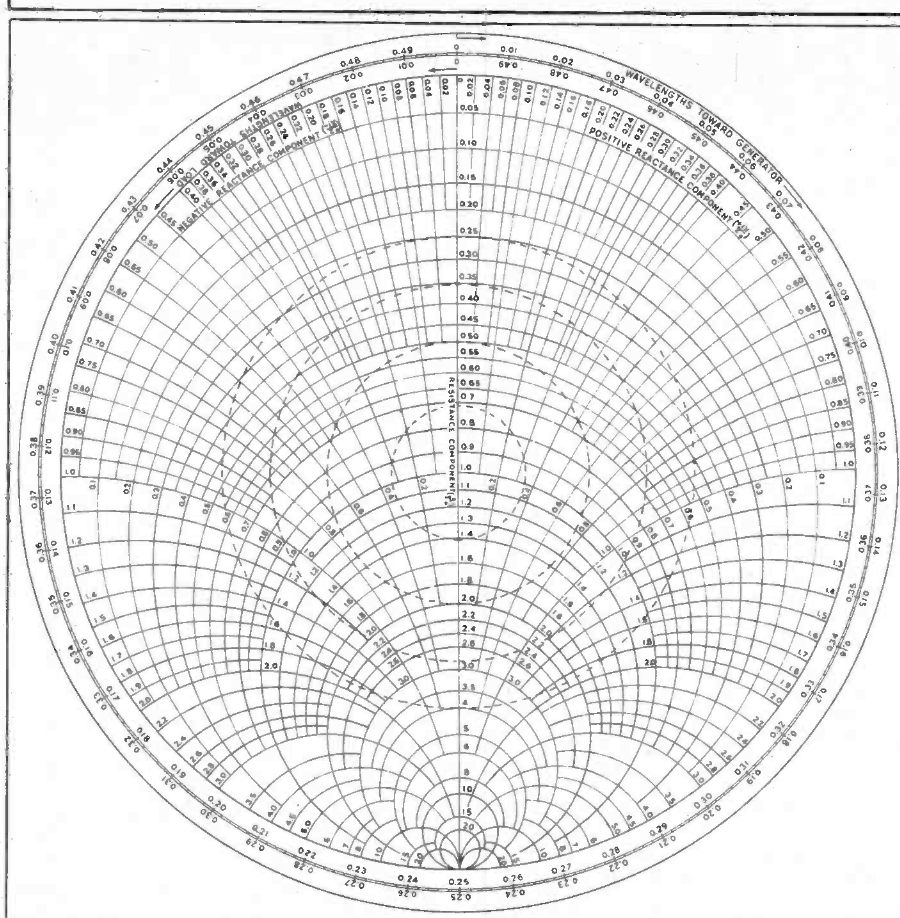

Fig. 3. Complete Smith chart, reproduced by kind permission of Chartwell.

are ohms inductive, the impedance (reactance) to AC of a coil, and these are taken as positive values as the j operator takes them through 90 deg clockwise.

Let's move round the Smith Chart, shown in simplified form in **Fig. 4**. Start at the right hand side of the chart. A point is marked *OC* for open circuit. This represents a point of infinite impedance (resistance and reactance). At the opposite side of this chart is a point marked *SC* for short circuit, where there is zero resistance and reactance. If we start from *SC,* there are three main routes we can take to reach *OC*. First, we can add pure resistance. This takes us along the diameter line of pure resistance until, eventually, if enough resistance is added, we reach *OC*. Alternatively, we can add series inductance which takes us along the circumference of the circle in a clockwise direction until eventually we reach *OC*. Thirdly, we could add capacitive reactance which goes anticlockwise along the perimeter to reach, eventually, *OC*.

Take a slightly more practical case. Assume a value of ½ ohm resistive. We want to make that up to 1 ohm resistive. We could just add ½ ohm in series to go straight along the resistive line to our objective. But let's be sneaky. Let us add 1 ohm of inductive reactance (coil) in series. This takes us from point **A** in **Fig.** 4 around the circle of constant resistance 0.5 until it cuts the reactive arc 1 at point **B**. Now add series resistance of ½ ohm. This takes us down the line of constant reactance 1 to point **C**. We now want to go in an anticlockwise direction. This means capacitive reactance. So add 1 ohm in capacitive reactance in series. We

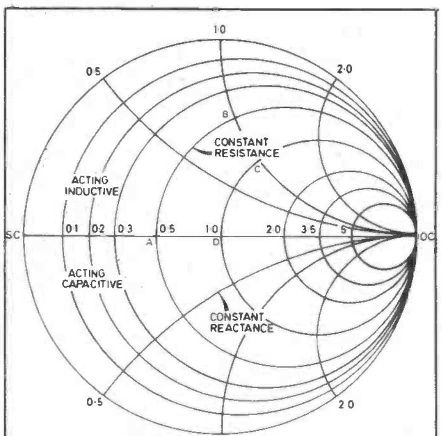

Fig. 4. Simplified Smith Chart.

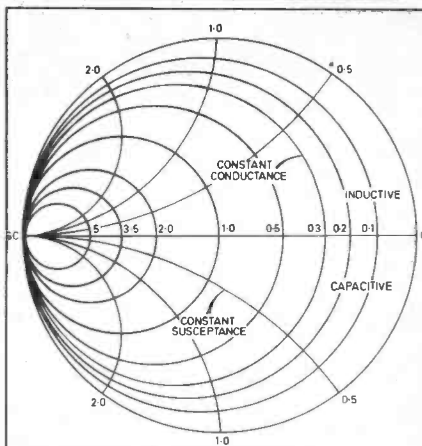

Fig. 5. Parallel impedances (admittances).

now travel along the line of constant resistance 1 from the point + 1 reactive by a distance of − 1 reactive, which brings us to 1 + j0, the point **D**. We have now produced a NETWORK to match ½ ohm to 1 ohm. In doing so, we have learned to move round the Smith Chart.

The problem with this is that the chart only works as it stands for series components. In practice, we need parallel components to get away from the dissipative resistances. Sneaky to the end, we just turn the chart through 180° and look at it the other way up. We now call the scales MHOs conductive and susceptive. The mho (or Siemens) is an inverse ohm. We now have a chart which works for parallel impedance, or more properly admittances, **Fig. 5**. So:

where
$Z = R \pm jX$ Impedance
$Y = G \mp jB$ Admittance (note reversal of + and - signs)
$G = R/(R^2 + X^2) = 1/R$ when $X = 0$
$B = X/R^2 + X^2) = 1/X$ when $R = 0$

For a resistance and coil, $Y = G - jB$; for a resistance and capacitor $Y = G + jB$, which is why the + and − signs are reversed above.

Most matching networks are designed for a pre-determined value of Q, the magnification factor. For VHF power amplifiers, this will be about 10. As you will know, the value of Q affects the bandwidth of the amplifier. It is necessary to draw lines of constant Q on the chart. Draw a line perpendicular to the main diameter going through the unity resistance point. (**Fig. 6**) Measure the length from the perimeter to the line of pure