

Nov. 11, 1958

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2,860,339

ULTRA-HIGH FREQUENCY ANTENNA UNIT

Filed Dec. 2, 1953

*Fig. 5*

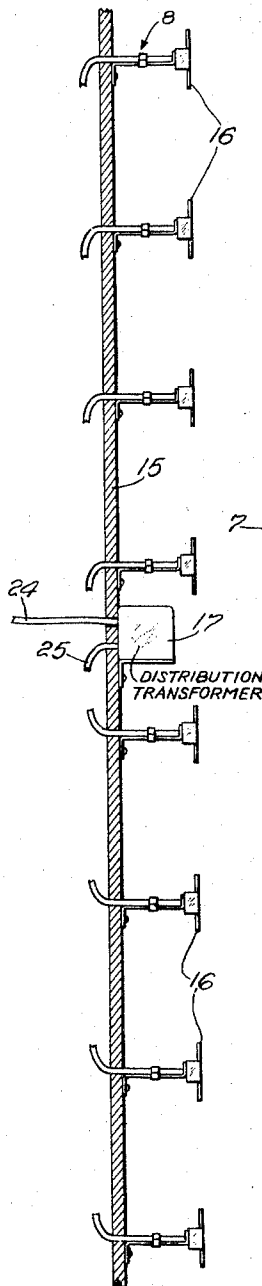


*Fig. 1*

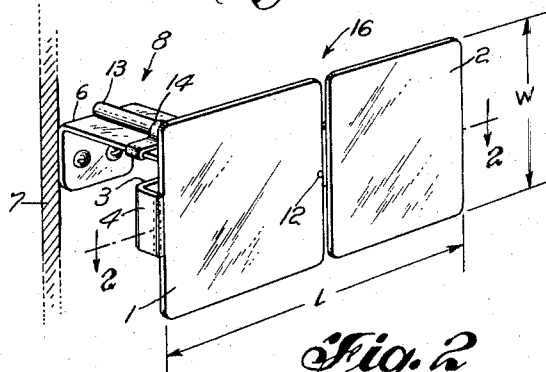


*Fig. 2*

*Fig. 4*

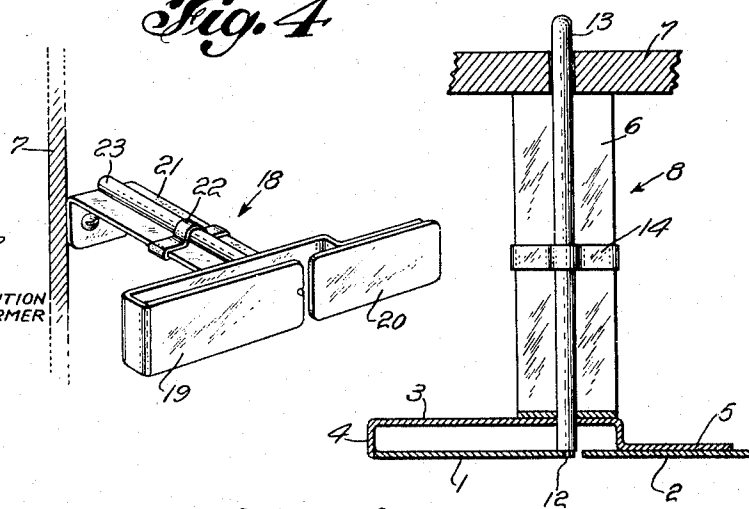
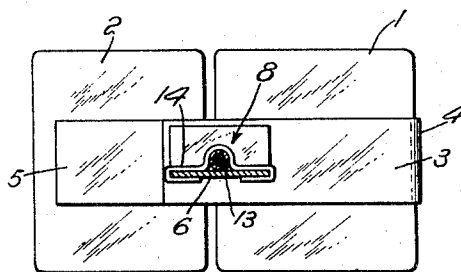


*Fig. 3*



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## ULTRA-HIGH FREQUENCY ANTENNA UNIT

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Application December 2, 1953, Serial No. 395,757

6 Claims. (Cl. 343—795)

This invention relates to ultra-high frequency antennas and more particularly to an ultra-high frequency antenna of the folded dipole type adapted for efficient operation over a relatively broad frequency band.

Various antenna structures have been devised for use as ultra-high frequency antenna radiators. In general, it is extremely desirable that these radiators be adapted for efficient operation over a relatively broad frequency band. In order to provide a desirable high gain it is essential that the antenna radiators be capable of being stacked so that the emitted energy may be concentrated. Since these antenna radiators must be stacked, thus requiring a plurality of such units, it is desirable that they be of relatively simple construction and yet remain structurally rigid without the use of complicated structural members. Such radiators when fabricated from a small number of easily manufactured parts which can be readily and relatively inexpensively produced, the radiator unit would find wide acceptance in the radio field.

One of the objects of this invention, therefore, is to provide an ultra-high frequency radiating unit for operation over a relatively wide frequency band which lends itself to economical manufacture and ease of assembly.

Another object of this invention is to provide an ultra-high frequency antenna radiator which lends itself readily for use in a stacked array to form an antenna system of high gain and omni-directional characteristics.

According to one of the features of my invention, I provide an antenna radiating unit in which the radiant acting members comprise a pair of substantially planar radiating areas disposed in spaced edgewise relation to each other. A metal strap having each of its ends connected to one of the radiating areas functions as a transformer section. A source of energy is coupled between the transformer section and the midpoint of the radiant member.

The above-mentioned and other features and objects of this invention will become more apparent by reference to the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a view in perspective of one embodiment of an antenna radiating unit in accordance with the principles of this invention;

Fig. 2 is a view in cross section taken along the lines 2—2 of Fig. 1 of the radiating members;

Fig. 3 is a rear elevational view of the radiating unit of this invention;

Fig. 4 is a view in perspective of an alternate embodiment of the antenna radiating unit of this invention; and,

Fig. 5 is a schematic illustration in elevation of one antenna system utilizing a stacked array of the radiant members of this invention.

Referring to Figs. 1, 2 and 3 of the drawing, one embodiment of the antenna radiator of this invention is shown therein to comprise a pair of substantially rectangular planar radiating areas 1 and 2 having their inner edges disposed in spaced edgewise relation to present the substantially flat conductive surface. Rearward of and

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spaced from the radiating areas 1 and 2 is a conductive metal strap 3 which has one end 4 angled and connected to the outer edge of radiating area 1 and the other end 5 angled and connected to the radiating area 2, thus mechanically supporting the conducting surface of the antenna radiator. A rigid spoke 6 composed of a conductive material has one end connected to the metal strap 3 and has its other end coupled to a support structure 7. Support structure 7 may be any well-known antenna tower structure or may take the form of a reflector surface. The inner conductor 12 of a transmission line 8 couples energy to the inner edge of radiating area 1. Surrounding the inner conductor 12 is a jacket 13 composed of an insulating material. The outer conductor of transmission line 8 is coupled to the antenna tower structure and thus to the conductive spoke 6 or of course the return path may be coupled directly to spoke 6. A metallic clamp 14 adjustable lengthwise of spoke 6 acts as an additional impedance matching device.

Preferably, the effective electrical length  $L$  of the radiating members 1 and 2 should be substantially equal to one-half wavelength at the mean operating frequency of the antenna system. The effective electrical width  $W$  of the areas 1 and 2 should preferably be at least equal to substantially one-quarter wavelength at the lowest operating frequency of the antenna system. It is obvious to those skilled in the art that if the width  $W$  of the radiating areas 1 and 2 is increased the end effect is increased, thereby decreasing the optimum operating frequency. The spacing between the areas 1 and 2 should be adjusted to obtain the minimum reactance for the input impedance. The metallic strap 3 in addition to mechanically supporting the conductor surface functions as a transformer or impedance matching device. Due to the currents which are mutually coupled between the conductor surface and the metallic strap 3, it is assumed that metallic strap 3 radiates and increases the impedance of the antenna of this invention relative to the impedance of an ordinary dipole.

I have found that by employing the above construction for a radiating unit and properly locating the coupling point of end 5 of metal strap 3 to area 2, it is possible to feed the antenna of this invention over a broad band of frequencies without requiring the use of additional conventional transformers or separate impedance matching transformers to connect the antenna to the transmission line. However if some additional matching of the antenna unit to feed lines is required it is possible to match the antenna impedance to the input impedance through the use of movable metal clamps 14 which when properly adjusted assist in providing a proper match.

Obviously, snow or ice formation in the space between areas 1 and 2 will adversely affect the characteristics of this antenna and, therefore, if desired the entire antenna structure can be enclosed within a suitable plastic housing or bag.

Referring to Fig. 4 an alternate embodiment of the antenna radiating unit in accordance with the principles of this invention is shown for narrow band frequency operation. The unit 18 comprises a pair of planar radiating surfaces 19 and 20 having their inner edges disposed in spaced edgewise relation to present a substantially flat conductive surface. The radiating surfaces 19 and 20 are coupled to a conductive support 21 via a strap 22 and is fed energy via conductor 23. The feeding and support of unit 18 is similar to the feeding and support of the radiating unit shown in Fig. 1. However, the width  $W$  of the unit 18 shown in Fig. 4 is substantially equal to the width of the metal strap 22. By decreasing the width  $W$  of radiating areas 19 and 20 the breadth of the operating frequency bandwidth is reduced. The construction of the radiating unit shown in Fig. 4 is most optimum

where operation over a restricted frequency band is contemplated.

Referring to Fig. 5, an antenna array utilizing the antenna units of Fig. 1 is shown for the radiation of horizontally polarized radio-frequency energy with an increase in vertical directivity. The antenna system comprises a supporting structure 15 which may comprise a reflective surface on which are mounted a plurality of radiating units 16. The radiating units are disposed in vertical alignment along the support structure 15. A distribution transformer 17 is located at the vertical midpoint of the radiating elements and a transmission feed line 24 coupling a source of radio-frequency energy is connected to the transformer. Antenna radiating unit feed lines 25 are connected from the distribution transformer 17 to feed each of the radiating units 16. By providing a stacked vertical alignment of radiating units 16 in front of reflecting surface 15, it is possible to provide a high concentration of energy in the vertical plane unidirectionally in the horizontal plane. The radiating units 16 are excited in the appropriate phase.

It should be distinctly understood that this particular antenna structure shown herein is given by way of example; the feed system of the antenna may take many other forms without departing from the spirit of my invention and likewise mechanical details of the supporting structure may be varied within the limits of my invention as desired by those skilled in the art.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the accompanying claims.

I claim:

1. A broad band antenna structure comprising two separate rectangular sheets of conductive material disposed in spaced edgewise relation to each other, each sheet having an inner edge adjacent the other sheet and an outer end and edge opposite thereto, the dimension across both sheets being substantially one-half wavelength at mid-band frequency, a strap of conductive material, the width of said strap being considerably narrower than both the length thereof and widest dimension of said sheets, said strap being connected to the outer end of one of said sheets and the planar area of the other of said sheets and supporting said separate sheets and an unbalanced transmission line means to couple a source of ultra-high frequency energy between said strap and the inner edge of said one of said sheets.

2. A broad band antenna structure according to claim 1 which further includes a supporting spoke connected at right angles to said strap, said spoke being part of said unbalanced transmission line means.

3. A broad band antenna structure according to claim 2 which further includes a conductor insulated from said

spoke and coupled to the said inner edge of one of said sheets, and an impedance matching device adjustably mounted on said spoke and around said insulated conductor.

4. A broad band antenna structure comprising first and second conductors each shaped to provide a substantially rectangular planar radiating area, said conductors being disposed in spaced edgewise relation, a radiating transformer section coupled in an electrically unbalanced manner to said conductors and unbalanced transmission line means to couple a source of ultra-high frequency energy between said transformer section and the radiating surfaces of said conductors, each of said conductors having an inner edge adjacent the other conductor and an outer edge opposite thereto, said radiating transformer section comprising a metal strap spaced from the radiating surfaces of said conductors and having one end angled and coupled to the outer edge of the radiating area of said first conductor and the other end of said strap angled and coupled to said second conductor and said unbalance transmission line energy coupling means having one lead thereof coupled to said transformer and the other lead thereof coupled to the inner edge of said first conductor.

5. An antenna structure according to claim 4 wherein the combined effective electrical length of the planar radiating areas of said conductors is equal substantially to one-half wavelength at the mean operating frequency of said source and the effective electrical width of said subject area is at least equal substantially to one-quarter wavelength at the mean operating frequency of said source.

6. A broad band antenna structure comprising a radiating unit including first and second conductors each shaped to provide a substantially planar radiating area, said conductors being disposed in spaced edgewise relation, each of said conductors having an inner edge adjacent the other conductor and an outer edge opposite thereto a radiating transformer section comprising a metal strap disposed in spaced relation to the radiating areas of said conductors and having one end angled and coupled to the outer edge of the radiating areas of said first conductor and the other end of said strap angled and coupled to said second conductor, and unbalanced transmission line means to couple a source of ultra-high frequency energy between said transformer section and the radiating surfaces of said conductors.

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