Full name(s) of Applicant(s)  Dnepropetrovsky inzhenerno-stroitelnuy Institut of USSR, Dnepropetrovsk, ulitsa Chernyshevskogo, 24-a

hereby apply for the grant of a standard patent for an invention entitled

"TOOL FOR FORMING EARTH HOLES HAVING FIXED WALLS AND METHOD THEREFOR"

which is described in the accompanying complete specification.

DETAILS OF BASIC APPLICATION(S)

Number(s) of Basic Application(s) 3330152 and 3330153

Name(s) of Convention Country(ies) in which Basic Application(s) were filed USSR (respectively)

Date(s) of Basic Application(s) 22nd September, 1981 and 22nd September, 1981 (respectively)

Our address for service is: Spruson Ferguson, PATENT ATTORNEYS CBA CENTRE, 60 MARGARET ST. SYDNEY, NEW SOUTH WALES AUSTRALIA

Dated this EIGHTH day of JUNE, 1982

To: The Commissioner of Patents

By: Registered Patent Attorney.
In support of the Convention Application for a patent for an invention entitled:
"TOOL FOR FORMING EARTH HOLES HAVING FIXED WALLS AND METHOD THEREFOR"

I, Igor Konstantinovich Florov
of USSR, Dnepropetrovsk, Naberezhnaya Pobedy, 94, kv.53
do solemnly and sincerely declare as follows:

1. I am the applicant for the patent of addition.

2. I am authorised by Dnepropetrovsky inzhenerno-stroitelnny Institut the applicant for the patent of addition to make this declaration on its behalf.

3. I am the actual inventor of the invention referred to in the basic application:

BORIS MIKAILOVICH MAZO
of USSR, Dnepropetrovsk, ulitsa Zhukovskogo, 2b, kv.20
and

VALENTIN IVANOVICH FEKLIN
of USSR, Dnepropetrovsk, ulitsa Sofi Kovalevskoi, 71A, kv.143

are the actual inventors of the invention and the facts upon
FORMING HOLES IN NON ROCK SOILS

DNEPROPETROVSKY INZHENERSNO-STROITELNY INSTITUT

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E21B 7/26 E21B 7/20

BORIS MIKHAILOVICH MAZO AND VALENTIN IVANOVICH FEKLIN

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Claim

1. A tool for forming earth holes having fixed walls, comprising a leading casing (1) provided with a cylindrical sizing portion (2), and frontal (3) and rear (4) conical tips provided with spiral tape surfaces for consolidating soil, disposed on both sides of the sizing portion (2), and a trailing casing (5) having a cylindrical sizing portion (7) and a frontal conical tip (8) provided with spiral tape surfaces for consolidating soil, disposed above the leading casing (4) in a coaxial relationship therewith, provided with an axial duct (10) for supplying a fixing material and connected with the leading casing (1) by a tubular coupling element (6) communicating with the axial duct (10) and provided with a port (14) for discharging the fixing material, characterized in that the sizing portion (7) of the trailing casing (5) has a greater diameter than that of the sizing portion (2) of the leading casing (1) and corresponds to the diameter of the hole being formed.

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3. A method of forming earth holes having fixed walls, consisting in that a primary hole is formed, whose diameter is smaller than the predetermined, and this hole is filled with a fixing material, following which the hole of a predetermined diameter is formed by pressing the fixing material into soil, characterized in that the hole of a predetermined diameter is formed by the tool claimed in claim 1 with the advancing sinking of the pilot hole using the same tool, and the fixing material is supplied into the pilot hole at the regions to be fixed, and after the formation of the hole of a predetermined diameter is over, the tool is lifted until it leaves the pilot hole, then the fixing material is fed into the hole, following which the secondary sinking of the hole is accomplished, while pressing the fixing material into walls and a bottom of the hole.
Complete Specification for the invention entitled:

"TOOL FOR FORMING EARTH HOLES HAVING FIXED WALLS AND METHOD THEREFOR"

The following statement is a full description of this invention, including the best method of performing it known to me/ us:

[Further description of the invention follows]
THE PRESENT INVENTION RELATES TO CONSTRUCTION TECHNOLOGY, AND IN PARTICULAR TO A METHOD AND APPARATUS FOR FORMING EARTH HOLES, HAVING FIXED WALLS, IN VARIOUS NON-ROCK SOILS, AND PREFERABLY IN WEAK AND WATER-SATURATED SOILS.

KNOWN IN THE ART IS A TOOL FOR FORMING EARTH HOLES, DISCLOSED IN THE EARLIER APPLICATION BY V.I. REKLAN ET AL., AND COMPRISING A LEADING CASING HAVING A CYLINDRICAL SIZING PORTION, AND A FRONTAL AND REAR CONICAL TIPS PROVIDED WITH SPIRAL TAPE SURFACES FOR CONSOLIDATING SOIL, AND A TRAILING CASING DISPOSED ABOVE SAID LEADING CASING AND IN COAXIAL RELATIONSHIP THERewith, THE TRAILING CASING HAVING A CONFIGURATION SIMILAR TO THAT OF THE LEADING ONE. THE LEADING AND TRAILING CASINGS ARE CONNECTED THEREBETWEEN BY A TUBULAR COUPLING ELEMENT PROVIDED WITH A CAVITY COMMUNICATING WITH A DUCT PROVIDED WITHIN THE TRAILING CASING, AND WITH OPENINGS MADE IN THE WALLS.

SUCH AN ARRANGEMENT ALLOWS THE FIXATION OF THE HOLE WALLS TO BE CARRIED OUT WITH VARIOUS FIXING MATERIALS IN THE COURSE OF TOOL INTRUSION INTO SOIL. HOWEVER, IN SO DOING, THE BOTTOM AND WALLS OF THE HOLE AT THE LOWER PORTION THEREOF ARE LEFT UNFIXED, WHICH FACT IN THE COURSE OF DEEPING THE HOLE BELOW THE LEVEL OF SUBSOIL WATERS CAN RESULT IN INUNDATION OF THE HOLE AND IN EMBARRASSMENT OF SUBSEQUENT ERECTION OF PILES. IN THE USE OF SUCH A TOOL FOR THE FIXATION OF THE HOLE BOTTOM, IT IS NECESSARY TO WITHDRAW THE TOOL TO THE SURFACE, TO SUPPLY THE FIXING MATERIAL INTO THE HOLE THROUGH THE COLLAR THEREOF, AND TO ACCOMPLISH SECONDARY SINKING OF THE WHOLE HOLE. THIS RESULTS IN A SUBSTANTIAL INCREASE IN THE LABOR CONSUMPTION OF THE PROCESS AND IN A DECREASE IN THE WORK QUALITY, SINCE THE HOLE WALLS AT A LOWER PORTION THEREOF DRIFT PRIOR TO THE FIXATION PROCESS IN THE COURSE OF SECONDARY SINKING, THE HOLE BECOMES FILLED.
with water filtering through the unfixed bottom.

In the above-mentioned application there is described a method of making a hole having fixed walls, comprising forming a hole without soil excavation, supplying a fixing material into the hole, and fixing hole walls by pressing the fixing material into the hole walls simultaneously with the hole formation.

Such a method ensures an increase in the stability of the hole walls and a decrease in the labor consumption in the course of the hole formation.

However, in the penetration of the hole bottom down to a level lying below the horizon of subsoil waters, the efficiency of the given method is decreased since in the use thereof is not achieved the fixation of the hole bottom and of the lower portion thereof, thereby resulting in the filtration of water into the hole and in the drift of its walls at the lower portion.

The invention is based on the problem to provide a tool and a method of forming earth holes having fixed walls, which allow the efficiency and reliability of the fixation of walls and a bottom of the hole to be increased.

This object is attained by that in a tool for forming holes having fixed walls a trailing casing is provided with a sizing portion whose diameter is greater than that of a leading casing. With such an arrangement the directions of coiling spiral surfaces of tips of both the casings coincide. A coupling element connecting both the casings is provided with blades disposed along a spiral relative to the axis thereof, the direction of coiling said spiral being opposite to the direction of coiling a spiral surface of the frontal tip of the tool leading casing.
This object is further attained by that in a method of forming earth holes having fixed walls at first a pilot hole is formed, whose diameter is smaller than that of the required hole, and whose depth is determined by the length of a leading portion of the tool, following which the sinking of the main hole is accomplished together with the advancing sinking of the pilot hole and with the supply of a fixing material into the pilot hole at the portions to be fixed, and after the sinking is over, the borehole tool is lifted to a height which is not less than the length of the leading portion thereof, and the fixing material is fed into the hole, following which the secondary sinking of the lower portion of the hole is carried out while fixing walls and bottom thereof.

The invention is further explained by the drawings, in which:

Fig. 1 shows a perspective view of the tool for forming holes;
Fig. 2 shows a view 2-2 of Fig. 1;
Fig. 3 shows an initial step of well sinking;
Fig. 4 shows the process of hole sinking with simultaneous fixation of walls thereof;
Fig. 5 shows the supply of a fixing material to the hole bottom;
Fig. 6 shows the fixation of walls of the hole lower portion and of the bottom thereof.

A tool for forming earth holes having fixed walls includes a leading casing 1 (Fig. 1) comprising a cylindrical sizing portion 2, a frontal 3 and a rear 4 conically shaped tips provided with spiral tape surfaces for consolidating soil, said surfaces having the same direction of coiling, and a trailing casing 5 disposed above the leading casing 1.
and connected therewith by means of a tubular coupling element 6, the leading casing 1, the trailing casing 5 and the coupling element 6 having a common longitudinal axis, and the trailing casing 5 comprises a cylindrical sizing portion 7 having a greater diameter than that of the sizing portion 2, i.e. the diameter of the main borehole, and a tip 8 of a conical shape, disposed coaxially with the cylindrical portion 7 and provided with a spiral tape surface whose coiling direction coincides with that of the spiral surfaces of the frontal 3 and the rear 4 tips of the leading casing 1, said surface being provided in the form of coaxially disposed cylindrical portions whose radii decrease stepwise downwards in the direction from the sizing portion 7 of the trailing casing 5 to the location of the connection between the casing 5 and the element 6, the cylindrical surfaces of the coaxial portions, constituting the tip of the trailing casing 5, being smoothly conjugated therebetween by adapting portions (Fig.2). The trailing casing 5 of the tool is provided with a duct 10 (Fig.1) for supplying a fixing material 11, communicating with a cavity 13 of a bore rod 12, and the element 6 has a cavity 13 communicating with the duct 10, ports 14 within the walls for discharging the fixing material 11 into a hole 15, and blades 16 disposed relative to the element 6 along a spiral whose coiling direction is opposite to that of the spiral surfaces of the tips of the leading 1 and the trailing 5 casings of the tool. The method is carried out as described below in the description of tool operation. In the course of rotation which is transmitted to the tool from a drive (not shown) the leading casing 1 of the tool, due to the provision of the frontal conically shaped tip 3 is screwed into soil, thereby forming the hole 15 (Fig.3) which hole, in the course of intrusion of
the trailing casing 5 thereinto, expands to a pre-determined diameter (Fig.4) which is equal to that of the cylindrical portion 7 of the trailing casing 5. The cylindrical portion 7 accomplishes the function of sizing the hole 15. As the tool is penetrating into the soil, the latter is pressed into the walls of the hole 15 by the surfaces of adapting portions 9 of the conical tip 8 of the trailing casing 5. In the course of sinking those portions of the hole 15 where soil is to be fixed, the fixing material 11 is fed through the cavity of the bore rod 12, the duct 10 provided inside the driven casing 5, and the cavity 13 provided within the element 6, which are serially communicating with one another, said fixing material being supplied through the ports 14 provided within the walls of the element 6 and into the space between the leading casing 1 and the trailing casing 5 and, as the tool penetrates into the soil, is pressed into the walls of the hole 15, thereby fixing same. The provision of the blades 16 disposed on the surface of the element 6 along a spiral relative said element, the coiling direction of said spiral being opposite to that of the spiral surfaces of the casing tips, makes it possible to mix the fixing material 11, due to which fact its consistence is maintained the same throughout the whole volume thereof, thereby promoting an increase in the efficiency of the fixation of the walls of the hole 15, and ensures the equal strength. Moreover, the blades 16 prevent from sticking soil to the surface of the element 6 and penetration of developed soil from the hole 15 into the cavity 13 through the ports 14. After the sinking of the hole is over, the tool is unscrewed (Fig.5) by changing the direction of its rotation, the fixing material 11 disposed within the
space between the leading casing 1 and the trailing casing 5 being pressed into the walls of the hole by the rear conical tip 4 and the sizing portion 2 of the leading casing 1. The device is lifted to the height which is not less than the length of the leading portion thereof, i.e., the distance from the lowermost point of the casing 1 to the lowermost point of the trailing casing 5, or until the tool leaves the pilot hole, while continuing the supply of the fixing material 11 which drops down to the bottom of the hole 15, and after the lower portion or the pilot hole in the primary well 15 is filled with the fixing material 11, the secondary sinking of the lower portion of the hole is accomplished (Fig.6). In so doing, the fixation of the hole bottom and of the walls of the lower portion thereof is achieved (Fig.7).

Also possible is such a modification of the above described device wherein the trailing casing is provided with a rear tip whose shape is similar to that of the rear tip of the leading casing. In this case it is possible to accomplish the fixation of the hole walls in two layers during one sinking operation, the second layer of the fixing material supplied directly into the hole prior to the withdrawal of the tool being pressed into the hole walls by the surface of the rear conical tip of the driven casing in the course of unscrewing the tool from the hole.

The coiling direction of the spiral surfaces of the rear tips of the leading and trailing casings can be opposite to that of the spiral surfaces of the frontal tips of these casings. In this case the withdrawal of the tool out of the hole is carried out by changing the direction of the tool feeding (from below upwardly), but without the change in the direction of tool rotation.

The use of the tool of the invention allows the
fixed holes to be formed within weak and water-saturated soils wherein the horizon of subsoil waters lies above the hole bottom. The filtration of water into the hole is prevented. When using the hole for filling piles, due to additional consolidation of soil at the hole bottom, the carrying capacity of a pile is increased by 15 to 30%.
CLAIMS
The claims defining the invention are as follows:

1. A tool for forming earth holes having fixed walls, comprising a leading casing (1) provided with a cylindrical sizing portion (2), and frontal (3) and rear (4) conical tips provided with spiral tape surfaces for consolidating soil, disposed on both sides of the sizing portion (2), and a trailing casing (5) having a cylindrical sizing portion (7) and a frontal conical tip (8) provided with spiral tape surfaces for consolidating soil, disposed above the leading casing (1) in a coaxial relationship therewith, provided with an axial duct (10) for supplying a fixing material and connected with the leading casing (1) by a tubular coupling element (6) communicating with the axial duct (10) and provided with a port (14) for discharging the fixing material, characterized in that the sizing portion (7) of the trailing casing (5) has a greater diameter than that of the sizing portion (2) of the leading casing (1) and corresponds to the diameter of the hole being formed.

2. A tool as claimed in claim 1, characterized in that the trailing casing (5) has a rear conical tip provided with spiral tape surfaces for consolidating soil.

3. A method of forming earth holes having fixed walls, consisting in that a primary hole is formed, whose diameter is smaller than the predetermined, and this hole is filled with a fixing material, following which the hole of a predetermined diameter is formed by pressing the fixing material into soil, characterized in that the hole of a predetermined diameter is formed by the tool claimed in claim 1 with the advancing sinking of the pilot hole using the same tool, and the fixing material is supplied into the pilot hole at the regions to be fixed, and after
the formation of the hole of a predetermined diameter is over, the tool is lifted until it leaves the pilot hole, then the fixing material is fed into the hole, following which the secondary sinking of the hole is accomplished, while pressing the fixing material into walls and a bottom of the hole.

4. A method as claimed in claim 3, characterized in that the secondary sinking of the hole is accomplished using the tool of claim 2, and prior to withdrawing the tool, the fixing material is fed into the hole collar, following which said tool is withdrawn, while pressing one more layer of the fixing material into the walls of the hole by the rear tip of the trailing casing.

DATED this EIGHTH day of JUNE, 1982
Dnepropetrovskiy inzhenerno-stroitelny Institut

Patent Attorneys for the Applicant
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