Nov. 14, 1944. D. G. C. LUCK 2,362,651

RADIO RANGE

Filed March 27, 1942

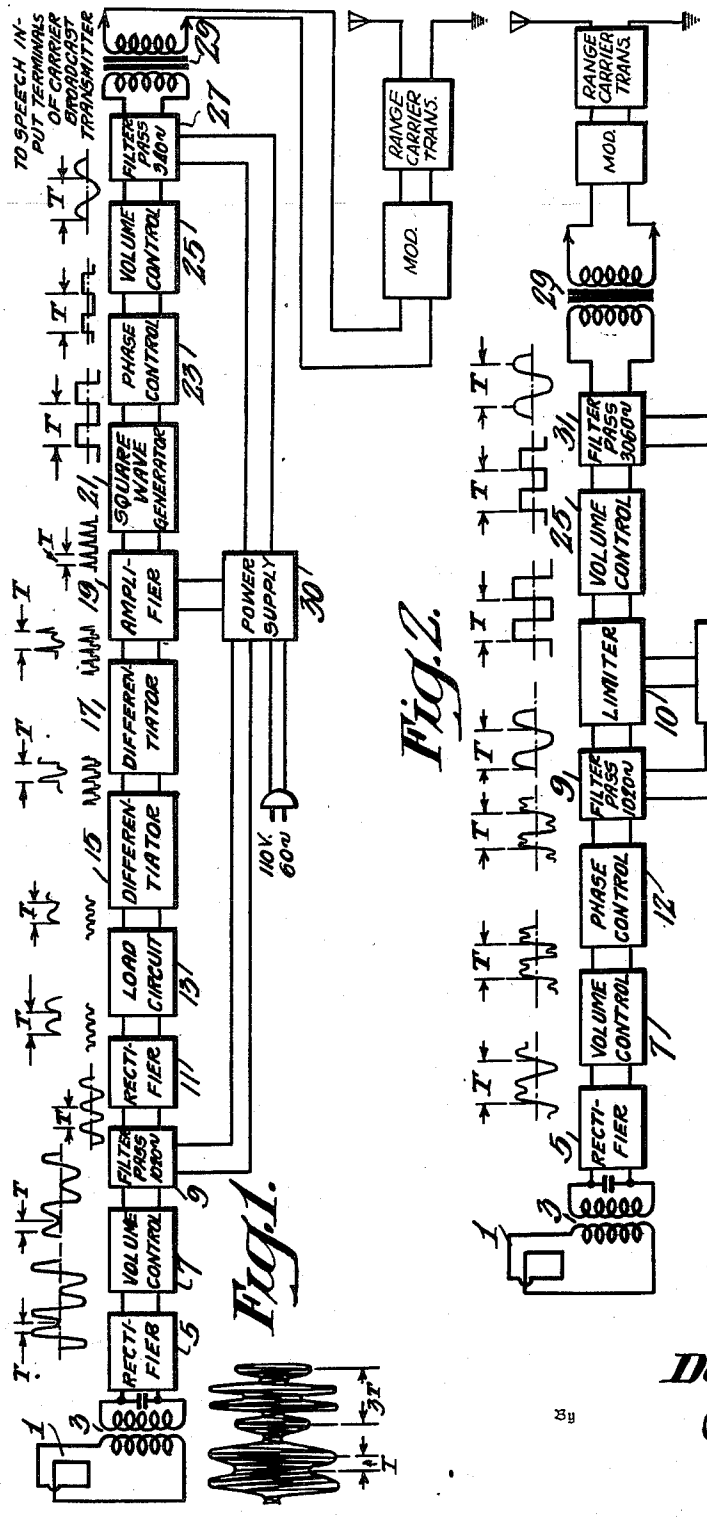


Fig. 1.

Fig. 2.

Inventor
David G. C. Luck
By C. D. Tuska
Attorney

Patented Nov. 14, 1944

2,362,651

UNITED STATES PATENT OFFICE

2,362,651

RADIO RANGE

David G. C. Luck, Merchantville, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application March 27, 1942, Serial No. 436,430

7 Claims. (Cl. 250—11)

This invention relates to radio ranges and more especially to means for providing tone modulation of reference phase for identifying the courses and quadrants of a simultaneous four-course radio range. In an application entitled improvement in radio ranges, Serial No. 272,017, filed May 5, 1939, by David G. C. Luck, Patent No. 2,314,795, dated March 23, 1943, there is disclosed and claimed a system of quadrant identification wherein a non-directionally radiated carrier is modulated, with a frequency related to the range tone frequency, to provide a reference phase voltage for quadrant determination. It is an object of this invention to provide means for producing and controlling a reference tone for this purpose.

The invention will be described by reference to the accompanying drawings in which Figure 1 is a schematic diagram of an apparatus used to produce from a radio frequency field with complex modulation, a pure low frequency voltage, sub-harmonically synchronous with and accurately related in phase to one pure tone modulation component; and Figure 2 is a schematic diagram of an apparatus for producing a voltage which is a harmonic of a modulation component. Similar reference characters indicate similar elements in the drawing.

Referring to Fig. 1, a loop 1 is placed in the vicinity of the antennas of a four-course radio range of the type described in the aforementioned application, S. N. 272,017, preferably near an "on course" sector in which the A and N tones have the same polarity. The voltage picked up from the range field is fed through a tuned radio frequency transformer 3 to a diode detector or a suitable rectifier 5, where it is rectified to give a pulsating output similar to the envelope of the radio frequency voltage of the range field. A volume control 7 is provided for adjusting the pulsating voltage to a standard level and to compensate for various loop installations. The range course tone frequency, which is usually 1020 cycles, is selected from the detector output by an adjustable narrow band filter 9, the output of which is half-wave rectified by a diode or suitable rectifier 11 feeding a slightly capacitive load 13. The voltage across the load circuit 13 is twice differentiated with respect to time by circuits 15 and 17, and the differentiated wave is amplified by an amplifier 19 to give a sequence of sharp voltage impulses repetitive at the range course tone frequency and constantly phased with respect to the field voltage envelope component of this frequency. The filter 9, load 13, differentiators 15, 17 and amplifier 19 comprise a system for deriving from a complex wave train an impulse train synchronous with one wave component, which is described in U. S. Patent No. 2,188,611 issued January 30, 1940, to L. E. Norton and assigned to the Radio Corporation of America.

The impulses control a square wave generator 21 operating at an odd integral subharmonic of the impulse frequency. The generator 21 may be any relaxation oscillator, such as the well-known Abraham multivibrator. The square-wave output of the device 21 is fed through a phase control 23 and a volume control 25 to a narrow band pass filter 27, which is adjusted to pass the desired subharmonic frequency of the range course tone. This may be one-third the frequency of the range course tone, 340 cycles. One suitable filter is the feedback amplifier filter described by H. H. Scott in Proceedings of the I. R. E. for February 1938, p. 226. Through an appropriate coupling device 29, such as an audio frequency transformer, the pure subharmonic tone is fed to the speech input terminals of the carrier broadcast transmitter of the simultaneous range as is disclosed in the aforesaid application Serial No. 272,017. The range carrier is thus modulated with a phase reference tone and transmitted uniformly in all directions. The modulation depth is set by the control 25 and the reference modulation is brought in phase with the course modulation by the phase control 23. The necessary direct current supply voltages to the unit may be provided by an ordinary socket power unit 30.

In the event that a reference tone at an odd multiple of the frequency of the range tone is preferred, as contemplated in the above-mentioned application Serial No. 272,017, the system illustrated in Fig. 2 may be used. As a matter of practical design, the phase control 12 is placed in this lower frequency circuit. The pure range course tone voltage appearing at the output of the filter 9 is fed to a limiter 10 which clips off the peaks, resulting in a square wave at range course tone frequency. The desired harmonic component of this wave is selected by the filter 31 and fed to the speech input of the carrier broadcast transmitter.

Thus the invention has been described as a unit for deriving from a radio frequency field with complex modulation, a pure low frequency voltage subharmonically or harmonically synchronous with and accurately related in phase to one modulation component of said field. This

is accomplished by rectifying the voltage picked up by an antenna placed in the field, filtering the rectified voltage to obtain a pure low frequency voltage wave corresponding to the desired modulation component, and deriving from it square waves which are filtered to isolate the required harmonic or subharmonic of the modulation component. This harmonic or subharmonic voltage is used to modulate the carrier broadcast transmitter of the usual four course simultaneous radio range, as described in application S. N. 272,017, for the purpose of quadrant identification.

I claim as my invention:

1. A device for producing, from a radiation field with complex modulation, a low frequency voltage harmonically related to one modulation component of said field, including means for deriving a radio frequency voltage from said field, means for deriving a sinusoidal voltage corresponding to one of the modulation components of said radio frequency voltage, means for deriving from said sinusoidal voltage a square wave having a frequency related to the frequency of said sinusoidal wave by an integral number, and means for deriving from said square wave a second sinusoidal wave.

2. A device for deriving a voltage alternating at a frequency which is related by an integral number to the frequency of one modulation component of a radio frequency field with complex modulation, comprising an antenna, a rectifier connected to said antenna to produce a voltage corresponding to the envelope of the amplitude of a radio frequency field in which said antenna is placed, a filter for selecting one component of the product of said rectifier, a circuit for differentiating said selected component with respect to time and a second circuit for differentiating said differentiated component with respect to time, an oscillation generator controlled by the output of said second differentiating circuit, adjustable phase shifting means arranged to control the phase of the output of said oscillation generator, an adjustable attenuator for controlling the amplitude of said generator output, and a filter for deriving a sinusoidal component of said generator output.

3. A device for deriving from a radiation field with complex modulation a voltage harmonically related to one modulation component of said field, comprising an antenna for deriving a modulated radio frequency voltage from said field, a rectifier and a filter for deriving a voltage corresponding to one modulation component of said radio frequency voltage, wave shape modification means for producing from said modulation component voltage a train of sharply defined voltage pulses recurrent at the frequency of said modulation component voltage and having a fixed phase with respect to said modulation component voltage, an oscillation generator controlled by said voltage pulses to produce non-sinusoidal waves recurrent at a frequency which is an odd subharmonic of the frequency of said pulses, adjustable phase shifting means for controlling the phase of said non-sinusoidal waves with respect to said pulses, and filter means for deriving the sinusoidal fundamental component voltage from said nonsinusoidal wave.

4. A device for deriving from a radiation field with complex modulation a voltage harmonically related to one modulation component of said field, comprising an antenna for deriving a modulated radio frequency voltage from said field, a rectifier and a filter for deriving a voltage corresponding to one modulation component of said radio frequency voltage, wave shape modification means for producing from said modulation component voltage a train of non-sinusoidal voltage waves recurrent at the frequency of said modulation component voltage and having a definite phase relation thereto, adjustable phase shifting means for controlling the phase of said non-sinusoidal waves with respect to said modulation component voltage, and filter means arranged to select one sinusoidal component voltage wave from said non-sinusoidal wave.

5. A device for deriving a voltage alternating at a frequency which is related by an integral number to one component of a complex wave, comprising a filter for isolating said component, a circuit for differentiating said isolated component with respect to time and a second circuit for differentiating said differentiated component with respect to time, an oscillation generator controlled by the output of said second differentiating circuit, adjustable phase shifting means arranged to control the phase of the output of said oscillation generator, and adjustable attenuator for controlling the amplitude of said generator output, and a filter for deriving a sinusoidal component of said generator output.

6. A radio range quadrant identification system comprising the system as claimed in claim 5, and a radio transmitter connected thereto so as to be modulated by the output thereof.

7. A radio range quadrant identification system comprising the system as claimed in claim 1, and a radio transmitter connected thereto so as to be modulated by the output thereof.

DAVID G. C. LUCK.