parallel-wire lines are never used for microwaves, whereas coaxial lines may be employed for frequencies up to at least 18 GHz. However, from the general point of view the limit is on the *lowest* usable frequency; below about 1 GHz, waveguide cross-sectional dimensions become inconveniently large. Within each broad grouping or type of transmission line there is an astonishing variety of different kinds, dictated by various applications. Lines may be rigid or flexible, air-spaced or filled with different dielectrics, with smooth or corrugated conductors as the circumstances warrant. Different diameters and properties are also available. Flexible lines are naturally more convenient than rigid ones, since they may be bent to follow any physical layout and are much easier to stow and transport. On the other hand, rigid cables can generally carry much higher powers, and it is easier to make them air-dielectric rather than filled with a solid dielectric. This consideration is important, especially for high powers, since all solid dielectrics have significantly higher losses than air, particularly as frequencies are increased.

Rigid coaxial air-dielectric lines consist of an inner and outer conductor with spacers of low-loss dielectric separating the two every few centimeters. There may be a sheath around the outer conductor to prevent corrosion, but this is not always the case. A flexible air-dielectric cable generally has corrugations in both the inner and the outer conductor, running at right angles to its length, and a spiral of dielectric material between the two.

The power-handling ability of a transmission line is limited by flashover between the conductors due to a high-voltage gradient breaking down the dielectric. It depends on the type of dielectric material used, as well as the distance between the conductors. Thus, for the high-power cables employed in transmitters, nitrogen under pressure may be used to fill the cable and reduce flashover. Since nitrogen is less reactive than the oxygen component of air, corrosion is reduced as well. Dry air under pressure is also used as a means of keeping out moisture. Clearly, as the power transmitted is increased, so must be the cross-sectional dimensions of the cable.

Since each conductor has a certain length and diameter, it must have resistance and inductance; since there are two wires close to each other, there must be capacitance between them. Finally, the wires are separated by a medium called the *dielectric,* which cannot be perfect in its insulation; the current leakage through it can be represented by a shunt conductance. The resulting equivalent circuit is as shown in Figure 17-2.

At radio frequencies, the inductive reactance is much larger than the resistance. The capacitive susceptance is also much larger than the shunt

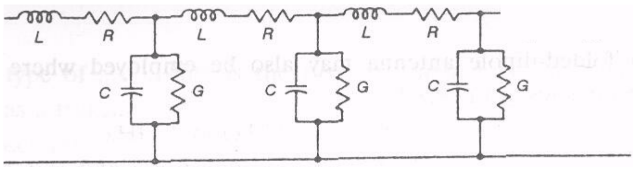

Figure 17-2. General Equivalent Circuit of Transmission Line.

conductance. Thus both *R* and *G* may be ignored, resulting in a line that is considered lossless (as a very good approximation for RF calculations). The equivalent circuit is simplified as shown in Figure 17-3.

It is to be noted that the quantities L, R, C, and G, shown in Figures 17-2 and 17-3, are all measured per unit length, e.g., per meter, because they Occur continuously along the line. They are thus distributed throughout the length of the line. Under no circumstances can they be assumed to be lumped at any one point.

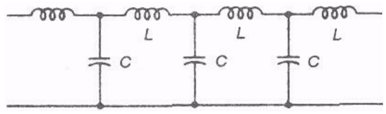

Figure 17-3. Transmission-Line RF Equivalent Circuit.

Part I. Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

.... 1. The parallel-wire line may be used to connect a broadcast transmitter to its grounded antenna.

.... 2. The parallel-wire line is usually used at HF and UHF frequencies.

.... 3. A parallel-wire line is more liable to radiation than a coaxial line.

.... 4. The higher the frequency, the higher the power loss a solid dielectric will have.

.... 5. The sheath around the outer conductor of a rigid coaxial air-dielectric cable is not of much use.

B. Choose a, b, c, or d which best completes each item.

1.The first paragraph mainly discusses ....….. .

a. the basic principles of transmission lines

b. the basic calculations for transmission lines

c. how signals are conveyed from one point to another

d. how transmission lines are arranged

2. As we understand from the text, ...… .

a. a rhombic antenna is the most popular antenna used in TV systems