where f_s is the signal frequency, f_r is the frequency of the i-f amplifier or radio receiver, and n is the harmonic number.

The desired and undesired responses may be fairly close to each other if the frequency is high and a high harmonic of the local oscillator is used. For instance, if the signal frequency is 300 Mc, the i-f 30 Mc, and the third harmonic of the local oscillator used, true responses will be obtained at local-oscillator frequencies of

$$\frac{300 - 30}{3} = 90 \text{ Mc} \quad \text{and} \quad \frac{300 + 30}{3} = 110 \text{ Mc}$$

If the second harmonic of the 300-Mc signal is present, it will produce responses in the vicinity of 100 Mc at

$$\frac{600 - 30}{6} = 95 \text{ Mc} \quad \text{and} \quad \frac{600 + 30}{6} = 105 \text{ Mc}$$

To minimize possible confusion, keep the local-oscillator harmonic low and the i-f high, thus reducing the number of possible responses and spreading them over as wide a frequency band as possible. For instance, if the fundamental of the local oscillator were used in the previous example, true responses would be obtained at 270 and 330 Mc, and responses due to the second harmonic of the 300-Mc signal at 285 and 315 Mc. Type 874-F Low-Pass Filters are also useful for eliminating undesired harmonics.

8. LOCAL-OSCILLATOR OUTPUT VOLTAGE. The output voltage required from the local oscillator depends on the signal source impedance at the local oscillator frequency, since the signal circuit appears directly in shunt with the crystal, and the 250-ohm resistor is connected in series with the local-oscillator input. Adjust the local-oscillator output so that, with the signal source connected, the crystal diode current, as measured with a d-c milliammeter across the output terminals, does not exceed 5 milliamperes. Currents as low as 0.2 ma can be used with no appreciable loss in sensitivity. At lower currents the sensitivity drops rapidly. In some instances the signal circuit may effectively short-circuit the crystal, causing a loss of all crystal current. To remedy this, vary the frequency slightly or change the length of line between the signal source and the mixer. The insertion of a section of Type 874-L10 Air Line is usually a satisfactory solution.

9. CRYSTAL REPLACEMENT. To replace the Type 1N21-B crystal diode, first remove the branch section of the mixer rectifier by unscrewing the knurled cylinder from the body of the unit, and then remove the small screw holding the spring that bears on the tip of the crystal cartridge.