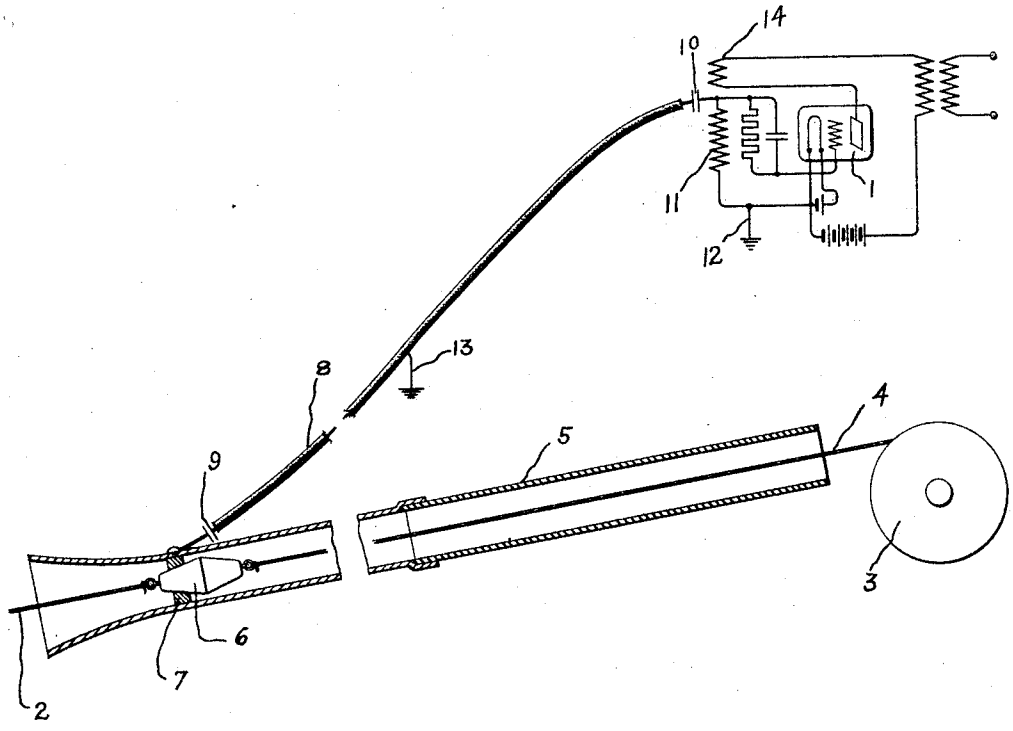
June 6, 1933. S. P. NIXDORFF 1,913,209

RADIO SYSTEM

Original Filed May 22, 1929



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Patented June 6, 1933 1,913,209

UNITED STATES PATENT OFFICE

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RADIO SYSTEM

Application filed May 22, 1929, Serial No. 365,163. Renewed April 13, 1933.

My invention relates to radio systems as used particularly on aircraft and has application particularly in systems of the type disclosed in copending application, Serial No. 319,989 of Ernst F. W. Alexanderson, filed November 17, 1928, entitled "Method and means for determining altitude from aircraft", and which is assigned to the same assignee as my present application.

In the system disclosed in the above mentioned application an antenna which oscillates at a natural wave length is supported from the craft at a point remote from the source of oscillations. This antenna is associated with the oscillatory circuit of an electron discharge oscillation generator by means of which it is excited with oscillations of desired wave length. The wave length of these oscillations is subject to variations dependent upon external influences which affect the antenna. Thus the frequency is affected by changes in capacity between the antenna and the craft and by waves which are emitted from the antenna and reflected back from the earth to the craft.

It is desirable in systems of this kind that the electron discharge oscillation generator be located in the cockpit of the craft, or at a point where it is in easy access of the operator. For this purpose a connection from the antenna to the oscillation generator may be employed, this connection being shielded to prevent capacity variations between the connection and the craft from affecting the frequency of oscillations produced.

My invention relates to means for neutralizing the reactance of this connection thereby to reduce its effect upon the oscillatory circuit. In this way the connection may be of considerable length without materially affecting the operation of the system or the frequency of oscillations produced.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, may best be understood by reference to the following description taken in connection with the accompanying drawing, in which the single figure represents an embodiment of my invention.

Referring to the drawing I have represented at 1 an electron discharge oscillation generator which may be located upon an air craft within easy access of the operator as in the cockpit. At 2, I have indicated an antenna which may be suspended from the craft at any desired point, as for example, near the rear thereof which point may be remote from the generator 1. The position of this antenna may be controlled by means of a reel 3 which is likewise mounted in easy access of the operator, and which is utilized to control the antenna through a suitable non-conducting cord 4. The cord 4 extends to the point of the craft from which the antenna is suspended through a suitable conduit 5, and is there attached to a conducting member 6 from which the antenna 2 is supported. The electrical connection with the antenna 2 is made through the conducting member 6 and a suitable contact member 7 which is illustrated as in the form of a ring mounted within the conduit 5, and arranged to be engaged by the member 6 when the antenna is in its outer position. Connection is made between the oscillation generator 1 and the ring 7 through a cable 8 and a pair of condensers 9 and 10. This cable is preferably covered with a metallic conducting shield which is connected to the metal framework of the craft as indicated at 13 and preferably comprises a light cotton insulating material which separates the conductor from the shield.

The oscillatory circuit of the generator 1 comprises an inductance 11 which is connected between the grid and the cathode of the discharge device, the condenser 10, cable 8, condenser 9, antenna 2, and the capacity between the antenna and the craft, the cathode of the discharge device being connected to the metal framework of the craft as indicated at 12. The inductance 11 is coupled with an inductance 14 in the plate circuit of the electron discharge oscillation generator whereby sustained oscillations are produced in the oscillatory circuit.

The antenna 2 is insulated from the craft and has a natural period of oscillation. Preferably this antenna has a length equal to a

quarter of a wave length of the oscillations produced. The capacity 10 is of a value such that it resonates with the inductance 11 at the natural period of the antenna. As thus arranged it will be apparent that the oscillatory circuit comprises two resonant portions, the first comprising the inductance of the antenna and the capacity between the antenna and the craft, and the second comprising the condenser 10 and inductance 11 the latter of which is connected to the craft. Since the condenser 10 and inductance 11 are adjusted to resonate at the natural period of the antenna, it will be apparent that the oscillatory circuit as a whole will oscillate with a node of voltage upon the conductor of the cable 8.

It will, of course, be apparent that a certain amount of distributed capacity exists between the conductor of the cable and the shield which is connected to the craft. This capacity may be made small by proper construction and dimensioning of the cable. This capacity is practically constant and not subject to variation due to moving objects on the craft which, were it not for the shield, would affect the frequency of the generator. I have found experimentally, however, that the effect of the cable upon the system is predominantly inductive and that because of this inductance difficulty may be encountered in producing satisfactory operation of the system. These difficulties, however, may be overcome by neutralizing the inductance of the cable with a series capacity. This capacity must be inserted at the outer end of the cable as at 9, although if desired it may be distributed along the cable at a plurality of points. In this way practically the entire conductor of the cable may be maintained at a very small alternating potential with respect to the shield and, hence, the capacity between the conductor and the shield has very little effect upon the circuit. In this way the electrical effect of the cable on the circuit is practically eliminated.

While in the drawing I have represented the condenser 9 as located at the outer end thereof, it will of course be understood that this condenser may be located at any suitable point along the cable or may in fact be incorporated into the condenser 10. Further, while I have described my invention with particular reference to its use on aircraft it will be apparent that it has other applications as well. It will also be understood that with cables of different characteristics and dimensions other means may be employed to neutralize its reactance. For example, the particular cable employed may have a predominant capacitance effect upon the oscillatory system in which case its effect may be neutralized by a series inductance connected at a suitable point along the cable. I contemplate in the appended claims to cover any such means as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a radio system for aircraft, an antenna supported from the craft having a natural period dependent upon the capacity between the antenna and the craft, a self-excited oscillation generator mounted on the craft at a point remote from the antenna, said generator including an impedance resonant at the natural period of the antenna, one point on said impedance being connected to the craft, a connection from another point on said impedance to said antenna, whereby said antenna and impedance oscillate as a system, at a frequency dependent upon external influences on said antenna and variable over a wide range responsively to said influences and said connection being so made that a nodal point of voltage appears on said connection and means for neutralizing the reactance of said connection.

2. In a radio system for aircraft, an antenna supported from the craft having a natural period dependent upon the capacity between the antenna and the craft, a self-excited oscillation generator mounted on the craft at a point remote from the antenna, said generator including an impedance resonant at the natural period of the antenna, one point on said impedance being connected to the craft, a connection from another point on said impedance to said antenna, said connection being so arranged that said antenna and impedance oscillate as a system having a nodal point of voltage on said connection and at a frequency determined by external influences on said antenna and variable over a wide range responsive to said influences, a conducting shield about said connection, said shield being connected to the craft, and a condenser included in said connection to neutralize the inductance of said connection thereby to reduce the effect of distributed inductance and capacity of said connection on said system.

3. In a radio system for aircraft, an antenna supported from the craft having a natural period dependent upon the capacity between the antenna and the craft, a self-excited oscillation generator located on the craft at a point remote from the antenna and comprising a circuit including series connected inductance and capacity resonant at the natural period of the antenna, said inductance being connected to the craft, a shielded cable connection between said condenser and said antenna, a condenser included in said cable connection having a capacity sufficient to neutralize the inductance of the cable whereby the circuit comprising said series connected inductance, capacity, antenna, and connection oscillate at a frequency determined by external influences on said antenna and variable over a wide range responsively to said

influences and the potential on the cable with respect to the craft is maintained at a small value, and a connection between the shield of said cable and the craft.

4. In a radio system for air craft, an antenna supported from the craft and electrically insulated therefrom, a self-excited electron discharge oscillation generator located remotely from said antenna having an oscillatory circuit, comprising said antenna, a resonant impedance located at said generator, and a substantially nonreactive connection between said antenna and said impedance, said impedance being connected between said connection and the craft and the inductance of said antenna being resonant with the capacity between said antenna and craft, whereby said circuit oscillates as a whole at a frequency determined by external influences upon the antenna and variable over a wide range responsively to said influences and said connection is maintained at a minimum of voltage with respect to the craft.

In witness whereof, I have hereunto set my hand this 21st day of May, 1929.

SAMUEL P. NIXDORFF.