

Aug. 8, 1944.

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2,355,395

ELECTROMAGNETIC ALARM DEVICE

Filed Nov. 6, 1942

4 Sheets-Sheet 2

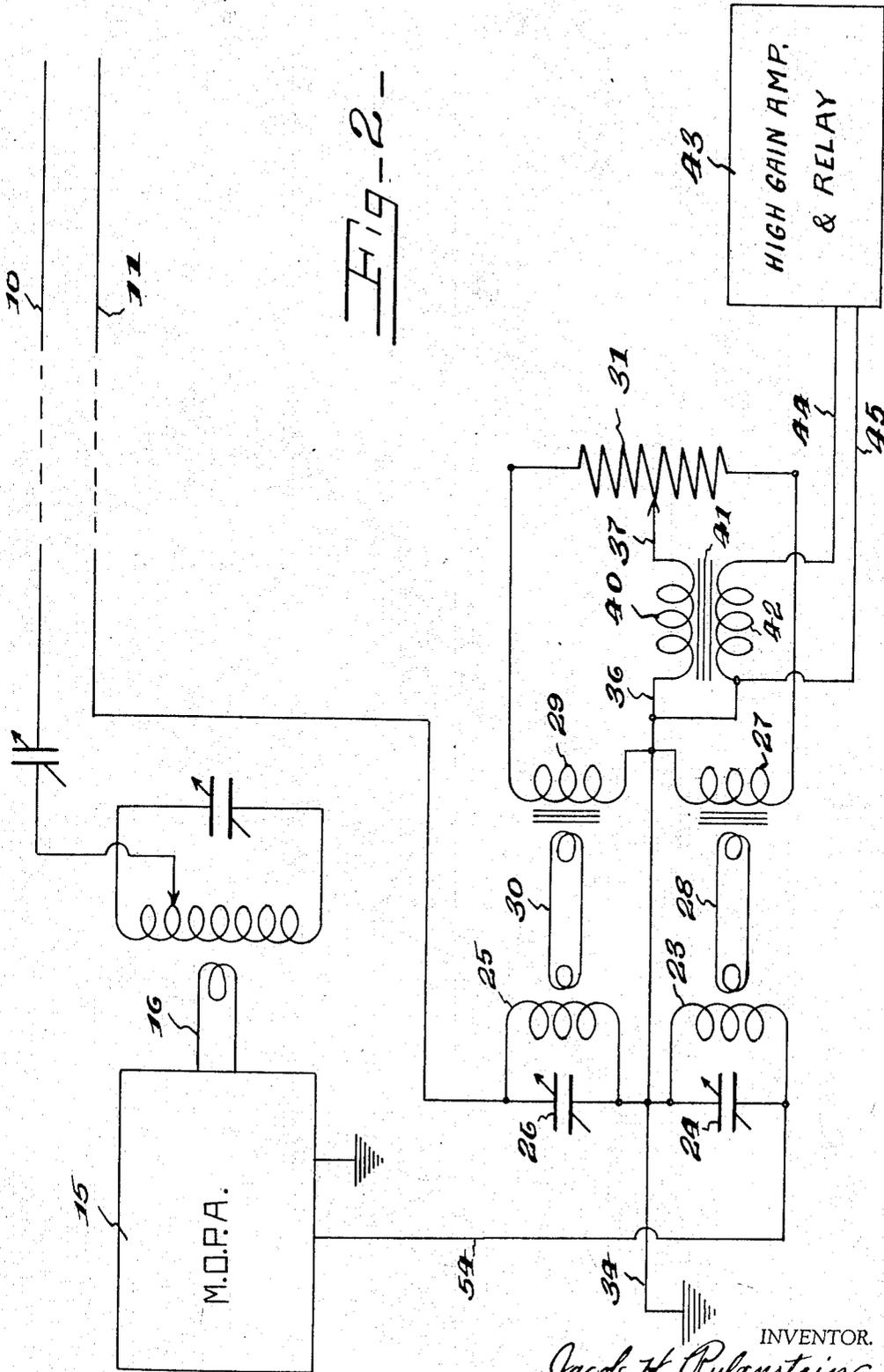


FIG-2-

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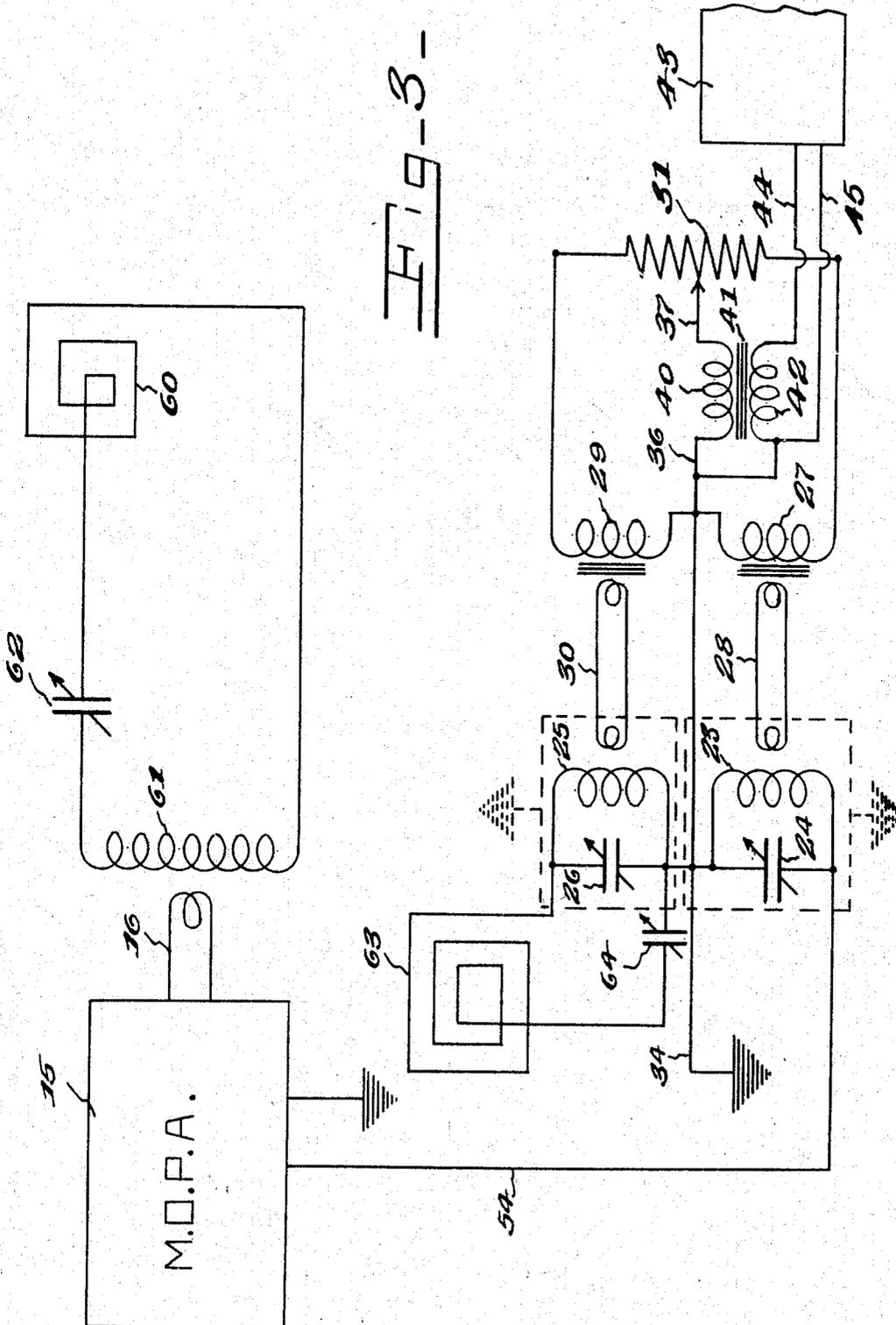
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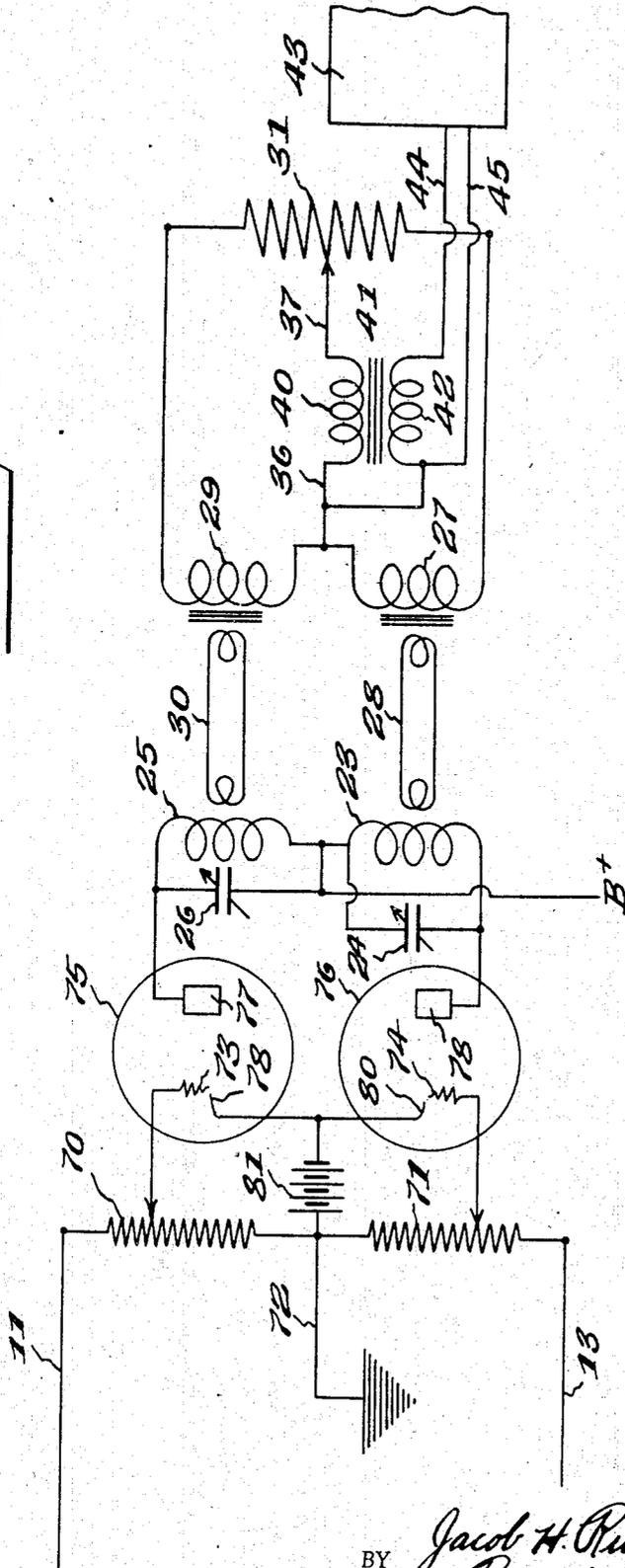
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FIG. 4 -



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UNITED STATES PATENT OFFICE

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ELECTROMAGNETIC ALARM DEVICE

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Application November 6, 1942, Serial No. 464,820

2 Claims. (Cl. 177—352)

This invention relates to alarm devices of the type employed to signal the approach of persons or objects in proximity to a guarded area, particularly large areas such as the property of manufacturing plants, ammunition dumps, oil storage areas, harbors, and the like.

Various electrically operated alarm systems are now employed for this purpose. For example, the area to be protected may be encircled by a series of microphones, the system being arranged so that the microphones pick up any vibration made by a person or object approaching the particular microphone, and the microphone is co-operable with other apparatus in the system to give an alarm at a central station. This system is extremely expensive to install and, of course, is operable to give an alarm only when the approaching person or object causes sound waves or vibrations to be impressed upon the microphone. This prohibits use of such a system if noisy operations are necessarily carried on in proximity of the perimeter of the guarded area.

Another system employs a wire or fence serving in the capacity of an antenna for radio apparatus which is operable upon change in capacity between the antenna and the ground to cause an alarm to be given. The chief disadvantage of this system resides in the fact that the antenna can not be more than 400 or 500 feet in length. Otherwise, the established capacity between the antenna and the ground is so great, relative to any change effected by a person or object approaching the antenna, that such change will not be sufficient to actuate the alarm apparatus.

My invention has as an object an alarm system of the general type referred to, including a pair of conductors extending into or around the area to be protected, the conductors being connected to electrical apparatus which is operable when a person or object approaches within proximity of the conductors along any point thereof, and the invention embodies a novel arrangement whereby it is permissible to extend the conductors a distance of thousands of feet, all whereby areas several acres in extent can be economically and efficiently protected.

The invention consists in the novel features and in the combinations and constructions hereinafter set forth and claimed.

In describing this invention, reference is made to the accompanying drawings in which like characters designate corresponding parts in all the views.

Figure 1 is a schematic wiring diagram illus-

trating a circuit in which my invention is carried out.

Figure 2 is a view, similar to Figure 1, illustrating a modified arrangement of the conductors.

Figure 3 is a diagrammatic view illustrating a further modification of the circuit employing antenna of loop form.

Figure 4 is a schematic diagram of the circuit embodying a further modification in part.

The invention consists generally of a pair of conductors arranged in spaced relation and extending into or around the area desired to be guarded. These conductors may be installed on ordinary fence posts set on the property, each conductor being insulated from the other and insulated from the ground. One of said conductors serving as an antenna radiator, and the other serving as a pick-up antenna.

The invention further includes energizing one of the conductors, the antenna radiator, with a source of alternating current, the frequency of which is preferably in the higher audio range, or the lower radio range, the frequency depending upon the length of the conductors. Also, the alternating current must be a pure sine wave substantially free from harmonics. The conductors are so arranged relatively that the second or antenna pick-up conductor is positioned in the electro-magnetic induction field of the energized conductor and accordingly is also energized thereby. This second conductor is connected to a tuned resonant circuit, and a second tuned resonant circuit is connected to a source of alternating current having the same wave characteristics and the same amplitude as the current in said second conductor. These two tuned resonant circuits are coupled to what may be termed a bridge circuit, the arrangement being such as to produce substantially zero current in the center connection or leg of the bridge which, in turn, is connected to a relay or suitable indicating device. With this arrangement, a person or object approaching in the magnetic field anywhere along the extent of the conductors effects a distortion of such field effecting in turn a change in the amplitude or phase of the current in the second conductor, and this change results in increasing the value of the current in the center leg of the bridge circuit, and thereby causing operation of the relay or alarm device connected thereto.

In Figure 1, the conductors 10, 11 extend around one-half of the perimeter of the guarded area A, and a second pair of conductors 12, 13 extend around the other half of the perimeter of the

guarded area. The conductors 10, 12 are energized by a master oscillator power amplifier 15 of conventional construction. The amplifier is coupled to an antenna coupling circuit through the line 16. The antenna coupling circuit includes a coil 17 and a variable condenser 18. The conductor 10 is connected to the coil 17 through variable condenser 19 and adjustable tap 20. The conductor 12 is likewise connected to the coil 17 through a variable condenser 21 and a tap 22. It will be understood that the antenna coupling circuit and condensers 18, 21 are employed to impress the proper wave length on the conductors 10 and 12, this, of course, varying with the actual length of these conductors.

The conductors 10 and 12 may be termed antenna radiators, and the conductors 11, 13 may be referred to as pick-up antennas or receivers. The conductors 10, 11, and 12, 13 extend in parallel spaced apart relationship. In practice, they are mounted upon posts, or other suitable supports, preferably with the pick-up conductors 11, 13, about three feet from the ground, and the conductors 10, 12 about six feet from the ground. The conductors are, of course, insulated from each other and from ground. The oscillator amplifier 15 functions to impress a pure sine wave, practically free from harmonics, upon the antenna conductors 10, 12. The pick-up conductors 11, 13, being positioned in proximity to the antenna conductors 10, 12, and in the electro-magnetic fields thereof, become energized to an extent proportional to the amount of power produced by the oscillator amplifier 15.

Each of the pick-up conductors 11, 13 are connected to a tuned resonant circuit. This circuit, to which the conductor 11 is connected, includes a coil 23 and variable condenser 24, and the resonant circuit, to which conductor 13 is connected, includes coil 25, variable condenser 26. Each of these tuned resonant circuits is, in turn, coupled to one side of a bridge circuit. For example, the coil 23 is coupled to coil 27 through link line 28, and coil 25 is similarly coupled to coil 29 through link line 30. The opposite sides of the bridge circuit include variable resistance 31. Like ends of coils 27, 29 and coils 25, 23 are connected to a grounded conductor 34. The function of the tuned resonant circuits is to match the phase of the current in coils 27, 29 of the bridge circuit. This can be done with great accuracy inasmuch as the energizing current in the antenna radiators 10, 12 is of pure sine wave quality to start with. Preferably, the tuned resonant circuits are shielded, as indicated in dotted outlines in Figure 3.

The conductor 36 constitutes the center leg of the bridge being connected at one end between the coils 27, 29, and being provided with a variable tap 37 at the opposite end, coacting with resistance 31. The function of the variable tap 37 is to permit an adjustment of the bridge circuit so that the current flowing in the central leg 36 is of zero value.

The central leg 36 is connected to a suitable relay or alarm device. This connection may be direct, or through means to amplify the current depending, of course, on the amount of energy picked up by conductors 11, 13 in a particular installation. As here shown, the central leg 36 is connected to coil 40 of a step-up transformer 41. The secondary coil 42 being connected to a conventional high gain amplifier 43 through lines 44, 45.

As previously stated, the tap 37 is adjusted so

that under normal conditions there is zero current flowing in the center leg 36 and accordingly zero current to the high gain amplifier. Under these conditions, if a person or object approaches the conductors 10, 11, or 12, 13, the electro-magnetic field is distorted causing a change in either phase or amplitude of the current in the pick-up conductors 11, 13. This results in an unbalanced condition in the bridge circuit as will be obvious, permitting current to be fed from either coil 27 or 29 through the center leg 36 to the high gain amplifier causing the alarm device to operate.

In Figure 2, the system employs a single pair of conductors 10, 11. The conductor 11 is connected to the tuned resonant circuit including the coil 25 and variable condenser 26, this circuit being coupled to coil 29 of the bridge circuit through link line 30. The coil 27 of the bridge circuit is similarly coupled to a tuned resonant circuit including coil 23, condenser 24, through link line 28. This latter tuned resonant circuit may be fed directly from one of the grids of the final stage of the amplifier through a blocking condenser and line, as 54, which will be well understood, the arrangement in all other respects being similar to that shown in Figure 1. This circuit is advantageous in certain conditions where it is not practical to extend the two pairs of antenna and pick-up conductors. However, where the device is employed to guard an outside area, the circuit shown in Figure 1 has some advantages over that shown in Figure 2 due to the fact that any external or atmospheric change, such as in weather conditions, or capacity variations from antennas to ground, will not unbalance the bridge circuit. That is, any change in respect to the conductors 10, 11 results in a similar change in the conditions as regards conductors 12, 13, so that the system is automatically balancing.

In Figure 3, I illustrate the invention in a modified circuit which is advantageous over both the circuits shown in Figures 1 and 2 in certain circumstances. In this circuit, the master oscillator power amplifier 15 is employed to energize an antenna loop 60, the amplifier being coupled to the loop through the conventional antenna tuning circuit including coil 61 and variable condenser 62. In this case, the pick-up conductor is in the nature of a receiving loop 63, this loop being connected to the tuned resonance circuit including coil 25, condenser 26 and condenser 64. The tuned resonant circuit, including the coil 23, condenser 24, is fed directly from the amplifier 15 through line 54, as illustrated in Figure 2. This loop arrangement is adapted for use in circumstances where it may not be practical to install antenna conductors, as shown in Figures 1 and 2. In some installations it may be advantageous to use a combination of antennas as, for example, if the system is employed on a vessel the radiating antenna may be of the conductor type 10 trailing from the vessel, and the receiving antenna may consist of a loop 63.

Figure 4 illustrates a modification of the tuned resonant circuits to which the pick-up conductors 11, 13 are connected. This modified structure is advantageously employed if the conductors 10-11; 12-13 are of relatively long lengths, wherein the greater capacity between the pick-up conductors and the ground, might lead to difficulty in obtaining the proper phase balance in the bridge circuit.

The conductors 11, 13 are connected respective-

ly to the resistances 70, 71, like ends of which are connected to a common ground 72. These resistances are connected to the grids 73, 74 of tubes 75, 76 respectively. The plate 77 of tube 75 is connected to coil 25, and the plate 78 of tube 76 is connected to coil 23. The cathodes 79, 80 of the tubes 75, 76 are connected to a battery 81, the opposite side of which is connected to conductor 72, this portion of the circuit being employed to impress a negative bias on the grids 73, 74, as will be well understood. The function of the tubes 75, 76 is to isolate the conductors 11, 13 from the respective tuned resonant circuits.

What I claim is:

1. An electromagnetic alarm device comprising a pair of conductors extending in proximity to the area to be protected and being insulated from each other and from ground, one of said conductors being energized with a source of alternating current, the other of said conductors being positioned in the magnetic induction field of said first conductor and being energized thereby, said second conductor being connected to a tuned resonant circuit, a second tuned resonant circuit connected to an alternating current source having the same wave characteristics as the current in said second conductor, one of said tuned resonant circuits including means operable to vary the phase of the current therein to match the phase of the current in said other tuned resonant circuit, said tuned resonant circuits being

coupled respectively to opposite sides of a bridge circuit, an electro-responsive device connected to the center leg of said bridge circuit, and means operable to normally effect substantially zero current in said center leg.

2. An electromagnetic alarm device comprising a first pair of radiating and pick-up antennas positioned in proximity to a portion of the area to be protected, a second pair of radiating and pick-up antennas positioned in proximity to another portion of the area to be protected, each of said radiating antennas being energized with a source of alternating current and each pick-up antenna being positioned in the magnetic induction field of each radiating antenna respectively and being energized thereby, each of said pick-up antennas being connected to a tuned resonant circuit, one of said resonant circuits including means operable to adjust the phase of said circuit to match the phase of the current in said other tuned resonant circuit, and said tuned resonant circuits being coupled respectively to the opposite sides of a bridge circuit, the center leg of said bridge circuit including means adjustable to produce a current of predetermined value in said center leg, an electro-responsive alarm means connected to said center leg and being operable upon change of the value of the current therein upon distortion of the magnetic induction field of either radiating antenna.

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