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A. HAUPTSCHHEIN
MULTIBAND TAIL-CAP ANTENNA

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Fig 3

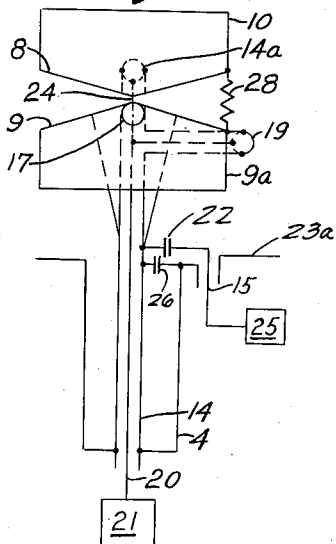


Fig 2

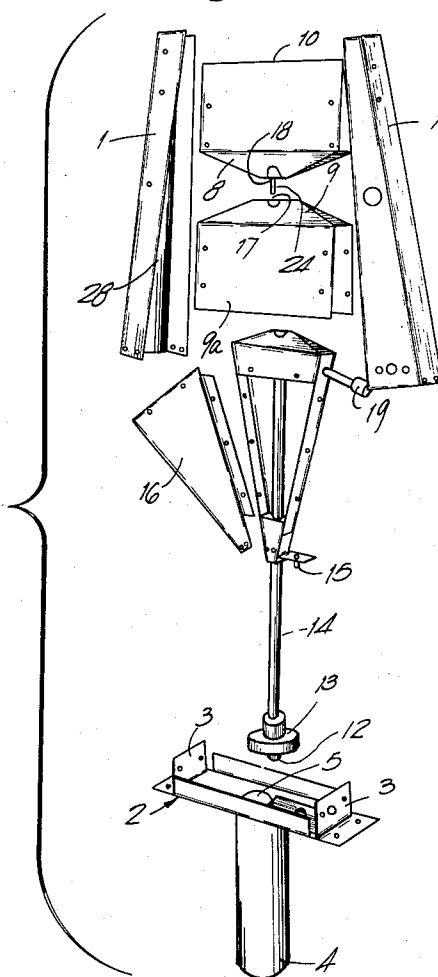
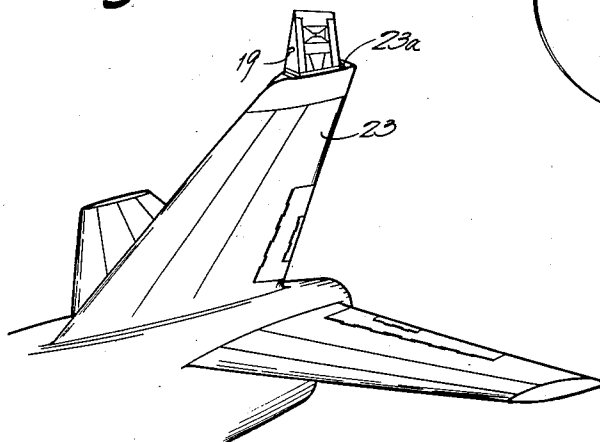


Fig 1



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MULTIBAND TAIL-CAP ANTENNA

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1 Claim. (Cl. 343-708)

This invention relates to electrical apparatus and more particularly to improvements in antennas.

It is an object of the present invention to provide a multiband antenna for installation atop the vertical stabilizer of aircraft, wherein the radiation therefrom is vertically polarized over the region of space between +30 degrees and -30 degrees in elevation.

Another object of the present invention is to provide an antenna which has a standing-wave ratio of less than 2.0 over a frequency range of 225-1215 megacycles when connected to a 52-ohm coaxial cable.

Another object is to provide a multiband tail-cap antenna that can be readily integrated into the design of present and future high-speed jet aircraft.

Yet another object is to provide a multiband tail-cap antenna that provides simultaneous interference-free operation at a frequency band of 225 to 400 mc. which band will hereinafter be called in the specification and in the claim the P band, at a frequency band of 460 to 515 mc. which band will hereinafter be called in the specification and in the claim the L_c band, and at a frequency band of 950 to 1215 mc. which band will hereinafter be called in the specification and in the claim the L_x band.

A further object of the present invention is to provide a multiband tail-cap antenna that requires only a minimum of space atop an aircraft's vertical stabilizer.

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:

A major problem in meeting the above requirements existed in developing an antenna to perform satisfactorily on the L_x band. The antenna impedance in the L_x band had to be closely controlled and in order to minimize the effects of the surrounding aircraft structure, the antenna had to take the form of a balanced antenna.

The balanced type of tail-cap antenna is designed to be independent of the characteristics of the vertical stabilizer in the aircraft. The use of this type of antenna is essential at the high frequencies because it prevents currents from being excited on the skin of the vertical stabilizer with consequent deleterious effects on the radiation patterns.

In an unbalanced tail-cap installation, the tip of the vertical stabilizer is constructed of a dielectric material within which the antenna is mounted. Antenna voltage is established between the antenna and the stabilizer. The upper portion of the vertical stabilizer is thus excited as a radiator, the lower portion being effectively shielded by the horizontal stabilizers. Such an antenna has an inherently broad-band impedance characteristic because of the large cross-section of the vertical stabilizer. Therefore, in order to provide a multiband tail-cap antenna which would cover the required bands, this invention comprises use of an unbalanced antenna to radiate energy on the P and L_c bands and a balanced antenna to radiate energy on the L_x band.

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In the accompanying drawings forming a part of this specification,

Fig. 1 is a view of the multiband tail-cap antenna mounted in the vertical stabilizer of an airplane;

Fig. 2 is an exploded view of the antenna of Fig. 1; and

Fig. 3 is a schematic view of the multiband antenna showing the relationship between the filter, and the feeds of the L_c and P bands and the L_x band.

In Fig. 1, the antenna assembly is supported fore and aft by the channels 1 and a mounting base 2. The base 2 is secured to the tip 23_a of the aircraft's stabilizer 23. Both the tip and stabilizer are constructed of a suitable dielectric material. The mounting base is constructed of aluminum or any electrically conductive metallic substance. The channels are fastened in any suitable manner to vertical flanges 3 that are integrated with the mounting base. A cylindrical shunt trap 4 is secured in any suitable manner to the bottom surface of the mounting base so that it extends downwardly from the aperture 5 in the base 2 into the stabilizer 23.

Supported at the top of the fiber glass channels in any suitable manner are the elements of the assembly which form the L_x band antenna. This portion of the antenna assembly includes the two opposed frusto pyramidal sections 8 and 9. The skirt-like lateral plates 9_a preferably extend downwardly from opposite sides of section 9 whereas the U-shaped plate 10 interconnects the lateral sides of section 8 as shown. The cylindrical tube or coaxial shield 14, which is centrally disposed within the tubular trap 4 by the disk shaped electrical insulator 13, extends upwardly to the apex of section 9 where it is secured to the insulation insert 17 which is affixed within the pyramid apex of section 9 in any suitable manner. The inner conductor 20 of the L_x band coaxial feed cable, which is centrally disposed within its shield 14, extends from the conventional connector 12 in the disk shaped insulator 13 upwardly through the dielectric insert 17 in the apex of section 9 through a similar dielectric insert 18 in the apex of section 8 and terminates a predetermined distance within the interior of section 8. The portion of conductor 20 within section 8 and its coaxial shield or the like 14_a, which is electrically connected to section 8, terminates as an open line therewithin. The interior of channel 1 is coated with a 2-megohm resistive film 28 which bridges the two halves of the sections 8 and 9 of the L_x antenna. This creates a leakage path for preventing static charge accumulation on the isolated upper section of the antenna without affecting the antenna impedance. The shunt tuning stub 19 is electrically coupled as shown to the L_x band feed line 20 at a point preferably adjacent the juncture of the feed line with the insert 17 of section 9. As is also shown in the drawing, the portion of the L_x band feed line 20 between the base 2 and the apex of section 9 of the L_x band antenna is preferably enclosed by the inverted pyramidal shielding structure 16.

The conventional connector 15 is secured to the mounting plate 2 and as will be more apparent hereinafter is coupled to a suitable external coaxial transmission line which transmits energy on the P and L_c bands to the antenna. The inner terminal of the connector 15 is series connected through the condenser 22 with the external shield 14 of the L_x band feed line 20, whereas the body of the connector is electrically connected to the top of the stabilizer 23_a and to the shield of feed line 20 through the shunt condenser 26 and the high frequency choke or trap 4.

In operation, energy within the L_x band is fed from a suitable source 21 through the coaxial feed line 20 to the antenna. The balanced high frequency L_x antenna from which it is radiated without effect of the aircraft struc-

ture. The balanced high frequency L_x antenna exhibits an impedance characteristic which is substantially independent of the terminating impedance across the P and L_c band feed since the skirt plates 9_a of section 9 of the L_x antenna act as current traps thereby preventing L_x band currents from flowing on the pyramid into the unbalanced feed of the P and L_c antenna. The shunt stub 19 provides the desired impedance match for the L_x antenna.

Energy within the P and L_c bands is fed from its source 25 through the connector 15 to the stabilizer of the aircraft and through the series connected impedance matching condenser 22 to the shield of the L_x band feed line. The section of open circuited coaxial line 20 which is connected in series with the wire 24 that feeds across the halves of the L_x band antenna series resonates with the L_x band feed line and gives the appearance of a very high capacitive impedance at the P and L_c bands thereby providing a minimum mismatch for the P and L_c band antenna. The shunting effect that the outer shield of the L_x band feed line has on the P and L_c band antenna is substantially reduced by the shunt current trap 4. In order to limit the physical size of the shunt trap 4, the small shunt condenser 26 is preferably placed as shown across the mouth of the trap.

The antenna structure hereinbefore described has been designed primarily for use with aircraft and because of its compact design is particularly suitable therefor. The antenna may, of course, be used in other environments. It will be apparent that there may be deviations from the invention as described which still fall fairly within the spirit and scope of the invention.

Accordingly, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim the invention may be practiced otherwise than as specifically described herein.

What is claimed is:

A multiband antenna for installation atop the vertical stabilizer of an aircraft wherein the radiation therefrom is vertically polarized over the region of space between +30 degrees and -30 degrees in elevation said antenna comprising a coaxial line of chosen impedance having an inner and an outer conductor; a source of energy having a frequency band of 950 to 1215 megacycles; means for connecting the said source with the inner conductor of the coaxial line through the bottom of the stabilizer; a second source of energy having a frequency band of 460 to 950 megacycles; a coaxial line connector mounted on the tip of the stabilizer, one terminal of the connector being coupled to the outer conductor of the coaxial line and the other terminal of the connector being connected to the stabilizer of the aircraft at a point about halfway up the said stabilizer; means for connecting the said second source with the connector; a pair of frusto-pyramidal sections mounted at a predetermined distance above the stabilizer and adapted to receive the outer conductor of the coaxial line; a section of open circuited coaxial line connected in series with the inner conductor whereby an improved impedance match for the various frequencies is provided; a shunt stub connected to the coaxial line adjacent the point at which it feeds said pyramidal sections whereby the various frequencies are able to be matched so that simultaneous interference-free operation of all three bands may be provided.

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