be detected with the type of conventional absorption wavemeter so beloved of the RAE examiners. It is essential to have an instrument which can detect spurii a couple of MHz out from the operating frequency. The best way to achieve this within the confines of the amateur radio station is to splice a tap on a high 'Q' tuned circuit across the feeder going to a 50 ohm dummy load. The other side of this combination is connected to the transmitter under test through a conventional sensitive SWR meter. With the tuned circuit taken out, a one to one SWR should be obtained whatever the condition of the transmitter. With a correctly tuned tank in circuit the same state should be obtainable. However, if the TX has got substantial spurii, these will be reflected as increased SWR. Furthermore, this SWR will alter with adjustment of the various PA trimmers. In particular, look for any discontinuity as you adjust the circuit. Spurious emissions of this kind tend to come and go at various positions of the circuit trimmers. When a spurious appears or disappears there will be a distinct kick or step change recorded on the SWR meter.

That describes the first type of negative resistance to affect these 'simple' PA circuits. The other — high frequency — kind relates to the parametric affect present in all bipolar transistors (and indeed to the majority of FETs but that is another story). The basic problem is that the base-collector junction is typically a reverse biased diode complete with all the depletion layers and general device physics associated with diodes. In short it means that the average bipolar power transistor behaves as though it has a variable capacitor connected between the collector and base, the exact value of the capacitance dependant on the instantaneous collector-base voltage. In other words the junction is a varicap, parametric diode, call it what you will.

Varactor diode

There are certain circumstances when the parametric effect can be used to good advantage. You can make highly efficient doublers and triplers simply by pumping these diodes with a fundamental voltage while siphoning off the harmonic current which flows., It's an interesting point, this. You apply a fundamental RF voltage across a reverse biased diode and might reasonably expect a fundamental current to flow in what is after all, pure capacitance. Not a bit of it. The capacitance actually changes during the RF voltage cycle with the result that it is harder for the applied voltage to change nearer the bottom (more capacitance). The current that flows in the device is forced to change its value twice as often than if it were purely fundamental. The current that flows is double the fundamental frequency.

If the harmonic current is forced back into the device by short-circuiting it with a series resonant tuned circuit, it becomes a harmonic voltage superimposed on a fundamental which interact to produce the next harmonic up. Thus a tripler circuit is born.

The typical PA transistor will do all these things. It is not always appreciated but a humble 2N3866 will work splendidly in most of the parametric tripler circuits which are published from time to time. The emitter and base are connected together with the collector used as the cathode. It is robust, efficient, cheaper and easier to obtain than a custom parametric device. But back to the business in hand of taming wild transistor PA circuits.

Under hard driving conditions, the typical circuits of **Fig 1** and **2** will cause high values of harmonic current to flow in both the collector and base circuits: Horrible prospect, isn't it? That same parametric current generated internally within the circuit device flows simultaneously in both the input and output circuits linking them together in a harmonic mash. The more I start to think about it, the more astonished I am that these things ever work at all.

There is a great temptation

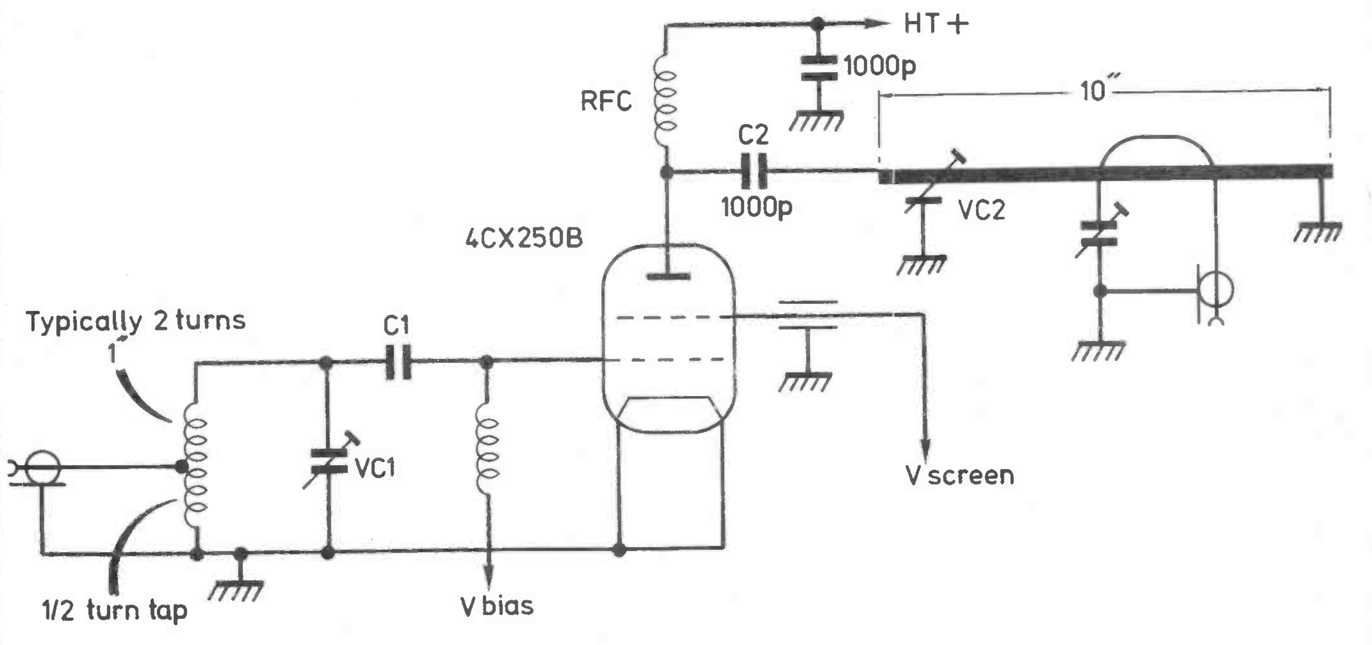

FIG.3. This 4CX250B circuit is trouble