

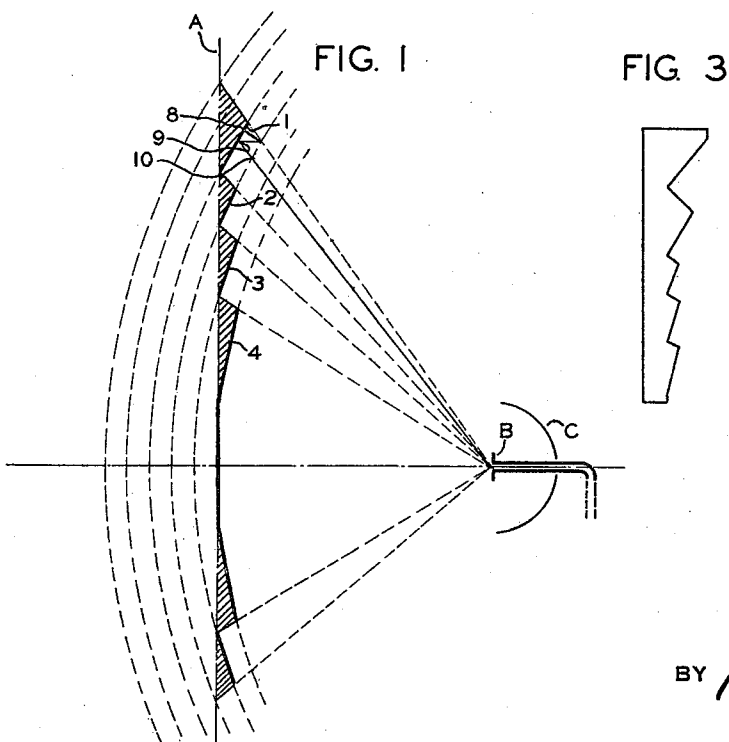
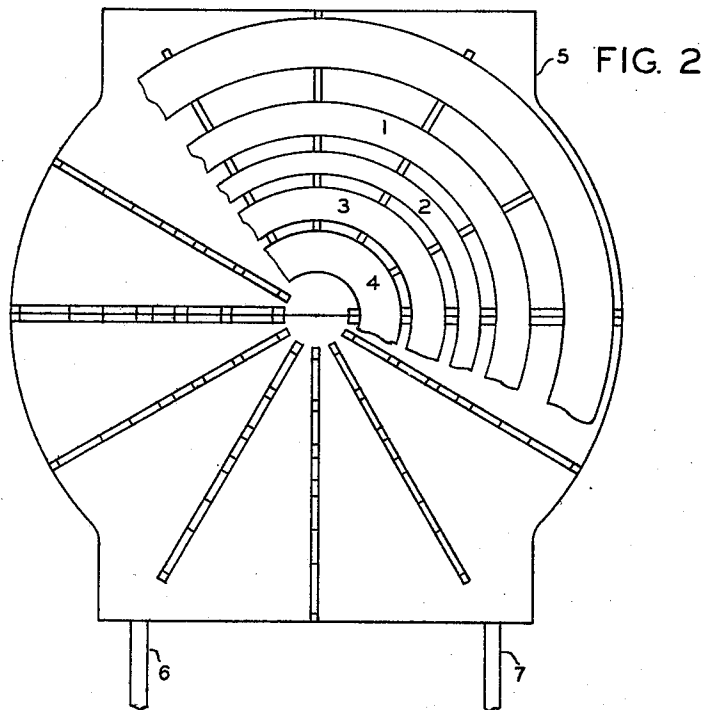
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ECHELON GRATING FOR REFLECTING ULTRA SHORT WAVES

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ECHELON GRATING FOR REFLECTING ULTRA SHORT WAVES

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This invention relates generally to ultra-short wave systems and more particularly to reflecting systems for efficiently utilizing the radiations from a high frequency source for purposes of transmission and reception.

The object of the present invention is to retain the advantages of diffracting systems of the zone plate type, which permit the ultra-short waves to be diffracted so as to be, to a certain degree, in phase at a distant point, and, at the same time, to provide a diffracting system that will concentrate a greater portion of the diffracted energy in a beam proceeding in the desired direction.

Heretofore, directional systems for ultra-short waves have been constructed by utilizing the well known optical principles applicable to zone plates. These systems have been found, however, to be somewhat inefficient because of the wide discrepancy between the direction of maximum intensity of the diffracted rays and the desired direction of transmission. To be explicit, the direction of maximum intensity of the diffracted rays is inclined, while the desired direction of transmission of these rays is parallel to the axis of the system. This discrepancy is the more accentuated as the incidence of the rays upon the zone plate becomes more oblique.

These disadvantageous effects are eliminated by the use of echelon reflectors, which not only cause the diffracted rays to arrive in phase at the receiving point, but also diffract the rays in a direction parallel to the axis of the system, and thus effect a concentration of the rays in the desired direction of transmission. This last-mentioned result is, in itself, a noteworthy improvement over zone plate reflectors.

These echelon reflectors comprise circular rings, parabolic in cross-section, each of the rings having the same focus and all the rings being successively placed at focal differences differing by one-half a wave-length or by multiples of one-half a wave-length. Because of the difference in the focal distances of the several rings, the waves reflected from them are reflected in phase; while, in accordance with geometrical optics, the waves are

also diffracted in a direction parallel to the common axis of the rings with a resulting concentration of the diffracted energy in a beam proceeding in the desired direction.

A preferred embodiment of the invention is disclosed in the following detailed description and in the accompanying drawing, in which

Fig. 1 illustrates a side elevation, and Fig. 2 illustrates a front elevation of the echelon reflector; while

Fig. 3 illustrates a support used in fastening the parabolic rings in place.

Referring now to Fig. 1, there is shown at A an echelon parabolic reflector, and at B an element which may be either a transmitting or receiving antenna, although the description will be limited to the case where B is a transmitting antenna. The element B is placed at the focus of the echelon reflector A and at the center of a spherical mirror C. A suitable source or suitable receiver of high frequency oscillations, depending upon whether B is a transmitting or receiving antenna, is connected to the element B through the spherical mirror C. The echelon reflector A is constructed of a number of rings, such as 1, 2, 3 and 4, which are parabolic in cross-section, as is shown in Fig. 1, and circular in aperture, as is shown in Fig. 2.

Each of these rings may be provided with any kind of metallic surface that is capable of reflecting the ultra-short waves. This surface, as is well known in the art, may be very thin and may be composed of a number of different metals. One method of construction is to attach the parabolic metal rings to supports, one of which is illustrated in Fig. 3, and to fasten these supports radially on a properly insulated vertical frame, such as 5, shown in Fig. 2. In this way the parabolic rings are firmly held in place.

The parabolic rings 1, 2, 3 and 4, as previously mentioned, have focal distances that differ by half a wave-length. For example, ring 1 has a focal distance one-half a wave-length greater than the focal distance of ring 2, and the same relation holds true for rings 2 and 3, and rings 3 and 4. The length of each parabolic portion is limited by a con-

sideration that will now be explained. In order that the waves from the high frequency surface B shall be reflected in phase from the parabolic rings comprising the echelon reflector A, it is essential that the distances traversed by the waves, when reflected from the several rings, differ by integral wave-lengths or by multiples of wave-lengths. Considering for the moment the path of waves reflected from parabolic rings 1 and 2, it is evident that waves reflected from ring 1 traverse a distance 10-9 plus 9-8 greater than the distance traversed by the waves reflected from the parabolic ring 2. But the distance 10-9 is equal to one-half a wave-length since rings 2 and 3 have focal distances differing by that amount. In order, therefore, that the waves reflected from rings 1 may be in phase with the waves reflected from ring 2, the distance 9-8 must be equal to half a wave-length. This is an essential condition of the structure. When this condition has been fulfilled, however, it is evident that the waves reflected from the several parabolic rings comprising the echelon reflector A are in phase.

It is to be understood that the echelon parabolic reflector may have any number of parabolic rings. However, to avoid undue cumbersomeness of the reflector, the number of rings is ordinarily limited to four or five. Furthermore, it is unnecessary that the parabolic rings 1, 2, 3, etc. have a cross-section in the exact form of a parabolic arc; for it is sufficiently exact to make the rings conical in cross-section. The center ring 4, although having a larger surface than the other rings, may also be made conical in cross-section. This is possible because the spherical mirror C limits the effectiveness of the ring 4 by stopping the rays transmitted from the center of the ring. When the rings are conical in cross-section the echelon reflector is more easily constructed than it is when the rings are parabolic in cross-section. This is evident from the fact that the cone is a developable surface and it is, therefore, unnecessary, as in the case of a parabolic ring, to have a form upon which the metal rings are mounted. In this case the different rings are approximately in the same plane and can be readily mounted on an insulated support by means of wooden triangles.

The source of high frequency oscillations B may be a doublet or any of the other suitable sources well known in the art. The spherical mirror C is placed about the high frequency source B with its aperture facing the echelon reflector A for the purpose of reflecting back upon the echelon zone plate the waves from the source B whose initial direction was away from the zone plate. As the use of a mirror for the purpose mentioned is well known in the art, no further description is thought necessary here.

It is evident that radiations from the

source of high frequency oscillations B will be projected upon the echelon reflector A with the aid of the spherical mirror C and that these radiations will be reflected in phase from rings 1 to 4 and will also be reflected along lines 13 and 14 in a direction parallel to the axis 6 of the echelon reflector A.

In Fig. 2 is shown in front elevation a detailed view of echelon reflector A. This reflector is provided with five instead of four rings. It has been previously mentioned, however, that the number of rings used may vary. Each of the rings is shown mounted on a support such as is shown in detail in Fig. 3 and these supports are, in turn, fastened radially to an insulated frame 5 which is mounted on standards 6 and 7.

Although the system has been described particularly with reference to a transmitting system, it is, of course, to be understood that the echelon reflector may also be used as a receiver.

The above description has been given to exemplify a preferred embodiment of the invention and it is to be understood that the invention is not to be unnecessarily limited by the particular embodiment herein described, but is to be as broad as the appended claims.

What is claimed is:

1. In ultra-short wave systems, the combination of a source of suitable oscillations, and a reflecting device comprising a plurality of concentric rings, cross-sections of said rings being parts of confocal parabolas, the focal distances of the parabolas differing by one-half a wave-length or by a multiple of half a wave-length.

2. As a new article of manufacture, a reflecting device comprising a plurality of concentric rings, said rings being parabolic in cross-section, being placed at focal distances differing by one-half a wave-length or multiples of half a wave-length, and each having a surface adapted to reflect ultra-short waves.

3. In an ultra-short wave system, the combination of a source of suitable oscillations, a reflecting device comprising a plurality of concentric rings, the surfaces of said rings being substantially paraboloidal and being suitably spaced from one another and from said source, whereby the oscillations from said source are reflected by said device substantially in phase and in a direction parallel to the common axis of said rings.

4. In an ultra-short wave system, the combination of a reflecting device comprising a plurality of concentric rings, a source of suitable oscillations located at the common focus of said rings, the surfaces of said rings being substantially paraboloidal, whereby the oscillations from said source are reflected by said devices substantially in phase.

5. As a new article of manufacture, an echelon reflecting device for ultra-short waves, comprising a plurality of spaced concentric rings, the surface of each ring being substantially paraboloidal.

6. As a new article of manufacture, an echelon reflecting device for ultra-short waves comprising a plurality of spaced concentric rings, the surface of each ring being substantially conical.

In witness whereof, I hereunto subscribe my name this 6th day of July, 1931.

RENÉ H. DARBORD.

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