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A Review and Survey on Reflector Antennas and Feeding Techniques

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Abstract

The study of wireless communication field is to its peak in recent days. The study of antennas in particular is very important and to have knowledge in the field one must the use and operation of various types of antennas. Although there are many types of antenna, antennas that are having light weight, long distance coverage, inexpensive and are capable of maintaining high performance over a wide range of frequencies are preferred. One of the antennas that fulfill the above mentioned criteria is the Reflector antenna [1]. Hence this paper reviews Reflector antennas with their feeding techniques that finds its application in ISM and WLAN.

Keywords: *reflector antenna; cassegrain; gregorian; axial; offset; feeds.*

INTRODUCTION

Reflector antennas works on the principle of reflection. The electromagnetic waves hitting the reflective surface from a source are reflected and hence the name reflector antenna. The antenna reflectors can be a standalone or can be combined as part of an antenna assembly. At smaller wavelengths antennas having a larger collecting areas are feasible, the collecting area can be larger than $\lambda^2/(4\pi)$ which is the collecting area of an isotropic antenna[2]. Reflector antennas are mainly used in satellite communications, since the directivity and gain of the reflector antenna is high and due its large reflectors the EM waves can be focused into a single beam. The reflector antennas are of different types varying in their reflecting surface shapes and their feeding techniques and in their feed antenna. This paper reviews various reflector antennas and their feeding methods.

REFLECTOR ANTENNAS

Corner Reflector

A reflector antenna has its reflecting surfaces mutually perpendicular forming a corner at their intersection and the feed antenna suspended in front of the antenna. The corner reflectors can have three reflecting surfaces or two reflecting surfaces mutually perpendicular to each other.[3]

Fig 1: *Corner reflector for radar testing.*

Fig 2: *Corner reflector with two reflecting surfaces.*

The incoming signals in corner reflector antennas are reflected three times or two times depending on the number of reflectors used, resulting in reversal of direction. The incoming signals are reflected back to the same direction from which they came but in parallel to the incoming signals. A corner reflector consists of two/three conducting metal sheets or surfaces perpendicular to each other and a corner is formed at their connecting edges.o one another at the edges, forming a "corner".

Flat Reflector

Standalone reflector are also known as flat reflector. They redirect EM energy in the same direction that it came from. Flat reflector antenna reflects the signal like a mirror and is often used as a passive repeater. A reflector antenna with flat dielectric reflector covered with a metallic structure forms a Fresnel zone plate.[5] The lens like properties of Fresnel zone plates, where especially the mm-wave characteristics of such devices are exposed. Figure 2 shows a flat reflector antenna with feed point.

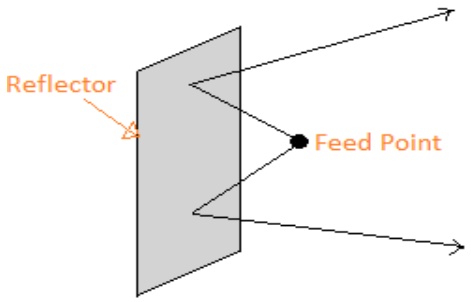

Fig 3: *Flat reflector.*

Parabolic Reflector

The reflecting surface of the parabolic reflector antenna is in the shape of a parabola and it can be thought as a dish. The concave curve side of the parabola is used to reflect the waves. The parabolic reflector can also take a shape as that of a hyperbola(only a small cross sectional part of hyperbola). The signals are directed in a narrow beam thus resulting in high directivity. Parabolic antennas can produce highest gain and narrowest beam widths, of various type of antennas. The signals travel in the form of a beam after being reflected from the reflector surface. The narrower the beam width higher is the gain. Parabolic antenna have narrow beam.[6][7] The reflecting surface of the parabola must be greater than the wavelength for an ideal reflecting surface and to reflect most of the waves. Out of all the reflector antennas this is used most widely for different applications and various frequencies.

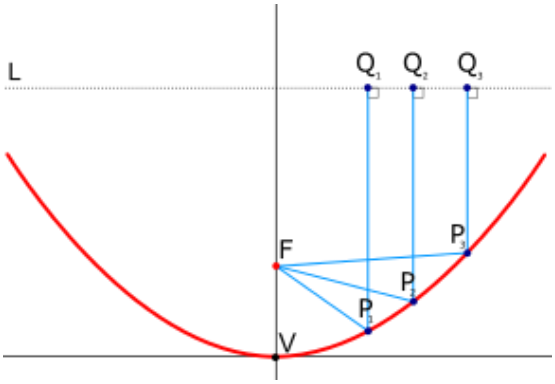

Fig 4: *Focal point of a parabolic reflector*

Gain plays an important role in determining the efficiency of an antenna, and in parabolic reflector antenna due to its parabolic reflector high levels of gain can be achieved. Gain of a parabolic reflector antenna are usually high(>30dB) and can be easily achieved when compared to other forms of antenna. Antennas with parabolic reflector would be mechanically large and unwieldy. Parabolic antenna gain is affected by number of factors; some of them are as follows:

Diameter of reflecting surface: as the size of ground plane increase so does the gain and in parabolic reflector antenna the reflector acts as the ground plane hence increasing the gain with its size (it also depends on the feeding methods).
Operational wavelength: depending on the wavelength the dimensions of the feed antenna changes and which in turn affects the reflector size. So the same reflector cannot be used for two different frequencies, which would result in low return loss and higher VSWR.

REFLECTOR ANTENNA FEEDS

Axial-feed(front feed)

Front nourish of radio wire implies putting the encourage recieving wire before the curved some portion of the parabola to its point of convergence. The sustain reception apparatus is a component through which the waves are wiped out towards the reflector surface. The vitality from the emanating component is masterminded with the goal that it lights up the reflecting surface. The vitality goes in a tight shaft once it is reflected by an allegorical reflector, bringing about extensive levels of pick up. Pick up is a basic component and it is not generally reliant on the reflector utilized subsequently the sustain receiving wire must be chosen shrewdly to accomplish the same. At lower frequencies an emanating component can be utilized and at higher frequencies a waveguide or a horn must be utilized. Circular waveguides or circular horns are extensively used as feed antenna for parabolic dish and they are suspended in front of the dish at the focal point of the parabolic dish. Placing the feed antenna in front of the parabolic reflector at its focal point is known as front feed or axial feed. The aperture efficiency is limited to only about 55% to 60% as the feed and its support block some of the beam, and this is a major disadvantage.

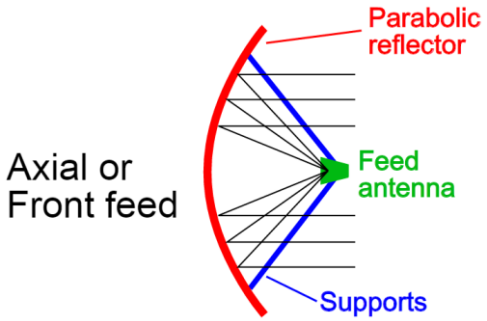

Fig 5: *Front or axial feed system*

Offset feed

As the name itself says this type of explanatory reflector recieving wires nourish is balanced from the focal point of the genuine allegorical reception apparatus dish utilized. The reflector utilized as a part of this sort is not symmetrical and subsequently it gives us an entry to migrate the sustain radio wire to the other side of the reflector where the point of convergence is been moved. The benefit of utilizing this strategy to the explanatory reflector radio wire bolster framework is to move the sustain structure out of the shaft way.

In this way the beam is not blocked by the feed antenna. Offset feed type is mostly used in satellite television antennas for homes. If offset feed is not used then some part of the reflected signal is blocked by the feed antenna itself which results in reduced efficiency and signal level. The offset feed system can also be used in various reflector design systems such as Cassegrain feed system and Gregorian feed system since the small reflector would also suffer from the same issues.

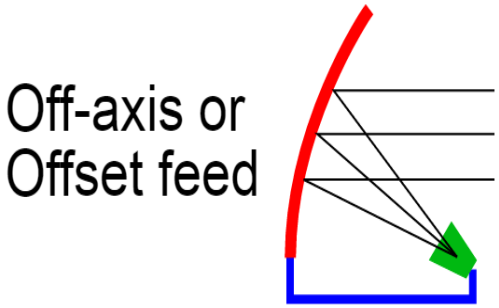

Fig 6: *Offset or Off-axis feed system*

Cassegrain feed

The idea of cassegrain telescope has been utilized as a part of cassegrain sustain sort of reception apparatus nourishing strategies. The cassegrain telescope was produced by French Priest Laurent Cassegrain around 1672. The Cassegrain encourage framework, requires a moment reflecting surface. Despite the fact that it requires another reflecting surface it has favorable position that the general reception apparatus length i.e. the length amongst primary and secondary reflectors is shorter than the length between allegorical reflector and emanating component. The nearness of reflection in the centering signal outcomes in the shortening of physical length. [8]

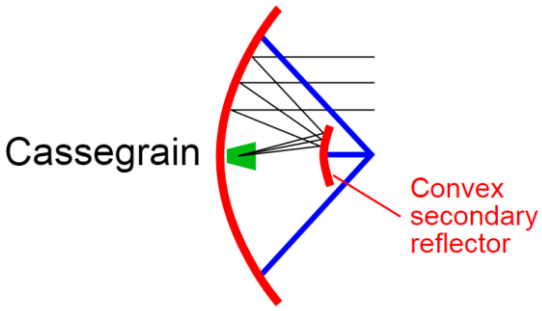

Fig 7: *Cassegrain feed system*

Gregorian feed

The Cassegrain and Gregorian feed techniques work on similar concept.

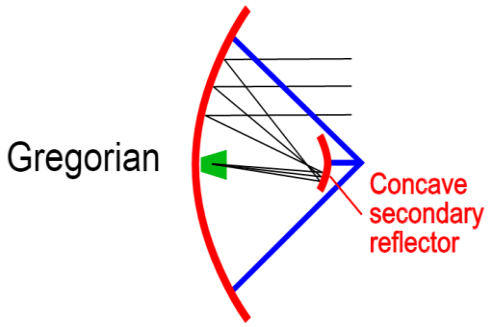

Fig 8: *Gregorian feed system*

The Cassegrain feed has its secondary reflector as a convex reflector and the Gregorian feed has its secondary reflector as a concave reflector. High efficiency levels could be achieved using this feed. Gregorian feed and Cassegrain feed can also be combined with offset feed techniques placing the secondary reflector away from the dish.

CONCLUSION

Reflector antennas are preferred because of its gain, directivity, and possibility of size reduction. Various techniques have been used to achieve the same. There are various feed antennas that can be combined with feeding types to get better results. This paper shows the review and survey of selection of reflector antenna and its feed type. Out of all reflector antenna and their feed shown above in this paper Parabolic reflector antenna with Cassegrain feed will provide a maximum gain, directivity and compact in size.

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