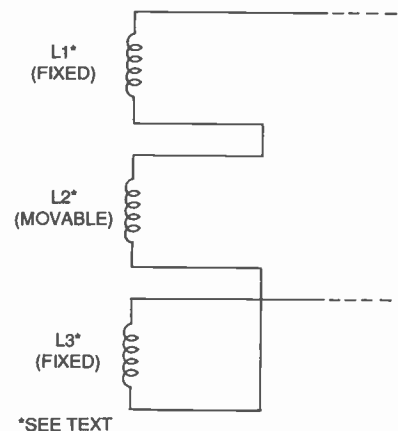


I've always wanted to make a radio using a variometer. In the old radio books that I read as a kid, variometers were pictured as two coils connected in series, one inside the other. The inner coil could be rotated and would either cancel or add to the inductance of the outer coil, depending on how it was oriented. Variometers were used to tune radios before variable capacitors became common. Unfortunately, I couldn't figure out an easy way to build one.

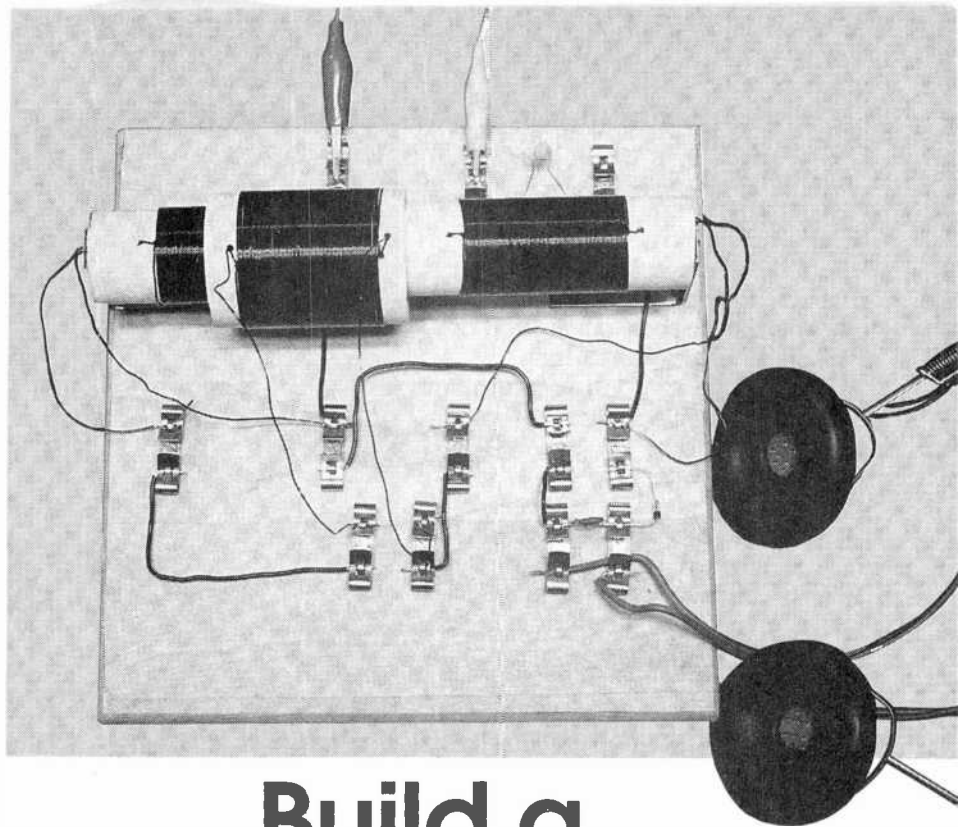
The problem must have stuck in my subconscious, because forty years later I realized that the coils didn't have to rotate; one coil could be slid over another. When I realized that, I put together the *Variometer Radio* described in this article in a couple of hours, and it works great! Even though it doesn't use a variable capacitor, it can still be tuned "on the nose" to stations in the broadcast band.

The Variometer Principle. In the original variometer design, when the inner coil is rotated to a 90-degree position with respect to the outer coil, the mutual inductance of the coils is at its minimum. For the mutual inductance of the coils to be at its maximum, the coils have to be aligned.

Figure 1 is a schematic diagram of how the variometer principle was adapted to a linear design in the project. Three coils, L1-L3, are connected in series; L1 and L3 are fixed, while L2 can be slid over them. Unlike in the



*SEE TEXT
 Fig. 1. This is the principle at work in the modern variometer. The middle coil, L2, can be slid over either of the other two. Because L1 and L3 are connected in opposite directions, the inductance of L2 will either add or cancel when it is moved over the other coils.



Build a Variometer Radio

A new version of a classic design.

BY LARRY LISLE

original variometer, it is the outer coil that moves over the inner coils. As L2 is moved over L1, their mutual inductance is increased to the maximum. But when L2 is moved over L3, their inductances cancel out because L3 is connected backwards (with respect to L2).

The Circuit. The schematic of the complete Variometer Radio is shown in Fig. 2. An antenna can be connected to the Radio through either of two points labeled ANT: either directly to the circuit or through a 100-pF capacitor. The ground connection can be made at any of the points marked GND. There is a reason for the preceding options: By varying the antenna capacitance, the ground connection, and the position of the sliding coil, the entire AM broadcast band can be tuned.

Depending on the antenna and ground connections, it might be necessary to add a small capacitor, C3, at

the point indicated in the schematic. If so, experiment with values between 25 and 200 pF (separately or in parallel) to find which gives the best result. If you build the Variometer using Fahnestock clips (as explained later), adding the capacitor(s) after the Radio is built should be easy, if the need arises.

When a signal is selected by adjusting the antenna, ground connection, and position of L2, the signal is passed on to the diode-detector part of the circuit, composed of D1, which demodulates the signal. That signal then goes through bypass capacitor C2 to the earphones. Only high-impedance earphones should be used with the Variometer.

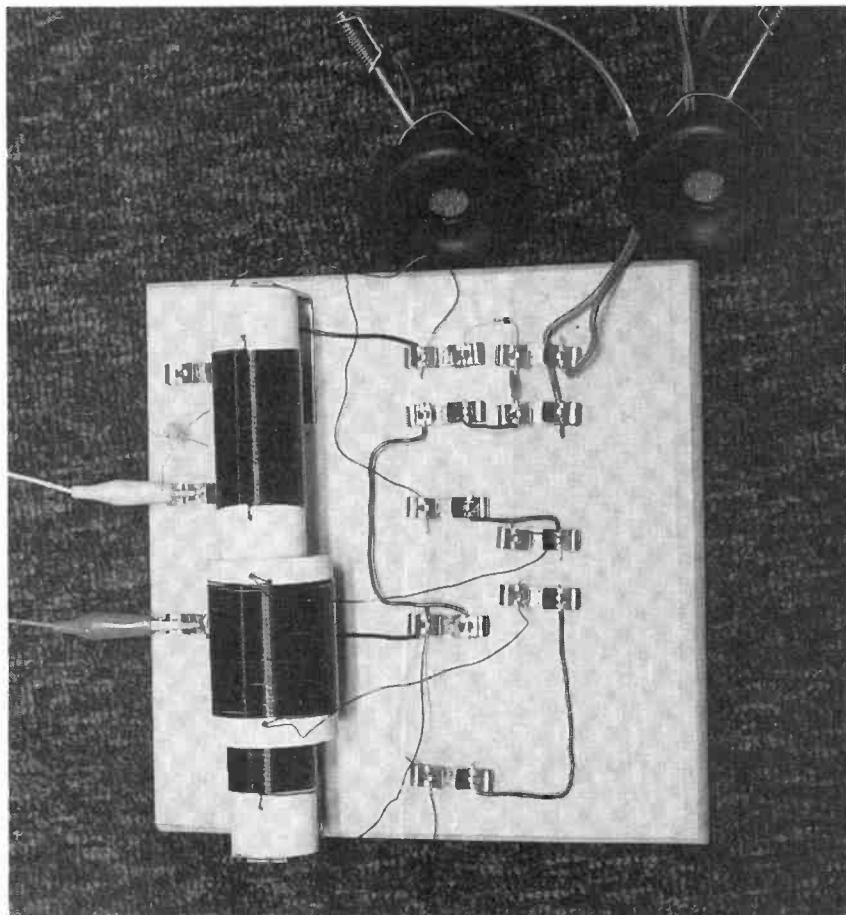
Construction. The two fixed coils of the Variometer, L1 and L3, are wound on an 8½-inch-long piece of 1-inch-diameter plastic pipe (its outer diameter is about 1¼ inches). Each coil is 2¼-inches long. The number of turns is

not critical, but in the author's prototype, 86 tightly wound turns of number-22 enameled wire were used. When winding the coils, make sure you start at a point that will allow them to be placed 2 inches apart on the pipe. Drill holes in the pipe and run the leads of the coils out the end of the pipe that is closest to each.

The movable coil, L2, is wound on a piece of 1½-inch plastic pipe (its outer diameter is about 1⅞ inches). The winding is 2 inches long. Like L1 and L3, the actual number of windings of this coil are not critical, as long as the winding is approximately the right length. However, in the author's prototype, 74 tightly wound turns of number-22 enameled wire were used.

One final note on winding the coils: Plastic pipe was used in the author's prototype for durability. An alternative to that is to use cardboard tubes, especially if you only plan on experimenting with the Variometer Radio.

To support the smaller plastic pipe that contains L1 and L3, get an 8½-inch-long piece of 1-inch dowel rod. Using sandpaper or a knife, slightly flatten one side of the dowel. Then, insert the dowel rod into the pipe, and orient the flattened side of the rod so that the wires can run along it with some clearance. Mount the assembly



Here's the author's completed radio. For simplicity, it is laid out much like the schematic shown in Fig. 2.

on a wooden baseboard (approximately 9-inches square) using a couple of corner brackets.

To make it easier to change ground and antenna connections, the prototype was built using Fahnestock clips. When laying out the placement of the parts on the baseboard, make sure to include adequate connection points for the possible use of capacitor C3 in the circuit. If you can't get Fahnestock clips, don't worry; an al-

ternative way to build the Radio is to use brass wood screws for the common points and simply wrap the wire around them.

Other Uses. Just by assembling your Variometer Radio and experimenting with tuning different stations, you might not realize that the variometer principle can be used in other applications as well. Some of those include uses in antenna loading coils, couplers, or matching devices.

Also, taps on one coil could give coarse adjustment, while a sliding coil can be used for fine tuning. With variable capacitors suitable for medium- or high-power ham transmitters becoming expensive and hard to find, the variometer principle might also find a use in the final output stage on the low-frequency bands.

The Variometer Radio is a modern version of an idea from radio past that's fun to play with in radio present. However, as you can see, the variometer principle might also become important in radio future. ■

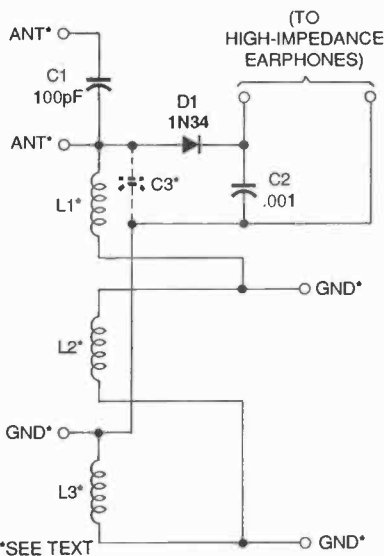


Fig. 2. Here is the modern variometer principle at use in a complete Variometer Radio. Even if you've never built a radio before, you can build this crystal set; the parts count is low, and the coil windings are not critical.

PARTS LIST FOR THE VARIOMETER RADIO

D1—1N34 germanium diode
 C1—100-pF ceramic-disc
 C2—0.001-μF ceramic-disc
 C3—Optional, see text
 L1, L3—See text
 L2—See text
 Baseboard (about 9-inches square), 1-inch-diameter dowel rod, 2 pieces of plastic pipe (see text), Fahnestock clips, corner brackets, screws, wire, hardware, etc.