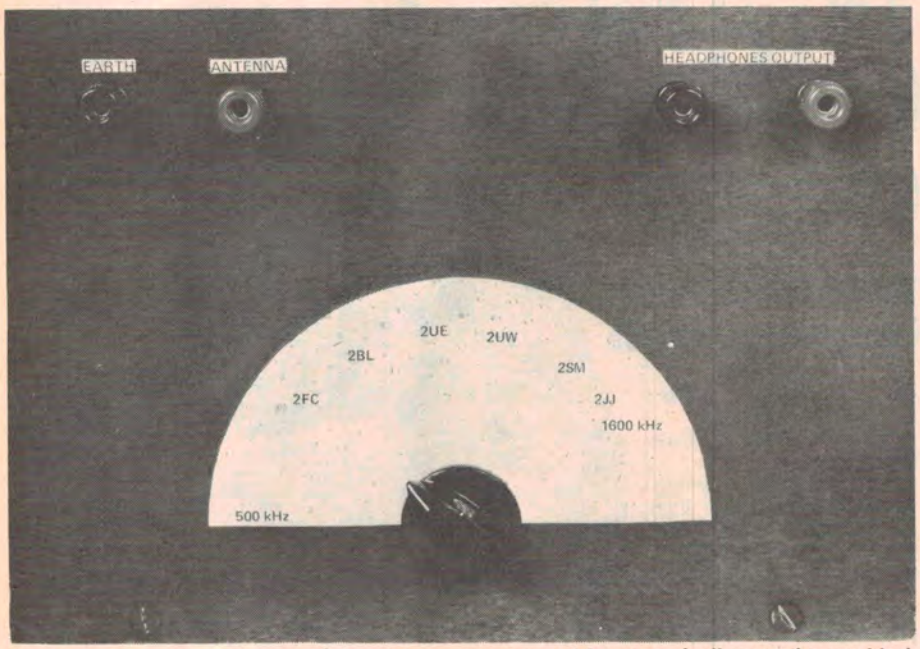
Two crystal sets to build

The crystal set was once every radio/electronics hobbyist's 'starter' project. Perhaps it should be returned to its former popularity. Beginner or not, try these two now.



We built our crystal sets on a chipboard base with plywood front panel, all sprayed matte black.

"IN MY DAY", said the old timer in his quavering rasp, "we built crystal sets with spider-wound coils and galena-and-catswhisker crystal detectors and listened to the stations on 2000 ohm Brown's headphones".

In deference to the old gent, we won't mention the era but that was a pretty hot-shot (read 'sophisticated') set-up in his day.

Modern beginners in electronics are more likely to cut their teeth on a project that includes at least one integrated circuit or a handful of transistors plus the usual resistors and capacitors.

Some hobbyists subscribe to the view that, if you haven't built a crystal set (*and* got it going!), then you haven't *lived*.

How it works

The crystal set basically consists of a tuned circuit, which selects the wanted station, and a detector, which separates the sound (music, speech etc) from the radio transmission, producing an audio voltage which is then impressed on the earpiece or headphones. This audio voltage is an exact copy of the sound from the radio station which has been superimposed on the radio signal at the transmitter.

The aerial receives all the electromagnetic radiation (radio waves) in your area. These signals have to be separated somehow, and the one station you're interested in must be sorted out from the mess otherwise, the signal will be hopelessly lost in the scramble of thousands of stations.

To select one station at a time we use a tuned circuit consisting of a coil of wire connected to a tuning capacitor. Signals picked up by the antenna cause the tuned circuit to 'resonate'. That is, signal currents close to a particular frequency will be greatly magnified, while those away from that frequency will be reduced, or attenuated.

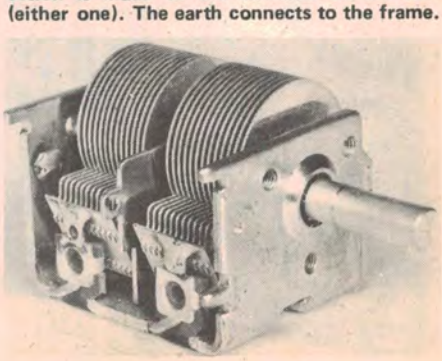
In our tuned circuit the frequency of resonance is determined largely by the number of turns on the coil, its diameter, and the value of the tuning capacitor. One way to tune the circuit over a range of frequencies is to use a fixed coil and make the capacitor variable. This is what we have done as components are convenient and readily obtainable. The variable capacitor enables us to tune the frequency range of interest, about 550 kHz to 1.6 MHz. Increasing the capacitance (plates more in mesh) decreases the resonant frequency; with the plates more out of mesh (less capacitance) the resonant frequency is increased.

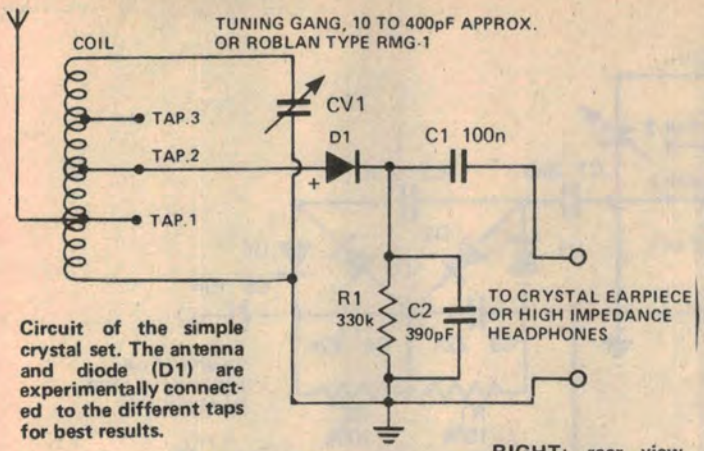
Now different stations can be selected, removed from the mess, and passed on to the detector. The size of the coil and the range of the capacitor must be selected to give a frequency coverage over the range of stations that you want to listen to.

Since tuned circuits are not perfect — nothing ever is in electronics! — frequencies close to the resonant frequency are also passed to the detector. The ability of a tuned circuit to select only one frequency is called its 'selectivity'. Our crystal set has a rather poor selectivity, but it's adequate for our purposes.

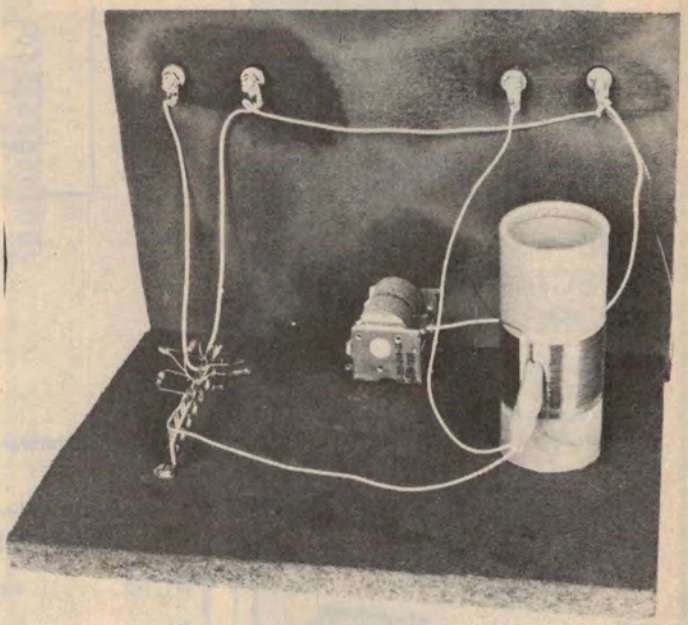
After the signal has been selected it is fed to the diode detector. At this point it is a high frequency radio signal, called a carrier, with the audio (music etc) superimposed or 'modulated' onto it. If this signal was fed directly to an earpiece, nothing would be heard as the earpiece cannot respond to the radio frequency signal. The diode "rectifies" the signal, leaving a half-wave radio signal which varies in amplitude with the audio signal. The fixed capacitor

Dual-gang tuning capacitors like this one are the most commonly available type. Only one section is used for these projects. The fixed plates are insulated from the frame and connection is made to the terminal on the side (either one). The earth connects to the frame.





Circuit of the simple crystal set. The antenna and diode (D1) are experimentally connected to the different taps for best results.



RIGHT: rear view of the crystal set showing placement of components and interconnections.

The dial on the front panel was cut from cardboard and lettered with rub-down lettering (see opposite page).

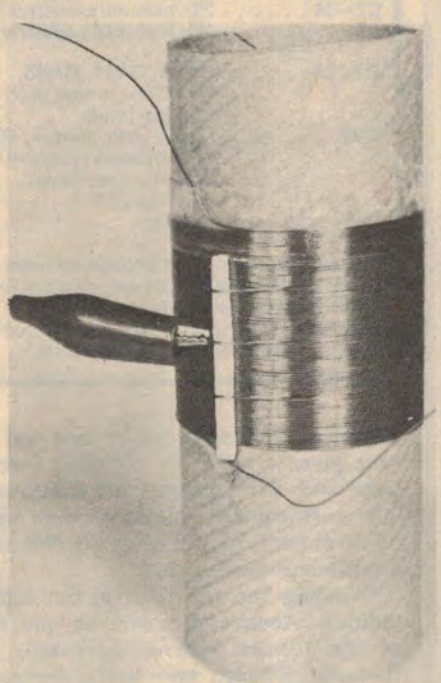
from the diode to earth 'shorts out' or 'bypasses' the RF signal, leaving the audio which is then fed to the earpiece.

In the first circuit, a single diode is used which gives good results, especially in areas with a local station, and is very easy to construct. The second circuit uses a more complex 'voltage multiplier' detector. This multiplies the signal level by four, increasing the volume in the earpiece. This circuit is commonly seen in high voltage power supplies.

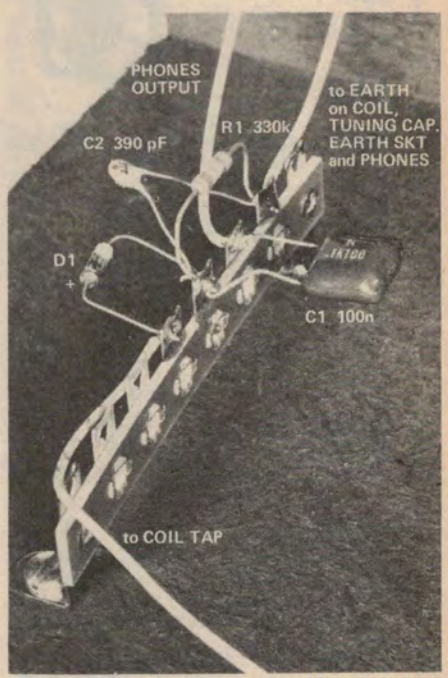
Construction

We built our two crystal sets on a chipboard base fitted with a plywood front panel. The tuning knob, terminals for the antenna and earth, and the earphone socket are mounted on the front panel.

The tuning capacitor we used was a common type available from most suppliers. This is the most expensive part in the set and a variable capacitor from a discarded mantle or floor-model radio will do equally as well. Some tuning capacitors may have two sections. If you obtain one of these 'dual-gang' capacitors, only use one section. ▶



We wound the coil for these projects on a former cut from a cardboard mailing tube. The matchstick is slid under each of the turns to be tapped. Clean the enamel from the wire at each tap to get a good connection.



The components for our simple crystal set were mounted on an eight-lug tag strip screwed to the baseboard.

PARTS LIST - ETI 266

R1 . . . . . .330k ½W, 5% resistor

C1. . . . . .100n greencap capacitor
C2. . . . . .390p ceramic capacitor

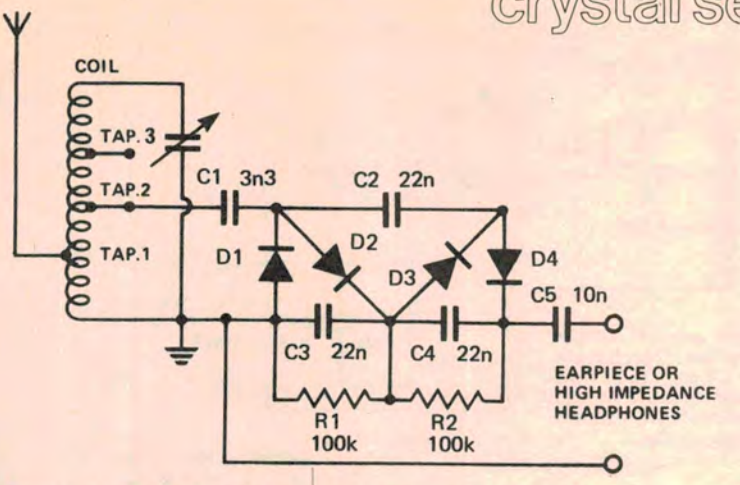
CV1. . . . . tuning gang approx. 10-400p, Roblan type RMG1 or similar, see Shop-around, p. 83.
D1 . . . . . OA90, OA91, OA95, OA202 or similar germanium diode
Coil. . . . . see text

Crystal earpiece or *high impedance* headphones; miniature jack socket to suit earpiece or terminals to suit headphones; screw terminals for aerial and earth connections; base board and front panel (see text).

TABLE 1

NUMBER OF TURNS FOR WIRE GAUGE

COIL DIA.	22 SWG	24 SWG	26 SWG	28 SWG	TAPS
30 mm				110	at ¼, ½ and
40 mm			96	90	¾ of the turns.
45 mm		88	80	70	You may tap
50 mm	82	72	68	60	every ten turns
55 mm	71	64	60	52	if you wish
65 mm	61	56	54	47	for more range
70 mm	54	52			of adjustment.



The voltage-multiplier crystal set provides more volume in your earphones.

PARTS LIST - ETI 267

R1, R2 . . . . . 100k ½W, 5% resistor

C1. . . . . 3n3 ceramic capacitor
C2–C4 . . . . . 22n ceramic capacitor
C5. . . . . 10n greencap capacitor

D1–D4. . . . . OA90, OA91, OA95, OA202 or similar germanium diode
CV1. . . . . tuning gang, approx. 10-400p, Roblan type RMG1 or similar, see Shop-around, p.83.
Coil . . . . . see text

Crystal earpiece or *high impedance* headphones; miniature jack to suit earpiece or terminals to suit headphones; screw terminals for aerial and earth connections; base board and front panel (see text).

Various coil sizes can be used and we have given a table for different former sizes and wire gauges. All these coils will work equally well on formers made of cardboard, plastic or wood. We used a cardboard mailing tube.

Winding the coil is easy, but rather tedious. Anchor the wire at one end of the former with adhesive tape, or threaded through two holes, and start winding. The coil must be 'tapped' at ¼, ½, and ¾ of the winding. To do this, slide a piece of match stick under the turn to be tapped to raise it above the other turns, as shown in the photo. When the coil is finished, fasten the end as you did the start. You could coat the ends with five minute Araldite to hold the windings in place. Carefully scrape the enamel off the wire at the tapping points.

The other components can be mounted on a tag strip, as we have done, and flying leads with small alligator clips taken to the tapping points on the coil.

Getting them going

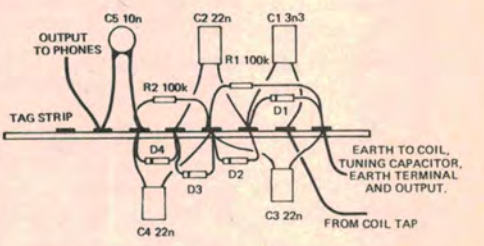
The performance of your crystal set will depend on the length and height of the antenna and the distance from the station. Remember, crystal sets are very crude devices compared to modern radios, and require long antennas, especially if you live a long way from a station.

An antenna can be made by running a long wire from the eaves of your house to a tall tree or mast, as shown in the accompanying illustration. The wire can be any gauge as long as it can support itself, and can be insulated or uninsulated. NEVER run an antenna wire near or above mains electricity wires.

An 'earth' usually helps reception. This can be provided by driving a metal stake into the ground to a depth of about one metre or attaching a wire to the house water pipes. NEVER attach an earth to a gas pipe or the house wiring earth.

The optimum position for connecting the antenna and diode to the taps on the coil is best found by experiment and will be affected largely by the size of the antenna.

Have fun with your crystal sets! ●



As with the simple crystal set, we mounted the components for the voltage-multiplier crystal set on an eight-lug tag strip. We have supplied a drawing as it is clearer than a photo in this instance.