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CA 2942801 A1 2015/10/01

(21) 2 942 801

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) Date de dépôt PCT/PCT Filing Date: 2014/03/28
(87) Date publication PCT/PCT Publication Date: 2015/10/01
(85) Entrée phase nationale/National Entry: 2016/09/14
(86) N° demande PCT/PCT Application No.: RU 2014/000211
(87) N° publication PCT/PCT Publication No.: 2015/147676

(51) Cl.Int./Int.Cl. *E02D 27/35* (2006.01)

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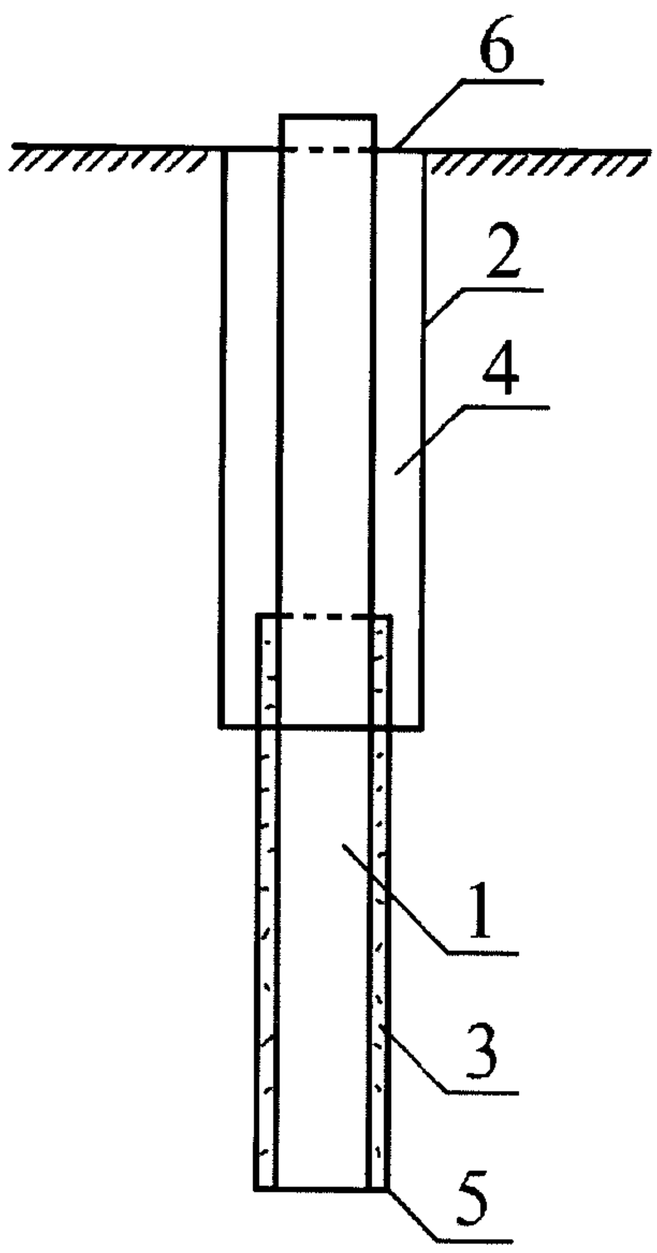
(54) Titre : PROCEDE DE MONTAGE DE PYLONES METALLIQUES SUR DES PERGELISOLS
(54) Title: METHOD FOR INSTALLING METAL PILES IN PERMAFROST SOILS



Фиг. 1

(57) Abrégé/Abstract:
?The invention relates to foundation engineering and can be used for installing drill-inserted pipeline supports and power transmission line supports, and also in installing buildings and structures on permafrost soil. The aim of the invention consists in

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(57) **Abrégé(suite)/Abstract(continued):**
developing a pile-installation process which makes it possible to prevent soil slurry and groundwater from entering a bore-hole during the summer installation of drill-inserted piles in permafrost soil in the presence of water-laden soil in the seasonal freezing and thawing layer, and also in preventing the possible effect of frost heaving forces arising from heaving deformations in seasonal freezing conditions. The present method involves driving a casing pipe to the depth of the seasonal freezing and thawing of the soil, drilling a pilot hole to a depth of no less than the standard depth of the freezing of the soil, pouring in a hardening material in an amount necessary to fill the cavities between the pilot hole and the piles from the bottom of the pilot hole to the bottom of the level of the seasonal freezing and thawing layer of the soil, inserting the piles, and filling the empty space between a pile and the casing pipe using a non-heaving inert particulate material.

ABSTRACT

The invention relates to the foundation engineering, and can be used both in the arrangement of driven cast-in-situ supports of pipes, power transmission towers, and in the mounting of buildings and structures on permafrost soils. The object of the invention is to design a technology of installation of piles, that excludes the ingress of slurry and groundwater into the hole when arranging driven cast-in-situ piles in permafrost soils in summer with watered and heaving soils of seasonal freezing and thawing layer and avoiding the impact of frost heaving forces of soil, resulting from the heaving deformations in seasonal freezing conditions. The method consists in driving a casing pipe at a depth of seasonal freezing and thawing of soil, drilling a pilot hole at a depth of not less than the depth of seasonal freezing and thawing of the soil, pouring hardening material in the amount required to fill in the cavities between the pilot hole and the pile from the bottom of the pilot hole to the bottom of seasonal freezing and thawing soil layer, immersion of the pile, and filling cavities between the pile and the casing pipe with non-frost heaving loose inert material.

METHOD FOR INSTALLING METAL PILES IN PERMAFROST SOILS

Technical field

The invention relates to construction, and particularly to the foundation engineering, and can be used both in the arrangement of driven cast-in-situ supports of pipes in the areas of above surface pipelining, power transmission towers, and in the mounting of buildings and structures on permafrost soils during summer works with watered and heaving soils of seasonal freezing and thawing layer.

Prior art

It is known that there are methods for manufacturing in situ piles, comprising the following basic operations: arrangement of the well and pouring hardening material, i.e. ready-mix concrete (Foundations, bases and tests of facilities, M.I. Garbunov-Pasadov, V.A. Ilyichev, Yu.G. Trofimenkova. – Moscow, Stroyizdat, 1985. – 480 pages, illustrated – (Designer's Handbook), p. 159).

However, this method does not preclude the ingress of slurry and groundwater in the hole.

It is also known an arrangement of driven cast-in-situ piles in all conditions at a temperature of the ground below -0.5 °C. First, holes with a diameter 5-10 cm greater than the transverse dimension of the pile are drilled in the foundation. Then the holes are filled with soil mortar, and the piles are immersed in. After the mortar has been frozen, the pile is securely clamped in the permafrost soil (Soil mechanics, bases and foundations, S.B. Ukhov, V.V. Semenov, V.V. Znamensky, Z.G. Ter-Martirosyan, S.N. Chernyshev, ASV Publishing House, 1994 – p. 405).

The disadvantage of this method for fabricating the driven cast-in-situ piles is non-preclusion of the impact of frost heaving forces of soil, resulting from the heaving deformations in seasonal freezing conditions. Also, this method does not exclude the ingress of slurry and groundwater into the hole when arranging driven cast-in-situ piles in permafrost soils in the summer during works with watered and heaving soils of seasonal freezing and thawing layer.

The closest method in technical essence and the effect achieved is construction of piles in mollisol heaving soils. The method consists of drilling a pilot hole and immersion of the pile into the hole. The pilot hole is drilled to a depth of not less than standard depth of soil freezing, and the pilot hole diameter is selected on the basis of this relation. Then, a cavity formed by the pilot hole is filled with non-frost heaving loose inert material up to the mouth of the pilot hole, after which a pile is immersed in its center at a target depth

(patent RU No.2474652, published on 10.02.2013, IPC E02D5/50).

However, during manufacturing the piles in permafrost soils in the summer with watered soils of seasonal freezing layer, this technology does not eliminate the problem of ingress of slurry and groundwater into the hole when installing driven cast-in-situ piles, that entails sludging-up and watering of the hole, and as a consequence, reduction in the bearing capacity of the driven cast-in-situ pile due to the failure to feed the required full amount of cement and sand mortar to fill the space between the pile and the hole.

Invention disclosure

The object of the invention is to design a technology of piles installation, that precludes an ingress of slurry and groundwater into the hole when arranging driven cast-in-situ piles in permafrost soils in summer with watered and heaving soils of seasonal freezing and thawing layer and avoiding the impact of frost heaving forces of soil, resulting from the heaving deformations in seasonal freezing conditions.

The technical result consists in compliance with appropriate quality of works in the installation of driven cast-in-situ piles in permafrost soils in summer with watered and heaving soils of seasonal freezing and thawing layer in order to exclude the reduction in the bearing capacity of driven cast-in-situ piles with the ingress of slurry and groundwater into the hole, and avoid the impact of frost heaving forces of soil, resulting from the heaving deformations in seasonal freezing conditions.

The solution of the set object is that the method of installation of metal piles, which includes drilling of a pilot hole, immersion of a pipe metal pile and pouring non-frost heaving loose inert material, according to technology, a casing pipe is driven at a depth of seasonal soil freezing and thawing before drilling a pilot hole, the pilot hole is drilled to a depth of not less than standard depth of freezing soil, pouring hardening material in the amount needed for filling cavities between the pilot hole and the pile from the bottom of the pilot hole to the bottom of seasonal freezing and thawing soil layer, immersing the pile and filling cavities between the pile and the casing pipe with non-frost heaving loose inert material.

The chosen diameter of the casing pipe is 10-20 cm greater than that of the pile. The optimal immersion depth for the casing pipe is the depth of seasonal freezing and thawing of soil + 0.5-1 m.

Diameter of the pilot hole is 5-15 cm greater than the pile diameter, and the depth is up to 30 meters. M10-M100 mortar is used as cement and sand mortar.

Non-frost heaving coarse sand and medium coarse sand is used as non-frost

heaving loose inert material.

The volume of cement and sand mortar is previously calculated by the following formula:

$$V=\pi R_1^2 * l_1 - \pi R_2^2 * l_2,$$

where R_1 is the radius of the pilot hole, l_1 is the length of the pilot hole; R_2 is the radius of the pile, l_2 is the length of the pile, and π is pi.

The time between pouring of cement and sand mortar and installation of the pile should not exceed 15 minutes.

Brief description of drawings

The invention is illustrated by a drawing, which shows a figure of the pile with the casing pipe, where 1 – pile, 2 – casing pipe, 3 – filler – hardening material, such as cement and sand mortar, 4 – filler – non-frost heaving loose inert material, 5 – pilot hole, 6 – casing pipe cavity.

The preferred embodiment of invention

The embodiment is implemented as follows. The casing pipe 2 is driven in the soil at a depth of seasonal freezing and thawing of the soil, for example 1.8-3 m, using a pile-driving engine with diesel or pneumatic hammer. This technology of installation of the casing pipe excludes the reduction in the bearing capacity of driven cast-in-situ piles when slurry or groundwater penetrates into the hole during the works in permafrost soils in summer with watered soils of seasonal freezing and thawing layer. This is followed by the drilling of a pilot hole at a depth equal to the depth of immersion of the pile, then the auger of the drilling machine is removed and the entire soil is drilled out from the cavity of the casing pipe 6 at a depth of seasonal freezing of soil, e.g., 1.8-3 m. After removing the auger, cement and sand mortar 3 is poured in the hole in the amount necessary to fill in the cavities between the pilot hole 5 and the pipe metal pile 1 from the bottom of the design mark of the pilot hole to the seasonal freezing and thawing soil layer level bottom. Upon completion of pouring the mortar, the pipe pile 1 is immersed up to the design mark using a vibro-driver. After immersing the pile 1, cavities 6 between the pile 1 and the casing pipe 2 are filled with non-frost heaving loose inert material 4 to a depth of 1.8-3 m to the top of the casing pipe 2 in order to exclude the impact of frost heaving forces arising from the deformation of heaving in seasonal freezing and thawing conditions.

Example of an embodiment. The casing pipe 3 with a diameter d=720-820 mm and wall thickness t=9-12 mm, 1.8-3 m long and with 17G1S, 17G1S-U, St2kp, St2ps, St2sp, St3kp, St3ps, St3sp, St3ps3, St3sp3, St3ps4, St3sp40, 9G2S steel grade, and K34-

K60 strength class is driven into the soil at a depth of seasonal freezing and thawing of soils equal to 1.8-3 m. The pilot hole 5 should have a diameter of d=480-500 mm and depth of 6-20 m. The soil of the cavity 6 of the casing pipe 2 is drilled out using an auger d-680-780mm. The pile 1 is made of pipe metal-roll with a diameter d=426 mm, wall thickness 10-12 mm and 6-20 m long and with 17G1S, 17G1S-U, St2kp, St2ps, St2sp, St3kp, St3ps, St3sp, St3ps3, St3sp3, St3ps4, St3sp40, 9G2S steel grade, and K34-K60 strength class. The pile serves to accommodate vertical, horizontal and other loads. Before immersing the pile 1 in the pilot hole 5, the pilot hole 5 is filled with cement and sand mortar 3 of M75-M150 grade in the amount necessary to fill in the cavities between the pilot hole 5 and the pile 1 from the bottom of the design mark of the pilot hole to the seasonal freezing and thawing soil layer level bottom. After immersing the pile 1 in the pilot hole 5, the cavity between the casing pipe 2 and the pile 1 is filled with non-frost heaving loose inert material 4.

Using this method of arrangement of driven cast-in-situ piles with the casing pipe in permafrost soils in summer with watered soils of seasonal freezing and thawing layer excludes reduction in bearing capacity of driven cast-in-situ piles with the ingress of slurry and groundwater in the hole, avoiding the impact of frost heaving forces resulting from heaving deformations in seasonal freezing and thawing conditions.

CLAIMS

1. A method for installing metal piles in permafrost soils is characterized in that the casing pipe is driven in the soil at a depth of not less than the depth of seasonal freezing and thawing of the soil, then a pilot hole is drilled to a depth of not less than the standard depth of freezing soils, the soil is drilled out of the cavity of the casing pipe, after which the pilot hole is filled with cement and sand mortar in the amount required to fill in the cavities between the pilot hole and the pile from the bottom of the pilot hole to the bottom of seasonal freezing and thawing soil layer, a pipe metal pile is immersed in the pilot hole with mortar, after with the cavities between the pile and the casing pipe are filled with non-frost heaving loose inert material.

2. The method of claim 1, characterized in that M10-M100 mortar is used as cement and sand mortar.

3. The method of claim 1, characterized in that coarse and medium coarse sand is chosen as non-frost heaving loose inert material.

4. The method of claim 1, characterized in that the volume of cement and sand mortar is calculated by the following formula: $V=\pi R_1^2 * l_1 - \pi R_2^2 * l_2$, where R_1 is the radius of the pilot hole, l_1 is the length of the pilot hole; R_2 is the radius of the pile, l_2 is the length of the pile, and π is pi.

5. The method of claim 1, characterized in that the time between pouring of cement and sand mortar and installation of the pile shall not exceed 15 minutes.

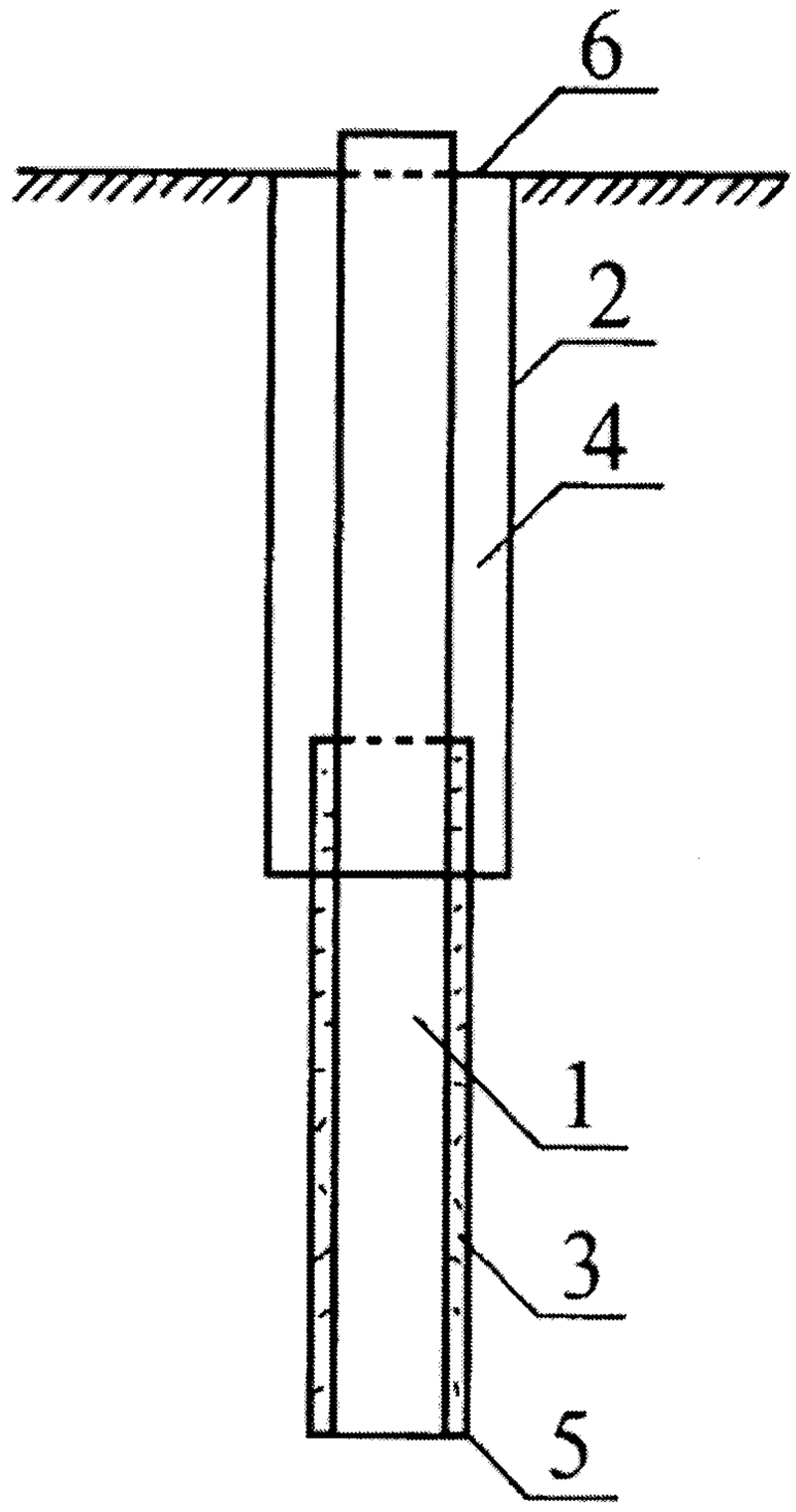
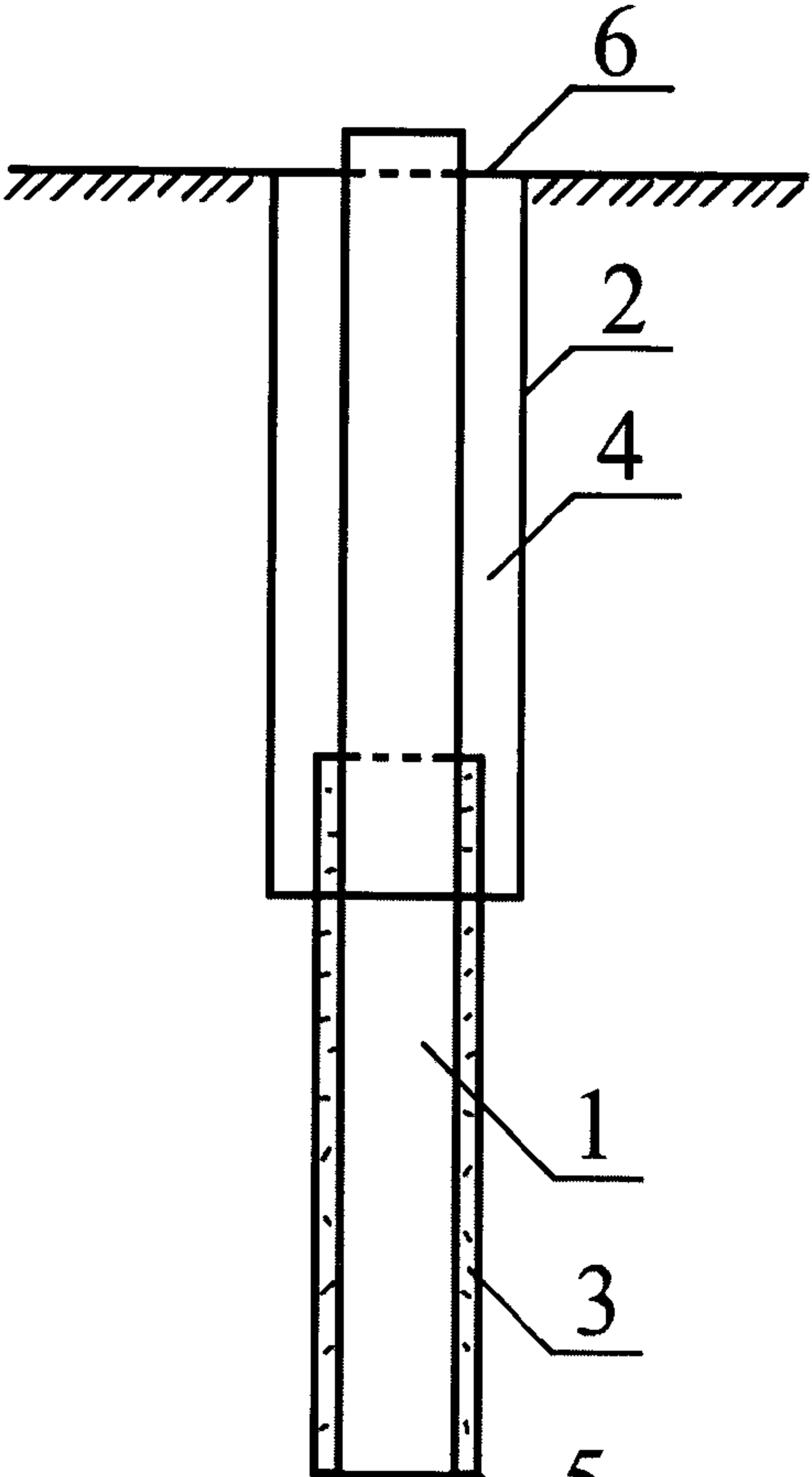


Fig. 1



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