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FUSE BEARING ANTENNA

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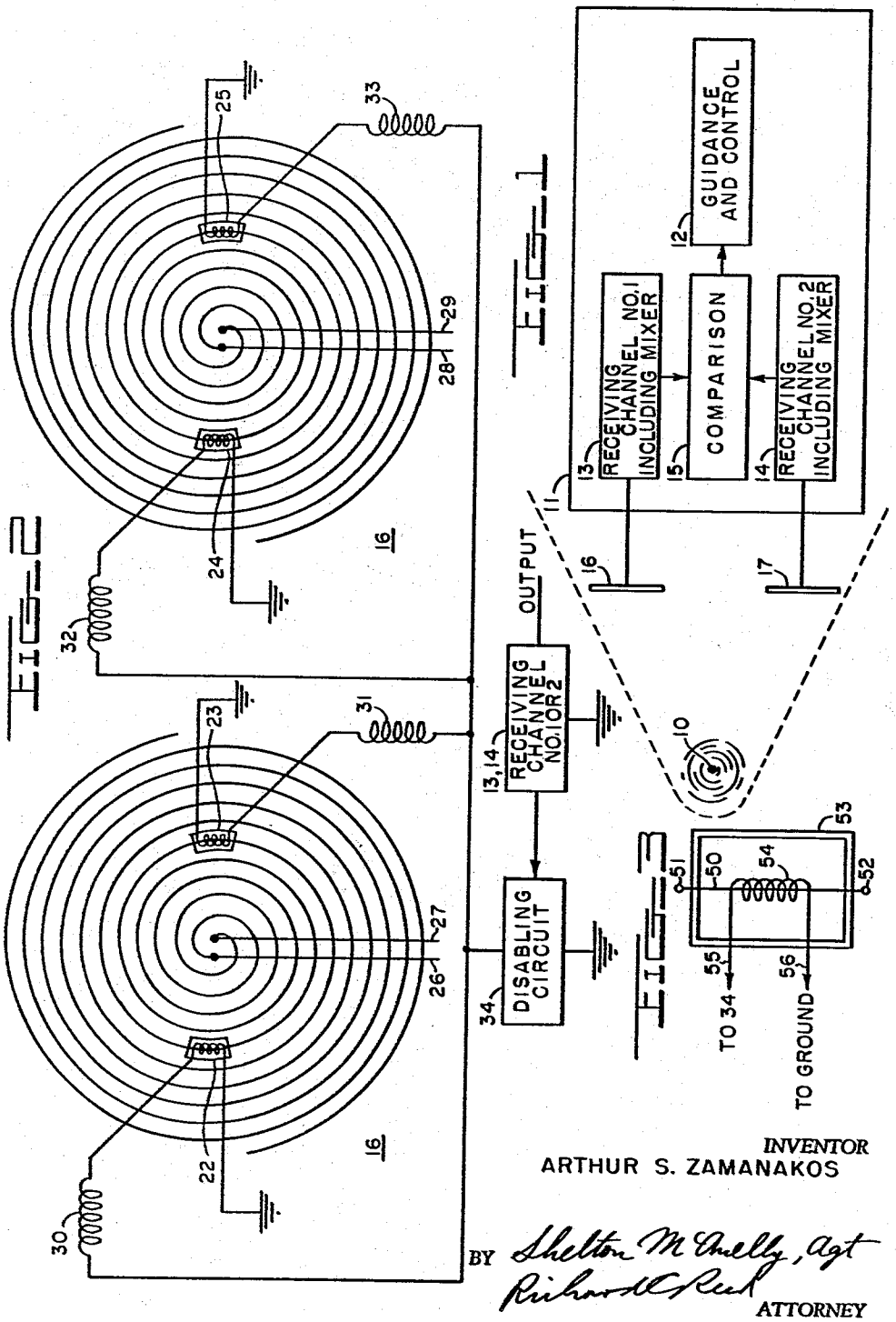


FIG. 1

FIG. 2

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FUSE BEARING ANTENNA

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to antenna systems in general and in particular to antenna systems for use in passive homing devices which seek out a source of electromagnetic energy.

In the field of passive homing devices a compromise must ordinarily be made between the various desirable characteristics of the antenna system. For example, for initial acquisition purposes it is desired that the electromagnetic wave coupling system be sufficiently broad in angular coverage so as to be able to pick up the source of electromagnetic waves and yet at the same time not be so broad as to possibly pick up an undesired source. Furthermore, once acquistion of the desired source of electromagnetic waves has occurred it is normally desired that the coupling device have suitable beamwidth characteristics so as to permit it to operate despite possible evasive tactics of the source of electromagnetic waves and yet not be misled by other sources of electromagnetic waves. A further difficulty involved in such a passive homing device is the tremendous variation in signal intensity encountered as the homing device moves from an initial starting point, which normally is at considerable range from the source of electromagnetic waves, to the more highly intense fields existent in proximity to the source of electromagnetic waves. Homing devices ordinarily must employ one of various forms of signal comparison or lobing techniques whereby it is possible to determine whether the passive homing device is traveling in the proper direction toward the source of electromagnetic waves. Such determination also must normally be made in two planes where the passive homing device is operable in a medium such that restriction to one plane of travel does not occur.

Because of the wide variation in signal intensity encountered as noted in the foregoing, it frequently occurs that a passive homing device which has adequate sensitivity for initial phases of operation will be overloaded long before the passive homing device reaches the source of electromagnetic waves. Such overload can be manifested in many ways and can have many different results depending upon the specific design of the apparatus. However, in general, it is expected where the source of electromagnetic waves is a powerful radio frequency device such as an enemy operated distant radar transmitter, that the passive homing device would employ several crystal detector devices in the initial stages thereof to perform the customary function of superheterodyne receiver mixing in various comparison channels. In such a device overload normally is manifested most significantly by a burn-out of the crystal mixer devices due to the application of excessive electromagnetic wave energy thereto as a result of proximity to the source of high powered electromagnetic wave energy.

By proper design of the receiver system, it is possible for continued operation to be obtained even with the mixers reduced to what would normally be considered a useless condition where low signal levels are involved. This is true because the mixer function can be caused to transfer to a less sensitive mixer or some other subsequent stage which may have some inherent nonlinearity therein at high signal levels. Such a condition could

normally occur in any more or less conventional receiver due to overdriving of grid circuits, anode circuit cutoff and the like, all of which can produce non-linearity at stages subsequent to the normal mixer stage so that mixing action can be obtained to produce the superheterodyne frequency conversion.

In the superheterodyne system when the mixer crystals of comparison channels are overloaded and burn out, it is essential that the burn-out of crystals in opposing zones of reception occur simultaneously, otherwise the channels associated with the two opposing zones of reception will have drastically different characteristics, one having a seriously deteriorated crystal mixer and the other a still operable crystal mixer. This situation is likely to cause seriously erroneous guidance information to be derived by the homing device causing it to veer sharply away from the direction of the source of electromagnetic waves upon which it is homing. It is thus seen that it would be desirable to provide a system arrangement wherein such unequal disablement of opposing comparison channels is avoided and also where if possible mixer crystal burn-out could also be retarded.

It is accordingly an object of the present invention to provide such a system in which the unequal burn-out of mixer crystals may be avoided.

Another object of the present invention is to provide a system wherein the strength of signals applied to a receiver in a passive homing device is automatically reduced as extremely high levels signal intensity are encountered.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 shows a typical embodiment of the features of the present invention.

FIG. 2 shows in greater detail the configuration of a typical antenna system embodying the principles of the present invention.

FIG. 3 shows typical details of a fusible link employed in the present invention.

With reference now to FIG. 1 of the drawing, the apparatus shown therein contains a more or less distant source of electromagnetic wave energy **10** which may produce any conventional form of emission and which would normally be entirely independent of the balance of the apparatus of FIG. 1 which is a schematic representation of a passive homing device such as a guided missile identified in general by the numeral **11**. This device **11** will normally contain some suitable form of propulsion apparatus not within the basic teachings of the present invention as to specific details of improvement thereof and in addition will contain some form of guidance device which is operated upon by apparatus of the present invention as contained within the block **12** which is labeled guidance and control apparatus. Normally the guidance and control apparatus would be accomplished by the operation of suitable aerodynamic surfaces or selective operation or direction of rocket motors and the like, to provide for sending the passive homing device **11** in the desired direction which is that of the distant signal source **10**. For guidance purposes in each plane in which the passive homing device **11** can be maneuvered, the device **11** has a pair of matched signal reception channels with suitable arrangements for comparing the signals received by said channels to determine if any correction is necessary to keep the passive homing device **11** traveling in the direction of the distant signal source **10**. As typified in FIG. 1 these channels contain the receiving channel No. 1 apparatus **13** and receiving channel No. 2 apparatus **14** each of which will ordinarily because of the frequencies

involved in most typical situations contain as the first stage thereof a crystal mixer device, such an arrangement being well known in the art employed in radar systems for example. The output from the receiver channels **13** and **14** is compared in a suitable comparison circuit **15**, which is not of any great specific importance in the present exemplification of the invention, by means of which the receiver output is compared for the operation of the guidance and control circuits **12**. Each receiving channel **13** and **14** has a suitable antenna **16**, **17** for interception of electromagnetic wave energy from the distant signal source **10**.

In accordance with the basic teachings of the present invention the antennas **16** and **17** are constructed in such a manner as to include self detuning or desensitizing devices of the nature of fuses which burn out simultaneously upon the attainment of a preselected antenna current to reduce the antenna dimensions in such a way as to also reduce the mixer current and hence avoid burn-out of mixers incorporated within the receivers **13** and **14**. When the antenna detuning devices are constructed it is possible to obtain precise control over the fusing characteristics because this fuse device has only one function to perform, as contrasted to the more or less fortuitous burn-out of a mixer device, which is normally selected only for its capabilities of providing desirable mixing characteristics and not also upon a basis of its burn-out current which could not be determined precisely in any event except by the destruction of the unit. The fuse art has progressed to a state wherein it is possible to obtain precisely controlled current burn-out characteristics for a plurality of units.

In a typical embodiment the specific antenna could be of any suitable form desired such as a dipole or the like. However, the spiral antenna has certain advantages which render it very desirable in connection with the apparatus of the present invention. The spiral antenna has broad characteristics not only with regard to frequency of operation but also with regard to beamwidth. Thus the spiral antenna provides the desired broad angle of reception for initial capture or location operation. As a result of the broad frequency characteristics it is capable of receiving signals over a wide frequency range without serious impedance matching problems. It does have certain general limitations however with regard to the periphery thereof and its relationship to the frequency of operation for maximum efficiency. However in this instance the efficiency is varied by incorporating into the conductors of the spiral antennas fusible elements **22**, **23** and **24**, **25** which are designed to "burn out" when a desired magnitude of antenna current in the elements is reached.

The spiral antenna elements may be described in greater detail as being two conductor archemedian spirals disposed in a plane in which the conductors spiral outward from a central portion of small diameter to a large diameter outer portion. Connection to the two conductors is by means of suitable lead wires **26**, **27** and **28**, **29**. Typically the spiral antennas may be produced by printed circuit techniques wherein the spiral conductors remain as ribbons of conductive material on a suitable printed circuit base member which is selected for its insulation and strength properties. The fusible elements **22**, **23** and **24**, **25** may be constructed of some suitable resistance wire, and preferably are encapsulated to minimize the deterioration effects of time, heat, humidity and the like. Typically the fusible elements are selected in such a manner as to have precisely matched burn-out characteristics and are connected across purposely placed discontinuities in the conductors of the spiral elements.

When the spiral antenna elements are used prior to burn-out of the fusible members **22**, **23**, **24** and **25**, the elements have continuous conductors so that the normal gain characteristics of the spiral antenna are experienced. As the passive homing device **11** approaches the signal source **10** however, eventually a point is reached at which the signal becomes so intense that the current in the antenna conductors **16** and **17** exceeds the capabilities of the fusible members, at which point burn-out occurs and the outer portions of the spiral antenna element conductors are no longer connected to the lead in conductors **26**, **27**, **28** and **29**. This reduces the effective periphery of the spiral antenna element to a small portion of the previously existing condition which by selection as to size on a trial and error basis or by calculation reduces the sensitivity of the spiral antenna element without producing a substantial undesired variation in the impedance charatceristics of the use exemplified herein. Thus the signal applied through the leads **26**, **27**, **28** and **29** to the receiving channels **13** and **14** is reduced in amplitude so that burn-out of the crystal mixers will not occur. Thus the passive homing device **11** is permitted to travel to the distant signal source **10** without the danger of nonsimultaneous burn-out of crystal mixers in the receiving channels **1** and **2**.

From the foregoing it is apparent that considerable variation in the specific structure shown is possible without exceeding the principles of the present invention. For example, the invention as described is not limited to the typical spiral antenna nor is it limited to devices employing single spiral antennas for the receiving channels No. **1** and No. **2**. Specifically the spiral antenna elements employed singly for each channel as in FIGS. 1 and 2 are circular polarization sensitive devices which in some instances may not be altogether desirable particularly if the distant signal source **10** is of such a nature as to produce linearly polarized signals, in which instance an antenna system for the passive homing device **11** would be desired having linear polarization characteristics. Where such is encountered it is also within the teachings of the present invention to employ a plurality of antenna elements for each channel, the antenna elements being in the form of spiral doublets having linear polarization characteristics. In such an instance fusible members **22**, **23**, **24**, **25** would be employed in each conductor of each spiral antenna element.

As a further exemplification of the variations possible with the apparatus of the present invention, in some instances it may be desirable to apply a deliberate signal from within the passive homing device **11** to cause the burn-out of the various fusible members **22**, **23**, **24** and **25** at the same instant. To accomplish this a separate lead can be made to each fusible member each containing suitable radio frequency isolation as by the chokes **30**, **31**, **32** and **33** whereby a disabling signal may be applied to all fusible members simultaneously from a disabling circuit **34** responsive to the signal level in the receiving channel **13** or **14**. Thus when the signal level in the receiving channel **13** or **14** for example reaches a selected level as sensed by any suitable form of measuring device, a signal is delivered to the disabling circuit **34**, which may be a suitable threshold circuit and amplifier, which is then applied through the radio frequency isolating devices **30**, **31**, **32** and **33** to cause the simultaneous destruction of all of the fusible members **22**, **23**, **24** and **25**.

FIG. 3 exemplifies the manner in which the fusible elements **22**, **23**, **24** and **25** may be constructed so as to be responsive to such a simultaneous destruct signal. As shown the fusible member contains a central wire **50** which is the heat fusible element having terminals **51** and **52** which connect the particular spiral conductor associated therewith. The fusible member **50** is contained within a suitable encapsulation **53** which may have suitable hermetic seals therethrough. Disposed in proximity to the fusible member **50** is a means for applying auxiliary heat thereto indicated as a coil of wire **54** wrapped around the fusible member, the coil **54** having leads **55** and **56** to which a suitable current may be applied for causing localized overheating of the fusible member **50** which added to the heating already present due to to the

passage of antenna current therethrough, will cause a burn-out of the fusible member **50**. Typically one of the leads **55** would go to the control lead of the disabling circuit **34** whereas the other lead **56** could go to the ground return of the disabling circuit **34**.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A signal energy coupling system comprising, a plurality of antenna components cooperative for high sensitivity with at least one component operative individually at lesser sensitivity, a radio frequency operative device, means connecting one of said antenna components to the radio frequency device, and current responsive means connecting said antenna components whereby connection between said antenna components is broken upon the occurrence of preselected current therethrough.

2. A signal energy coupling system comprising, a spiral antenna having a discontinuity in at least one conductor thereof, a radio frequency operative device, means connecting said spiral antenna to said device, and current responsive means for bridging the discontinuity in the spiral antenna whereby the connection across the continuity is broken upon the occurrence of preselected current flow therethrough.

3. In apparatus for homing on a source of electromagnetic wave energy, means for comparing two incoming signals to determine errors of homing, a plurality of antenna components cooperative in pairs for high sensitivity with at least one component of each pair operative individually at reduced sensitivity for deriving the two incoming signals, means connecting a first one of each pair of the antenna components to said first named means, and fusible current responsive disconnect means connecting the second of each pair of antenna components respectively to the first one of each pair of antenna components whereby greater overall signal coupling to the means for comparing is obtained until preselected current is realized due to proximity of the apparatus to the source, causing destruction of the fusible current responsive means.

4. In apparatus for homing on a source of electromagnetic wave energy, a plurality of spiral antennas having a discontinuity in at least one conductor thereof, means for amplifying signals picked up by the antennas, means for comparing amplified signals from two of the antennas to derive guidance control signals for the homing apparatus, and current responsive disconnect means for bridging the spiral antenna discontinuity whereby the connection across the discontinuity is broken upon the occurrence of preselected current flow therethrough.

5. In apparatus for homing on a source of electromagnetic wave energy, a plurality of spiral antennas having a discontinuity in at least one conductor of each, means for amplifying signals picked up by the antennas, means for comparing amplified signals from two of the antennas to derive guidance control signals for the homing apparatus, a plurality of current responsive disconnect means for bridging the spiral antenna discontinuities whereby the connections across the discontinuities are broken upon the occurrence of preselected current flow therethrough, and means for applying a destruct signal to said disconnect means to cause the connections through all of said disconnect means to be broken simultaneously.

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