Institute of Engineering
JIWAJI UNIVERSITY

PRESENTATION
ON
TV & RADAR

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ANTENNAS

An antenna is such a structure. It is generally a metallic object, often a rod or wire, that is used to convert high frequency current into electromagnetic waves, and vice versa. Though their functions are different, transmitting and receiving antennas behave identically.

Radiation Mechanism

The electromagnetic radiation from the transmitting antenna has two components a magnetic field associated with current in the antenna and an electric fleld associated with the potential. The two fields are perpendicular to each other in space and both are perpendicular to he direction of propagation of the wave.

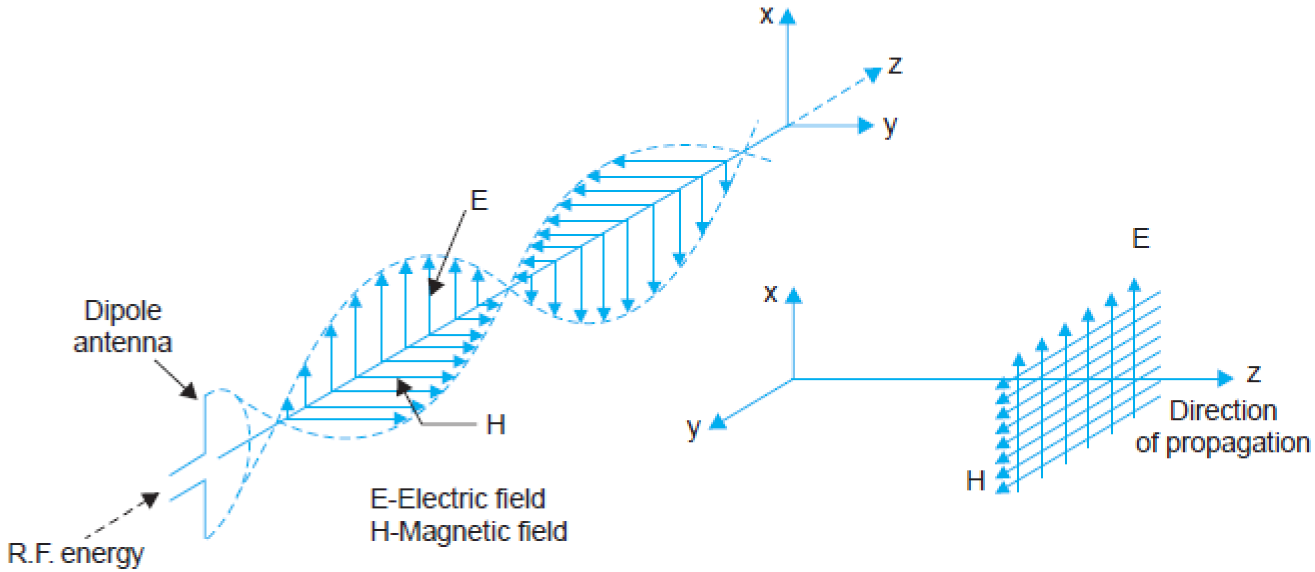

Fig. 9.5. Transverse electromagnetic wave in free space.

Radiation Patterns of Resonant Antennas

A resonant antenna is a transmission line whose length is an exact multiple of wavelengths and is open at both ends.

Fig. 9.7. Current distribution on resonant dipoles.

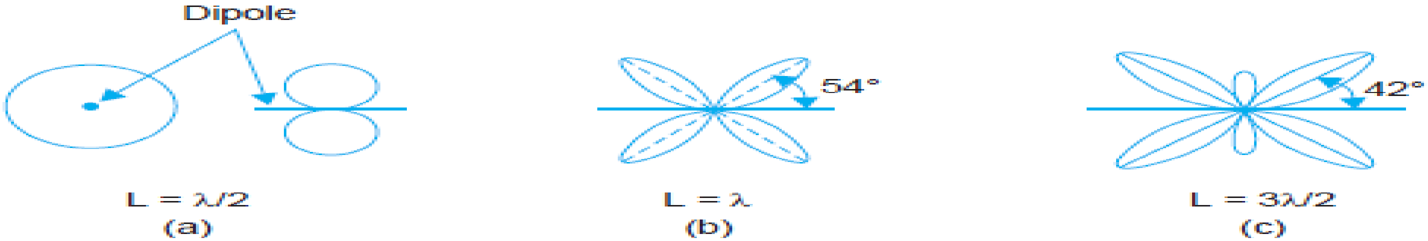

Fig. 9.8. Radiation patterns (Polar diagrams) of various resonant dipoles located remote from ground.

Nonresonant Antennas

A nonresonant antenna *is one which is correctly terminated and as such only a* forward travelling wave exists and there are no standing waves

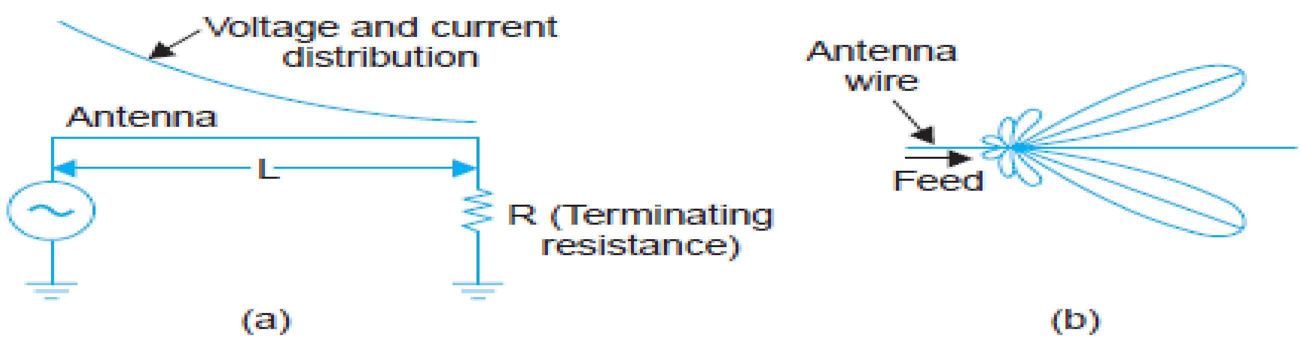

Fig. 9.9. Nonresonant antenna (a) layout and current distribution (b) typical directional radiation pattern for L = 4λ.

Ungrounded Antennas

When the antenna is very close to the ground, its radiation pattern gets modified on account of reflections from the ground. If the ground is assumed to be a perfect conductor, a true mirror image of the actual antenna is considered to exist below the ground.

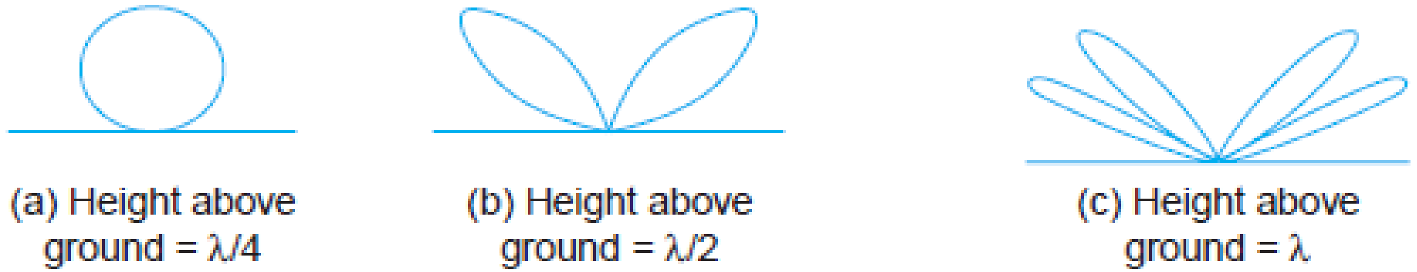

Fig. 9.10. Vertical radiation patterns of an ungrounded half-wave horizontal dipole with varying heights above the ground surface.

Grounded Antennas

When one end of the antenna is actually grounded, the image of the antenna behaves as if it has been joined to the physical antenna and the combination acts as an antenna of double the size.

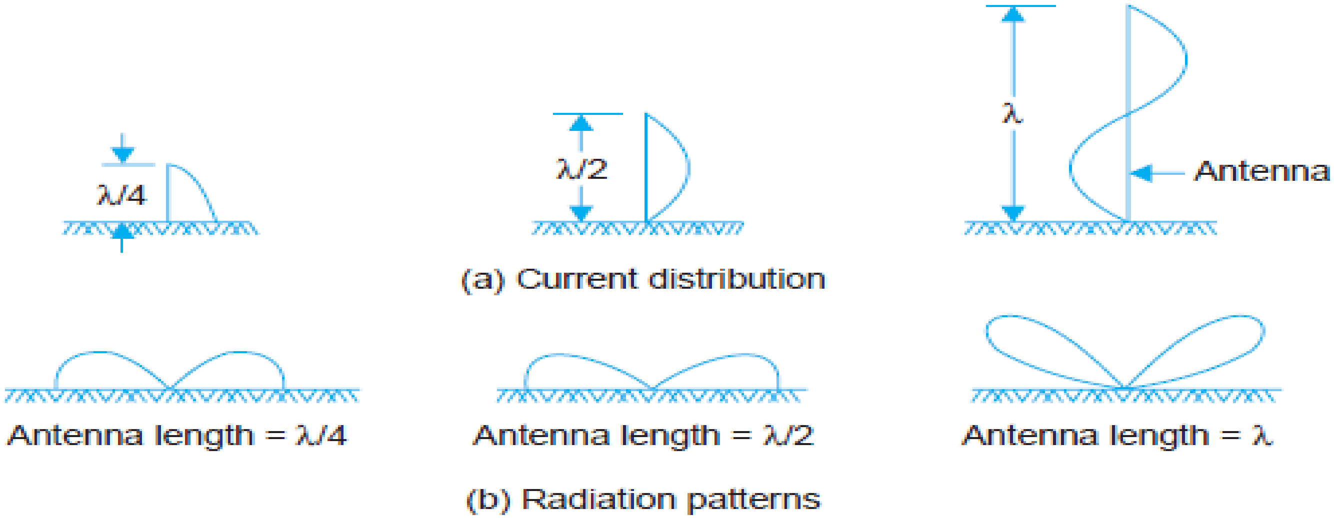

Fig. 9.11. Current distribution and vertical directional patterns of grounded antennas.

Antenna Gain

The directive gain is thus defined as the ratio of the power density in the direction of maximum radiation to the power density that would be radiated by an isotropic antenna. The gain being a ratio of powers is expressed in decibels.

Antenna Arrays

It is clear from previous discussion that radiation from different types of antennas is not uniform in all directions. Though an antenna can be suitably oriented to get maximum response in any desired direction

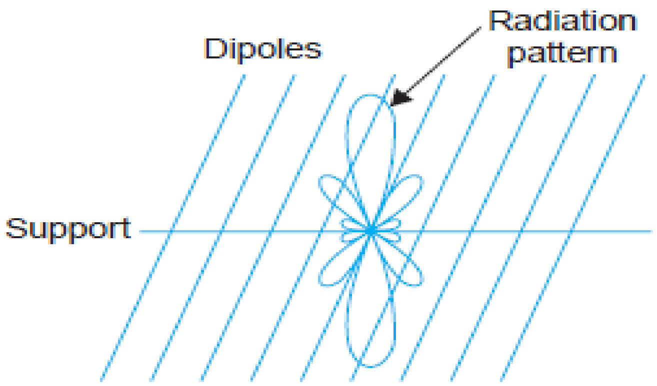

Fig. 9.13 (a). Broadside array and pattern.

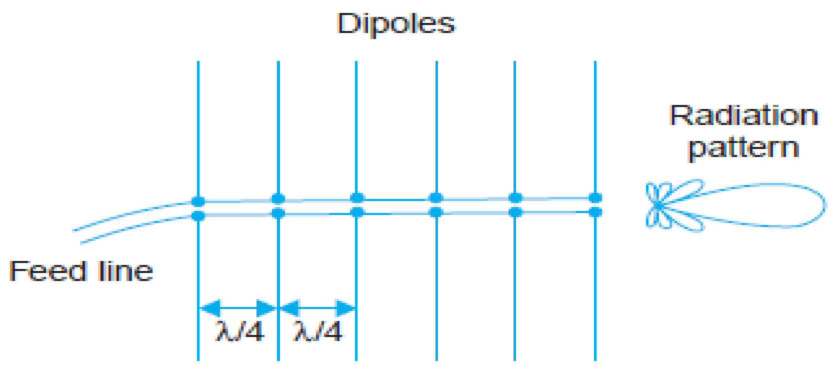

Fig. 9.13 (b). End-fire array and pattern.

Folded Dipole

The folded dipole is made of two half-wave antennas joined at the ends with one open at the centre where the transmission line is connected. The spacing between the two conductors is small compared with a half wave length.

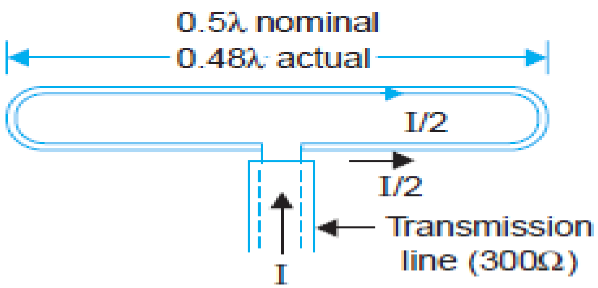

Fig. 9.14 (a). Folded dipole antenna.

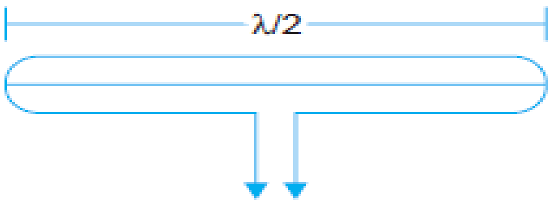

Fig. 9.14 (b). High impedance folded dipole antenna.

TELEVISION TRANSMISSION ANTENNAS

As already explained, television signals are transmitted by space wave propagation and so the height of antenna must be as high as possible in order to increase the line-of-sight distance. Horizontal polarization is standard for television broadcasting

Turnstile Array

To obtain an omnidirectional radiation pattern in the horizontal plane, for equal television signal radiation in all directions, an arrangement known as ‘turnstile array’ is often used.

Dipole Panel Antenna System

Another antenna system that is often used for band I and band III transmitters consists of dipole panels mounted on the four sides at the top of the antenna tower Each panel consists of an array of full-wave dipoles mounted in front of reftectors.

Combining Network

The AM picture signal and FM sound signal from the corresponding transmitters are fed to the same antenna through a balancing unit called diplexer. As illustrated the antenna combining system is a bridge configuration in which first two arms are formed by the two radiators of the turnstile antenna and the other two arms consist of two capacitive reactances.

TELEVISION RECEIVER ANTENNAS

For both VHF and UHF television channels, one-half-wave length is a practical size and therefore an ungrounded resonant dipole is the basic antenna often employed for reception of television signals.

Antennas for VHF Channels

Although most receivers can produce a picture with sufficient contrast even with a weak signal, but for a picture with no snow and ghosts, the required antenna signal strength lies between 100 and 2000 μV.

Yagi-Uda Antenna

The antenna widely used with television receivers for locations within 40 to 60 km from the transmitter is the folded dipole with one reflector and one director. This is commonly known as Yagi-Uda or simplyYagi antenna.

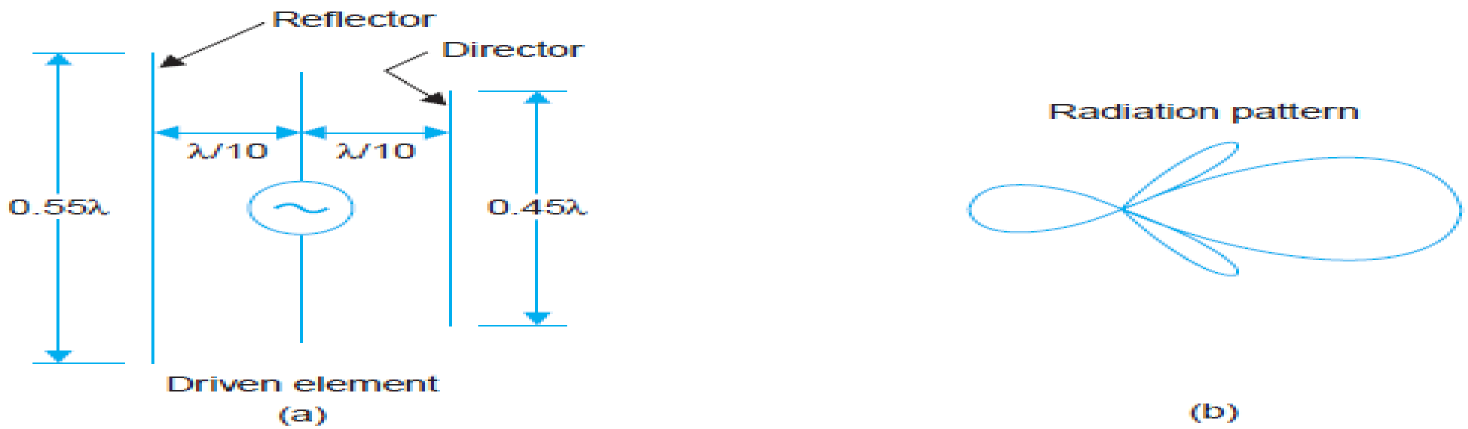

Fig. 9.18. Yagi-Uda antenna (a) antenna (b) radiation pattern.

Antenna Length

Antenna Mounting

Indoor Antennas

In strong signal areas it is sometimes feasible to use indoor antennas provided the receiver is sufficiently sensitive. These antennas come in a variety of shapes. Most types have selector switches

Fringe Area Antenna

In fringe areas where the signal level is very low, high-gain antenna arrays are needed. The gain of the antenna increases with the number of elements employed. A Yagi antenna with a large number of directors is commonly used with success in fringe areas for stations in the VHF band.

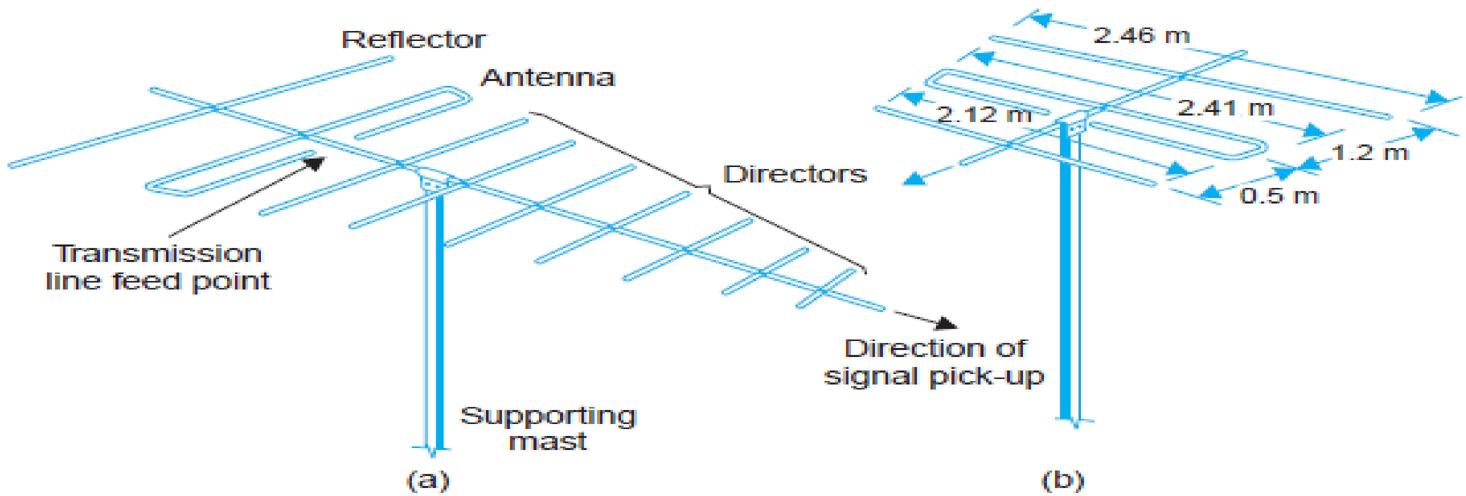

Fig. 9.19 (a) A typical Yagi antenna, (b) Channel four antenna.

Yagi Antenna Design

Multiband Antennas

It is not possible to receive all the channels of lower and higher VHF band with one antenna. The main problem in using one dipole for both the VHF bands is the difficulty of maintaining a broadside response.

Conical Dipole Antenna

The VHF dual-band antenna pictured in *is generally called a conical or fan dipole.* As shown in *this antenna consists of two half-wave dipoles inclined at about 30°* from the horizontal plane, similar to a section of a cone.

Fig. 9.21. VHF fan (conical) dipole with reflector (a) pictorial view, (b) spacing of elements.

In-line Antenna

Another combination antenna which is known as in-line antenna It consists of a half-wave folded dipole with reflector for the lower VHF band, that is in line with the shorter half-wave folded dipole meant for the upper VHF band.

UHF Antennas

The basic principle of antennas for picking up signals from stations that operate in the UHF band is more or less the same as that in the VHF band.

Bow-Tie or Di-Fan Antenna

This di-fan half-wave dipole is the simplest type of UHF antenna as the basic Yagi is for the VHF band. the dipoles are triangular in shape made out of metal sheet, instead of rods.

Parabolic Reflector Antenna

In this type of antenna the dipole is placed at the focal point of a parabolic reflector. The principle is the same as that of parabolic reflectors of the headlights of a vehicle though in an inverse way.

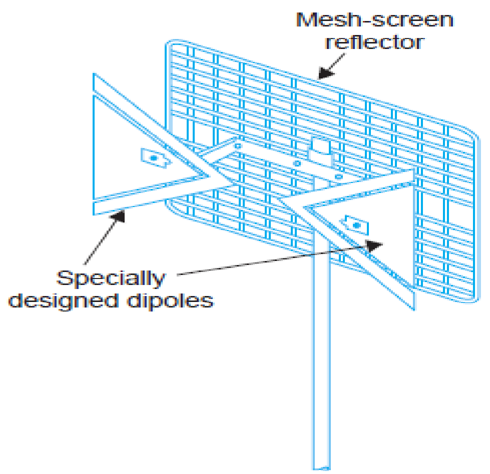

Fig. 9.23. Fan dipole UHF antenna.

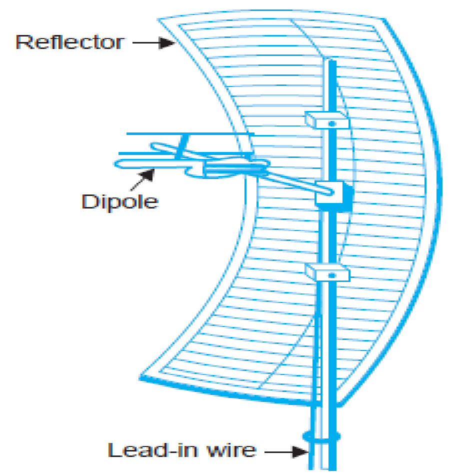

Fig. 9.24. Parabolic reflector antenna.

COLOUR TELEVISION ANTENNAS

The requirements to be met by colour television antennas are somewhat different than those for monochrome receivers. In monochrome receiver antennas, the emphasis is on higher gain while it may vary from channel to channel because of the wide frequency range.

Log Periodic Antennas

The stringent requirement of almost flat response besides high gain over any single channel has led to the development of a relatively new class of broadband antennas. The most popular of this type is the log periodic antenna. The name log periodic stems from the fact that the impedance of the antenna has a periodic variation when plotted against logarithm of frequency.

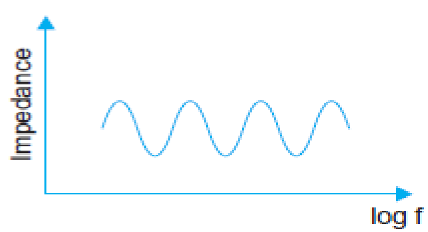

Fig. 9.26 (a). Periodic nature of the impedance of a log periodic antenna when plotted on a logarithmic scale.

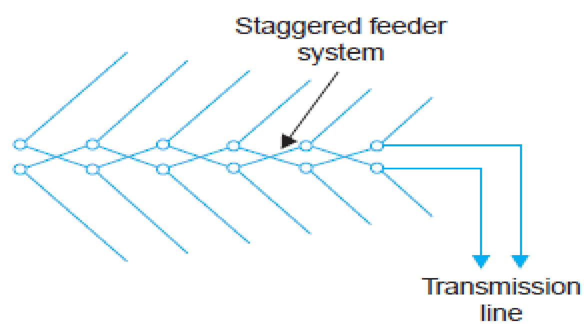

Fig. 9.26 (b). Constructional details of a log periodic antenna.

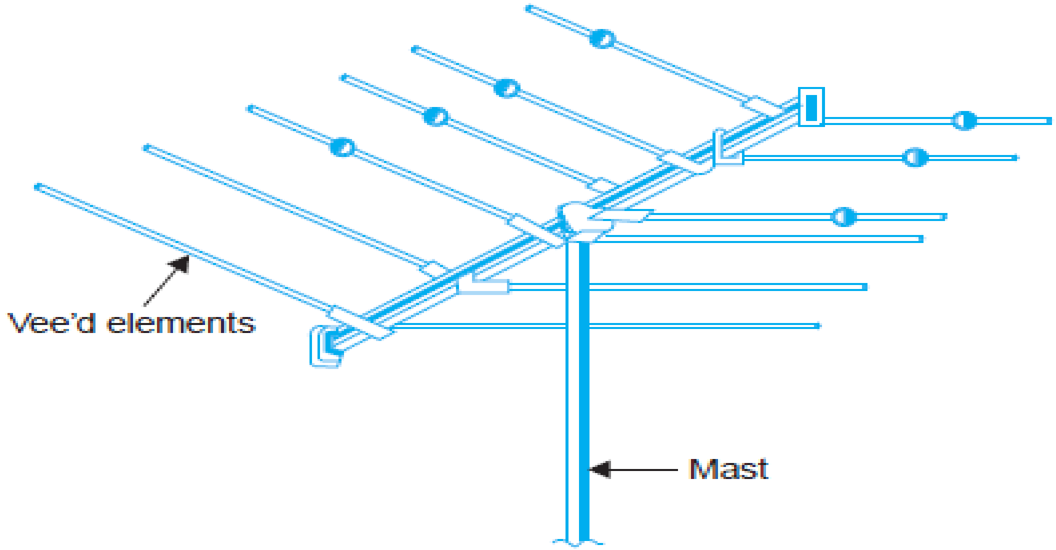

Fig. 9.27. A colour log periodic antenna. The elements are vee'd to eliminate dual phase problems.

When colour transmission is to be received from only one channel, there is no need for a specially designed antenna. For example, the antenna designed for monochrome reception on channel four only can also be used with good results for receiving colour transmission from the same channel.

THANK YOU