June 10, 1941. F. L. CREAGER 2,244,678

AUTOMATIC TUNING MECHANISM

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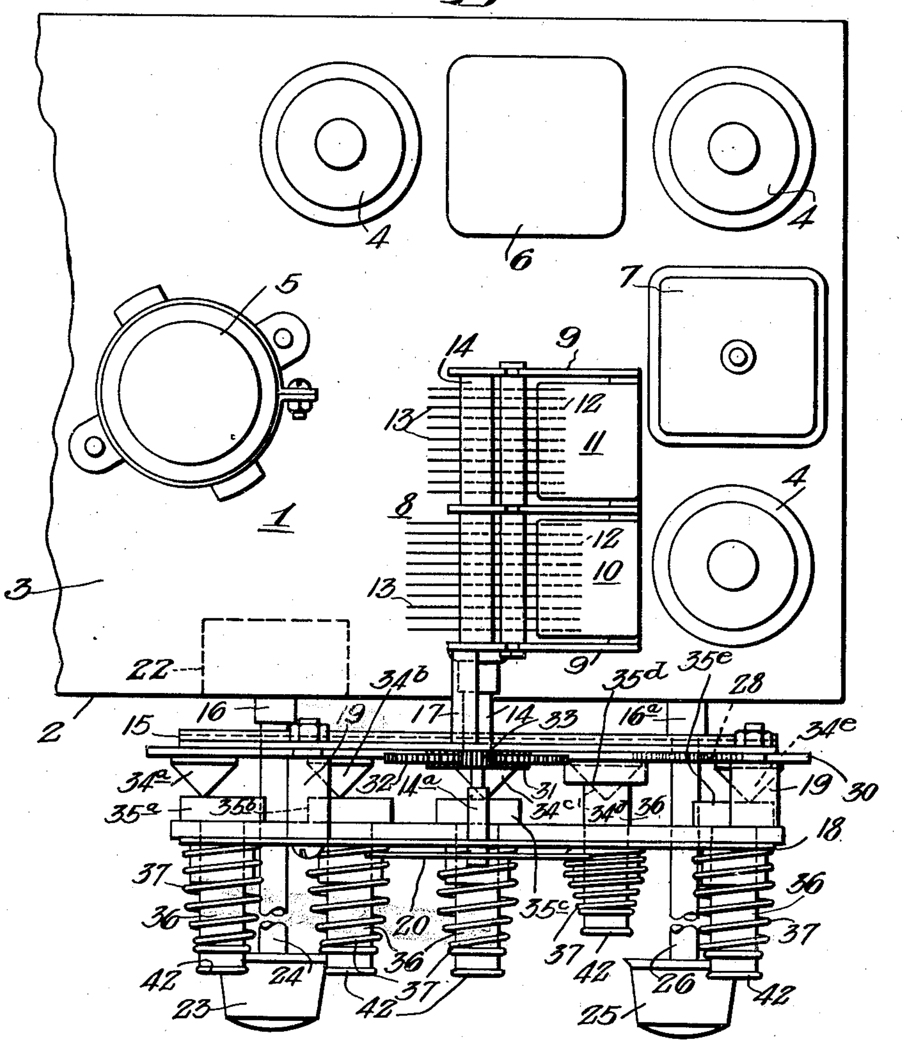
Fig. 1.



Inventor

Frederick L. Creager

By J. Huff

Attorney

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AUTOMATIC TUNING MECHANISM

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Fig. 2.

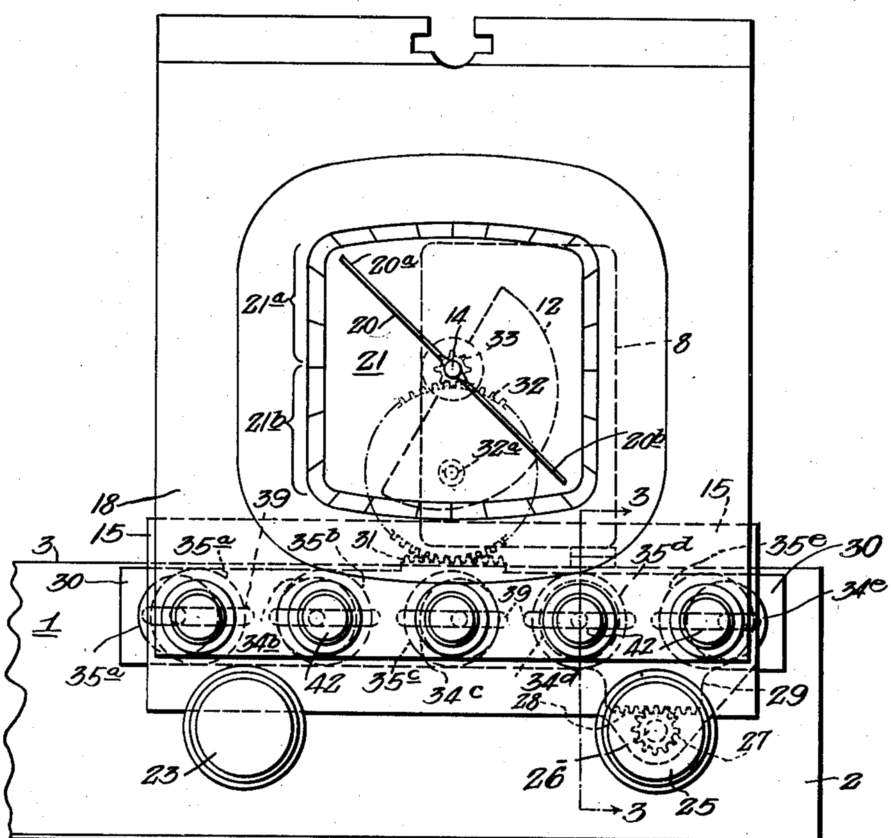
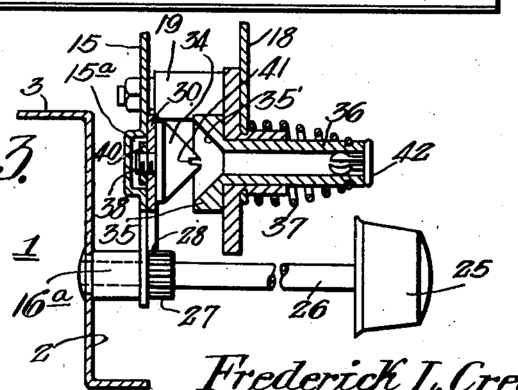


Fig. 3.



Inventor
Frederick L. Creager
By
J. W. Huff
Attorney

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AUTOMATIC TUNING MECHANISM

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Fig. 4.

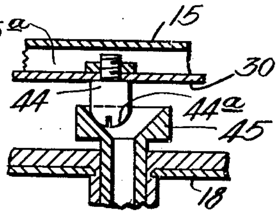


Fig. 5.

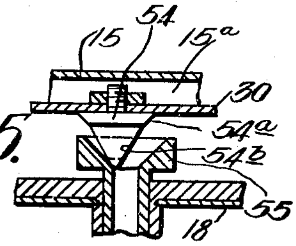
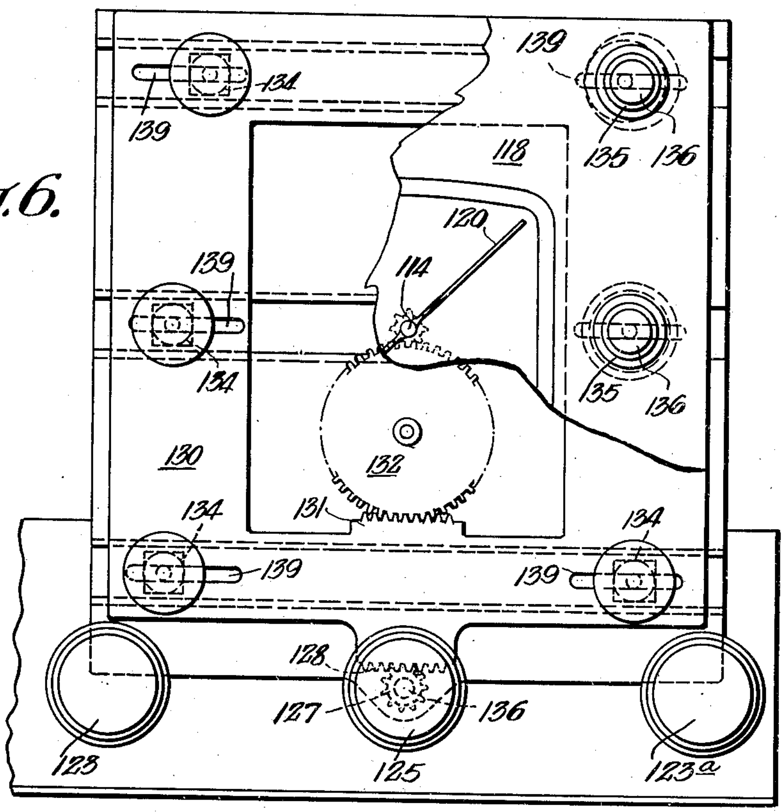


Fig. 6.



Inventor

Frederick L. Creager

By J. Huff

Attorney

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AUTOMATIC TUNING MECHANISM

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Fig. 7.

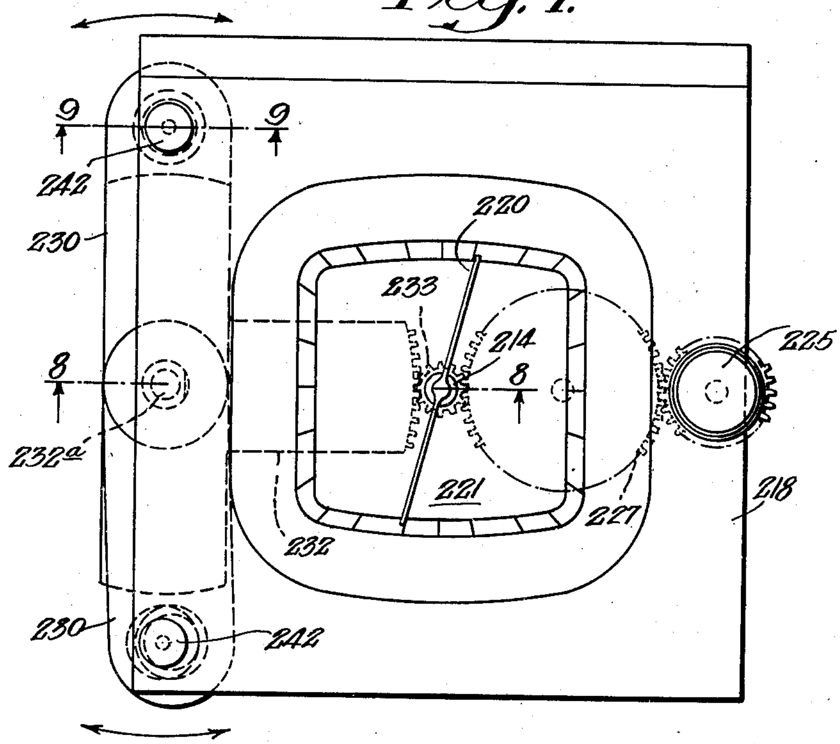


Fig. 8.

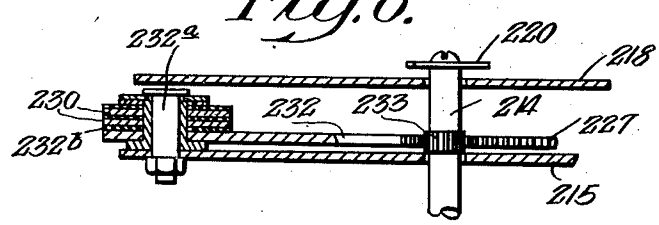
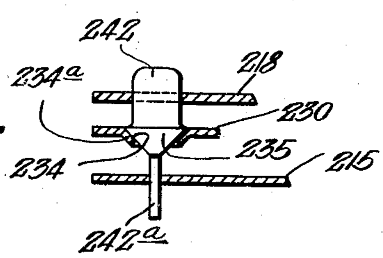


Fig. 9.



Inventor

Frederick L. Creager

By [signature]

Attorney

Patented June 10, 1941 2,244,678

UNITED STATES PATENT OFFICE

2,244,678

AUTOMATIC TUNING MECHANISM

Frederick L. Creager, Camden, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application September 24, 1937, Serial No. 165,469

5 Claims. (Cl. 74—10)

This invention relates to automatic tuning control systems for radio apparatus and the like, and particularly to a system wherein the tuning element of the controlled apparatus is actuated by mechanical means, as distinguished from systems employing electric motors for the same purpose.

A principal object of the present invention is to provide an improved and simplified "automatic tuner" of the mechanical preselection type.

Another object of the invention is to provide an extremely simple, inexpensive, compact, accurate and trouble-free selector mechanism for radio receivers, and one which lends itself readily to mass production methods.

Another object of the invention is to provide an automatic station selector of the type above referred to and wherein the stations may be set up conveniently from the exterior of the cabinet which houses the set.

Another object of the invention is to provide an automatic station selector capable of tuning-in a desired maximum of stations, and this too with the application of a minimum intensity of actuating force.

A further object of the invention is to provide a tuning device employing push-buttons for selecting the more frequently tuned stations (for example, "local" stations) and provided with the usual rotary knob for tuning the less frequently dialed stations (for example, distant and "short-wave" stations) and wherein the push-buttons are self-disengaging whereby the tuning mechanism is automatically "cleared" so that change-over from one mode of operation to the other is accomplished at will and without in any wise affecting the set-up of the preselector mechanism.

Still another object of the invention is to provide a novel mechanism for converting a simple thrust movement, applied selectively to any of several push-buttons, into torque capable of driving a rotor shaft through its entire range of movement, said mechanism being characterized by an economy and simplicity of parts.

Certain details of construction together with additional objects and advantages will be apparent and the invention itself will be more readily understood by reference to the following specification and to the accompanying drawings, wherein

Figure 1 is a top plan view of a portion of a radio receiver provided with an automatic tuning control mechanism embodying the invention,

Figure 2 is a front view in elevation of the apparatus of Fig. 1,

Figure 3 is a sectional view of the actuating mechanism taken on the line 3—3 of Fig. 2,

Figures 4 and 5 are elevational views, partly in section of alternative forms of driving elements suitable for use with the selector mechanism of the invention,

Figure 6 is a front view in elevation of another form of rack or driven member and showing an alternative arrangement of the station-selecting buttons or driving members,

Figure 7 is a front view in elevation of another embodiment of the invention,

Figure 8 is a sectional view taken on the line 8—8 of Fig. 7, and

Figure 9 is a sectional view taken on the line 9—9 of Fig. 7 and shows certain details of the actuating element there employed.

Referring now to Figs. 1, 2 and 3, wherein like reference characters designate the same parts in each figure: Here 1 designates generally a portion of a radio receiver chassis having a front panel 2 and a shelf or base 3 upon which base certain component parts such, for example, as tubes 4, a coil 5, a transformer 6, a fixed capacitor 7, and a variable tuning element 8, are mounted. The tuning element 8 may be constituted by a frame 9 containing one or more units 10 and 11 including the usual stator 12 and rotor plates 13. The rotor plates are mounted on a common tuning shaft 14 which is adapted to be rotated through a range of 180° in a manner later described.

As shown more clearly in Figs. 1 and 3, a mounting plate 15 is secured to the front panel 2 of the chassis 1, as by hollow studs 16, 16*a*, and is braced by additional studs or spacers 17 fixed to the condenser frame 9. The mounting plate 15 in turn supports a front dial plate 18 which is spaced therefrom and secured thereto by spacers 19 (Fig. 3).

An extension 14*a* of the main tuning shaft 14 extends through plates 15 and 18 and is provided with a double ended pointer 20 which is fixed directly on the end of the extension 14*a* so that its position accurately depicts the angular position of the main tuning shaft 14, and hence the setting of the condenser 8. The pointer 20, when read in connection with a dial 21 on the front plate 18, thus indicates the exact frequency to which the receiver is tuned.

The radio receiver which has been selected for purposes of illustration will be understood to comprise a two-band set having a band selector switch indicated generally at 22 (Fig. 1) and a dial 21 which is provided with a pair of 180°

arcuate scales 21a and 21b. One of the scales, say the top scale 21a, is allotted to the "broadcast" band, and the bottom scale, 21b, to another band, say a "short-wave" band. The correspondingly lettered ends of the double-ended pointer 20 are individual to these 180° dial scales. The band switch 22 may, as shown in Fig. 1, be controlled by a knob 23 affixed to a shaft 24 which extends to the front of the set through one of the hollow spacers 16 which supports the mounting plate 15.

As shown more clearly in Fig. 3, a second knob 25 on the end of a tuning control shaft 26, which extends from the front panel 2 of the chassis, through supporting stud 16a and the mounting plate 15, provides means for making tuning adjustments when the band selector 22 (Figs. 1 and 2) is switched to that position whereat the receiver is capable of translating "short-waves." Knob 25 may also be employed independently of the selector mechanism, later described for logging stations in the broadcast band.

The shaft 26 to which the tuning knob 25 is attached carries a pinion 27 (see Figs. 3 and 2) the teeth of which mesh with complementary teeth 28 on a dependent section 29 of a rack 30. This drive element 30 is supported for linear movement as in a groove 15a in the mounting plate 15. The upper edge of rack 30 is provided intermediate its ends with a toothed segment 31 which serves to drive a gear wheel 32 which is mounted for rotation as on a stud shaft 32a carried by the mounting plate 15. Gear 32, in turn, drives a pinion 33 carried on the main tuning shaft 14, so that this shaft and the rotor plates 13 thereon are rotated to vary the frequency of the set upon the application of torque to the tuning control knob 25.

The manual tuning mechanism, as thus far described, is of more or less conventional design. The automatic station selector of the invention utilizes the rack 30, gears 31, 32 and 33, and additional elements including a plurality of pre-set adjustable male members or "stops" 34a, 34b, 34c, 34d and 34e, one for each pre-selected station, and female or "stop-engaging" members 35a, 35b, 35c, 35d and 35e, individual, respectively, to each stop 34. The stop engaging members 35 are the driving elements of the preselector; each is affixed to the end of a hollow plunger 36, and the plungers are journaled in and are supported by the plate 18 which supports the tuning dial 21. The plungers are preferably equally spaced and each is provided with a spring 37 for returning it to its idle position. If desired, these springs may be covered by caps, not shown. The pre-set stops 34 are the driven members; they are adjustably secured to the rack 30, each by a screw 38 (Fig. 3) which extends rearwardly through one of a number of slots 39 with which the rack is provided. These screws 38 terminate within the groove 15a of the mounting plate 15; a nut 40, on each screw, retains each stop 34 against displacement with respect to the rack 30. The nuts are prevented from turning by contact with the top and bottom surfaces of the groove, whereby the screws are readily turned therein.

As clearly shown in Fig. 3, each stop or male member 34 may be in the form of a 90° included-angle cone and each stop-engaging or female member 35 has an opening of complementary contour for receiving and centering its stop when the plunger 36, to which the stop is affixed, is thrust inwardly. Each stop is provided at its apex with a slot 41 so that it may be loosened and tightened as by means of a screw driver (not shown). Adjustment of each stop may be made from the front of the set by removing a spring-retained cap 42 on the end of the plungers 36 and inserting the tool through the bore.

As previously indicated, the main tuning shaft 14 has a 180° range of rotation. Thus, to rotate this shaft through its entire range of movement the length of the toothed segment 31 on rack 30 should be no less than one-half the circumference of the pinion 33, for it is that distance which the rack must travel to rotate the tuning element from one limit of its movement to the other. Now, since one of the preselected stations to which the set is to be automatically tuned may be "at one end of the scale" (21a) and another at the other end, it is obvious that each stop engaging member 35 must be capable of driving its stop 34 (and hence the rack 30 and condenser shaft 14) this maximum distance. This condition is fulfilled when (a) the large diameter of the opening 35′ in the stop-engaging members 35 is substantially twice the length the rack must travel in driving the condenser shaft through its entire 180° range of movement and (b) when each stop 34 is so positioned with respect to its stop-engaging member 35 that its apex at all times falls within the large circumference of the opening 35′ of the stop-engaging member to which it is presented. In this latter connection (b) it will be noted that the length of each slot 39 in which the individual stops 34 are secured is such as to ensure that the apex of each stop will fall within the boundaries of its stop-engaging member 35.

The automatic tuner of the receiving set shown in Figs. 1 and 2 is provided with five plungers or push-buttons 36 and a similar number of stops 34 and stop-engaging members 35. It is thus capable of rotating the main tuning shaft 14 selectively and automatically to any five angular positions required to achieve that number of different station frequencies.

Assuming now that it is desired to "set-up" the automatic tuning mechanism of Figs. 1 and 2. In order to do this the cap 42 on each plunger 36 is removed and each stop 34 loosened as by means of a screw driver (not shown) which is inserted through the bore of the plunger into engagement with the slot 41 with which each stop is provided (see Fig. 3). With the current turned on, the manual tuning knob 25 is then rotated to bring in the first of the desired stations. With the set perfectly tuned to that frequency, one (any one) of the plungers 36 is pressed in to the limit of its movement. Since the stops 34 have been loosened, each is free to move with respect to the rack 30. This relative movement is initiated when the stop 34 contacts the wall of the opening 35′ in the inwardly moving stop-engaging member 35, and terminates when that stop is perfectly centered with respect to its stop-engaging member. The correctly centered stop is then tightened on the rack, some care being taken that the rack is not inadvertently moved during the tightening operation. Thus, the apparatus is set up for one station.

The manual tuning knob 25 is then turned to tune the apparatus to the frequency of a second desired station. Another button or plunger is assigned to this station and the stop individual to the selected plunger is centered with respect to its stop-engaging member (by pressing in that plunger) and then tightened on the rack by means of the screw driver. The other stations are set up in the same manner. It is immaterial which plunger is assigned to a given station frequency. For example, it is not necessary that a button on the left of center be assigned to a station whose frequency is indicated at a point on the left side of the dial.

Referring particularly to Fig. 1: When the apparatus is set up to the different stations, the stops (five in this case) **34**[a], **34**[b], etc. are spaced different distances from each other (and hence different distances from the respective centers of the uniformly spaced stop-engaging members **35**[a], **35**[b], etc.), as determined by the different degrees of rotation required by the rack **30** to rotate the condenser shaft **14** from any given angular position to any of the selected positions whereat a particular station is tuned in.

As previously set forth, regardless of the relative setting of the stops, the apex of each stop is always directed to a point within the opening of its stop-engaging member. It will, therefore, be apparent that each stop engaging member is adapted to engage and to drive its stop irrespective of the position of the rack upon which the stops are mounted. Thus, regardless of the frequency to which the receiver has previously been tuned, the actuation of a plunger (say **36**[d], Fig. 1) individual to another station will bring the inclined surface of the stop-engaging member **35**[d] on the end of that plunger **36**[d], into contact with a portion of the surface of its stop **34**[d] and continued inward movement of the plunger will cause a movement of the stop **34**[d] (and hence of the rack **30**, gears **32**, **33**, and tuning shaft **14**) which movement is not halted until the stop is perfectly centered in its stop-engaging member, at which time the plunger will have reached the limit of its movement. Each pair of complementary members **34**—**35** may therefore be said to include means operable at the limit of the above-described movement for locating the variable tuning element at the position whereat the selected frequency, individual to each stop and its stop-engaging member, is achieved.

As previously set forth, each button or plunger **36** is preferably provided with a spring **37** for returning it to its idle position. In their idle positions, the stop-engaging members **35** are out of engagement with their stops **34** so that the set is in condition to be operated either automatically by means of the plungers **36** or manually by means of the tuning knob **25**. Changeover from one mode of operation is thus possible without any positive supplementary action on the part of the operator.

The stops **34** need not necessarily be in the form of 90° included angle cones, as shown in Figs. 1, 2 and 3, but may be mere cylinders, as indicated at **44**, Fig. 4, in which case the end presented to the stop-engaging member **45** is preferably rounded, as shown at **44**[a]. Alternatively, and as shown in Fig. 5, the stops may be in the form of a generally conical member **54** having two surfaces of revolution (**54**[a] and **54**[b]) exhibiting different degrees of convergence, in which case the angle of that portion **54**[a] of its surface adjacent its base preferably is the same as that of its stop-engaging member **55**. The stops **44** and **54** of Figs. 4 and 5 respectively possess the advantage of requiring less force to initiate their movement. This is so because only a small fraction of their surfaces of revolution is in contact with the stop-engaging members at the time when they are being moved. Further, the angle of engagement is smaller and the subsequent movement is more in the nature of a "thrusting" than "wedging" movement.

The driven member or rack, **30**, of the embodiment of the invention shown in Figs. 1, 2 and 3 is a mere strip of metal with the stops **34** arranged in line thereon, and the actuating members **36** are similarly arranged, in register with these stops, beneath the dial **21**. Other arrangements of the station selecting or actuating members may be made without departing from the spirit or scope of the invention. Thus, in Fig. 6 a four sided rack, here designated **130**, is shown, making it practical to distribute the stops **134** and hence the selector buttons or plungers **136** at various points about the dial plate **118**. In this embodiment of the invention, the slots **139**, in which the stops **134** are adjustably fixed, are arranged in two groups of three, the slots in each group (one group is on the left arm of the rack **130** and the other group on the right arm) are arranged one above and in line with another. As in the first described embodiment of the invention, the long dimension of these duplicate slots, and hence the limits within which each stop must be set, corresponds to the distance the rack must be moved to rotate the tuning shaft **114** through its entire 180° range of movement. As previously described, the stops are individual to the separate frequencies and are relatively spaced in their slots as determined by the different degrees of movement required by the rack to rotate the tuning shaft from any given position to any of the selected positions individual to the different station frequencies. The plunger **136** to which the stop-engaging members **135** are affixed are preferably equally spaced from each other on the dial plate **118**.

Referring still to Fig. 6, the tuning control knob **125** is here shown disposed in line with the center of the dial plate. The pinion **127** and teeth **128** actuated by the shaft **136** to which knob **135** is affixed are conveniently similarly disposed. The knob **123** for actuating the wave change switch and another knob **123**[a] for actuating a manual volume control (not shown) are shown arranged, in the interests of symmetry, on opposite sides of the tuning control knob **135**. The embodiment of the invention shown in Fig. 6 may otherwise be similar in all respects to that shown in Figs. 1 and 5, inclusive.

In the embodiments of the invention thus far described, the driving elements or stop-engaging members **35**, Figs. 1 to 3; **45**, Fig. 4; **55**, Fig. 5; and **135**, Fig. 6, are female elements and the stops **34**, Figs. 1 to 3; **44**, Fig. 4; **54**, Fig. 5; and **134**, Fig. 6, are male elements. The relative form of the stops and stop-engaging members may be reversed if desired. This is brought out, together with certain other modifications, in the embodiment of the invention shown in Figs. 7 to 9, inclusive.

In Figs. 7 to 9, the main tuning shaft is designated **214**, the rear mounting plate **215**, and the dial plate **218**. As in the previously described embodiments a two-band dial scale **221** and double-ended pointer **220** are shown. In the interests of simplicity these drawings show but two station selecting elements **242**. They are arranged on one side of the dial plate. Each element or button **242** has an extension **242**[a] (Fig. 9) of a reduced diameter which is journaled for axial movement in the rear mounting plate **215** and is provided intermediate its ends with a male (instead of a female) driving or "stop-engaging" element **235** of conical contour. When a button is depressed, the sloping surface of the male element thereon will engage a complementary sloping surface of a driven female or "stop" element **234** which may constitute an orifice having a bevelled rim **234a** arranged adjacent the end portion of a surface of an arm **230** which is pivoted as at **232a** on the rear mounting plate **215**. Only one female element may be arranged on any given arm since each is individual to a given station frequency. When a given arm is actuated (by the force incident to the centering of its male and female elements) its movement will be a pivotal one, about the common axis **232a** of the several arms **230**, instead of a linear movement, as in the case of the driven element (rack **30**, or **130**) of the earlier described embodiments of the invention.

The pivotal movement of an arm **230** serves to move a gear sector **232** to which the several arms are fixed as by means of a washer **232b** (see Fig. 8). The gear sector in turn drives a pinion **233** secured to the main tuning shaft **214**. The degree of movement imparted to the gears **232–233** and shaft **214** depends upon the arcuate distance an arm **230** must be moved to center its stop-engaging male element **235** with respect to its stop or female element **234**. The curved arrows adjacent the ends of the arms indicate such pivotal or arcuate movement.

In order to rotate the shaft **214** to the different angular settings required to achieve the selected station frequencies, the arms **230** must be fixed to the gear sector at certain angles. (It will be noted in connection with Fig. 7 that the arms **230** intersect the line 8—8 at different angles.) To adjust the relative angle between arms **230**, first one and then another of the buttons **242** is depressed and held in while the tuning knob **225** is forcibly turned (to overcome the friction of the washer **232b**) to the desired stations. Torque applied to knob **225** and transmitted through gear **227** and pinion **233** to the gear sector **232** will serve to move the gear sector with respect to that arm which is being momentarily held against movement. Thereafter (the buttons being released), each arm **230** is relatively fixed with respect to the gear sector **232** by the friction washer **232b** and movement of an arm resulting from the "centering" action of the male and female elements **235**, **234**, produces a corresponding movement of the gear sector **232** and tuning shaft **214**.

Obviously, more than two arms can be affixed to the gear sector providing only that they are preset at different angles. Alternatively, a second, or indeed a third, sector (not shown) all meshing, if desired, with the same pinion **233** may be provided. Other modifications will suggest themselves to those skilled in the art. It is to be understood, therefore, that the foregoing is to be interpreted as illustrative and not in a limiting sense, except as required by the prior art and the spirit of the appended claims.

What is claimed is:

1. In a radio apparatus, an element to be tuned, a rotor shaft on which said element is mounted, driven means connected to said shaft, a plurality of preset adjustable stops on said driven means and through which a driving force for rotating said shaft may be applied to said driven means, and a movable stop engaging member for applying said driving force mounted adjacent each stop, said stops and stop engaging members comprising male and female elements, the opening in each female element being of a diameter sufficient to permit the entrance therein of its male element irrespective of the position to which said driven means may be moved.

2. The invention as set forth in claim 1 wherein said driven means is constituted by a toothed rack having duplicate slots therein within which said pre-set stops are seated, and wherein the dimensions of each of said slots and hence the limits within which each stop must be set corresponds to the distance said rack must be moved to rotate said shaft through its entire range of movement.

3. The invention as set forth in claim 1 wherein said stop engaging members are contained on plungers mounted for axial movement and which extend to the exterior of said apparatus, said plungers being hollow to permit of access to said pre-set stops for purposes of adjustment.

4. In a radio apparatus, a variable tuning element requiring different degrees of angular movement to tune said apparatus to separate selected frequencies, a rotor shaft on which said tuning element is mounted, a driven element connected to said shaft for rotating said shaft through its entire range of movement, and means for selectively applying a driving force to said rotor shaft through said driven element sufficient to move said variable tuning element from any given position to any of said selected angular positions, said driving means comprising a plurality of spaced stops mounted on said driven element, a plurality of movable female stop-engaging members individual to said stops and each of a diameter sufficient to engage its stop irrespective of the position of said driven element, and means including the selected stop and its stop-engaging member for halting the movement of said driven element when said rotor shaft completes the movement it requires to move said tuning element to that angular position whereat the selected frequency is achieved.

5. In a radio apparatus, a variable tuning element, a rotor shaft on which said element is mounted, driving and driven elements operatively connected to said shaft for rotating said shaft through its entire range of movement, and auxiliary means for rotating said shaft from any given angular position to any of a plurality of selected angular positions, said auxiliary means comprising a plurality of pre-set adjustable stops of substantially conical contour mounted on a common driven element for applying a driving force thereto, said stops being spaced one from another as determined by the different degrees of movement required by said driven means to rotate said shaft from the limits of its movement to any given of said selected angular positions, a movable stop engaging member for each stop for applying a driving force to said driven element, said stop engaging members each being of a contour complementary to its stop and of a diameter sufficient to engage and to drive its stop irrespective of the position of said driven element.

FREDERICK L. CREAGER.