A NEW TYPE OF BROADBAND MICROSTRIP ANTENNA COMPRIZING A SLOT SURROUNDED BY A LOOP HAVING A PERIMETER OF APPROXIMATELY ONE WAVELENGTH

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INTRODUCTION

It is well known that the folded dipole antenna covers a broader range of frequencies than a half-wavelength dipole does (1). Likewise, a variety of polygonal loop antennas has been proposed and applied for practical use because of its preferable impedance characteristics (2). In view of these facts, we are motivated to construct a new class of microstrip antenna of which the impedance is less sensitive to frequency change compared with a conventional microstrip antenna.

CONFIGURATION OF THE NEW ANTENNA DESIGN

After a series of cut-and-try attempts,it is revealed that a microstrip antenna that satisfies the following criteria produces a 8-9dBi gain over a frequency range (defined by return loss less than or equal to 10dB) of 24 percent.

I. The loop is placed parallel to the ground plane which acts as a reflector. The appropriate separation is somewhere near 1/8 of the wavelength at center frequency.

II. Most portion of the inner perimeter of the loop must be parallel to form a radiating slot.

III. The outer perimeter may be rather arbitrary,provided that it is symmetric about the center line of the slot.(The outer perimeter may be trimmed to adjust impedance or center frequency)

IV. The feeder line is connected to either:

(a) at the center of the slot if the loop is closed,or

(b) at one end of the slot where the loop has a small gap.

A typical example of center fed design is sketched in Fig.1(a) and that of gap fed design is given in Fig.1(b). At the feed point, the narrow strip and the wide strip are connected to the axial line and the ground line of a coax-fed line respectively.

CHARACTERISTICS

The input impedances and the radiation patterns of the antennas shown in Fig.1(a) and Fig.1(b) are presented in Fig.2 and Fig.3. The effect of the ground plane on the input impedances is shown in Fig.2, and the effect of the ground plane on the radiation patterns is shown in Table.1.

From the radiation pattern shown in Fig.3(a), it is apparent that the distributed electric dipoles formed over the center slot are the principal source of radiation fields. At beam center,polarization discrimination is excellent, because this direction is the null of the radiation from magnetic dipoles formed over the slot and surrounding loop by the surface current. The radiation pattern of the cross polarization component, suggests us that the source of this component may be the magnetic dipoles mentioned above.

The less preferable radiation pattern of the gap fed type shown in Fig.3(b) may be attributed to the lack of symmetry in the configuration of slot.

CONCLUSION

A new class of microstrip antenna distinguished by its radiation mechanism is introduced. The gain and impedance characteristics are comparable to or better than those produced by the microstrip antenna with parasitic element (3), and much better than those by the conventional types (4). Comparing the size of new design with that of parasitic element,height between ground plane and the element placed at the top is comparable or the new design may be a little taller,but the lateral extension remains almost the same. Hence the new design comes to on a par with the microstrip antenna with parasitic element.

The items remaining yet to be investigated include the configuration for a circularly polarized radiation and the problems associated with the array arrangement.

REFERENCES

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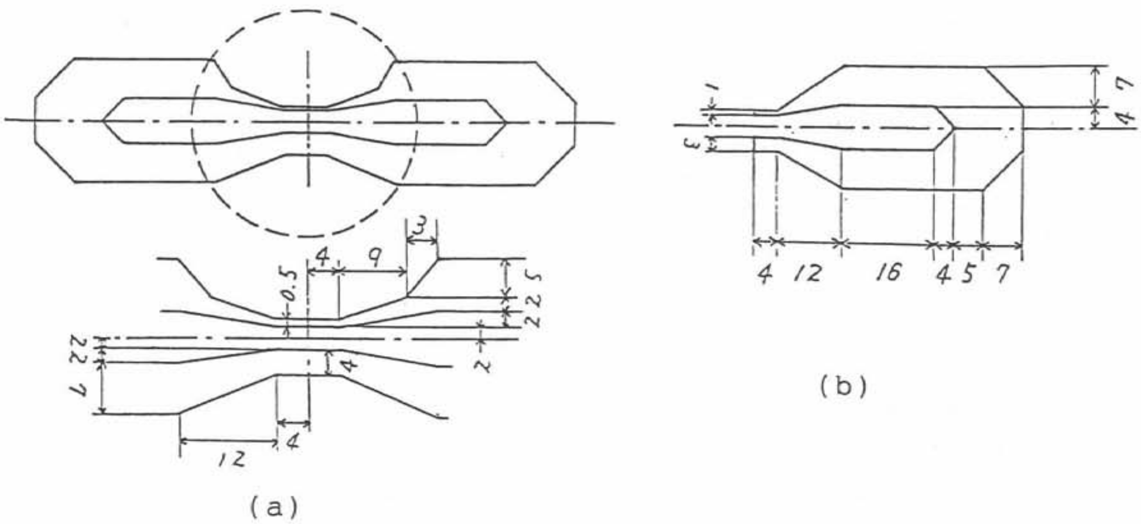
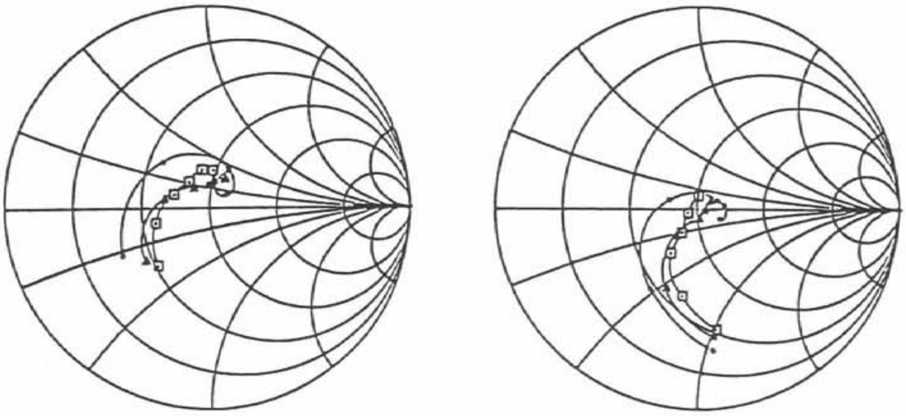
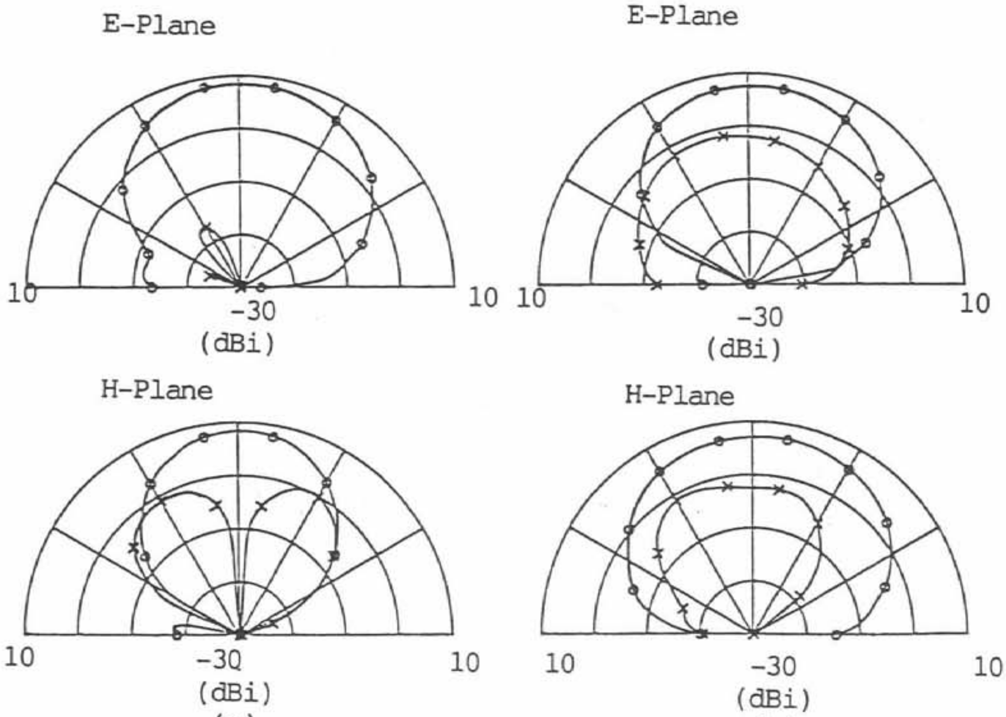


Fig.1 Configuration
(a) Center-fed design; (b) Gap-fed design.



(a) (b)

Fig.2 Input impedance characteristics
f=2.8-3.8 (GHz); h=12, h=16, h=20.
(h (mm) is the distance between the loop and the ground plane)



(a) (b)

Fig.3 Radiation patterns
h=16 (mm); f=3.3 (GHz).
Main polarization; Cross polarization.

Table.1 The effect of h on the broadside gains (3.3 GHz)

h (mm)	Broadside Gain (dBi)	
	Center-fed	Gap-fed
12	8.44	7.36
16	8.39	7.05
20	8.00	6.19