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CASSEGRAINIAN ANTENNA SUBREFLECTOR FLANGE FOR SUPPRESSING GROUND NOISE

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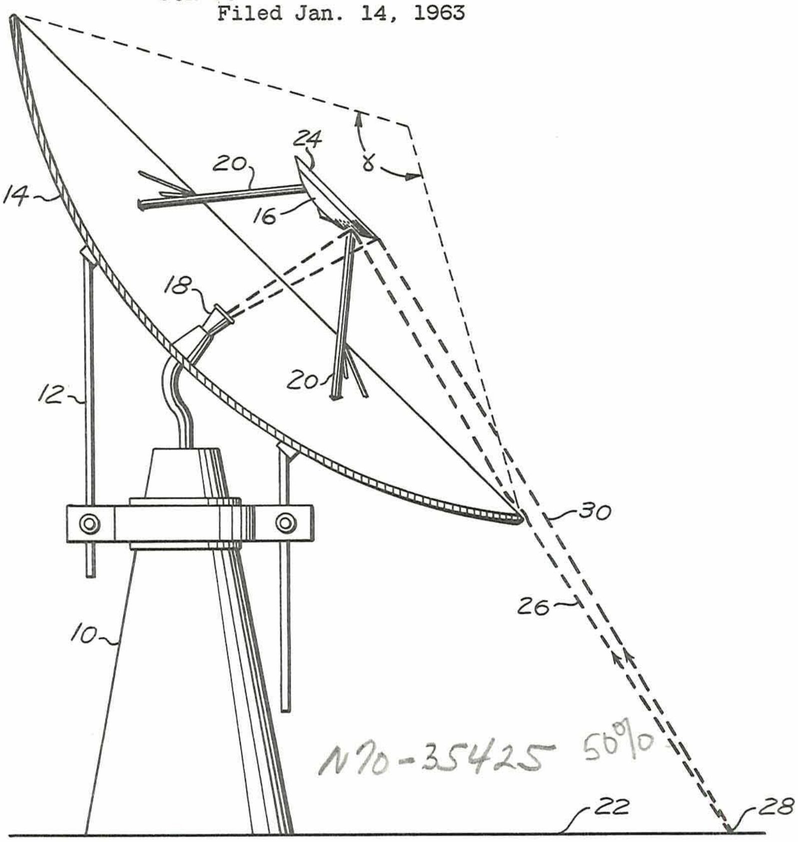

Fig. 1

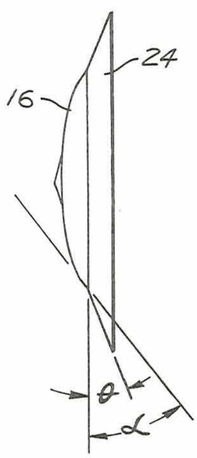

Fig. 2

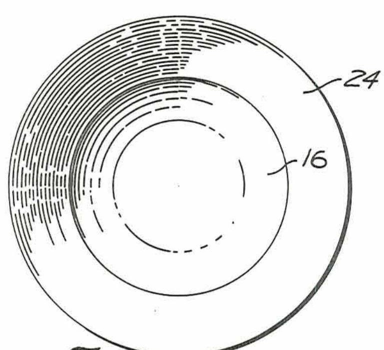

Fig. 3

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CASSEGRAINIAN ANTENNA SUBREFLECTOR FLANGE FOR SUPPRESSING GROUND NOISE

James E. Webb, administrator of the National Aeronautics and Space Administration, with respect to an invention of Philip D. Potter

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5 Claims. (Cl. 343—781)

This invention relates to antennas and more particularly to an improvement to antennas of the Cassegrainian type.

A Cassegrainian antenna usually comprises a parabolic main reflector dish, a smaller subreflector facing the parabolic reflector, and a horn feed facing the subreflector. When the antenna is used for receiving wavelengths which are of significant size as compared to the size of the antenna, some energy radiated by the surrounding ground strikes the subreflector and enters the horn feed, and this adds noise to the received signal. Similarly, when the antenna is used to transmit energy some of the energy radiated by the horn feed bypasses the subreflector or the main reflector dish, and is lost.

An object of this invention is the provision of structure for substantially minimizing noise in signals received by this antenna.

Another object of this invention is the provision of an improved Cassegrainian antenna which is more efficient than presently known antennas of this type.

Yet another object of the present invention is the provision of a novel and improved Cassegrainian antenna structure.

These and other objects of the invention may be achieved by providing a flange around the edge portion of the subreflector of a Cassegrainian antenna. The flange makes a smaller angle with the plane of the subreflector than does the edge of the major hyperbolically shaped portion of the subreflector. The optional flange size depends on the frequency being used. The flange not only reduces the noise level of received signals, but also improves the efficiency of the antenna when it is used for transmitting.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIGURE 1 is a side sectional view of a Cassegrainian antenna showing the improvement in accordance with this invention.

FIGURE 2 is a side view of the subreflector and flange in accordance with this invention.

FIGURE 3 is a front elevation view of the subreflector and flange in accordance with this invention.

A Cassegrainian antenna comprises a rotatable pedestal **10** supporting an adjustable mount **12** which supports the main reflector dish **14**. The main reflector dish **14** receives microwaves from space and directs them toward a subreflector **16** which reflects them to a horn feed **18**, positioned at the center of the main dish **14**. A subreflector is usually supported by members **20**, extending from the edges of the main dish **14**.

The Cassegrainian antenna is used for receiving microwaves, some of which have frequencies for which the wavelengths are not insignificantly small when compared to the sizes of the main dish and the subreflector. Microwaves having these wavelength dimensions which are emitted by the warm surrounding ground area **22**, bend around the edges of the main dish **14**, strike the subreflector **16** and are reflected into the horn feed to appear as noise which is added to the received signal.

In accordance with this invention, a conical reflector flange **24** may be mounted on the edge of the subreflector where it is desired to prove an already built antenna, or may be formed integrally with the subreflector when the antenna is made. FIGURES 2 and 3, respectively side and front elevation views of the subreflector and flange, illustrate the position of the flange with respect to the subreflector. The flange also serves to reflect microwaves from the surrounding warm ground **22**, into the horn feed **18**. However, as represented by the dotted lines in FIGURE 1, the path **26** from a point **28** on the ground to the subreflector **16** and thereafter to the horn feed **18**, is approximately one-half wavelength shorter than a direct path **30** from the same ground point **28** to the flange **24**, and then to the horn feed **18**. When the two waves arrive at the horn feed they are about one hundred and eighty degrees out of phase and cancel each other out, and the amount of noise is accordingly substantially minimized.

When the antenna is used for the purpose of transmitting, some of the energy emitted from the horn feed **18** which is then reflected from the subreflector **16**, bends around the edges of the main dish **14** and is lost, since it is not reflected back by the main dish. The flange **24** also reflects energy past the edge of the main dish **14** but this operates to cancel out the bent rays from the subreflector **16**. This prevents the loss of this energy to the surrounding ground and increases antenna efficiency. Also, some of the energy from the horn feed **18** which passes around the subreflector and would ordinarily be lost, hits the flange **24**, and is reflected toward the main dish to further increase antenna efficiency.

The size of the flange **24**, and its angle with respect to the axis of the subreflector **16**, are adjusted until the noise level is reduced to a small amount, while the efficiency of the antenna is still large. In FIGURE 2, θ is the angle between the flange **4** and the plane of the subreflector, and α is the angle between a target to the subreflector and the plane of the subreflector. It is found in practice that, with a Cassegrainian antenna operating at a given frequency, a flange having an inner to outer radius difference of two wavelengths at an angle θ of about three fourths the size of the angle α will reduce the noise level to a low level while maintaining a high antenna efficiency. Specifically, it is found that a Cassegrainian antenna with a main dish **14** of 8.5 feet in diameter subtending an angle γ of one hundred twenty-two degrees (shown by the dotted lines in FIG. 1), and having a subreflector **16** with a diameter of 0.8 feet, with an edge making an angle α of 24.4 degrees with the plane of the subreflector, and receiving and transmitting at a frequency of 9.6 kmc., that a flange having a rim of 0.2 feet between inner and outer radii and making an angle θ of 18.4 degrees with the plane of the subreflector **16**, will reduce the noise to almost a minimum while increasing the efficiency to near its maximum.

A flange having a shape other than conical may be used to achieve the same or a somewhat better effect, though the conical shape is very simple to manufacture. Any of these shapes will involve a departure from the hyperbolic shape of the typical Cassegrainian subreflector (which is the shape for best results with very small wavelengths compared to antenna size, as with visual light). The main element of the departure, in accordance with this invention, is a rim or flange portion on the subreflector, which makes a smaller angle with the plane of the subreflector than a target to the edge of the major hyperbolically shaped portion of the subreflector. As was previously pointed out, instead of a flange, the subreflector may be enlarged to include a rim portion of the proper shape to make the subreflector and flange comprise a single article.

Accordingly, there has been shown and described herein a novel, and improved Cassegrainian antenna.

I claim:

1. The improvement in a Cassegrainian antenna having a subreflector with a curved reflecting face and defining a plane with the edges of said curved reflecting face, said improvement comprising a reflecting flange extending radially from the curved reflecting face and making an angle with the plane defined by the edges of said curved reflecting face which is smaller than the angle made by the portion of the curved reflecting face near the edge thereof with said plane, the radial length of said reflecting flange being on the order of an integral number of wavelengths of the frequency at which said antenna is used.

2. The improvement in a Cassegrainian antenna of the type having a subreflector with a curved reflecting face and defining a plane with the edges of said face, said improvement comprising a flange extending from the edge of said curved reflecting face, said flange having an inner to outer radius difference on the order of two wavelengths at the frequency with which said antenna is employed, said flange making an angle with the plane defined by the edges of said face which is less than the angle made by the material of said subreflector adjacent to said edges with said plane.

3. A Cassegrainian antenna subreflector comprising a central region having a curved reflecting face, and a peripheral region comprising a flange extending from the edge of said curved reflecting face, said curved reflecting face defining a plane with the edges thereof, the inner and outer radius of said flange differing by substantially two wavelengths of the frequency at which said antenna is employed, said flange making an angle with the plane defined by the edges of said subreflector which is substantially three fourths of the angle made

by the material around the edges of said subreflector with said plane.

4. In a Cassegrainian antenna of the type having a parabolic main reflector dish, a smaller subreflector facing the parabolic reflector and a horn feed facing the subreflector, and wherein signals outside of the target of said main reflector dish are reflected by said subreflector to said horn feed as noise signals, the improvement comprising flange means extending outwardly from the edge of said subreflector for reflecting signals received from the locations outside of the target of said main reflector to said horn feed one hundred and eighty degrees out of phase with said signals reflected to said horn feed by said subreflector received from said locations outside of said main reflector to cause a cancellation of said noise signals.

5. A Cassegrainian antenna comprising a parabolic main reflector dish, a smaller subreflector facing the parabolic reflector and a horn feed facing said subreflector, said subreflector including a flange extending from the edges thereof, said flange extending radially a distance on the order of twice the wavelength at the frequency of operation of said antenna, said flange making an angle with the plane defined by the edges of said subreflector which is on the order of three fourths of the angle made by the material of the subreflector near its edges with the plane defined by the edges of said subreflector.

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