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MEANS AND METHOD OF MEASURING DISTANCE

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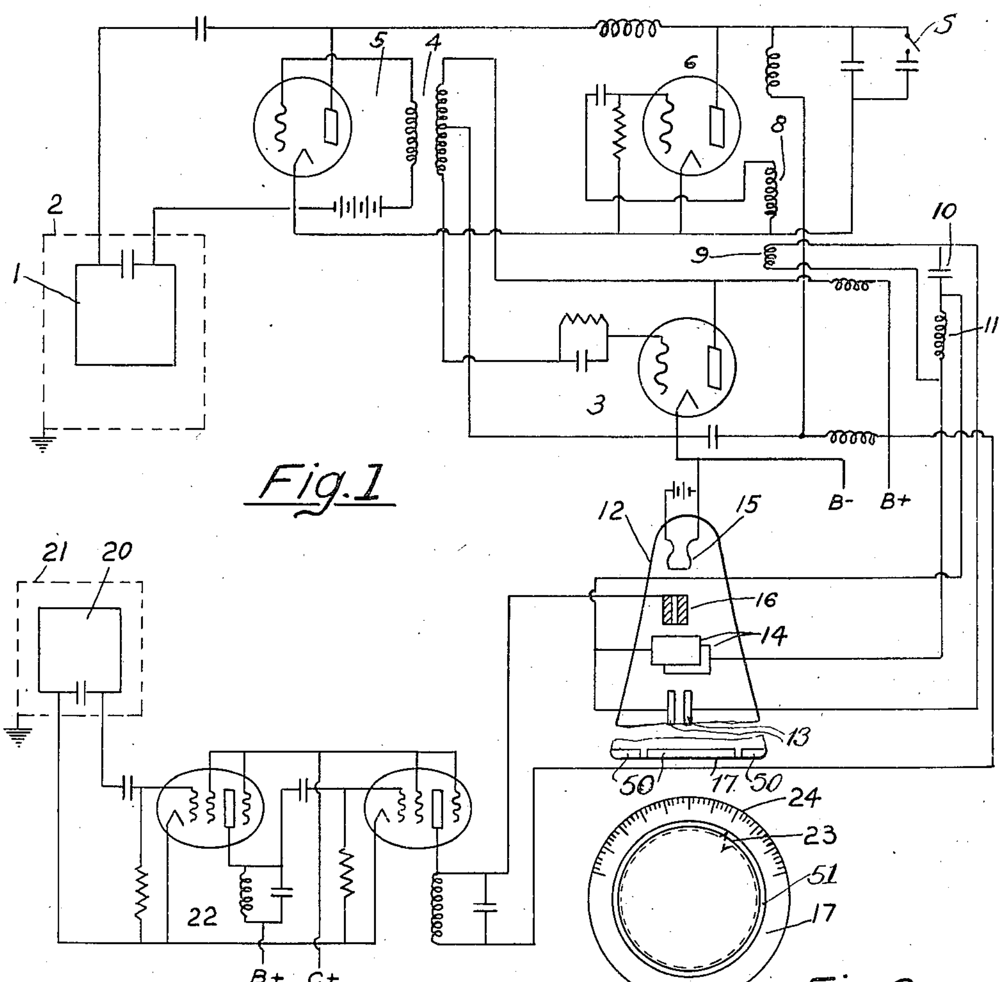

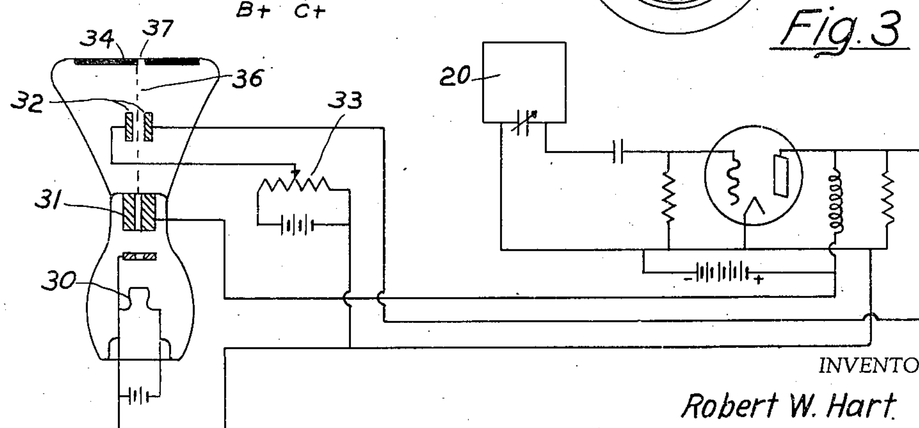

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MEANS AND METHOD OF MEASURING DISTANCE

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4 Claims. (Cl. 250—1)

The present invention relates to a means and method of measuring distance by the use of radiant energy particularly electromagnetic waves.

The present application is a division of my application Ser. No. 453,725 filed May 19, 1930.

In my application Ser. No. 453,726 filed May 19, 1930, a companion application to Ser. No. 453,725, I describe a method and means of determining heights and distances, particularly for use in finding the height of an aircraft above the ground by means of a system employing modulated high frequency radio waves. In this companion application the distance is measured by synchronizing the direct and reflected modulated waves.

In the present application there is described a means and method whereby overmodulated high frequency waves may be used. This method and apparatus have the same advantages that the apparatus described in the companion application has over the prior art. The advantage of the present system over that disclosed in the companion application is the absence of any moving mechanical parts.

The present invention will be more fully described in connection with the drawing in which Fig. 1 shows schematically the system. Fig. 2 shows a modification and Fig. 3 shows an end view of the cathode ray tube described in the specification.

In Fig. 1 the antenna 1 is used to emit the overmodulated high frequency waves. This may be shielded by a shield 2 substantially as described in my companion application. The source of wave energy is derived from an oscillating circuit 3 which oscillates at the high frequency carrier wave to be used and which impresses this high frequency by means of the coupling coil 4 upon an amplifier circuit 5.

The modulating wave is supplied from the oscillatory circuit 6 which oscillates at the modulating frequency and which impresses its modulating current into the plate filament circuit of the amplifier 5. While, therefore, the amplifier 5 is tuned to the high frequency signal, it is modulated at the desired frequency. A switch S is provided in the modulated circuit so that there may be a choice of two modulating frequencies for the operator to use. Coupled with the coil 8 of the modulating circuit 6 is a coil 9 across which is a capacity 10 and inductance 11. This inductance and capacity serve to control the voltage on the plates of the cathode ray tube 12, the capacity 10 being connected across the plates 13, 13 while the inductance 11 is connected across the plates 14, 14. The cathode ray tube is provided with a cathode 15 and an anode 16. The modulating wave impressed upon the plates 14 and the plates 13 create a rotating electron beam which is normally invisible from the end of the tube marked 17 in Figure 3. Normally the beam rotates behind the mask portion 50 on the inside of the end 17 of the tube. The mask is formed with a circular opening or slit 51 as shown in Figure 3 to which the beam is diverted to produce an indication when the received signal is impressed upon the accelerating anode 16. The diameter of rotation of the beam is dependent upon the voltage between the cathode and the anode of the amplifier 5 and upon the potential of the accelerating anode 16. When the voltage is greater, the diameter of the figure on the end of the tube marked by the rotating beam is smaller, and when the potential on the accelerating anode is increased with the voltage applied to the plates 13 and 14 remaining the same, the diameter of the beam is also diminished.

During one complete modulating cycle the beam will make one complete rotation. The rotating period of the beam and the interval between periodic signals should be commensurate with each other so that the beam has the same relative position with respect to the measuring scale.

During this cycle there will be emitted from the antenna 1 a short group of vibrations when the amplitude of the modulating wave is such as to allow the amplifier circuit to radiate the carrier frequencies. These trains of high frequency vibrations will be peaked depending upon the shape of the modulating wave and will have the period of the modulating wave. These trains of vibration emitted at the modulated frequency will be picked up after reflection from the object whose distance is being measured by the antenna 20 which may be of the loop type described in my companion application and which may be shielded by the shield 21, and passed through a receiving circuit. The receiving circuit 22 may be of the usual type but I preferably employ, as shown in my companion application, screen grid receiving means, since the capacities of the short wave systems may thereby be more easily controlled. The receiving circuit 22 has its output impressed across the filament anode or cathode-anode of the Braun tube 12. When a periodic vibration is received, the voltage across the cathode-anode will change, and, in the rotating beam there will be present a serration 23 adjacent to the scale 24 in the annular slit on the end of the tube.

Since the modulating frequency may be, and preferably is, a radio frequency wave, the serrations 23 will be repeated successively at the same position of the scale and will, therefore, give a continuous reading.

In place of the method shown in Fig. 1 for indicating the received impulse, the modification shown in Fig. 2 may be used in which a constant potential is applied between the filament or cathode 30 and the anode 31 and in which the incoming signal is impressed across the control plates 32, 32. The control plates 32 have initially a potential impressed upon them by means of the potentiometer 33 sufficient to cause the beam passing through the anode 31 to fall on the mask portion 34 of the tube. When the reflected signal is received by the receiving circuit, it causes a change in voltage across the plates 32 and shifts the beam shown by the dotted line 36 to the opening 37 in the mask.

In Figure 3 there is indicated only a means for receiving the signal. The timing device used may be of the type previously described, the beam being made to travel across the tube and being made visible by the electrodes 32 when the signal is received. To make the beam travel across the tube in this manner only a single pair of electrodes, as, for instance, 14 of Figure 1, is required with the potential similarly applied thereto. Instead of producing the serration by means of the change in anode potential, the indication may be produced by a separate electrode in the form of a conducting coil within or about the outside of the tube above the control plates or by a coil connected to the receiving circuit.

Having now described my invention, I claim:

1. In a system for measuring distance, a cathode ray tube having an electron beam, control plates and means at the end of the tube for making the beam visible only in a narrow annular band, means for emitting periodically wave energy impulses, means for causing a sinusoidal voltage variation on said control plates for rotating the electron beam normally in a circular path concentric with, but of a different diameter from said annular band at a period commensurate with the interval between the periodic signals, means for receiving the emitted wave after reflection, means operated by the receiving means to produce momentarily an anode voltage variation when the signal is received whereby the beam is deflected from its normal path upon said annular band, producing an indication and a scale associated with said annular band for reading the distance.

2. A system for measuring distance including a source of high-frequency electromagnetic waves, means for producing periodic high-frequency vibrations, means for receiving said high-frequency vibrations after reflection from the object whose distance is to be measured, a cathode-ray tube, means providing an electrical vibration on said cathode-ray tube to create a rotating electron beam, said cathode-ray tube having a masked surface normally in the path of the rotating electron beam with an annular opening adjacent thereto and means operated by said receiving means to affect momentarily the anode voltage of said tube to bring the beam within the annular opening and a scale adjacent thereto to indicate the distance.

3. A system for measuring distance including a source of high-frequency electromagnetic waves, means for producing periodic high-frequency vibrations, means for receiving said periodic high-frequency vibrations after reflection from the object whose distance is to be measured, a cathode-ray tube, means for impressing a varying potential on said cathode-ray tube to produce a moving electron beam, means normally masking said beam having an opening parallelly adjacent to the normal movement of the beam and means operated by said receiving means to affect momentarily the anode voltage of said tube to produce an indication, the movement of said beam and the production of the high-frequency vibration being synchronized and a scale adjacent to the open portion of said mask to indicate the distance.

4. A system for measuring distance including a source of high-frequency electromagnetic waves, means for overmodulating said high-frequency waves to produce periodic high-frequency vibrations, means for receiving said periodic high-frequency vibrations after reflection from the object whose distance is to be measured, a cathode-ray tube, means for impressing said modulating frequency on said cathode-ray tube to create a rotating electron beam, means normally masking the visibility of said beam and means adjacent to the normal path of said rotating beam where said beam becomes visible, means operated by the receiving means to affect momentarily the anode voltage of said tube to produce an indication and a scale adjacent to the means where the beam becomes visible.

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