

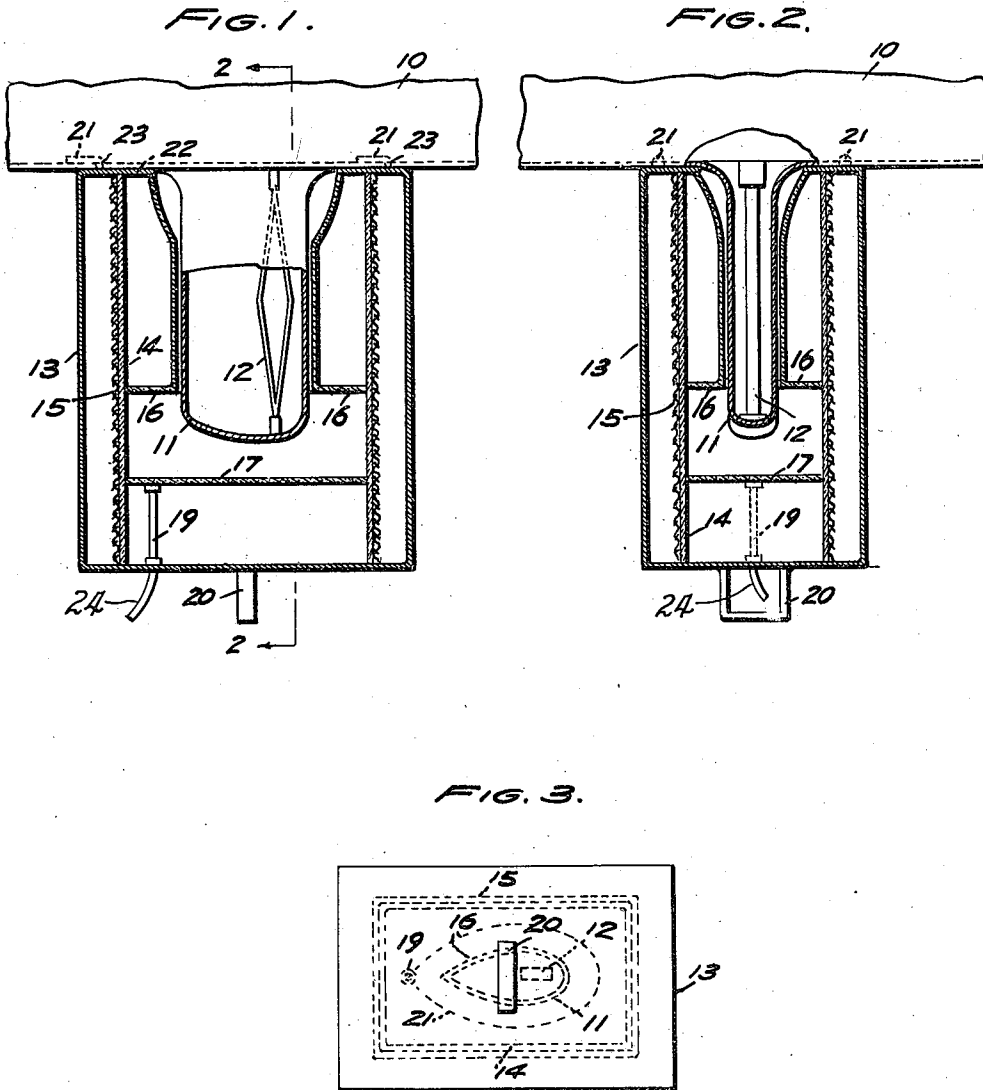
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ANTENNA TESTING SHIELD

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ANTENNA TESTING SHIELD

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment of any royalty thereon.

This invention concerns a shield which is fitted over an antenna (particularly of the transponder type mounted on an airplane or other vehicle) to prevent radiation during test of this antenna from reaching other antennas in the vicinity.

An object of the invention is to provide a shield (preferably non-circular) which surrounds the antenna being tested and which is asymmetrical-ly located with respect to it, the shield also including within it radiation-absorbing cloth for the purpose of absorbing the radiation from the antenna.

Another object of the invention is to provide within the shield, a radiator for triggering the transponder and for taking off the transponder reply.

Still another object of the invention is to provide a shield for testing a transponder antenna, the shield being so constructed as to minimize symmetrical reflections from it to the antenna.

Fig. 1 shows a generally cross-sectional view of the shield in position over the antenna of a vehicle.

Fig. 2 is a cross-section taken on the line 2—2 of Fig. 1.

Fig. 3 is a bottom plan view of the shield.

In the drawings, 10 represents a portion of the body of an airplane or other vehicle, to which is attached a streamlined casing 11. Within casing 11 is located a transponder antenna 12.

The antenna test shield itself includes a casing 13 made of electrically-conducting material and preferably of rectangular cross-section, within which there is another casing 14 of the same shape as casing 13. Casing 14 is made of a good high-frequency dielectric having a low dielectric constant, low absorbing power, and low reflecting qualities. A suitable material of this character is polystyrene.

Casing 14 serves to support, and is covered with, radiation-absorbing "space cloth" 15. This cloth is preferably a thin rubberized fabric having a deposit of graphite on its surface, and having an impedance of 377 ohms per unit square which is equal to that of atmosphere. The distance between cloth 15 and outside casing 13 is on all possible sides made to be substantially $\lambda/4$, where λ is the wave-length of the radiation emitted by the antenna. This distance is capable of some variation, particularly since the

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wave-length of the antenna may not be fixed but may vary within a certain range. Where there is such variation, λ should be taken as the mean wave-length within the range. Considerations of practical construction may also necessitate some adjustment of this distance.

The radiation from the antenna 12 sets up currents in the space cloth 15 which are substantially absorbed by such cloth. These currents cause some radiation toward the antenna 12 as well as some toward the casing 13. The waves which are radiated toward the casing are, by reason of the $\lambda/4$ spacing of the casing from the cloth, returned to the cloth in opposite phase to the waves which are radiated from the cloth toward antenna 12. Thus the two sets of waves largely tend to cancel each other.

Antenna 12 must be asymmetrical-ly located with respect to casing 13 in order to minimize the effect of stray reflections by causing these to be returned to the antenna by the shield in random phase. This result is effectively and preferably accomplished by making the shield of rectangular cross-section and placing the antenna within the shield at a location which is asymmetrical with respect to at least the long axis of the shield. However, it is possible to accomplish reasonable reduction of the effect of stray reflections with cross-sections of the shield other than rectangular.

In order to prevent radiation from antenna 12 from reaching other antennas, the former must be surrounded by metal to the fullest extent possible.

Within casing 14 there is an additional casing 16 made of a material like that of which casing 14 is constructed. Casing 16 has an opening 21 into which the streamlined casing 11 is inserted when antenna 12 is to be tested. Casing 16 is so shaped as to fit closely around casing 11 and thus to position the antenna properly with respect to casing 13.

Extending between the sides and near the lower end of casing 14 there is a partition 17 which is also made of a material like that used in this casing. Located in the space between partition 17, the bottom of casing 13 and casing 14 is a radiator 19 which, in its simplest form but not necessarily, is of the $\lambda/4$ type. Radiator 19 is used to trigger transponder antenna 12 and to take off the transponder reply. Radiator 19 is so located with reference to antenna 12 that the former will not have any appreciable reaction on the impedance of the latter, and so that the self-impedance of the former has a value which

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matches that of its connecting cable 24 and which remains substantially constant over the range of frequencies radiated by antenna 12. Ordinarily, the attenuation between radiator 19 and antenna 12 should be at least 12 db. Ordinarily, these requirements will be satisfied only if the radiator is located between antenna 12 and space cloth 15. If desired, radiator 19 need not actually be fixedly situated within casing 13, but may instead be separate from this casing and simply inserted into it through an opening in the bottom of the latter when antenna 12 is to be tested.

In the top 22 of the casing 13, lugs 21 are provided. These lugs pass through slots 23 in the body 10 and serve to support the shield on this body. A handle 20 is also provided for convenience in using the shield.

While because of limitations of size and practical construction, this testing shield is especially suitable for use with antennas which are part of ultra-high-frequency systems, it could be adapted for use with systems employing other frequency bands.

The invention has been specifically described in connection with the testing of a transponder antenna mounted on an airplane or other vehicle. However, it is capable of use in the testing of one antenna at a fixed location in the presence of other antennas at the same location.

I claim:

1. A shield for preventing radiation originating from a first antenna from reaching other antennas in the vicinity of the first antenna, this shield comprising a box-like casing made of electrically-conductive material, within such casing an opening into which is inserted the first antenna, such opening being so situated as to place this first antenna asymmetrically with respect to the casing, and also within the casing, means for absorbing radiation from the first antenna, these means being separated from substantially all the sides of the casing by a distance substantially equal to $\lambda/4$ where λ is the mean wave length of the radiation from the first antenna.

2. A shield, as described in claim 1, in which the casing has a rectangular cross-section and in which the first antenna is placed asymmetrically with respect to at least two opposite sides of the rectangle.

3. A shield for preventing radiation from a first antenna of the transponder type from reaching other similar antennas in the vicinity of the first antenna, this shield comprising a box-like casing made of electrically-conductive material, within such casing a first opening into which is inserted the first antenna, such opening being so situated as to place this first antenna asymmetrically with respect to the casing, also within such casing a second opening into which may be inserted a radiator for the purpose of triggering the first antenna and taking off the transponder reply, a connecting cable for the radiator, the second opening being so situated as to place

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the radiator where its self-impedance matches that of its connecting cable and remains substantially constant with varying frequency of the radiation from the first antenna and where this radiator will not have any appreciable reaction on the impedance of the first antenna, and also within the casing, means for absorbing radiation from the first antenna, these means being separated from substantially all the sides of the casing by a distance substantially equal to $\lambda/4$ where λ is the mean wave length of the radiation from the first antenna.

4. A shield, as described in claim 3, in which the casing has a rectangular cross-section and in which the first antenna is placed asymmetrically with respect to at least two opposite sides of the rectangle.

5. A shield, as described in claim 3, in which the means for absorbing radiation from the first antenna include a rubberized fabric having a deposit of graphite on its surface and having an impedance of 377 ohms per unit square.

6. A shield for preventing radiation from a first antenna of the transponder type from reaching other similar antennas in the vicinity of the first antenna, this shield comprising a box-like casing made of electrically-conductive material, within such casing a first opening into which is inserted the first antenna, such opening being so situated as to place this first antenna asymmetrically with respect to the casing, also within such casing a radiator for the purpose of triggering the first antenna and taking off the transponder reply, a connecting cable for the radiator, the radiator being so situated that its self-impedance matches that of its connecting cable and remains substantially constant with varying frequency of the radiation from the first antenna and where this radiator will not have any appreciable reaction on the impedance of the first antenna, and also within the casing, means for absorbing radiation from the first antenna, these means being separated from substantially all the sides of the casing by a distance substantially equal to $\lambda/4$ where λ is the mean wave length of the radiation from the first antenna.

7. A shield, as described in claim 6, in which the casing has a rectangular cross-section and in which the first antenna is placed asymmetrically with respect to at least two opposite sides of the rectangle.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,847,872	Hand	Mar. 1, 1932
2,293,839	Linder	Aug. 24, 1942
2,296,678	Linder	Sept. 22, 1942
2,412,562	Crawshaw	Dec. 17, 1946