MAXIMIZING Your MAGNETIC LOCATOR

A staple in the surveyor's toolbox, this instrument can pay big dividends if you learn the fine points of using it.

By Warren Dunham

The capabilities of a magnetic locator are virtually limitless, and an experienced operator will find many uses for this instrument. Utility companies and other services use them to locate water valves, water meters, gas and water pipes, manhole covers, and even septic tanks. It only makes sense that surveyors find them especially useful in their everyday fieldwork as well.

When used properly, a magnetic locator will greatly simplify the task of pinpointing survey markers. Just turn on the power and set the volume control to a comfortable level. Most survey pins can be located quickly and easily with the sensitivity control set on the number 3 setting. Just wave the locator back and forth as you walk along, and you will have no difficulty locating your pin. The locator's audio output idles when there are no ferrous targets nearby, gradually increases in frequency as you approach your target, and finally peaks directly over your survey pin.

But how does this seemingly magic box do this? The primary sensing elements are fluxgate magnetometers that measure the average magnetic field component along their sensitive axis, i.e. along the axis of the sensor tube.

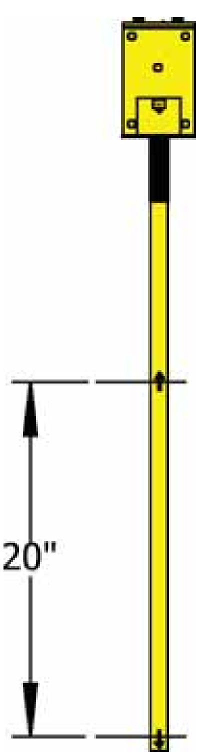
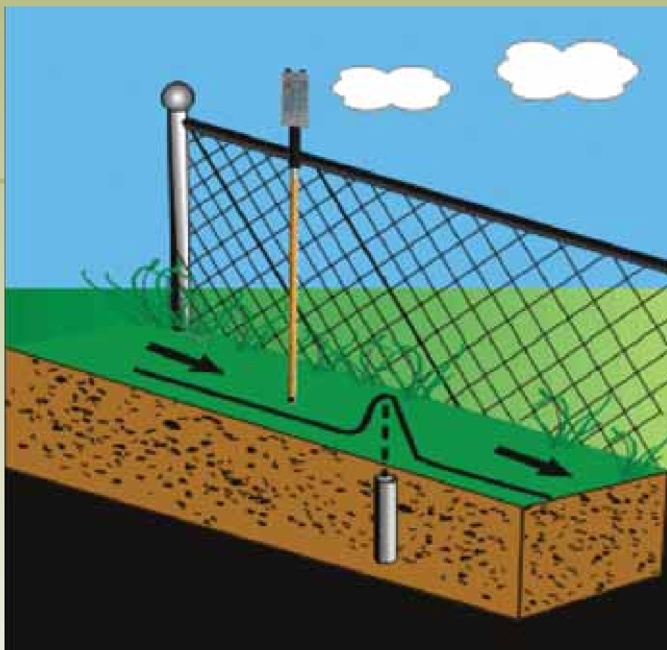


FIGURE 1 Sensor location

Figure 1 shows a typical magnetic locator with two magnetometer sensors at the lower end of the instrument sensor tube approximately 20 inches apart. The lower sensor measures the positive magnetic field at the tip while the upper sensor measures the negative magnetic field 20 inches away. The electronics combines these two signals, and if there are no ferrous targets near the sensors, the signals will cancel and the instrument will remain at idle. By summing the two output signals, you cancel any field common to both sensors, such as the Earth's magnetic field, and leave only the differential magnetic field. The magnetic field detected by one sensor and not the other becomes the magnetic field of interest.

In **figure 2**, we show how to hold your magnetic locator while searching for survey markers. To maximize your search operation, hold your locator by the electronics case and reach out at a 30-degree angle. Then sweep your locator back and forth as you walk along. This technique allows you to survey a wide area with just one pass and to probe into bushes and dense vegetation. If you hear an increase in the instrument's output frequency, concentrate on that area. Gradually bring your locator to a vertical position and perform an "X," or "crossing pattern," to pinpoint the source. If you hear a fluctuation or warble in the audio output, BEWARE! A strong warble output from the locator means you are probably over an energized power line, whereas a weak warble output often indicates the presence of a telephone or communications cable.

FIGURE 2 General search operation



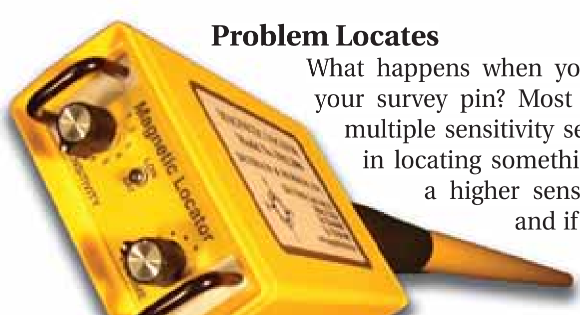
▲ FIGURE 3
Chain-link or "cyclone" fences

When working around chain-link fences **(figure 3)**, your task will be greatly simplified if you hold the locator vertically and walk along parallel to the fence approximately eight inches to a foot away. You will hear the magnetic field of the fence as you walk along, including the field from the posts. However, if your target is near or under the fence, there will be a dramatic increase in the instrument frequency as you approach the target, and you will have no difficulty distinguishing your target from the fence

Buying a Unit

When it comes to purchasing a new locator, there are many items to consider besides the instrument's obvious factors such as performance, cost, reliability, and ruggedness. Ideally, you would like to know something about the manufacturer, i.e. their repair department and the instrument warranty.

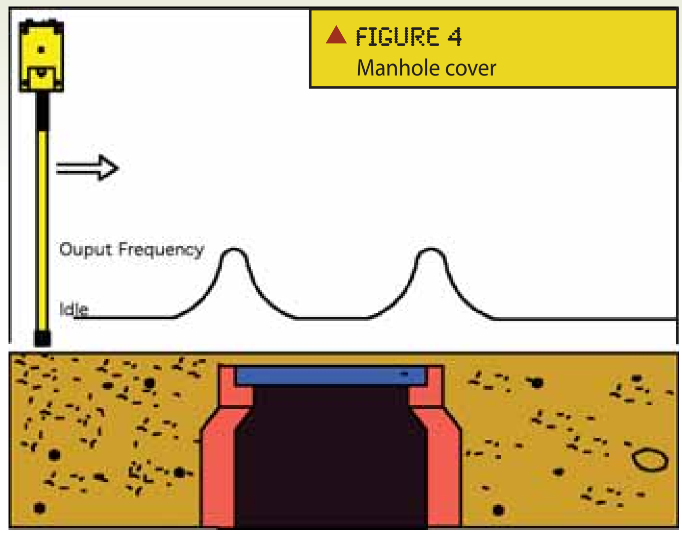
By far the most important item listed above is performance; if the locator is poorly designed and poorly calibrated, it will produce false targets as you swing it side-to-side. This can be both frustrating and costly. There are plenty of expensive magnetic locators on the market that perform poorly. The best way to avoid the problem of being strapped with a costly mistake is to test several different locators and select the one with the best performance.



Problem Locates

What happens when you can't locate your survey pin? Most locators have multiple sensitivity settings to help in locating something. Just select a higher sensitivity setting, and if there is a survey pin in the area you will find it.

What happens if the locator produces a higher tone when you swing it in one direction, no matter where you stand? This is called a false target and is usually associated with poor sensor alignment and poor instrument calibration or a combination of the two. The solution is quite simple. The Earth's magnetic field is oriented in a north-south direction. When you are looking for survey pins while traversing in the east-west direction, the magnetic locator's sensors are swinging through a magnetic field range varying from full positive to zero with each swing of the wand. This magnifies the problem of false targets. Fortunately, you can practically eliminate the problem of false targets if you confine your traverses to the north-south direction. When you make north-south traverses, the magnetic locator sensors are nominally in a plane perpendicular to the Earth's magnetic field. This practically eliminates problems associated with sensor alignment, signal channel tracking, and calibration errors. With a well-maintained locator, you should not have this problem, but it always helps to know how to work through the issue should it occur.



▲ FIGURE 4
Manhole cover

A typical manhole cover **(figure 4)** is actually a combination of two magnetic fields, those of the cover itself and the steel support ring. When both fields are aligned, they add and are easy to detect. When they fall 180 degrees out of alignment, they tend to cancel, and detection becomes more difficult.

The peaking of the Dunham & Morrow model DML2000 output frequency normally indicates you are over the end of a pipe section, which can be either a weld or a "Bell" joint as shown in **figure 5**. When searching for horizontal gas and water lines, look for a polarity change on the digital panel meter. A polarity change that occurs when the output frequency is low means you are nominally over the midpoint of the pipe section. A polarity change when the output frequency is high typically indicates a pipe joint or weld.

Frequency peaking occurs over service connections and valve boxes—any place the pipe has been cut and a service connection, valve box, or other magnetic anomaly inserted **(figure 6)**.

Continued from page 27

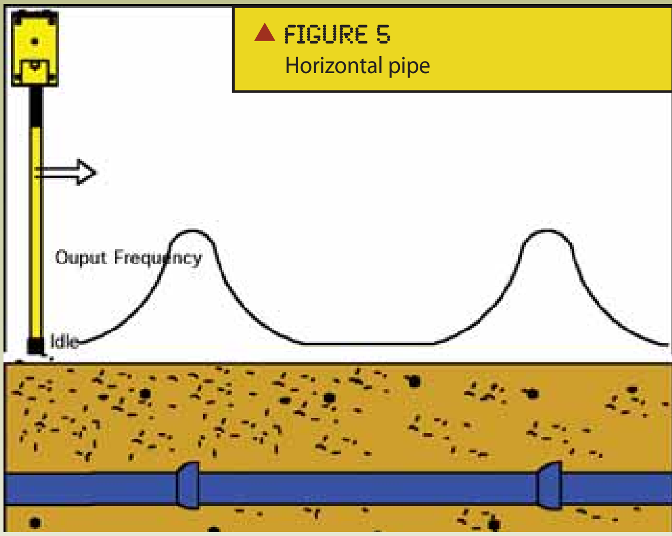


FIGURE 5
Horizontal pipe

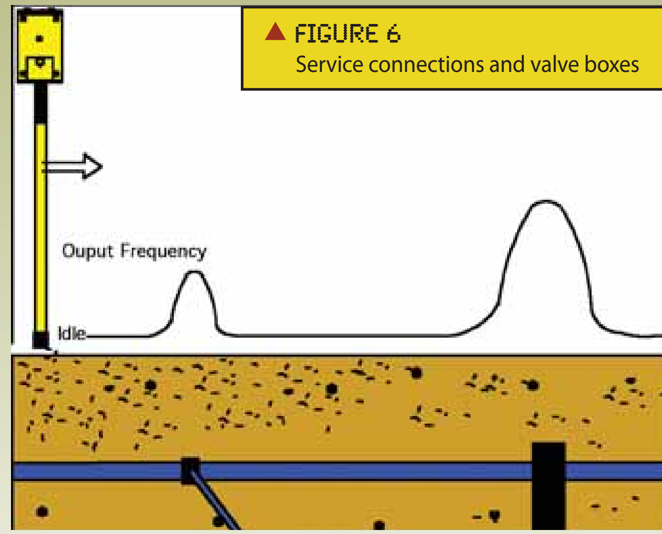


FIGURE 6
Service connections and valve boxes

Historical Notes

Some of the earliest work on fluxgate magnetometers took place at Bell Labs prior to and during World War II. Much of that work was later transferred to the Naval Ordinance Laboratory, where the magnetically triggered torpedo design was perfected. The magnetometer sensors detected the magnetic field of their target and then detonated the torpedo warhead when the signal polarity changed, just as it passed under the keel of the boat. Precision fluxgate magnetometer sensors have been used for decades in earthquake prediction instruments, and they have also been used to monitor solar flare activity, control the attitude (or orientation) of satellites, and guide cruise missiles to their target.

The first practical use of a gradiometer, a system employing two coaxial fluxgate magnetometer sensors arranged in the typical magnetic locator design, occurred during the Vietnam War, where they were used to detect Vietcong tunnels. Commercial use of magnetic locators has expanded greatly since then, and they are now used to pinpoint survey markers and a host of other objects. The FBI has used commercial magnetic locators for years to detect and pinpoint discarded weapons such as handguns and knives in dense shrubbery and shallow waters. The potential uses of magnetic locators are numerous, and in the hands of a skilled operator, they have proven an invaluable tool.

With a B.S. degree in electrical engineering from the University of Maryland, **Warren Dunham** *has served as a consultant to NASA, NOAA, and the U.S. intelligence community for over 35 years. His most notable designs include the satellite attitude and control magnetometers for the Hubble Space Telescope, Gamma Ray Observatory, and GOES weather satellites. For 22 years, he worked at the Schonstedt Instrument Company as a principle engineer responsible for satellite magnetometers and magnetic locator products. In 1994, he founded Dunham & Morrow Inc. and for the first five years continued the design and production of satellite magnetometers. In November 1999, Dunham & Morrow introduced its first commercial product, the DML2000 magnetic locator.*

Magnetic Locator

Model DML2000

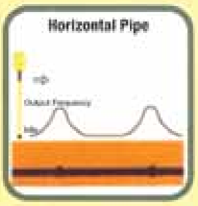
Ideal for:
- Surveyors
- Excavators
- Public Works

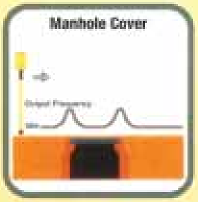
The latest Fluxgate Magnetometer for precision location and sensitivity.

- **Works Better**
- **Lasts Longer**
- **Costs Less**

Backed by 35 years of locator manufacture

Made in USA





Advantages of the DML2000

- Outstanding Sensitivity
  - Greater Depth
- Fewest False Targets
- Top Mounted Protected Controls
- Lightweight
- Low Battery Indicator
- Externally Accessible Batteries

Specifications

- 80 to 100 hours operating time
- 4 x "AA" alkaline batteries
- Red flashing LED low battery indicator
- Variable frequency output signal (20 to 3,500 Hertz
- 42.5 in. overall length
- 36 in. waterproof length (base of electronics case to tip of sensor tube)
- Weighs only 1.6 lb.
- -20° F to 120° F temperature range

TARGET	DEPTH
Iron Marker (0.75" x 18")	Up to 9 feet
Cast-Iron Pipe (4" Pipe)	Up to 10 feet
Manhole Cover	Up to 10 feet
Well Casing	Up to 18 feet
PK Nail (1.5")	Up to 1 foot
Iron Valve	Up to 10 feet
55 Gallon Drum	Up to 10 feet
Septic Tank (Handles)	Up to 5 feet

Authorized Dealer

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