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INDICATOR INSURING SHARP TUNING OF A RECEIVER SET

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Fig. 1a

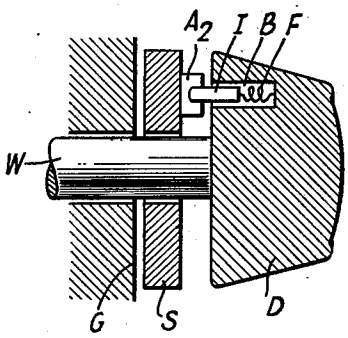


Fig. 1b

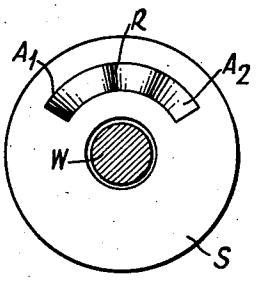


Fig. 1c

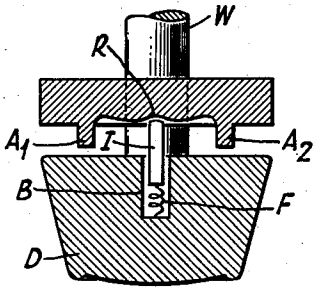


Fig. 2a

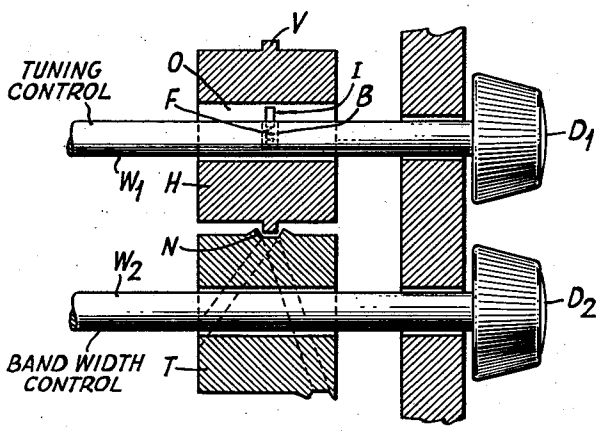


Fig. 2b

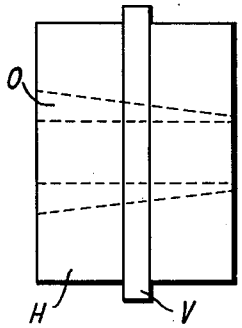


Fig. 2c

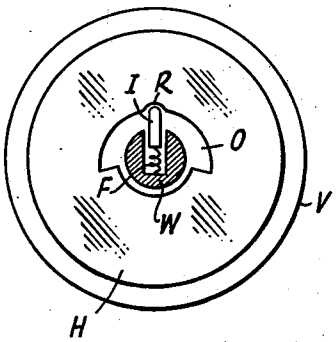
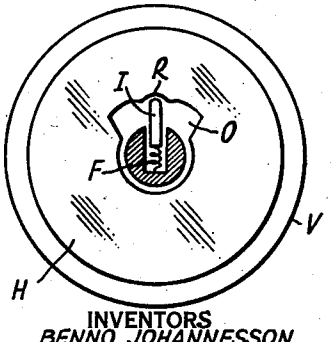


Fig. 2d



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Fig. 3

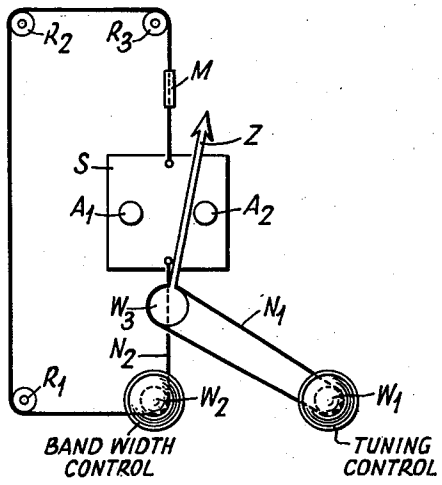


Fig. 4a

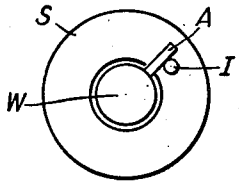


Fig. 4b

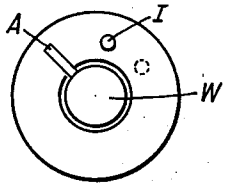


Fig. 4c

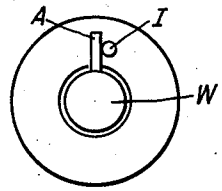
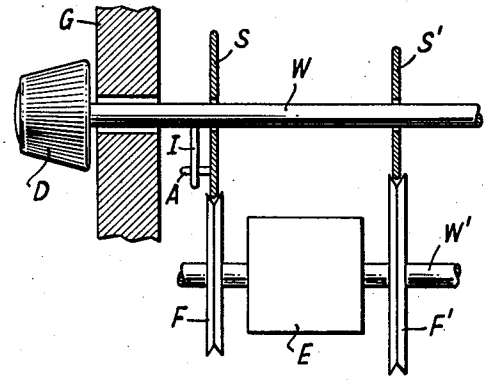


Fig. 5



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UNITED STATES PATENT OFFICE

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INDICATOR INSURING SHARP TUNING OF A RECEIVER SET

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Application October 25, 1938, Serial No. 236,884
In Germany November 9, 1937

5 Claims. (Cl. 250—20)

In receiver apparatus which comprise no means adapted to insure sharp tuning automatically, exact tuning to a station, as well known in the prior art, is accomplishable by the aid of optical tuning indicator means. This indicator device is fed with the rectified signal oscillation to act as a control potential.

Indicator devices of this nature still operate faultily for the reason that the amplitude resonance curve, in the neighborhood of the exact tuning point, is very flat, whereas the phase resonance curve which is important from the viewpoint of distortion presents a very steep form at the resonance point. As a matter of fact, what may be observed with great precision and clarity, especially in modern receivers with a practically rectangular form of resonance curve, are the two tuning positions where the incoming carrier is located near either of the two boundaries or cut-off points of the transmission range or channel. In fact, at these two points or positions the amplitude drops abruptly accompanied by a conspicuous increase in the distortion. In the past, roughly accurate tuning has been feasible only by setting the receiver apparatus first to one limit and then to the other limit of the signal or transmitted band, while noting the positions of the manipulator knob serving for the tuning, and finally setting the same roughly midway between these two extremes. It will be obvious that this procedure is both inaccurate and tedious.

A substantial saving in time and labor in this kind of tuning is obtainable according to the invention by the adoption of an arrangement which, in one direction of rotation of the tuning shaft, is entrained and driven by the latter or a means rigidly connected therewith by way of a stop and which, in the opposite direction of rotation of the tuning shaft is either disengaged with the shaft (with a sensible or visible notch position being provided at the same time at an angular distance equal to one-half the band-width of the receiver), or else is driven along at a speed reduction of 1:2 which is operative only in this direction of rotation.

The arrangement here disclosed insures precise tuning in the following manner: The tuner actuates the tuning condenser in the sense of rotation in which the device is driven along by way of the stop until the desired station and the limit of the transmission band has been reached, say, the point where the signal amplitude appreciably diminishes or where noticeable distortion of a priorly clear signal arises. Next, the rotary condenser is set in the opposite direction in order to ascertain the exact median position. Now, at an angular distance equal to one-half of the band-width of the tuning shaft from the point of reversal of rotation, there must be provided a notch or detention point sensible to touch or eye in order to indicate exact and sharp tuning. The said notch or detention position may be provided from the outset in the driven means at a prearranged angular distance from the stop. In this case, in the opposite sense of rotation, the device is out of engagement with the tuning shaft with the result that it will not be entrained or driven along thereby, but will be arrested. This notch position could also be created by the tuning process in this manner that the driven device is in coupling relation with the tuning shaft (or the means being in fixed coupling relation therewith) by means of a reduction gear operating at a 1:2 ratio. In this case the user and tuner of the set must shift the condenser as far as the opposite boundary of the transmission band so that the device will cover a distance equal only to one-half of the band-width. If, then, the rotation is continued in the original direction the device will come to a stop until exactly in the median position between the two limits, that is to say, at the point of sharp tuning the stop again comes to make engagement. The ensuing brake action upon the setting or tuning shaft may again be rendered perceivable either to touch or visually. In other words, in the last-named embodiment of the object of this invention there occurs automatic bisecting of the angle of rotation between the limits.

An exemplified embodiment of the invention is shown in Figs. 1*a*, 1*b*, and 1*c* in three planes at right angles to one another. Figs. 2*a* to 2*d* are views showing another embodiment. Fig. 3 illustrates still another embodiment, and Figs. 4*a*, 4*b*, 4*c* and 5 depict still another embodiment of the invention. Referring now to the first embodiment as shown in Figs. 1*a* to 1*c*, W is the tuning shaft which extends through an opening in the wall or panel G of the casing or cabinet and has a knob D fastened at its outer end. Between the knob D and the panel there is a disk S with a concentric hole mounted on the shaft W in such a way that it comes to bear against the cabinet wall or panel with gentle friction, while being revoluble in reference to the tuning shaft. In the inner face of the knob is a cylindrical bore B in which are fitted a compression or coil spring F and a pin I. The disk S has two stops A1 and A2 on an arcuate strip which faces the pin I.

The portion of the strip between these two stops is recessed or hollowed out adjacent the stops, there being raised portions in the neighborhood of the center of the strip while directly at the center there is again a slight depression R.

The operation of the arrangement is as follows: When the knob is turned, say, to the right-hand side, it will entrain and drive the disk S through the yieldingly extruding pin I until the desired station and the right-hand limit of the band has been reached. Then the knob is reversed, with the disk S being arrested, until the pin I snaps into the central recess R. When this position has been attained, the user or tuner senses that a point of detention or a notch has been reached. Assuming that the range of rotation as bounded by the stops equals exactly the band-width or band-pass of the receiver, the central or median position will exactly correspond to sharpest tuning.

If, then, the user of the set is to tune to another station, he simply continues rotating the knob in the desired direction. The pin I slips out of the notch position and, in case of a right-hand turn, reaches the stop A2, or else, in case of turning the knob in the contrary direction, the stop A1 is reached, and then the disk S will be driven.

The scheme hereinbefore disclosed will be perfectly sufficient and satisfactory whenever the receiver set has a non-variable and fixed band-width or else is equipped with means by the aid of which, when tuning, the apparatus is adjusted by positively acting means to a definite, and, more particularly, to the smallest, band-width of the receiver set. It will also be recommendable in cases where, as disclosed in the earlier art, the user or tuner receives a cut to make adjustment to a definite band-pass width in coarse tuning by the fact that the tuning indicator operates only in this position.

On the contrary, when it is to be expected that the set is to operate occasionally on a narrow band and on other occasions on a wider band, then it will be recommendable to make also the distance separating the stops A1 and A2 variable. More particularly speaking, to effect the adjustment of the stops also automatically and interlocked with the operation of the band-width variation knob, and in the same sense so that the range of rotation bounded by the stops will always correspond to the band-width to which the apparatus has been adjusted.

An exemplified embodiment of the invention which satisfies this demand is shown in Figs. 2*a* to 2*d*. The shaft W_1 supporting the knob D1 and serving for tuning the set has a cylindrical bore B. Into the said bore, similar to the arrangement in Fig. 1 are fitted a coil spring and a stop pin I. The said pin I engages in the recess O of a hollow shaft H seated on the shaft W1. The recess of the said hollow shaft is of such form that the pin will drive the hollow shaft outside a range of rotation, whereas inside this range of rotation the said hollow shaft will not be entrained, while in the middle of the range of rotation there is a detention point or notch in the form of depression R. The angular range of the recess is not constant throughout the hollow shaft, in fact, as can be seen from a comparison of Figs. 2*c* and 2*d* and the cross-sections shown therein, it decreases from one end of the hollow to the other end.

Seated on the hollow shaft is also an annular extension V which engages in the helical slot N of the drum T. The latter is secured upon the shaft W_2 which supports the rotary knob D_2, shaft W_2 serving for the variation of the band-width. Upon adjusting the band-width, the range of regulation of which may amount to 270 degrees of a full revolution of the shaft W_2, the hollow shaft is axially shifted in such a way that the pin is located now near one end of the hollow shaft and now close to the other end of the hollow shaft. The friction which is set up between the helical thread N and the ring V has also this effect that the hollow shaft inside the free range of rotation between the stops of the recess is not driven along by the shaft W1. By choosing a suitable form for the recess O or of the helical slot N, conditions can always be made so that the free range of rotation is always just equal to the band-width to which the receiver set has been adjusted.

It is moreover feasible to modify the mechanism in such a way that, in lieu of a sensible indication of the median position, an optical or visual indication is used. Such an arrangement is illustrated in Fig. 3. The tuning shaft W1 which is coupled to the rotary condenser is at the same time coupled by way of a cord drive N1 with a shaft W3 in such a way that, with the shaft being retained, the cord will slip on one of the two shafts. Shaft W3 carries a pointer Z which is visible from the outside and which, when at rest, is placed opposite a mark which is also visible. The movement of the pointer and thus that of the shaft W_3 is limited by two stops A1 and A2 which are seated upon a slide S shiftable parallel to the pointer. When the slide moves downward, the free range of rotation of the pointer Z is increased. The slide S is coupled with the band-width variation means by way of a cord drive N_2 which leads over the rollers R1, R2, R3 and the shaft W2 which supports the knob used to adjust the band-width. The distance separating the stops as well as the gearing are so chosen that the range of free rotation of the pointer will always correspond to the adjusted band-width of the receiver. The adjustment is again effected in such a way that upon rotation to the right-hand side one rotates as far as the right limit or cut-off of the transmission range or band, with the pointer Z as shown coming to bear against the stop A2. This is followed by rotation in the contrary sense until the pointer Z comes to be placed in front of the datum or mark M. The same rule applies for rotation to the left-hand side. This embodiment represents a kinematic reversion of the arrangement of the invention in so far as the stops are stationary, permitting slipping, of the shaft W3 and the tuning spindle W1 operative inside the angle of rotation bounded by the stops.

The indicator means hereinbefore described will be perfectly adequate if the assumption is made that the limits or cut-off points of the band pass are very easily perceivable and that they will be sensed as being located at one and the same place by all users of the set. If this presupposition be not fulfilled, or if the apparent band-width is a function of the transmitted signal strength owing to imperfect rectangularity of the resonance curve and insufficient volume control, then the other embodiment of the invention will be of greater advantage in which adjustment is made to both limits of the pass band and in which automatic bisecting of the angular range is obtained by the reduction gear operative only in one sense of rotation. The principle underly-

ing such a scheme is illustrated in Figs. 4*a*, 4*b* and 4*c*. Seated revolubly upon the tuning shaft W is the disk S. Both of them support a stop pin A and I, respectively, so that the disk will be driven by the stop when the tuning shaft is turned to the right or clockwise, until adjustment has been made to the right-hand boundary of the signal band. If, then, the knob is rotated backwards to the left-hand cutoff point of the band as shown in Fig. 4*b*, a speed reduction gear of a ratio of 1:2 is rendered operative between the disk S and the shaft W. The disk as a result covers exactly one half of the angle of rotation which has been covered by the tuning shaft. If the shaft is thereupon turned to the right-hand side in the original sense of rotation, then the disk S will be arrested until the stop pins A and I come to be engaged again. This instant when exact and sharp tuning exists may again be rendered sensible or visual by suitable means.

A more detailed exemplified embodiment of such an indicator device is illustrated in Fig. 5. The disk S is rotatably mounted upon the tuning shaft W, while disk S′ is fixed upon the shaft. The disk S has a stop pin A which, in case of right-hand or clockwise rotation, will be entrained and driven by the stop pin I fixed on the shaft. Parallel to the shaft W is a shaft W′. Reduction gearing E is interposed between the two ends of the latter shaft. A friction disk or wheel F′ mounted on the right hand end of the shaft is in frictional engagement with the disk S′. Upon the left-hand end of the shaft there is seated a similar friction disk F which is in frictional engagement with the disk S. Upon rotation in counterclockwise sense the disk S will be driven through disk S′, the friction disk F′, gear reduction mechanism E and the friction disk F, whereas the gear mechanism E is inoperative upon a right-hand rotation. The sizes of the disks S, S′, F, and F′ must be so chosen that disk S, in left-hand rotation, will be driven just at half the rate of speed of the shaft W. The operation of the assembly is the same as in Fig. 4. The shaft W supports preferably another arrangement of the same kind which is exactly the same as the one before described, with this distinction that driving occurs upon left-hand or counter-clockwise rotation and speed reduction upon right-hand or clockwise rotation.

Of course, the arrangement hereinbefore described presupposes that the angle of rotation of the tuning spindle W which correspond to the maximum band-width of the receiver for which the mechanism is still to be operative, is not over 360 degrees. If, on the contrary, the same is substantially less than 360 degrees, it will be advisable to provide upon the disk S another stop to prevent the stop pin I, in case of left-hand rotation, moving unduly far away from the stop pin A.

Also in this scheme a kinematic reversal of the motions as well as a visual indication of the medium position are feasible.

The arrangements may then be made similar to those shown in Fig. 3, although in lieu of two stops only one stop is used, and this stop is not coupled with the band-width variation means (for instance, A_2). In case of backward rotation, to the left-hand side, after adjustment to the right-hand slope of the transmission band, the shaft W_3 is driven at a speed reduction which is merely halved. After resumption of clockwise rotation (after the left-hand slope has been reached) the speed reduction is complete. The fact that the stop has been struck again is rendered sensible to touch or to the eye, and this serves to indicate the median or central position.

We claim:

1. In a radio receiver, tuning control means to facilitate tuning the receiver to the mid-frequency of a band of frequencies capable of being transmitted by the tunable circuits of the receiver, comprising a tuning shaft for adjusting the tunable circuits, a member having a pair of stops spaced apart a distance proportional to the angular distance necessary to rotate the shaft to vary the tunable circuits from one limit frequency of the band to the other, means controlled by the shaft to coact with one or the other of said stops, depending on the direction of rotation of the tuning shaft, to determine the adjustment of the shaft to one of the limit frequencies, and means interposed midway between the above mentioned stops for determining the limit of rotation of the tuning shaft in a reverse sense so that the tunable circuits wil be adjusted to the mid-frequency of the transmitted frequency band.

2. In a radio receiver, tuning control means to facilitate tuning the receiver to the mid-frequency of a band of frequencies capable of being transmitted by the tunable circuits of the receiver, comprising a tuning shaft for adjusting the tunable circuits, means for controlling the band width of said circuits, a member having a pair of stops spaced apart a distance proportional to the angular distance necessary to rotate the shaft to vary the tunable circuits from one limit frequency of the band to the other, for a particular setting of the band with control means, means controlled by the tuning shaft to coact with one or the other of said stops, depending on the direction of rotation of the tuning shaft, to determine the adjustment of the shaft to one of the limit frequencies, and means interposed midway between the above mentioned stops for determining the limit of rotation of the tuning shaft in a reverse sense so that the tunable circuits will be adjusted to the mid-frequency of the transmitted frequency band.

3. In a radio receiver, tuning control means to facilitate tuning the receiver to the mid-frequency of a band of frequencies capable of being transmitted by the tunable circuits of the receiver, comprising a tuning shaft for adjusting the tunable circuits, a member loosely mounted on said shaft and having a pair of stops spaced apart a distance proportional to the angular distance necessary to rotate the shaft to vary the tunable circuits from one limit frequency of the band to the other, means carried by the tuning shaft and cooperating with one or the other of said stops, depending on the direction of rotation of the tuning shaft, to rotate the member to a position determined by the setting of the shaft to one of the limit frequencies, and stop means on the member midway between the above mentioned stops which limits the rotation of the tuning shaft in a reverse sense to thereby adjust the tunable circuits to the mid-frequency of the transmitted frequency band.

4. In a radio receiver, tuning control means to facilitate tuning the receiver to the mid-frequency of a variable band of frequencies capable of being transmitted by the tunable circuits of the receiver, comprising a tuning shaft for adjusting the tunable circuits, means for controlling the band width of said circuits, a member loosely

mounted on said shaft, means under the control of the band width control means for longitudinally adjusting said member, a pair of stops carried by said member and spaced apart for each longitudinal adjustment of the member a distance proportional to the angular distance necessary to rotate the shaft to vary the tunable circuits from one limit frequency of the band to the other, means carried by the tuning shaft and cooperating with one or the other of said stops, depending on the direction of rotation of the tuning shaft, to rotate the member to a position determined by the setting of the shaft to one of the limit frequencies, and stop means on the member midway between the above mentioned stops which limits the rotation of the tuning shaft in a reverse sense to thereby adjust the tunable circuits to the mid-frequency of the transmitted frequency band.

5. In a radio receiver, tuning control means to facilitate tuning the receiver to the mid-frequency of a variable band of frequencies capable of being transmitted by the tunable circuits of the receiver, comprising a tuning shaft for adjusting the tunable circuits, means for controlling the band width of said circuits, a member adapted for adjustment by the band width control means, said member having a pair of stops which for any adjustment of said member are spaced apart a distance proportional to the angular distance necessary to rotate the shaft to vary the tunable circuits from one limit frequency of the band to the other, means controlled by the tuning shaft and cooperating with one or the other of said stops, depending on the direction of rotation of the tuning shaft, to determine the adjustment of the shaft to one of the limit frequencies, and means midway between the above mentioned stops for determining the limit of rotation of the tuning shaft in a reverse sense so that the tunable circuits will be adjusted to the mid-frequency of the transmitted frequency band.

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