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USE OF PIPE FINDERS IN SEARCHING OF UNDERGROUND PIPELINES IN GEODETIC MEASUREMENTS

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Abstract
This article shows how important pipe finders are in surveying and construction in general today. The article describes the importance of pipe finders and how accurately measurements can be carried out. In addition, there are various instructions on how to prepare and use pipe finders. Various safety rules are explained in order to prevent possible problems. Most importantly, information is given about the necessity of this equipment in the field of geodesy. Some information about what to pay attention to when using a pipe finder and how to use a pipe finder is given.

Keywords: transmitter, generator, electromagnetic field, electromagnetic signal, electromagnetic induction, frequencies, GPS system, signal microprocessor, induction current, decibel(dB), milliAmpere(mA), marker, topographic plan, closed circuit, plastic pipes, LCD display.

Introduction

Today, every industry is rapidly developing, and the construction industry is no exception. Currently, many factors are taken into account when carrying out construction work, including underground pipelines. Today, almost all communication, water, gas and communication lines are carried through underground pipelines. If these pipes are not taken care of, builders can cut them off. This can lead to very bad consequences. Therefore, pipe finders are now widely used to search for and locate such pipes.

Main Body

Qurilma to‘plami ikkita asbob: transmitter, quvur qidirgich va ulardan tashqari maxsus magnit, kabel va qoziqlardan iborat hisoblanadi. Ularning ishlash prinsipi quyidagi ko‘rinishda: transmitter maxsus kabellar orqali magnit bir tomondan yer ostiga kiruvchi quvurga, ikkinchi tomondan maxsus qoziq yordamida yer ostiga ulanadi. Bunday ulanishdan maqsad transmitter yoki boshqacha qilib aytganda, generator yordamida elektromagnit maydonni hosil qiladi. Generator bu elektr magnit maydon hosil qilib, uni quvur qidirgichga yuboradi. Hosil bo‘lgan maydonda quvur qidirgich elektromagnit signallarni elektromagnit induksiya ko‘rinishida yer ostiga yuboradi va qaytib kelgan signal yordamida quvur haqidagi ma’lumotlarni ekranda ko‘rsatib beradi.

The device set consists of two devices: a transmitter, a pipe finder, as well as special magnets, cables and stakes. The principle of their operation is as follows: the transmitter is connected through special cables to the magnet from one side to the underground pipe, and from the other side to the underground using a special stake. The purpose of such a connection is to create an electromagnetic field using a transmitter or, in other words, a generator. The generator creates this electro-magnetic field and sends it to the pipe finder. In the created area, the pipe finder sends electromagnetic signals underground in the form of electromagnetic induction and shows information about the pipe on the screen using the returned signal.

English physicist Michael Faraday proved the phenomenon of electromagnetic induction in 1831. The phenomenon of electromagnetic induction is a change in the flux of the induction of the magnetic field surrounding a closed circuit and the generation of an electric current in the circuit. This current is called induction current. The pipe finder sends this current underground and detects data through the signal returned from it. [3].

The location of the pipe is indicated by arrows on the pipe finder screen, that is, the arrow indicates which direction to go. When hovering over a pipe, the arrow will become vertical and will place the pipe location on the sketch. This equipment still has errors, it can measure the height from the pipe to the ground with an accuracy of a few 10 centimeters, and its other drawback is that it cannot detect plastic pipes. In order to prevent this, today, before laying plastic pipes on the ground, metal wires are laid on them, which helps to clearly find the pipes.

A pipe finder can perform some searches without connecting to a generator, but the accuracy will not be high. Nowadays, modern pipe finders can not only find underground pipes, but also can receive information from the desired location based on the GPS system using satellite technology. Pipe finders can only find pipes that are running at the same time. A receiving antenna is a system that can detect electromagnetic waves in a certain frequency range and display the received values. The simplest locator uses an induction phenomenon to pick up electromagnetic waves and headphones to display the results. In this case, when the specialist places the pipe finder over the cable, he hears the maximum power signal in the headphones. The farther the receiver is from the cable, the less the signal will be heard in the headphones.

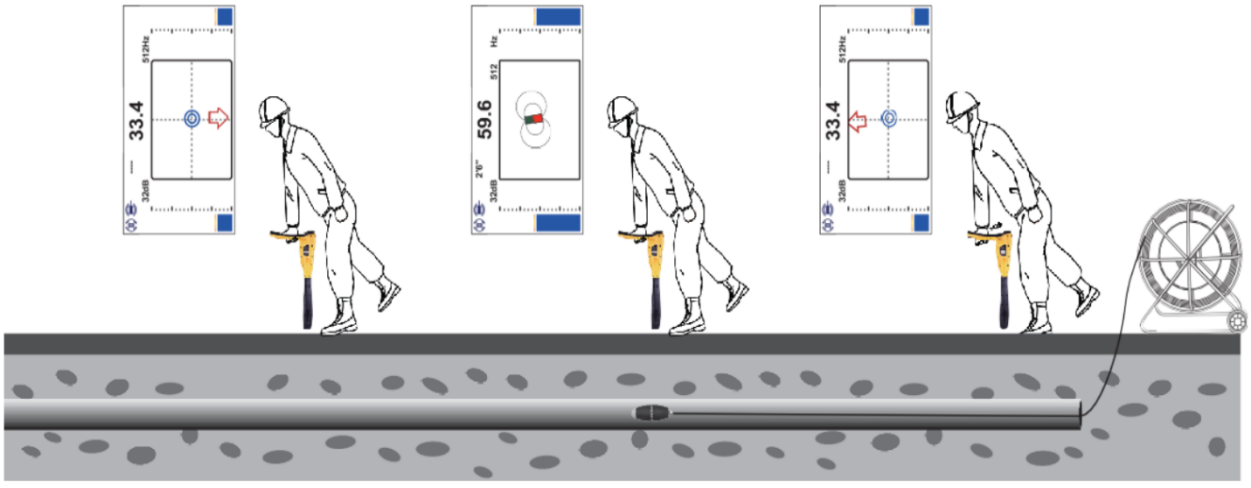


Figure 1. Search for pipes using the pipe finder

The receivers of modern locators have not one, but two, three or more inductors. The signal received from them is processed by a microprocessor and the result is displayed on the LCD screen. In this case, the user receives additional information. For example: the depth of the cable, the direction of the current through it, a graphic representation of the position of the cable in relation to the receiver, etc. As a result, the pipe finder is not looking for the cable, but the electromagnetic field emitted by it.

If an electric current passes through a cable, it creates an electromagnetic field with a frequency of 50 Hz around the cable. Gas pipes often contain a cathodic protection current, which also creates an electromagnetic field, but with a frequency of 100 Hz.

In the area where the cable enters, any external sources of electromagnetic signals can create eddy currents, which lead to the appearance of a weak field around the cable itself. If the cable is not connected to anything and does not carry current, it should be artificially signaled. For this we need a generator.

A generator is a device that generates a signal at a certain frequency and delivers it to the cable.

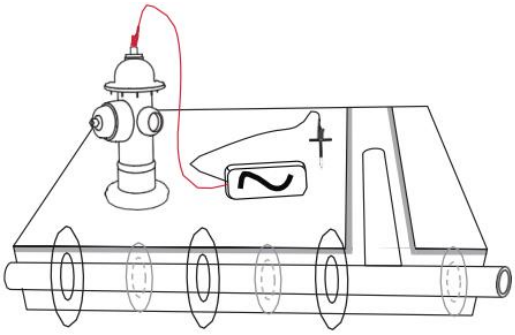


Figure 2. Connect the generator to the underground pipeline through a clamp

Materials and Methods

There are three methods to transmit a signal to a cable:

1. Directly (through clamps). In this case, one end of the generator is connected to the shell with the insulation layer moved or to the group of metal cores of the cable, and the other is connected to the ground. The disadvantage of this method is that it requires direct access to the wire cores, which is connected or distributed can be in a box or in a relationship. The advantage is in the large signal propagation range, because in this case a low signal frequency is used and its dispersion is reduced when passing through the cable.

2. Using induction transmission pincers. In this case, access to the wire cores is not required. An induction transmission pincers is attached to the cable and transmits a high-frequency signal to it (if it contains metal elements). The advantage of this method is its simplicity and convenience.

3. Using an induction antenna. In this way, it is not necessary to connect the generator directly to the cable or pipe. At the same time, in order to know exactly the direction of the cable and give it a signal, it is necessary to install the antenna on the ground, directly above the cable. This method is the simplest, but the current induced in this way cannot go far in the cable. Because it has a high frequency and easily propagates through the cable. Also, it is not recommended to use this method in places where there are many cables, because the signal will be directed to all the cables at the same time and we will not be able to determine the desired result.

Below are just a few of the uses pipe finders have:

1. “Sonda” mode through this mode we can also search for non-metallic pipes. For this, a special device is inserted into the pipe, the “Sonda” section is selected from the device, and measurements are made.

2. The mode of searching for the marker is that it is placed in a plastic box and placed underground beforehand. In the menu of pipe finders, there is a separate section called search for markers, through this section it is possible to search for markers. This function is usually marked with the letter “M” on pipe finders.

In addition, the pipe finder can work on active and passive frequencies.

To operate at active frequencies, the generator is connected to a section of pipe or cable that goes underground and sends signals through the conductor, the signals being tuned to the same frequencies. The main advantage of uniform frequency transmission is that a magnetic field of uniform strength can be generated through it.

To use passive frequencies, pre-existing magnetic fields are used. A pipe finder can detect many communication lines without connecting to a generator. Pipe finders also have marker search sections. In this mode, it is possible to determine the depth of the pipes, their openings, wire insulation, damaged areas.

To work in induction mode, communication lines should be located close to the surface of the earth. In this case, the signals are sent at higher frequencies and are therefore more useful.

Pipe detectors cannot work at a very close distance to the generator, because the electromagnetic field around the generator is very strong, and this affects the principles of operation of the pipe detector. The generator also has technical safety rules, which increases the efficiency of the generator and ensures the safety of the user.

Pipes can also be found on specific frequencies using the pipe finder. For example: power for electric cables is 50-60 Hz.

In this case, the special magnet of the generator is attached to the place where the shell of the pipe is cleaned, and one side of the special clamps is connected to the magnet, and the other end to the generator.

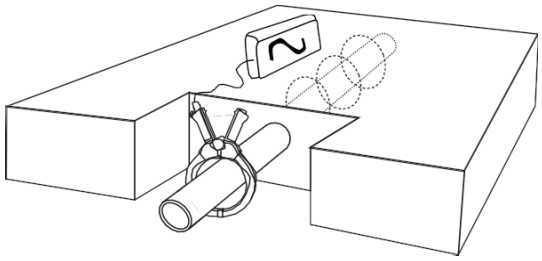


Figure 3. Connecting the generator to the pipe through transmission pincers

When connecting the generator to the pipe in this way, we need a clamp called “transmission pincers”. The transmission pincers is connected to a pipe with cables on one side, and to a generator on the other.

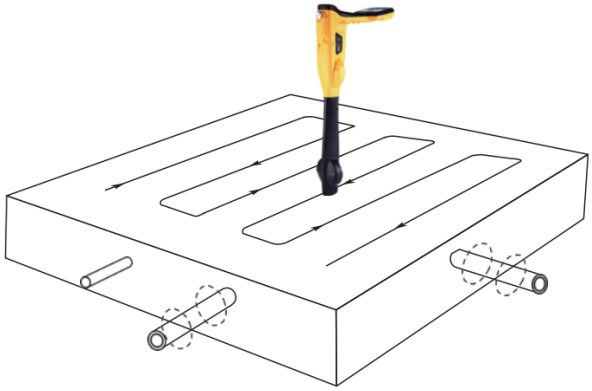
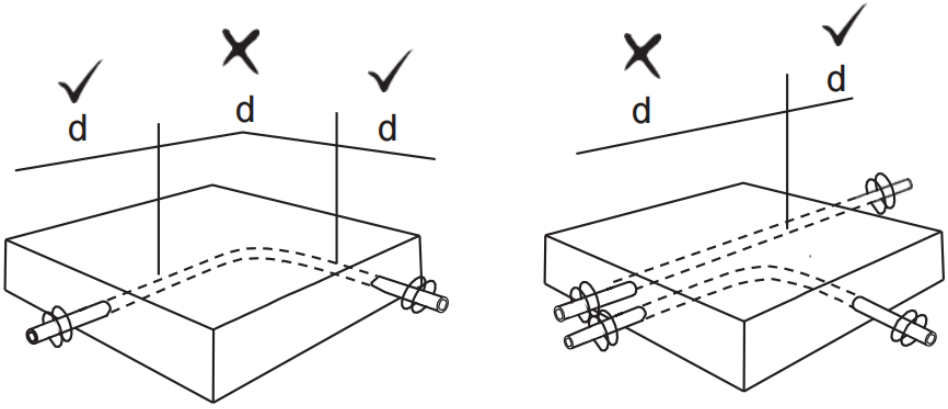


Figure 4. Field inspection scheme in pipe finder

It is advisable to check the area using a pipe finder in the following way.



a) b)

Figure 5. Determining the direction of the pipe at the point where it turns

a) when reaching the turning point of the pipe, the device shows a slight error in the direction, therefore, it is recommended to set the direction a short distance before and after the turn of the pipe.

b) If several pipes move in the same direction and split into two after a certain distance, the device will be wrong in indicating the direction. Therefore, it is advisable to determine the direction from the turning point.

Figure 6. Practical use of pipe finders in the search of pipe networks

Results: The table below shows the results obtained using pipe finders.

Table 1. Measurement results obtained from the pipe finder

№	Depth, m	Current received by the pipe finder, mA	Frequency, Hz	Power, dB
1	1.52	51.5	273	95
2	1.23	60.8	273	95
3	1.57	47.1	273	95
4	2.91	68.3	273	60
5	2.98	67.6	273	60
6	3.07	44	273	71
7	3.26	61.3	273	71
8	3.26	58.6	273	71
9	2.59	59.7	273	95
10	2.16	45.2	273	95
11	2.65	56.2	273	60
12	2.8	46.3	273	71
13	2.77	61.2	273	71
14	2.7	70.8	273	60
15	2.04	72.5	273	95
16	2.08	76.4	273	71
17	2.3	58.3	273	60
18	2.52	65.9	273	95
19	2.9	66.8	273	95
20	2.7	55.3	273	71
21	2.8	56.5	273	60
22	2.56	48.5	273	60

Through this table we can see the depth of the pipes at a given point and how the current is coming from the generator to the pipe finder. To do this, it is necessary to hold the pipe finder at the desired point for a certain time, after which we can see the depth of the pipe on the screen.

Ridgid
(USA)

Radio detection
(England)

Stalker
(Russia)

Vivax-metrotech
(USA)

Figure 7. Pipe finder manufacturers

In the process of geodetic surveying, it is important to describe the underground pipelines in the topographical plan of the area. In such situations, a pipe finder is a very necessary device, because if the pipes are entered incorrectly in the topographical plan, it can cause major problems in the subsequent construction processes. In order to prevent this, pipe finders are used. If pipe finders are not available, surveyors will have to inspect the sewer pipes one by one to determine the approximate route of the pipes. Even then, they would have to approximate the direction and depth of the pipes, and this would certainly increase the error. As a result, interruptions in construction processes may occur. In order to prevent such problems, pipe finders are very important in the field of geodesy [2].

Conclusion\Recommendations

In conclusion, it can be said that today pipe detectors are an integral part of construction work. Because the work that a pipe finder can do cannot be done with geodetic tools. The exact location of underground pipelines in the projects makes the construction work easier to a certain extent, because no builder wants to pierce the underground pipelines, damage them and create additional work and money for himself.

When using pipe finders, please follow the following recommendations. Separate frequencies are selected for each pipe, it is recommended to pay attention to this. Because there is a possibility of losing the tube through the wrong frequency. In addition, additional equipment in the equipment package can be used only for this pipe finder. This device's hardware may not be compatible with other devices. One of the most important recommendations is to put the equipment in working order and start the generator according to the rules. Failure to follow the instructions for starting the generator can cause the generator to fail.

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