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ANTENNA SYSTEM

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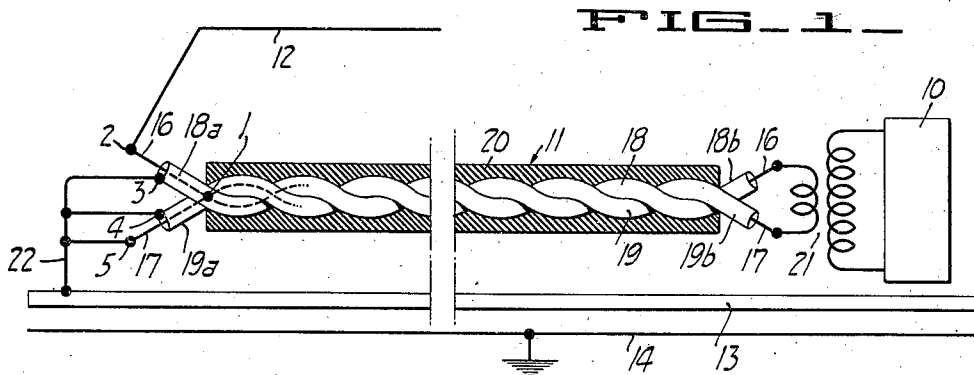


FIG. 2

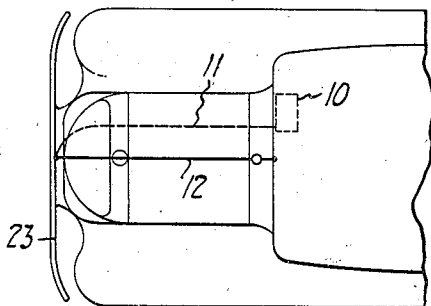


FIG. 3

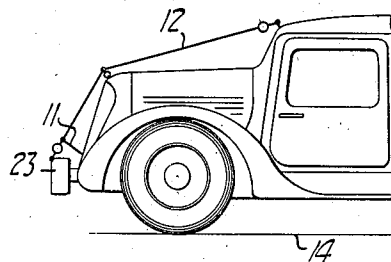


FIG. 4

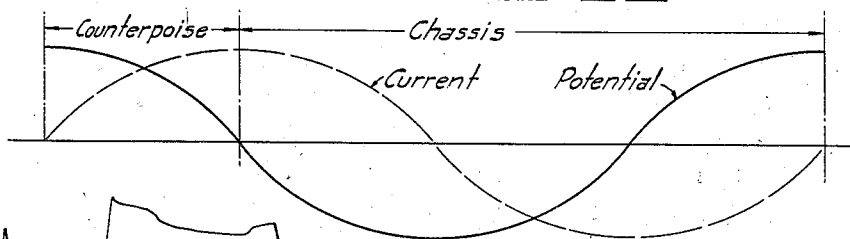
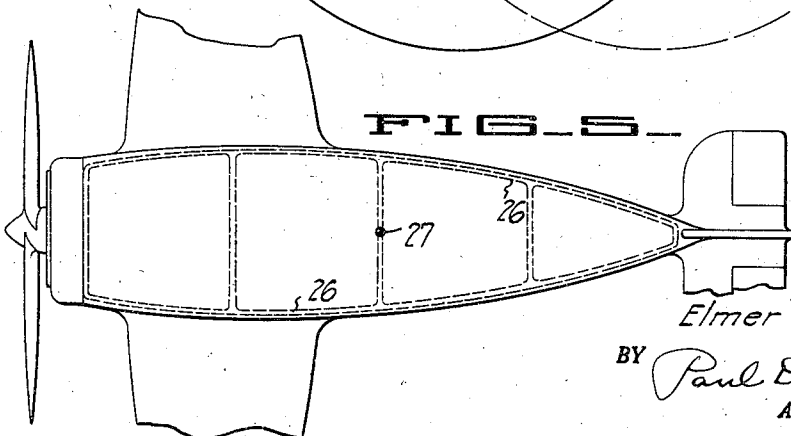


FIG. 5



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ANTENNA SYSTEM

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8 Claims. (Cl. 250—33)

This invention relates generally to antenna systems for use on various types of mobile craft, such as airplanes, automobiles, and motorcycles, and is particularly adapted for short wave radio transmission and reception.

In installing radio equipment on automobiles or other mobile craft, it has been common to make use of the framing of the vehicle as a counterpoise, together with an antenna insulated with respect to the vehicle frame. Systems of this character which have been developed in the past have been subject to certain inherent disadvantages. For example they have been markedly directional, particularly when constructed to have a fair degree of efficiency. While directional characteristics are at times desired, for example in radio beacon systems used for airplanes, such characteristics are a distinct detriment to ordinary radio communication. For example in short wave communicating systems used for police cars, it is evident that directional characteristics result in fade-out of signals, as the vehicle changes its position with respect to the central station. A further disadvantage has been that such systems as used in the past tend to vary their frequency of operation, in response to variations in the height of the vehicle from the ground, or variations in the character of the ground over which the vehicle is operated. Such changes in frequency likewise cause fading or variations in the intensity of the signal strength.

It is an object of the present invention to provide an efficient radio antenna system for mobile craft, which will have substantially non-directional characteristics, and which will not be affected to a material degree by a change in elevation between the vehicle and the ground, or variations in the character of the ground over which the vehicle is operating.

Another object of the invention is to provide an antenna system for mobile craft which will cause the frame of the craft or vehicle to absorb or radiate the majority of the radio energy.

Further objects of the invention will appear from the following description in which the preferred embodiments of the invention have been set forth in detail, in conjunction with the accompanying drawing.

Referring to the drawing:

Fig. 1 is a circuit diagram, illustrating application of my system to mobile craft.

Fig. 2 is a diagrammatic plan view of an automobile, showing a desirable location for the counterpoise.

Fig. 3 is a side elevational view, showing more

clearly the location of the counterpoise, incorporated in Fig. 2.

Fig. 4 is a curve illustrating distribution of potential and current waves, in the antenna system.

Fig. 5 is a plan view, showing application of the system to an airplane.

Referring first to Fig. 1, the system illustrated includes signalling means 10, such as a short wave radio transmitter or receiver. A current feed line designated generally at 11, serves to couple the signalling means 10, to the counterpoise 12 and the vehicle framing 13. The ground surface over which the craft or vehicle is operated, is represented at 14.

The current feed line 11 consists of a pair of conductors 16 and 17, which are provided with individual metallic shields 18 and 19. The shielding can be in the form of metal tubes or tubular metal braid, embracing suitable insulation about the conductors 16 and 17. Both the conductors, and the shielding about the same, are twisted upon each other for substantially the entire length of the feed line. The twisted relationship is such that the shields 18 and 19 are in direct conductive engagement, for substantially their entire length. Inductive coupling means 21 serves to couple one end of the current feed line, to the signalling means 10. The feed line is shown enclosed within a suitable insulating sheath 20, such as a covering of resilient rubber, to insulate it from direct electrical connection with the framing.

At that end of the current feed line which is coupled to the counterpoise 12 and framing 13, it is convenient to provide relatively short end portions 18a and 19a of the shielding 18 and 19, which are insulated with respect to direct electrical engagement. When providing such insulated portions of the shielding, they should be considerably less than one-quarter wave in length. The conductor extending from the shield portion 18a is shown directly connected to the counterpoise 12, while the conductor extending from the shield portion 19a is connected to the framing 13, through a path of low impedance, formed by the conductor 22. Conductor 22 is also directly connected to the adjacent terminals of the metallic shields. At that end of the current feed line which is coupled to the signalling means 10, it is also convenient to provide insulated shield portions 18b and 19b.

In installing the system of Fig. 1, it is desirable to have the conductor 22 as short as possible, and connected to a point of electrical

symmetry with respect to the framing. For example when installed on an automobile, connection can be made to metal parts of the water cooling system. It is likewise preferable to dispose the counterpoise 12 in a vertical plane extending longitudinally and centrally of the car. Such an arrangement for the counterpoise 12 has been shown in Figs. 2 and 3, in which its forward end has been connected to the center of the front bumper 23, and its rear end connected to the top of the car.

The optimum length of the current feed line depends principally upon two factors, namely the frequency of operation desired, and the size of the conductors 16 and 17. For example for a frequency of operation of 37,100 kilocycles, and assuming that the conductors 16 and 17 consist of two No. 14 B&S stranded wires provided with individual rubber insulation, an optimum total length for the current feed line is about 11 feet 6 inches. For the same frequency of operation, but making use of No. 16 B&S stranded conductor, the current feed line has an optimum length of about 8 feet 3 inches. In other words, the larger the conductors, the longer the feed line should be for a given frequency of operation. Such an arrangement will permit tuning of the system through a substantial range, as for example about 4 megacycles each side of resonance. A maximum reading of a meter introduced between the connection of counterpoise 12 with the conductor 16, indicates a condition of optimum resonance. If desired however, the feed line can be of infinite length provided a potential node coincides with the point of last transposition, as presently explained.

The system is preferably adjusted so that a substantially three-quarter potential wave is set up in the mobile chassis or framing, and about one-quarter wave in the counterpoise 12. The last point of transposition of the conductors 16 and 17, represented by point 1, corresponds to a potential node. Point 2, representing the point of connection between conductor 16 and counterpoise 12, is therefore slightly off voltage node. Likewise points 3, 4 and 5 which are connected to the chassis or framing 13, by conductor 22, are slightly off voltage node, particularly if such points are separated by conducting paths from point 1.

Fig. 4 illustrates more clearly the disposition of potential and current waves, upon the counterpoise and framing. It will be noted that only about one-quarter wave exists in the counterpoise, while about three-quarter wave exists in the chassis. The open end of the counterpoise, and also the rear end of the chassis, correspond with current nodes. It follows from this explanation that the framing or chassis radiates a greater proportion of the high frequency energy than that radiated by the counterpoise.

The chief characteristic of the system described above is that it has substantially non-directional characteristics. In other words, when installed upon an automobile, there will be substantially no fading of signals, for any angle which the vehicle may assume with respect to a central station. Likewise the system is more efficient than conventional systems, and relatively loose coupling can be used between the signalling means and the current feed line. The system is also characterized by the use of a relatively short counterpoise, and thus it is well adapted for vehicles, such as motorcycles, where a conventional antenna is difficult to install. A

further characteristic is that the frequency or efficiency of operation are not effected to any marked degree by proximity of the vehicle to large metal masses, or by variations in capacitance to the ground over which the vehicle is operating. This is because any change in capacitance between the chassis 13 and the ground 14, is a minor fraction of the capacitance between the feed conductors 16 and 17, and the shielding 18 and 19.

It will be noted that connections between one point of the framing and the current feed line, occur only at that end of the feed line which is connected to the counterpoise. Connections between various points of the framing and intermediate portions of the shielding, or between other points on the framing and that end of the feed line which is coupled to the signalling means 10, can cause the system to possess directional characteristics, and be lacking in the desired efficiency, particularly because such connections to points spaced longitudinally of the framing, would interfere with the desired potential wave form applied to the same.

Where the chassis or framing is of considerable length as compared to the desired frequency of operation, conductor 22 can be connected to a point mid-way between the ends of the framing, whereby the framing is in effect divided into two sections, each having a current node at its end. Thus in an airplane installation such as illustrated in Fig. 5, the metal framing 26 of the fuselage has considerable length. In this case conductor 22 is connected to a point 27, substantially mid-way between the forward and rear ends of the framing. Therefore with such an insulation the framing can become an efficient radiator of high frequency energy, at the wave length desired.

In the foregoing I have referred to the use of a chassis or framing to serve as one element of the antenna system. Where my system is not being employed in conjunction with mobile craft, a special radiator can be provided, to take the place of such framing.

I claim:

1. In a short wave antenna system, for mobile craft, having a metallic framing or chassis, radio signalling means, a high frequency current feed line having one end thereof coupled to said signalling means, an antenna having an effective length less than that of the framing, and means for coupling the other end of the current feed line to the antenna and a point on said metallic framing, said feed line including shielding means which is conductively connected to the framing at only said other end of the current feed line.

2. In a short wave radio antenna system, for mobile craft having a metallic framing capable of forming a radiator or absorber of radio energy, radio signalling means, a high frequency current feed line having one end of the same coupled to said signalling means, an antenna element, and means for coupling the other end of the current feed line to the antenna element and to said metallic framing, said current feed line consisting of two conductors twisted with respect to each other, individual metallic shielding for each conductor, said shielding being in direct conductive engagement for substantially the entire length of the conductors, and means forming a short conductive path of low impedance connecting the terminals of the shielding at said other end of the feed line with one point on said metallic framing.

3. In a short wave radio antenna system, for mobile craft having metallic framing capable of forming a radiator or absorber of radio energy, radio signalling means, a high frequency current feed line having one end thereof coupled to said signalling means, said current feed line consisting of two conductors twisted with respect to each other, individual metallic shielding for each conductor, said shielding being in direct conductive engagement for substantially the entire length of the conductors, said shielding also having terminals at the other end of the feed line, an antenna element connected to one of the conductors at the other end of the feed line, and means forming a short conductive path of low impedance connecting one point on the metallic framing to the terminals of said shielding, and also to the other conductor of the feed line.

4. In a short wave radio antenna system, for mobile craft having metallic framing capable of forming a radiator or absorber of radio energy, radio signalling means, a high frequency current feed line having one end of the same coupled to said signalling means, said current feed line consisting of two conductors twisted with respect to each other, individual metallic shielding for each conductor, said shielding being in direct conductive engagement for substantially the entire length of the conductors, an antenna element conductively connected to one of said conductors at said other end of the feed line, and means forming a conductive connection of low high frequency impedance between one point on said framing, the terminal of the shielding at said other end of the feed line, and the other conductor of the current feed line at said other end of the feed line, said current feed line and the shielding incorporated in the same being otherwise insulated with respect to said framing.

5. In a short wave antenna system, for mobile craft having metallic framing capable of forming a radiator or absorber of radio energy, radio signalling means, a high frequency current feed line having one end of the same coupled to said signalling means, said current feed line consisting of two conductors twisted with respect to each other, individual metallic shielding for each conductor, said shielding being in direct conductive engagement for substantially the entire length of the conductors but being insulated for a short distance at the other end of the current feed line, insulation surrounding both conductors and said shielding, means forming a conductive connection of low impedance between the terminals of both said insulated ends of the shield-

ing and said framing, and also between the terminal of one of said conductors and the framing, the remainder of the feed line being insulated with respect to the framing, and an antenna element connected to the other conductor, the effective length of the antenna element being substantially less than the effective length of the framing.

6. In a radio method of the character described, for mobile craft having metallic parts capable of forming a radiator or absorber of radio energy, characterized by the use of signalling means carried by the vehicle, an antenna element carried by the vehicle, and a current feed line for transferring energy between the signalling means and the antenna means formed by the framing and the antenna element, said method comprising causing at least one potential node to be formed in the length of the framing and a current node at at least one end of the framing, and causing substantially one quarter of a potential wave to be formed in the antenna element, with the free end of the antenna element coinciding substantially with a current node.

7. In a non-directional short wave antenna system, an element forming a radiator or absorber of radio energy, an antenna element, radio signalling means, and a current feed line having one end of the same coupled to the signalling means and the other end of the same coupled to said first element and said antenna element, said feed line consisting of two conductors twisted with respect to each other, individual metallic shielding surrounding each conductor, the shield for the two conductors being in direct conductive engagement for substantially the entire length of the feed line, and an insulating sheath surrounding said shielding.

8. In a short wave radio antenna system for use with conventional automobiles, signaling means, a current feed line having one end of the same coupled to the signaling means, a linear antenna element disposed in a vertical plane symmetrical with respect to the longitudinal center line of the automobile, one end of said element being anchored to the medial point of the front bumper of the automobile, and the element extending from the front bumper over the radiator and hood to the top of the automobile, and means for conductively coupling the other end of the feed line to the center point of the bumper and to the adjacent end of the antenna element.

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