Fig. 6. Q arcs (for Q = 10).

Fig. 7. Input matching network to be constructed.

Fig. 8c. Finding the value of the series inductor, X_{L1}.

resistance (L). Using compasses, draw the arc passing through the SC and OC points with the compasses' point on the vertical line at distance L/Q from the pure resistance line in both the inductive and capacitive halves of the chart. These two arcs form the lines of constant Q.

In practical terms, the input and output impedances are of the order of 1 to 10 ohms for transistors used in VHF and UHF power amplifiers. The usual cable impedance to which we want to match the amplifier is 50 ohms. The range over which the chart can easily be read is 0.025 to 20 ohms. So a normalising value is chosen so that all values can be resolved. In the case of transistor amplifiers, normalise to 10 ohms absolute is 1 ohm on the chart. In the aerial case shown later, a value of 200 ohms is used, or it could have been 180, or whatever is needed. With 10 ohms, all values we encounter in the design of matching networks for transistor amplifiers are easily resolved. Normalising is done purely to make the range of values to handle.

Now we shall take a practical example to see how to make our way round the Smith Chart. If you look in the RSGB Radio Data Reference Book, 4th Ed., 1977, you will see on page 69 the calculations for a 25W PA using a Mullard BLY89A. Take the input network for this, fed from a 50 ohm source. The transistor has in input impedance of 1.7 + j1.4 ohms. We normalise at 10 ohms is 1, so the input impedance of the transistor becomes 0.17 + j0.14. The matching network whose component values we are going to find is
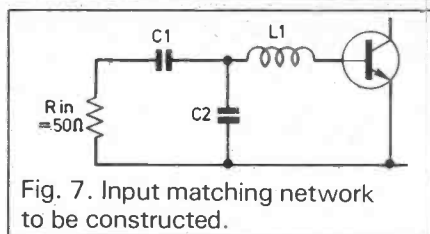
shown in **Fig. 7**. The simplified Smitch Chart where the values are plotted is given in **Fig. 8**. The "Q" value of the amplifier in this example is 10 (**Fig. 8A**).

Take the point 0.17 on the resistive axis, and travel round the line of constant resistance until we cross the inductive line +0.14 (**Fig. 8B**). This gives us the start point for our calculations. The first component is a series inductance L, so we continue in the same direction clockwise until we reach the
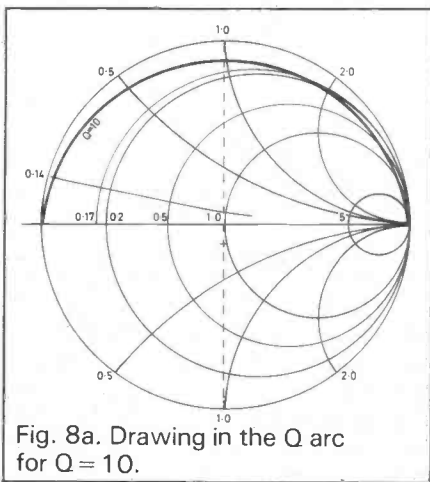

Fig. 8a. Drawing in the Q arc for Q = 10.

Q = 10 arc (**Fig. 8C**). It does this at $X_L = 1.7$. We started at X = 0.14, so the value of the inductor is 1.7 − 0.14 = 1.56 ohms.

The next component is a parallel capacitor, so we change to the admittance form by turning over the graph paper. I used an overlay system as recommended in
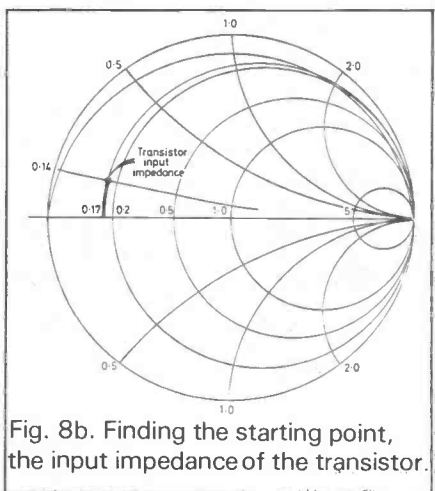

Fig. 8b. Finding the starting point, the input impedance of the transistor.
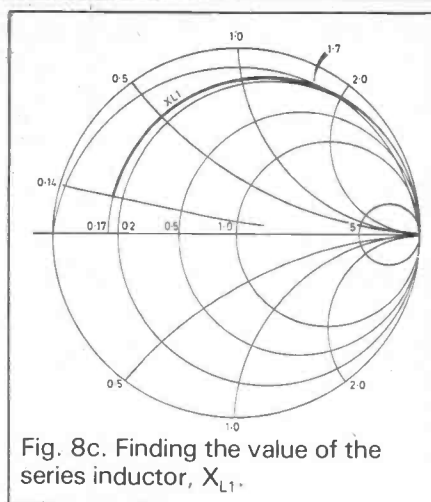
Phillip Smith's book. One American article on the Smith Chart used graph paper with double markings, but this does not seem to be available in this country. Later on, we shall see there is a simpler method of using one sheet of graph paper to convert from impedance to admittance. However, we know the final destination is reached after a series capacitor at a constant
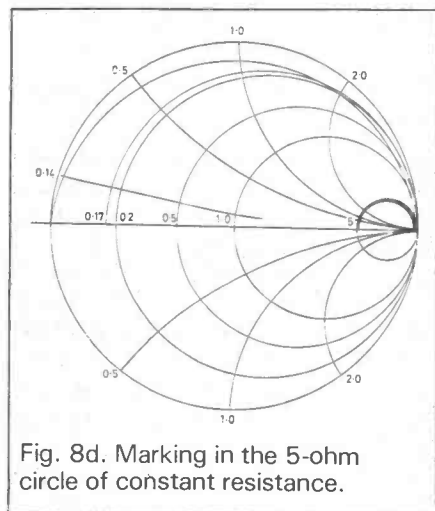

Fig. 8d. Marking in the 5-ohm circle of constant resistance.

resistance of 5 ohms. Hence before we mark in the parallel component, we mark the circle of constant resistance 5, **Fig. 8D**.

Looking through the overlay, **Fig. 8E**, we now see the equivalent line of constant conductance. Take the line of constant susceptance which passes through the point X_L and continue this down until it cuts the circle of constant conductance. We can see from the chart that this line equivalent to C in parallel runs from 0.575 mho to 0.085 mho, so the capacitance will have a susceptance of 0.49 mho.

Reverting to the impedance mode, we see that the line equivalent to C in parallel cuts the