June 28, 1949. M. WALLACE ET AL 2,474,387

VIBRATING REACTANCE PANORAMIC RADIO RECEIVER

Original Filed July 17, 1941 2 Sheets-Sheet 1

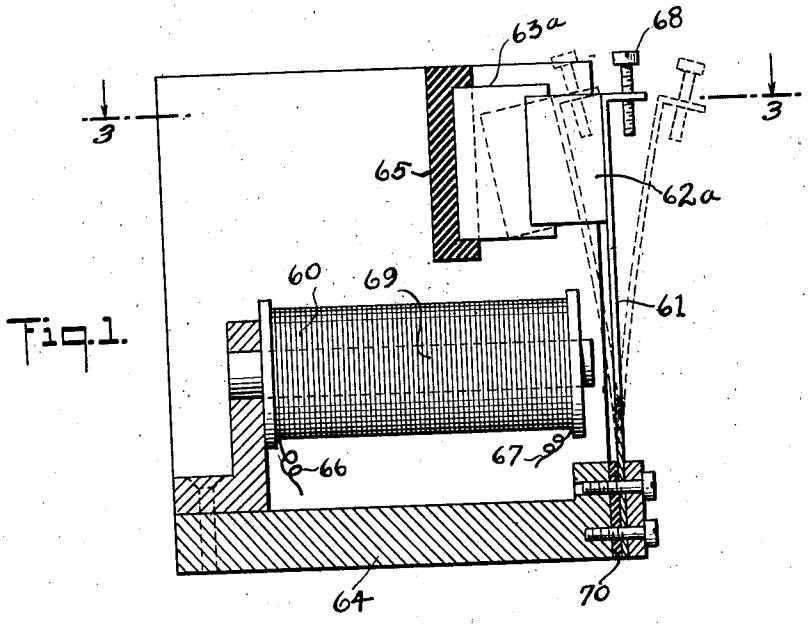


Fig. 1.

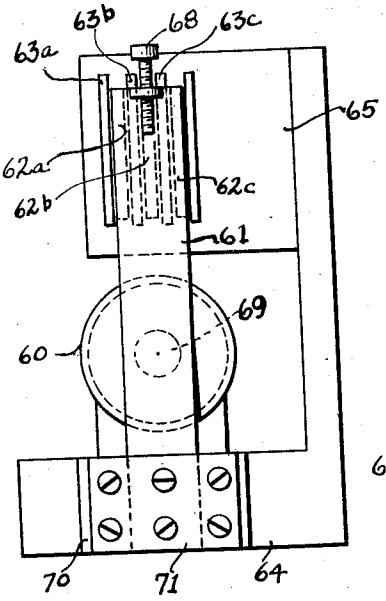


Fig. 2.

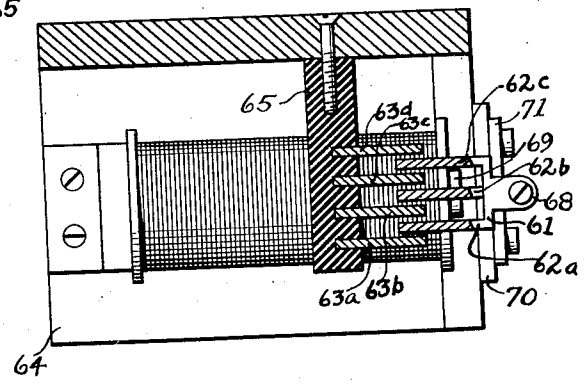


Fig. 3.

INVENTORS
MARCEL WALLACE
HORACE G. MILLER
BY Darby & Darby
ATTORNEYS

June 28, 1949. M. WALLACE ET AL 2,474,387

VIBRATING REACTANCE PANORAMIC RADIO RECEIVER

Original Filed July 17, 1941 2 Sheets-Sheet 2

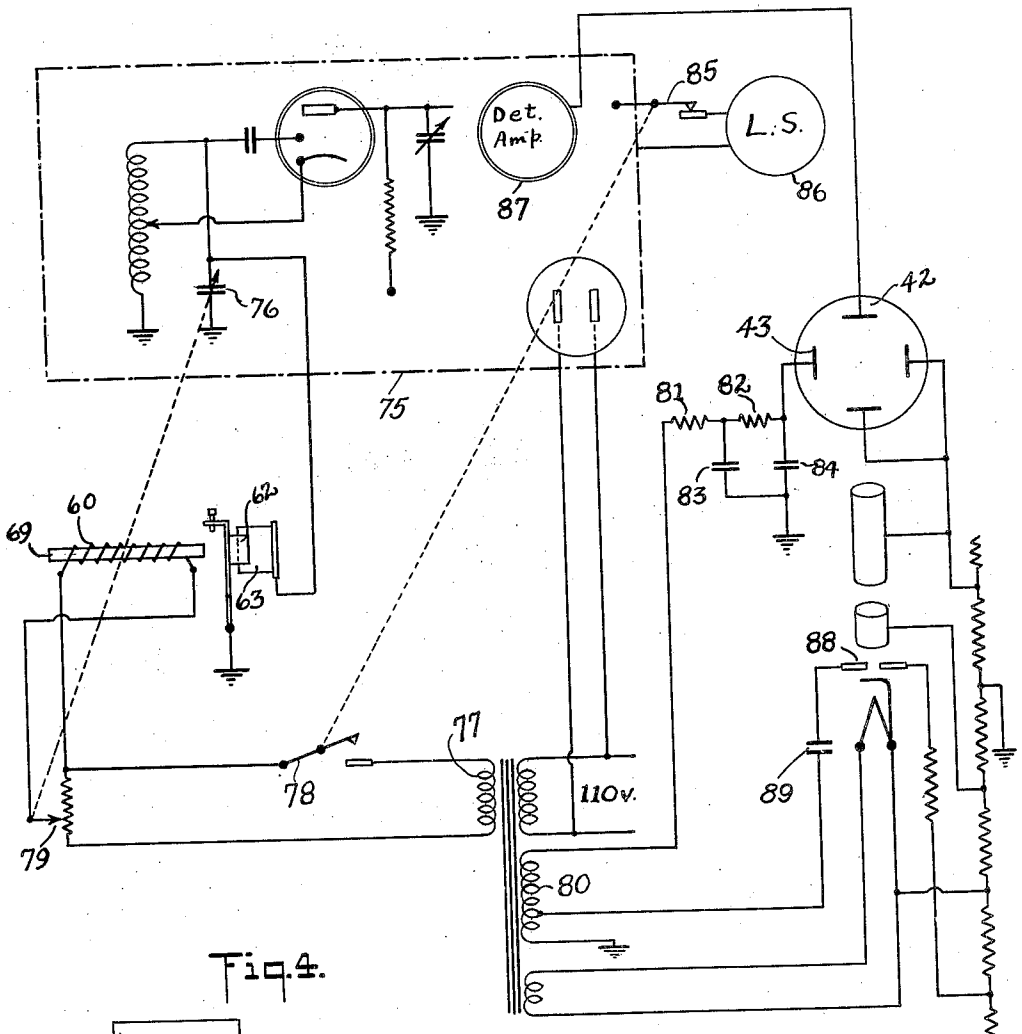


Fig. 4.

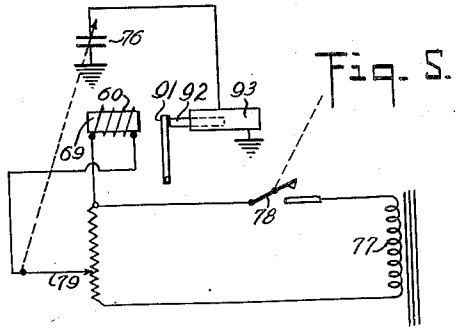


Fig. 5.

INVENTORS
MARCEL WALLACE
HORACE G. MILLER
BY Darby & Darby
ATTORNEYS

Patented June 28, 1949

2,474,387

UNITED STATES PATENT OFFICE

2,474,387

VIBRATING REACTANCE PANORAMIC RADIO RECEIVER

Marcel Wallace, New York, N. Y., and Horace G. Miller, Belleville, N. J., assignors, by mesne assignments, of one-half to Marcel Wallace, New York, N. Y., doing business as Panoramic Laboratories, New York, N. Y., and one-half to Panoramic Radio Corporation, New York, N. Y., a corporation of New York

Original application July 17, 1941, Serial No. 402,822, now Patent No. 2,381,940, August 14, 1945. Divided and this application December 11, 1943, Serial No. 513,895

16 Claims. (Cl. 250—20)

1

This application is a division of our co-pending application Serial No. 402,822, filed July 17, 1941, for "Method and apparatus for simultaneous aural and panoramic radio reception," now Patent No. 2,381,940, issued August 14, 1945.

In patents to Marcel Wallace No. 2,279,151, issued February 7, 1942, for "Panoramic radio receiving system," No. 2,273,914, issued February 24, 1942, for "Radio navigation system" and No. 2,312,203, issued February 23, 1943, for "Radio beacon and panoramic reception system," in Marcel Wallace pending application Serial No. 357,814, filed September 21, 1940, for "Radio altimeter and panoramic reception system," now Patent No. 2,378,604, issued June 19, 1945, and in our co-pending parent application Serial No. 402,822, there are disclosed various types of panoramic receivers and various uses therefor.

This application is related to said patents and patent applications in that it discloses a structure for use in such panoramic systems.

The object of this invention is to provide a simplified structure for use in panoramic receiver systems.

A feature of this invention is the provision of one or more vibrating reactances for tuning an oscillator or an amplifier circuit, or both, periodically over a range of frequencies for panoramic reception. Such vibrating reactances may also be used for simultaneously tuning a plurality of panoramic channels when used simultaneously for displaying different portions of the frequency spectrum as disclosed in our parent application.

In the drawings,

Figure 1 is a side elevation of the structure of a vibrating condenser for use in my invention.

Figure 2 is an end view of the structure of Figure 1;

Figure 3 is a top sectional view of the structure of Figure 1 along the lines 3—3 thereof; and

Figure 4 is a circuit diagram of a panoramic adapter for a radio receiver, using a synchronous vibrating condenser as shown in the other figures, and

Figure 5 is a partial circuit diagram and schematic illustrating the use of a vibrating inductance.

In the prior patents and patent applications

2

above referred to, there are disclosed various methods and apparatus for panoramic radio reception, that is, simultaneous display on the screen of a cathode ray tube of a band of frequencies which may contain a number of signals, each of which will indicate its presence by a trace on the screen. This is accomplished by a sweep circuit which applies sweep voltage to the horizontal deflecting plates of a cathode ray tube, and by periodically tuning an input circuit of a radio receiver above and below a mid frequency in synchronism with the sweep voltage, and applying the detected signal to the vertical deflecting plates of the cathode ray tube.

If a synchronous vibrating reactance, such as a condenser, is used to vary the frequency of tuning, the apparatus of a panoramic receiver may be greatly simplified.

In Figures 1 to 3 I have shown such a vibratory condenser. Alternating current is fed into the exciting coil 60 through leads 66, 67. A soft iron core or a permanent steel magnet 69 inserted in this coil creates an alternating magnetic field at its ends. A vibrating steel reed 61 is placed in this field. This will vibrate in step with the magnetic forces produced and will be attracted and repulsed in synchronism. By using a soft iron core, the number of vibrations will be equal to double the frequency of the voltage applied, whereas by using a permanent magnet core the magnetic field is neutralized during half of the time, and the number of vibrations is equal to the frequency of the alternating current. The reed 61 is fastened in the base of 64 of the instrument by means of block 71, and on the free end one or more parallel condenser plates 62*a*, *b*, *c*, are mounted normally to its surface. These constitute the moving armature of a capacitor. The other armature is fixed and consists of stator plates 63*a*, *b*, *c*, *d*, which are insulated by means of insulating block 65. The dimensions and weight of the reed and moving armature are so proportioned that its natural period of resonance is very nearly that at which it is made to vibrate. This reduces the required amount of exciting power in the coil 60. This period is adjustable by means of a screw 68 mounted on the extreme end of the reed, which varies slightly its effective length. We find it advantageous to slightly dampen the vibrating reed by, for example, inserting a

sheet of rubber 70, between the base 66 and block 71. While this arrangement requires a little more driving power, the amplitude and phase relationship with the driving A. C. voltage remain more nearly constant even if the frequency of the A. C. varies noticeably.

Figure 1 shows in full lines the reed in stationary position corresponding to capacity C_0, and in dotted lines the reed in extreme vibrating positions, corresponding to capacities C_{max} and C_{min}. It can be seen that it is possible to make this variation equal in each direction

$$(C_{max}-C_0=C_0-C_{min})$$

or to give, according to the shape of the plates, any desirable variation of capacity versus amplitude of vibration. Thus we can periodically tune a circuit equally above and below a given center frequency, making $F_{max}-F_0=F_0-F_{min}$. Such a condenser will vary in step with the A. C. voltage applied. In case of a sine wave, its instantaneous velocity will also vary according to a sine wave. The velocity is lowest, passing through zero, at the extreme ends corresponding to capacities C_{min} and C_{max} and it is the highest in the central position corresponding to capacity C_0. This maximum velocity $V_{max}=\pi V$, in which V is the average velocity, corresponding to the frequency of the sine wave.

Figures 2 and 3 show respectively an end view and top view of the alternating condenser.

Such a condenser may be used to replace the reactance tube used to vary the frequency of a panoramic oscillator in the above mentioned patents and applications, for example the condenser 59 in Figures 6 and 7 of our parent application. In this case, there is no need of the reactance tube 29 in those figures. The design can be still further simplified by eliminating the sawtooth sweep voltage generator and its amplifier. The horizontal deflecting element 43 (Figure 4) of the cathode ray oscillograph can be then energized directly with the A. C. current from the same source which energizes the synchronous vibrating condenser, as will be shown in Figure 4.

Due to the fact that the motion of the condenser is reciprocating, it is sometimes difficult to make the capacity and sweep voltage variations identical. In other words, there may exist a variable phase difference between the sine wave producing the capacity variations and that producing the sweep on the screen; this phase difference may change as the reed moves toward the coil, or away from the coil. Such a change will cause the image on the screen to appear blurred or double.

In order to avoid this condition, this phase difference must either be corrected or one half cycle of the image must be blanked out. This may be done by applying on the grid of the cathode ray tube in synchronism a blanking potential during each half cycle of sweep. This will be shown in Figure 4.

The advantage of the synchronous vibrating condenser is the great simplicity it affords for making a panoramic receiver. By inserting a voltage controlling device in the exciting coil 63, the amplitude of the vibration may be so varied that it is possible to cover wider or narrower visual bandwidths at will, such bandwidths extending equally above and below a fixed frequency.

Due to the fact, however, that the instantaneous velocity of the reed varies, the resolution will be unequal, the maximum resolution being shown

at the extremities of the screen and the lowest resolution in the center.

Such a vibrating condenser, with a cathode ray oscillograph, may constitute a simple attachment to any ordinary type of receiver which will become a panoramic type receiver, or aural reception receiver, at will. Such an attachment is referred to in the claims as a panoramic adaptor.

Figure 4 shows the essential parts of such a combination. 75 represents a conventional radio receiver having a manually tunable condenser 76. In parallel with this condenser is connected a vibrating condenser 62—63. The exciting coil voltage is derived from the secondary 77 of a power supply transformer through a switch 78 and a potentiometer 79. This controls the amplitude swing of the vibrating reed 61. The output of the receiver is connected to an aural device 86, and a switch 85 is provided for interrupting its operating when the vibro-condenser is in operation. Switches 78 and 85 may be operated simultaneously: when one is "on" the other is "off" and vice-versa. The vertical deflecting element 42 is also connected to the output of the receiver (detector or audio frequency amplifier). The horizontal element 43 is connected to the secondary 80 of the power supply transformer, through a phase shifting bridge 81—84, which shifts the phase by 90°. This is necessary because the vibration of the condenser varies in phase with the current variation which is 90° out of phase with the voltage variation. From the same power supply voltage the blanking wave is supplied to the grid 88 of the cathode ray tube through condenser 89, as described above.

The controls 79 and 76 may be ganged together if desired, and the value of the potentiometer 79 may be made such as to maintain a substantially constant visual bandwidth as the condenser 76 is rotated from minimum to maximum.

Several vibrating reactances may be connected in a panoramic receiver, having more than one tuning condenser. By applying the excitation voltage from a common source, at the same voltage and phase, all vibrating reactances will vibrate in synchronism.

What has been said about a vibrating condenser may be said about a vibrating inductance. Instead of moving the armature of a capacitor the reed may move one or several iron cores in one or several coils. The combination of a variable capacitor 76 for manually tuning the receiver, with a periodically varying inductance has the advantage that the visual bandwidth W varies proportionally directly with the frequency rather than to the cube of the frequency as in the use of a vibrating condenser. This proves important for special applications.

This is illustrated in Fig. 5, in which the circuit will be the same as Fig. 4, which is repeated in part with the same reference numerals to indicate the substitution of a vibrating inductance for the vibrating condenser of Fig. 4. In Fig. 5 the coil 60 is supplied with current from the secondary 77 as in Fig. 4. The coil 60 actuates its armature 91 to which is secured a core 92 which vibrates within a tuning coil 93.

It will be obvious to those skilled in the art that our invention is capable of various modifications, and we do not wish to be restricted to the specific circuits and instrumentalities shown and described, but only by the scope of the appended claims.

What is claimed is:

1. A panoramic radio receiver comprising a

radio receiver, a vibrating reactance, a cathode ray oscillograph having means for generating a cathode ray beam and means for deflecting said beam in coordinate directions, a power line, means for deriving a voltage from said power line and applying said voltage to said deflecting means to deflect said beam in one direction, means for applying said voltage to said vibrating reactance, said reactance being connected in the tuning circuit of said panoramic radio receiver, for periodically tuning it over a predetermined range, and means for applying a voltage from the output of said radio receiver to said deflecting means to deflect said beam in a coordinate direction.

2. A panoramic wave energy receiver comprising a radio receiver, an alternating current power line, and a panoramic adaptor having a cathode ray oscilloscope, said adaptor having a vibrating reactance operated by current from said line and connected for periodically tuning said radio receiver, the beam in said oscilloscope being deflected in one direction by voltage derived from said line and in a coordinate direction by voltage from the output of said receiver, and means for simultaneously adjusting the amount of current operating said vibrating reactance and the setting of the frequency range of reception of said receiver, whereby said panoramic wave energy receiver will operate over a frequency range of the same extent at any frequency.

3. A panoramic receiver comprising a wave energy receiver, an alternating current power line, and a panoramic adaptor having a cathode ray oscilloscope, said adaptor having a vibrating reactance operated by current from said line and connected for periodically tuning said radio receiver, the beam in said oscilloscope being deflected in one direction by voltage derived from said line and in a coordinate direction by voltage from the output of said radio receiver, and means for adjusting the amount of current operating said vibrating reactance and the setting of the frequency of reception of said wave energy receiver, whereby said panoramic receiver will operate over a frequency range of the same extent at any frequency.

4. A panoramic radio receiver comprising a radio receiver, a vibrating reactance, a cathode ray oscillograph having means for generating a cathode ray beam and means for deflecting said beam in coordinating directions, a power line, means for deriving a voltage from said power line and applying said voltage to said deflecting means to deflect said beam in one direction, means for applying said voltage to said vibrating reactance, said reactance being connected in the tuning circuit of said panoramic radio receiver, for periodically tuning it for over a predetermined range, and means for applying a voltage from the output of said radio receiver to said deflecting means to deflect said beam in a coordinate direction.

5. A panoramic receiving system including a signal receiving channel, means for periodically tuning said channel, said means comprising a mechanically vibrating element, a source of alternating sinusoidal voltage, means for energizing said vibrating element to vibrate in synchronism with said source of alternating sinusoidal voltage, visual means comprising a cathode ray tube having means for generating a cathode ray beam, for displaying signals received in said signal receiving channel, and means for applying said alternating sinusoidal voltage to said cathode ray beam for separating displayed signals by space intervals in accordance with the respective frequencies of the displayed signals.

6. A panoramic receiver comprising a vibrating reactance, a cathode ray beam indicator having two pairs of beam deflecting electrodes, an alternating current source of sinusoidal voltage, means for applying said voltage to one of said pairs of beam deflecting electrodes, means for applying said voltage to effect vibration of said vibrating reactance, means coupling said vibrating reactance with said receiver to vary the tuning thereof in synchronism with said vibration, and means for applying output signals from said receiver to the other of said pairs of deflecting electrodes.

7. A frequency spectrum analyzer comprising a tunable element, means for applying to said tunable element signals in a predetermined frequency spectrum, means for tuning said tunable element comprising a mechanically resonant vibrating reactance, and means synchronized with vibrations of said mechanically vibrating reactance for generating a visual plot of signals passing through said tunable element against the tuned frequency of said tunable element, said last named means comprising a source of alternating current power at the resonant frequency of said mechanically resonant vibrating reactance, and means for applying power from said source to vibrate said mechanically vibrating reactance.

8. A spectrum analyzer comprising means for receiving a band of frequencies, means for converting frequencies of said band of frequencies to an intermediate frequency, said means for converting comprising a tunable local oscillator, and means for periodically varying the frequency of said tunable local oscillator comprising a mechanically resonant vibrating reactance, visual means for displaying a plot of said band of frequencies comprising means for establishing a frequency representative base line for said plot, and a common source of alternating current power for establishing said base line and for vibrating said reactance, said source of alternating current power having a frequency approximately equal to the resonant frequency of said vibrating reactance.

9. A signal analyzer comprising an oscillator, said oscillator comprising a vibrating member for varying the tuning thereof, means comprising devices for generating a cathode ray beam for displaying the frequency content of a spectrum in response to variations of tuning of said oscillator, and a single source of sinusoidal voltage for synchronously actuating said cathode ray beam for displaying frequency content of said spectrum and for actuating said vibrating member, said voltage applied directly to said cathode ray beam for actuating said cathode ray beam.

10. A signal analyzer comprising an oscillator, said oscillator comprising a resonant vibrating reed for varying the tuning thereof, means for generating a display of the frequency content of a signal spectrum in response to variations of tuning of said local oscillator, and means comprising a common source of power for synchronously actuating said resonant vibrating reed and for providing a frequency base line for said display.

11. A spectrum analyzer comprising a periodically tunable device comprising a relatively narrow band frequency selective circuit, a mechanically resonant vibrating device for varying the frequency response of said frequency selective circuit, a visual display device comprising means

for generating a visual indication, means for applying to said frequency selective circuit a relatively broad band of frequencies for transfer therethrough of a selected sub-band of said band of frequencies, means for applying signals transferred by said frequency selective circuit to move said visual indication of said visual display device, and means for further periodically and synchronously moving in sinusoidal motion said visual indication and vibrating in sinusoidal motion said mechanically vibrating device.

12. A panoramic system comprising a wave energy receiver, a vibrating reactance comprising an oscillating damped resonant mechanical element, a visual display means having means for generating a visual indication, means for periodically translating said visual indication, an alternating current power line, means for deriving an alternating voltage from said power line and for energizing said means for periodically translating in synchronism with the said alternating voltage, means for applying power from said power line to said vibrating reactance to effect vibration thereof, said alternating voltage having approximately the natural frequency of said oscillating mechanical element means for coupling said vibrating reactance with said receiver for periodically tuning said receiver, and means responsive to the output of said receiver for moving said visual indication of said visual display means.

13. A spectrum analyzer comprising a wave energy receiver, a vibrating reactance comprising a tuned reed, a cathode ray oscillograph having means for generating a cathode ray beam and means for deflecting said cathode ray beam, a source of power, means for applying power from said source of power to said deflecting means and to said vibrating reactance, said vibrating reactance being connected in the tuning circuit of said receiver for periodically tuning said receiver over a predetermined range, means for applying signal from the output of said receiver for further controlling said cathode ray beam, and means for varying the resonant frequency of said tuned reed.

14. A spectrum analyzer including a tunable signal receiver, mechanically vibrating means for periodically tuning said receiver over a predetermined band of frequencies, visual display means comprising means for generating an electron beam and deflection means for deflecting said beam in a first direction, a source of sinusoidal voltage, means for applying said voltage jointly to said mechanically vibrating means for periodically tuning and to said deflection means for deflecting said beam, whereby to synchronize the tuning of said receiver and the deflections of said beam, and means responsive to the output of said receiver for actuating said beam to create a visible signal at said visual display means.

15. The combination in accordance with claim 14 wherein is further provided means for controlling the vibrational amplitude of said mechanically vibrating means for periodically tuning said receiver.

16. A panoramic receiving system including a signal receiving channel, means for periodically tuning said channel, said means comprising a mechanically vibrating element, a source of single frequency sinusoidal alternating current, means for energizing said vibrating element to vibrate in harmonic motion in synchronism with said source of alternating current, visual means for displaying signals received in said signal receiving channel, means responsive to said alternating current for separating displayed signals by spaced intervals in accordance with the respective frequencies of said displayed signals, and means for controlling the vibrational amplitude of the vibration of said mechanically vibrating element for varying the range of the periodic tuning of said signal receiving channel.

MARCEL WALLACE.
HORACE G. MILLER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,638,993	Hartley	Aug. 16, 1927
1,977,939	Fichandler	Oct. 23, 1934
1,994,232	Schuck, Jr.	Mar. 12, 1935
2,034,787	Williams, Jr.	Mar. 24, 1936
2,084,760	Beverage	June 22, 1937
Re. 22,150	Bagno et al.	Aug. 4, 1942
2,292,790	Millar	Aug. 11, 1942
2,318,936	Fisher	May 11, 1943
2,349,125	Turner	May 16, 1944
2,368,090	Abernathy	Jan. 30, 1945
2,368,842	Kealoha	Feb. 6, 1945

FOREIGN PATENTS

Number	Country	Date
155,854	Great Britain	1921
505,906	Germany	Aug. 27, 1930
72,110	Sweden	June 30, 1931
736,470	France	Nov. 24, 1932