Sept. 3, 1946. P. S. CARTER 2,407,057

ANTENNA SYSTEM

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*Fig. 1.*

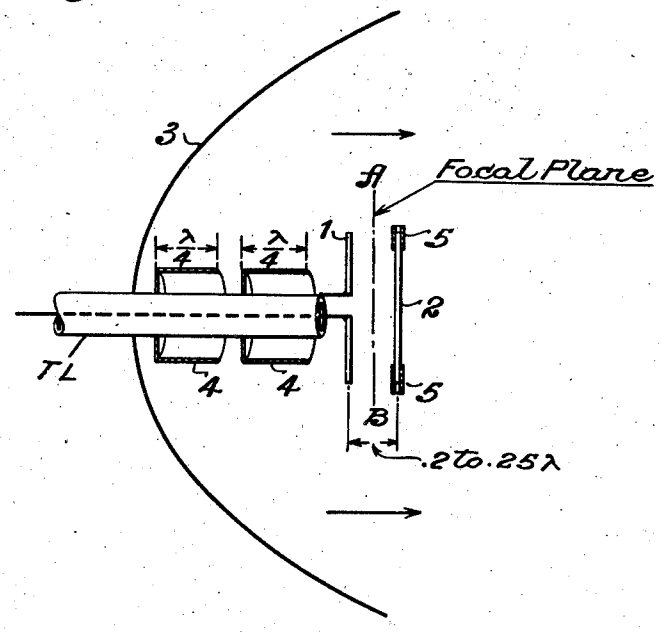
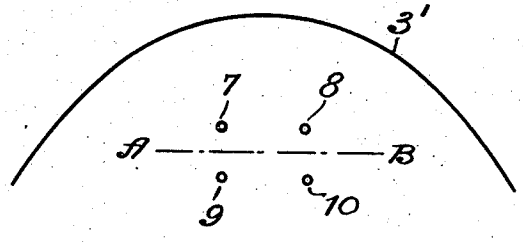



*Fig. 2.*




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## ANTENNA SYSTEM

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2 Claims. (Cl. 250—11)

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This invention relates to improvements in antenna systems employing reflectors to obtain unidirectivity.

One of the objects of the present invention is to provide a reflector type unidirectional antenna system which eliminates substantially the minor or secondary lobes customarily present in the radiation pattern of the antenna element.

Another object is to provide a parabolic reflector antenna system having a larger gain than obtained by the customary scheme employing a single dipole located in the focus of the reflector.

A more detailed description of the invention follows in conjunction with a drawing, wherein Figs. 1 and 2 illustrate two different embodiments of the present invention.

Referring to Fig. 1 in more detail, there is shown a paraboloid reflector 3 having a pair of dipoles 1 and 2 located on opposite sides of the focal plane A, B. Dipole 1 is directly fed with energy from a remote transmitter over coaxial transmission line TL. One arm of the dipole is connected at one end to the outer conductor of the transmission line TL, while the other arm of the dipole is connected at its adjacent end to the inner conductor of the line TL (as shown). Dipole 2 is a parasitic radiator whose overall length is substantially identical with the overall length of the dipole 1. Both dipoles 1 and 2 are each approximately one-half wavelength long, preferably a little less than one-half wavelength. Dipole 2 is provided with adjustable end sleeves 5, 5 for adjusting the length of the dipole. Both dipole radiator elements 1, 2 are separated from each other by a distance in the range between .2 to .25 wavelengths. Dipole element 2 is excited by the space radiation from dipole element 1 and serves to reflect the waves radiated from dipole 1 back toward the parabolic reflector 3, from which the waves are sent out in a desired pattern, away from the mouth of the parabolic reflector in the direction of the arrows. The use of parasitic radiator elements for reflectors is well known in the art, attention being invited to my United States Patents Nos. 2,040,079 and 2,204,175, for descriptions of antenna elements employing parasitic radiators. The parasitic reflector 2 may be supported in any suitable manner, one way being by linking the parasitic unit to the sheath of the concentric line TL.

In order to attenuate undesired waves tending to travel along the outer surface of the outer conductor of the transmission line TL, there are provided a pair of quarter wavelength sleeves

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4, 4 placed end to end and which are open-ended at the ends nearest the dipole 1, but connected at their other ends to the outer conductor of the line TL (as shown). Sleeves 4, 4 present extremely high impedances to currents flowing in a direction toward reflector 3 along the outside of the sheath of transmission line TL.

Dipoles 1 and 2, by themselves, provide a cardioid radiation pattern with a maximum radiation toward reflector 3 and with a minimum radiation in the opposite direction. This arrangement, it has been observed, gives a gain of 1.6 over the use of known schemes employing the single dipole in the focus of a paraboloid reflector. In addition to the foregoing advantage, my arrangement provides a cleaner radiation pattern, that is, one without undesired minor or secondary lobes or ears, and an increased gain over known antenna schemes employing a hemispherical reflector placed in front of the dipole antenna and facing a paraboloid reflector.

The present invention is useful in all wavelength ranges where it is desired to employ a parabolic reflector. In one arrangement successfully tried out in practice, there was employed for reflector 3 a 30'' diameter parabola having a 7½'' focal length. The dipoles 1 and 2 were each a little less than one-half wavelength; namely, slightly less than two inches long. The wavelength employed was 9.8 centimeters. The dipole elements 1 and 2 were disposed very close to one another on opposite sides of the focus, and the parasitic unit 2 was supported by a metal arm projecting from the outside tube of the coaxial line TL and soldered to the center of the parasitic unit. In another experimental model tested satisfactorily, the transmission line was an open two-wire line.

Fig. 2 shows a plan view of another embodiment of the present invention, wherein there are employed a pair of directly excited dipoles 7 and 8, and a pair of parasitic dipoles 9 and 10. The directly excited units 7 and 8, it should be noted, are on opposite sides of the focal plane A, B relative to the parasitic elements 9 and 10. The parabolic reflector 3', it should be noted, is outside the antenna array. Such an arrangement is especially applicable for small parabolic reflectors where, due to dimensional considerations, the antenna array must be considerably outside the parabola. It will be evident from what has been said above that the parabola 3' is relatively small, its diameter being only a few wavelengths. The dipole elements can be excited in the same

manner mentioned above in connection with the corresponding dipole elements of Fig. 1.

Although the invention has been described in connection with the use of parasitic units associated with the directly excited dipoles, it should be understood that, if desired, the parasitic elements 2, 9 and 10 can be replaced by dipoles which are also directly fed or excited from the transmission line leading to the transmitter, in which case the dipole replacing the parasitic should be excited in quarter phase relation (90° leading) relative to the dipole nearest to the parabolic reflector. Further, the invention is also applicable to arrangements employing other types of reflectors in place of the parabolic reflector. For example, the paraboloid reflector may be replaced by a flat metallic sheet type of reflector or by a parabolic cylinder type of reflector. If a flat metallic sheet reflector is employed, the center of gravity of the antenna system should be approximately an odd multiple, including unity, of a quarter wavelength from the reflecting surface.

If desired, the parasitic unit 2 may lie in a plane with a plywood cover for the open end of the paraboloid reflector 3 of Fig. 1, in order to prevent dust, rain, sleet or snow etc. from changing the characteristics of the antenna system.

What is claimed is:

1. A directive antenna system comprising a parabolic reflector whose dimensions are large compared to the length of the operating wave, to thereby produce a relatively sharp focal point, a primary radiator located inside said focal point and having its center on the axis of said reflector, and another radiator located outside said focal



point and also having its center on the axis of said reflector, said radiators being parallel and spaced from each other by a distance in the range from .2 to .25 wavelength at the operating frequency and symmetrically located on opposite sides of said focal point, whereby the effective source of radiation toward said parabolic reflector is at the focal point, a coaxial line feeder extending through the axis of said parabolic reflector and connected to said primary radiator, and spaced quarter wavelength sleeves on the outer conductor of said feeder for preventing currents flowing in a direction toward the reflector along the outside of the outer conductor.

2. A directive antenna system comprising a parabolic reflector whose dimensions are large compared to the length of the operating wave, to thereby produce a relatively sharp focal point, a primary radiator located inside said focal point and having its center on the axis of said reflector, and another radiator located outside said focal point and also having its center on the axis of said reflector, said radiators being parallel and spaced from each other by a distance in the range from .2 to .25 wavelength at the operating frequency and symmetrically located on opposite sides of said focal point, whereby the effective source of radiation toward said parabolic reflector is at the focal point, a coaxial line feeder extending through the axis of said parabolic reflector and connected to said primary radiator, and a quarter wavelength sleeve on the outer conductor of said feeder for preventing currents flowing in a direction toward the reflector along the outside of the outer conductor.

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