May 7, 1946. G. C. PERKINS 2,400,052

RADIO TUNING MECHANISM

Filed July 2, 1942 2 Sheets-Sheet 1

FIG. 1.

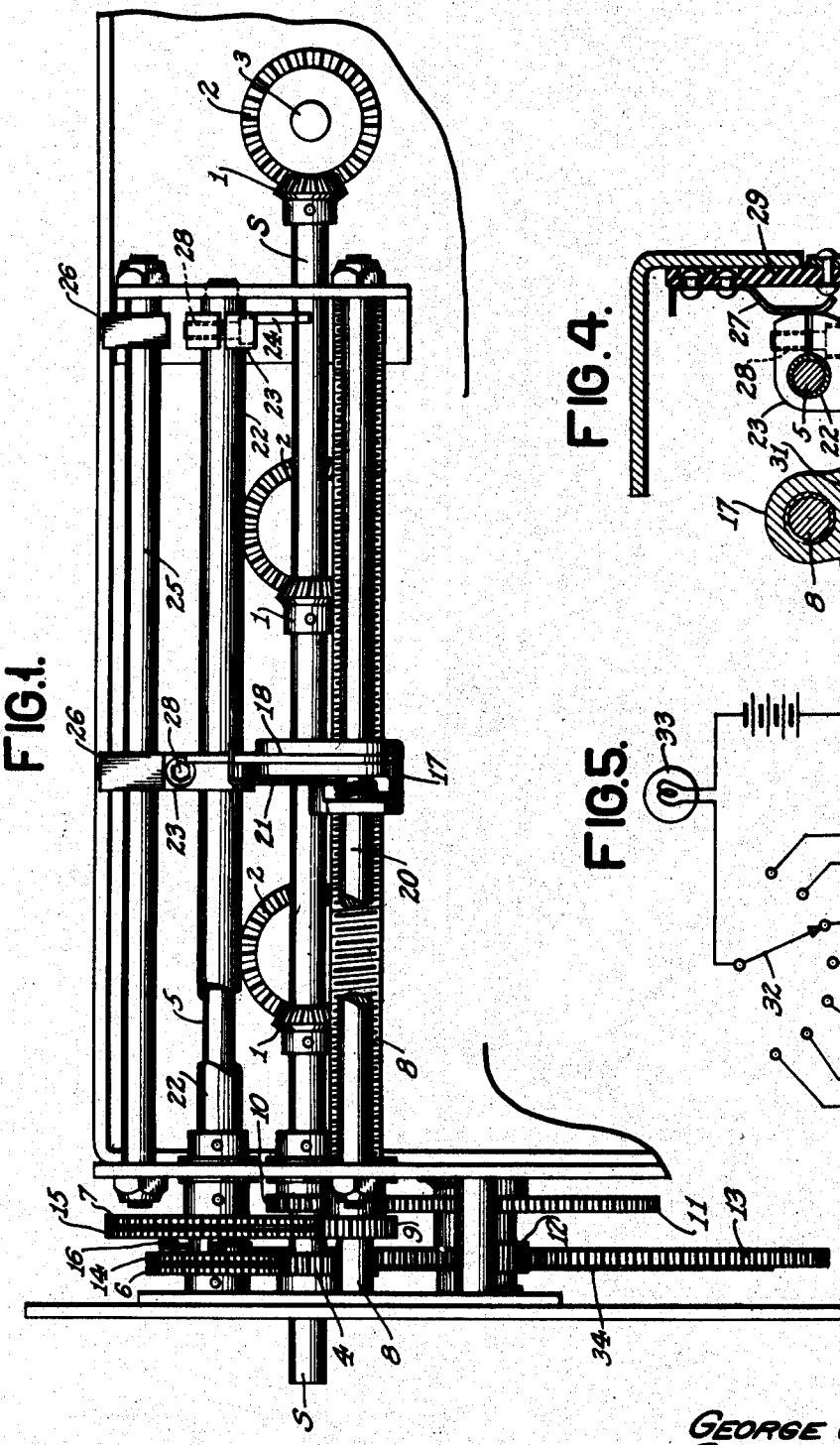
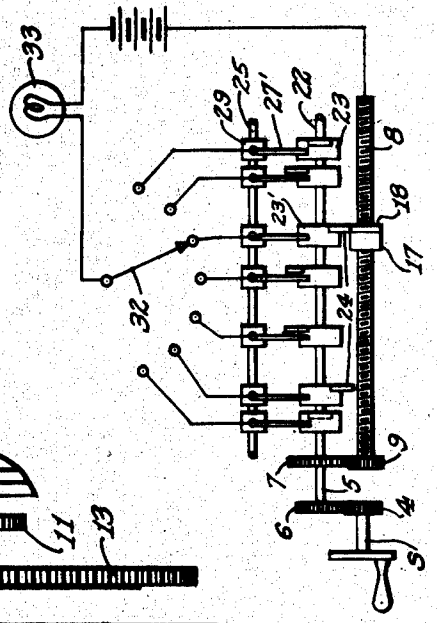


FIG. 4.

FIG. 5.



INVENTOR.
GEORGE C. PERKINS
BY E. O. Kinney
ATTORNEY.

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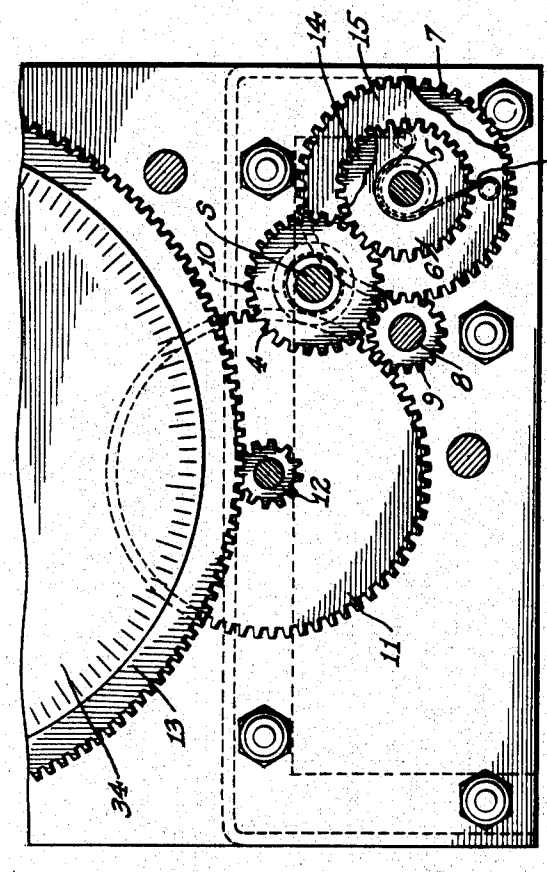


FIG. 3.

FIG. 2.

INVENTOR.
GEORGE C. PERKINS
BY E. O. Kinney
ATTORNEY.

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RADIO TUNING MECHANISM

George C. Perkins, West Orange, N. J., assignor to Federal Telephone and Radio Corporation, a corporation of Delaware

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7 Claims. (Cl. 177—311)

This invention relates to tuning mechanisms for radio transmitters or receivers, and in particular to a means for setting the reactances of tuned circuits associated with this type of apparatus.

It is old in the art to employ so-called detent mechanisms for accurately presetting the capacitance values of ganged variable condensers of radio receivers in order that a given station may be indexed and rapidly selected at the will of the operator. However, insofar as I am aware, the mechanisms of the prior art are in effect arranged on the periphery of a single disc or dial in much the same manner as is disclosed in Enderwood Patent 1,834,272. Without employing discs of excessive diameter, it is obvious that due to structural interference only a limited number of stops or detents can be positioned on the periphery thereof. In the event that two or more of the reactance values, corresponding to the required predetermined frequencies, are nearly equal, the physical size of the stops will be so large that the position of one stop will encroach on the space required by the other stop. In other words, one has the condition that two stops are required to occupy substantially the same space at the same time. In this specification and claims devices which yieldingly resist the passage of a moving member through a given position in its path are referred to as detents.

It also will be observed that in mechanisms of the class typified by the Enderwood patent, the detents are in fixed angular relationship to a shaft and dial which rotates at a slower rate than the shaft which is under the direct control of the operator. If this difference in rotation is relatively large, as it may well be in cases where a very fine or vernier setting of the dial is desired, the operator loses that sense of touch or "feel" which indicates that the stop has been engaged. By placing the detents on shafts which rotate at substantially the same or at greater rates than the operating shaft, the operator has this "feel" of adjustment which is so essential as a practical matter.

It is therefore one purpose of this invention to arrange a detent mechanism in which any number of detents can be employed, regardless of limitations which may be imposed due to small differences in predetermined frequencies.

Another object of the invention is to construct a detent mechanism in which the various detents are placed on a shaft which rotates at substantially the same rate as the operating shaft.

A further object of the invention is to construct a detent mechanism by which an operator may readily detect when detenting action has occurred.

Still another object of the invention is to arrange a detent mechanism in which the detents are located along the length of a rotating shaft rather than on the periphery of a disc.

During the operation of changing from one predetermined frequency to another it is quite likely to be required that one or more intermediate frequencies marked by stops or detents are passed through. To enable the operator to know when the detent mechanism has reached the detent corresponding to the desired frequency, a suitable indicating means is provided.

It is therefore a further object of this invention to combine a detent mechanism with an indicating means to show when the desired frequency has been reached.

Additional object and advantages of this invention will become apparent to those skilled in this art by a study of the following descriptions and claims, taken in connection with the drawings showing a preferred embodiment and one modification of the invention, wherein:

Fig. 1 shows a plan view of a detent mechanism, together with gearing for adjusting the reactances of the transmitter or receiver;

Fig. 2 shows in side elevation a view of the mechanism of Fig. 1;

Fig. 3 is an end elevation taken at section 3—3 of Fig. 2 showing a gearing arrangement for driving the detent mechanism from the control shaft and also for operating a tuning dial;

Fig. 4 is a view of section 4—4 of Fig. 2 showing the essential elements of the detent mechanism; and

Fig. 5 is a schematic wiring diagram illustrating a preferred manner of combining an indicating lamp with a slightly modified form of detent mechanism.

Referring to Figs. 1 and 2, S represents a drive shaft by which the values of the various reactances of tuned radio circuits are adjusted, and also from which the drive of the detent mechanism is preferably accomplished through intermediate gearing. Bevel gears 1, attached to shaft S, mesh with bevel gears 2 to drive the shafts 3. Connected to the latter are the variable reactances (Fig. 2) for adjusting the frequency of the tuned circuits. These reactances may be in the form of either variable inductances or capacitances. The reactances are not shown in detail, since their particular construction forms no part of the present invention.

It will be noticed that there is illustrated a step-down ratio between gears 1 and 2. The greater this step-down ratio, the greater are the number of turns required by the operating shaft S to produce a given reactance change. If a very large step-down ratio is required, each pair of gears 1 and 2 may take the form of a worm and worm wheel. It will be obvious from the further discussion that the more turns shaft S makes for a given reactance change, the more closely spaced can be the predetermined frequencies while still retaining satisfactory detent action.

On shaft S is also mounted spur gear 4, which drives the shaft 5 through intermediate gear 6. Attached to shaft 5 is gear 7, which in turn rotates lead screw 8 through gear 9. Gears 4 and 6 maintain a 1 to 1 ratio between shafts S and 5, while gears 7 and 9 maintain a 1 to 3 ratio respectively between shaft 5 and lead screw 8. This ratio of gearing is merely shown by way of example, but in general it is desirable to have several rotations of lead screw to one rotation of shaft. The reason for this will be brought out hereinafter.

Mounted on shaft 5 are two gears, 14 and 15, for the purpose of eliminating any back lash which might otherwise be present in the gear train. Gear 14 is similar to gear 6 and gear 15 is similar to gear 7. These gears, 14 and 15, are not fastened to shaft 5, but are constrained to tend to rotate thereon in opposite directions by means of spring 16. Actual opposite rotation does not occur since the gears are in mesh with gears 4 and 9. This reduction of back lash by spring-loading, as it is called, is old in the art and constitutes no part of the present invention.

Also attached to shaft S is spur gear 10, which meshes with gear 11. Mounted on the same shaft as gear 11 and rotating therewith is spur gear 12, this later gear meshing with gear 13, on which an indicating dial 34 is mounted. The gear ratio of this last set of gearing is purely arbitrary, but in general there should be several revolutions of the driving shaft S to one revolution of the indicator dial.

On the lead screw 8 is mounted a traveling nut 17 and a contact arm 18, having a notched contact face 19, (Fig. 4). Arm 18 is pivotally mounted in a recess in nut 17 by means of bar 20, which passes through a hole in both the arm and the nut and extends parallel with shaft 8. Bar 20 also operates to keep the nut 17 from turning during rotation of the lead screw. During operation the nut 17 and arm 18 thus travel along shaft 8 with bar 20 as a guiding member. Suitable means such as spring 21 urges the contact arm 18 in a counter-clockwise direction, as seen in Fig. 4. The counterclockwise motion is limited by abutting surfaces 30 and 31 on pawl 18 and nut 17, respectively, arm 18 being free to yield downwardly.

Shaft 5 may be made of metal for the sake of rigidity, but in such case it has mounted thereon an insulating sleeve 22. On this insulating sleeve are mounted a plurality of contact members 23 each having an extension 24 adapted to mate with the notch 19 of arm 18. The several contact members may be fixed in any position along the length of the insulating sleeve, and with the extensions 24 directed along any radius. Figs. 1 and 2 show only two contact members to avoid complicating the figures. Any number of members may be employed depending on the number of required predetermined frequencies.

It was previously mentioned that it is desirable to produce several turns of shaft 8 during one rotation of shaft 5. In the present instance a 3 to 1 ratio is employed. This enables a relatively large longitudinal movement of the traveling nut on the lead screw, while at the same time the latter is provided with a relatively fine thread. In the present example, the lead screw is cut with 32 threads per inch, one turn of the screw thereby advancing the traveling nut $\frac{1}{32}$ of an inch. During one turn of the operating shaft S, the lead screw makes three revolutions and the traveling nut moves $\frac{3}{32}$ of an inch. During the same time that this movement takes place, there is also one complete rotation of shaft 5. The thickness of the extension 24 on each contact member 23 is in this example $\frac{1}{16}$ of an inch. Likewise the thickness of arm 18 is $\frac{1}{16}$ of an inch. It will now be obvious that during one revolution of shaft 5 together with members 23, arm 18 travels longitudinally $\frac{3}{32}$ of an inch. If in a given contact position, an extension 24 and arm 18 are so arranged that their surfaces are in alignment, it will be seen that a $\frac{3}{32}$ inch motion in either direction will be sufficient to permit the cam to clear the pawl, and there will be no interference between them during consecutive revolutions.

The extension 24 on the contact members 23 can be either at the right or left hand side of the member. If all members are of the same hand the closest spacing of any two extensions 24 (and therefore of the predetermined frequencies) is determined by the width of the member 23. However, if adjacent extensions are at contiguous sides of their respective members they may be so placed that one side of one extension is substantially in a common plane with one side of another. In the above example wherein the lead screw has 32 turns per inch this is equivalent to two-thirds of a revolution of shaft 5. The members 23 cannot be in contact on the insulating sleeve 22, otherwise the indicating lamp 33 would give a false indication. A slight separation of the members is therefore necessary to give the desired insulation between them. It is of course possible to vary the widths of the members and their extensions, the width of the arm, the turns per inch of the lead screw and also the gear ratios to obtain even closer settings than those given in the above example.

Bar 25, which also extends parallel to the other shafts of the mechanism, carries a plurality of adjustable blocks 26, each of these latter in turn being fixed to an insulating strip 29 carrying a spring contact 27. This contact through a circuit passing through the contact 27, the cam-shaped member 23, an arm 18, nut 17 and lead screw 8, together with a suitable voltage supply and a selective switch, operates a signal light to indicate when the desired frequency is reached during operation of the equipment.

Reference is now made to Fig. 5 which schematically shows this circuit together with a modification in structure. It will be noticed that the circuit is actually completed through three different contacts in series one between the nut and arm unit 17—18 and the contact member 23' corresponding to member 23, another between said contact member and the spring arm 27' corresponding to spring 27, and the third at a contact on the selective switch 32. When the operator wishes to select a given frequency he turns dial switch 32 to the proper position and starts turning shaft S until the indicating lamp 33 lights and the corresponding detent engages. In so doing he may pass through several detent positions,

each of said positions being manually perceptible because of the increased resistance to the turning of shaft S while extension 24 of the contact member 23 in each of said positions is forced past the extension-engaging portion of arm 18 against the pressure of spring 21; but he will know that they do not correspond to the desired frequency since the indicating lamp does not light up.

It will be noted that in Figs. 1–4 inclusive the member 23 has a cam-shaped face arranged to make or break the indicator connection by its contact with spring 27. This arrangement permits members 23 to be small, thereby affording a saving in weight—important whenever the apparatus is used on aircraft. However, it is not necessary to make and break contact with spring 27, as the latter may take the form of a spring arm 27' continually wiping a circular member 23 as shown in Fig. 5. In any event the lighting of the lamp 33 is determined by the setting of the switch 32 and the contact between the corresponding arm 18 and extension 24.

In adjusting the tuning of the radio equipment, whether it be a transmitter or a receiver, the procedure is as follows. The frequency values and the number used are of course predetermined. Starting with either the highest or the lowest frequency, the transmitter is tuned by rotating shaft S until the frequency of the desired value is obtained. In the case of a transmitter, this frequency can be found by a suitable wave meter. If the apparatus be a receiver, the frequency can be found by beating the receiver with a signal of the desired value until a zero beat note is obtained. When the desired frequency has been obtained, one of the contact members 23 stored at the end of shaft 5 is shifted along sleeve 22 until its extension 24 fits into notch 19 of contact arm 18, as shown in Fig. 4. It is then clamped in position by means of screw 28. One of the blocks 26 is moved along shaft 25 until the contact spring 27 (or 27') mounted thereon engages member 23 (or 23').

The shaft S is then rotated until the next predetermined frequency is reached and the next adjacent contact member 23 is adjusted and set in the same manner as was the first member. Another block 26 is placed opposite this cam. This procedure is continued until the equipment has been tuned for all of the predetermined frequencies.

In operation the tuning shaft S is manually rotated, turning dial 34 in the usual manner and simultaneously adjusting the reactors on shafts 3. At the same time the nut 17 is shifted along feed screw 8, its position on the screw corresponding to the setting of dial 34. At the same time shaft 5 together with its insulating sleeve 22 and the various contact members 23 mounted thereon, is rotated in synchronism with screw 8 and shaft S, so that each extension 24 swings across the path of contact arm 18 once during each revolution of shaft 5. When the rotation of screw 8 brings arm 18 into alignment with an extension 24 the latter during its downward travel will contact the upper face of the arm, which will yield; but the pressure of spring 21 will produce sufficient resistance to the rotation of the extension 24 and shaft 5 to be noticeable to the operator who is turning shaft S. If he desires to stop the mechanism at that tuning point the registration of the nose of extension 24 with notch 19 will permit highly accurate location of said mechanism at the desired setting. If he does not wish to stop at that setting continued rotation of shaft S will shift extension 24 circumferentially beyond arm 18 and permit further unobstructed rotation of shaft S. The pitch of screw 8, the relative rate of rotation of said screw and shaft 5, and the relative thickness of extension 24 and arm 18 are such that when the extension 24 completes its next rotation after disengaging arm 18 it will clear said arm regardless of the direction in which the arm is shifted. The body of contact member 23 in the form illustrated in Fig. 4 is arranged to make contact with spring 27 each time that the extension 24 is in position to engage an arm 18, so that a circuit through the signal light 33 will be completed whenever said extension makes contact with the arm, provided switch 32 is set for that particular contact.

The provision for circumferential as well as longitudinal adjustment of contact members 23 greatly facilitates a high degree of accuracy in setting the contact members for a desired reactance value, since circumferential adjustment of a contact member 23 through a fraction of the circle along which it travels will have the same effect as a longitudinal adjustment through a corresponding fraction of the distance traveled by arm 18 during one revolution of shaft 5, thereby permitting very fine longitudinal adjustment by means of substantial circumferential adjustment of such member 23.

While I have shown and described only one specific embodiment and a slight modification of my invention, it is to be clearly understood that changes and modifications as will occur to those skilled in this art are contemplated and that I do not intend to limit the invention except as required by the following claims.

What is claimed is:

1. Position indicating mechanism for radio tuning apparatus comprising a rotatable tuning shaft, a traveling contact member adapted to be driven along a straight path by said tuning shaft, a plurality of rotating contact members spaced from the shaft and located in spaced relationship adjacent the path of the traveling contact member, means on said traveling contact member for yieldably interengaging any of said rotating contact members when the traveling member is in alignment therewith, thereby indicating a predetermined setting position of the tuning shaft; and means including gears driven by said tuning shaft for shifting the traveling contact member and for rotating the other contact members in synchronism with the rotation of the tuning shaft.

2. Position indicating mechanism as set forth in claim 1, in which each rotating contact member includes a contact extension traveling across the path of the traveling contact member, said rotating contact member being circumferentially adjustable to vary the circumferential location of said extension.

3. Position-indicating mechanism for radio-tuning apparatus comprising a rotatable tuning shaft, a movable contact member, guide means for supporting said contact member for longitudinal movement thereon, means having a drive connection with the tuning shaft for moving the contact member along said guide means in synchronism with the rotation of said shaft, a plurality of detent means disposed in spaced relationship along said guide means, each engaging the contact member at a predetermined point in the cycle of rotation of the tuning shaft, an electrical signal and a selective switch having a plurality of contacts each connected to a detent means, whereby said electrical signal is selectively

actuated when the contact member is in engagement with a selected detent means.

4. Position-indicating mechanism for radio-tuning apparatus comprising a rotatable tuning shaft, a feed screw, means comprising gear means driven by said rotating shaft for rotating said shaft and screw in synchronism, a contact shaft parallel and adjacent to the feed screw, means for rotating the contact shaft in synchronism with the feed screw, a traveling contact member having a threaded driving connection with the feed screw, adapted to travel in an axial direction in respect thereto, a plurality of cooperating contact members mounted in spaced relationship adjacent the path of the traveling member and arranged to contact respectively the latter member at predetermined settings of the tuning shaft, and means for adjustably mounting said plurality of cooperating contact members in spaced relationship along said contact shaft for rotation therewith in position to engage the traveling contact member when the latter is shifted by the feed screw into alignment with the contact members on said contact shaft.

5. A position indicating mechanism for radio tuning apparatus comprising a rotatable tuning shaft, a single contact member arranged for passing along a straight path, a plurality of contact members arranged relatively stationary at different points along said path for rotation about an axis parallel thereto in frictional engagement with said passing contact member, and means driven by said tuning shaft for moving said single contact member and rotating said plurality of contact members in synchronism with the tuning shaft.

6. In a mechanism according to claim 5, rotating contact members each adjustable by a translatory movement parallel to the straight path and by an angular movement in a plane perpendicular to said path so that each of said rotating contact members engages the passing contact member in a predetermined angular position, one of the engaging members being flexible and formed as a socket and the other being formed as a plug so as to permit the closing of an electric circuit in a predetermined angular position.

7. In a mechanism according to claim 5, rotating contact members each adjustable by a translatory movement parallel to the straight path and by an angular movement in a plane perpendicular to said path so that each of said rotating contact members engages the passing contact member in a predetermined angular position, the latter contact member being provided with a spring supported cam having a depression in its top, and each of the rotating contact members being provided with two arms, a first arm having a convex end adapted to fit into said depression after bending back said spring supported cam, and a second arm at an angle to, and shorter than, said first arm to avoid engagement with the spring supported cam and the passing contact member, and a stationary spring contact arranged to engage the second arm of each of the rotating members, said two arms being offset with respect to each other along the axis of rotation to prevent engagement between first arm and stationary spring contact, and to permit an electrical connection between stationary spring contact and rotating contact member in a predetermined angular position.

GEORGE C. PERKINS.