Aug. 2, 1960 S. H. M. DODINGTON 2,947,987

ANTENNA DECOUPLING ARRANGEMENT

Filed May 5, 1958

Fig. 1

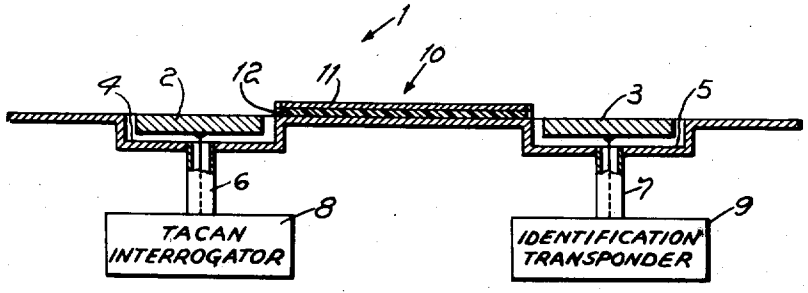
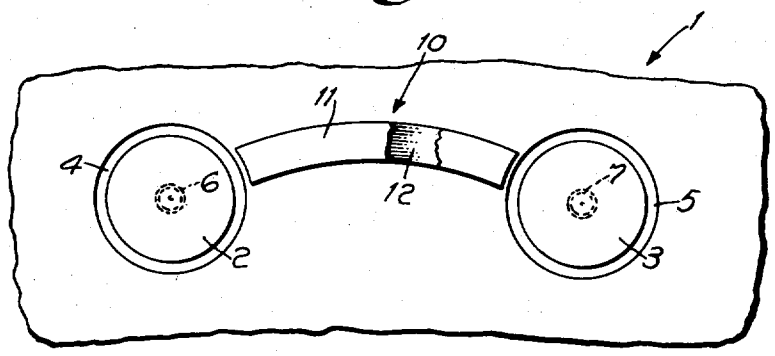


Fig. 2



Inventor
SVEN H. M. DODINGTON
By Philip M. Bolton
Attorney

United States Patent Office

2,947,987

Patented Aug. 2, 1960

2,947,987

ANTENNA DECOUPLING ARRANGEMENT

Sven H. M. Dodington, Mountain Lakes, N.J., assignor to International Telephone and Telegraph Corporation, Nutley, N.J., a corporation of Maryland

Filed May 5, 1958, Ser. No. 733,090

4 Claims. (Cl. 343—180)

This invention relates to arrangements for effectively reducing the coupling between antennas, and more particularly to arrangements for reducing the coupling between airborne antennas by deliberately feeding signals from one antenna to the other in such a manner as to attenuate undesirable signals coupled from one antenna to the other.

In many applications, a plurality of antennas are mounted on a missile or an aircraft, and it is desirable that radiation coupling between these antennas be held to a minimum. A typical example of such a situation is in the case of an aircraft carrying both a Tacan antenna and an identification transponder. The Tacan antenna and its associated equipment transmits and receives signals to provide navigational information for the plane, while the identification transponder antenna and its associated equipment also receives and transmits in providing identification and other information to a ground station in response to interrogations therefrom. The Tacan system and the transponder system have certain portions of their frequency bands in common, and consequently, radiation coupling between these antennas becomes a serious problem. In the past, various shielding methods have been employed to shield these antennas from each other. In certain instances, these antennas have been located at different places on the missile or craft so that the body thereof serves to shield one from the other. In still other applications, the antennas have been flush-mounted to minimize coupling therebetween. It has also been suggested that a part of the signal fed to one antenna be deliberately applied to the other antenna equal and opposite in phase to the signal produced in said other antenna by the undesirable coupling. Various schemes for implementing the last-mentioned idea have been suggested but, in general, they have been unnecessarily complex or have presented undesirable difficulties. One such scheme is to pick up some of the energy from one of the antennas and feed it through a relatively long transmission line to the other antenna, the feed line being of sufficient length produce a phase inversion (or additional means are employed with the line to effect this). In installing such equipment, it has been necessary to get under the aircraft skin in order to install the feed line. It has also been necessary in adjusting the feed line to have access to it under the aircraft skin. This is particularly inconvenient where the antennas have already been installed, and it now becomes necessary to insert the feed line. On the other hand, because of the velocity of aircraft, it is not feasible to mount such feed lines on the outside of the skin since the drag introduced is undesirable.

Therefore, it is an object of this invention to provide an improved arrangement for reducing the effects of radiation and other undesirable coupling between antennas.

It is another object of this invention to provide a simple light weight arrangement introducing a minimum of drag and weight for reducing the undesired coupling between antennas on a missile or aircraft.

It is another object of this invention to provide means as mentioned above which may be externally installed on the skin of a missile or aircraft for reducing the effects of such undesired coupling.

In accordance with a feature of the present invention, a "microstrip" line consisting of a thin strip of conducting material separated by a dielectric from the metallic aircraft skin surface is arranged between the antenna so that the ends of said microstrip are capacitively coupled to the antennas, and the length of the strip is such as to produce a 180-degree phase reversal so that the signal from one antenna is deliberately applied to the other antenna with a 180-degree phase reversal so as to cancel out the undesired signal coupled by radiation, induction, etc., from one antenna to the other.

Other and further objects and features of this invention will become apparent, and the foregoing will be better understood with reference to the following description of embodiments thereof, reference being had to the drawings, in which:

Fig. 1 is a schematic side elevational view of an antenna arrangement including means for reducing undesirable coupling; and

Fig. 2 is a plan view of the arrangement shown in Fig. 1.

Referring now to the drawings, there is shown a section of metallic aircraft surface skin **1** within which two antennas **2** and **3** are flush-mounted in suitable recesses **4** and **5** provided in the aircraft skin. These antennas **2** and **3** are coupled by coaxial lines **6** and **7** to the Tacan airborne equipment **8** and to an identification transponder **9**, respectively. Such antennas are often as close together as 4 feet, at which distance it is often found that the radiation coupling between the antennas is 30 db down, whereas a value of 50 db is desirable. To provide the additional 20 db, there is provided a microstrip line **10** consisting of a strip conductor **11** mounted on a dielectric **12**, for example by being painted thereon, the dielectric **12**, in turn, being fixed to the aircraft skin **1**. The microstrip line **10** provides a conductor **11** over a ground plane (the metallic aircraft skin **1**) separated by a dielectric **12**, but differs from the ordinary line-over-ground plane in that the major portion of the field is confined between the strip conductor **11** and the portion of the ground plane (the aircraft skin **1**) directly beneath it. For this purpose, the dielectric thickness is a minor fraction of a wavelength. For further details on the nature of the microstrip line, see the article by D. D. Grieg and H. F. Engelmann "Microstrip—A New Transmission Technique for the Kilomegacycle Range," Proceeding of the IRE, volume 40, pages 1644–1650, December 1952; and also the two subsequent articles beginning on pages 1651 and pages 1658 of the opus cited.

The microstrip line **10** has its ends positioned adjacent antennas **2** and **3** so as to be capacitively coupled thereto and to pick up the signal from one of these antennas and feed it to the other, the length of the microstrip **10** being selected so as to produce a 180-degree phase reversal between the signal which it picks up from one antenna and applied to the other and the unwanted signal picked up by said other antenna. For this purpose, the strip may be curved so as to provide the desired length and, as shown in Fig. 2, need not run in a straight line from one antenna to the other. By adjusting the distance between the ends of the microstrip line and the antennas (the capactive coupling), the relative strength of the signal coupled via microstrip with respect to that coupled by radiation, induction, etc., from one antenna to the other may be adjusted to equality to produce the desired cancellation of the unwanted signal. Here the additional 20 db may be obtained.

It will be readily seen that the microstrip line can be

readily added after the antennas have been mounted and thus is a simple means of providing for the reduction of undesired coupling on aircraft where antennas have been already installed.

While I have described my invention in connection with two flush-mounted antennas, obviously, it may be employed with other types of airborne antennas.

I claim:

1. An arrangement for reducing undesirable coupling between antennas mounted on a body having a conductive surface comprising a pair of spaced antennas mounted on said body with a portion of said conductive surface positioned therebetween, a layer of dielectric material mounted on said conductive surface and a conductor mounted on said dielectric, said conductor, dielectric layer and the portion of said conductive surface beneath and adjacent said conductor forming a transmission line, the ends of said line extending towards each of said antennas in coupled relationship thereto, said line having a length producing substantially a 180-degree phase reversal of the signal coupled by said line from one antenna to the other with respect to the undesired signal coupled between said antennas.

2. An arrangement according to claim 1, wherein said conductive surface has recesses therein, said antennas being flush-mounted with respect to said surface.

3. An arrangement for reducing undesirable coupling between antennas mounted on an airborne body having a conductive surface comprising a pair of spaced antennas mounted on said body with a portion of said conductive surface positioned therebetween, a microstrip line having its ends adjacent said antennas and capacitively coupled thereto, said microstrip line being mounted on said body between said antennas and having a length producing a 180-degree phase reversal of the signal applied from one antenna to the other with respect to the signal otherwise coupled from said one antenna to the other, said capacitive coupling between the ends of said microstrip line and said antennas being of a value such as to couple an amount of energy through said line equal to that otherwise coupled between the two antennas.

4. An arrangement according to claim 3, wherein said microstrip line includes as its ground plane, a portion of the conductive surface of said body, a dielectric mounted thereon and a planar conductor mounted flat on said dielectric, said dielectric and said planar conductor extending from a point adjacent one of said antennas in an arc to a point adjacent the other of said antennas.

References Cited in the file of this patent

UNITED STATES PATENTS

2,103,357	Gerhard	Dec. 28, 1937
2,414,266	Lindenblad	Jan. 14, 1947
2,659,004	Lindenblad	Nov. 10, 1953