

HOUNDGOG

BY
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HUGGARD

This electronic metal detector is a thoroughbred

One of the problems with the hobby of treasure-hunting is that much more money has been spent on looking for it than the value of what might and has been found gives. One of the best ways to balance the books is to start out as inexpensively as possible, and that opportunity is provided by Hounddog, a relatively simple and inexpensive metal detection device. Hounddog can sniff out metal objects as small as a penny buried as deep as 3 to 5-inches, and will operate reliably for up to a year on one 9-volt transistor battery.

Operational Principle.

Hounddog's "nose" consists of three

large inductance coils which, when placed in proximity with a conductive metal will exhibit a change in their total inductance value, the change being read by the circuitry and translated into an audible signal. In short, when Hounddog "barks," it's time to start digging.

The Circuit.

The heart of the circuit is U1, an audio amplifier, whose differential inputs are fed by a bridge circuit consisting of L1, L2, and R7, fed through R6A and R6B. U1's output is coupled to L3 by either C1 or C1 and C2, depending upon the setting of sensitivity switch S1. The placement of L1, L2 and

L3 is such that the total field set up in L1 and L2 by current flowing in L3 is effectively zero. Therefore, the inputs to the amplifier are equal and opposite (zero), and it's output will be zero. When a conductive metal enters the field, it changes the distribution to the effect that the field across L1 and L2 is no longer zero, and a voltage appears across the amplifier's inputs. The coil connections are such that when this condition exists, the positive input voltage is in phase with that of the output, and the circuit oscillates. The signal is fed to Q1, causing it to turn on, allowing current to flow to buzzer BZ1, creating Hounddog's "bark."

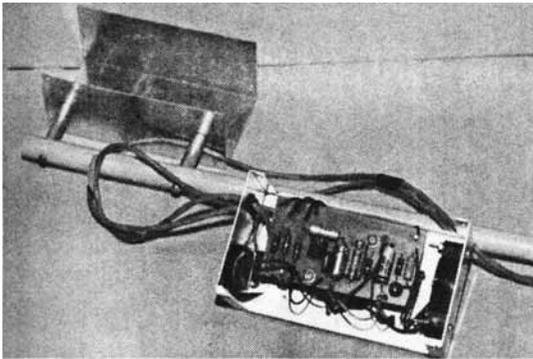
Because the coils used in Hounddog are designed to be hand-wound, and also due to the effects of stray capacitance and noise generated internally in the circuit itself, a feedback loop has been included (through R7) which will allow the user to keep Hounddog from sounding off due to false signals caused by variations from the theoretically perfect zero field.

Construction.

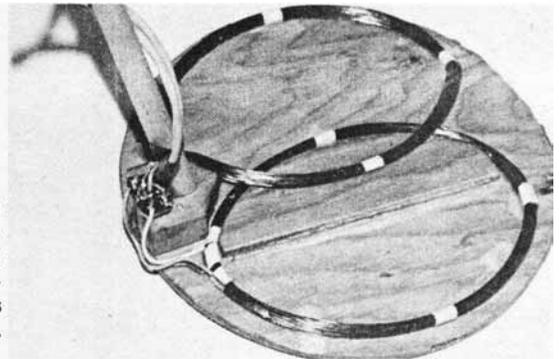
There are actually two steps involved in the assembly of the Hounddog; wiring the PC board for the control circuitry, and the construction of the coils for the search head (which we'll discuss later). With the exception of C7, the potentiometers, the switches and BZ1, all components mount directly on the PC board, as indicated in the PC component layout guide. C7 is soldered directly to the terminals of S1, and the potentiometers and switches and the buzzer are mounted to the aluminum or plastic chassis. As always, pay careful attention to the polarities of the electrolytic capacitors during installation. Although not completely necessary, use of an IC socket for U1 is recommended.

The circled numbers appearing on the schematic and parts layout guide are for keying up the connections to the off-board components. It is not necessary for you to etch the numbers onto the PC board, so long as you refer to them during the final wiring stages.

To assist you in construction of the coils (L1, L2 and L3), we have provided a diagram of a coil form which may be cut from plywood. This, at the very least, will allow you to wind LT/L2 and L3 to the same basic dimension, which is about the only critical factor (outside of getting the number of turns of wire correct) in the construction of



This photo shows the circuit board mounted in the cabinet, and the method used for attaching the cabinet cover to the handle.



Closeup of the search head shows the position of coils L1/L2 and L3, and their respective overlaps as described in the text.

the search head.

When winding L1/L2, rather than winding two sets of 30 turns each, we suggest that at turn 30 of L1, you scrape away a bit of the insulation and solder the ground tap in, wrap the solder junction with a small bit of tape, and then begin the next 30 turns for L2. This pro-

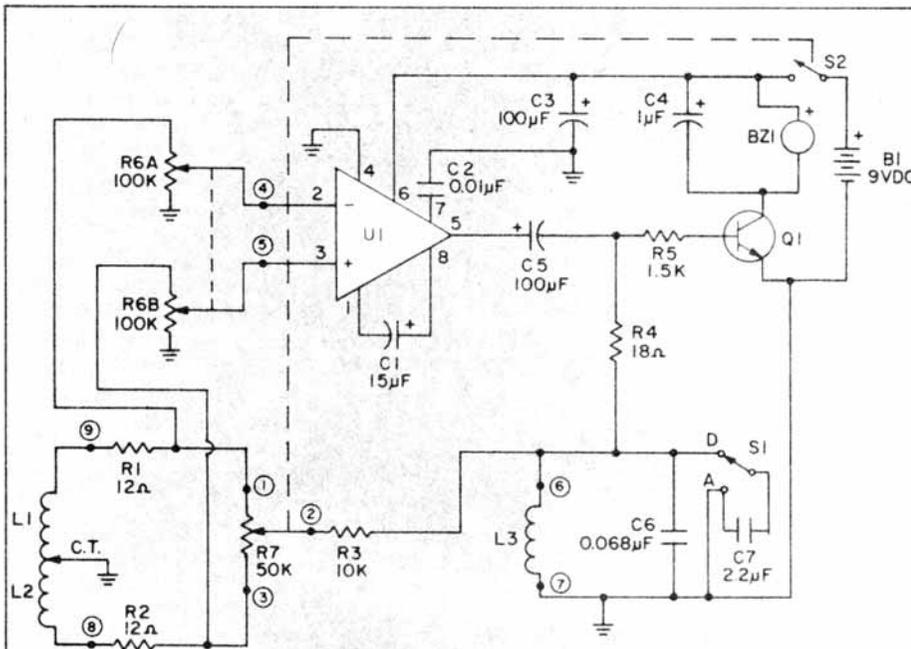
vides a stronger final assembly, and less of an alignment problem (you now need deal only with aligning two coils instead of three). When the coils are completely wound, bind them with tape before removing them from the form. This will help to hold their shape until they are installed on the search head.

Final Assembly/Calibration.

Before permanently attaching the coils to the plywood head, it is best to tack them down temporarily with either tape or rubber cement (for obvious reasons, no metal fasteners can be used now or during the final attachment).

Connect L1/L2 to the PC board with 2-conductor shielded wire, attaching the inner conductors to the outside ends of L1 and L2 (points 8 and 9), and using the braided shield for the center tap ground connection. The shield should be grounded to circuit ground on the PC board. Single conductor shielded wire is used for the connection of L3 to the circuit, with the braided shield used for the grounded side of the coil. Solder the braid to circuit ground on the PC board as you did for L1/L2.

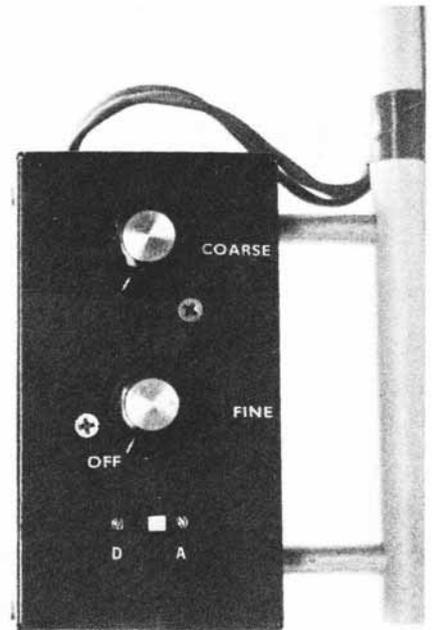
Set R6A/R6B to a two-thirds clockwise position, and set R7 to its midpoint. When you throw power switch S2 on, the buzzer should not sound. If it does, reverse the L3 connec-



PARTS LIST FOR HOUNDGOG

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|--|---|
| B1 —9-VDC transistor battery | R5 —1,500-ohm, ½-watt resistor, 10% |
| BZ1 —piezoelectric buzzer (Radio Shack #273-060) | R6A/R6B —dual-section 100,000-ohm linear-taper potentiometer |
| C1 —15-µF, 15-VDC electrolytic capacitor | R7 —50,000-ohm linear-taper potentiometer with SPST switch (S2) |
| C2 —0.01-µF, 50-VDC ceramic capacitor | S1 —SPDT slide switch |
| C3, C5 —100-µF, 35-VDC electrolytic capacitor | S2 —SPST rotary switch (part of R7) |
| C4 —1-µF, 35-VDC electrolytic capacitor | U1 —LM386 audio amp integrated circuit |
| C6 —0.068-µF, 25-VDC mylar capacitor | |
| C7 —2.2-µF, 35-VDC non-polarized electrolytic capacitor | |
| L1, L2 —30 turns of #20 enameled copper wire see text | Misc. —battery clip, aluminum chassis, hookup wire, solder, spacers, knobs, 100-foot roll of #20 enameled copper wire, weatherproofing finisher (varnish, shellac, polyurethane, etc.), non-metallic support rod, 10-feet of 2-conductor shielded wire, 10-feet of 1-conductor shielded wire, ¼-inch plywood stock, etc. |
| L3 —60 turns of #20 enameled copper wire | |
| Q1 —2N5210 NPN low-level transistor | |
| R1, R2 —12-ohm, ½-watt resistor, 10% | |
| R3 —10,000-ohm, ½-watt resistor, 10% | |
| R4 —18-ohm, ½-watt resistor, 10% | |

A complete parts kit for Hounddog including pre-etched PC board and all components (but less case) is available from Niccum Electronics, Rte. 3, Box 271B, Stroud, OK 74079. Price for the complete kit is \$24.50; a pre-etched and labeled PC board only is \$5.50. No CODs, Please.



Hounddog's control head is laid out simply; there's an SPDT switch and two adjustments.

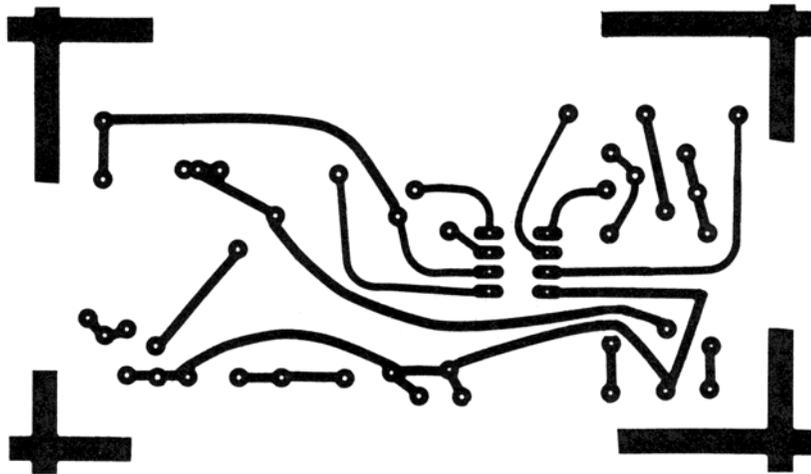
tions at the coil end and try again. Slowly reduce the amount of overlap between the two coils until the buzzer sounds. At this point, backing off counter-clockwise on R6A/R6B should cause the buzzer to silence. If this is the case, carefully mark the position of the two coils, and prepare to attach them permanently to the search head.

As a final test, return R6A/R6B to the two-thirds position, set R7 just below the point where the buzzer sounds, and S1 to the "discriminate" position. Bring a penny directly above the coils' overlap, and lower it to a height of about 3-inches above the coils. If the buzzer does not sound, try re-peaking R6A/R6B and R7 for a lower threshold (increase R6A/R6B more clockwise, while backing off more on R7 to stop oscillation) and repeat the procedure. Three inches should be the minimum

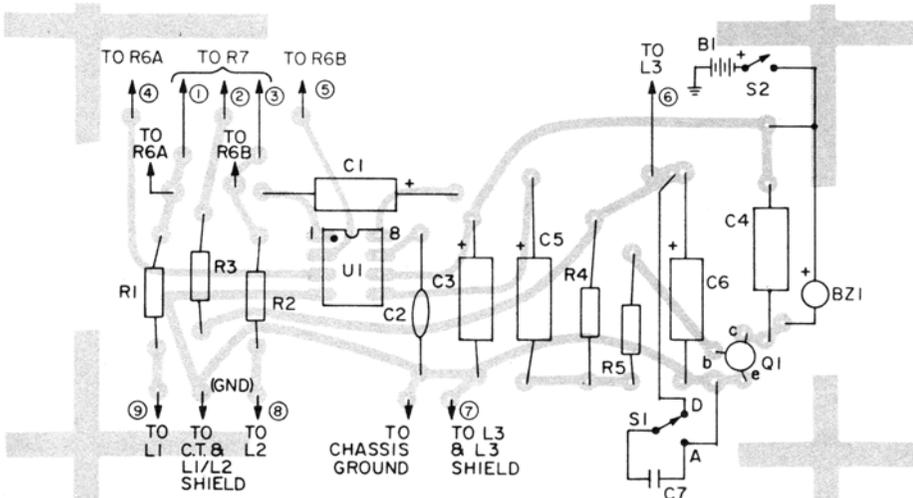
distance at which Houndog detects the presence of the penny.

Remember that when conducting these tests, you should be in an area free from the presence of large metallic objects, such as radiators, pipes and ducts, etc. Their presence may cause you to set the sensitivity of R6A/R6B too low, making actual measurements against coins ineffective to the point of believing that the unit is not working.

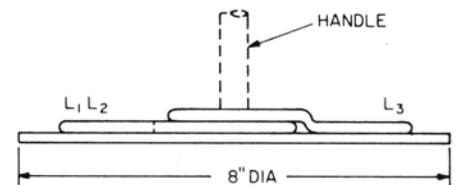
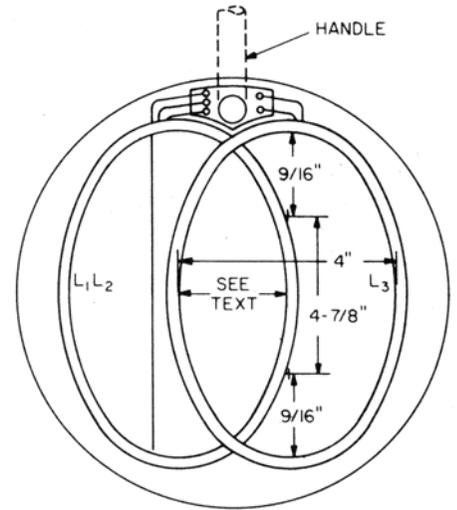
You may now attach the coils to the head in a permanent manner with epoxy or several coats of polyurethane or shellac, in order to affix the coils firmly and make the assembly weatherproof. Conclusion. Once you get out of doors with Houndog, it might be wise to bury some treasure of your own, and adjust the controls for maximum sensitivity depending upon the type of soil - found in your locality. These adjustments will



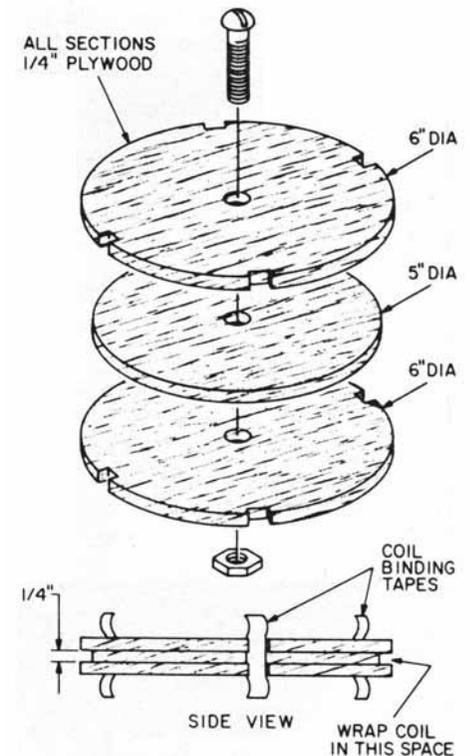
Here is the full scale etching guide for Houndog's PC board. If you purchase a Niccum PC board, the layout may differ slightly. Follow their assembly instructions for it.



The component layout guide gives you the connections for the off-board components. If you use another method of assembly, rest assured that parts layout isn't critical.



The dimensioning guide for the search head shows you how to bend round coils into the elliptical shape necessary for installation on the search head plywood base.



Use this template for winding the coils. The finished coils will be circular, and you will have to bend them into an oval, as seen in the diagram above, to fit them.

vary from area to area, depending upon soil composition, which is why we haven't used a calibrated dial for the potentiometers. Don't be discouraged if

your first few hours of searching with S1 set to the "discriminate" (coins) position don't unearth Captain Kidd's treasure chest. With S1 set in the "all"

position, you'll get a lot more "barks," but you might find a lot of tin cans and beer can pull-tops for your efforts. Patience is a virtue in this hobby.