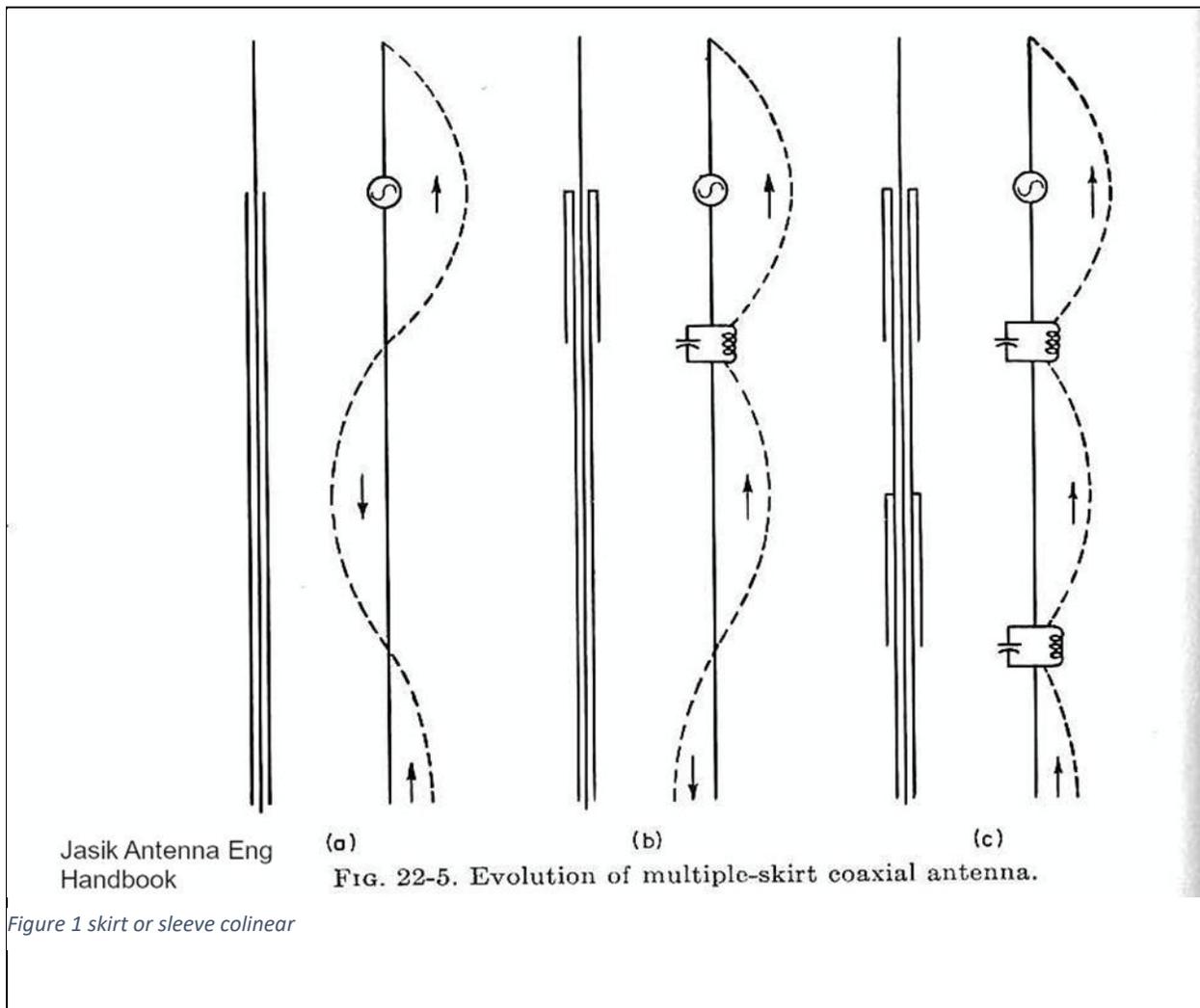


Understanding the W5GI Mystery Antenna and Other Stub-phased Colinear Antennas

The W5GI Mystery antenna is a simple stub-phased colinear antenna. Once stub behavior is understood, any stub phased colinear can be modeled in EZNEC and other programs. Let's look at how stubs work.

Coaxial Sleeves and Stubs

My first formal exposure to coaxial phasing and decoupling stubs occurred in the late 1960s with commercial VHF antennas in Jasik's Antenna Engineering Handbook:



A properly spaced $\frac{1}{4}$ wave skirt that is *open away from the feedpoint* forms a colinear phasing stub.

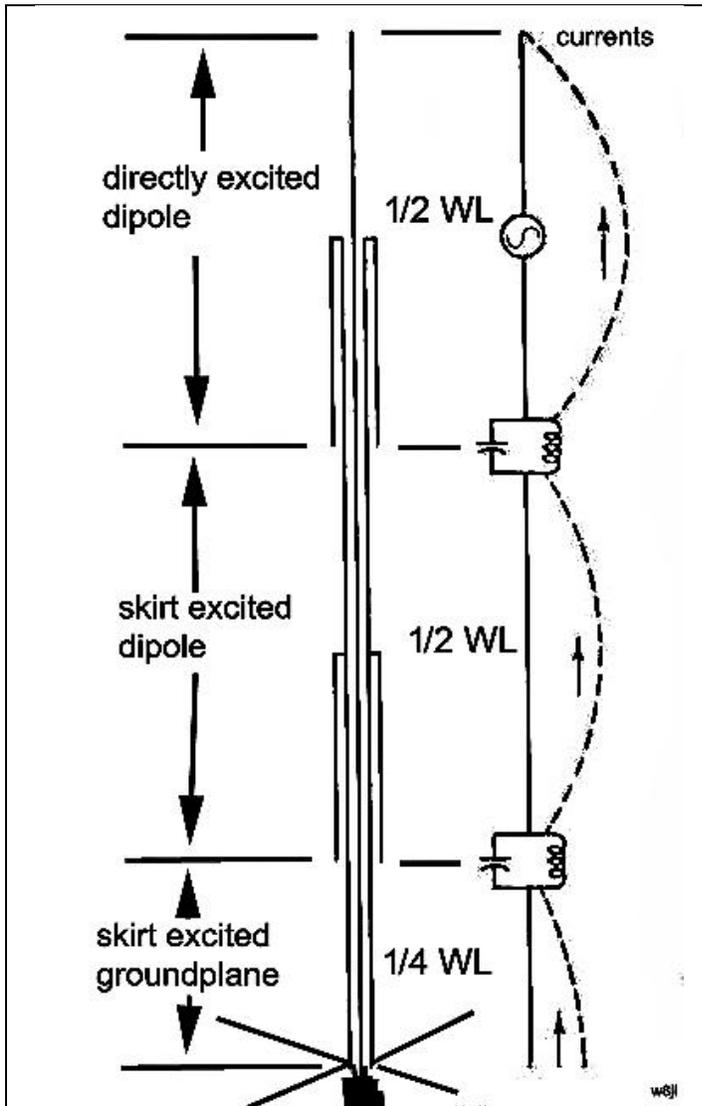


Figure 2 Skirt or sleeve colinear

This is two half waves and a $\frac{1}{4}$ wave in-phase. Down sloping the four radials would make it three half waves in phase.

By altering the open-end locations of the skirts or sleeves, we can change the system between colinear operation and simple skirt isolation or choke operation. Look at the open-end locations. Open toward feedpoint is generally a choke, while the open-end facing outward from the feed is a radiating skirt:

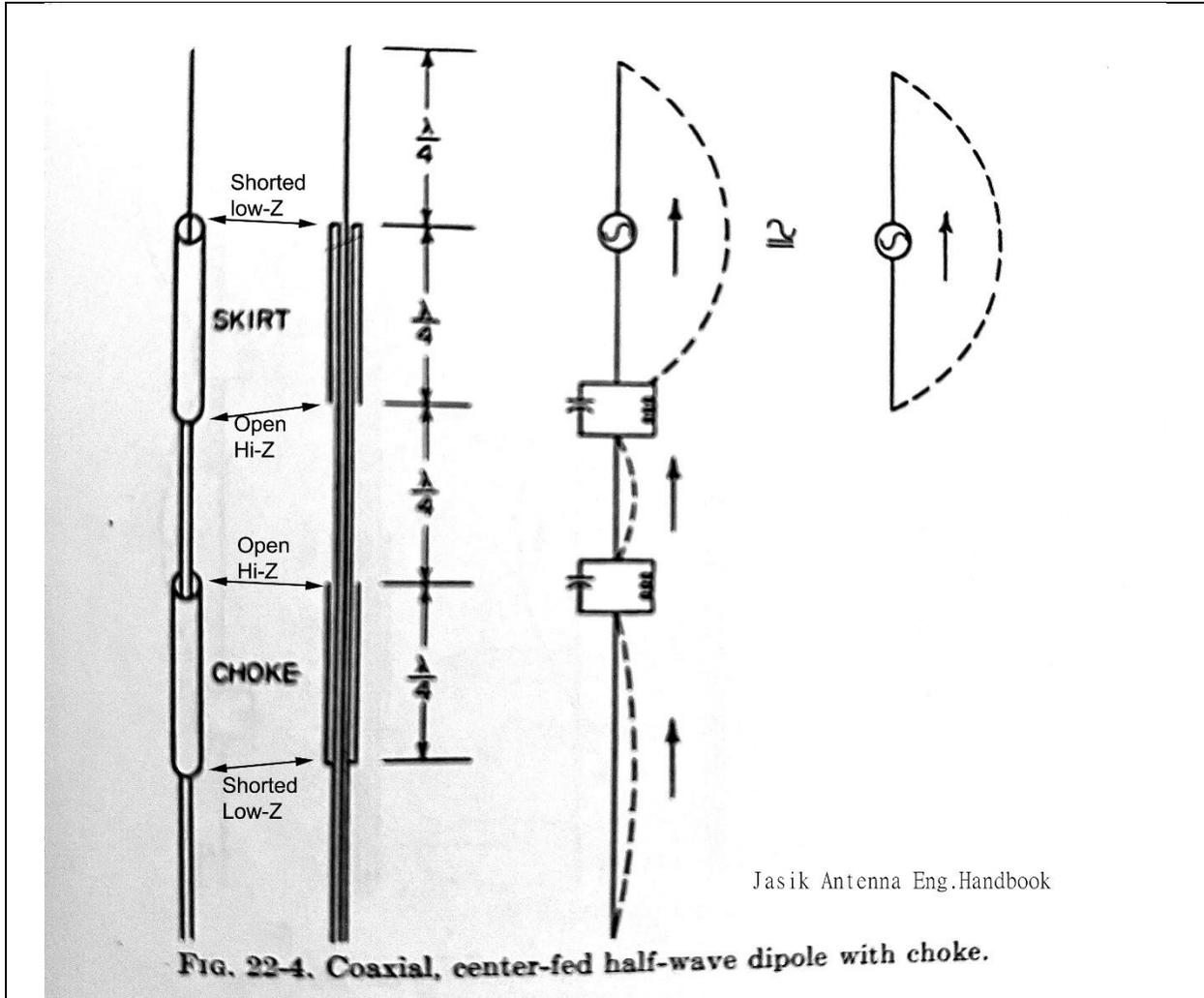
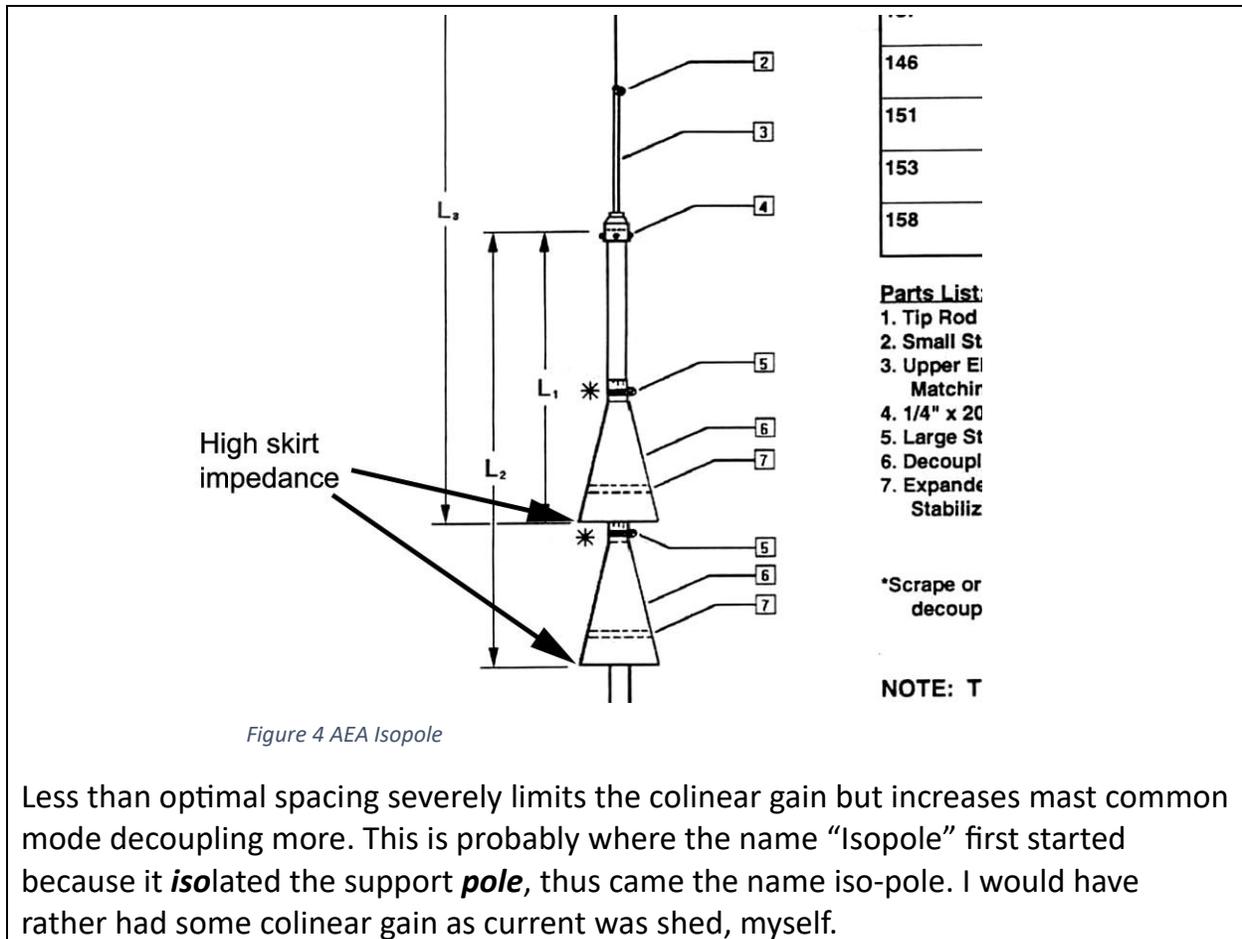


Figure 3

Notice open end of the choke is toward the feedpoint and spaced $\frac{1}{4}$ wavelength from the open end of the skirt or sleeve. The skirt is one end of a $\frac{1}{2}$ wave dipole.

The old AEA Isopole antenna is a skirt decoupled antenna; it is not a skirt colinear.



This all leads to the question "how do outer coaxial skirts change phase or decouple sections"? We need to understand the answer to understand the W5GI Mystery Antenna, the AEA Isopole, and other stub and skirt antennas. Understanding coaxial skirts will not only let us understand skirt antennas, but it will also let us understand coaxial feedlines. Coaxial lines and all concentric conductors at radio frequencies follow the same basic rules.

Skin Depth and Isolated Currents

Understanding these antennas, common mode currents, and the W5GI antenna requires understanding behavior of concentric conductors like coaxial cables and lines.

If the outer wall is thicker than many skin depths, a single center and single outer sleeve (we call it a shield in cables) forms **three** conductors. These conductors are:

- 1.) The outside surface of the center conductor

- 2.) The inside wall of the shield
- 3.) The outside wall or surface of the shield.

Shield skin depth forms an isolating or “insulating” area centered in the shield wall’s thickness. Current on the shield outside is independent of shield current inside...just as if the center of the shield wall is a good insulator.

At high frequencies:

Skin depth isolates the inside of the shield from the outside. This isolates the inside of the cable from the outside. The only unattenuated or direct connection to the shield inside is through cable flaws or at cable ends.

The shield **inside** is connected to the shield **outside** at shield breaks or at shield ends. The outside skin connects to the inner skin at those points.

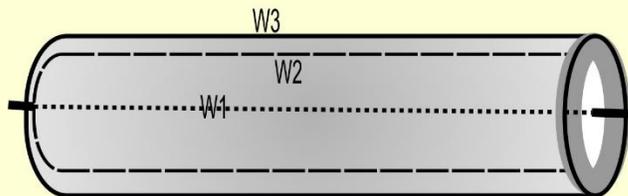


Figure 5 concentric conductors

Rules of concentric conductors at high frequencies:

- 1.) The only place(s) current can move between the cable inside and outside is at an open end.
- 2.) Current can exist on the center only when or if the inside of the shield has an opposing current of equal amplitude and opposite direction.
- 3.) Current on the shield outer wall surface can be any direction and level.
- 4.) Velocity factor of the inner conductor and inner wall is independent of the outer conductor velocity factor, and **corresponding dielectric factors always apply.**

The actual coupling and radiation, caused by common mode, is all on the shield outside! The shield outside becomes the radiating or coupling conductor.

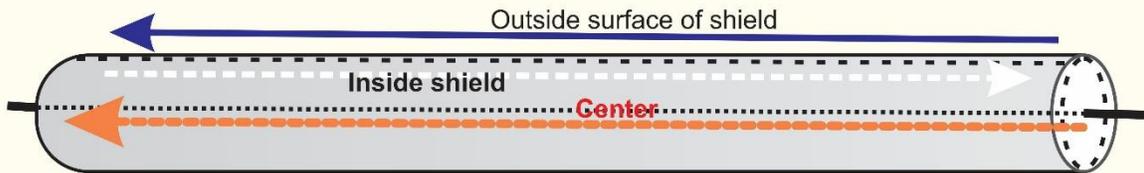


Figure 6 coaxial currents

Currents inside a line and on the outside of a line are independent. The only currents that can radiate are those that exist on the line's outer shield wall. Anything on the inside, no matter how you connect the cable, is confined to the inside unless the current spills over an open end.

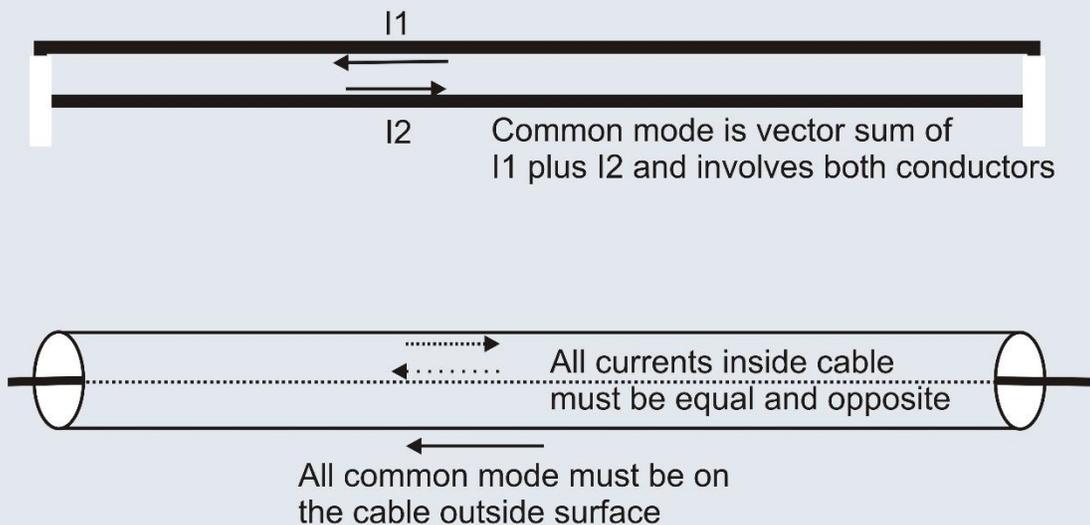


Figure 7 common mode

How a Stub Changes or Inverts Phase

To be continued