

Sept. 8, 1964

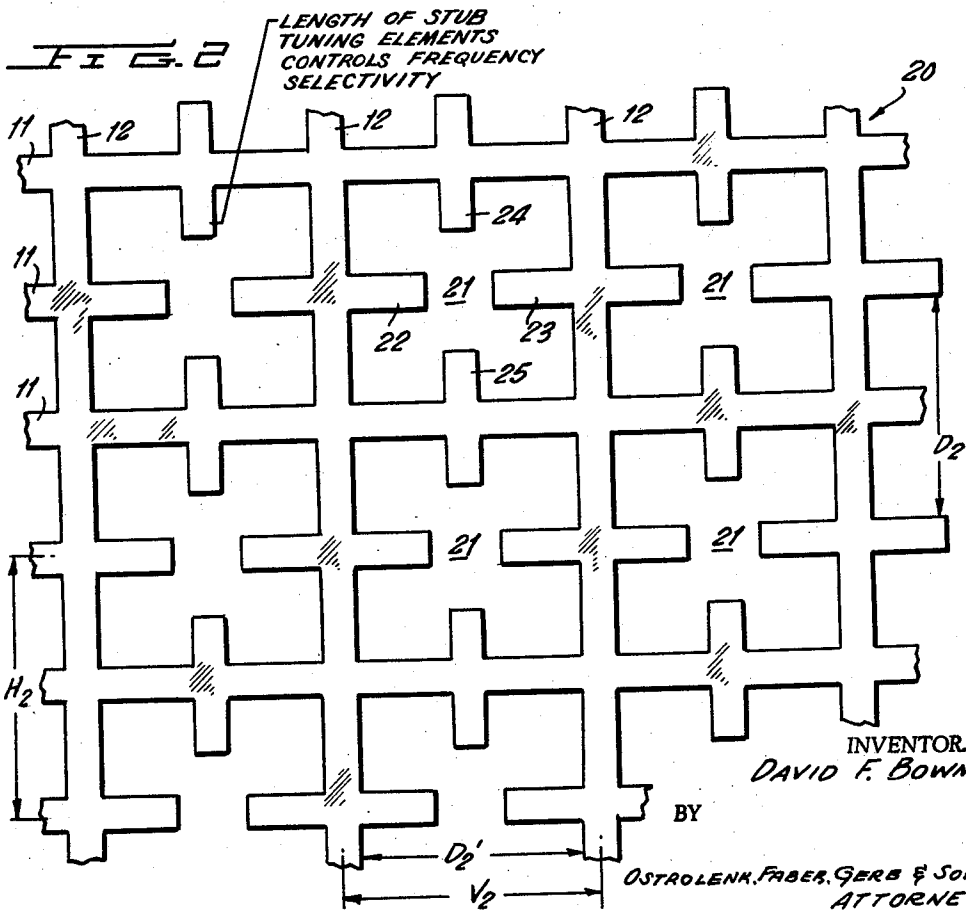
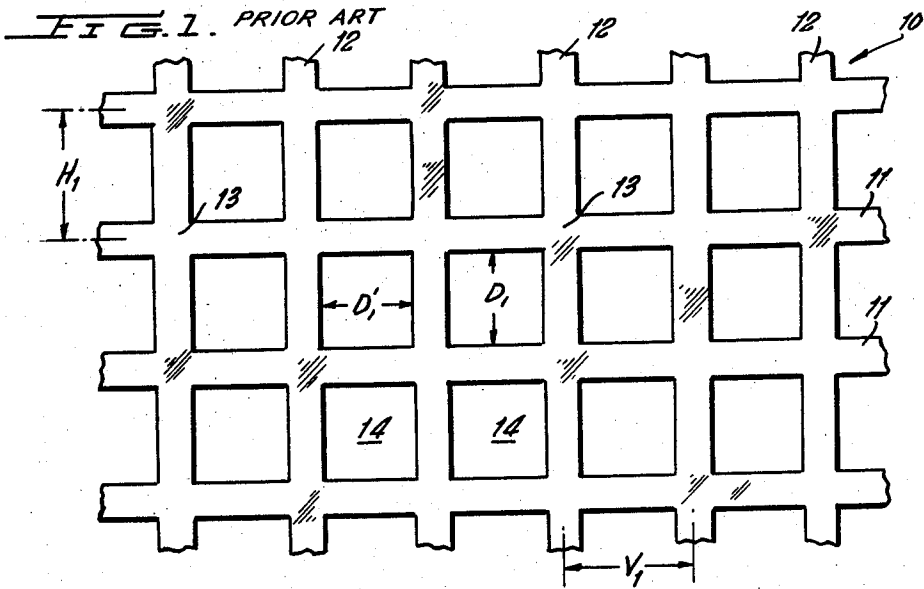
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3,148,370

FREQUENCY SELECTIVE MESH WITH CONTROLLABLE MESH TUNING

Filed May 8, 1962

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

FIG. 3.

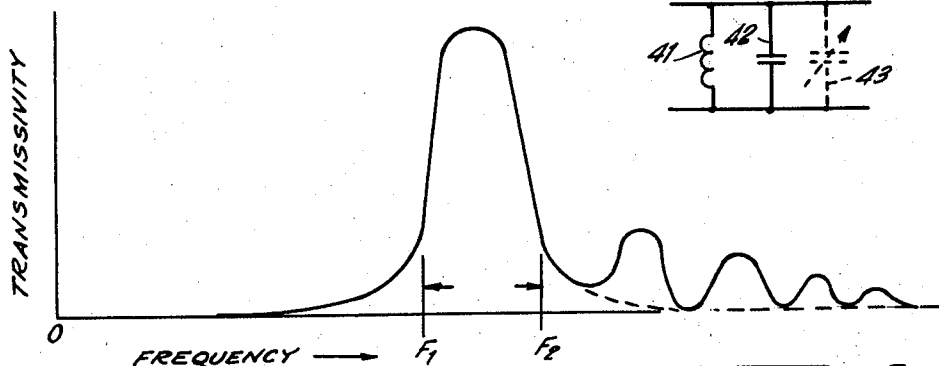


FIG. 4.

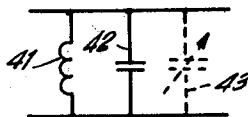


FIG. 5.

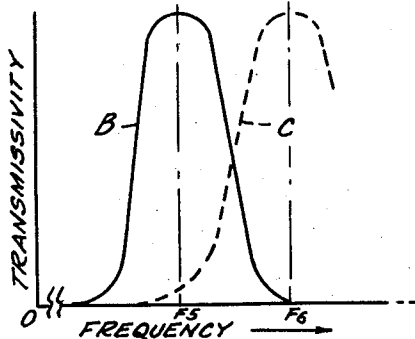


FIG. 6.

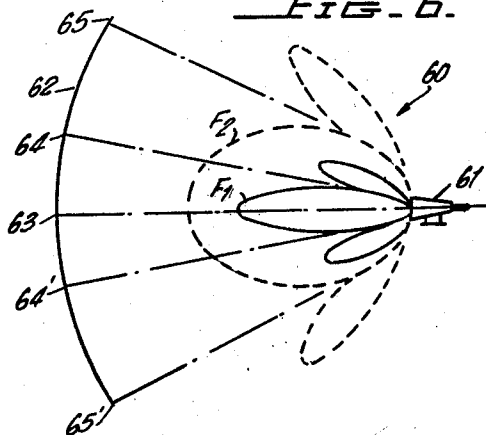


FIG. 7.

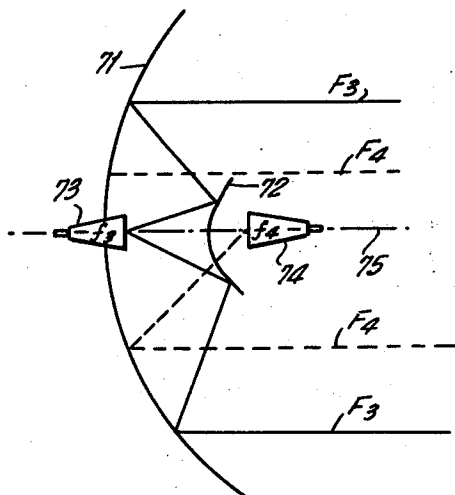
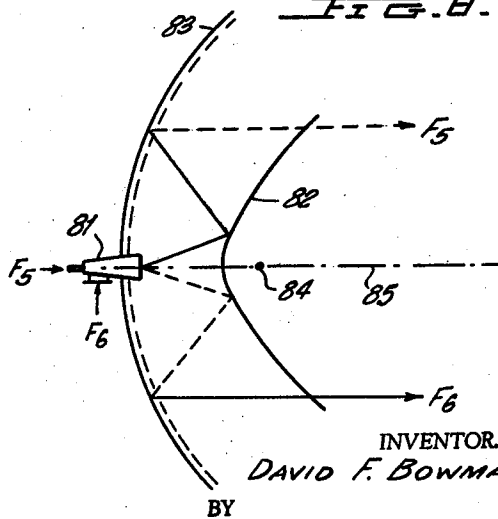


FIG. 8.



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FREQUENCY SELECTIVE MESH WITH CONTROLLABLE MESH TUNING

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20 Claims. (Cl. 343-756)

This invention relates to a frequency selective signal impinging surface and more particularly to a standard mesh surface in which individual portions thereof may be readily modified to vary their reflection and transmission characteristics to impinging radiation.

In many electronic communication or radar systems it is necessary to provide a reflecting surface for electromagnetic energy. A typical example is the reflector type antenna wherein a suitably shaped reflecting surface acts in conjunction with the illuminating feed to improve the gain and field pattern of the radiated energy. A particularly well known antenna of this type is the parabolic antenna, wherein the signal feed is placed at the principal focus of a parabolic reflecting surface. The parabolic surface thereby concentrates the electromagnetic radiation of the antenna in the same way that a search light reflector produces a sharply defined beam of light. The parabolic reflector accomplishes this by converting the spherical wave originating at the focus of the parabola into a plane wave of uniform phase across the mouth or aperture of the parabola. Conversely, such an antenna when used in conjunction with a receiver, concentrates the impinging plane wave into a spherical wave at the focus.

It is well known in the art to construct the parabolic reflecting surface of a sheet metal mesh perforated with apertures in a regular two-dimensional pattern. Another mesh surface presently being used is formed of a crossed array of parallel extending wires. The size and spacing of the mesh apertures determine the frequency characteristics of the surface. As the hole size or spacing is decreased the signal pass band of the surface is raised, thereby raising the upper frequency limit for good reflection.

In some applications it is desirable to provide a variation of the frequency characteristics at different portions of the reflecting surface. Typically this might be desired in a parabolic antenna wherein a uniform reflecting surface should preferably be presented to signals impinging at either the vertex region or the peripheral region. Since the angle of incidence differs at these different portions of the surface, appropriate modifications would have to be made to the surface itself for it to present the same characteristics throughout to a signal emanating at the focus. Attempts have been previously made to so optimize each portion of the reflecting surface by varying the size and spacing of the apertures at different portions of the surface. This method is, however, quite undesirable because of the increased cost involved in effecting a special set-up in the manufacture of the original mesh surface. My invention permits such a variation to be readily obtained from a standard perforated metal sheet or wire mesh without changing the original spacing between the openings. Thus a standard reflecting surface may be selectively modified to optimize the frequency characteristics over each portion of its surface after the original manufacture thereof.

Basically the reflecting surface of this invention is constructed of a modified standard mesh surface wherein alternate intersections of the metallic members of the mesh are removed, as by cutting, permitting a length of stub to remain. The presence of these stubs in the newly formed enlarged mesh openings act as capacitive elements,

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the length of which may be adjusted to change the frequency characteristics of portions of the surface. The capacitive loading effect of the controlled length of stub lowers the resonant frequency of its associated portion of mesh surface, thereby lowering its transmission pass band. Each enlarged mesh opening can have two sets of such capacitive elements which may be independently adjusted to modify the transmission pass band of portions of the surface to horizontally and vertically polarized waves. Thus, by varying the lengths of the capacitive stubs remaining from the previously intersecting surfaces of the standard mesh, the frequency characteristics of individual portions of the surface may be selectively modified after the original manufacture of such surfaces.

In one exemplary application of my invention, a single parabolic reflecting surface is used in conjunction with a dual feed of signals F_1 and F_2 located at its principal focus; these signals may be of the same or different polarities. Should the field patterns of the two signals F_1 and F_2 differ, the required parabolic reflecting surface to properly concentrate their radiation should correspondingly differ. For example, if F_2 has a broader main lobe field pattern than F_1 , the parabolic reflecting surface for F_2 should correspondingly extend sufficiently to include the main lobe of F_2 . However, should this extending portion of the reflecting surface act as a reflector to the F_1 energy it will have the deleterious effect of permitting the side load energy of F_1 to be included in the radiated beam. To avoid this, the extending portion of the parabolic surface should preferably permit the transmission of F_1 . Inasmuch as the angle of incidence of F_1 will progressively increase towards the furthestmost extending peripheral region of the parabolic reflecting surface, the individual portions of this surface must be selectively modified to maintain the centering of the transmission pass band about F_2 . This may be readily accomplished with my invention by gradually extending the length of the capacitive stubs in this region to provide increased capacitive loading as the surface progresses towards the furthestmost peripheral region.

Should the above parabolic antenna system be constructed in accordance with the previously available reflection surfaces, a specially manufactured surface would typically be used wherein the inter-mesh spacings are gradually varied to maintain complete transmission with varying angle of incidence. Alternatively, the transmission pass band would be centered about the median angle of incidence, with transmission being incomplete as the angle of incidence varies. Thus this invention permits an improved practical construction of a dual signal parabolic antenna system wherein the reflecting surface may be individually matched to the field pattern of each of the signals. In a typical application the extending portion of the mesh may be constructed to reflect L band signals (in the vicinity of 1200 megacycles) and transmit X band signals (in the vicinity of 9400 megacycles).

In another application of my invention the sub-dish of a double reflective antenna, such as a Cassegrain or Schwarzschild system, is constructed in accordance with my invention to provide a reflective surface to one of the antenna signals and a transmission surface to another of the antenna signals. In an illustrative Cassegrain embodiment the two signals are introduced from separate feeds. One feed is at the common focus of both dishes; the other feed is at the other focus of the hyperbolic sub-dish. In such a Cassegrain antenna system both signals may be of the same polarity with the sub-dish surface being selectively adjusted in accordance with the teachings of my invention to permit complete transmission to only the signal emanating from the common focus.

In a preferred doubly reflective embodiment (illustratively shown in a Cassegrain system), illuminating signals

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may be fed from a dual polarized feed at the hyperbolic sub-dish focus, with the main parabolic dish producing a twisting of polarization of the incident signal. The hyperbolic sub-dish of this Cassegrain embodiment would be selectively adjusted to provide a different pass band for the two modes of polarization employed.

In both Cassegrain embodiments the peripheral region characteristics of the hyperbolic sub-dish would preferably be modified with respect to its vertex region to provide the requisite complete transmission of energy at different angles of incidence.

It is accordingly a primary object of this invention to provide a signal impinging surface which may be selectively adjusted to modify the frequency transmission and reflection characteristics of individual portions thereof.

Another object of this invention is to provide a frequency selective signal reflecting surface constructed of a standard mesh surface modified to contain controllable length capacitive stubs within the mesh openings.

A further object of this invention is to provide a signal reflection surface wherein the frequency transmission characteristics of various portions of a standard mesh surface may be selectively modified after its original manufacture.

An additional object of this invention is to provide a signal impinging surface constructed of a standard mesh surface modified to provide adjustable capacitive stubs for selectively varying the frequency characteristics of individual portions of the surface.

Still another object of this invention is to provide a signal impinging surface constructed of a standard mesh surface adjusted to provide adjustable capacitive stubs for independently varying the frequency transmission characteristics of individual portions of the surface to signals of different polarities.

Still a further object of this invention is to provide a signal impinging surface which may be selectively modified to present the same transmission characteristics to a signal striking different portions of the surface at correspondingly different angles of incidence.

Yet a further object of this invention is to provide a parabolic reflecting surface which uniformly transmits a desired signal over portions of the surface having different angles of incidence with respect to the signal.

A still further object of this invention is to provide a parabolic reflecting surface which uniformly transmits a desired signal over portions of its surface and reflects the same signal over other portions of its surface.

Another object of this invention is to provide a parabolic reflecting surface which may be selectively modified to uniformly transmit a signal striking different portions of the surface at different angles of incidence, and uniformly reflect another signal similarly striking the surface.

These as well as other objects of my invention will readily become apparent after reading the following descriptions of the accompanying drawings in which:

FIGURE 1 is a plan view of a portion of a standard mesh reflecting surface of the type presently being used.

FIGURE 2 is a plan view of the reflecting surface of FIGURE 1 modified in accordance with my invention.

FIGURE 3 is a typical frequency characteristic of the standard mesh surface of FIGURE 1.

FIGURE 4 is a schematic representation of the equivalent electrical circuit, within the preferable usable band width of principal resonance, of the standard mesh surfaces of FIGURES 1 and 2.

FIGURE 5 is a typical frequency characteristic of the modified selected mesh surface of FIGURE 2 adjusted to have a different transmission pass band for horizontally and vertically polarized signals.

FIGURE 6 is a simplified illustration of a dual signal parabolic antenna constructed in accordance with my invention, with the field pattern of both signals being shown.

FIGURE 7 is a simplified illustration of a Cassegrain

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antenna system utilizing a hyperbolic sub-dish constructed in accordance with my invention.

FIGURE 8 is a simplified illustration of another Cassegrain antenna system utilizing a hyperbolic sub-dish constructed in accordance with my invention.

Referring initially to FIGURE 1, the standard mesh surface 10 contains a plurality of narrow conductive surfaces 11 respectively separated and shown extending in a horizontal direction. A similar plurality of narrow conductive surfaces 12 extend in a vertical direction. These surfaces respectively intersect at points 13 to serve as boundaries for square openings 14 of dimensions D_1 . Mesh surface 10 may be formed of a single metallic member constructed of steel, copper, or any other similar material having the requisite conductive and structural qualities for a particular application. Such a sheet is then perforated to obtain openings 14 which are preferably, though not necessarily, square. Alternatively mesh 10 may be constructed of a crossed array of individual wires 11 and 12 or similar conductive members to form a mesh. The mesh sheet is bent into the desired form, which may typically be a parabolical of revolution.

As it well known in the micro-wave antenna art, mesh surface 10 will act as a low Q circuit to impinging electromagnetic energy. The spacing H_1 between the horizontally extending members 11 determines the properties of that portion of the reflecting surface to the transmission of horizontally polarized waves. This spacing will not effect the transmission of vertically polarized waves. Likewise the spacing V_1 between the vertically extending members 12 determines the properties of that portion of reflecting surface 10 to the transmission of vertically polarized waves. Similarly, spacing V_1 will not effect the transmission of horizontally polarized waves.

Mesh surface 10 has a frequency characteristic to either vertically or horizontally polarized waves as indicated in FIGURE 3. The main resonance encompasses a frequency band existing between f_1 and f_2 . The location of this band within the frequency spectrum is determined by the intermesh spacing. Also, a number of higher order subsidiary resonances are obtained beyond frequency f_2 . Such higher order resonances have been found to have an undesirable effect upon the signal being reflected. Hence, the preferable usable operating range of the mesh within the frequency spectrum would only extend to f_2 , with appreciable reflection taking place at frequencies below f_1 . Should the horizontal spacing H_1 and the hole size D_1 correspond to the vertical spacing V_1 and hole size D_1 , the mesh surface 10 will exhibit the same frequency characteristic for both horizontally and vertically polarized waves. Should it be desired that the mesh surface have a different characteristic for horizontally and vertically polarized waves, one of these spacings or hole sizes may be modified accordingly. Also, the spacings V_1 or H_1 may be made to vary at different portions of the mesh to effect a variation of the frequency characteristics of the mesh at such different portions. Thus a selective variation in the frequency characteristic of individual portions of the prior art surface of FIGURE 1 may only be effected by changing the intermesh spacings or hole sizes in the original manufacture. This would necessitate a specially manufactured reflecting surface specifically tailored to the requirements of a particular application.

The mesh reflecting surface having the frequency characteristic as shown in FIGURE 3 may be analogized, within the preferable usable band width of principal resonance, to a low Q equivalent circuit, as schematically represented in FIGURE 4. This circuit comprises the parallel combination of inductive element 41 and capacitive element 42. The essence of my invention, the physical realization of which will be set forth below, is the addition of a controllable loading capacitor 43 in parallel therewith. By adjusting capacitor 43 to introduce a controlled amount of capacitive loading to the circuit, the

position of the mesh pass band within the frequency spectrum may be varied. That is, increasing values of capacitor 43 will accordingly lower the transmission pass band of the mesh surface. The capacitor element 43 will also vary the Q of the circuit. However, such a variation is quite negligible in a reflecting surface in which the pass band is approximately centered about the impinging radiation for transmission, or the frequency of the signal reflected is appreciably lower than f_1 of the pass band.

The physical realization of such an added controllable additional capacitor, as schematically shown in FIGURE 4 is shown in FIGURE 2. The mesh surface 20 of my invention is constructed of a standard mesh, as shown in FIGURE 10, modified by removing, as by cutting, the alternate intersections of the members 11 and 12. The newly formed enlarged mesh openings 21 will be of size D_2-D_2' , the dimensions of which equal the original opening size D_1-D_1' plus V_1 or H_1 , the original inter-hole spacing. The enlarged spacing H_2 and V_2 between the newly formed openings 21 is equal to twice the spacings V_1 and H_1 of the original openings 14. Within each of the openings 21 are contained a number of stub elements 22-25 formed from the remaining portions of the alternate conductors which had had their intersections removed. The presence of such stub-like metallic members in the openings of the mesh will have a capacitive loading effect, as schematically shown in FIGURE 4, with the length of the stubs determining the degree of such loading. Stub lengths 22 and 23 will only effect the transmission characteristic of the mesh with respect to the horizontally polarized component of the impinging radiation. Likewise, stub lengths 24 and 25 will similarly effect the characteristics of the surface with respect to the vertical polarized component 4 of the impinging radiation.

Stub length 22 and 23 within a single aperture 21 would preferably, though not necessarily, be of the same length. Likewise, stubs 24 and 25 within a single aperture 21 would preferably be of the same length. Stub pairs 22-23 may be independently adjusted to control the characteristics of the reflecting surface 20 with respect to a horizontally polarized wave. Similarly stub pairs 24-25 may be independently adjusted to control the characteristics of surface 20 with respect to a vertically polarized wave. Also, the stub pairs of each of the apertures 21 may be independently controlled to selectively vary the frequency characteristics of individual portions of surface 20. Thus, it is seen that my invention permits a presently available standard mesh surface to be selectively modified at individual portions thereof with respect to signals of both the same and different polarities.

The mesh surface of FIGURE 20 has been exemplary modified to have a greater amount of additional capacitive loading for horizontally polarized signals. Thus, the lengths of stubs 22 and 23 is greater than the length of stubs 24 and 25. FIGURE 5 depicts the frequency characteristic of such a mesh wherein curve B corresponds to the surface presented to a horizontally polarized wave and curve C corresponds to the surface presented to a vertically polarized wave. The additional capacitive loading effect of the horizontal stubs 22-23 is seen to cause a lower pass band as shown by curve B.

Reference is now made to FIGURE 6 which illustrates a typical application of my invention in a dual signal parabolic antenna system 60. Antenna feed 61 is located at the principal focus of the parabolic reflecting surface 62 which may be a cylindrical parabola or a paraboloid of revolution. Reflecting surface 62 is constructed in accordance with the teachings of my invention. Feed 61 has two signals F_1 and F_2 emanating therefrom. For purposes of clarity the field pattern F_1 is shown in solid lines and that of F_2 is shown in dotted lines. The required extent of parabolic surface 62 to reflect all of the

main lobe energy of F_1 is from the vertex 63 to oppositely extending peripheral regions 64 and 64'. Since signal F_2 has a broader main lobe, parabolic reflecting surface 62 would have to extend into peripheral regions 65 and 65' to effect reflection of all of the main lobe energy of that signal. The presence of a reflecting surface at the furthestmost peripheral portions 64 to 65 and 64' to 65' would provide a source of side lobe reflection for F_1 . To avoid this, these furthestmost regions are modified in accordance with my invention to permit complete transmission of F_1 , while reflecting F_2 . Since the angle of incidence is progressively increased towards the extremities 65 and 65' of the surface, the capacitive tuning elements of my invention may be progressively made longer towards this region to compensate for such variation in the angle of incidence. Signals F_1 and F_2 may be of the same or different polarities with the appropriate modifications being made in the tuning elements 22 through 25, as discussed above.

FIGURE 7 illustrates one type of a Cassegrain antenna system utilizing my invention, with it being understood that other doubly reflective systems (e.g. Schwarzschild) may similarly be constructed using the teachings of my invention. This antenna system includes a main parabolic dish 71 and a hyperbolic sub-dish 72. Feed 73 of frequency F_3 is located at the focus of hyperbolic surface 72, and feed 74 of frequency F_4 is located at the focus of parabolic surface 71, the latter also being the other focus of sub-dish 72. Surface 72 is constructed in accordance with my invention to reflect F_3 but completely transmit F_4 . The F_3 energy reflected from hyperbolic surface 72 is reflected as if it emanated from 74 and will, therefore, be reflected from parabolic surface 71 in rays parallel to the principle axis 75 of the antenna system. The energy F_4 emanating from 74, shown dotted for purposes of clarity, is unaffected by the presence of hyperbolic surface 72 and will, therefore, undergo a similar reflection from parabolic surface 71 to yield parallel rays. As discussed above the extreme portions of hyperbolic surface 72 will preferably be modified to provide complete transmission of signal F_4 as the angle of incidence varies.

Reference is now made to FIGURE 8 which illustrates a somewhat different doubly reflective antenna system also utilizing a hyperbolic sub-dish constructed in accordance with my invention. This Cassegrain antenna is of the type described in Jasik, Antenna Engineering Handbook, McGraw-Hill, Inc., 1961, pages 25-3 and 25-14. A dual polarized feed 81 at a focus of the hyperbolic sub-dish 82 emits signals F_5 and F_6 of respectively vertical and horizontal polarization, the latter polarization being shown dotted for purposes of clarity. Dual feed 81 constructed in the manner well known in the art to simultaneously emit both signals while maintaining a substantial degree of isolation between their separate sources. Parabolic main dish 83 is constructed of a polarization twisting reflection surface as described in the aforementioned reference. Hyperbolic sub-dish 82 is modified to have a different frequency characteristic for horizontally and vertically polarized signals and more specifically in this embodiment has a lower pass band for horizontally polarized signals, obtained as shown in FIGURES 2 and 5. The vertical polarized signal 84 will be reflected from the hyperbolic sub-dish 82 as if it emanated from common focus F_5 . Reflection by the main parabolic dish 83 converts F_5 to horizontally polarized waves; thus the waves of F_5 which strike the sub-dish 82 for the second time will be transmitted therethrough. Similarly the horizontally polarized signals F_6 are reflected upon initial occurrence with the hyperbolic sub-dish 82 as if they emanated from the main focus 84. Upon reflection by the main dish 82 they will become vertically polarized, thereby passing through sub-dish 82. Thus, it is seen that sub-dish 82 provides the double reflection of both signals parallel to the principal axis 85 and does not im-

pede the passage of the doubly reflected signal there-through.

Thus it is seen that my invention provides a frequency selective signal reflective surface wherein individual portions thereof may be independently modified to suit the particular requirements of an antenna system. Specifically, I have illustrated my invention with a parabolic antenna system and two Cassegrain antenna systems. It is naturally understood that the reflective surface of my invention may be utilized in various other applications wherein selective reflection and transmission of impinging radiation is desired. Thus, I prefer to be bound not by the specific disclosure herein but only by the appended claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows.

1. A signal impinging mesh surface comprising a plurality of apertures bounded by intersecting conductive surfaces; at least some of said apertures including a controllable stub tuning element.

2. A signal impinging mesh surface comprising a plurality of apertures bounded by intersecting conductive surfaces; at least some of said apertures including a controllable stub tuning element formed of a conductive surface substantially similar to said intersecting conductive surfaces.

3. A signal impinging mesh surface comprising a plurality of apertures bounded by intersecting conductive surfaces; at least some of said apertures including a controllable stub tuning element formed of a conductive surface substantially similar to said intersecting conductive surfaces; said stub element being affixed to one of said intersecting conductive surfaces intermediate the aperture boundaries thereof, and extending towards an oppositely disposed one of said intersecting surfaces.

4. A signal impinging mesh surface comprising a plurality of apertures bounded by respectively intersecting pairs of substantially parallel conductive surfaces; at least some of said apertures including a first pair of controllable stub tuning elements formed of a conductive surface substantially similar to said intersecting conductive surfaces; one of said first pair of stub elements being affixed to a first bounding conductive surface of a first parallel pair of said conductive surfaces, intermediate the aperture boundaries thereof and extending towards a second bounding conductive surface of said first parallel pair of conductive surfaces; the other of said first pair of tuning elements being affixed to said second conductive surface intermediate the aperture boundary thereof, and extending towards said first conductive surface.

5. The signal impinging mesh surface of claim 4, wherein each of said first pair of stub elements are of equal length and are located midway between the aperture boundaries thereof.

6. A signal impinging mesh surface comprising a plurality of apertures bounded by respectively intersecting pairs of substantially parallel conductive surfaces; at least some of said apertures including a first and a second pair of controllable stub tuning elements formed of a conductive surface substantially similar to said intersecting conductive surfaces; one of said first pair of stub elements being affixed to a first bounding conductive surface of a first parallel pair of said conductive surfaces, intermediate the aperture boundaries thereof and extending towards a second bounding conductive surface of said first parallel pair of conductive surfaces; the other of said first pair of tuning elements being affixed to said second conductive surface intermediate the aperture boundary thereof, and extending towards said first conductive surface; one of said second pair of stub elements being affixed to a third boundary conductive surface of a second pair of parallel conductive surfaces; the other of said second pair of stub elements being affixed to a fourth boundary conductive surface of said second pair of parallel conductive sur-

faces; said second pair of parallel conductive surfaces intersecting said first pair of parallel conductive surfaces; said second pair of stub elements being intermediate the aperture boundaries established by said first pair of parallel conductor surfaces, and extending towards each other.

7. The signal impinging mesh surface of claim 6, wherein said first pair of stub elements are located midway between said second pair of conductive surfaces and extend generally parallel thereto; and said second pair of stub elements are located midway between said first pair of conductive surfaces and extend generally parallel thereto.

8. The signal impinging mesh surface of claim 6, wherein each of said first pair of stub elements are of a first equal length; and each of said second pair of stub elements are of a second equal length.

9. A signal impinging mesh surface comprising a plurality of apertures bounded by respectively intersecting pairs of substantially parallel conductive surfaces; at least some of said apertures including a first and second pair of controllable stub tuning elements forward of a conductive surface substantially similar to said intersecting conductive surfaces; one of said first pair of stub elements being affixed to a first bounding conductive surface of a first parallel pair of said conductive surfaces, intermediate the aperture boundaries thereof and extending towards a second bounding conductive surface of said first parallel pair of conductive surfaces; the other of said first pair of tuning elements being affixed to said second conductive surface intermediate the aperture boundary thereof, and extending towards said first conductive surface; one of said second pair of stub elements being affixed to a third boundary conductive surface of a second pair of parallel conductive surfaces; the other of said second pair of stub elements being affixed to a fourth boundary conductor of surface of said second pair of parallel conductor surfaces; said second pair of parallel conductor surfaces intersecting said second pair of parallel conductor surfaces; said second pair of stub elements being intermediate the aperture boundaries established by said first pair of parallel conductor surfaces, and extending towards each other; said first pair of stub elements being located midway between said second pair of conductive surfaces and extending generally parallel thereto; and said second pair of stub elements being located midway between said first pair of conductive surfaces and extending generally parallel thereto; each of said first pair of stub elements being of a first equal length; each of said second pair of stub elements being of a second equal length; and said first length differing from said second length.

10. A signal impinging surface comprising a first plurality of narrow conductive surfaces, respectively separated and extending in a first direction; a second plurality of substantially similar narrow conductive surfaces respectively separated and extending in a second direction; said first and second surfaces intersecting to form a mesh; each adjacent pair of intersecting first and second surfaces bounding an aperture; at least some of said apertures including a first controllable stub element affixed to one of said intersecting first boundary surfaces intermediate the boundary established by said second intersecting surfaces, and extending towards the other of said intersecting first surfaces.

11. A signal impinging surface comprising a first plurality of narrow conductive surfaces, respectively separated and extending in a first direction; a second plurality of substantially similar narrow conductive surfaces respectively separated and extending in a second direction; said first and second surfaces intersecting to form a mesh; each adjacent pair of intersecting first and second surfaces bounding an opening; at least some of said openings including a first pair of controllable stub elements, each affixed to one of said first surfaces, intermediate the boundary established by said second pair of intersecting surfaces, and extending towards each other; a second pair of conductive stub elements, each affixed to one of said sec-

ond surfaces, intermediate the boundary established by said first pair of intersecting surfaces, and extending toward each other.

12. The signal impinging mesh surface of claim 11, wherein each of said first pair of stub elements are located midway between said second pair of intersecting surfaces, and extend generally parallel thereto; each of said second pair of stub elements are located midway between said first pair of intersecting surfaces, and extend generally parallel thereto.

13. A signal impinging mesh surface comprising a plurality of apertures bounded by intersecting conductive surfaces; said apertures including a first pair of controllable length stub tuning elements; the length of the stub elements in some of said apertures differing from the length in other of said apertures.

14. A signal impinging mesh surface comprising a plurality of apertures bounded by intersecting conductive surfaces; said apertures including a first and second pair of controllable length stub tuning elements; said stub element pairs being respectively affixed to oppositely disposed pairs of said intersecting conductive surfaces; said stub element pairs varying the characteristics of said mesh surface to differently polarized signals; the lengths of the stub elements in some of said apertures differing from the lengths in other of said apertures.

15. An antenna system including a frequency selective reflective surface; said reflective surface comprising a plurality of apertures bounded by intersecting conductive surfaces; at least some of said apertures including a controllable stub tuning element.

16. In combination, a parabolic reflecting surface and a dual signal feed located at a focus thereof; said reflective surface comprising a plurality of apertures bounded by intersecting conductive surfaces; at least some of said apertures including a controllable length stub tuning element; and the length of some of said stub elements at the extreme peripheral region differing from the length of said stub elements at the vertex region.

17. In combination, a parabolic reflecting surface and a dual signal feed located at a focus thereof; said reflecting surface comprising a plurality of apertures bounded by intersecting conductive surfaces; said apertures includ-

ing a first and second pair of controllable length stub tuning elements; said stub element pairs being respectively affixed to oppositely disposed pairs of said intersecting conductive surfaces; said stub element pairs varying the characteristics of said mesh surface to differently polarized signals emitted by said signal feed.

18. A signal impinging mesh surface comprising a plurality of apertures bounded by intersecting conductive surfaces; said apertures including a first pair of controllable length stub tuning elements; the length of the stub elements in some of said apertures differing from the length in other of said apertures; whereby said mesh surface presents a first uniform frequency characteristic to a first impinging signal having different angles of incidence over different portions of said mesh surface.

19. A signal impinging mesh surface comprising a plurality of apertures bounded by intersecting conductive surfaces; said apertures including a first pair of controllable length stub tuning elements; the length of the stub elements in some of said apertures differing from the length in other of said apertures; whereby said mesh surface presents a first uniform frequency characteristic to a first impinging signal having different angles of incidence over different portions of said mesh surface and a second uniform frequency characteristic to a second signal similarly impinging said mesh surface.

20. A signal impinging mesh surface comprising a plurality of apertures bounded by intersecting conductive surfaces; said apertures including a first and second pair of controllable length stub tuning elements; said stub element pairs being respectively affixed to oppositely disposed pairs of said intersecting conductive surfaces; said stub element pairs varying the characteristics of said mesh surface to differently polarized signals; the lengths of the stub elements in some of said apertures differing from the lengths in other of said apertures; whereby said mesh surface presents a first uniform frequency characteristic to a first impinging signal having different angles of incidence over different portions of said mesh surface and a second uniform frequency characteristic to a second signal similarly impinging said mesh surface, said first and second signals being differently polarized.

No references cited.