Oct. 11, 1966 G. F. LEYDORF 3,278,937

ANTENNA NEAR FIELD COUPLING SYSTEM

Filed Aug. 31, 1962 2 Sheets-Sheet 1

FIG. 1

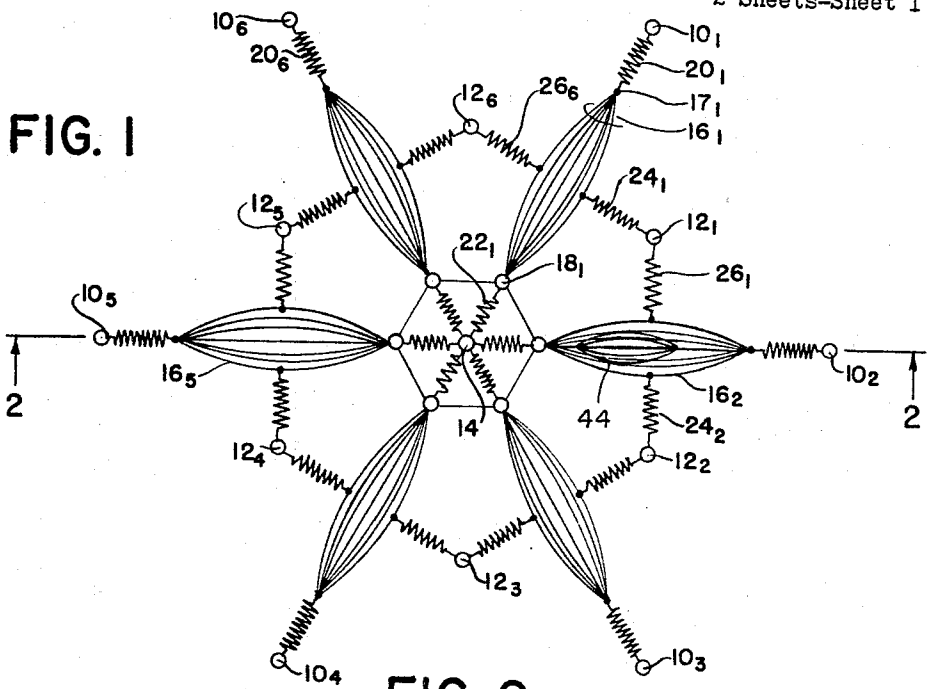
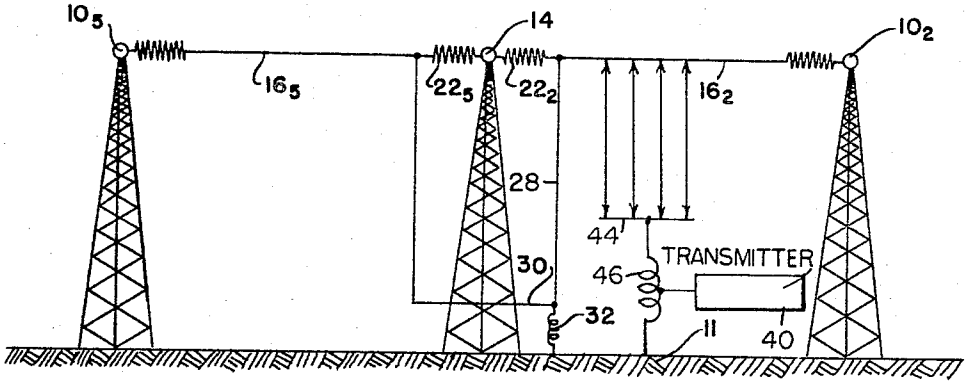


FIG. 2



INVENTOR.
GEORGE F. LEYDORF

BY Nolte & Nolte

ATTORNEYS

Oct. 11, 1966 G. F. LEYDORF 3,278,937

ANTENNA NEAR FIELD COUPLING SYSTEM

Filed Aug. 31, 1962 2 Sheets-Sheet 2

FIG. 3

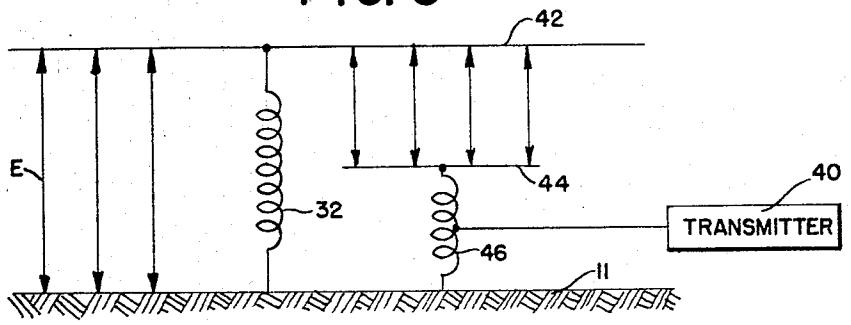


FIG. 4

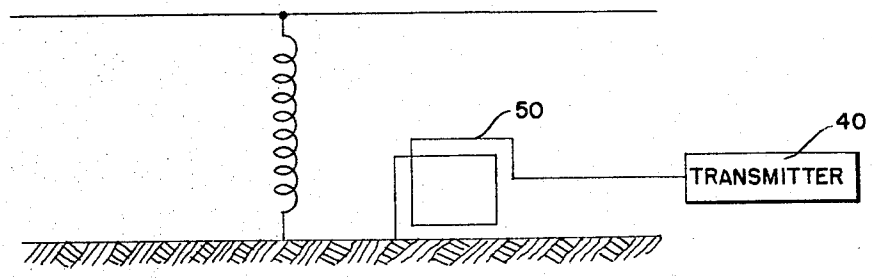
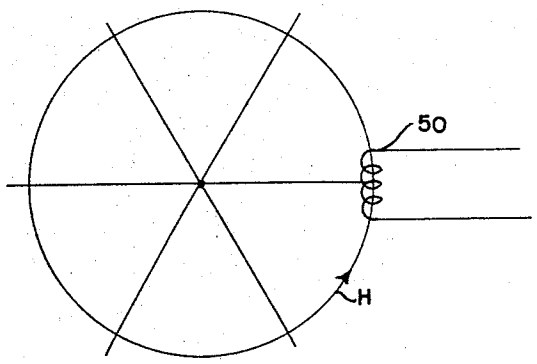


FIG. 5



INVENTOR.
GEORGE F. LEYDORF

BY Nolte & Nolte
ATTORNEYS

United States Patent Office 3,278,937 Patented Oct. 11, 1966

3,278,937

ANTENNA NEAR FIELD COUPLING SYSTEM

George F. Leydorf, Birmingham, Mich., assignor to DECO Electronics, Inc., Washington, D.C., a corporation of Delaware

Filed Aug. 31, 1962, Ser. No. 220,601
3 Claims. (Cl. 343—856)

This invention relates to antenna systems. More particularly, this invention relates to a novel means for coupling energy to a very low frequency, high power antenna.

If radio energy is to be transmitted to a receiver located within a body of water, very low frequencies, for example fourteen to thirty kilo-cycles, must be used because high frequencies are unable to penetrate the surface of the water and reach the receiver. At very low frequencies, the necessary transmitter antennas have extremely large physical dimensions. Furthermore, since the requisite high power transmission necessitates great inductances, it is difficult to couple the energy from the transmitter to the antenna. Previous systems have required extremely complex mechanical switching systems to couple the transmitter energy to the antenna and thereafter properly tune the network.

Accordingly, it is a main object of this invention to provide a method for coupling a transmitter to an antenna.

Another object is to provide an antenna coupling system for a high power, very low frequency transmission system which will eliminate much of the conventional circuitry and mechanical switches.

Another object is to provide a coupling system for a high power, very low frequency transmission system, which requires a reduced number of transmission lines and matching networks.

Still another object is to increase the system flexibility of high power, very low frequency transmission systems.

The objects of the invention are accomplished by coupling the energy from the transmitter into the near field of the antenna, rather than directly coupling the energy into the feed line of the antenna. The energy may be coupled into the electric or magnetic components of the near field thus obviating the necessity for the expensive and complex prior art switching systems.

The manner in which the above objects of the invention are accomplished will be further described with reference to the following specification and drawings, wherein:

FIG. 1 represents a top view of the type of antenna with which the invention is employed;

FIG. 2 represents a side view of the antenna of FIG. 1;

FIG. 3 is a schematic view of one embodiment of the invention; and

FIGS. 4 and 5 are schematic illustrations of a second embodiment of the invention.

The type of antenna to which the invention pertains is illustrated in FIGS. 1 and 2 as a monopole, flat top antenna. The overall diameter of the antenna may be in the neighborhood of one to two miles with the upper conductors located from one tenth to two tenth mile above the surface of the earth. For purposes of clarity, the antenna has not been properly drawn to scale.

The antenna is supported by a first plurality of supporting towers 10_1–10_6 spaced to form the corners of a hexagon on the ground surface **11**. In addition, a second plurality of six inner supporting towers 12_1–12_6 are situated as shown at the corners of a smaller hexagon. The antenna is supported at its center by a center supporting tower **14**.

The antenna itself consists of six legs 16_1–16_6 supported between center tower **14** and respective outer supporting towers 10_1–10_6. The legs of the antenna are identical and consist of a plurality of heavy conductors joined at their outer and inner extremities **17** and **18**, respectively. The antenna legs are supported by means of insulated cables 20_1–20_6 connected between respective outer towers 10_1–10_6 and outer extremities **17**, and insulated cables 22_1–22_6 extending between center tower **14** and the inner junctions **18**. In addition, the sides of the individual legs are supported by insulated cables 24_1–24_6 and 26_1–26_6, extending from inner supporting towers 12_1–12_6 to the respective sides of antenna legs 16_1–16_6. Each of the legs of the antenna also includes a downwardly extending conductor **28** secured to its inner junction **18** at one end. The ends of conductors **28** closest to the ground are secured to a hexagonal conductor **30** which in practice may be situated at a distance of about eighty feet from the surface of the earth to form the complete flat top antenna. As shown schematically, a coupling inductor **32** is connected between the hexagonal conductor **30** and ground surface **11**.

The above described antenna is designed to handle tremendous amounts of power, e.g. 2,000,000 watts. Under these conditions the voltage drop between the top of the antenna and ground is about 200,000 volts and the current flow approximately 2000 amperes. At such extreme values the size of inductor **32** must be considerable to provide the necessary inductance and may, for example, have a height and diameter of about eighteen feet. It will be clear to one skilled in the art that because of the great current and inductance involved in such a system, it is exceedingly difficult to directly couple the transmitter to the antenna. In addition, transmission problems arise since it is desirable to locate the transmitter away from the near field beneath the antenna, thus necessitating the transfer of this high power energy for a distance of about one mile to coupling inductor **32**.

FIGURE 3 illustrates an embodiment of the invention for coupling the energy from the transmitter to the antenna. The antenna is illustrated schematically as comprising the flat top **42** and inductor **32** connected between the center of the flat top and the ground surface **11**. It is to be understood that the antenna of FIGS. 3, 4 and 5 may have the mechanical configuration illustrated in FIGS. 1 and 2. According to the invention, a second flat-top antenna **44** having an inductor **46** is adapted to couple the energy from transmitter **40** into the near field of the main antenna. The near field existing in this type of antenna is analogous to the field existing in a circular cavity in the basic TEM mode and the electric vector E is perpendicular to the earth as shown. Hence, by the simple expedient of coupling into the near field of the main antenna **42**, it is possible to couple energy from transmitter **40** to the antenna. Antenna **44** may be a flat top antenna similar to the configuration shown in FIGS. 1 and 2, and may be positioned about three hundred feet above the surface of the earth. Since its only purpose is to couple into the near field of the main antenna, inductor **46** will be sufficiently small to obviate the previous mechanical difficulties in coupling the energy to antenna **42**. The transmitter may be directly coupled to inductor **46** as shown, or alternatively, the two may be transformer coupled in a known manner.

A second embodiment of the invention is illustrated in FIGS. 4 and 5 which are side and top views, respectively, of the antenna. The operation of this embodiment is similar in principle to that of FIG. 3, the difference being that in this case the transmitter is coupled into the magnetic field rather than the electric field of antenna **42**. Since the magnetic field H will have the circular configuration illustrated in FIG. 5, a coil **50** connected as shown between ground **11** and transmitter **40** will cou-

ple into the magnetic component of the near field of antenna **42** permitting energy to be coupled between transmitter **40** and the antenna.

Although specific embodiments have been described, many modifications thereof will be obvious to one skilled in the art and the invention should not be limited except as defined in the following claims.

What is claimed is:

1. In combination, a high powered very low frequency transmitter, a flat top antenna located above the surface of the earth, said antenna having a diameter relatively large compared to its height, a spirally wound antenna coil positioned perpendicular to the plane of the magnetic component of the near field of said high powered antenna.

2. In combination, a high powered antenna having a height relatively small compared to the wave length, transmitter means, and a flat top antenna positioned perpendicular to the electric component of the near field of said high power antenna for coupling energy between said transmitter means and said high power antenna.

3. In combination, a high powered flat top antenna having a height relatively small compared to the wave length, transmitter means, and a second flat top antenna positioned perpendicular to the electric component of the near field of said high powered flat top antenna for coupling energy between said transmitter means and said first antenna.

References Cited by the Examiner

UNITED STATES PATENTS

1,792,662	2/1931	Sterba	343—886
2,334,279	11/1943	Neiman	343—856 X
2,527,609	10/1950	Willoughby	343—856 X

OTHER REFERENCES

Continental Electronics Pamphlet.

ELI LIEBERMAN, *Acting Primary Examiner.*

HERMAN KARL SAALBACH, *Assistant Examiner.*