INSTRUCTION MANUAL

MODEL AT-9
LOADED LINE LOCATOR

the
"power-pup"

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I.—GENERAL INFORMATION:

The Power-Pup has been designed for locating energized loaded power cables. Because of the rugged one piece design, extreme sensitivity, and easy operation, the Model AT-9 Power-Pup is the quickest and most convenient method for locating energized buried power cables.

No instrument will pinpoint an accurate location beyond the operators ability or skill in interpreting signals. For this reason, we recommend the operator read the entire manual. The operation of the Power-Pup is not difficult, and with a little experience, the operator will become very accurate at pinpointing his cable locations. On the first few locations, it will help the operator if he could stay and observe the cable being exposed. This will enable him to compare the cable position and depth with his readings. Not only will this be valuable in learning to interpret the Power-Pup's signals, but more importantly, it will help build the operator's confidence in the instrument and his ability to use it.

The Power-Pup is a receiver tuned to the 60 hz field being radiated from a cable when current is present, thus, the cable must be loaded. If no load is on the cable, a 120 volt heater element, a power drill, or similar appliance will provide the necessary current flow. The more current in the cable, the easier the location will be. This will be especially true where the environmental noise (60 hz in the air), or heavy loaded cables are near your location. The 60 hz field on the cable to be located **must** be greater than the other 60 hz field in your area. A good example would be in trying to locate a small secondary near a large sub-station. Any 60 hz receiver will be flooded with signal in an area of this type. If no load is available, or if the outside environment is flooding the Power-Pup to the point where positive readings are not being obtained, do not fight it. No instrument will be all

things to every location. A good pipe and cable tracing instrument such as the Model A6 Tracer from Aqua-Tronics, Inc. has its own tone that can be put on the cable and a positive location can then be made.

Unlike other 60 hz locators, a sensitivity (volume) control is the only control an operator needs in making his location with the Power-Pup. Make free use of the sensitivity control when making a location as current in the cable may vary over a wide range during the time a location is being made.

1. Description

The Model AT-9 Power-Pup: A solid state receiver tuned to 60 hz, and a top quality set of headphones with protective ear cushions make up the complete instrument.

2. Operation

Turn on the Power-Pup by plugging in the headphones. A three (3) second turn-on time is built in to allow all of the voltage levels within the electronics to charge up and stabilize.

II. — BATTERY TEST

A spring loaded battery test switch, mounted between the depth gauge and sensitivity control allows the operator to test the battery voltage at any time. The receiver must be turned on to test the battery. When making a battery test, the meter will respond to the battery voltage level, but the audio portion will be responding to the 60 hz signal level. This allows the operator to test the battery while making a location. If the meter indicates a voltage level below the Batt. Ok section (below7), the battery should be replaced by an Eveready #216 or 9 volt equivalent. (NEDA-number 1604)

1. Battery Replacement:

The battery compartment is located just behind the pistol grip handle on the bottom side of the Power-Pup. Use a dime or a small screw driver and rotate the battery release screw head 1/4 turn, counter-clockwise. The battery holder is attached to the battery lid and will be easily accessible when the battery lid is opened.

III. — MAXIMUM OR PEAK — See fig. 1. A maximum meter reading will be found directly over the cable and the meter will decrease to lesser readings as the instrument moves away from either side of the cable location.

MAXIMUM METHOD:

With the receiving antenna in the horizontal position and close to the ground (see Fig. 1), use the sensitivity control and set the meter to some on-scale reading. Walk in the direction that increases the meter reading. The meter reading will increase as you near the cable. If the meter goes off-scale (above 10), reduce the sensitivity control to an on-scale reading again (the operator cannot see a maximum meter reading if the meter is off-scale). By keeping the meter reading on-scale as the operator walks in the direction the meter reading is increasing, a maximum meter indication will be found as the operator crosses the cable. As the operator continues past the cable, the meter reading will start decreasing. Hold the receiving antenna directly over the maximum or peak reading and slowly rotate the instrument until a new peak reading is found. When the antenna is directly over and at right angles (90°) to the direction of the cable path, the highest reading will be found. The cable will be directly below the center of the antenna.

Now that the cable has been located, the cable path can easily be traced. With the antenna directly over and at right angles to the cable path, walk in the direction to be traced. Keep moving the instrument from one side of a maximum reading to the other. Each time a maximum reading is found, the cable will be directly below the receiving antenna.

The audio signal heard in the headphones will respond the same way the meter responds to signal level. The maximum audio will be heard when the meter reading is at its highest point.

When the cable has been found and the exact position is needed, turn down the sensitivity control until a very small movement of the meter can be seen as the antenna passes over the cable (the lowest reading the operator can detect on the meter). This will help insure that other cables in the area are not influencing the location.

NOTE: If the antenna is positioned horizontal with the ground for a maximum reading, no signal will be found if the antenna is in line with the cable. When locating and tracing a cable, the instrument should be rotated from time to time to insure a right angle (90°) is being kept between the receiving antenna and the cable path.

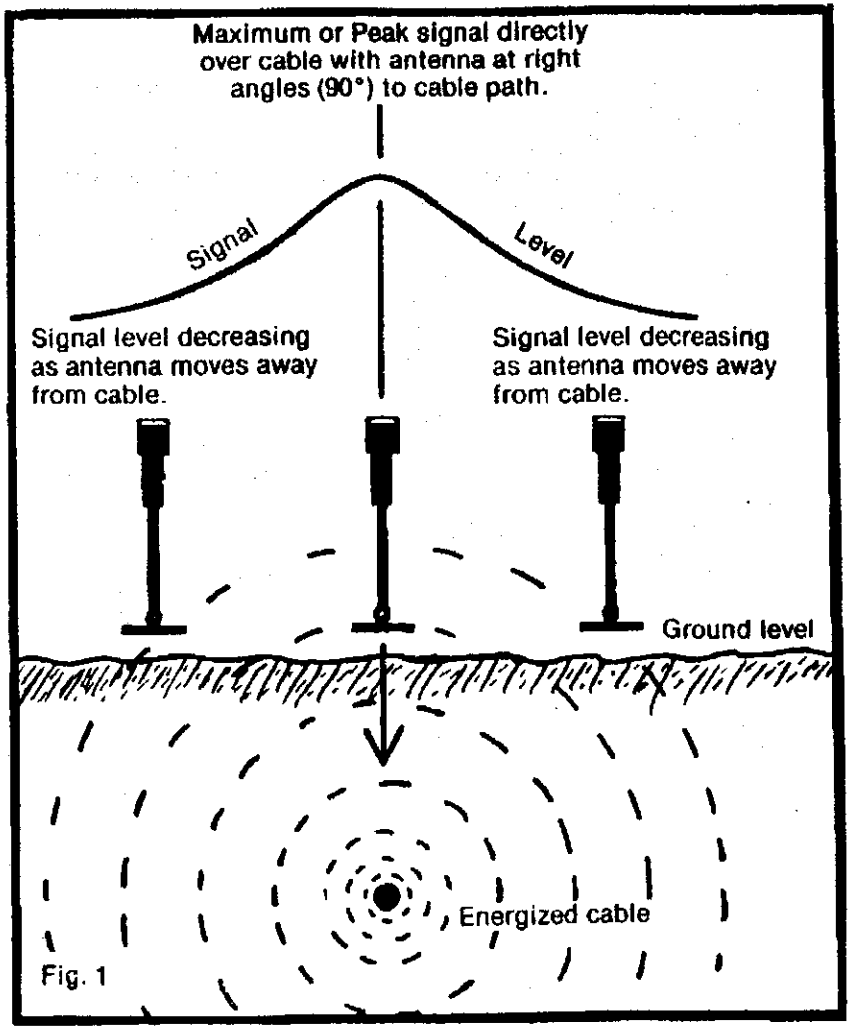

Fig. 1

IV. — NULL — See fig. 2. With the antenna vertical to the ground (parallel to the extension arm), the meter reading will increase as the antenna approaches the energized cable. Directly over the cable, a loss of signal will be found and the meter will decrease to a zero or minimum level. The signal will return to a high level and then start falling off as the antenna leaves the exact center of the cable. On both sides of the cable, a high meter reading is available, but a loss of signal occurs when the antenna is directly over the cable.

NULL METHOD:

With the receiving antenna moved to the vertical position (see fig. 2), adjust the sensitivity control for an on-scale meter reading. Walk in the direction the meter reading increases. As the antenna crosses the energized cable, the meter will fall to some lower reading and then will return to a higher level on the other side of the cable. The center of the cable will be directly below the null or minimum meter reading.

The cable will be directly below the center of the null. The sensitivity control will determine how sharp or how broad the null will be. The operator cannot see the lowest reading if the meter is below a "0" reading. If the null is broad, increase the sensitivity control until a sharp null is found. If the null is so sharp that the meter does not have time to respond, the operator could walk over the cable and not see a null; however, he might hear a small loss of tone in the headphones. The sensitivity should be reduced to the point where a sharp null can be found.

Make free use of the sensitivity control when making a location. As mentioned earlier, the current in the cable may vary over a wide range during the time a location is being made, thus the electromagnetic field being radiated from the cable could be increasing or decreasing at any given time.

The cable can now be traced by finding two (2) null points. This will give the operator the direction of the cable run at that point. By walking in the direction to be traced, move the instrument (receiving antenna) from side to side, keeping the receiving antenna vertical to the ground at all times (do not swing the antenna from side to side). A higher meter reading will be found on each side of

the cable with a null occurring directly over the center of the cable.

The audio heard in the headphones will respond the same way the meter responds to signal level. When a null or loss of signal is found on the meter, a loss of tone will occur in the headphones. Because of distorted field patterns being radiated from some cables, a null on the meter may not be found; however, a loss or change in audio tone may be heard. See helpful location techniques found on page 10.

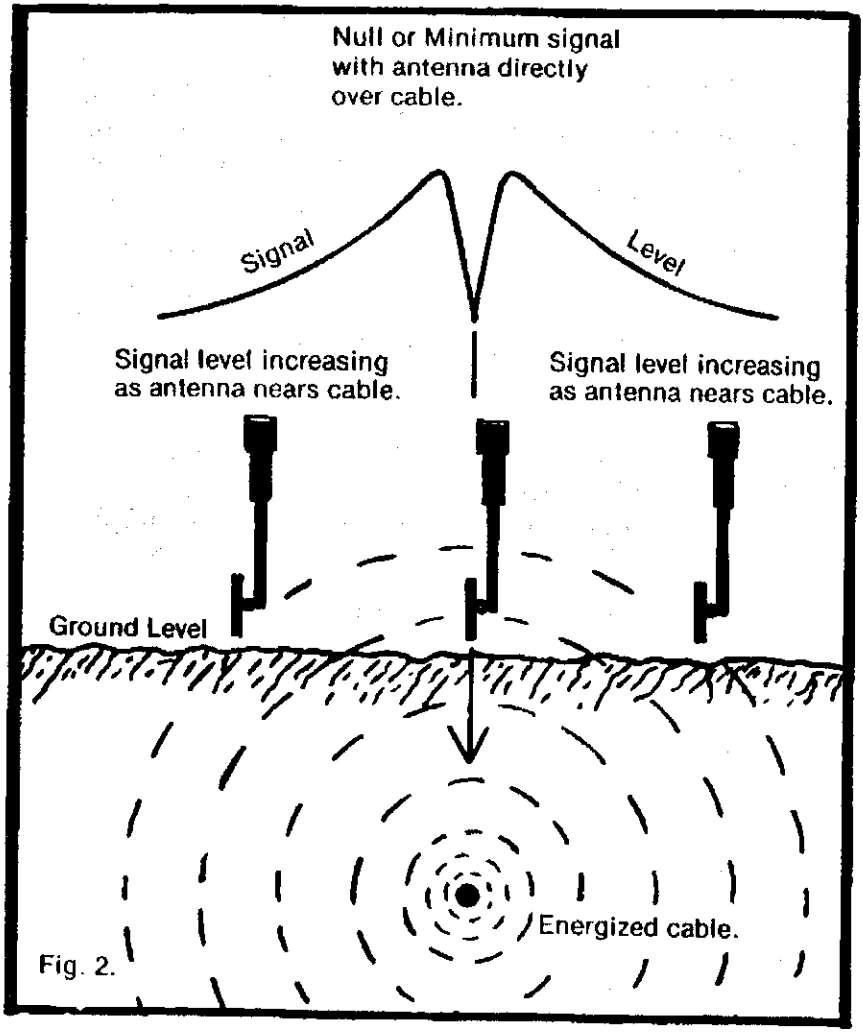

Fig. 2.

V. — DEPTH MEASUREMENT:

The null or maximum method will locate the depth of an energized cable. While this manual only explains the null method, the maximum method can be used if the operator positions the receiving antenna for a maximum signal at 45°.

On a 45° triangle, two of the three sides will always be equal. The true 45° angle for the null method will be when the bubble is centered or shows level on the depth gauge.

The receiving antenna should be adjusted to the vertical position for a null reading. After the cable has been located and its exact position marked, the Power-Pup should be tilted to a 45° angle with the antenna close to the ground. With the operator facing the cable and off to one side, move away from the cable at a right angle, see fig. 3. When the receiving antenna is again pointing at the cable, a new null will be found. Mark this depth null on the ground. Measure the distance between the depth mark and the cable position mark. The distance between these two marks will be the depth of the cable.

The sensitivity control may have to be adjusted while making a depth reading. The null found should be sharp enough to pinpoint the spot you want marked. Also, bear in mind that the distance is calculated at a 45° angle from the receiving antenna. The calculations will have to take into account any slope of the terrain, or the height that the receiving antenna was held above the ground when making the depth measurement.

When possible, a depth reading should be made from both sides of the cable. If both depth measurements agree with each other, the operator can assume a good depth measurement has been made. If the two depth readings do not agree with each other, the operator should again locate the position of the cable and then repeat the two depth measurements. If the two readings still are not the same, care should be used when digging up the cable. Other cables in the area, or other utilities that have 60 hz on them could be distorting the field being radiated from the cable under location. If this distortion is present, the located position and depth could be off.

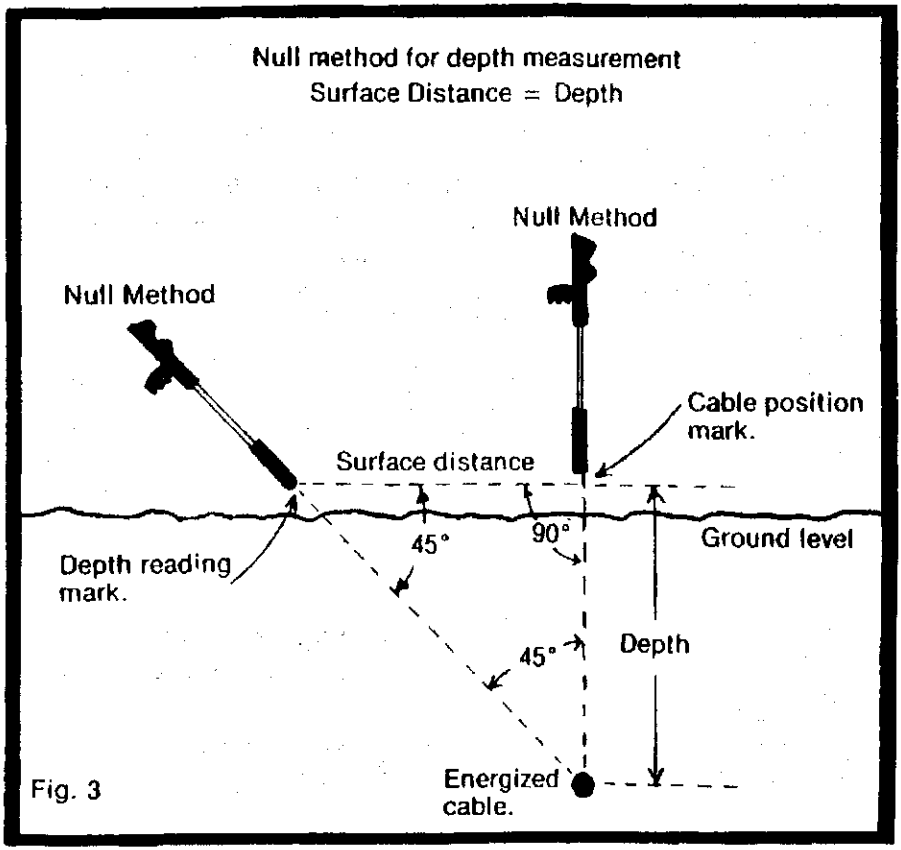

Fig. 3

VI. — LOCATING A LOW IMPEDANCE GROUNDED FAULT:

Locate and trace out the energized cable using the maximum method. A sharp loss of signal will occur at the point of fault. This is because the strong electromagnetic field will be reduced by the amount of current going to ground at the point of fault. Because the field will be distorted near the fault, the null method will not work on a grounded fault.

VII. — LOCATING A "T" OR "Y" SPLICE:

When locating a T or Y splice, each of the cables involved must be located at some distance from the splice. Use the maximum method as the distorted field at the point of splice will cover up or hide a null reading. Each of the cables can be traced toward their point of intersection. The splice will be at the point where the cables intersect with each other. Because of the different current levels in each cable, make free use of the sensitivity control while making this location.

VIII. — LOCATING UNDERGROUND TRANSFORMERS:

Locate and trace the cable toward the transformer using the maximum method. As the operator nears the transformer, the maximum signal level being found over the cable will start increasing. Reduce the sensitivity control until a maximum meter reading can be found in one small area. At the same sensitivity setting used to locate this small area, the cables leading to the area will no longer respond. A higher sensitivity setting would be needed to relocate the cables. The transformer will be directly below the small area found when the sensitivity control was reduced. This is because the large electromagnetic field being radiated from the transformer will be many times greater than that field radiated from the cable. Because of the large and distorted field around a transformer, the null method will not work. The maximum method must be used.

IX. — HELPFUL LOCATION TECHNIQUES:

1. The cable being located must have current flowing, thus, a load of some type is needed.
2. Since most utilities ground their system to the cold water at the house, other utilities will often have a small 60 hz field on them. The power cable will generally have the strongest field, but the opeator could end up locating one of the other utilities if he is not careful.
3. Using the maximum method, the receiving antenna will feed the strongest signal level into the electronics to be amplified. This will probably be the cable you are trying to locate, but there could be times when the cable being located has the weakest signal.
4. The null method requires more current in the cable than the maximum method.
5. The null method will be the easiest and fastest method to use on most locations, because the null will generally be much sharper than a maximum reading.

6. No 60 hz locator will provide a good null reading when a 60 hz field is being radiated from more than one cable at a given location. The interaction of the fields will appear distorted at the receiving antenna, and the null will be covered up. The maximum method will generally provide a good location. This will be especially true when more than one power cable is in the same trench such as a URD house feed.

7. A strong 60 hz field from other cables can render the null method useless. The receiving antenna will null out on the cable being located, but the instrument will not show the null. When the null occurs, the receiving antenna will also be picking up the other electromagnetic fields. The other 60 hz fields will be the strongest when the cable field nulls out, thus the other fields will be fed to the electronics covering up or hiding the nulled out field.

8. The cable feeding a house would be an easy location for the null method if the three (3) cables were always close together in the trench or in a metal duct. Sometimes the three cables are laid in the trench with some distance between them and the distortion of the fields between each other will be broad enough that a maximum method will be the only thing that works.

9. When tracing a house feed, the null method will be increasingly hard to obtain as you near the main secondary. The field from the secondary will flood the receiver and hide or cover up the null obtained from the small current unbalance in the house feed.

10. There will be times when a null is not being found, but a very small tone change might be heard. This tone change could be the cross-over point within the electronics when the null is dropping out and the outside 60 hz signals from other areas are being amplified. This small audio pitch change could also be present on a house service feed where the null has been lost because of a distorted signal.

11. As a rule of thumb, try the null method first. If the null method can be used, it is the easiest and fastest method. If the operator is having trouble using the null method because of the environment he is working in, go to the maximum method. If poor results are being obtained using the maximum method, go to a good pipe and cable tracing instrument like the Model A6 Tracer from Aqua-Tronics, Inc. A good pipe and cable tracing instrument has its own tone that can be coupled to the cable for an easy location.

At first, our helpful location techniques may indicate nothing but problems for the operator. This is not true. On most locations, the Power-Pup will give an absolute location and depth reading to the operator. An instruction manual shows how to use an instrument under ideal or normal conditions. Knowing that some of your work will not be under ideal or normal conditions, we have tried to point out some of the problems an operator can have. As mentioned earlier, no instrument will be all things to every location. If the operator only had to locate single power cables with no other 60 hz fields in his area, an easy location could always be made. Any time there is more than one field present, there is the chance that the fields could start interacting with each other and this will tend to confuse any 60 hz locator. On some of these locations, another type of instrument should be used. It takes more time and technique to use a tracing instrument that has its own built in tone, but any operator will soon find that he needs a 60 hz locator and a pipe and cable tracing instrument of some type if he is to make all of his locations.

The interaction of fields is very complex and much beyond the scope of this manual. All of the Aqua-Tronics, Inc. salesmen have been schooled in this area, and if special help or instruction is needed, contact our nearest outlet and request their help. Once an operator understands how the receiving antenna responds to the various field patterns in a given area, his job of locating becomes much easier.

X. — SERVICE AND WARRANTY:

Instrument Service:

If for any reason you have trouble, or require assistance with your instruments, contact the nearest Aqua-Tronics sales outlet. You may, if you so desire, write or call directly to our manufacturing plant and give full details of your problem or needs.

Warranty:

All Aqua-Tronics products are warranted against defective materials and workmanship. This warranty applies for one year from the date of delivery. Aqua-Tronics will repair or replace all products which prove to be defective during the warranty period. All repair will take place at our manufacturing plant or one of our field Service Centers. The decision of determining warranty defects from abuse or breakage, and where the instrument is to be repaired, lies with Aqua-Tronics, Inc.

If you send your instrument in for factory service, please send it pre-paid. If the service is covered under warranty the instrument will be returned pre-paid. If the instrument is not covered by warranty the instrument will be sent to you C.O.D.