Aug. 4, 1970 R. ELLIS 3,522,609

AIRBORNE ANTENNA COUPLED TO ADJUSTABLE HELICAL COUNTERPOISE

Filed July 23, 1968

FIG. 1

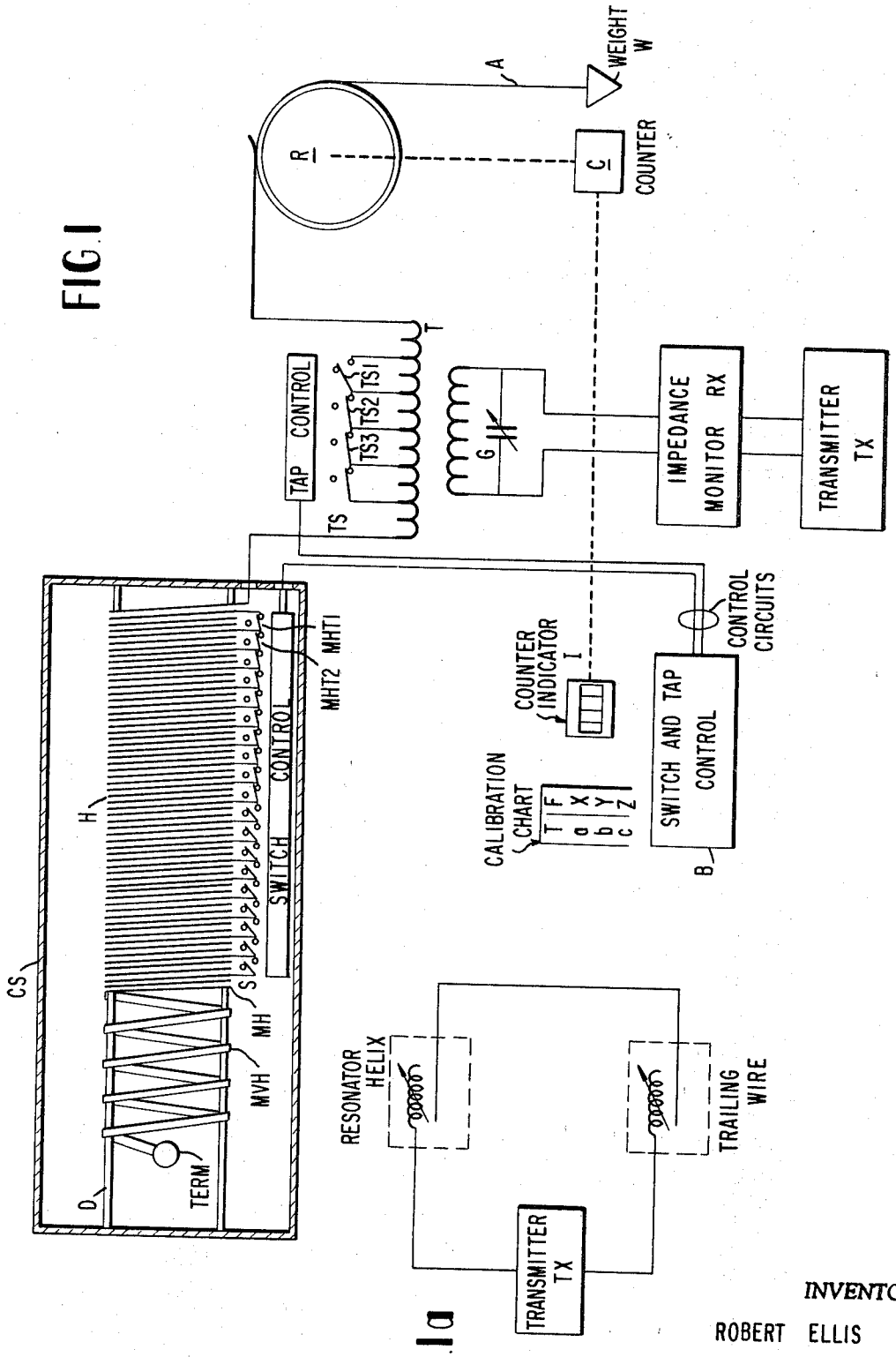


FIG. 1a

INVENTOR

ROBERT ELLIS

BY Abraham A. Saffitz

ATTORNEY

United States Patent Office

3,522,609

Patented Aug. 4, 1970

3,522,609

AIRBORNE ANTENNA COUPLED TO ADJUSTABLE HELICAL COUNTERPOISE

Robert Ellis, 102—30 66th Road,
Forest Hills, N.Y. 11375

Filed July 23, 1968, Ser. No. 746,908
Int. Cl. H01q 1/30
U.S. Cl. 343—703 7 Claims

ABSTRACT OF THE DISCLOSURE

In place of the usual half-wave-length trailing antenna in very low frequency radio operation from airborne vehicles, it is proposed to use a shorter, ¼ wave-length antenna and an adjustable tuning helix. Time required for playing out and rewinding the antenna is reduced, antenna weight and drag are lessened, and the weight of take-up machinery is decreased. Electrical insulation requirements are also lessened by the use of a tuned helix for the counterpoise.

PRIOR ART

The art of radio communication to and from an aeroplane is a very old one. Rouzet, in U.S. Pat. No. 1,106,729, shows a radio communication device in an aeroplane and shows a trailing or "floating" wire antenna A. When the radio is operative, this wire antenna is unwound and then must be rewound by the winch C when the plane is about to land or when transmission has been completed.

This unwinding and rewinding is a consequence of the inherent characteristic of radio transmission and its velocity in any given medium is fixed. In the air, this velocity is about 300,000,000 meters/second. If high or very high frequencies of signaling are used, the wave-length (e.g. velocity/frequency) is short, and short antennae, such as a so-called whip antenna, will suffice. Such short antennae can be structural parts of aeroplanes without serious aerodynamic drag or insulation problems.

However, when low frequency transmission is necessary, for instance 10,000 cycles per second, the wavelength becomes 30,000 (nearly 18 miles). Even a quarter-wave antenna, e.g. 4.5 miles of copper wire, represents an enormous weight. This weight, combined with the aerodynamic drag, creates a force which requires a material having a higher tensile strength than copper alone to withstand the force. A stronger copper-clad wire, such as a copper-steel alloy wire, has been suggested for use but this further increases the weight to be carried by the plane and further increases the size of the winding and unwinding machinery needed.

Since the trailing antenna must be taken in before the plane may land, the take-up winch, such as C in Rouzet, must be quite powerful to effect the rapid windup of several miles of steel-copper wire in an emergency.

The winch carrying the antenna wire is necessarily at the high potential prevailing during radio transmission. In the very limited space in the aeroplane, a high potential mechanism, as large as an antenna winch, represents a constant electrical hazard to the crew members of the plane.

Fox U.S. Pat. No. 2,417,191 shows a trailing antenna on an aeroplane with a reel **3** to adjust the length of the antenna. As in Rouzet above, the reel **3** would be at high potential because the antenna counterpoise **16** is a fixed ground connection to the frame of the plane.

BRIEF DESCRIPTION

The present invention eliminates the electrical hazard at the antenna winch. An airborne antenna is coupled to an adjustable helical counterpoise so that the plane end of the antenna (a winding reel or winch) will be at

or near zero potential. A ground to the plane's frame is not needed and details of the helix are given.

THE DRAWING

FIG. 1 is the complete radio transmission and antenna reeling system control, the container being shown in sections.

FIG. 1*a* is the electrical resonator system underlying the ungrounded transmission of FIG. 1.

GENERAL DESCRIPTION

In FIG. 1, a reel or winch R carries the antenna wire A. The motor to drive the reel R and the motor control circuits are not shown but may be any of the well-known systems for such power drives. A weight W has been found useful in avoiding whipping of the antenna against the body of the plane when the unreeled part is short.

Connected to the shaft of reel R is a revolution counter C. Counter C, in turn, is connected to indicator I which shows an observer how many feet of antenna are unreeled. Indicator I, preferably, is located adjacent the control unit "SWITCH AND TAP CONTROL" so that the observer can adjust both controls in accordance with the antenna length. A previously prepared CALIBRATION CHART assists the observer in setting the controls.

The transmitter TX is coupled through an impedance balance monitor RX to a coupling circuit G which includes the primary winding of a transformer T. The secondary winding of the transformer T is divided into a plurality of sections. The two end sections are always in circuit between the antenna A and the counterpoise composed of a helix H. The other secondary sections (four in the illustration) can be short-circuited by tap switches TS. As illustrated, the second section from the right (antenna) end is not shorted and, thus, is in series with two end sections, the antenna and the counterpoise helix H.

From the above description, it will be seen that there is no ground connection to the body of the plane and that, if the impedance of the antenna and the counterpoise helix H are kept equal, the reel end R of the antenna will not be at a high potential. Theoretically, the reel potential can be practically zero.

The helix H comprises a frame D of dielectric material upon which are wound two spiral helical coils MVH and MH. The high voltage helix MVH consists of several turns of relatively large conductor having an open circuit termination TERM. The terminals TERM of this winding are spaced sufficiently far apart to avoid any arcing or corona discharges.

The main lateral winding MH has many turns and a plurality of taps MHTI, MHT, etc. connected thereto. Switches controlled by a switch control enable most of the sections of the main helical winding MH to be short-circuited. As shown in FIG. 1, 10 of the weight end of the coil are short-circuited and 9 of the other end are not shorted.

As shown, the whole helix comprising MVH, MH, switches S, the switch control and the dielectric framework D are contained in a conductive can or shield, this being shown in section in FIG. 1. Thus, induction feedback to the plane's radio system and other electronic gear is prevented or reduced and the high voltage hazards for the crew are reduced.

Sharpness of tuning is best obtainable when the resistances in the tuning circuits are as low as possible. For this reason, the main section of the tuner MH is wound of the low resistance stranded silver or copper wire known as "Litzendraht."

The operation of the helix H contactors, MHT_1, MHT_2 and the transformer T tap switches TS1, TS2, TS3, etc. is effected from the switch and tap control unit B. Elec-

tric-mechanical switches are preferred. Relay type units readily provide insulation between the low-voltage relay operating circuits and the high-voltages in the controls being switched. Purely mechanical switch operations can be used, if desired.

OPERATION

When transmission is to be started with a selected wave length, the reeling mechanism is run until the indicator I shows the correct length of antenna, then control unit B is set for the wave length. When the transmitter TX is energized, the monitor R–X indicates any impedance mismatch between the counterpoise helix H and the antenna A. Changes in the control B or in the fine tuning adjustable condenser in coupler G can restore impedance match.

When a change in wave length is to be made while the transmitter is on the reel, counter indicator I gives the attendant the information that, with the help of the previously prepared calibration chart, enables him to follow with an appropriate change in the setting of taps TS and MH. As before, a fine control of impedance match can be effected by the adjustable condenser in coupling circuit G.

FIG. 1*a* is an electrical simplification of the complete system in FIG. 1. The transmitter TX energizes a variable resonator in the counterpoise helix and a second resonator in the trailing variable length antenna.

Variations are possible in one or more of the elements of the present disclosure. I desire that it be understood that such modifications may be made as are compatible with the scope of the appended claims.

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

1. In an air-borne radio system having a reeling device for a trailing antenna, an antenna counterpoise on board the aircraft, a trasformer coupling connected between said reeling device and said antenna counterpoise, a radio transmitter inductively coupled to said transformer coupling, the radio system being unconnected to the body of the aircraft, that improvement comprising:

(a) an indicator for said reeling device showing the length of antenna trailing from the aircraft;

(b) said antenna counterpoise on board the aircraft comprising a helical winding having adjustable taps thereon;

(c) said transformer coupling being provided with a plurality of adjustable taps; and,

(d) control means for adjusting the taps in said antenna counterpoise and said transformer coupling to a length compatible with that of the trailing antenna as indicated by said indicator.

2. A system as claimed in claim **1**, wherein said antenna counterpoise helical winding is mounted on a dielectric framework and the winding and plurality of contacts are contained in a conductive housing.

3. A system as claimed in claim **2**, wherein said dielectric framework also carries a second open-circuited helical winding conductively joined to the first winding.

4. A system as claimed in claim **3**, wherein said helical winding of said antenna counterpoise is a fine stranded conductor and said second helical coil is wound of substantially larger wire than that of said antenna counterpoise.

5. A system as claimed in claim **1**, wherein a previously prepared calibration chart of antenna lengths and tap positions for taps on said antenna counterpoise and said transformer coupling indicates the adjustments in said control means.

6. A system as claimed in claim **1**, wherein said radio transmitter coupling includes a variable capacitor for fine tuning the coupling.

7. A system as claimed in claim **1** including an impedance monitor in said radio transmitter coupling circuit.

References Cited

UNITED STATES PATENTS

2,430,173 11/1947 Holmes ---------- 343—707

ELI LIEBERMAN, Primary Examiner

U.S. Cl. X.R.

343—707, 861