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TW-6

Pipe and Cable Locator



Operating Manual

FISHER RESEARCH LABORATORY

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INTRODUCTION

Since 1931, utility and construction craftsmen have looked to Fisher to set the standard of quality in the design and manufacture of locating equipment. The Model TW-6 with its many timesaving accessories continues the Fisher M-Scope tradition of giving you even greater speed and precision in locating underground pipes and cables.

The surest way to effectively use the TW-6 and its new accessories is to practice on known "conductors". Such items as valve box covers, manhole covers, or valves clearly visible at the surface of the ground are excellent items to start locating. This way you will quickly get the "feel" of the instrument before taking it into the field.

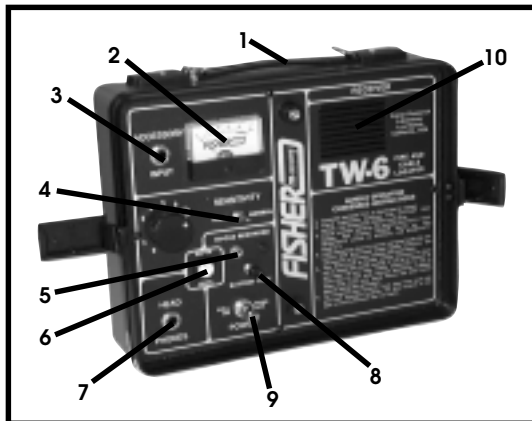


WARNING: The optional recharge kit (NiCd) is not available for Europe and cannot be used there.

WARNING: Batteries can contain hazardous materials and must be disposed according to the laws in your country.

RECEIVER

- 1. Carrying Strap:** Keeps one hand free for marking ground or pavement while using Tracer Probe.
- 2. Meter:** Indicates signal strength up to a point from metallic conductors while locating or tracing. Meter also gives a visual indication of battery strength.
- 3. Accessory Input:** Use this jack to plug in all accessories except the headphones.
- 4. Sensitivity:**
 - A.** Toggle switch to select NORMAL or HIGH range.
 - B.** Knob to control sensitivity level within the NORMAL or HIGH range.
- 5. Ni-Cad Recharge:** When using Ni-Cad rechargeable batteries, plug the charger jack into this receptacle. If red light is on, connection is made. (NOT available in Europe)
- 6. Depth Level:** This bubble indicates the angle of the receiver to the ground. Use it to keep Receiver and Transmitter level during Inductive Locating and for making the 45-degree angle necessary in depth determination.
- 7. Headphones:** Use this jack to plug in headphones only. It automatically silences speaker. Use in particularly noisy areas.
- 8. Battery Test:** Press this black button and



SPECIFICATIONS

Transmitter

Receiver

Operating Frequency	81.92 kHz +.005%.....	81.92 kHz +.005%
Batteries	8 each, AA (NEDA 15)	8 each, AA (NEDA 15)
Weight	2 1/2 lbs. (1.1 kg)	3 lbs. (1.36 kg)
Sensitivity	N/A ... Normal: 400 uV typical	High: 8 uV typical
Signal-to-noise ratio	N/A	110dB
Headset Impedance	N/A	600 ohms (mono)
	N / A	8 ohms (stereo)
Dimensions	11 1/2" x 9" x 3"	11 1/2" x 9" x 3"
	(29 x 23 x .7.6 cm)	(29 x 23 x 7.6 cm)
Operating Temperature	1 OOF to +1200, (-230C to +480C)	
	depending on	
	batteries used.	
Total Weight	5 1/2 lbs. (2.5 kg)	
	-(without handle or accessories, ground plate assembly or operating manual).	
Total Shipping Weight	6 3/4 lbs. (3 kg)	
	-(including only ground plate assembly and operating manual.)	
Total Shipping Volume	69 cu. ft. (119.5 liters)	

RECEIVER

observe battery strength on meter. If meter reads below 80, replace receiver batteries. Usually transmitter and receiver batteries are replaced at the same time.

9. Power: Pull out for ON, push in for OFF.

10. Speaker: Produces the audible signal, which increases in volume and pitch as signal strength increases. The volume and pitch increase even after the meter has peaked at 100.

TRANSMITTER

1. Battery Test Meter: Gives a visual indication of battery strength.

2. Battery Test/Warble Tone Switch:

A. When toggle switch is held toward the meter, battery strength is indicated on meter. Replace batteries if indication is below 5, (5 is the line with the arrow attached).

Usually transmitter and receiver -batteries are replaced at the same time.

B. When Toggle Switch is pressed to the right it clicks into that position. This results in a pulsating sound from the receiver speaker and an oscillation of the needle between zero and 100 instead of the normal continuous sound and needle level.



3. Ni-Cad Recharge: When equipped with Ni-Cad rechargeable batteries, the recharger jack is plugged into this socket. If the red light is lit, proper contact has been made. (NOT available in Europe)

4. Accessory Output: The Ground Plate Assemblies Coupling Clamp or Ground Rod Assembly connects into this jack for a Conductive Trace or Direct Induced Trace.

COMPONENT DESCRIPTIONS

1. Ground Plate Assembly: Provides a "ground" for greatest efficiency in CONDUCTIVE TRACING. For hard ground, the accessory Ground-Plate/ Ground Rod Assembly is recommended.

2. 3-Piece handle: For use in INDUCTIVE LOCATING.

3. Handle Carrying Strap: Allows you to lower handle closer to the ground for greater depth penetration and sensitivity in locating. The same strap is used for carrying the receiver.

4. Handle Carrying Case: Protects 3 piece handle and makes a neater bundle.

5. Carrying Case: Sturdy protection for your TW-6 and storage for accessories, such as coupling clamp, headphones, mini probe, and ground plate assembly.

6. Headphones: Stereotype headphones are available for the TW-6. They are switch selectable from monaural to stereo and may not work with the TW-6 when switched to mono. You may prefer to use the stereo phones because volume is adjustable separately to each ear. The VCO sound is shrill and without a volume control on the mono headphones, the sound may be uncomfortable.

7. Ni-Cad Battery Recharge Kit: Replaces the standard eight (8) packs of carbon zinc batteries that come with the unit and includes the charger for charging both transmitter and receiver simultaneously. (NOT available in Europe)

CHANGING BATTERIES

Turn the instrument over on its face (position is the same for both transmitter and receiver) and remove access plate with coin or large blade screwdriver.

Lift the battery pack out carefully. Turn the battery pack slightly and unsnap the battery connector. Change all eight batteries. Then reattach the connector to the pack. Slip the battery pack back into its compartment and do battery test. Refasten the access plate.

Both the transmitter and receiver will work from 30 to 40 hours on a set of 8 standard quality AA batteries. Alkaline batteries will give at least 30 to 40% greater life. In cold weather, alkaline batteries are much livelier than standard carbon zinc batteries.

Recharging Ni-Cad Batteries

Be sure that all of the AA batteries in the battery pack for the transmitter and receiver are Ni-Cad rechargeables.

WARNING: The optional recharge kit (NiCd) is not available for Europe and cannot be used there.

WARNING: Batteries can contain hazardous materials and must be disposed according to the laws in your country.

CAUTION: *Do not try to recharge the batteries that come with the TW-6, or any other batteries, except Ni-Cad rechargeables.*

The battery packs of 8 batteries remain in the transmitter and receiver. The wall outlet recharger has two wires with connectors so that the TW-6 transmitter and receiver can be recharged simultaneously. Plug one jack into the Ni-Cad recharge receptacle of the transmitter and the other jack into the Ni-Cad recharge receptacle of the receiver, and the charger itself into a wall outlet that has 100-120 VAC 60 Hz. The red light on both transmitter and receiver indicate only that the connections are correct, not rate of charge, nor charge level of the battery packs.

Rechargeable batteries will last approximately 20 hours of intermittent use before they need to be recharged.

Recharging time should be at least 16 hours.

OPERATING HINTS

To develop your operator technique, practice with known pipes and cables to thoroughly familiarize you with your TW-6. Of particular importance in this regard is the SENSITIVITY knob. Learning to vary the SENSITIVITY knob and studying the effects of those variations remains the key to getting the most precision out of the instrument. These practice sessions will not only allow you to get used to how the TW-6 responds to different kinds of pipes and cables, but it will also teach you how to interpret each reading.

When using the TW-6 on the handle in the presence of CONDUCTIVE SOIL (those with high mineral salt content and usually rather damp), it may be necessary to turn down the SENSITIVITY control from the suggested position. With each repeated reduction, the operator should readjust the front knob as given in the "How To Tune" instructions.

When locating near-surface and/or very large pipes, you can sharply decrease the width of indication by tuning the SENSITIVITY control down or counter-clockwise. This narrowing of the indication will allow more accurate pinpointing. The TW-6 has a slightly slower response than earlier models. This is more noticeable at extended tracing ranges. Be sure that when you "wag" either the receiver or the Tracer Probe, you do so slowly enough for the receiver to sense the signal emitted by the underground pipe or cable.

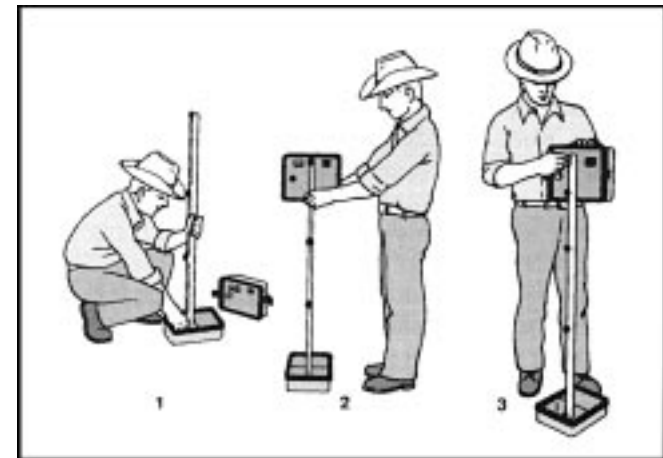
If the signal remains reasonably strong as you are tracing out a pipe or cable and it mysteriously disappears, use the "null method" of locating with the receiver instead of the "signal method". Sometimes at extended ranges in HIGH power, the "null-method" will give you greater tracing distance, however, usually the signal method will give a longer trace.

MODES OF OPERATION

Your Fisher Model TW-6 allows two modes of operation: INDUCTIVE and CONDUCTIVE. In the INDUCTIVE mode, the Transmitter induces the electromagnetic field around the object sought. The Transmitter radiates this field through both soil and water. INDUCTIVE is subdivided into two modes: (1) On the handle for LOCATING and (2) Transmitter placed on the ground directly above and in line with the conductor for TRACING and the path of the conductor.

The CONDUCTIVE mode operates when you connect the Transmitter directly to an exposed portion of the pipe or cable in question with the Ground Plate Assembly, or with the Coupling Clamp, or the Ground Rod Assembly.

THE INDUCTIVE MODE



HOW TO ASSEMBLE

1. If you have the 3-piece handle, insert the two end sections into the central section and turn the knobs until they are "finger-tight".
2. Place the Transmitter on its back and insert handle end with one screw into V-shaped slot.
3. Turn the knob until it is "finger-tight".
4. With the Transmitter still on its back, align the

two holes in the panel of the Receiver with the knobs.

5. Turn the lower knob of the two knobs until it is "finger-tight". Turn the knob with the arrow until the spring is compressed and the panel is pulled within 3/8" of the handle at the end.

HOW TO TUNE

1. Check batteries on both Transmitter and Receiver.
2. Place the Receiver Sensitivity Switch in the NORMAL position.
3. Turn SENSITIVITY knob to 7.
4. To turn ON, pull POWER switches on Receiver and Transmitter.
5. Pick the unit up by the handle and balance it so that it is level with the ground and at normal carrying height (arms length). For a deeper search, hold with the carrying strap which has been fully lengthened. You will need to hold the instrument at this lower level while tuning if you plan to use it lowered. On some highly mineralized ground and some asphalt, you may not be able to use it with strap fully lengthened. You will know this if you cannot reach a "null". Not reaching a null can also indicate the presence of nearby metal.

CAUTION: *Never attempt to tune the TW-6 in the presence of metal objects like cars, metal walls, roofs or heavy metal reinforcements in any structure. Their presence will make proper balancing impossible.*

6. Turn front knob on handle counter-clockwise, until lowest meter and speaker indications are reached. You have reached the lowest point if a 1/8- 1/4th turn in either direction results in an increase in sound and meter reading. If at the

LOCATING NON-METALLIC PIPES

One method is to run an electrician's "fish-tape" or plumber's "snake" down the pipe and connect the transmitter to it using the ground plate assembly. Attach the ground plate assembly clamp to the tape or "snake" and trace the pipe with receiver or receiver and tracer probe. Blockages in pipes can be located this way too in that the tracing signal will stop where the tape or "snake" ends at the stoppage. Tracer tape which is aluminum foil tape sandwiched in printed mylar is available from 3 or 4 U.S. manufacturers in two-inch widths and wider. It can be laid into the trench above a non-metallic pipe. When laid according to the tape manufacturer's instructions, the tape and hence pipe can be located Inductively or Conductively. When laid only 8" or 10" below the surface, it can also be traced with a valve and box locator such as a Fisher M-66 or M-97.

TRACING PROCEDURE

It is useful to carry a "jumper" with two clips and a rod to be driven into the ground to be sure of the ground. Two Coupling Clamps can be used together to perform manhole-to-manhole and drop-to-junction types of work. Plug the second Clamp into receiver ACCESSORY INPUT jack. Then, test different strands with the receiver Clamp to find your signal.

MODES OF OPERATION

lowest point there is still sound and meter reading, turn down sensitivity slowly until meter goes to zero.

If you can turn the front knob more than 1/4th turn without an increase in sound and meter reading, turn the sensitivity knob up from 7 to 8 and try again, going through the null area making sure it does not exceed 1/4th turn. You may need to readjust the sensitivity knob to give you a zero reading at the balance.

CAUTION: *Keep away from cars, fences and metal objects during this procedure.*

You are now ready to locate. Crossing over buried metal causes an increase in sound and meter reading.



INDUCTIVE LOCATING (with handle)

Use Inductive Locating when you want to find metal objects or locate lost or unknown metal pipes and cables. Walk at a right angle toward what you assume to be the conductor's position. As you near the conductor, the speaker sound and meter indication will increase. They will reach maximum readings when you are directly over the conductor.

Remember, on the TW-6, unlike earlier models, the sound volume and pitch increases far higher than when the meter peaks. This will allow you to do most of your locating without several readjustments of the Sensitivity knob.

As you cross over, the indications will begin to decrease because you are moving away. To get a precise fix on the location, make a mark at your feet when readings reach their maximum. Cross over the pipe, turn around and come back. Make a second mark when readings return to maximum. Measure between the two marks and bisect the distance. That is where the conductor is.

To establish the path of a pipe or cable (conductor) move "up" and "down" the line 15 or 20 feet and locate again. From these three locations you should be able to draw a straight line (unless pipe has turned). Careful additional locations may be necessary if no prints of the area are available.

It may be necessary to reduce sensitivity with the knob when the pipe or cable is large and/or shallow. If the meter needle has peaked and sound is at a high level, you will want to bring the sensitivity down to see the peak of the needle at a point less than 100 as you move in half or quarter steps back and forth to get your peak reading.

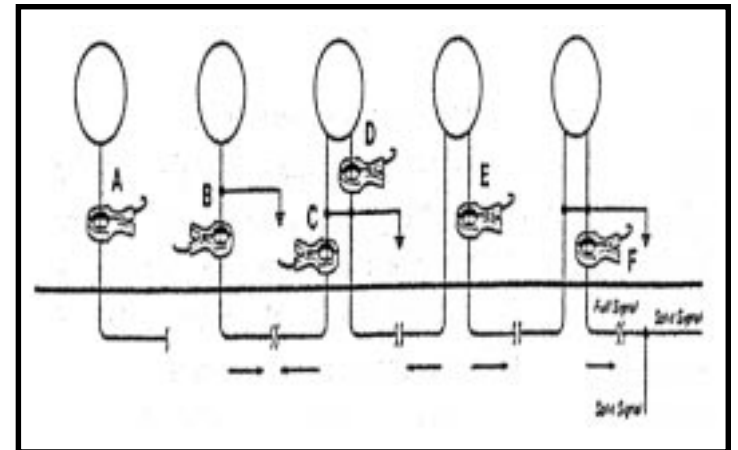
Tracer Probe for the TW-5 can be used with the TW-6 but reduces tracing distance.

Once you have located the pipe or cable with a sharp "null", back away at right angles, dragging the tip of the Tracer Probe on the ground and maintaining the level bubble centered in its circle. You need to be close enough to the transmitter for a strong signal so that the sound will quit or "null" as you back away and then resume again as you move backwards. You measure from the middle of the null area back to the centerline of the pipe or cable and that is its depth.

COUPLING CLAMP

Use the Coupling Clamp to Inductively energize and trace without a metal-to-metal contact. Tracing distance will be less than when using the ground plate assembly, so there is no advantage to using the coupling clamp on pipes, unless a non-conductive wrapping prevents bare metal contact.

Begin by plugging the Clamp into ACCESSORY OUTPUT on the transmitter. Place Clamp around cable or other conductor (make sure jaws are completely closed). Turn receiver and transmitter ON and precede using tracing techniques as described earlier. The conductor must make a closed loop, or circuit, or be grounded for best tracing results.



TRACING PROCEDURE

Turn the transmitter ON and turn receiver SENSITIVITY knob all the way up in NORMAL. Then, when the conductor is located, turn SENSITIVITY down to get a precise indication of the location. Use NORMAL for ordinary tracing, HIGH for extended tracing. In the Conductive Mode, you can have Transmitter and

Receiver as near to each other as 20 feet apart and closer yet if you use the Tracer Probe, without air coupling occurring.

With HIGH power, the distance increases.

With settings and connections completed, the operator need only walk out his trace while paying attention to signal strength over the conductor. As in the Inductive Mode, the receiver should be carried vertically and parallel to the pipe or cable being traced. However, once the position is discovered, you may turn the receiver to a horizontal position to get a pinpoint reading.

If you're dealing with a maze of pipes, trace each line and mark its surface location on pavement with colored chalk or spray paint as you locate it. Extra long yellow or white golf tees are very handy markers when locating over turf or open ground.

Another tip...start tracing operations away from the congested location. The pipe is then carefully traced into the desired area with little chance of false indications. The Tracer Probe also helps reduce spurious signals from nearby pipes and cables.

The Tracer Probe

As you trace out the pipe or cable, signal strength gradually diminishes. When you reach the limit of NORMAL, switch to HIGH sensitivity and adjust the sensitivity knob for a sharp null over the conductor you are following.

The tracer probe designed especially for the TW-6 is slightly shorter than the earlier model and does not need a separate SENSITIVITY knob. It can be used effectively with the earlier TW-5 model. The

MODES OF OPERATION

HIGH POWER (with handle)

An interesting phenomenon on the TW-6 compared to the TW-5 and an earlier model is that you may prefer to use it in HIGH power, on-the-handle. The Sensitivity knob will need to be lowered to about 3 or slightly less to get the meter reading down to zero and no sound when balancing. As you approach a pipe or cable lying beneath the ground, the signal may be slight, approximately 20 to 30 and it can be difficult to identify the peak.

Now turn the Sensitivity knob up so the meter reading becomes 70-75. As you move forward and backward, you will easily see a peak on the meter. Mark the spot on the ground where you have stopped, with both feet together. Then go on beyond the conductor, turn around and approach the conductor in the same way, stopping with feet together at the highest meter reading and mark the spot on the ground. Measure between the two points, bisect it and you have the centerline of the conductor.

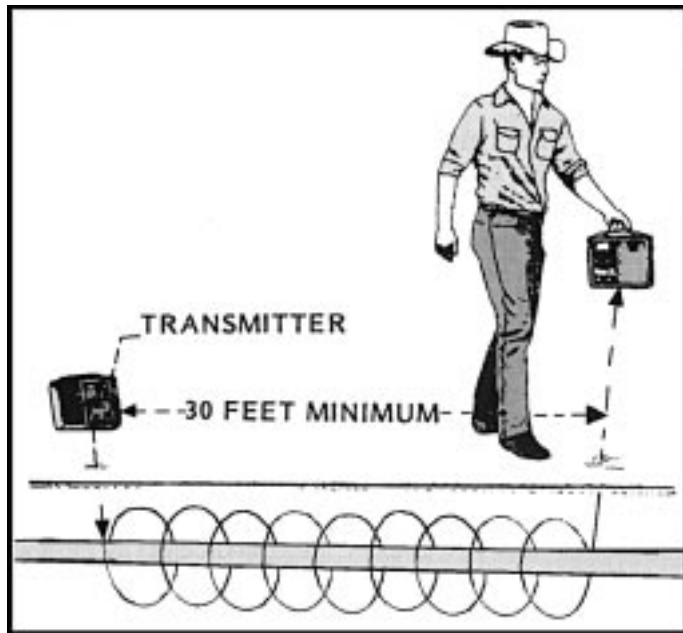
Be aware that when you use HIGH power on the handle, you will need to be further away from vehicles, metal buildings and metal fences to avoid sensing them as well.

INDUCTIVE TRACING (without handle)

Use Inductive Tracing as a one-man operation when you know a starting point of the object pipe or conductor. You will maximize signal strength by having the bottom edge of the Transmitter directly over and in line with the conductor you're tracing. Placing the receiver on its back will give no signal or a "null" directly over the conductor and a signal on either side.

If you place the transmitter and receiver too close together "direct air coupling" will result, meaning the transmitter is sending to the receiver through the air, the electromagnetic field is simply ignoring your pipe. If this happens, you can either (1) turn the SENSITIVITY control down until you lose the air signal, or (2) simply move the receiver further away until the air signal fades.

NOTE: With the SENSITIVITY knob on full and the Sensitivity Selection Switch set to NORMAL, the two units should be at least 30 feet apart to avoid air coupling. With HIGH SENSITIVITY, they must be even further apart.



a conductor running parallel to the pipe or cable you are tracing, because even if you are not hooked up to the conductor you crossed over, the signal has to cross back past the path of this conductor and will induce a certain amount of signal into it. This signal can mislead you when tracing it out.

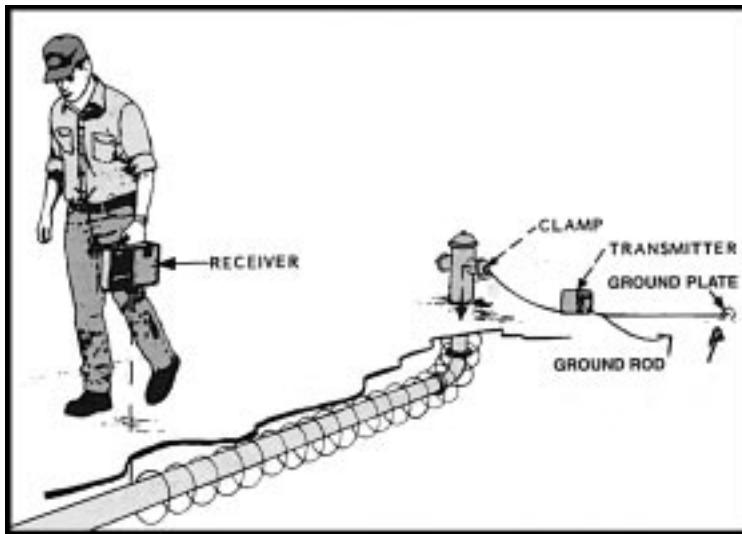
If you're working on pavement, simply lay the Ground Plate on its side, parallel to the conductor in the direction of the tracing. Weighting it down with a rock or someone standing on it makes it a better ground contact. If the plate is weighted down in a puddle or at least if the pavement is wet, tracing distance is improved. You may pour some water on the pavement to improve ground contact.

CONDUCTIVE TRACING (without handle)

The most satisfactory method of tracing when you need to trace an individual pipe when another pipe is nearby is CONDUCTIVE tracing. In the CONDUCTIVE mode, the transmitter energizes the pipe through direct connection. Before attaching the ground plate clamp to the conductor, clean the conductor with a wire brush (this creates a good metal-to-metal contact).

After cleaning, plug the jack into the transmitter and secure the clamp to the pipe or non-energized cable. Place the transmitter in an upright position and as far away from the pipe as possible to the side opposite any other lines. As far away as possible means it will be at 90°.

If you are working in an area with several other conductors near the pipe or cable you want to trace, place the ground plate as close as possible to the point at which you fasten the clip to the pipe or cable. This will reduce the signal strength and reduce the amount of signal induced into another nearby conductor, giving a more concentrated signal in the pipe or cable you are tracing. Never stretch the ground plate across



INDUCTIVE LOCATING WHEN ONLY APPROXIMATE POSITION OF A LINEAR CONDUCTOR IS KNOWN

Two people most efficiently perform this operation. Each holds the unit with its face towards him and parallel to the other's instrument. Standing at least 30 feet apart, they walk parallel to each other from the curb toward the opposite side of the street. When the two operators are directly over the pipe, the receiver meter and speaker will indicate the location. The pipe is directly below the point at which the maximum signal occurs.

If only one operator is available, he should begin by placing the transmitter over and in line with an assumed position of the buried conductor. While maintaining a distance of at least 30 feet from the transmitter, hold the receiver parallel to the other instrument and begin to walk forward until the signal reads its maximum indication. In a one-person search, you may find it necessary to move the transmitter several times in order to be precisely over the buried conductor.

PINPOINTING CENTER OF THE PIPELINE

After determining the position of the pipe, set the transmitter down on its bottom edge and in line with the indicated position. Then, at a distance of at least 30 feet, hold the receiver with its backside down and begin moving the receiver from side to side over the general location line of the conductor. This back and forth motion will give a null directly over the position of the buried conductor.

DETERMINING CONDUCTOR DEPTH BY TRIANGULATION

This procedure is only accomplished when the transmitter is close enough for the receiver to receive a strong and clear signal.

Once you have determined the exact centerline of the conductor (either Inductively or Conductively), place the receiver above and parallel to it. Hold the receiver as close to the ground as possible. Now, tip the receiver back until the bubble inside the depth level indicator rests between the outer edge of the center ring and the black border of the level.

When it does, the receiver will be at a 45-degree angle to the level ground. Care should be taken at this point, as a few degrees of deviation will affect the final depth analysis. The operator should be holding the receiver at 45 degrees and facing toward the conductor centerline. Now, back away slowly, at a right angle to the conductor, keeping the bubble as steady as possible. The meter indication should manually be adjusted by means of the sensitivity control to stay on scale in order to observe the point where the needle will fall to a minimum signal. After this point, the signal begins to increase again.

Position the receiver at the minimum or null point. Measure the horizontal distance from the centerline of the conductor to center of the fastener, which holds transmitter and receiver together. This distance, minus the distance of the center of the locator loop above the ground distance (5") is the depth of the conductor.

If the conductor is buried in sloping ground, make a depth determination on each side of the conductor and average the two distances to find the cable depth.

A tracer probe with its smaller receiver coil in the tip, is quicker and easier to use, hence it yields greater accuracy in depth finding and tracing. The same principle of triangulation is used when using the receiver or receiver with tracer probe.

LOCATING MANHOLE COVERS, VALVES, TEES AND RISERS

These jobs are best performed in the Inductive Mode using the handle. To find a valve, tee or riser, locate the main pipe using any of the previously discussed methods, then, holding the center of the handle with the receiver leading (face up), walk alongside the main pipe. Be sure you're far enough away from the centerline of the pipe to have a low or no reading. When you cross the sought after valve, tee or riser, the meter and speaker will signal a larger mass of metal indicating the valve. At that point, you can cross and return over the suspected valve location from 3 or 4 directions to pinpoint its location.

In the case of the paved-over manhole cover, search systematically by walking out a grid pattern, each "line" of which should be 4 feet apart. Practice this grid technique with a visible cover so that you can get the "feel" of it.

LOCATING PIPE WHEN OTHER LINES ARE CLOSE BY

Two methods of Inductive Tracing may be employed. In the first method, set the transmitter vertically and parallel to the line to be traced, approximately three to five feet from the pipe you're tracing and away from the pipe not wanted. Now, follow normal Inductive Tracing instructions. To locate the other pipe, move the transmitter to the opposite side, three to five feet away from the second pipe. In the second method, set up the transmitter so that its plane points toward the pipe desired. This positioning induces a maximum field in the pipe desired and a minimum field in the secondary pipe.