

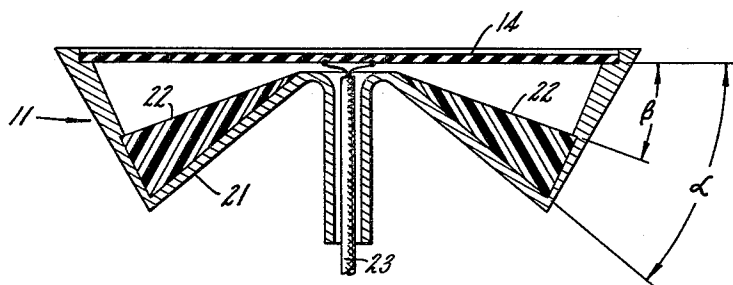
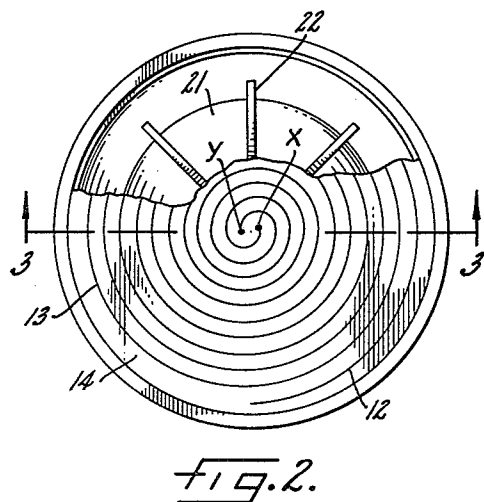
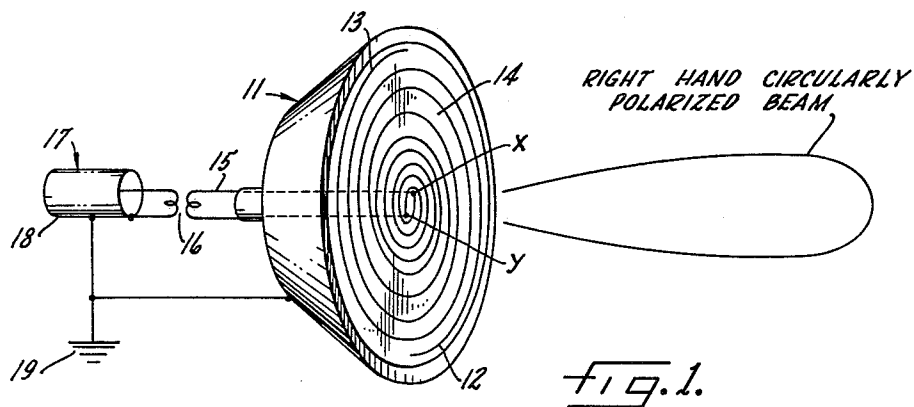
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R. E. COX ETAL

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FREQUENCY INDEPENDENT BACKUP CAVITY FOR SPIRAL ANTENNAS

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## FREQUENCY INDEPENDENT BACKUP CAVITY FOR SPIRAL ANTENNAS

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5 Claims. (Cl. 343—895)

The present invention relates to improvements in spiral antenna apparatus, and more particularly to reflecting structure for spiral antennas that will limit a radiated beam to one direction.

In many applications of radio frequency operative devices it is desirable to have an antenna system of simple structure which is capable of providing scanning of a beam of radiated energy over a sector of space. Conventionally such scanning may be accomplished, mechanically, electromechanically, or electronically.

Spiral antennas with no additional reflecting structure are broadband, circularly polarized, and radiate two broad beams, one in each direction perpendicular to the plane of the spiral. When it is desired to limit the radiated beam to one direction, a backup cavity may be provided behind one side of the spiral thereby forcing radiation from the uncovered face. However, the use of a backup cavity causes a radial wave to be generated in the cavity region which travels outwardly and re-excites the outer turns of the spiral incorrectly. This results in a rough irregular forward reradiating pattern which changes in character with frequency.

It is an object of the present invention to eliminate, or at least greatly reduce, the undesired effect caused by the radial wave which is generated in the cavity region. A plurality of absorbing card attenuators are placed radially and symmetrically in the backup cavity. The attenuators are defined by angles and extend from the bottom of the cavity to an angle  $\beta$  below the spiral. The angle  $\beta$  is critical for when the tops of the attenuators are too close to the spiral, the attenuators adversely absorb energy from the intended wave on the spiral arms. When the tops of the attenuators are too far from the spiral, the attenuators do not absorb the unwanted radial wave.

It is therefore a general object of the present invention to provide new and improved spiral antenna apparatus.

Another object of the present invention is to provide an antenna apparatus having electronic scanning means and improved backup cavity apparatus.

Still another object of the present invention is to provide an improved backup cavity apparatus having means for absorbing unwanted radial waves.

Other objects and advantages of the present 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 drawing wherein:

FIGURE 1 is a view of a two arm spiral antenna of the prior art;

FIGURE 2 is a top view, partly broken away, showing a preferred embodiment of the present invention; and

FIGURE 3 is a sectional view taken on line 3—3 of FIGURE 2.

Referring now to the drawing for a more detailed understanding of the invention, in which like reference numerals are used to designate like parts throughout the several views, there is shown in FIGURE 1 an antenna reflector 11 having disposed therein or thereon a pair of spiral arms 12 and 13 which are mounted on a suitable backing plate 14.

The spiral arms 12 and 13 have feed points X and Y,

respectively, and these are connected by feed means 15 and balun 16 to an R-F transmission line 17. Preferably, the outer conductor 18 of the transmission line 17 is connected to ground 19. The spirals may be wound arms of a dipole antenna, and the spirals are usually in one of two forms, a logarithmic spiral, or an Archimedes spiral. The spirals themselves radiate in two principal beams, one forward and one backward. By use of reflector 11, the beam is limited to one principal direction, as indicated by the beam illustrated in FIGURE 1 of the drawing. The beam is right hand circularly polarized or left hand circularly polarized depending upon whether the spirals are wound in clockwise or counterclockwise direction. The balun, shown at 16, may be omitted for simplicity if desired.

Referring now to FIGURES 2 and 3 of the drawing, it can be seen that the bottom portion 21 of the antenna reflector 11 is disposed at an angle  $\alpha$  with respect to the position of backing plate 14. The optimum value for the angle  $\alpha$  has been found to be about forty degrees. A plurality of absorbing card attenuators 22, which have a triangular configuration, are positioned radially and symmetrically on the bottom portion 21 of the antenna reflector 11. The absorbing card attenuators 22, which by way of example may be comprised of a resistive material applied to a phenolic backing, extend from the bottom portion 21 to a line that is  $\beta$  degrees below the backing plate 14. If the absorbing card attenuators are too close to backing plate 14, the attenuators will adversely absorb energy from the intended wave on the spiral arms. When the attenuators are displaced too far from backing plate 14, the attenuators do not absorb the unwanted radial wave. It has been found that an optimum value for the angle  $\beta$  is about twenty degrees. By way of example, eight absorbing card attenuators are shown equally spaced in the antenna reflector 11, however, a greater or lesser number of equally spaced attenuators could be used.

In operation, the spiral arms are fed through a shielded cable 23 which is provided with a pair of lines that are connected one each to the spiral feed points "X" and "Y." The backup cavity behind the spiral forces radiation from the uncovered face thereby limiting the radiated beam to one direction which is perpendicular to the plane of the spiral. Any radial waves which are generated in the cavity region, and which if permitted to travel outwardly would re-excite the outer turns of the spiral incorrectly, are absorbed by the absorbing card attenuators.

It can thus be seen a reflector is provided that is defined in terms of an angle and also the attenuators are defined by angles only. As the original spiral is defined only by angles, thereby having no frequency sensitive lengths, a reflector that can be defined from angles will result in a backup cavity that is independent of frequency.

Obviously 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 claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A unidirectional antenna system comprising:

- a spiral antenna,
- a source of energy to be transmitted,
- feed means connecting said antenna to said source of energy,
- a reflector disposed on one side of and in proximity to said spiral, and
- a plurality of absorbing card attenuators positioned radially and symmetrically on said reflector for absorbing radial waves reflected from said reflector.

2. A unidirectional antenna system as set forth in claim

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1 wherein said absorbing card attenuators are triangular configuration.

3. A unidirectional antenna system comprising:  
 an antenna element comprised of a flat backing plate  
 of insulating material having first and second spiral  
 conductors thereon,  
 a source of energy to be transmitted,  
 feed means connecting said antenna element to said  
 source of energy,  
 a reflector positioned on one side of said antenna ele- 10  
 ment and having a bottom portion disposed at an  
 angle to said flat backing plate, and  
 a plurality of absorbing card attenuators positioned  
 radially and symmetrically on said bottom portion  
 of said reflector.

4. A unidirectional antenna system as set forth in claim

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3 wherein said bottom portion of said reflector is disposed  
 at an angle of approximately forty degrees to said flat  
 backing plate.

5. A unidirectional antenna system as set forth in claim  
 4 wherein said absorbing card attenuators are triangular  
 in configuration with one triangular side being disposed  
 at an angle of approximately twenty degrees to said  
 backing plate.

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15 HERMAN KARL SAALBACH, *Primary Examiner*.