May 9, 1933. E. BELLINI 1,908,006

RADIO GONIOMETER

Filed Nov. 19, 1928

Fig. 1

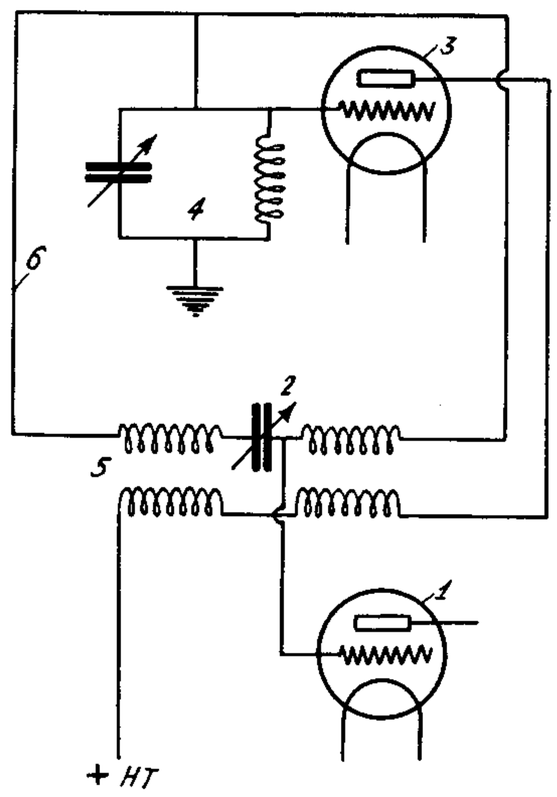


Fig. 2

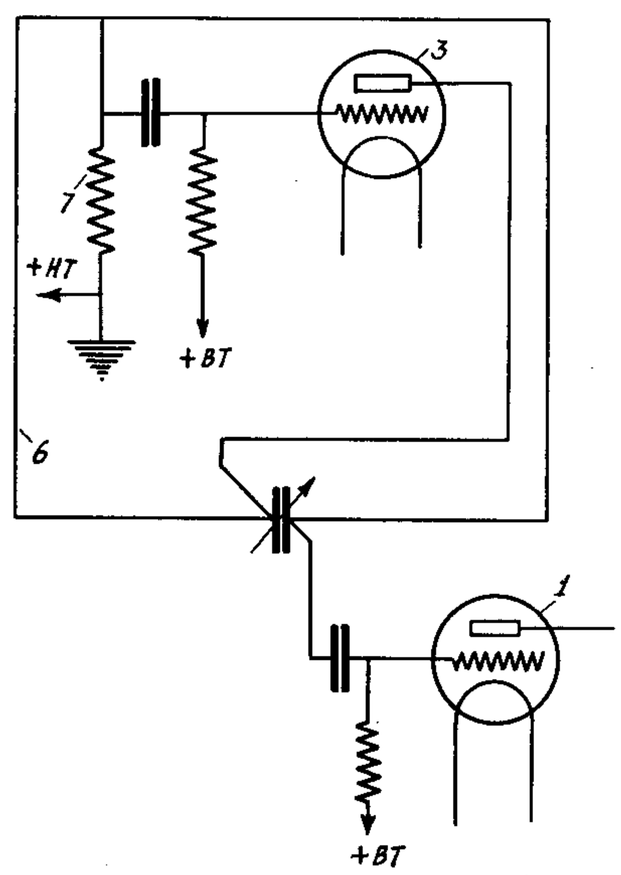


Fig. 3

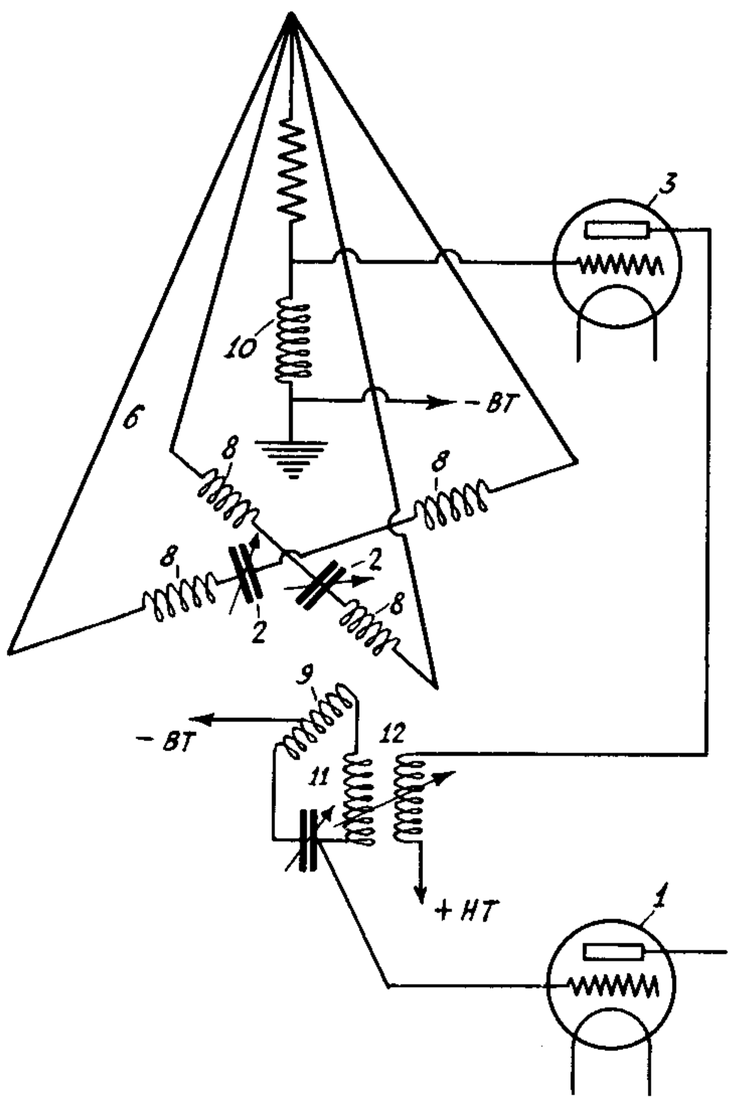
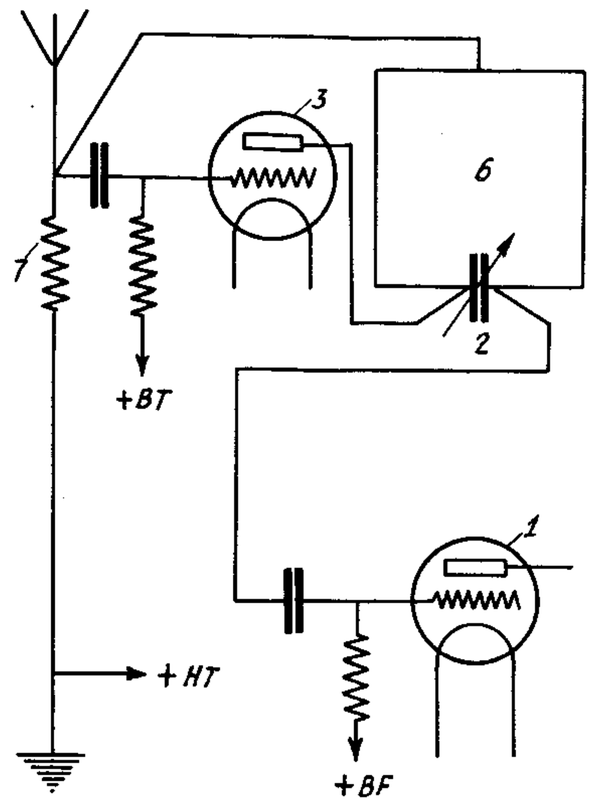


Fig. 4



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UNITED STATES PATENT OFFICE

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RADIO GONIOMETER

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In order to eliminate doubt as to direction of incoming waves, in indications obtained with radio goniometers, it is general practice to have recourse to the method consisting in superposing the action of a vertical antenna upon that of the coil or loop, as disclosed in French Patent #387,933, dated March 7th, 1908.

In order to avoid the necessity of mounting a separate vertical antenna, recourse is often had to the loop or coil itself, indeed, the latter is then used both as a loop and as a vertical antenna. A method with this end in view has been disclosed in French Patent #567,587, dated June 11, 1923, and the two additions thereto, #29,671 of March 19, 1924 and #30,309, dated Nov. 20, 1924.

In the parent patent and the first two additions there has been disclosed a method to eliminate errors in direction finding consisting essentially in connecting a resistance of convenient value between the middle point of the coil antenna or the coil antenna systems in radiogoniometers, and the ground. In an arrangement like that it has been suggested as fully set forth in the French Patent #32,287, Mar. 4, 1926 to substitute for the said resistance either an ordinary stopper circuit or a stopper circuit in which the coil antenna itself would form the middle.

But when the coil antenna comprises a large number of turns, or when its radio frequency impedance is very low, error elimination is not quite distinct and dependable, because the vertical aerial effect is too feeble in order to balance sufficiently the directional effect of the coil.

The object of the invention forming the subject matter of this specification is to boost the vertical action so as to insure elimination of directional error in a sharp and dependable manner.

This aim is realized by amplifying the vertical action by one or more triodes, amplifiers of radio frequency and by bringing the amplified current to act upon the coil antenna or antennæ.

A better understanding of the novel features of my invention and the operation thereof will be had from the following description and therefrom when read in connection with the accompanying drawing in which:

Figures 1, 2 and 3 show by way of example three embodiments of the basic idea of the invention while,

Figure 4 serves to explain the operation of the arrangement shown in Figure 2.

In the arrangement shown in Figure 1 which is self-explanatory, the potential drop across the tuned circuit 4 due to the vertical aerial effect of the coil antenna 6 is set up on the input element of the triode 3 amplified to the desired extent and combined in the desired manner with the coil antenna effect by means of the coupling 5 between the inductance of the coil antenna and the inductance in the plate circuit of triode 3. The resultant potential drop which appears across the plates of the coil antenna tuning condenser 2 is set up on the input elements of a second triode 1 which may in turn actuate an indicating device directly or through an amplifier.

Since the filament heating and plate potential sources and their connection in the circuits are deemed unnecessary to an understanding of the invention they have for the sake of clearness been omitted from all of the figures of the drawing.

The operation of the arrangement shown in Figure 2 may be explained by reference to that shown in Figure 4 which differs from the former only by that a vertical antenna is shown.

The potential drop applied between the grid and the filament of the amplifier tube 1 is the resultant of the potential drop between the coats or plates of tuning condenser 2 in coil antenna 6 and that prevailing between the plate and the filament of the amplifier tube 3 due to the potential drop in the antenna current through resistance 7 acting on the input elements of the amplifier tube 3.

In first approximation, the first potential drop is that due to the directive action of the coil antenna and it changes in sign whenever the coil antenna is turned through an angle of 180 degrees, whereas the second one is equal to the electromotive force of the vertical

antenna effect multiplied by the amplification factor of the tube. This last named potential drop is independent of the direction of the incoming waves. These two potential drops are in phase and as a consequence they become added to each other or diminish each other when the coil antenna is turned through an angle of 180 degrees.

In Figure 3 is shown an arrangement whereby my novel improvement is applied to an aerial system of the type wherein the signals are picked up by means of a pair of antenna coils 6 fixed at right angles to each other and each closed through series inductances 8 and capacitances 2, the signal energy being taken off by means of an inductance 9 movably coupled to the inductances 8 in the coil antennæ. In view of the detailed description of the previous modifications the scheme shown in Figure 3 is not in need of any explanations, except to state that the potential drop applied to the grid of the amplifier tube 3 for the vertical aerial effect of the frames is that existant across the terminals of the inductance coil 10 connected between the midpoint of the frames and ground in order that the vertical aerial effect of the coil antenna impressed in the circuit 11 by means of the inductive coupling 12 between said circuit and the plate circuit of triode 3 may be in phase with the coil antenna effect impressed in the circuit 11 due to the coupling between the inductances 8 and the movable coil 9 of the circuit 11. The resultant of these two effects is as explained in connection with the previously described modifications set up on the input elements of the triode 1.

I claim:

1. In a signalling device, a plurality of tuned closed circuits non-uniformly responsive to signal energy, an inductance in each of said closed circuits, an aperiodic circuit uniformly responsive to signal energy connecting the midpoints of said closed circuits to ground, an impedance in said aperiodic circuit, a thermionic amplifier the input elements of which are connected to opposite ends of said impedance, an output circuit including an inductance associated with the output elements of said amplifier, and a tuned closed circuit having a plurality of inductances one of which is coupled to the inductances in said first named tuned closed circuits and another of which is coupled to the inductance in the output circuit of said amplifier.

2. In a unilateral receiving system, in combination, a directive antenna system including a tuning condenser, a non-directive antenna system connected between the electrical midpoint of said directive system and earth, an impedance in said last-named connection, thermionic amplifying means having input elements coupled with said impedance, means for coupling the output elements of said amplifying means to the circuit including said tuning condenser, and a conductive connection for connecting a terminal of said condenser to receiving apparatus.

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