated, provision is made for engaging the roller 57 with the other stops 42 in order that the latter may be adjusted to condition the receiver to receive a predetermined desired series of stations when automatically tuned upon energization of the solenoid 33 by actuation of the switch bar 4, and to this end, as shown in Figures 12 and 13 of the drawings, the free end of the spring plate 61 is provided with spaced projecting portions 63 which engage under a bridge plate 64 through spaced openings 65 formed therein, the bridge plate 64 being secured in upstanding relation upon the base plate 9.

Now the shafts 55 and 56 are mounted upon the base plate 9 in such manner that when pressure is applied inwardly to the knob 5 the said shafts, as well as the friction roller 57 and plate 61, are caused to move inwardly a short distance sufficient to engage the rearward edges of the aforesaid projections 63 against the adjacent or rearward edge portions of the openings 65 in the bridge plate 64. As best shown in Figure 13 of the drawings, these rearward edge portions of the openings 65 curve downwardly and provide cam surfaces 66 which, upon engagement thereof by the rearward edges of the plate projection 63, cause the plate 61 and friction roller 57 to be deflected downwardly a distance sufficient to cause said friction roller 57 to engage the heads of an underlying one of the stops 42 with enough pressure so that said stop 42 may be adjusted radially of the turret 43 by rotation of the knob 5 in the appropriate direction.

Thus it will be seen that each of the stops 42 may be brought into position beneath the roller 57 and the latter then engaged therewith by pressing inwardly on the knob 5 which may then be rotated in the appropriate direction to adjust that particular stop and consequently lever 26, carriage 15 and cores 12 to the position for receiving the station desired. Upon release of pressure on the knob 5 the particular stop 42 will remain in the position to which adjusted, and when said stop is moved by solenoid 33 into position for cooperation with the abutment 41 on lever 26 under conditions of automatic tuning, the receiver will be tuned to that station.

In this connection, it is pointed out that this adjustment of the stops 42 is effected with the receiving set in operation, and that the lever 26 is moved by the rotation of each stop 42 until a certain desired station is heard, the spring elements 46 serving to retain the stops 42 at the positions or settings to which adjusted. Adjustment and conditioning of the receiving set in this

manner is very easily accomplished and can be done by the owner or operator thereof without the necessity of a special servicing operation.

For providing positive visible indication of the tuning position under conditions of both automatic and manual tuning of the set, a novel mechanism is provided which is actuated through direct mechanical linkage with the carriage plate 24 that is moved by the lever 26. As shown in Figures 2, 15 and 16 of the drawings, secured to the flange 19 of base plate 9 is the vertical depending flange portion 67 of an angle member, the horizontal portion 68 of which extends inwardly and above the base plate 9 with sufficient clearance between the two for travel of the carriage 15. Pivotally connected by a pin 69 to this portion 68 of the angle member is a bell crank 70, one arm 71 of which extends outwardly to the carriage block 24 and is connected thereto by a pin 72 on said block which is slidably engaged in a slot 73 in said arm, while the other arm 74 of said bell crank 70 extends forwardly at right angles to said arm 71, and has its extremity bifurcated longitudinally as indicated at 75.

Overlying and arranged for relative sliding movement longitudinally with respect to the arm 74 of the bell crank 70 is an elongated member 76 which, at its outer end, carries the pointer 7 and at its inner end is provided with a longitudinal slot 78 in which the bell crank pivot pin 69 is slidably received. Also carried by and depending from the member 76 is a pin 79 which slidably engages a slot 80 formed in the portion 68 of the angle member adjacent and along the forward edge thereof.

Thus it will be seen that as the block 24 is moved outwardly by lever 26 or inwardly by the spring 23, the bell crank 70 is caused to pivot counterclockwise or clockwise about its pin 69 carrying with it the member 76 and causing the pointer 7 to traverse the dial 6. Rotary motion imparted to said bell crank 70 is converted into substantially straight line movement of the pointer 7 by the particular configuration of the slot 80 which causes the member 76 to slide longitudinally relative to the bell crank arm 74 by virtue of the slotted connection thereof with the pin 69, the bifurcation 75 at the extremity of said bell crank arm 74 providing a recess or clearance for pin 79 as the latter moves through the arcuate mid-portion of its slot 80. Embracing the pin 69 and extending outwardly and engaging the arm 71 of the bell crank 70 at a point remote from said pin is a spring member 81 which serves to urge the edge of the slot 73 in said arm 71 into contact with the pin 68 on the block 24 and thereby eliminate backlash resulting from too great a tolerance or looseness therebetween.

As previously stated herein the device may be equipped with a suitable switch for energizing a light (not shown) only when the mechanism is positioned for manual tuning thereof by the knob 5. As shown in Figures 4 and 5, this switch may comprise a suitably insulated spring element 82 fixed to the base plate 9 by a rivet or the like 83 and having a portion arranged to underlie the lower surface of the turret 43. Secured upon the underface of the turret 43 is a grounded contact 84 positioned so as to engage the spring element 82 and close the circuit therethrough only when the special screw stop 59 is positioned for cooperation with the lever 26 in the manner aforesaid.

From the foregoing it will be seen that the present invention provides a compact, unitary

tuning device of the mechanical type that is capable of both automatically and manually tuning with extreme accuracy a number of elements in a radio circuit without limitation as to the number of tuned stages employed. Too, the invention provides a novel construction and arrangement of parts whereby the automatic tuning controls can be readily and quickly adjusted by the user to condition the apparatus to select a particular set or series of stations without the necessity of having this done by an experienced serviceman, as in the past. This invention is further characterized by its complete tuning accuracy through elimination of backlash, and this has been accomplished in the present construction without the use of costly and precision machined parts.

While a particular embodiment of the invention has herein been illustrated and described, it is not intended that the invention be limited to such disclosure but that changes and modifications may be made therein and thereto within the scope of the annexed claims.

We claim:

1. In a tuning device for radio apparatus incorporating an adjustable tuning element, a first movable member operatively connected with said tuning element and actuable to adjustably position the same, a second movable member carrying a plurality of stops arranged for individual cooperation with said first movable member to stop the same and the tuning element at various predetermined positions, one of said stops normally being positioned to cooperate with said first movable member, mechanism for simultaneously moving the first movable member out of cooperative relation with the stops of the second movable member and for moving said second member to bring another stop into position for cooperation with said first movable member, and means operative independently of said mechanism for returning the first movable member into cooperative relation with said other stop.

2. In a tuning device for radio apparatus incorporating an adjustable tuning element, a movable member operatively connected with said tuning element and actuable to adjustably position the same, a rotary element carrying a plurality of stops arranged for individual cooperation with said movable member to stop the same and the tuning element at various predetermined positions, said stops being adjustable with respect to said rotary element and one of said stops being positioned to cooperate with said movable member, mechanism for simultaneously actuating the movable member out of cooperative relation with the stops of said rotary element and for rotating said rotary element to bring another stop into position for cooperation with said movable member, means for returning the movable member into cooperative relation with said other stop, and mechanism operable to individually adjust the stops with respect to the rotary member.

3. In a tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted member having one end operatively connected with said tuning element and actuable to adjustably position the same, a rotatable member carrying a plurality of spaced peripherally disposed stops arranged for individual cooperation with said pivoted member to stop the same and the tuning element at various predetermined positions, one of said stops normally being positioned to cooperate with the pivoted member,

mechanism for simultaneously actuating said pivoted member out of cooperative relation with the stops of said rotatable member and for moving the rotatable member to bring another stop into position for cooperation with the pivoted member, and means for returning said pivoted member into cooperative relation with said other stop.

4. In a tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever having one end operatively connected with said tuning element and actuable to adjustably position the same, a rotatable disk carrying a plurality of spaced circumferentially disposed stops arranged for individual cooperation with said pivoted lever to stop the same and the tuning element at various predetermined positions, said stops being adjustable relative to the rotatable disk and one of said stops normally being positioned to cooperate with the pivoted lever, mechanism for simultaneously actuating said pivoted lever out of cooperative relation with the stops of said rotatable disk and for moving the rotatable disk to bring another stop into position for cooperation with the pivoted lever, means for returning said pivoted lever into cooperative relation with said other stop, and mechanism operable to individually adjust the stops with respect to the rotary disk.

5. In a tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever having one end operatively connected with said tuning element and actuable to adjustably position the same, a member mounted for rotation adjacent said lever and carrying a plurality of stops disposed about its periphery, said stops being arranged in turn to individually cooperate with the lever to stop the same and the tuning element at various predetermined positions and one of said stops normally being positioned for cooperation with said lever, mechanism for simultaneously swinging the lever away from said member out of cooperative relation with the stops thereon and for rotating the member to bring another of said stops into position for cooperation with said lever, and means for returning said lever into contact with said other stop.

6. In a tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever having one end operatively connected with said tuning element and actuable to adjustably position the same, a disk member mounted for rotation adjacent said lever and carrying a plurality of radially adjustable stops circumferentially thereof, said stops being arranged in turn to individually cooperate with the lever to stop the same and the tuning element at various predetermined positions and one of said stops normally being positioned for cooperation with said lever, mechanism for simultaneously swinging the lever away from said disk out of cooperative relation with the stops thereon and for rotating the disk to bring another of said stops into position for cooperation with said lever, means for returning the lever into contact with said other stop, and mechanism operable to individually adjust the stops radially with respect to the disk.

7. In a tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever operatively connected with said tuning element and actuable to adjustably position the same, a disk carrying a plurality of stops arranged peripherally thereof and each extending a predetermined distance therefrom, said disk

being mounted for rotation adjacent said lever to position said stops successively for cooperation with the lever to stop the same and the tuning element at various predetermined positions and one of said stops normally being positioned for cooperation with said lever, mechanism for swinging the lever away from said disk out of cooperative relation with the stops thereon and for rotating the disk to bring the succeeding stop into cooperative relation with said lever, and resilient means for returning the lever into cooperative engagement with said succeeding stop.

8. In a tuning device for radio apparatus incorporating an adjustable tuning element, a first movable member operatively connected with said tuning element and actuable to adjustably position the same, a second movable member carrying a plurality of stops arranged for individual cooperation with said first movable member to stop the same and the tuning element at various predetermined positions, one of said stops normally being positioned to cooperate with said first movable member, mechanism for moving the first movable member out of cooperative relation with the stops of the second movable member, a pivoted plate actuable by said mechanism operable to engage said second member to bring another stop into position for cooperation with said first movable member, and means for returning the first movable member into cooperative relation with said other stop.

9. A tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever operatively connected with said tuning element and actuable to adjustably position the same, a disk carrying a plurality of stops arranged peripherally thereof and each extending a predetermined distance therefrom, said disk being mounted for rotation adjacent said lever to position said stops successively for cooperation with the lever to stop the same and the tuning element at various predetermined positions and one of said stops normally being positioned for cooperation with said lever, means for swinging the lever away from said disk out of cooperative relation with the stops thereon, a pivoted plate actuable by said means operable to engage and rotate the disk to bring the succeeding stop into cooperative relation with said lever, and resilient means for returning the lever into cooperative engagement with said succeeding stop.

10. In a tuning device for radio apparatus incorporating an adjustable tuning element, a first movable member operatively connected with said tuning element and actuable to adjustably position the same, a second movable member carrying a plurality of stops arranged for individual cooperation with said first movable member to stop the same and the tuning element at various predetermined positions, one of said stops normally being positioned to cooperate with said first movable member, mechanism for moving the first movable member out of cooperative relation with the stops of the second movable member, a plurality of drive elements carried by said second movable member, a pivoted plate actuable by said mechanism operable to engage one of said drive elements and move the said second member to bring another stop into position for cooperation with said first movable member, and means for returning the first movable member into cooperative relation with said other stop.

11. A tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever operatively connected with said tuning ele-

ment and actuable to adjustably position the same, a disk carrying a plurality of stops arranged peripherally thereof and each extending a predetermined distance therefrom, said disk being mounted for rotation adjacent said lever to position said stops successively for cooperation with the lever to stop the same and the tuning element at various predetermined positions and one of said stops normally being positioned for cooperation with said lever, means for swinging the lever away from said disk out of cooperative relation with the stops thereon, a plurality of drive elements carried by said disk, a pivoted plate actuable by said mechanism operable to engage one of said drive elements and move the rotating disk to bring the succeeding stop into cooperative relation with said lever, and resilient means for returning the lever into cooperative engagement with said succeeding stop.

12. A tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever operatively connected with said tuning element and actuable to adjustably position the same, a disk carrying a plurality of adjustable stops arranged peripherally thereof and each extending a predetermined distance therefrom, said disk being mounted for rotation adjacent said lever to position said stops successively for cooperation with the lever to stop the same and the tuning element at various predetermined positions and one of said stops normally being positioned for cooperation with said lever, means for swinging the lever away from said disk out of cooperative relation with the stops thereon, a pivoted plate actuable by said means operable to engage and rotate the disk to bring the succeeding stop into cooperative relation with said lever, resilient means for returning the lever into cooperative engagement with said succeeding stop, and means operable at will for individually adjusting the stops with respect to said disk.

13. A tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever operatively connected with said tuning element and actuable to adjustably position the same, a disk carrying a plurality of adjustable stops arranged peripherally thereof and each extending a predetermined distance therefrom, said disk being mounted for rotation adjacent said lever to position said stops successively for cooperation with the lever to stop the same and the tuning element at various predetermined positions and one of said stops normally being positioned for cooperation with said lever, mechanism for swinging the lever away from said disk out of cooperative relation with the stops thereon, a plurality of drive elements carried by said disk, a pivoted plate actuable by said mechanism operable to engage one of said drive elements and move the rotating disk to bring the succeeding stop into cooperative relation with said lever, resilient means for returning the lever into cooperative engagement with said succeeding stop, and means operable at will for individually adjusting the stops with respect to said disk.

14. In a tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever having one end operatively connected with said tuning element and actuable to adjustably position the same, a disk carrying a plurality of stops each extending a predetermined distance therefrom, said disk being mounted for step-by-step rotation adjacent the other end of said lever to position said stops successively for

cooperation with said lever to stop the same and the tuning element at various predetermined positions, a plurality of drive means carried by the disk, mechanism actuable to swing the lever away from said disk out of cooperative relation with the stops thereon, said mechanism including means operable upon each actuation of the mechanism to engage one of said drive means on the disk and bring a succeeding stop into cooperative relation with said lever, and means for returning the lever into contact with said succeeding stop.

15. In a tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever having one end operatively connected with said tuning element and actuable to adjustably position the same, a disk carrying a plurality of stops each extending a predetermined distance therefrom, said disk being mounted for step-by-step rotation adjacent the other end of said lever to position said stops successively for cooperation with said lever to stop the same and the tuning element at various predetermined positions, a plurality of drive means carried by the disk, mechanism actuable to swing the lever away from said disk out of cooperative relation with the stops thereon, said mechanism including means operable upon each actuation of the mechanism to engage one of said drive means on the disk and bring a succeeding stop into cooperative relation with said lever, means for returning the lever into contact with said succeeding stop, and means operable to return said mechanism to rest position ready for reactuation after each actuation thereof.

16. In a tuning device for radio apparatus incorporating an adjustable tuning element, a first movable member operatively connected with said tuning element and actuable to adjustably position the same, a second movable member carrying a plurality of stops arranged for individual cooperation with said first movable member to stop the same and the tuning element at various predetermined positions, one of said stops normally being positioned to cooperate with said first movable member, drive means carried by said second movable member, mechanism for moving the first and second movable members including a pair of resiliently coupled link elements, one of said link elements being in driving relation with said first movable member and operable to move the same out of cooperative relation with the stops of the second member and the other of said link elements being arranged to engage the drive means on said second member and rotate the same to bring another stop into cooperative relation with the first movable member, means in driving relation with one of said link elements for actuating the same, and means for returning the first movable member into cooperative engagement with said other stop.

17. In a tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever having one end operatively connected with said tuning element and actuable to adjustably position the same, a member mounted for rotation adjacent said lever and carrying a plurality of stops disposed about its periphery, said stops being arranged in turn to individually cooperate with the lever to stop the same and the tuning element at various predetermined positions and one of said stops normally being positioned for cooperation with said lever, a plurality of drive pins carried by said disk, mechanism operable to swing the lever away from the

disk out of cooperative relation with the stops thereon, a pivoted plate actuable by said mechanism and having oscillatory motion defining a drive stroke and a return stroke upon each actuation thereof, and said plate having an opening therein arranged during the drive stroke of the plate to engage one of the drive pins on the disk and rotate the latter to bring another stop into cooperative relation with said lever, and means for returning the lever into cooperative engagement with said other stop.

18. A construction as claimed in claim 17 wherein the pivoted plate is provided with an offset portion forming a clearance constructed and arranged to permit the drive pin engaged and actuated during the driving stroke of said plate to escape from the opening in the plate during the return stroke of said plate.

19. A construction as claimed in claim 17 wherein the pivoted plate is provided with a ramp portion operable during a return stroke of the plate to guide and position the succeeding drive pin in the opening in the plate for engagement and actuation thereby upon subsequent actuation of said plate.

20. A construction as claimed in claim 17 wherein the pivoted plate is provided with an offset portion and a ramp portion adjacent the opening therein, said offset and ramp portions being operable during the return stroke of said plate respectively to permit the drive pin engaged and actuated during the drive stroke of the plate to escape from said opening and to permit passage of the succeeding drive pin into the opening for engagement and actuation by the plate during the next driving stroke thereof.

21. In a tuning device for radio apparatus incorporating an adjustable tuning element, a first member operatively connected with said tuning element and actuable to adjust the same, a second member carrying a plurality of stops adapted individually to cooperate with said first member, drive means for actuating the first member away from said second member and the stop thereon, means for returning said drive means to its original position after actuation of said first member, means operative independently of said drive means for moving the first member back into contact with one of said stops, and a lost-motion connection between said drive means and said first member operable to permit the first member to be returned different distances than said drive means and free from interference with the full return of the latter to its original position.

22. A construction as claimed in claim 3 wherein the actuating mechanism comprises a first link mounted for pivotal movement around a fixed point, a second link adapted to be driven by said first link and having an elongated aperture therein, connecting means carried by the first link slidably engaging the aperture in said second link, an actuator including an armature having a driving connection with said first link, and means for returning said armature to its original position after each actuation of the drive means.

23. In a tuning device for radio apparatus incorporating an adjustable tuning element, a movable member operatively connected with said element and actuable to adjust the same, a disk mounted for rotation adjacent said member, a plurality of stop elements carried by said disk in threaded relation therewith and each of said stops being arranged to extend a predetermined

distance radially outward from the disk for individual cooperation with the movable member to stop the same and the tuning element at various predetermined preselected positions, means for effecting step-by-step rotation of said disk to position said stops successively in cooperative relation with said movable member, and means engageable with said stops when positioned for cooperation with the movable member operable manually to project or retract the stops radially with respect to the disk and thereby selectively predetermine the positions in which the movable member will be stopped.

24. In a tuning device for radio apparatus incorporating an adjustable tuning element, a movable member operatively connected with said element and actuable to adjust the same, a disk mounted for rotation adjacent said member, a plurality of stop elements carried by said disk in threaded relation therewith and each of said stops being arranged to extend a predetermined distance radially outward from the disk for individual cooperation with the movable member to stop the same and the tuning element at various predetermined preselected positions, means for effecting step-by-step rotation of said disk to position said stops successively in cooperative relation with said movable member, and means engageable with said stops when positioned for cooperation with the movable member operable manually to project or retract the stops radially with respect to the disk and thereby selectively predetermine the positions in which the movable member will be stopped, said means normally overlying said disk out of contact with most of the stops thereon and being actuable into contact with said stops individually for adjusting the same as the stops are positioned for cooperation with said movable member.

25. In a tuning device for radio apparatus incorporating an adjustable tuning element, a first movable member operatively connected with said tuning element and actuable to adjust the same, a second movable member carrying a plurality of stops arranged for individual cooperation with said first movable member to stop the same and the tuning element at various predetermined positions, one of said stops normally being positioned to cooperate with said first movable member and one of said stops being disposed at a level above the other stops, mechanism for simultaneously moving the first movable member out of cooperative relation with the stops of the second movable member and for moving said second member to bring another stop into position for cooperation with said first movable member, means for returning the first movable member into cooperative relation with said other stop, and means arranged normally to engage the one stop disposed at a level above the other stops when said one stop is positioned for cooperation with its first movable member, said means being operable manually to adjust said one stop and vary the position of the tuning element for manual tuning of the device.

26. In a tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever having one end operatively connected with said tuning element and actuable to adjustably position the same, a rotatable disk carrying a plurality of circumferentially disposed stops arranged for individual cooperation with said pivoted lever to stop the same and the tuning element at various predetermined positions, said stops being adjustable relative to the rotatable

disk and one of said stops normally being positioned to cooperate with the pivoted lever, mechanism for simultaneously actuating said pivoted lever out of cooperative relation with the stops of said rotatable disk and for moving the rotatable disk to bring another stop into position for cooperation with the pivoted lever, means for returning said pivoted lever into cooperative relation with said other stop, and mechanism operable to individually adjust the stops with respect to the rotary disk, said means normally overlying said disk out of contact with most of the stops thereon and being actuable into contact with said stops individually for adjusting the same as the stops are positioned for cooperation with said movable member.

27. In a tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever having one end operatively connected with said tuning element and actuable to adjustably position the same, a rotatable disk carrying a plurality of circumferentially disposed stops arranged for individual cooperation with said pivoted lever to stop the same and the tuning element at various predetermined positions, said stops being adjustable relative to the rotatable disk and one of said stops normally being positioned to cooperate with the pivoted lever, one of said stops being disposed at a level above the other stops, mechanism for simultaneously actuating said pivoted lever out of cooperative relation with the stops of said rotatable disk and for moving the rotatable disk and for moving the rotatable disk to bring another stop into position for cooperation with the pivoted lever, means for returning said pivoted lever into cooperative relation with said other stop, and means arranged normally to engage the one stop disposed at a level above the other stops when said one stop is positioned for cooperation with the first movable member, said means being operable manually to adjust said one stop and vary the position of the first movable member and the tuning element for manual tuning of the device.

28. In a tuning device for radio apparatus incorporating an adjustable tuning element, a pivoted lever having one end operatively connected with said tuning element and actuable to adjustably position the same, a rotatable disk carrying a plurality of circumferentially disposed stops arranged for individual cooperation with said pivoted lever to stop the same and the tuning element at various predetermined positions, said stops being adjustable relative to the rotatable disk and one of said stops normally being positioned to cooperate with the pivoted lever, one of said stops being disposed at a level above the other stops, mechanism for simultaneously actuating said pivoted lever out of cooperative relation with the stops of said rotatable disk and for moving the rotatable disk to bring another stop into position for cooperation with the pivoted lever, means for returning said pivoted lever into cooperative relation with said other stop, and means arranged normally to engage the one stop disposed at a level above the other stops when said one stop is positioned for cooperation with the first movable member, said means being operable manually to adjust said one stop and vary the position of the first movable member and the tuning element for manual tuning of the device, and said means being actuable into contact with the other stops when positioned for

cooperation with said lever thereby to adjust said other stops.

29. In a tuning device for radio apparatus incorporating a tuning element capable of both manual and automatic adjustment, a movable member operatively connected with said element and actuable to adjust the same, an element carrying a plurality of stops extending therefrom and each adapted to cooperate with said member to position the same, said stops further being adjustable with respect to said stop-carrying element to vary their extension therefrom, drive means for said movable member cooperating with certain of said stops to automatically and selectively position said member, one of said stops being adapted to vary the position of said movable member under the manual condition of operation, and means including a manual control movable between two positions and adjustable in each, adjustment of said control when in one position serving to actuate said manual tuning stop, and adjustment when in the other position serving to vary the extension of the automatic positioning stops.

30. A construction as claimed in claim 29 wherein the stops are in threaded engagement with the element and the manual control comprises a rotatable friction element engageable with said stops to rotate and thereby adjust the same.

31. For a radio tuning device capable of both automatic and manual control, a rotatable disk carrying a plurality of stops each in turn adapted when in operative position to determine the tuning position of said device, said stops comprising screw elements in threaded engagement with said disk with their longitudinal axes lying on substantially radial lines thereof, means for effecting step-by-step rotation of said disk, one of said stops lying at a different elevation than the others of said stops, a manually rotatable friction element mounted for movement toward and away from said disk and adapted to engage said stops to rotate and thereby vary the radial extension thereof from said disk, and resilient means normally urging said friction element away from said disk, said friction element being arranged normally to engage the stop of different elevation when in operative position to effect manual control of said tuning element, and said friction element being engageable with the others of said stops when in operative position to vary their radial extension from said disk upon movement of the friction element toward the disk against the action of said resilient means.

32. In a tuning device for radio apparatus in-

corporating an adjustable tuning element, a member operatively connected with said tuning element and actuable to adjust the same, a disk carrying a plurality of stops each extending a different distance therefrom, said disk being mounted for step-by-step rotation adjacent said member to position each of said stops for individual cooperation with the member to stop the same and the tuning element at various predetermined positions, means for simultaneously moving said member away from the disk and for rotating said disk to bring another stop into cooperative relation with the member, means for returning said member into contact with said other stop, and manually operable means arranged for cooperation with at least one of said stops when positioned to cooperate with the member thereby to vary the extension of said stop from the disk and provide manual control of the tuning element by varying the position of said member.

33. In a tuning device for radio apparatus incorporating an adjustable tuning element, means operatively associated with said element for adjusting the same and including a plurality of stops arranged individually to cooperate with said tuning element to stop the same at various predetermined positions, actuating mechanism operable simultaneously to actuate said means and the tuning element associated therewith and to cooperatively position one of said stops, means for returning said mechanism to rest position after each actuation thereof, and means operative independently of said actuating mechanism for returning the tuning element to a predetermined rest position after actuation thereof by said mechanism.

34. In a tuning device for radio apparatus incorporating an adjustable tuning element, means operatively associated with said element for adjusting the same and including a movable member and a plurality of stops arranged individually to cooperate with said member to stop the same and the tuning element at various predetermined positions, actuating mechanism operable simultaneously to actuate said means and the tuning element associated therewith and to cooperatively position one of said stops, means for returning said mechanism to rest position after each actuation thereof, and means operative independently of the mechanism for returning the member and the tuning element to a predetermined rest position after each actuation thereof.

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