

May 25, 1937.

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2,081,746

TUNING DEVICE

Filed March 28, 1934

2 Sheets-Sheet 1

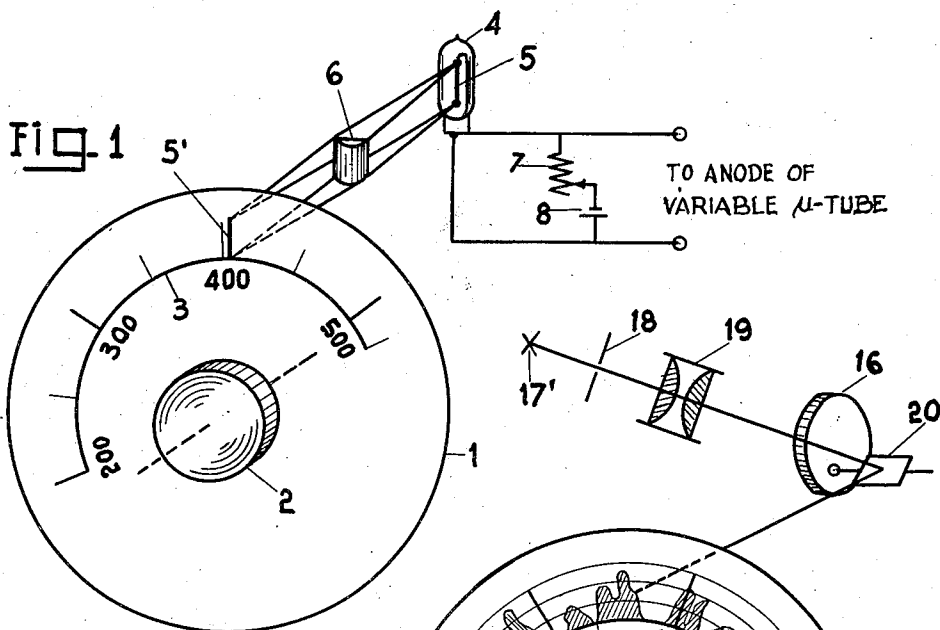


Fig. 3

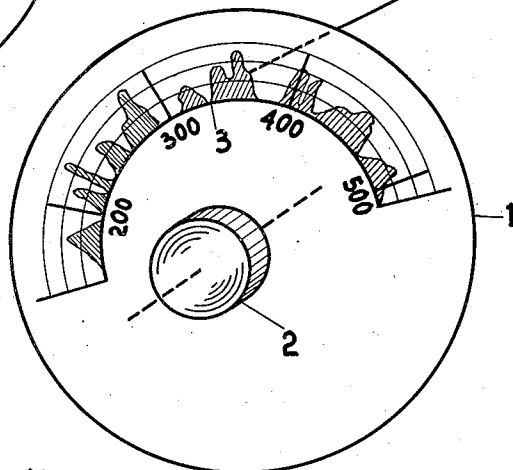
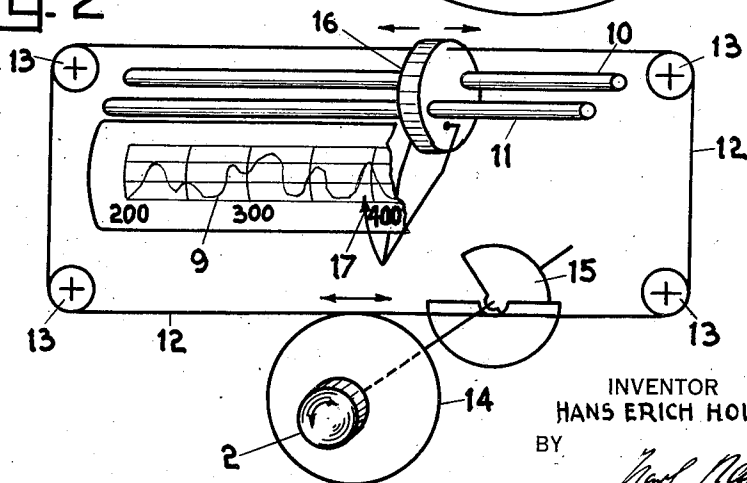


Fig. 2



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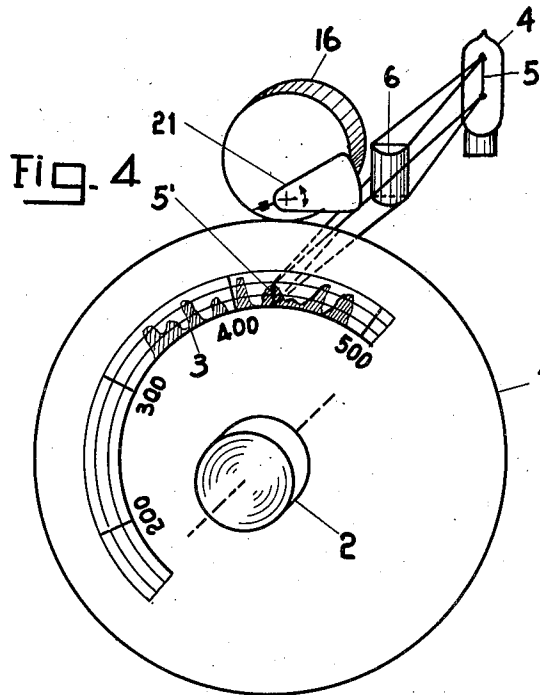
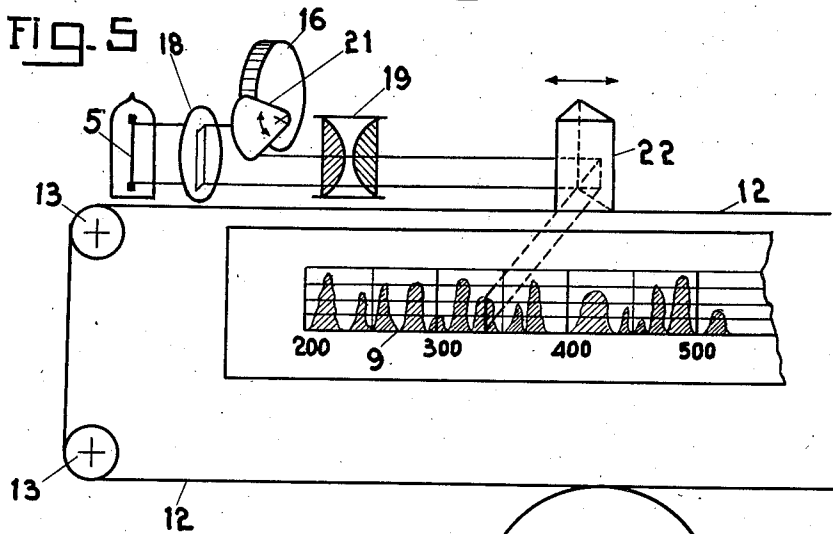
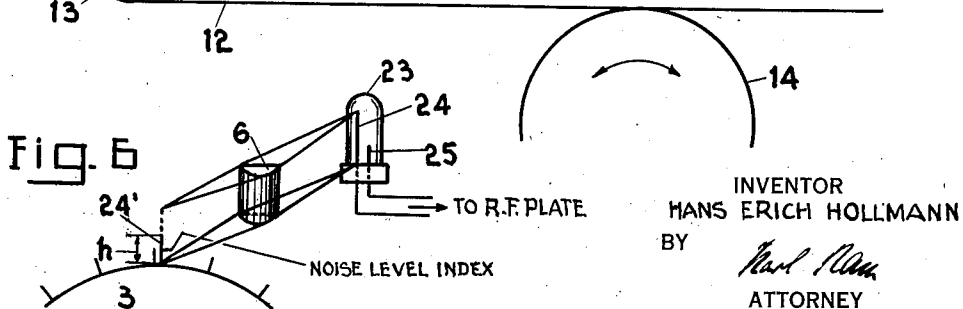
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2 Sheets-Sheet 2



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TUNING DEVICE

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11 Claims. (Cl. 250—40)

My invention relates to a visual indicating device for signalling receiving apparatus and more particularly to a broadcasting station indicator and tuning device, and has for its principal object the provision of an improved means for visual station indication and tuning in such systems.

Modern radio receivers, in particular those of the superheterodyne type, have an extremely sharp resonance curve. Receivers of this type and especially those which are equipped with automatic volume control, although yielding very satisfactory reception when adjusted or tuned exactly to the carrier frequency of the transmitting station, prove very difficult for the user to adjust.

In order to facilitate the adjustment, visual tuning devices, such as indicating instruments, have been proposed by means of which the exact resonance condition or tuning of a desired station is ascertained by the objective observation of the maximum reading of a meter or similar device in place of the subjective tuning operation on the part of the operator by orally ascertaining the maximum volume of the receiving signal.

One object of my invention consists in the provision of a combined visual tuning and station indicating device by which the adjustment to optimum receiving condition of a radio set is greatly simplified.

Another object of my invention consists in providing a tuning system considerably minimizing the inconvenience experienced due to inter-carrier noise pickup when tuning from one station to another station, in particular when using a receiver equipped with automatic volume control.

Still a further object of my invention is to provide a combined index member for indicating the particular station to which the set is tuned and at the same time ascertaining the receiving field strength of the particular station to which the set is tuned, resulting in greatly increased ease of operation and operation of the set on the part of the operator or broadcast listener.

A more specific object of my invention consists in the provision of a combined tuning and station indicator by which the station or frequency, respectively, and the receiving field strength thereof are shown in their coordinate relationship in the manner well known in coordinate systems, the station frequency being represented along one coordinate dimension and the receiving field strength being shown by another coordinate dimension.

My invention will be better understood when

considered in connection with the accompanying drawings showing some exemplifications and practical embodiments of a combined tuning and indicating device for radio receiving sets in accordance with the invention.

Further aspects and objects of the invention will also become apparent from the description and its broad scope will be pointed out in the appended claims.

Figure 1 shows one embodiment of a combined tuning and station indicating device according to the invention utilizing an electric lamp as an indicator.

Figure 2 shows a modification of Figure 1 using an indicating instrument.

Figure 3 represents a further modification of the invention utilizing an optical indicating and tuning means.

Figure 4 shows a modification of an arrangement according to Figure 3.

Figure 5 illustrates still a further modification of a combined optical indicating and tuning device of the invention, and

Figure 6 illustrates a further embodiment of the invention utilizing a gas discharge tube as an indicator and tuning device in accordance with the invention.

Similar reference numerals identify similar parts throughout the entire views of the drawings.

It is well known in the art that an ordinary receiver without adjustable regeneration can only be tuned to a broadcast transmitter if the transmitter is modulated by speech or other signals. In order to enable tuning when the transmitter is not modulated, it has become customary to transmit special intermission signals between successive broadcast programs.

The adjustment and tuning may be greatly simplified according to known methods in the art by providing an electric indicating or measuring instrument which directly indicates the high frequency carrier wave or receiving field strength, respectively, produced by the transmitter at the receiving station. In this latter case, exact resonance condition and tuning of the receiver can be ascertained by observing the maximum reading of the instrument.

Such an indicating instrument which may be equipped with an optical indicator in place of the usual pointer moving over a scale, may be directly connected in the detector output circuit. However, it has been found to be of greater advantage, especially in connection with receivers featuring automatic volume control, to

energize the indicating instrument directly by the anode current of an exponential or variable mu tube usually used in connection with this type of receiver equipped with automatic volume control. Since the anode current of a variable mu tube is directly proportional to the receiving field strength or intensity of the carrier wave of a modulated signal, the reading of the instrument will be proportional to the receiving field strength of the particular transmitter produced at the receiving point and resonance tuning of the receiver may thus be easily ascertained by observing the maximum reading of the instrument.

However, great difficulties have been experienced on the part of the operator or listener due to the necessity of observing a special indicator, besides watching the tuning scale indicating the wave lengths, frequency, or other designation of the transmitting stations within the range for which the receiver is designed.

In accordance with my invention, this inconvenience is completely eliminated by the provision of a combined receiving strength and station indicator in such a manner that the entire adjustment of the set may be carried out in a purely visual manner by observing a single scale or similar indicating device.

In accordance with my invention, I provide an index moving over a tuning scale or vice versa, or a stationary index cooperating with a moving scale and means whereby a physical characteristic of said index varies in accordance with the tuning or variations of the receiving field strength in such a manner that the station and the tuning condition may be ascertained simultaneously by a single operation and a single observation.

In accordance with my invention, for the purpose specified, the index moving over the tuning scale or vice versa, or a stationary index cooperating with a moving tuning scale, has a physical characteristic such as its brightness or luminosity when using an optical indication or its length in one dimension etc., which varies directly in proportion to the intensity of the carrier wave or receiving field strength of the particular station received.

Principally this variation of the index may be accomplished by a variation of the width of a linear index or in the case of a luminous index by variations of its brightness or luminosity in such a manner that the index becomes the brighter the higher the field strength of the received station to which the set is tuned.

An improved result, however, is obtained by utilizing the movement or variation of the width of the index in a direction at right angles to the tuning or wave length scale. In this manner, the receiving scale becomes a coordinate system, whose abscissa indicates the frequency or stations to which the set may be tuned and whose ordinate represents the receiving field strength of the stations received. If the scale is of circular shape, a so-called polar coordinate relationship is obtained as is readily understood, otherwise, that is, when using a linear scale the coordinate system is of the rectangular type well known. The field strength scale may be calibrated directly in microvolts field strength, prevailing at the location of the receiver. However, in general a relative indication will be sufficient, it being merely of importance to indicate the threshold of sensitivity of the receiver by a mark on the receiving strength ordinate. It is

understood that the ordinate or other variable characteristic of the index with stationary or fixed tuning of the receiver will indicate the receiving field strength variations of the particular transmitter produced by fading phenomena or any other effects.

Referring now more particularly to the drawings, I have shown in Figure 1 a translucent dial 1 of known design carrying a circular scale 3 calibrated in wave length; that is, in the example shown from 200 meters to 500 meters comprising the broadcast range now in use. I have furthermore shown means for producing a luminous index comprising an electric lamp 4 having a linear filament 5. The filament is projected by means of a cylindrical lens 6 upon the scale 5, thus producing an image or linear index 5' of desired width or sharpness. The filament 5 is supplied from the anode current of a variable mu tube used in the receiver (not shown for the sake of simplicity).

In this manner, the brightness of the filament will vary in accordance with the high frequency or carrier amplitude received. In order to prevent a complete extinction of the lamp and to insure operation at the steepest and most favorable part of its operating characteristic, I have furthermore shown a biasing battery 8 in series with a variable resistor 7 for producing a biasing current resulting in an initial brightness of the filament 5 when no station is received. Thus, the anode current from the variable mu tube of the receiver is superimposed upon the current from battery 8, which latter may be adjusted to its most favorable value by means of the resistance 7.

While an arrangement as described in connection with Figure 1 using variable degrees of brightness for operating the luminous index does not easily lend itself to calibration in carrier intensity or receiving field strength, I have shown an improved arrangement as illustrated by Figure 2 utilizing an electro-mechanically operated index. Referring to this latter figure, I have shown a linear tuning scale 9 carrying the names or call letters of the transmitting stations, and an electric indicating instrument 16 which is arranged to be moved alongside the scale 9, such as by means of guiding rods 10, 11 and a cooperating driving system comprising a friction wheel, wire and guiding pulley system 12, 13, 14, respectively, well known in the art for operating tuning dials in radio receivers. It is understood that any other driving mechanism, such as a rack and pinion arrangement, may be provided for moving the instrument 16 alongside the scale 9. The instrument 16 is again connected in the anode circuit of a variable mu tube of the receiver and is provided with a pointer 17 bent and constructed in the manner as shown and moving over the scale 9 at right angles thereto, as seen from the drawings. The guide rods 10 and 11 may be insulated and serve at the same time for supplying the current to the meter 16. The greater the receiving field strength of the station to which the set is tuned, the higher the pointer 17 will move in such a manner that its upper point will describe a curve as shown on the scale 9 when the tuning condenser 15 of the set is varied from its minimum to maximum capacity by operating the tuning knob 2 mounted on the condenser shaft and also mechanically connected with the friction wheel 14 of the driving mechanism for the instrument 16. The maxima of the curve described by the

pointer 17 will then indicate the accurate tuning of the particular station marked on the scale.

It is understood that the operation may be reversed in such a manner that the instrument 16 is made stationary and that the scale 9 is moved alongside in a straight direction by a driving mechanism similar as described.

It is also possible, in an arrangement according to the invention as described, to mark a minimum field strength on the tuning scale 9 of the receiver as shown in Figure 6 equal to the minimum or noise level below which it is not desired to receive any stations and in this manner the operator is at once apprised of the receiving condition of a particular station, without being inconvenienced by trying a large number of stations with the attendant annoyance due to noise pickup, especially as experienced in connection with sets equipped with automatic volume control.

Referring to Figure 3, I have shown a further constructional embodiment of the invention utilizing a luminous indicator in place of the pointer of an electrical instrument as shown before. This figure again illustrates a tuning dial 1 carrying a circular scale 3, and means for producing a punctiform luminous index of constant luminosity and moving at right angles to the indicating scale. This point-like index is produced by means of a lamp indicated at 17' and a diaphragm 18 with a small hole mounted in front of the lamp. The narrow light beam thus produced is then thrown upon a mirror 20 through an optical system, such as a condenser 19 as shown. The mirror 20 is arranged to swing about an axis by being mounted directly upon the movable system of an indicating instrument 16 similar to the instrument as shown by Figure 2. In this manner the narrow beam is reflected upon the translucent dial, producing thereon a point-like luminous index which moves at right angles to the scale and with its deviation being directly proportional to the strength of the carrier wave or the receiving field strength, respectively, of the receiver applied to the instrument 16 such as through the anode current of a variable mu receiving tube. In this manner a polar coordinate curve is described by the punctiform light spot on the receiving dial as shown, simultaneously indicating the receiving field strength and the station to which the set is tuned in a manner similar as described in connection with Figure 2.

It is understood that any other arrangement may be provided for projecting a punctiform luminous spot upon a translucent dial as shown and that the light beam may be operated by any suitable operating arrangement varying in accordance with the intensity of the carrier wave or receiving field strength, respectively.

Referring to Figure 4, this illustrates a further embodiment differing from Figure 3 by using an electric indicating lamp similar to Figure 1 but with constant brightness of the filament 5. The filament is again projected by means of a lens 6 to produce a linear luminous index 5' at right angles to the scale 3. I have furthermore shown means for varying the height of the index comprising a vane 21 acting as a shutter and operated preferably from the movable system of the indicating instrument 16. In this manner the linear light beam produced by the filament 5 will be interrupted at variable lengths, depending on the intensity of the carrier or receiving field strength of the receiver in such a manner as to produce a linear luminous index at right

angles to the scale 3 whose height varies in proportion to the intensity of the receiving carrier or receiving field strength of the receiver in a manner similar as described in connection with the preceding figures, resulting in a direct coordinate indication of wave length and field strength of the individual stations when tuning the receiver.

Referring to Figure 5, this shows a similar arrangement to Figure 4 with the exception that a linear scale is provided in place of a circular scale shown by Figure 4. This figure furthermore has the advantage over Figure 2 in that it is not necessary to move the entire indicating system or tuning scale, respectively, as in the case of Figure 2. Referring to Figure 5, I have shown for this purpose a prism or other reflecting member which is moved alongside the scale 9 by the driving mechanism operated directly in conjunction with the tuning element such as the tuning condenser of the receiving set. The prism 22 serves to direct a linear light beam to the scale 9. The light beam is produced by the filament 5 of a lamp by means of a diaphragm with a slot-like opening 18, and condenser 19 in a manner similar to Figure 4. The thus produced linear luminous index at right angles to the scale is varied in its length by means of the shutter vane 21 operated by the instrument 16 in exactly the same manner as described hereinbefore.

Another arrangement in which the invention may be embodied is shown by Figure 6. This figure differs from the preceding figures in that a luminous indicator and tuning device is used in place of an instrument and mechanical operation shown hereinbefore. For this purpose, I have shown a neon tube 23 or similar indicating device well known in the art for tuning radio receivers and comprising substantially a linear cathode 24 and anode 25. The cathode is usually connected to the plate of an R.F. or I.F. receiving tube in such a manner that the negative glow on the linear cathode will extend to variable lengths along the cathode in substantially direct proportion to the receiving field strength of the receiver. Such a tube lends itself advantageously for use as a combined station indicator and tuning device in accordance with my invention, as is well understood.

To this end, I have again shown in Figure 6 a lens 6 for projecting the linear glow on the cathode 24 upon the translucent dial 1 to act as an index for ascertaining the stations to which the set is adjusted on the one hand and for observing the receiving field strength as indicated by the height h of the glowing layer, on the other hand. I have furthermore indicated a mark at the index line 24' indicating the noise level h or threshold of sensitivity below which it is not desired to receive any station, so that the operator is immediately apprised of the prevailing conditions and the operation of the set is greatly simplified and the annoyance due to noise pickup substantially minimized.

It is understood that the invention as described is subject to various modifications and variations and that special amplifying tubes may be provided between a variable mu tube and the indicating system if necessary. The broad underlying idea of the invention as is understood consists in the provision of a combined and cooperating station indicator and tuning device enabling the proper tuning and adjustment of a desired station with the greatest ease and by a single operation and observation.

I claim:

1. A visual tuning device for radio receiving sets comprising a translucent dial carrying a scale calibrated according to transmitting stations, means for projecting a punctiform luminous spot upon said scale acting as an index mark for indicating the station received, and further means for moving said spot at right angles to said scale and to variable distances in accordance with the input signal current produced by the station received to indicate the tuning to resonance of the receiver.

2. A tuning device for radio receivers comprising means carrying a wave length scale, index means cooperating with said scale to indicate the station being received, and further means for displacing said index variably relative to said scale and in accordance with the input signal current produced by the station being received to indicate the tuning to resonance of the receiver, said displacement representing a variable coordinate to said wave length scale.

3. A tuning device as claimed in claim 2 comprising means for indicating the signal current corresponding to a minimum receiving field strength level.

4. A tuning device for radio receivers comprising scale means calibrated according to transmitting stations, means for producing an elongated index extending substantially transversely to and cooperating with said scale to indicate the station being received, and means for varying the extension of said index from said scale in accordance with the input signal current produced by the station received to indicate the tuning to resonance of the receiver.

5. A tuning device for radio receivers comprising scale means having graduations calibrated in transmitting stations, means for producing an index extending substantially transversely to and cooperating with said graduations for indicating the station being received, and means for varying the extension of said index in accordance with the input signal current produced by the station received to indicate the tuning to resonance of the receiver.

6. A tuning device for radio receivers comprising scale means having graduations calibrated ac-

cording to transmitting stations, index means cooperating with said scale means for indicating the station being received, and means for variably displacing said index means substantially transversely to the scale graduations in accordance with the input signal current produced by the station received to indicate the tuning to resonance of the receiver.

7. A tuning device for radio receivers comprising scale means having graduations calibrated according to transmitting stations, index means cooperating therewith for indicating the station being received, and means for varying a physical dimension of said index means in accordance with the input signal current produced by the station received to indicate the tuning to resonance of the receiver.

8. A tuning device for radio receivers comprising a translucent dial carrying a scale calibrated according to transmitting stations, means for producing a beam of light of linear cross-section, means for projecting said beam upon said scale to produce a luminous index line thereon substantially transverse to said scale, and further means for varying the cross-sectional length of said beam in accordance with the input signal current produced by the station received to indicate the tuning to resonance of the receiver.

9. A tuning device as claimed in claim 8 in which said last means is comprised of a shutter variably intercepting said light beam.

10. A tuning device as claimed in claim 5 in which said index means is comprised of a glow discharge tuning indicator producing a luminous column of varying length in accordance with the receiving current strength produced by the station received, and means for producing an image of said luminous column to serve as an index cooperating with said scale means.

11. A tuning device for radio receivers comprising scale means having graduations calibrated according to transmitting stations, index means cooperating therewith to indicate the station being received, and means for varying a geometric relation between said index means and said scale means in accordance with the input signal current produced by the station received.

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