the core to operate at. Break the coaxial connection between the aerial tuner/signal generator and the receiver. Slip the core under test onto the inner of the coax and rejoin the cable. The signal strength of the signal monitored on the receiver will now have dropped. The precise fall off will equate to the reactance introduced by the permeability of the core. See **Fig. 2.** The average permeability general purpose RF ferrite core will produce about ½ to 1 S-point drop over the straight through connection between generator and receiver at 5MHz.

It is possible to deduce from this single measurement that your would need roughly two turns on the core for a 50 ohm winding or six turns for a 450 ohm winding. The rule of thumb is that two turns are required on the core for a 50 ohm winding when using a typical core. Beware though. Some types of core will show either no attenuation on the test jig indicating that they are very low permeability VHF devices — no use for HF designs — or massive attenuation at the 5MHz test frequency indicating that they will probably be very lossy.

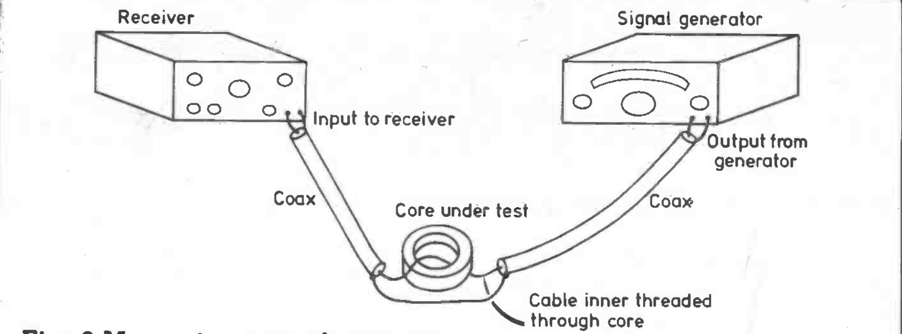

Fig. 2 Measuring core characteristics

How much power?

Although this question doesn't arise very often in receiver design, the power handling characteristics are all important in transmit applications. The perpetual energising and de-energising of the RF cycle in the magnetic material causes some losses due to the hysteresis. These losses amount to fractions of a dB at low frequencies. However, since the losses, which show up as heating of the core, are a function of the number of times that the magnetic state switches in a given time, while the actual hysteresis is a function of the peak flux induced into the core, the two characteristics combine to place a power/frequency limit on the core. There is a further loss. Eddy currents produce losses and associated heating which rise fairly linearly with frequency. All in all, there are definite top limits on what a core can do. If you go beyond that point, the core heats up towards its Curie point at which all losses increase dramatically with an associated collapse of permeability. After the Curie point, it's thermal runaway all the way.

Typical Curie temperatures are around 150°C. They could be more. They could be much less. In the practical case a temperature rise of around 50°C is about the limit.

Fig. 3 shows a power test jig. Make a 1:1 transformer out of the core under test and connect in between a transmitter and power meter/dummy load combination. Wind up the power slowly. Transmitters with variable drive are essential for this test, and an additional SWR meter ahead of the input to the transformer is a distinct advantage. An eye on the power meter and a finger on the core will tell all that you need to know about the RF characteristics of a given core type. For guidance, small ones handle in the region of 3W without distress while the big TVI rings, several tens of watts.

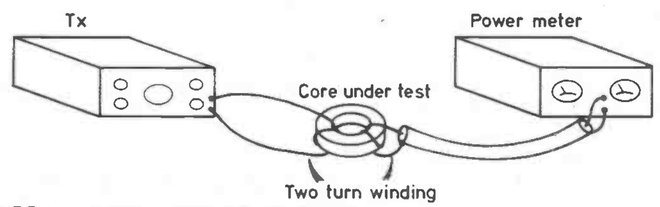

Fig. 3 Measuring power handling

Transmission line transformers

Whenever the discussion comes around to this particular topic, it never fails to amaze me how many otherwise clever people get their undergarments in a twist. They will witter on *ad nauseam* about the differences and even try to kid you that normal transformer laws no longer apply.

The difference is purely this. A conventional two winding ie, primary and secondary, transformer is wound in such a way as to minimise the capacitance both from one winding end to the other, and between the windings. The reduction of the interwinding capacitance thus enhances the high frequency response.

The transmission line transformer regards capacity as a fact of life and seeks to use it to *boost* the frequency response. The windings are introduced onto the core in such a way as to distribute the self capacitance evenly throughout the winding length. This forms a transmission line with the distributed inductance of the winding. Transmission line structures can operate predictably only if the winding capacitance is distributed very evenly, and preferrably concentrated between adjacent turns. Bifilar winding — that is the simultaneous winding of two strands, side by side, on the core — achieves this as does the use of thin coaxial cable. The only other provision is that the transmission line structure 'sees' a termination somewhere near its characteristic impedance. Despite what some of the pundits say, there is no practical difference in operation between transmission line and conventional transforms at low frequencies. Turn for turn, the characterisitcs are decided entirely by the properties of the ferrite core. At high frequencies the story is different. Addition of waves on the transmission line (by