Fig. 3 shows how to build a programmable loading coil using a 4.5 inch PVC coupling (found in the plumbing supply area of the local home improvement store) and 22 gauge insulated wire. The coil is wound with 100 turns with taps brought out every 10 turns by twisting a little loop in the wire The total inductance of this inductor is about 1 millihenry so short antennas may need more turns for the lower frequencies.

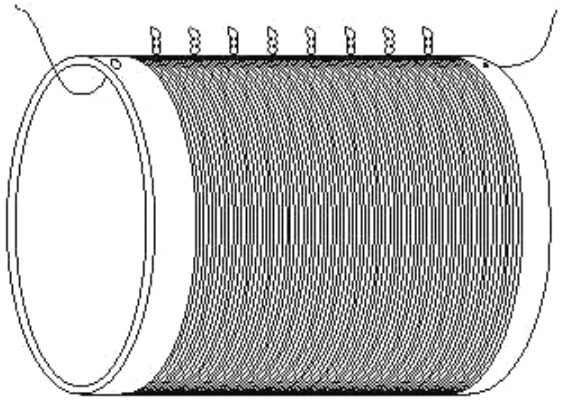

Figure 3: Multi-tapped loading coil wound on 4.5 inch PVC coupling.

Fixed inductors and a multi-position switch can be used to build a more compact and convenient unit shown schematically in fig.4. 220 microhenry chokes are shown to give enough inductance to handle shorter antennas but other values may be used depending on the application.

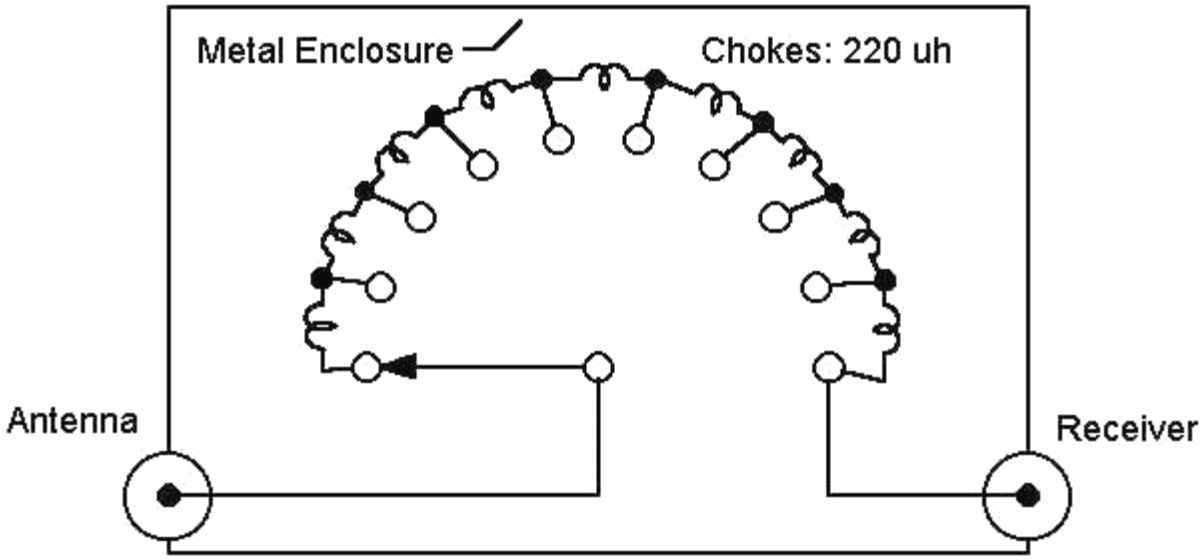

Figure 4: Adjustable loading coil built with a 10-position switch.

A directional antenna may be constructed with a ferrite rod and amplifier as shown in fig.5. A ferrite rod 5/16 inches in diameter and 7 inches long was wound with 90 turns which gave sufficient inductance (about 300 uh) to cover the AM band without tuning and gave good reception well into the short-wave band. Experiment with whatever loopstick is available but larger is better.

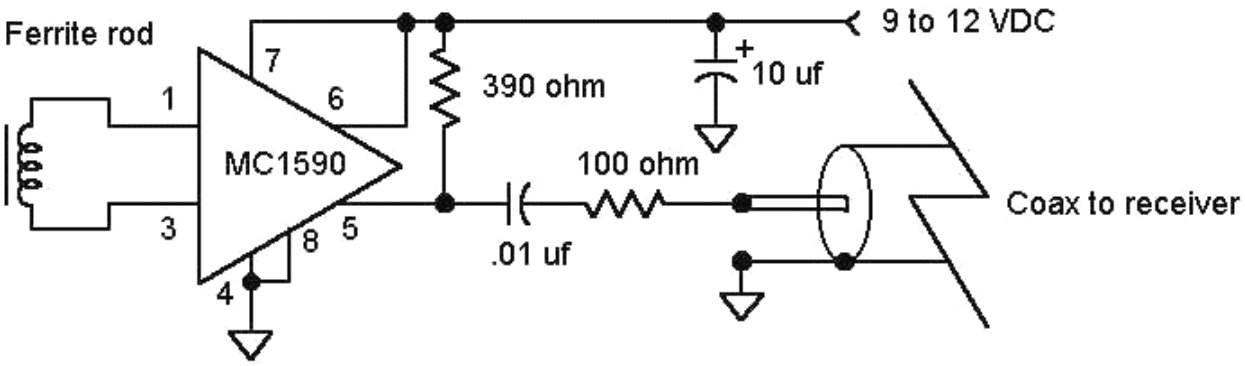

Figure 5: Ferrite antenna with built-in amplifier.

The MC1590 differential amplifier may be constructed on a small piece of copper-clad circuit board material using the copper board for ground connections. The amplifier should be mounted near the ferrite loopstick with the coax and power wire leading to the radio. No separate ground wire is shown since the coax shield will serve both purposes. The loopstick and amplifier may be slipped into a piece of 13/8 inch PVC with a cap on one end and a right angle coupling and pipe on the other (Fig. 6).

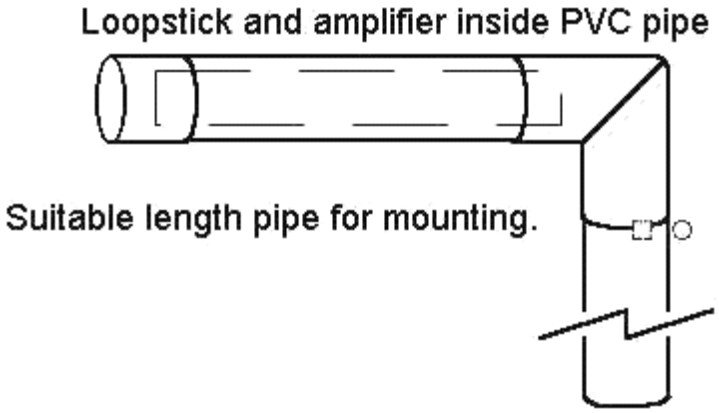

Figure 6: PVC enclosure for loopstick antenna.

The vertical pipe may be secured to the outside wall of the house with clamps loose enough to allow the antenna to be aimed. The wires can simply hang out of the bottom of the tube without any seal or a little squirt of foaming urethane caulking could be used to keep out insects. Ground the coax to the cold water pipe for lightning protection if the loop is outside and high.

A totally different approach to low frequency antennas is shown in fig.7. A very short antenna can give amazing results, often performing as well as a long wire antenna if the proper buffer amplifier is added between the radio and the antenna. The electrical model of a short antenna includes a very small series capacitor - so small that little signal gets through and the required resonating loading coil is impracticably large. However, if the antenna is connected to a high impedance buffer with a very low input capacity, the antenna capacity will not attenuate the signal significantly. The amplifier must have good intermodulation characteristics so that phantom stations don't appear all over the dial and the antenna must be kept short to prevent amplifier overload. Don't connect this circuit to a long wire antenna unless you are curious to hear what radio chaos sounds like. Keep the antenna under a few feet in length, especially if strong stations are nearby.

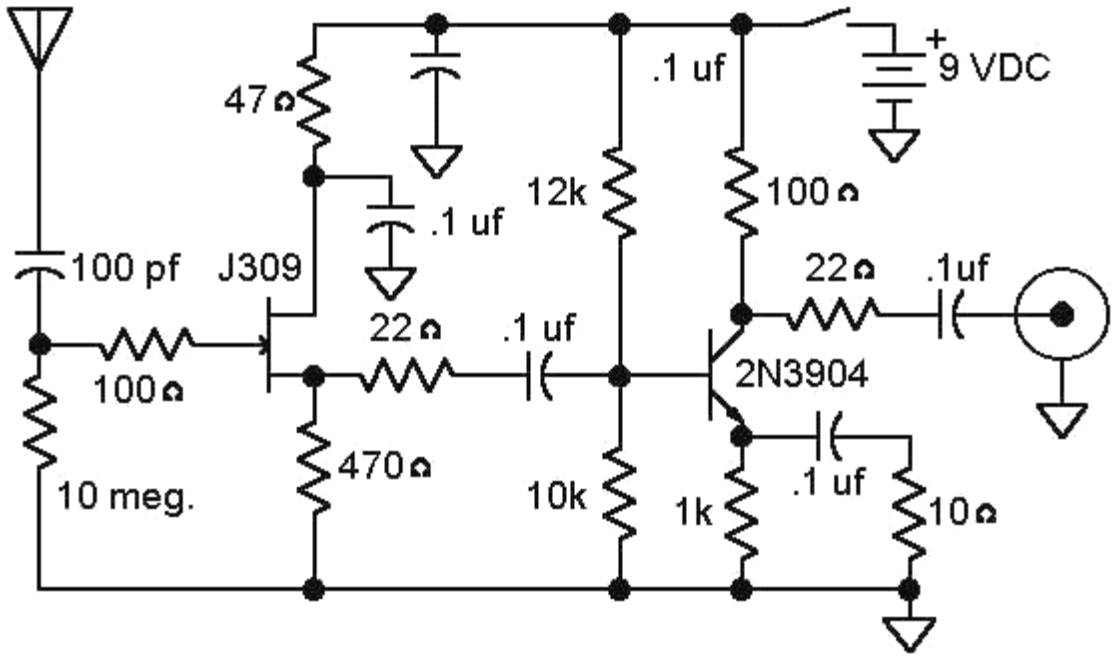

Figure 7: Short antenna buffer/amplifier.

The N-channel JFET shown is a J309 but most other numbers may be substituted. (Possible subs include: J308-310, U310, 2N4857-4860.) The source voltage (on the 470 ohm resistor) should be about 1.5 to 5 volts. This source resistor could be changed to get about 4 mA of FET current using the formula: New R = V/.004 where V is the voltage on the initial 470 ohm resistor. This source voltage will change when the new resistor is installed to replace the original 470 ohm but the final current value is not particularly critical. Even lower current could be used (bigger R) to prolong battery life but the performance will begin to suffer somewhere below a couple of mA. The antenna may be a few inches to about 6 feet but avoid using longer antennas. With the values shown the buffer will work well from below 100 kHz to about 15 MHz which covers the frequency range where an antenna buffer is useful. Here is how it works: The 10 megohm resistor sets the DC gate voltage to zero volts and the voltage on the source will rise to about 2 volts as the negative gate to source voltage reaches equilibrium with the source current. The FET is a very high impedance voltage follower which converts the high impedance antenna voltage into a much lower impedance voltage suitable for driving the 2N3904 amplifier. The base of the 2N3904 is biased to about 4 volts by the two base resistors and the 1k emitter resistor sets the collector current to about 3 mA. The amplifier has an RF voltage gain of about 10 which is set by the ratio of the 100 ohm collector resistor and 10 ohm emitter resistor. Lower gain may be achieved by increasing the 10 ohm resistor if the circuit is being overloaded by large signals but a shorter antenna is usually the best approach.

For higher frequencies, a resonant antenna becomes feasible. For example, Fig. 8 shows a simple vertical ground-plane antenna which connects directly to 50 ohm coaxial cable without a loading coil or matching network.

Using the equations shown, a 49 MHz antenna would have a vertical element 57 inches long and ground elements 59 inches long. The vertical element simply connects to the center conductor of the coax and the ground elements connect to the coax braid. The elements may be mounted on a small square of phenolic, fiberglass, or other weatherproof board material. Try not to let dissimilar metals come in contact or, if they must, coat the contact area with silicone rubber. One simple approach is to make the whole affair from PVC pipe with copper wire or tubing on the inside. It is often desirable to have a fixed-frequency antenna with directionality for monitoring a particular station or for installing on an antenna rotator. For example, if you live within a mile or two of a fast food restaurant you can probably pick up the little wireless microphones they use to take orders. You are probably wondering why anyone would want to pick up those signals (which are around 33 MHz). Hmmm. Well, it would be a challenge. Or, how about building a dedicated antenna to receive a distant weather transmitter instead. Or the police in a neighboring town, or a remote airport. Those sound a little better. (When my kids were small I thought of making a tricycle "drive-up" window with real audio from the local fast-food restaurant - never got around to it...) The point is

that a directional antenna will give greatly improved performance for any of the signals on your scanner. Multi-element yagi antennas are a good choice for single frequency reception and log-periodic antennas give excellent multi-band reception. The construction of these antennas can prove difficult and purchasing a factory assembled unit is usually a preferable approach. A three-element yagi is not overly difficult for the more experienced hobbyist and several design references are easily found on the internet. A search using "3-element yagi" turned up nearly 600 hits including excellent design articles and commercial sources.