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(54) **Telescopic type riser system equipment for digging round pits and its utilization method**

(57) This application belongs to the pit digging technology field and relates to reusable telescopic metal risers (1) used for pit digging and later, when required construction or repair work in the pit has been completed, for full or partial filling of the pit. In digging a deep pit in confined space where other objects are 1-1.5 metre away from the edge of the pit telescopic-type retractable round metal risers (1) of different diameters are used to ensure stability of walls of the pit being dug and safely achieve the desired depth of the pit, enable doing the required repair or construction work; this work having been done the risers are pulled out from the pit one after another and the pit gets gradually completely or partially filled as the telescopic-type risers are pulled out back to the surface one after another.

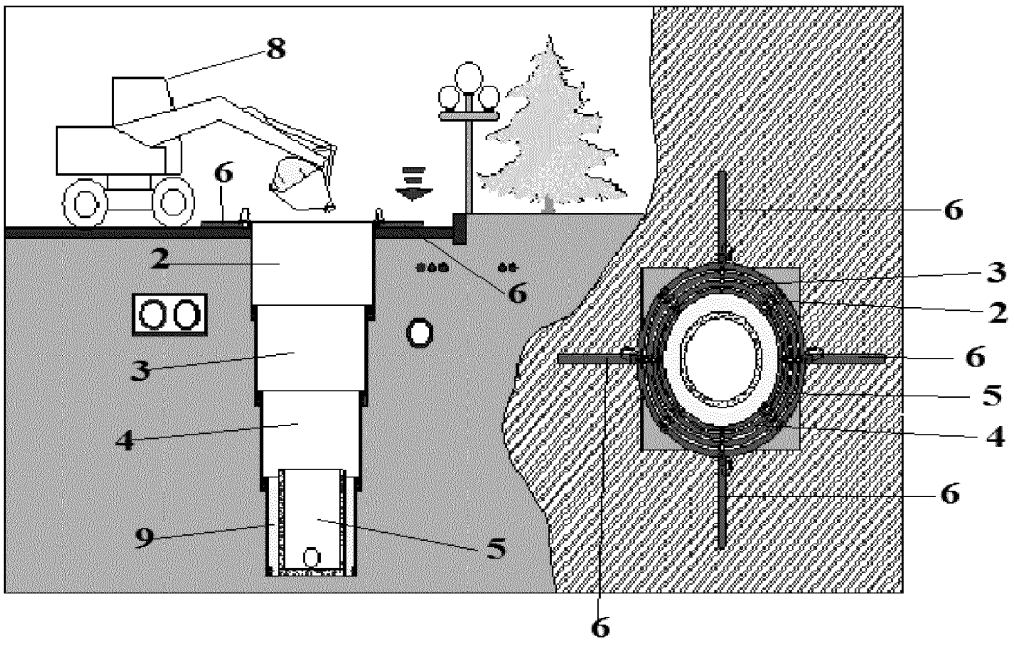

Fig. 6

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Description

FIELD OF THE INVENTION

[0001] The invention belongs to the field of round pit excavation technology and relates to reusable telescopic, metal risers for digging pits, reinforcing pit walls, doing construction work in the pit, and complete or partial filling of the pits.

BACKGROUND OF INVENTION

[0002] Excavating ground from pits is a dangerous and complex process requiring special precautions and planning, particularly when digging work must be done at great depths and in confined space because of proximity of other objects to the pit. Various ground reinforcement equipment is used in real-world pit digging operations, but it is not practicable for use in dense infrastructure locations or heavy traffic streets. Ground reinforcement equipment is also used to reduce digging costs as well as for installing and repairing various communications and for building manholes. One of the main purposes in using pit riser systems is to ensure safety for people working in the pit by resisting ground and groundwater pressure on the walls of risers. The risers provide the workers with an easy way to protect pits from collapsing during digging and other work.

[0003] The patent CN201756709 published on 9 March 2011 describes a pit digging method utilizing uniform risers of equal diameter that is adjustable with shrink-rings located on their sides. An excavator is positioned inside such a riser to dig ground from the inside of the pit. But the said embodiment of the invention is applicable for digging pits of large diameter and not suitable for use in dense infrastructure locations or heavy traffic streets close to objects that must remain intact.

[0004] The patent EP0708225 published on 24 April 1996 describes a method for digging small-diameter pits by using two telescopic longitudinal risers. However, the said embodiment of the invention is applicable for digging pits of small diameter and the pit dug in this way would not have space for a worker.

[0005] The closest related art can be found in the patent GB1248085 published on 29 September 1971. It describes a pit digging method where round plastics receptacles of equal diameter sealing off from the ground are inserted in the pit one after another. This invention can be used for making burial vaults. However, this invention is tailored for digging pits that are not deep and have small diameters and therefore such pits are not suitable for repairs and other construction work on pipelines and communications placed deep under ground. The risers according to this invention are not reusable as they are not pulled out.

SUMMARY OF THE INVENTION

[0006] The essential uniqueness of this invention is that in digging 4-12 metre deep pits in confined spaces where other objects (such as road, fence, building or some other static object) are at least 1-1.5 metre away from the edge of the pit telescopic retractable round reusable metal risers of different diameters are used to ensure stability of walls of the pit being dug and safely achieve the desired depth of the pit, enable doing the required repair or construction work; this work having been done the risers are pulled out from the pit one after another and the pit gets gradually completely or partially filled from the bottom as the risers are pulled out one after another.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

Fig. 1 shows digging of initial pit (7).
Fig. 2 shows supporting riser (2) placed in the pit.
Fig. 3 shows supports (6) screwed to supporting riser (2).
Fig. 4 shows placing of the second riser (3) in the pit.
Fig. 5 shows two first risers placed in the pit.
Fig. 6 shows four risers placed in the pit.
Fig. 7 shows pulling out of risers from the pit.
Fig. 8 shows a photo of telescopic risers intended for reinforcing the pits.
Fig. 9 shows telescopic connection of the supporting riser (2) to the second riser (3) and capturing members (12, 13) that are identical for all other risers.
Fig. 10 shows putting any two risers together by utilizing the connecting members (12, 13).

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] Pit telescopic riser structure (1) (also the term "riser" in this invention can be called as "telescopic type formwork") may comprise of the components of the following dimensions:

1) The first (supporting) round cross-section riser with lifting points (2) (dimensions: diameter - 2000-3000 mm, height - 1500-2000 mm);
2) The second round cross-section riser with lifting points (3) (dimensions: diameter - 1800-2800 mm, height - 1500-2000 mm);
3) The third round cross-section riser with lifting points (4) (dimensions: diameter - 1600-2600 mm, height - 1500-2000 mm);
4) The fourth (deep) round cross-section riser with lifting points (5) (dimensions: diameter - 1400-2400 mm, height - 1500-2000 mm);
5) Four 1000-1500 mm long supports (6) resting on the ground surface and attached to the top part of the first/supporting riser (2).

[0009] The optimum sizes for components of the telescopic riser system are:

1) First/supporting round cross-section riser with lifting points (2) (dimensions: diameter - 2710 mm, height - 1500 mm);
2) Second round cross-section riser with lifting points (3) (dimensions: diameter - 2540 mm, height - 2000 mm);
3) Third round cross-section riser with lifting points (4) (dimensions: diameter - 2370 mm, height - 2000 mm);
4) Fourth/deep round cross-section riser with lifting points (5) (dimensions: diameter - 2200 mm, height - 2000 mm);
5) Four 1500 mm long supports (6) resting on the ground surface and attached on the top part of the first riser (2).

[0010] Telescopic riser system may consist of less or more than 4 risers, but the optimum quantity of telescopic risers is 4. The cross-section difference of the risers must be 160-200 mm, the optimum difference in cross-sections is 170 mm. The weight of one riser is approximately 500-800 kg.

[0011] Dimensions of telescopic riser structure are chosen with regard to the type of digging work to be done. As metal telescopic risers are made to be reusable, they are adapted for use in different ground conditions. The choice of pit reinforcement structure for ground works is determined by engineering-geological surveys of the ground done in advance and scheduled in technical documentation of the particular project underway. Calculations of limiting pressure of ground on pit reinforcement structure exerted when digging pits of different depths are based on the requirements in the PN-B-03010 standard. Safe project of riser wall structure can be produced only after making calculations of limiting pressure by considering relevant ground properties at the planned digging site. If during digging operations it is found that the actual ground condition does not match the one in calculations done in advance, additional surveys of the ground must be done and pressure of ground must be recalculated. To choose appropriate components for the telescopic riser system for ground reinforcement the following conditions must be taken into consideration: (i) planned depth of the pit; (ii) required cross-section of the pit at the end point of the pit; (iii) planned type and technology of construction and installation work in the pit; (iv) planned speed of work; (v) area of the zone where digging operations are to take place.

[0012] Installation of telescopic riser system for pit reinforcement (1) comprises four main stages. The first stage involves selection and fencing of work zone and marking of existing communications. During the second stage (shown in Fig. 1 and Fig. 2), before starting setting risers into the ground, initial pit (7) is dug (if asphalt cover is present, then asphalt must be removed) to the depth of 0.5-2.0 m (actual depth varies depending on stability of ground). The pit (7) must be about 10% larger than cross-section of the first/supporting riser (2). During the third stage (shown in Fig. 3 and Fig. 4), four supports (6) (the best choice) to rest on the ground surface are attached on the first/supporting riser (2) and then the first/supporting riser (2) is set into the prepared pit (7) by using a machine/vehicle. If the depth of the prepared pit (7) is smaller than the height of supporting riser (2) then sinking of the supporting riser (2) is started and continues until its lateral supports (6) touch the ground surface. The sinking occurs as the digging machine (excavator) (8) digs the ground from the inside of the supporting riser (2) evenly along the entire cross-section and exerts pressure on the supporting riser (2) from time to time from the top. The pressing must be even on the entire length of the circle of the supporting riser (2), without pressing too much so that deformation and inclination of the supporting riser (2) is avoided. During the fourth stage (shown in Fig. 5 and Fig. 6), when supports (6) of the first/ supporting riser (2) touch the ground surface, the next telescopic pit reinforcement system riser (3) is picked and its sinking process is started. The sinking occurs as the digging machine digs the ground from the inside of the riser evenly along the entire cross-section of the riser and exerts pressure on the riser (3) from time to time from the top until the capturing member (12) (shown in Fig. 9 and Fig. 10) located in the top part of the riser (3) touches the capturing member (13) located in the bottom part of the supporting riser (2) inserted before. The pressing must be even along the entire length of the circle of the riser without pressing too much so that deformation and inclination of the riser and therefore tripping of the risers is avoided. With digging and gradual pressing on the risers the remaining risers are inserted and the process is repeated until the required depth of the pit is achieved.

[0013] Interconnection of telescopic risers is shown in Fig. 9 and Fig. 10. At the top part of each telescopic riser there is an externally encircling and outwardly protruding capturing member (12). Furthermore, at the bottom part of each telescopic riser there is an internally encircling and inwardly protruding triangular capturing member (13). As the telescopic risers are being set into the pit one after another they attach to each other at the said capturing members (12, 13). For example, as the second riser (3) is being set into the pit through the first/supporting riser (2) the capturing member (12) of the second riser (3) makes a firm grip with the capturing member (13) of the first/supporting riser (2) and prevents the being set risers from coming off each other and falling into the pit. Accordingly, all telescopic risers get connected to each other in the pit.

[0014] The required depth of the pit having been achieved, construction work that necessitated digging this pit can be started: for example, installation of manholes to reach underground pipelines, underground communication network accident recovery, pumping station installation, or other construction work underground. Of-

ten the ground properties of the particular location require that such a telescopic riser system (1) for pit reinforcement is used in combination with ground drainage systems. In such a case the particularities of riser installation (insertion) remain the same except that needle filters (9) are installed around the risers at the beginning of the works. The needle filters enable removal of groundwater from the ground in the pit or lowering of groundwater level in the pit.

[0015] Removal of telescopic risers from the pit (shown in Fig. 7) starts with pulling out the inner riser located the deepest in the pit, afterwards the remaining risers are pulled out one by one. Before starting pulling the risers out ground is poured to the bottom part of the pit to achieve thickness of at least 0.5 metre and then this ground is compacted. Once the riser has been elevated to the level of compacted ground, the gaps resulting from lifting the riser must be filled with compacted ground so that no cavities remain after filling up the unneeded part of the pit with the ground. The remaining risers are pulled out in the same manner until the entire pit gets filled up with the ground.

[0016] The working properties of the telescopic riser system (1) are intended for use of risers in digging operations at construction sites and communications channels and therefore the entire construction site must be well protected from entry of unauthorized persons to the area of digging operations. Given the large dimensions and weight of the risers (1) it is absolutely necessary to, inter alia, follow these rules for their safe storage: (i) all components of the telescopic riser system (1) must be placed on the plane of the riser ring, preferably grouped by dimensions and type; (ii) holders and ladders (10) must be cleaned and properly protected and stored indoors. Every time the risers are brought from the construction site to storage location they must be washed. Riser capturing members (12, 13) must be protected with anticorrosive agent.

[0017] Installation and uninstallation of the telescopic risers for pit reinforcement (1) are subject to the following special safety requirements. Only the factory-made and undamaged components are to be used when installing the telescopic riser system. Use of damaged or incomplete riser structures may lead to an accident at the construction site and endanger life and health of staff. When installing risers in the pit cables and hooks must be used for positioning the risers so that the workers do not come into contact with these components as they are rotated or relocated. The following rules must be obeyed to prevent damage to risers when working: when sinking (setting) the risers equal pressure must be applied to the entire length of the circle of the riser so that deformation and inclination of the riser and therefore tripping of the risers is avoided. The risers must not be hit with excavator bucket or other digger machinery. The risers must be used for pit wall reinforcement only. Moreover, risers must be protected from getting damaged while they are stored at the construction site.

[0018] A telescopic riser system (1) enables digging a pit at smaller area compared to that needed when digging a pit in other ways. To prevent pit collapse when digging a pit without using risers it is usually necessary that a pit radius at the surface is equal to or more than the depth of the pit being dug multiplied by approximately 40 degree tangent. For example, when digging a 7.5 metre deep pit the pit radius at the surface should be at least 7.65 metre (if manholes with radius equal to the radius of the first / supporting riser 1.35 metre were to be used). When using telescopic risers (1), however, the minimum radius at the pit surface might be about 2.35 metre (calculated by adding the radius of the first / supporting riser (2) 1.35 metre to 1 metre long support). Despite that the nature of these calculations is rough and the ground characteristics have not been taken into consideration, they still show that by using telescopic risers (1) the radius of the 7.5 metre deep pit being dug (7) at the pit surface might be reduced by about 10 times. The deeper the pit being dug, the greater reduction can be achieved. This enables much more efficient pit digging operations at dense infrastructure locations.

[0019] To illustrate and describe this invention, descriptions of preferred embodiments are given above. This is not a complete or limiting description aimed at prescribing a precise embodiment or implementation option. The description given above should be regarded more as an illustration than a constraint. Obviously, the specialists in this field may clearly see a multitude of modifications and variations. The preferred embodiments have been selected and described so as to enable the specialists in this field to best understand the principles behind this invention and their best practical application for different embodiments with different modifications fit for a specific application or embodiment customisation. The invention scope is defined by the attached claims and their equivalents wherein all these terms have the broadest possible meanings unless stated otherwise. It must be admitted that embodiments described by specialists in that field may contain changes that do not depart from the scope of this invention, as described in the claims given next.

Claims

1. A telescopic-type riser structure for digging round pits that are used for enabling construction or repair work at underground pipelines and communications, which comprises of:

   at least two round cross-section risers: the supporting and the deep one where four supports are attached to the top part of the supporting riser and rest on the ground surface to prevent the supporting riser from sinking into the pit being dug;
   machine for setting into / pulling out of the pit;

riser insertion and pulling out cables,
loops for attachment of cables to supporting riser; and
riser interconnections,

the difference being that it comprises:

- reusable round metal risers that can easily pass through each other and that make up the telescopic riser system (1) where the narrower/insertable riser can be inserted from above through the wider/receiving riser into the pit being dug (7) and can be pulled out telescopically once the work has been done;
- inwardly protruding capturing member (13) that is along the entire perimeter attached to the inside of the bottom part of each receiving riser into which another riser is inserted from above and that keeps the narrower riser inserted from above from falling out because of presence of a capturing member (12) in the inserted riser;
- outwardly protruding capturing member (12) that is along the entire perimeter attached to the outside of the top part of each insertable riser and that has a capturing member (13) keeping the insertable riser from completely passing through and out of the receiving riser;
- supports (6) to ensure stability of the supporting riser (2) and the entire riser system (1); the optimum length of the supports is 1-1.5 m;
where
- the said risers have such cross-sections that make it possible for one or two workers to descend through them to the pit bottom and do the required repair or construction work; the optimum cross-section of the supporting riser (2) is 2-3 m and height is 1.5-2 m, the optimum cross-section of the bottommost riser is 1.4-2.4 m, and height is 1.5-2 m;
- distance between the centre point of the supporting riser (2) set into the pit (7) and the infrastructure objects near the pit, which must receive no impact, is equal to or more than the sum of the length of the supports used (6) and the radius of the supporting riser (2).

2. Where space is limited because of dense infrastructure the riser setting and removal method used for digging pits comprises:

selection of the pit digging work zone,
its fencing,
marking of existing communications,
digging of 0.5-2.0 m deep initial pit that is 10% larger than the cross-section of the supporting riser,
use of pit digging and filling machine,
the difference being that

- supports (6) are attached to the edge of supporting riser (2);
- supporting riser (2) is gradually set into the pit (7) and sunk until its supports (6) touch the ground surface, where riser sinking occurs as the digging machine (8) digs the ground from the inside of the said supporting riser (2) evenly along the entire cross-section of the supporting riser (2) and exerts pressure on the said riser (2) from time to time from the top, where pressing is even on the entire length of the circle of the riser (2), without pressing too much so that deformation and inclination of the supporting riser (2) is avoided, and when the supports (6) of the supporting riser (2) touch the ground surface the sinking of remaining risers into the pit (7) one through another is started in the same way and the process is continued until the required depth of the pit (7) is achieved,
- pulling the telescopic risers out of the pit (7) after completion of construction or repair work at underground pipelines and communications is started by gradually pulling the riser (5) located the deepest in the pit up while filling the resulting unnecessary cavity with ground until the entire pit or part of it is filled up.

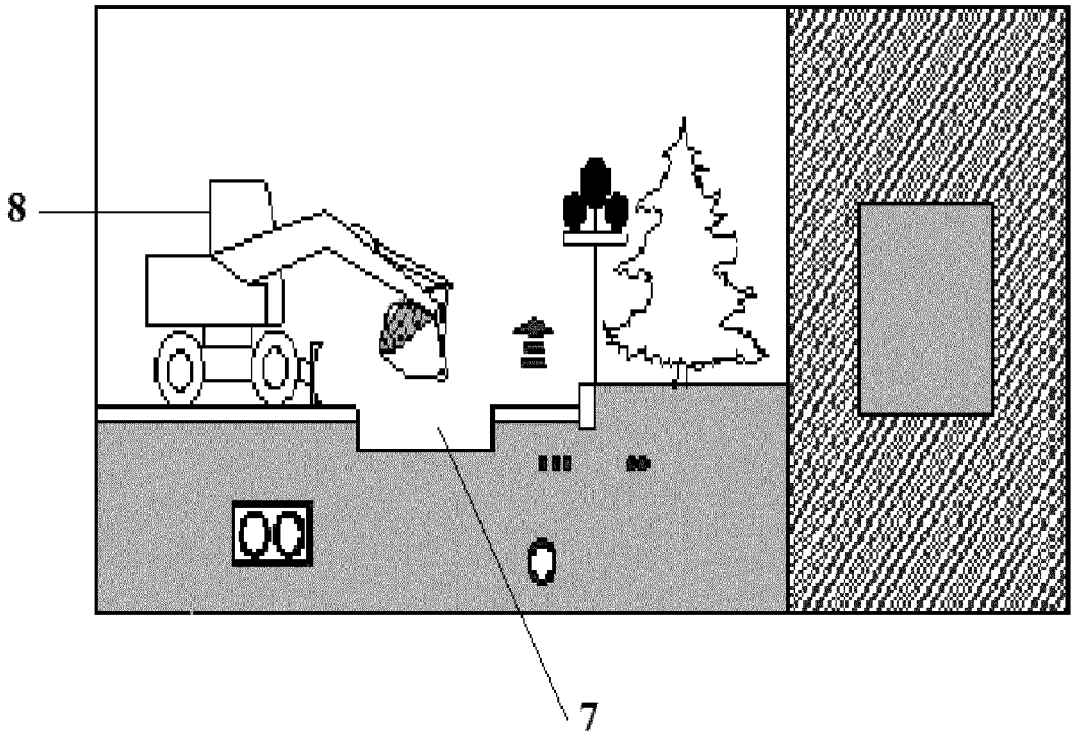

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Fig. 1

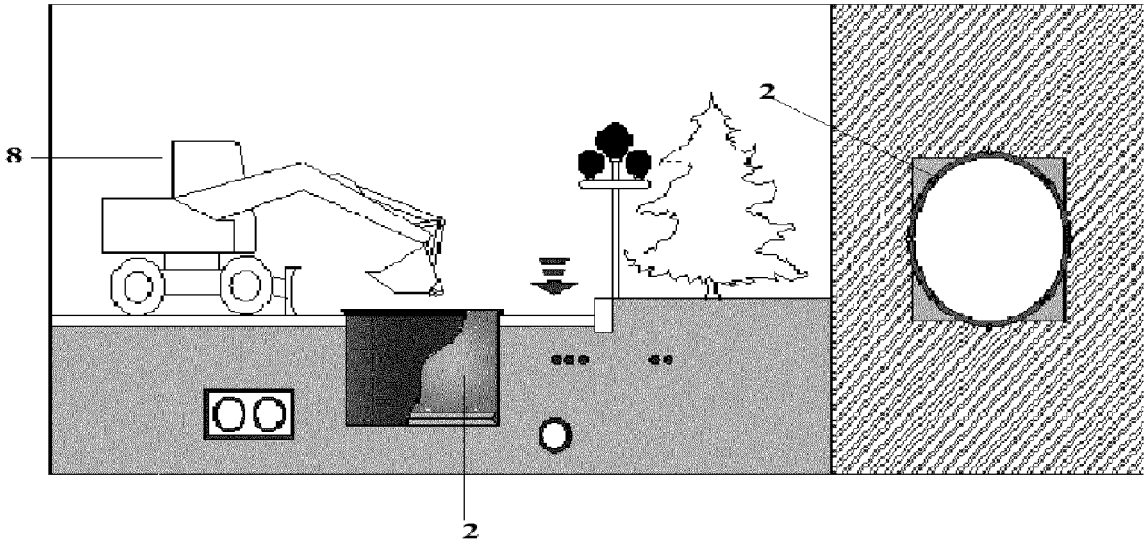

Fig. 2

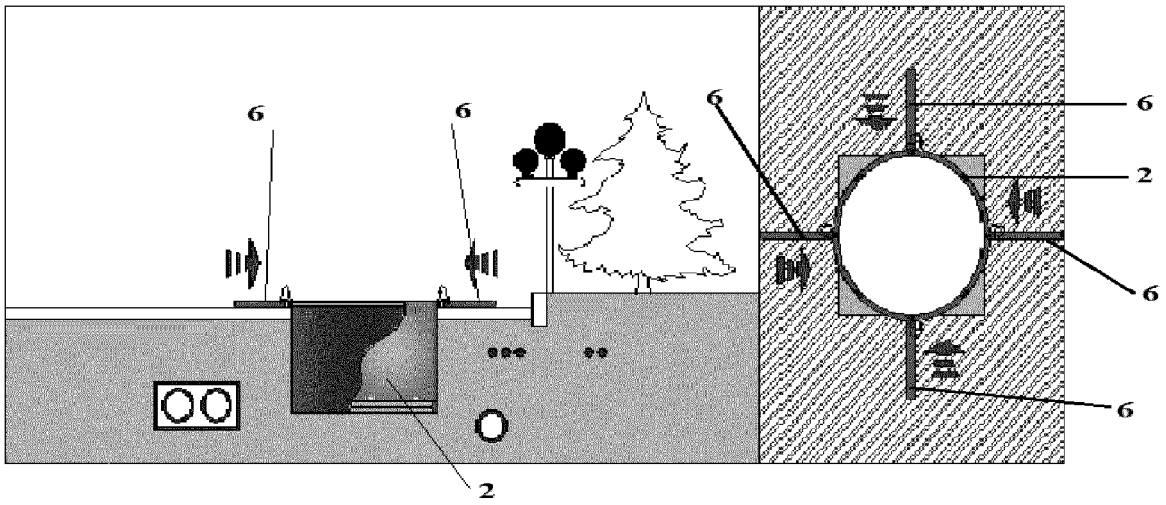

Fig. 3

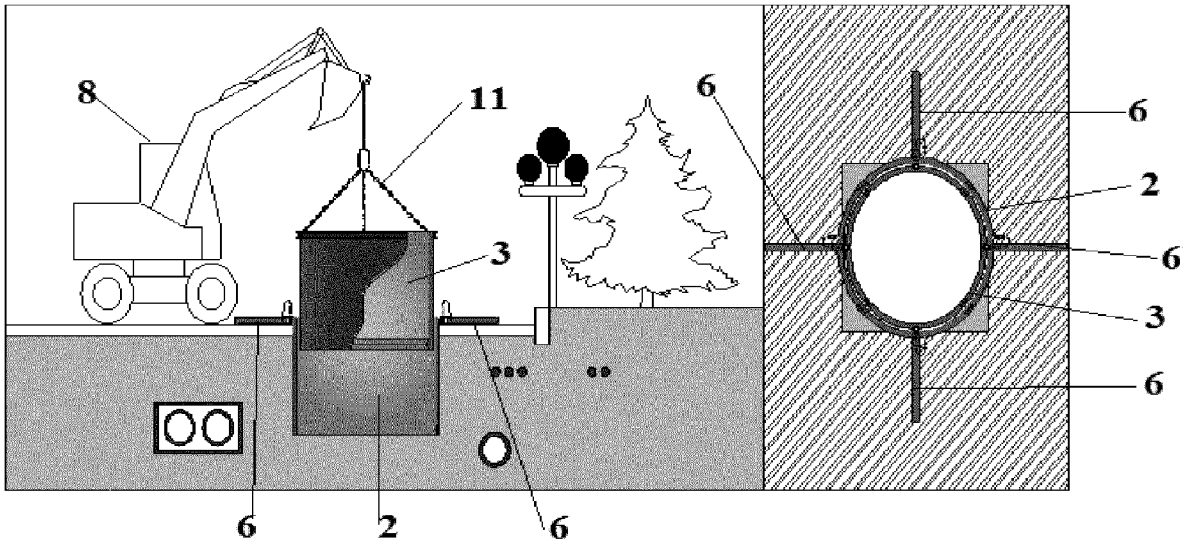

Fig. 4

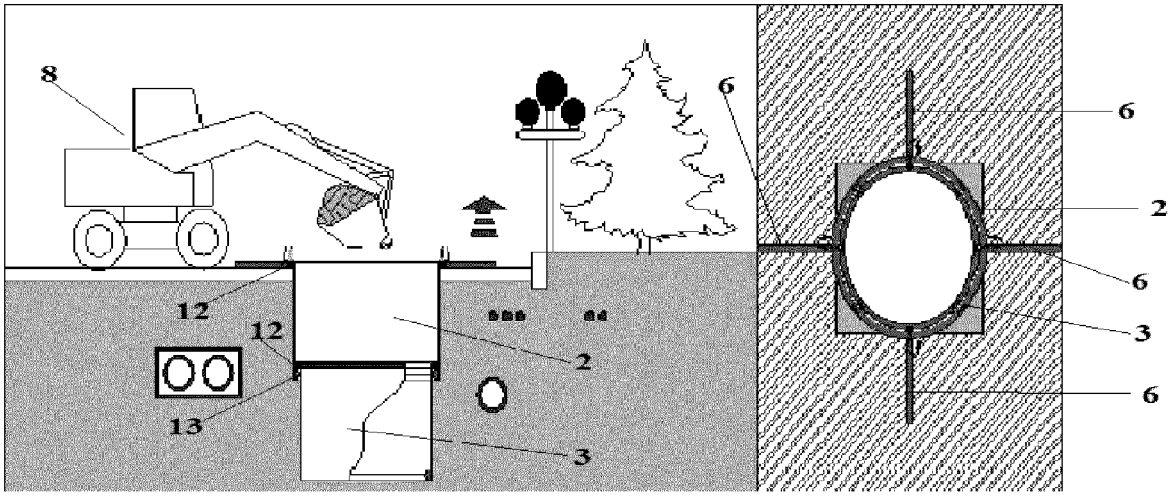

Fig. 5

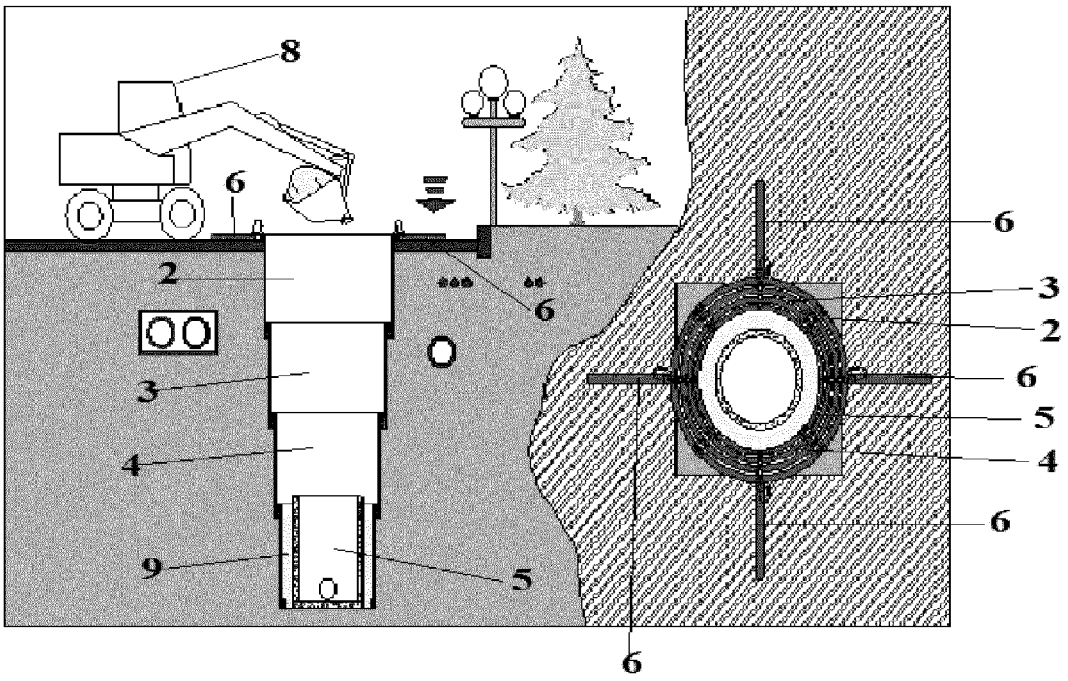

Fig. 6

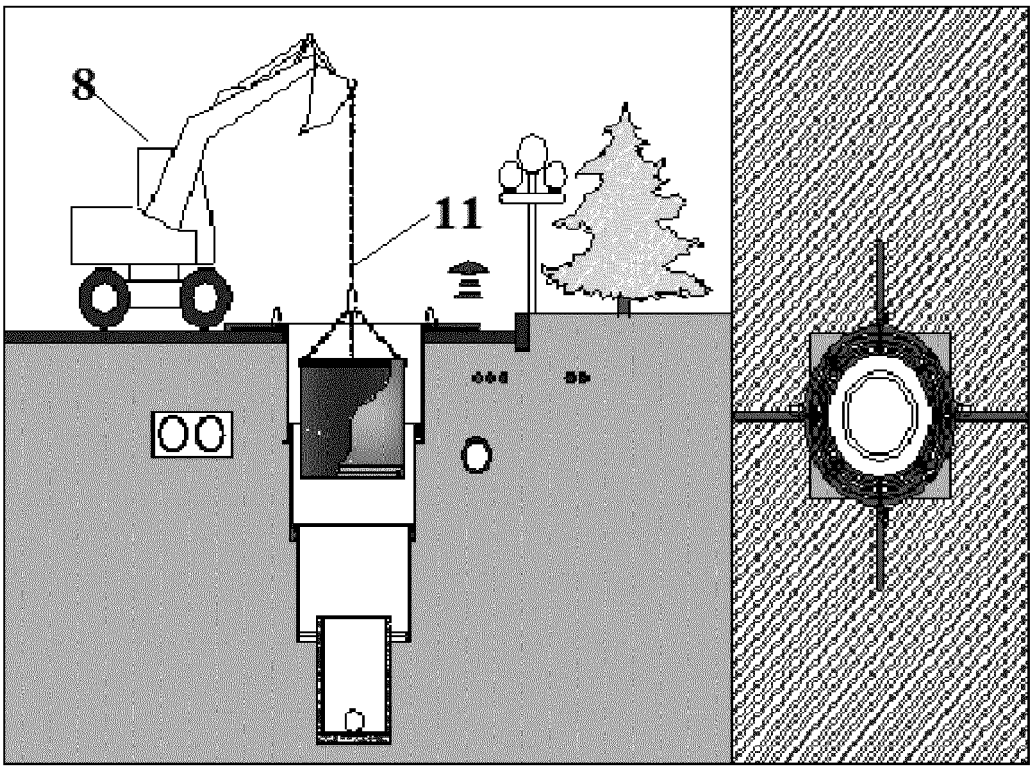

Fig. 7

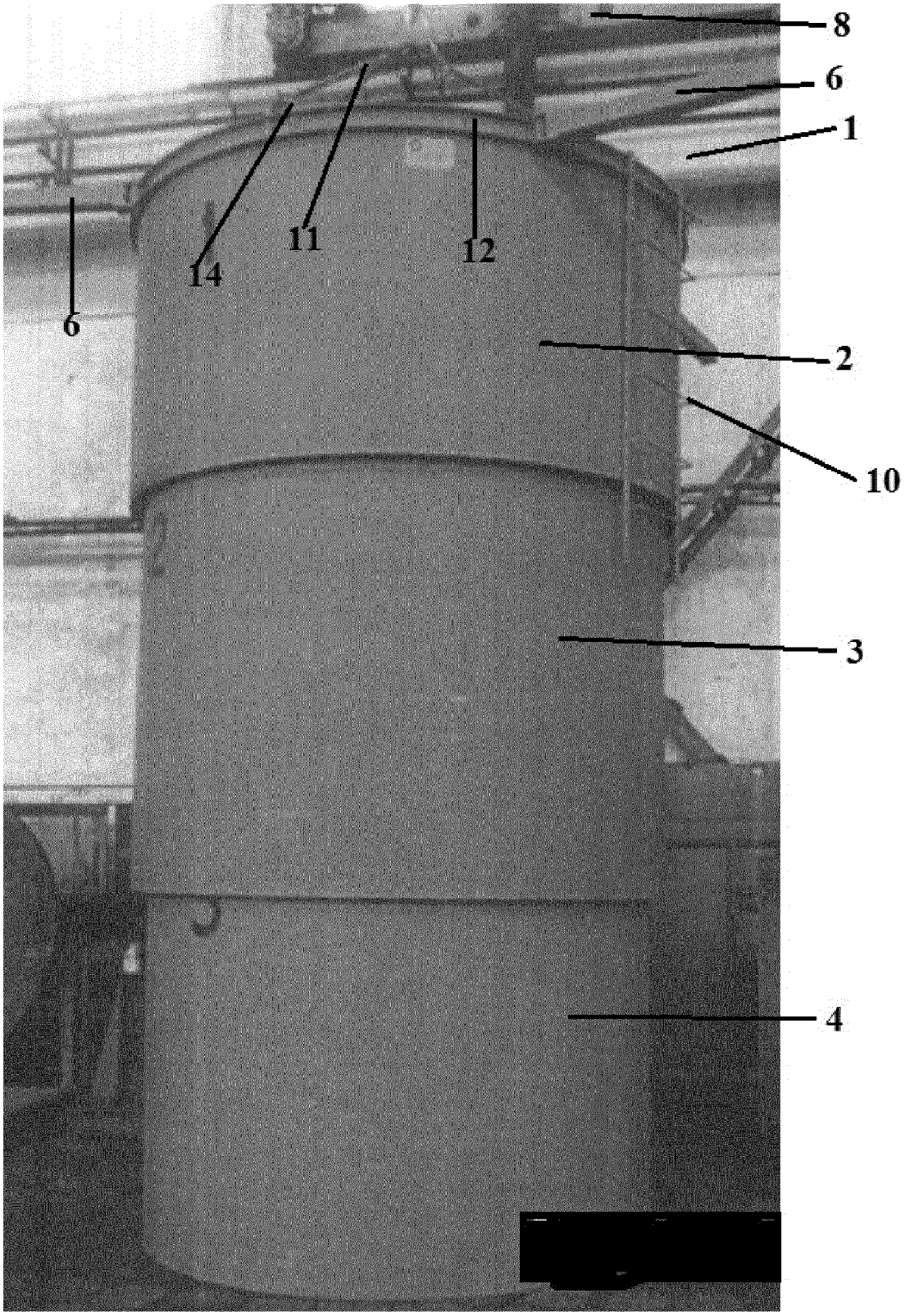

Fig. 8

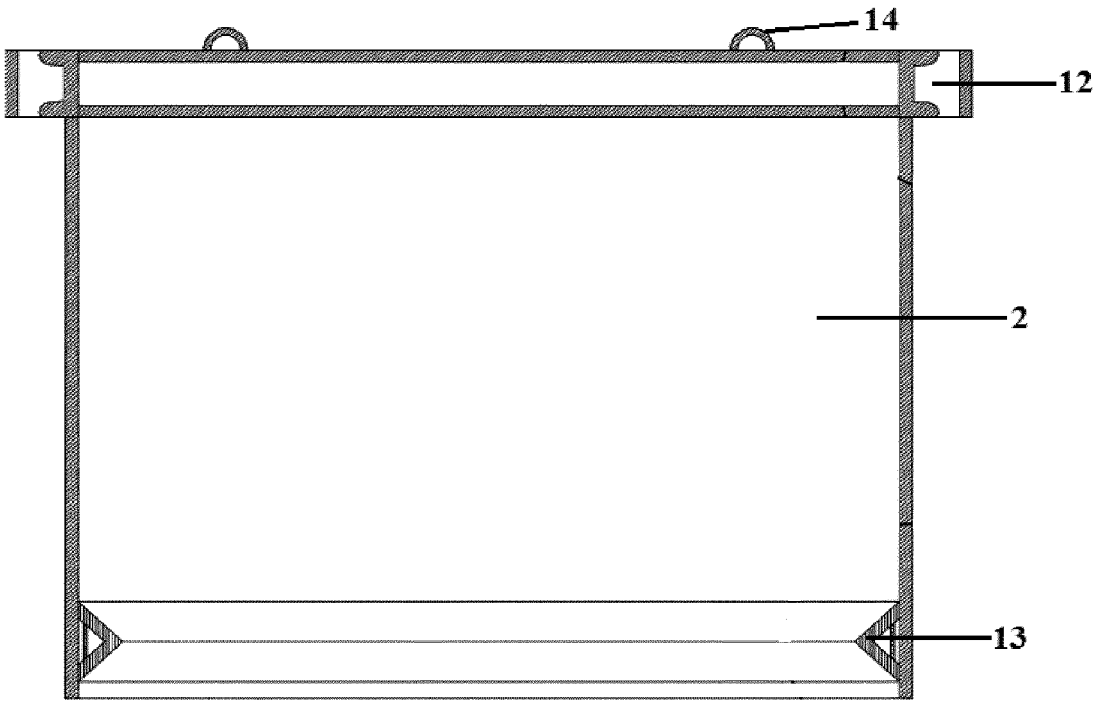

Fig. 9

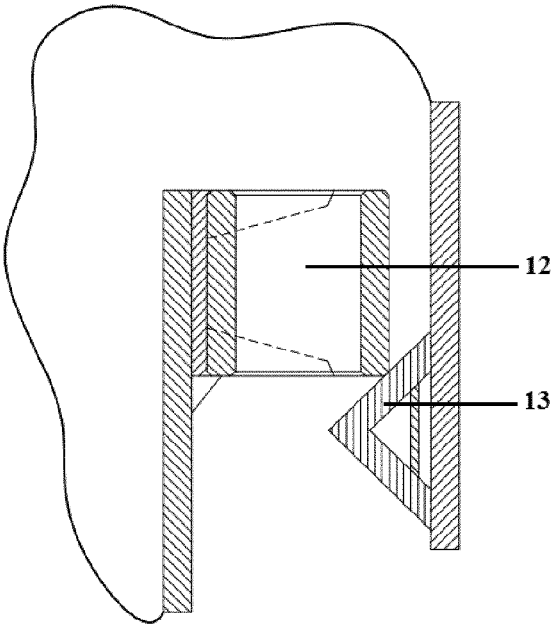

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 2677

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	LT 4 748 B (UZDAROJI AKCINE BENDROVE GRUND [LT]) 27 December 2000 (2000-12-27) * page 1, line 23 - page 4; figures 1,2 * -----	1,2	INV. E02D29/12 E02D17/08
A	CN 203 320 563 U (CHANGZHOU HIPPO PLASTICS CO) 4 December 2013 (2013-12-04) * abstract; figures 1,2; compounds 41,42,43 * -----	1,2	

TECHNICAL FIELDS SEARCHED (IPC)

E02D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 September 2015	Koulo, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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P : intermediate document

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 19 2677

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15-09-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
LT 4748 B	27-12-2000	NONE	
CN 203320563 U	04-12-2013	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 201756709 **[0003]**
- EP 0708225 A **[0004]**
- GB 1248085 A **[0005]**