Nov. 13, 1962 J. H. SREB 3,064,194

RADIO SONDE

Filed April 10, 1945

FIG. 1

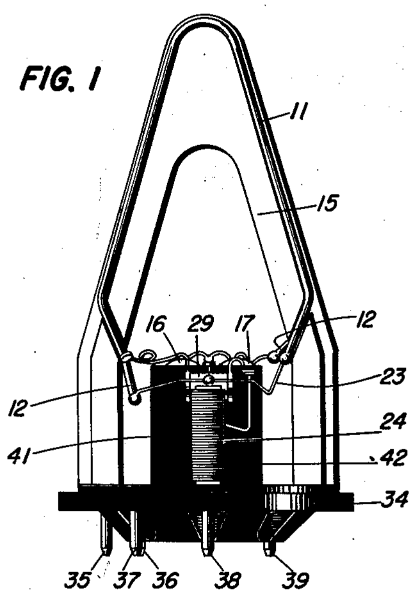


FIG. 2

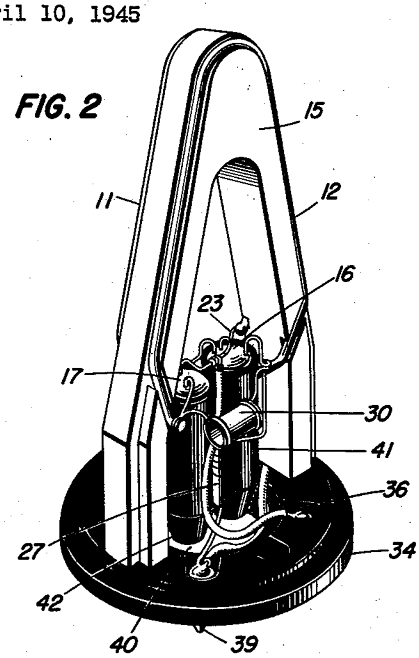


FIG. 3

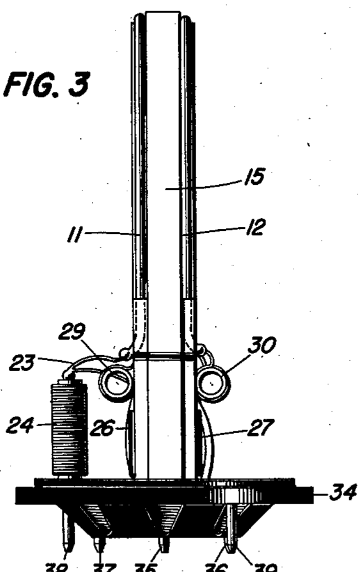


FIG. 5

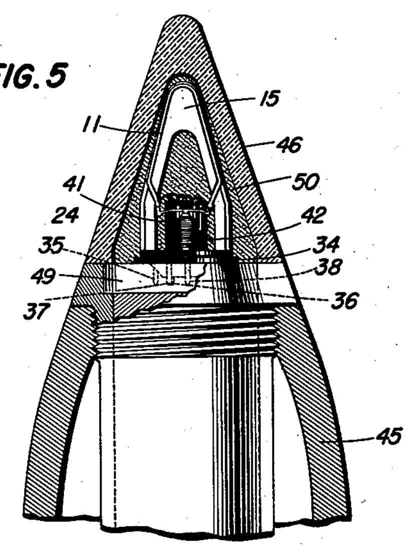
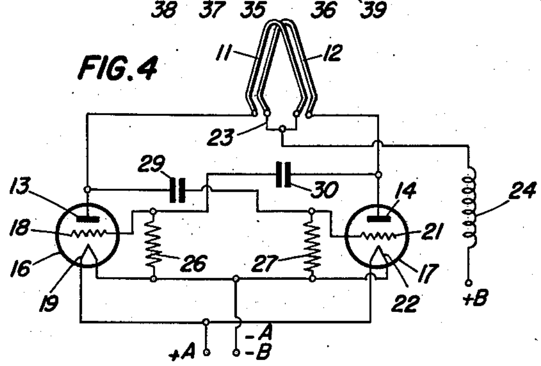


FIG. 4



INVENTOR

JULES H. SREB

BY [signature]

ATTORNEY

3,064,194
Patented Nov. 13, 1962

3,064,194
RADIO SONDE

Jules H. Sreb, Washington, D.C., assignor to the United States of America as represented by the Secretary of the Navy

Filed Apr. 10, 1945, Ser. No. 587,542
5 Claims. (Cl. 325—115)

This invention relates generally to radiant energy transmitters, and more particularly to radio sondes of the type employed in meteorological observations and ballistics studies. While the invention has a considerable range of prospective application, it is herein described in connection with missile behavior, since the determination of projectile spin is the problem which required the development of the invention.

An object of the invention is to provide an improved radio sonde having a radiating antenna which also serves as a parameter in its radio frequency-determining circuit, so that the number of circuit components is reduced to a minimum.

Another object of the invention is to provide an improved radio sonde which is capable of ready installation in projectiles or missiles of various sizes and calibers in order to measure the rates of spin thereof during flight.

It is also an object of the invention to provide an improved radio sonde of such character that the frequency of its carrier signal may be readily predetermined, involving means rendering its frequency of oscillation substantially independent of capacitance between the radiating element and the body of the projectile or missile in which it is installed.

Still another object of the invention is to provide, in a radiant-energy transmitter of the type indicated, an antenna so disposed and arranged as to conform to the ogive of the projectile or missile, thereby avoiding protrusions from streamlined portions of the projectile or missile, with the overall result that the sonde does not introduce a retarding effect on the ballistics of the projectile or missile.

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 is a front elevational view of a preferred form of radio sonde in accordance with the present invention;

FIG. 2 is a perspective view showing the sonde in another position;

FIG. 3 is a side elevational view of the sonde;

FIG. 4 is a circuit schematic of the electrical circuits of the FIG. 1 embodiment;

FIG. 5 is an elevational sectional view showing the radio sonde installed in a projectile.

Referring now specifically to FIG. 4 of the drawing there is illustrated a circuit diagram of my improved radiant-energy transmitter of the radio sonde type and adapted to be carried by a projectile or missile for transmitting signals indicative of missile behavior. The transmitter includes means for radiating radio-frequency carrier signals. This means comprises a V-shaped form which supports the antenna consisting of two loops 11, 12, coupled to the output circuits of electron tubes 16 and 17, respectively. The tubes, antenna and associated circuit components constitute a push-pull oscillator circuit for generating radio-frequency carrier signals. Tubes 16 and 17 include anodes 13 and 14, control electrodes 18 and 21, and filamentary cathodes 19 and 22, respectively. The output circuit of tube 16 is coupled to the input circuit of tube 17 by a capacitor 29 and the output circuit of tube 17 is similarly coupled to the input circuit of tube 16 by a capacitor 30. Connected to control electrodes 18 and 21 are individual grid resistors 26 and 27, respectively. Cathodes 19 and 22 are connected in parallel and coupled to the terminals of an appropriate source of filament heating current (not shown) indicated as +A, —A. The —A terminal also constitutes the —B or plate return terminal of the anode circuits. A conductive jumper 23 interconnects antenna loops 11 and 12. Coupled to the mid-point of this jumper 23 through a choke 24 is the positive terminal of an appropriate source of space current and anode potential (not shown) indicated as +B. The distributed inductance and capacitance of antenna means 11, 12 are included in the frequency-determining or resonant circuit of the oscillator and at the same time function as radiating means for radiating signals generated by the oscillator.

Referring now to FIG. 1 of the drawing, there is illustrated a preferred embodiment of the radio sonde in accordance with the present invention and including the electrical circuit components hereinabove described. Mounted on a base 34 is a generally inverted V-shaped form 15 fashioned of a suitable insulating material such as Lucite. This form is flat sided throughout its length and is formed with grooves extending along the whole length of each of the outer edges. The antenna elements 11, 12 are individually supported in the main grooves and are rigidly secured to the form by imbedding reentrant end portions of the loops in the Lucite.

Base 34 is circular in shape and formed of a suitable insulating material. Projecting from the base are conductive terminal prongs 35, 36, 37, 38 and 39. Prong 36 is connected to one side of cathodes 19, 22 and is adapted to mate with a complementary socket element installed in a projectile and connected to terminal +A. Prong 38 is connected to choke 24 and adapted to mate with a similar socket element connected to terminal +B. Prong 39 is connected to the remaining side of cathodes 19, 22 and constitutes the —A, —B terminal. Prongs 37 and 35 are connected to prongs 38 and 39, respectively, and are adapted to couple the anode current source to a self-destruction or other auxiliary device. Tubes 16 and 17 are protected by rubber jackets 41 and 42 and are supported by a potting compound 50 and the rigidity of the electrical connecting wires disposed within the V-shaped interior of form 15 and within the opening 40 in base 34.

Referring now to FIG. 5 of the drawing the above-described radio sonde is shown installed in a projectile. The projectile includes a metallic casing 45 and a streamlined plastic nose portion 46 having an ogive. The radio sonde is plugged into a socket containing socket elements adapted to mate with its prongs and included in a power supply unit 49. This unit includes sources A and B and a self-destructor device. This device is coupled through an appropriate timing arrangement and terminals 35, 37 to source B in order to cause detonation of the projectile at a desired time in a manner well known to the art. The antenna elements supported by form 15 conform to the ogive of nose 46. The radio sonde and power supply assemblies are rigidly secured within nose 46 by means such as said suitable potting compound 50.

During flight of the projectile in which the radio sonde is installed, the oscillator transmits radio-frequency carrier signals. The radio sonde has such operation that these signals indicate to a receiving station a characteristic of the behavior of the projectile, i.e. its spin. The radiating means 11, 12 is so arranged that its directional pattern of radiant-energy transmission in a plane transverse to the line of projectile flight has a figure-of-eight shape. Since the energy is so directed the frequency of oscillation is not affected by casing 45. However, projectile spin causes the directional pattern to rotate after the fashion of a propeller so that the intensity of the receiver carrier signal is cyclically varied. The modulation components of the received carrier signal are caused by spin, since the received signal attains two maxima for each spin-cycle of the projectile. The signals are received at the receiving station and the modulation components thereof derived and employed to indicate projectile spin. For example, the modulation components may be applied to one set of beam deflecting plates of a cathode ray tube indicating device, say the horizontal trace. A movie film record of the excursions of the spot on the oscillograph tube screen is made with the film continuously passing vertically across the field of view. No shutter is used in the camera. Thus, a spread out permanent record of the modulation is obtained. By simultaneously photographing on the same film a timing trace, as might be obtained, for example, from a neon bulb supplied with power at a known frequency, a direct comparison and count of the modulation frequency may be made. By suitably marking the instant of firing, the spin against flight time is effectively plotted.

The sonde may be used in such a way as to stop the oscillator when an apparatus such as a self-destruction switch or other device operates. In such a case, the trace on the film record would be abruptly terminated and thus the time of action of the device, while in flight, determined.

In one operative embodiment of my invention, in accordance with FIGURES 1 to 5, inclusive, sondes made according to this invention were heard without fading, during flight, attaining a height of approximately 55,000 feet and of a duration of 139 seconds. In this test, the receiving antenna was horizontally disposed and was oriented in a plane generally perpendicular to the plane of the trajectory of the projectile.

While there has been shown and described what is at present considered to be the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the true spirit thereof and it is, accordingly, intended in the appended claims to cover all such changes and modifications as fall within the true scope of the invention.

What is claimed is:

1. In combination with an aerial missile having an ogive, a radiant-energy transmitter adapted to be carried by said missile for transmitting signals indicative of said missile behavior, and a radiating loop antenna mounted in a plane including the axis of said missile and so disposed and shaped to conform to said ogive.

2. In combination with an aerial missile having an ogive, a radio sonde adapted to be carried by said missile for transmitting signals indicative of missile behavior, comprising oscillator means having a frequency-determining circuit for generating radio-frequency carrier signals, loop antenna means shaped to conform to said ogive and included in said circuit for radiating said signals, said loop antenna means being mounted in a plane including the longitudinal axis of said missile so as to give a directivity pattern laterally of said direction of flight of said missile, and means for mounting said oscillator and radiating means in said missile, said mounting means consisting of a rigid insulating support.

3. In combination with an aerial missile having an ogive, a radio sonde adapted to be carried by said missile for transmitting signals indicative of missile behavior, comprising oscillator means having a frequency-determining circuit for generating radio-frequency carrier signals, loop antenna means including an inductance having converging portions shaped to conform to said ogive and included in said circuit for radiating said signals, said inductance being mounted in a plane including the axis of said missile so as to give a directivity pattern laterally of the direction of flight of said missile, and means for mounting said oscillator and said inductance in said missile, said mounting means comprising a rigid support of dielectric material shaped to conform to the shape of said inductance and said ogive.

4. In combination with an aerial missile having a converging nose, a radio sonde adapted to be carried in said converging nose of said missile for transmitting signals indicative of said missile behavior, comprising means having a frequency-determining circuit for generating radio-frequency carrier signals, loop antenna radiating means having converging conductive portions shaped to conform to said converging nose and included in said circuit for radiating said signals, said loop antenna radiating means being mounted in a plane including the axis of said missile so as to give a directivity pattern laterally of the direction of flight of said missile, and means for mounting said oscillator and loop antenna radiating means in said missile, said mounting means comprising a support of dielectric material shaped to conform to the shape of said conductive portions and said converging nose, said portions being firmly secured to said dielectric material.

5. In combination with an aerial missile having a converging nose, a radio sonde adapted to be carried in said converging nose of said missile for transmitting signals indicative of missile behavior, comprising means having a frequency-determining circuit for generating radio-frequency carrier signals, a loop antenna having converging portions shaped to conform to said converging nose and included in said circuit, said loop antenna being mounted in a plane including the axis of said missile so as to give a directivity pattern laterally of the direction of flight of said missile, a support for maintaining said antenna in conformity to the nose of said missile, and means for mounting all of the aforementioned means as a unitary assembly in said missile, said antenna being embedded in said support, and said support being made of rigid dielectric material.

References Cited in the file of this patent

UNITED STATES PATENTS

1,993,436	Eberhard	Mar. 5, 1935
2,151,336	Scharlau	Mar. 21, 1939
2,281,284	Hammond	Apr. 28, 1942
2,281,550	Barrow	May 5, 1942
2,293,949	Potter	Aug. 25, 1942
2,403,567	Wales	July 9, 1946
2,404,745	Roberts	July 23, 1946
2,414,479	Miller	Jan. 21, 1947

FOREIGN PATENTS

463,938	Great Britain	Apr. 5, 1937
539,224	Great Britain	Sept. 2, 1941
546,488	Great Britain	July 26, 1942